



بسم الله الرحمن الرحيم

Sudan University of Science and Technology
College of Graduate Studies

**The Effect of Occupational Lead Exposure on Liver Enzymes
Activities among Factory Workers**

أثر التعرض المهني للرصاص على نشاط إنزيمات الكبد لدى عمال المصانع

*A dissertation submitted for partial fulfillment for the requirement of M.Sc Degree in Medical
Laboratory science- Clinical chemistry*

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الآية :

قال تعالى:

فَإِذَا بَلَغْنَ أَجَلَهُنَّ فَأَمْسِكُوهُنَّ بِمَعْرُوفٍ أَوْ فَارِقُوهُنَّ بِمَعْرُوفٍ وَأَشْهِدُوا ذَوَى عَدْلٍ مِنْكُمْ وَأَقِيمُوا الشَّهَادَةَ لِلَّهِ ۚ

۝ لَكُمْ يُوعِظُ بِهِ مَنْ كَانَ يُؤْمِنُ بِاللَّهِ وَالْيَوْمِ الْآخِرِ ۚ وَمَنْ يَتَّقِ اللَّهَ يَجْعَلْ لَهُ مَخْرَجًا (٢)

صدق الله العظيم

سورة الطلاق الآية 2

Dedication

To my dear husband Hamid for his support and
encouragement

To my lovely daughter Reem

To my great father and lovely mother

To my Sisters and brother

To my friend

&

To all I love

I man

Acknowledgement

Firstly and foremost, praise to Allah, who gave me the strength to do this work.

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Abstract

Lead toxicity has been recognized as a major public health risk. It has harmful effect on human body tissues. This study aimed to evaluate the effect of occupational lead exposure on liver enzymes (ALT, AST and GGT) among factory workers. Eighty one subjects were included in this study, classified as 41 occupational Lead exposures as (case group), age range from 19 to 60 years old and 40 health apparently as (control match group). Blood samples were collected from each participant under aseptic condition. Serum ALT, AST and GGT activities were measured by using full automatic analyzer Mindery BS series. The results showed insignificant differences in liver enzymes (ALT, AST and GGT) activity of Lead exposed subject when compared with unexposed with *p*-value (0.854, 0.188 and 0.437) respectively. Also the results showed insignificant differences in mean (ALT, AST and GGT) activity of highly exposed versus low exposed subjects with *p*-value of (0.566, 0.575 and 0.070) respectively. Also our results showed no correlation between liver enzymes and lead concentration. GGT enzyme activity showed positive correlation with age and duration of work.

This study concludes that the occupational lead exposure has no effect on liver enzymes activity (ALT, AST and GGT). The elderly exposed subjects are more susceptible to hepatobiliary disease than younger subjects. GGT could be useful as early predictor marker for liver damage.

المخلص

يعتبر تسمم الرصاص بانه واحد من اكثر المخاطر الصحية وله تاثيرات مضره على انسجة الجسم.هدفت هذه الدراسة الى تقييم تاثير التعرض المهني للرصاص على إنزيمات الكبد (ألانين أمينو ترانسفيراز, أسبرتات أمينو ترانسفيراز وجاما جلوتاميل ترانسفيراز) لعمال المصنع. تم ادخال 81 شخصا في هذه الدراسة, وتم تقسيمهم الي 41 شخص معرض مهنيا للرصاص تتراوح اعمارهم من 19 الي 60 سنة و40 شخص صحيح استخدموا كمجموعة ضابطة, وتم جمع عينات الدم في بيئة معقمة من كل الاشخاص المشاركين في الدراسة. وقد تم قياس النشاط المصلي لإنزيمات الألانين أمينو ترانسفيراز, الأسبرتات أمينو ترانسفيراز والجاما جلوتاميل ترانسفيراز لكلتا المجموعتين باستخدام محلل تلقائي كامل (ميندري بي اس). واطهرت نتائج الدراسة بانه لاتوجد اي اختلافات احصائية مؤثرة لنشاط إنزيمات الكبد في الاشخاص المعرضين للرصاص مقارنة بالاشخاص غير المعرضين للرصاص مع قيمه إحصائية (0.844, 0.188, 0.437) لإنزيمات الكبد (ألانين أمينو ترانسفيراز, أسبرتات أمينو ترانسفيراز وجاما جلوتاميل ترانسفيراز) على التوالي. وايضاً أظهرت النتائج بانه لاتوجد اي إختلافات إحصائية مؤثرة لنشاط إنزيمات الكبد في الأشخاص الأكثر عرضة للرصاص مقارنة مع الأشخاص الأقل عرضة للرصاص مع قيمة إحصائية (0.566, 0.575, 0.070) لإنزيمات الكبد (ألانين أمينو ترانسفيراز, أسبرتات أمينو ترانسفيراز وجاما جلوتاميل ترانسفيراز) على التوالي. أيضاً أظهرت نتائج هذه الدراسة عدم وجود علاقة بين انزيمات الكبد ومعدل الرصاص في الدم. النشاط المصلي لإنزيم الجاما جلوتاميل ترانسفيراز أظهر عن وجود علاقة ايجابية مع عمر الأفراد ومدة العمل.

وتخلص هذه الدراسة إلى أن التعرض المهني للرصاص ليس له أي تأثير على انزيمات الكبد الثلاثة. كبار السن هم أكثر عرضة لأمراض الكبد من الأصغر سناً. إنزيم الجاما جلوتاميل ترانسفيراز يمكن ان يستخدم كعلامة تنبؤ مبكرة لضرر الكبد

Chapter1

Introduction

& literature review

1.1 Introduction

Exposure to the Lead usually occurs when people are exposed via inhalation, ingestion, and via skin to Lead compounds originating from Lead paint, dust, occupational exposure, ceramics and other compounds (Bishop *et al.*, 2013 ; Gagan *et al.*, 2012).

The exposure to Lead has harmful effect on human body. It affects on central nervous system (CNS), and leads to CNS disorder and damage. Also it affects on renal system result on nephropathy. Also it affects on cardiovascular system (CVS) lead to hypertension and CVS disorder. Lead also affects on bone and it deposited on it. Also it affects on blood cell formation and hemoglobin formation result in anemia. It affects also on reproductive system and leads to decrease fertility. Also it has effect on liver and causes liver damage. Also it affects on the level of some blood parameters (Gagan *et al.*, 2012; Lyn, 2006). Accordingly the present study is carried out to assess the effect of occupational Lead exposure on liver enzymes (AST, ALT, and GGT).

1.2 Literature review

1.2.1 Definition of Lead

Lead (pb) is ubiquitous and one of the earliest metals discovered by the human race. It has unique properties like softness, high malleability, ductility, low melting point and resistance to corrosion. This properties have resulted in its wide spread usage in different industries like automobiles, paint, ceramics, plastics, batteries, and military equipment. Also Lead has pro-oxidative activity and can generate reactive oxygen species (ROS) and reduce cell antioxidant defences such as antioxidant enzymes and glutathione (Aleksandra *et al.*, 2012; Bishop *et al.*, 2013; Gagan *et al.*, 2012).

1.2.2 Liver enzymes

Liver enzymes play an important role in the assessment of liver functions, because injury to the liver resulting in cytolysis or necrosis will cause the release of enzymes into circulation. Enzymes also play an important role in differentiating hepatocellular (functional) from obstructive (mechanical) liver disease (Bishop *et al.*, 2013).

Liver enzymes are classified into two types:

- 1- Enzymes that indicate hepatocellular injury (AST and ALT).
- 2- Enzymes that indicate obstructive liver disease (ALP, GGT and 5'Nucleotidase) (Thapa and Anuj, 2007; Geoffrey *et al.*, 2005).

1.2.2.1 Aspartate amino transferase (AST) or glutamic oxaloacetic transaminase (GOT)

AST is an enzyme belonging to the class of the transferase (Bishop *et al.*, 2013).

Function

It is involved in the transfer of an amino group from aspartate to α -ketoglutarate with the formation of glutamate and oxaloacetate. It needs pyridoxal phosphate as coenzyme (Bishop *et al.*, 2013).

Tissue source

AST is widely distributed in human tissues. The highest concentration are found in cardiac tissue, liver and skeletal muscle. The smallest amount found in the kidney, pancreas and erythrocyte. AST exists as two isoenzymes fraction located in the cell cytoplasm and mitochondria. The cytoplasm isoenzyme is the predominant form occurring in serum. In disorders producing cellular necrosis, the mitochondrial form may be significantly increased (Bishop *et al.*, 2013; Geoffrey *et al.*, 2005; Bruns *et al.*, 2006).

Diagnostic significant

Elevated AST level seen in heart disease, in acute myocardial infarction and congestive heart failure. Also the AST level is increased in hepatocellular disorders such as in viral hepatitis, hepatic ischemia, and drugs-toxins induced liver necrosis (Bishop *et al.*, 2013; Geoffrey *et al.*, 2005; Edoardo *et al.*, 2005; Limdi and Hyde, 2003; Bruns *et al.*, 2006; Thapa and Anuj, 2007; Shivaraj *et al.*, 2009).

1.2.2.2 Alanine amino transferase (ALT) or glutamic pyruvic transaminase (GPT)

ALT is a transferase with enzymatic activity similar to that of AST (Bishop *et al.*, 2013).

Function

It catalyzes the transfer of amino group from alanine to α . Ketoglutarate with the formation of glutamate and pyruvate. It needs pyridoxal phosphate as coenzyme (Bishop *et al.*, 2013).

Tissue source

ALT is distributed in many tissues, but mainly found in liver. It is considered the more liver specific enzyme of the transferases (Bishop *et al.*, 2013; Geoffrey *et al.*, 2005; Bruns *et al.*, 2006).

Diagnostic significant

Clinical application of ALT assays is confined mainly to evaluation of hepatic disorders. Higher elevations are found in hepatocellular disorders (viral hepatitis, drug-toxin induced liver necrosis and hepatic ischemia) than in extra hepatic or intra hepatic obstructive disorders. In hepatocellular disorders, the increase in ALT activity is usually greater than that for AST.

Serum transaminases (AST, ALT) may actually decreased in patients with severe acute hepatitis, owing to the exhaustive release of hepatocellular enzymes.

AST and ALT are found to be normal or only mildly elevated in cases of obstructive liver damage (Bishop *et al.*, 2013; Geoffrey *et al.*, 2005; Edoardo *et al.*, 2005; Limdi and Hyde, 2003; Bruns *et al.*, 2006; Thapa and Anuj, 2007; Shivaraj *et al.*, 2009).

1.2.2.3 γ -Glutamyl transferase (GGT)

GGT is an enzyme involved in the transfer of the γ -glutamyl residue from γ -glutamyl peptides to amino acids, water and other small peptides. In most biologic systems, glutathione serves as the γ -glutamyl donor (Bishop *et al.*, 2013).

Function

GGT is involved in peptide and protein synthesis, regulation of tissue glutathione level and the transport of amino acids across cell membranes (Bishop *et al.*, 2013).

Tissue source

GGT is found primarily in tissues of kidney, brain, prostate, pancreas and liver (Bishop *et al.*, 2013; Bruns *et al.*, 2006).

Diagnostic significant

In the liver GGT is located in the canaliculi of the hepatic cells and particularly in the epithelial cells lining the biliary ductules. Because of this location GGT is elevated in all hepatobiliary disorders, making it one of the most sensitive enzymes in this condition. Higher elevation is generally observed in biliary tract obstruction. Also the level of GGT will be increased in patients receiving anticonvulsant drugs such as Phenobarbital and phenytoin. Also elevated GGT level may indicate alcoholism, particularly chronic alcoholism. GGT plays a role in differentiating the cause of elevated level of alkaline phosphatase, which it is increased also in cholestatic liver diseases. But also it is increased in cases of bone disorders, during pregnancy and during bone growth (Bishop *et al.*, 2013; Edoardo *et al.*, 2005;

Limdi and Hyde, 2003; Bruns *etal.*, 2006; Thapa and Anuj, 2007; Shivaraj *et al.*, 2009).

1.2.3 Effect of Lead toxicity on liver enzymes

In 2008 a study on the effect of occupational Lead exposure in gasoline station workers in Gaza strip on liver enzymes was conducted, and the result showed that, the serum AST and ALT were significantly higher in workers than control (Abed Al-Rahman 2008).

Also other study was carried on battery manufacture workers in India, to evaluate the effect of Lead exposure on liver function and the results showed the liver enzymes AST and ALT are not affected (Vinod *et al.*, 2008).

In 2015 a study was conducted in Kurdistan region in Iraq, to study the effect of painting products on liver function, and the results showed there is significant elevation of AST and ALT among the exposed workers (Tavqa, 2015).

Also other study was carried out on Iran, on the workers of car battery manufacturing factory, which also are exposed to Lead. The aim of the study was to evaluate liver function, the results showed there is no significant relationship was found between liver enzymes (AST and ALT) and blood Lead concentration (Bita *et al.*, 2016)

Also a study was conducted in Egypt to study the effect of Lead acetate toxicity on experimental male albino rats, and the results showed that there is significant elevation of AST and ALT among the exposed rats (Nabil *et al.*, 2012).

1.2.4 Effect of Lead toxicity on liver morphology

In 2012 a study was conducted in Saudia Arabia to study the histological alteration in the liver induced by Lead chronic toxicity in adult males of the Wister albino rats, which they were exposed to Lead acetate trihydrate in drinking water, the histological results showed that the chronic exposure to Lead produced histological

changes in liver. It produced changes in hepatocytes, portal triads and the sinusoid. The alteration in the hepatocytes were mainly anisokaryosis, nuclear vesiculation, binucleation, cytoplasmic inclusions, cytoplasmic swelling, hydropic degeneration, necrosis and reduction in glycogen content. In addition, portal triads' mild chronic inflammation, kupffer cells hyperplasia, and occasional fatty change were seen together with hemosiderosis. No portal fibrosis or cirrhosis was detected (Bashir and Noory, 2012).

Also other study was conducted in Hungary to evaluate the effect of Lead toxicity on liver of broiler chickens which were fed with diet contaminated with Lead. The results showed that the Lead toxicity with higher concentration resulted in severe periportal inflammation in chicken liver which can result in liver damage (Peter *et al.*, 2003).

1.3 Rationale

Exposure to the Lead has a harmful effects on human body, it effects on CNS, renal system, CVS, liver, bone, reproductive system, blood cell formation, Hemoglobin formation and also effects on the level of some blood parameters.

Exposure to the Lead usually occurs when people are exposed via inhalation, ingestion and via skin to Lead compounds originating from Lead paints, dusts, occupational exposure, ceramics, and other compounds.

Lead toxicity has been extensively studied worldwide. However, yet there have not such studies published concerning occupational Lead exposure in the Sudan, accordingly, the present study was conducted to assess the effect of occupational Lead exposure on liver enzymes (ALT, AST and GGT).

1.4 Objectives

1.4.1 General objective

To study the effect of occupational Lead exposure on liver enzymes (ALT, AST and GGT) among factory workers.

1.4.2 Specific objectives

1. To measure the Lead concentration in study groups.
2. To measure the liver enzymes (AST, ALT, GGT) activity in study groups.
3. To compare mean concentrations of study parameters in cases versus control group.
4. To correlate between study parameters and study variables (Age, duration of exposure).

Chapter 2

Materials

& methods

2.1 Materials

2.1.1 Study design

Descriptive cross-sectional study, conducted during the period of February to March 2016.

2.1.2 Study area

This study was carried out in Khartoum state.

2.1.3 Study population

Eighty one samples were enrolled in this study which divided into 2 groups, 41 Lead exposure subjects as case group, and 40 Lead unexposure subjects as control group.

2.1.4 Inclusion criteria

Specimens were collected from factory workers which are exposed to Lead (cases), and from workers not exposed to lead (control).

2.1.5 Exclusion criteria

Factory worker who has hypertension, diabetes mellitus, renal diseases and or alcoholism was excluded from this study

2.1.6 Collection of Samples

Samples were collected by using dry, plastic syringes, tourniquet was used to make the veins more prominent, blood samples (5ml) was collected in plane containers from each volunteer under aseptic condition. All blood samples were allowed to clot at room temperature, and then they were centrifuged at 4000 rpm to obtain the serum samples, and stored in -20° until the analysis.

2.1.7 Ethical Considerations

Study was approved from ethical committee of the Sudan University of Science and Technology, verbal informed consent was obtained and all participants were informed by aims of the study.

2.2 Methods

2.2.1 Principle of atomic absorption spectrophotometer

Electron of the ground state atom promoted to higher orbital (excited state) for a short period of time by absorbing light energy of specific wave length. As number of atoms in light path increase, the amount of light absorbed also increases. By measuring the amount of light absorbed, a quantitative determination of the amount of analyte can be made.

2.2.2 Estimation of Lead concentration

Brief according to manufacturer, serum sample is diluted, by add 0.3ml of serum to 2.7ml of nitric acid, then the diluted serum is aspirated and the absorbance is measured at 283.3nm by atomic absorption spectrophotometer.

2.2.3 Estimation of ALT activity

Alanine aminotransferase catalyzes the reversible transamination of L-alanine and α -oxoglutarate to pyruvate and L-glutamate. The pyruvate is then reduced to lactate in the presence of lactate dehydrogenase (LDH) with the concurrent oxidation of reduced β -nicotinamide adenine dinucleotide (NADH) to β -nicotinamide adenine dinucleotide (NAD). This change in absorbance is directly proportional to the activity of ALT in the sample.

Brief according to Mindray BS series analyzer manufactured in test tube 100 μ L of sample was added to 1000 μ L of reagent 1, mixed and incubated for 5 min. Then added 250 μ L of reagent 2 and mixed thoroughly, absorbance was measured after 1min interval time, then delta absorbance was calculated and enzyme activity was calculated by multiplied Δ absorption/time X factor.

2.2.4 Estimation of AST activity

Aspartate Aminotransferase (AST) catalyzes the reversible transamination of L-aspartate and α -oxoglutarate to oxaloacetate and L-glutamate. The oxaloacetate is then reduced to malate in the presence of malate dehydrogenase (MDH) with

NADH being oxidized to NAD. The rate of the photometrically determined NADH decrease is directly proportional to the rate of formation of oxaloacetate and thus the AST activity.

Brief according to Mindary BS series analyzer manufactured in test tube 100 μ L of sample was added to 1000 μ L of reagent 1, mixed and incubated for 5 min. Then added 250 μ L of reagent 2 and mixed thoroughly, absorbance was measured after 1 min interval time, then delta absorbance was calculated and enzyme activity was calculated by multiplied Δ absorption/time X factor.

2.2.5 Estimation of GGT activity

Gamma- glutamyltransferase transfers the gamma-glutamyl group of gamma-glutamyl-3-carboxy-4-nitroanilide to glycyl-glycine with the production of p-nitroaniline. The amount of 5-amino-2-nitrobenzoate results in the elevated absorbance which is directly proportional to the activity of GGT in the sample.

Brief according to Mindary BS series analyzer manufactured in test tube 100 μ L of sample was added to 1000 μ L of reagent 1, mixed and incubated for 1 min. Then added 250 μ L of reagent 2 and mixed thoroughly, absorbance was measured after 1 min interval time, then delta absorbance was calculated and enzyme activity was calculated by multiplied Δ absorption/time X factor.

2.2.6 Data analysis

The data was analyzed using statistical package of social science (SPSS computer program) version 21. Descriptive statistics (mean, standard deviation and standard error of mean) were calculated. Independent sample t-test was employed to compare mean concentration. Also Pearson's correlation was applied to correlate between study variables.

Chapter 3

Results

3 Results

This study included 41 Lead exposed workers and 40 unexposed workers. The independent t- test analyses showed that there was insignificant differences between mean concentration of Lead among exposed subjects (0.379 ± 0.204 mg/l) in comparison with unexposed subjects (0.382 ± 0.111 mg/l) with (p -value= 0.423) which is presented in table 3.1.

The results of ALT showed that there was insignificant differences between mean activity of ALT among exposed subjects (12.51 ± 9.79 U/L) in comparison with unexposed subjects (11.97 ± 15.61 U/L) with (p -value= 0.854) which is presented in figure 3.1.

The results of AST showed that there was insignificant differences between mean activity of AST among exposed group (26.07 ± 16.87 U/L) in comparison with unexposed group (21.95 ± 10.36 U/L) with (p -value= 0.188) which is presented in figure 3.2 .

The results of GGT showed that there was insignificant differences between mean activity of GGT among exposed group (32.83 ± 16.64 U/L) in comparison with unexposed group (30.17 ± 13.86 U/L) with (p -value= 0.437) which is presented in figure 3.3.

Also in this study the subjects of exposed group were divided into highly exposed and low exposed subjects. Independent t-test analyses showed that, there was insignificant differences between mean concentration of Lead among highly exposed subjects (0.361 ± 0.189 mg/l) in comparison with low exposed subjects (0.396 ± 0.221 mg/l) with (p -value =0.592) which is presented in table 3.2.

The results of ALT showed that, there was insignificant differences between mean activity of ALT among highly exposed subjects (11.60 ± 9.27 U/L) in comparison

with low exposed subjects (13.38 ± 10.42 U/L) with (p -value =0.566) which is presented in figure 3.4.

The results of AST showed that, there was insignificant differences between mean activity of AST among highly exposed subjects (24.55 ± 10.97 U/L) in comparison with low exposed subjects (27.52 ± 21.22 U/L) with (p -value =0.575) which is presented in figure 3.5.

The results of GGT showed that, there was insignificant differences between mean activity of GGT among highly exposed subjects (37.65 ± 28.24 U/L) in comparison with low exposed subjects (16.33 ± 15.96 U/L) with (p -value =0.070) which is presented in figure 3.6.

Person's correlation analyses found that the ALT activity is positively correlated with AST and GGT activities with p -value of (0.000 and 0.003) respectively, while it is not correlated with other parameters, all are presented in table3.3.

The results of AST showed that the AST activity positively correlated with ALT and GGT activities with p -value of (0.000 and 0.004) respectively, while it is not correlated with other parameters, all are presented in table3.4.

The results of GGT provide evidence that, GGT activity is positively correlated with ALT, AST, age and duration of work with p -value of (0.003, 0.004, 0.021 and 0.031) respectively, while it is just not correlated with Lead concentration, all are presented in table 3.5.

Table 3.1: Shows mean concentration of Lead among Lead exposed and unexposed

Groups	Lead concentration	P-value
	Mean±SD	
Exposed	0.379±0.204	0.423
Unexposed	0.382 ±0.111	

Mean activity of ALT among Lead exposed and unexposed

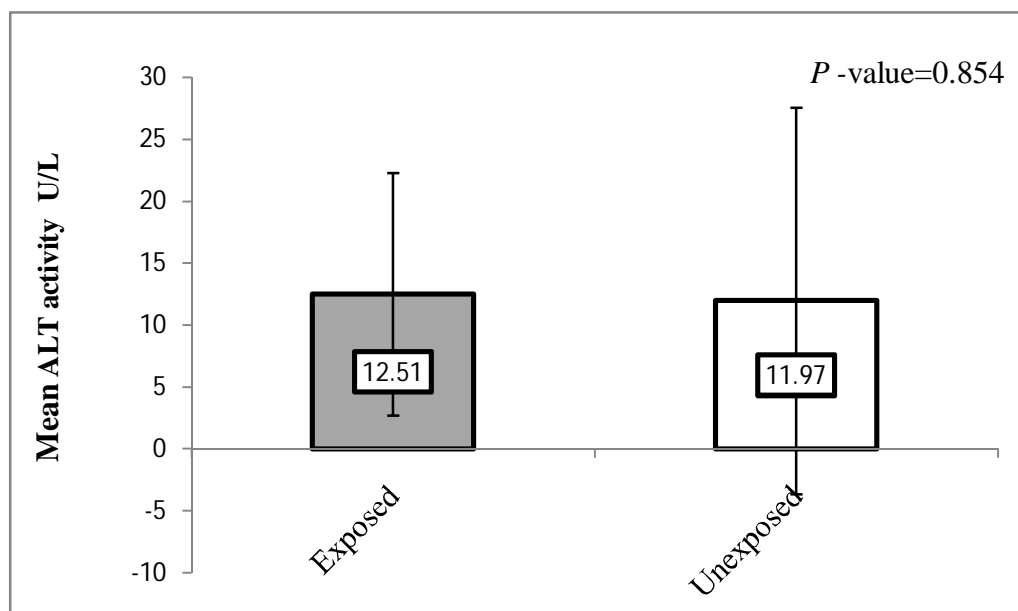


Figure 3.1: Shows Mean activity of ALT among Lead exposed and unexposed.

Results expressed as Mean \pm SD, significant difference considered as p -value ≤ 0.05

Mean activity of AST among Lead exposed and unexposed

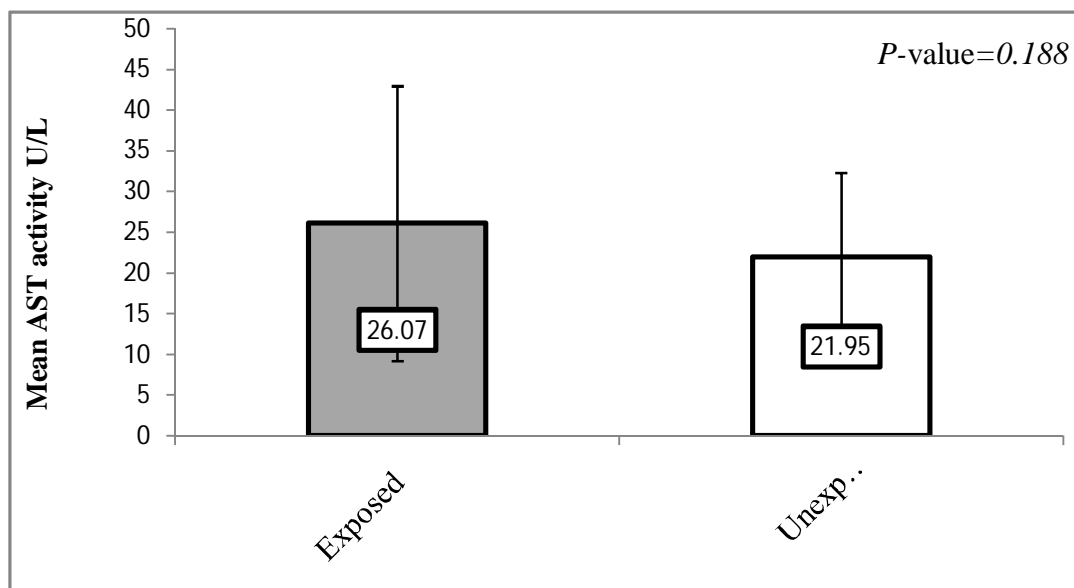


Figure 3.2: Shows Mean activity of AST, results expressed as Mean \pm SD, significant difference considered as p -value ≤ 0.05

Mean activity of GGT among Lead exposed and unexposed

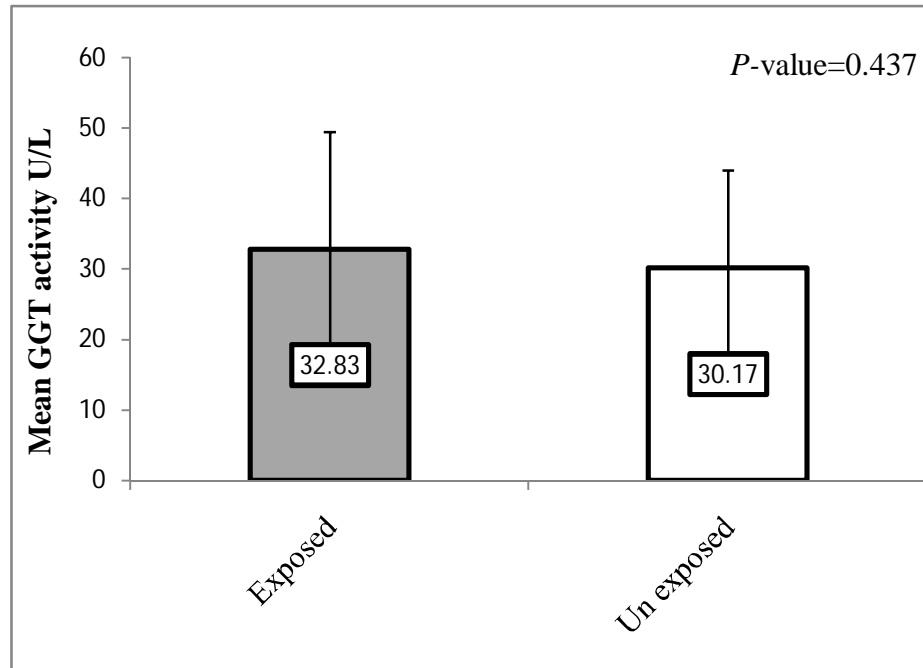


Figure 3.3: Shows Mean activity of GGT, results expressed as Mean \pm SD, significant difference considered as p -value ≤ 0.05

Table 3.2: Shows mean concentration of Lead among highly and low exposed

Groups	Lead concentration	P-value
	Mean±SD	
Highly exposed	0.361±0.189	0.592
Low exposed	0.396 ±0.221	

Mean activity of ALT among highly and low exposed

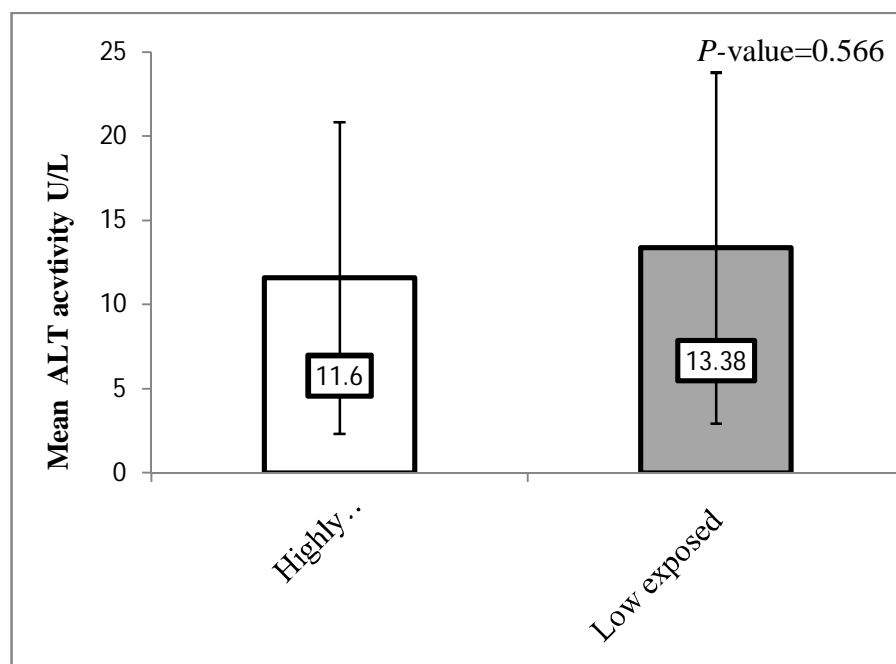


Figure 3.4: Shows Mean activity of ALT, results expressed as Mean \pm SD, significant difference considered as p -value ≤ 0.05

Mean activity of AST among highly and low exposed

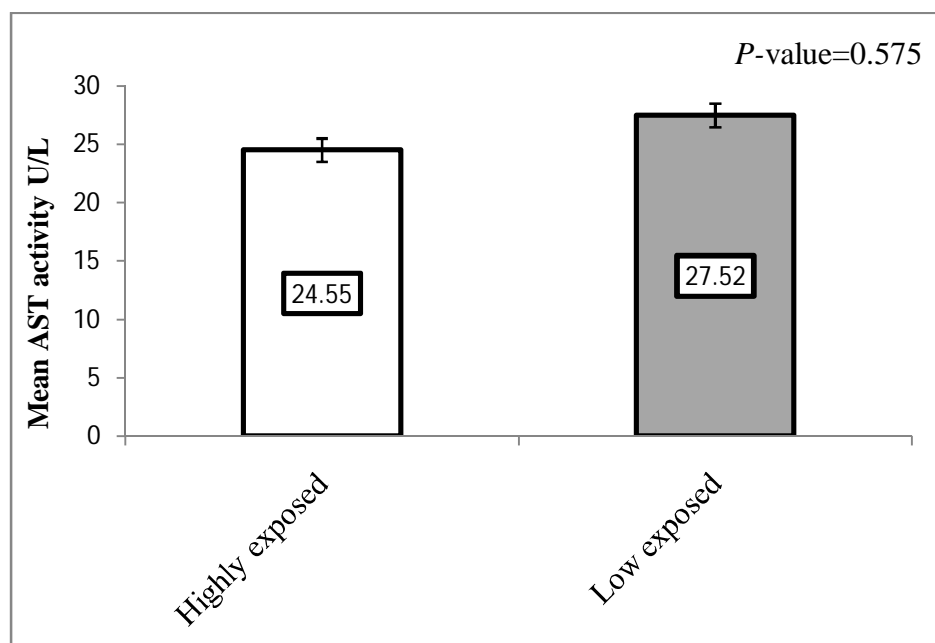


Figure 3.5: Shows Mean activity of AST, results expressed as Mean \pm SD, significant difference considered as p -value ≤ 0.05

Mean activity of GGT among highly and low exposed

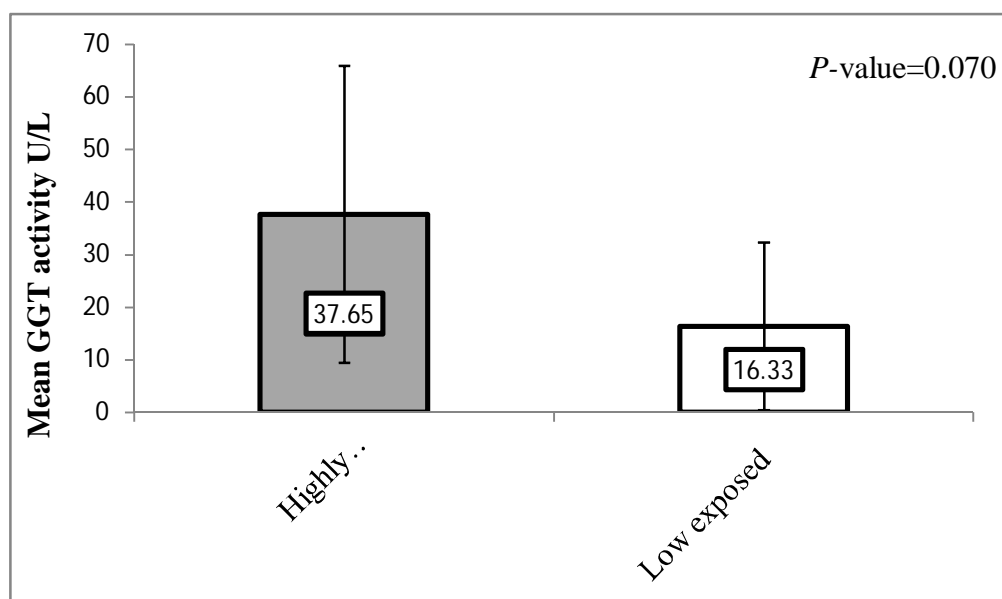


Figure 3.6: Shows Mean activity of ALT, results expressed as Mean \pm SD, significant difference considered as p -value ≤ 0.05

Table 3.3: Correlation between ALT and study variables.

Variables	R-value	P-value
Age	0.157	0.326
Duration	0.239	0.133
Lead	-0.075	0.642
AST	0.740**	0.000
GGT	0.453**	0.003

R =positive or negative correlation. P= Strength of correlation

* = significant **= highly significant.

Table 3.4: Correlation between AST and study variables.

Variables	R-value	P-value
Age	-0.095	0.556
Duration	-0.050	0.758
Lead	-0.094	0.561
ALT	0.740**	0.000
GGT	0.435**	0.004

R =positive or negative correlation. P= Strength of correlation

* = significant **= highly significant.

Table 3.5: Correlation between GGT and study variables.

Variables	R-value	P-value
Age	0.359*	0.021
Duration	0.337*	0.031
Lead	-0.196	0.219
ALT	0.453**	0.003
AST	0.435**	0.004

R =positive or negative correlation. P= Strength of correlation

* = significant **= highly significant.

Chapter 4

Discussion, conclusion & recommendations

4.1 Discussion

Exposure to the Lead has a harmful effects on human body, it effects on CNS, renal system, CVS, liver, bone, reproductive system, blood cell formation, Hemoglobin formation and also effects on the level of some blood parameters. Accordingly, the present study was carried out to study the effect of occupational Lead exposure on liver enzymes (ALT, AST and GGT) among factory workers.

The results of present study found that, there was insignificant differences in means activity of liver enzymes (ALT, AST and GGT) of Lead exposed in comparison with unexposed subject with p -value of (0.854, 0.188 and 0.437) respectively. This finding indicates there was no effect of Lead exposure on liver enzymes (ALT, AST, and GGT) among factory workers. This finding agreed with previous studies in which they found that, Lead exposure did not affect on ALT and AST (Vinod *et al.*, 2008; Bitu *et al.*, 2015), but also this finding disagreed with some studies (Abed-Al-Rahman 2008; Nabil *et al.*, 2012; Tavqa 2015) which stated that, the Lead exposure affect on ALT and AST. They found that the serum ALT and AST were significantly higher in exposed group than unexposed group. The contradict finding might be justified by time, dose of exposure, safety precaution and dietary control in our study, because differences in the period of exposure, time of exposure per day, safety precaution and dietary control have an impact on Lead toxicity. There was no previous study on the effect of Lead exposure on GGT.

Also in this study, the subjects of exposed group were divided into two sub groups, highly and low exposed group according to the level of lead exposure during their work. The results found that there were insignificant differences in means activity of liver enzymes (ALT, AST and GGT) between highly exposed and low exposed group with p -value of (0.566, 0.575 and 0.070) respectively, which indicates that the level of lead exposure not affect on the liver enzymes.

Person's correlation results showed that, the GGT activity was positively correlated to age with p -value of (0.021) which indicates that the elderly are more susceptible to hepatobiliary disease than younger, in other word elderly are more vulnerable to exposure to lead than younger adults. Also the results showed that the serum GGT activity was positively correlated to the duration of exposure (work) with p -value of (0.031) which indicates that GGT could be useful as early predictor marker for liver damage.

All liver enzymes (ALT, AST and GGT) showed no correlation with Lead concentration, while only ALT and AST showed no correlation with age and duration of work. Also all liver enzymes showed strong positive correlation to each other, ALT is positively correlated to AST and GGT with p -value of (0.000 and 0.003) respectively, AST is positively correlated to ALT and GGT with p -value of (0.000 and 0.004) respectively, while GGT is positively correlated to ALT and AST with p -value of (0.003 and 0.004) respectively.

Also the results of this study found that there was insignificant differences between means concentration of Lead among exposed and unexposed subjects with p -value of (0.423) and also among highly and low exposed group with p -value of (0.592). This result indicates that the serum Lead concentration does not represent the cellular level.

4.2 Conclusion

This study concludes that the occupational lead exposure has no effect on liver enzymes activity (ALT, AST and GGT).

4.3 Recommendations

1. Increase the awareness about lead toxicity and its effects on human body.
2. Increase the awareness about the importance of safety precaution and dietary control which they decrease the effect of lead toxicity on human body.
3. Health evaluation should be done continuously for workers.
4. Work rotation is very important to prevent the workers from continuous highly exposure.
5. Use chelator to neutralize lead toxicity.
6. Estimation of cellular Lead concentration.

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