

Survey study of lead exposure among lead workers in Erbil

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ABSTRACT

Objectives: The aim of this work was to assess lead contamination among lead workers in Erbil city.

Patients and methods: This study was carried out on male people working in printing press (30 workers), radiator repairing (26 workers), battery repairing (26 workers), and gasoline power generator (20 workers), compared with control group (30 males).

Results: Blood lead levels significantly increased in printing press workers ($P < 0.05$), radiator and battery repairing workers ($p < 0.01$), while there was non-significant difference in gasoline power generator workers. A significant correlation was found between duration of exposure and blood lead level in all the above groups and there was insignificant correlation between age and blood lead levels.

Conclusion: Lead blood levels in, printing, battery, radiator repairing, and gasoline generator workers were elevated. Blood lead levels correlated with duration of lead exposure in printing, battery, and radiator workers, but not with their ages.

Keywords: Lead exposure, workers, printing, battery, radiator workers.

الخلاصة

هدف الدراسة: كان هدف الدراسة هو تقييم التلوث بالرصاص عند الأشخاص المتعرضين للرصاص نتيجة العمل في مدينة اربيل.

الأشخاص: ثلاثون رجلا يعملون في المطابع، ست وعشرون رجلا يعملون في تصليح رادياترات السيارات، ست وعشرون رجلا يعملون في تصليح بطاريات السيارات، خمس وعشرون رجلا يعملون في المولدات الكهربائية،

النتائج: وجد زيادة معنوية $P < 0.05$ في مستوى الرصاص عند الذكور الذين يعملون في المطابع، وزيادة معنوية $P < 0.01$ عند الأشخاص الذين يعملون في تصليح الرادياترات والبطاريات بينما لم يلاحظ اي فرق معنوي عند العاملين في المولدات الكهربائية بالمقارنة مع مجموعة الضبط من الرجال. ووجد علاقة بين مدة التعامل مع الرصاص ومستواه في الدم عند العاملين. ولم توجد اي علاقة بين الأعمار ومستوى الرصاص في الدم عند كل المجاميع مع مستوى الرصاص في الدم **الاستنتاج:** ارتفع مستوى الرصاص في دم العاملين في الطباعة والبطاريات والرادياترات والمولدات. كان هناك علاقة بين مستوى الدم للرصاص ومدة التعرض ولم يكن هناك علاقة بين مستوى الرصاص في الدم وعمر العاملين.

Lead is a highly toxic metal that has been used by humans for over 2000 years and is one of the most toxic metals known due to its wide ranging effects on multiple body systems, affecting many

processes that are necessary for normal function'. The renal, gastrointestinal, reproductive, central nervous and peripheral nervous systems and the

biosynthesis of haeme are all adversely affected by lead⁷.

Lead absorption by lungs depends on a number of factors in addition to concentration, these include volume of air respired per day, whether the lead is in particle or vapor form and size distribution of lead-containing particles. Only a very minor fraction of particles over $1.0 \mu\text{m}$ in maximal external diameter are retained in lung but are cleared from the respiratory tract and swallowed. The gastrointestinal absorption of lead is influenced by large number of factors of which age and nutrition which are of particular importance⁷.

Lead is heavily used in industry including batteries, additive to gasoline, paints, explosives, pesticides, soldering, cosmetics, radiation shields, crystal glass, among others⁸. However, due to its highly toxic effects, its uses in industry have been highly limited in recent years. Several diseases and syndromes were attributed to lead exposure. The nervous system is the most affected, expressed mostly as sensory deficits and encephalopathy⁹; anemia is one of the common symptoms⁷. Moreover, lead influences the kidney by development of hyperuricemia⁷, and above $400 \mu\text{g/dL}$ causes testicular atrophy and hypospermia (lower fertility in men) as well as miscarriage in pregnant woman.

One of the most identified health problems of lead is the deterioration in the bone strength, where Pb^{2+} may replace Ca^{2+} in the bone mineral phases and causes osteoporosis¹⁰. Lead may causes mental retardation in children when exposed to more than $20 \mu\text{g Pb/dL}$ ¹¹.

Up to 10% of inhaled inorganic lead may be absorbed in the lungs. Adults take up 1-10% of lead in food, whereas

children may absorb up to 10% via the gastrointestinal tract. Lead in blood is bound to erythrocytes, and elimination is slow and principally via urine. Lead is accumulated in the skeleton, and is only slowly released from this body compartment. Half-life of lead in blood is about 1 month and in the skeleton 20-30 years¹².

The aim of this study was to determine the blood lead levels in printing press workers, radiator repairing workers, battery repairing workers and gasoline power generator workers, in Erbil city, Iraq in order to assess the effects of environmental contamination on the levels of lead in body fluids.

Subjects and methods

The present study was conducted on workers from several work places where exposed to materials containing lead. The study done between 2010-2011 in Erbil City. Written agreement informed consents of each workers were obtained. Subjects were categorized into five groups as follows:

- Male control group: This included 30 apparently healthy male volunteers their ages ranged between 18-50 years (mean \pm SD: 31 ± 11.84), who were not exposed to lead.
- Printing press worker group: This included 30 individuals, their ages ranged between 22-54 years (mean \pm SD: 34 ± 10.09), who were working in printing and they were mixing, preparing, handing ink of printing and operating the printing machine. The duration of exposure

- ranged between 3-10 years (mean \pm SD: 4.3 \pm 2.42).
- Radiator repairing worker group: This included 26 individuals their ages ranged between 22-54 years (mean \pm SD: 34 \pm 10.09), who were working in radiator repairing in industrial area, and exposed to lead by inhalation and dermal contact during repairing. The duration of exposure ranged between 2-13 years (mean \pm SD: 4.0 \pm 2.90).
 - Battery repairing worker group: This included 26 individuals, their ages ranged between 17-52 years (mean \pm SD: 29 \pm 10.44), who were working in lead-acid battery repairing shops. The duration of exposure ranged between 3-14 years (mean \pm SD: 4.8 \pm 2.76).
 - Gasoline power generator worker group: This included 20 individuals, their ages ranged between 19-44 years (mean \pm SD: 30 \pm 7.87), who were at the gasoline power generator of Erbil city and exposed to lead from gasoline by inhalation and dermal contact. The duration of exposure ranged between 2-10 years (mean \pm SD: 6.0 \pm 2.24).

Blood lead levels were determined by "LeadCare® Blood Lead Test System". This test is considered to be appropriate for field studies due to its cost-effective, easy-

to-apply, portable features and reliable method¹¹. Samples were collected using all equipment lead free, by a disposable injector, 0.1 μ l of blood were drawn by a capillary tube from each worker, and then transferred into a vacuum blood tubes containing ethylenediaminetetraacetic acid (EDTA). The sample was mixed by gently rocking the tube. The tube was left to stand upright for a minute. The prepared samples were deposited onto an electrode strip that is then inserted into analyser. Within three minutes the result appeared on the screen in μ g/dL.

The results were analyzed statistically by using the unpaired student's t-test to compare lead levels among worker groups and control group. Correlation coefficient (r) was used to determine the relationship between lead levels and ages or duration of exposure among workers groups.

Results

Blood lead levels increased significantly in workers within printing presses (10.2 \pm 7.00, $p < 0.05$), radiator (22.7 \pm 7.79, $p < 0.01$) and battery repairing (17.4 \pm 0.81, $p < 0.01$), and non-significantly increased in gasoline power generator workers (11.2 \pm 2.34) as compared with the control group (4.3 \pm 1.34).

The mean blood lead levels for radiator and battery repairing workers groups were relatively higher than the blood lead levels of printing press, and gasoline power generator. Table 1 shows the results mentioned above.

Table 1. Blood lead levels (mean \pm S.D., range) of printing press, radiator repairing, battery repairing, gasoline power generator workers, and control group

Parameter	Control Group No.= 30	Printing No.= 30	Radiator No.= 26	Batteries No.= 26	Generators No.= 20
Pb μ g/dL	8.3 \pm 1.34 (0.0-13.0)	10.2 \pm 6.00* (7.7-36.3)	22.7 \pm 7.79** (9.4-34.9)	17.4 \pm 5.81** (7.7-30.9)	11.2 \pm 2.34 (7.2-16.24)

* $p < 0.05$, ** $p < 0.01$

Figures 1, 2, 3 and 4 show significant correlation between the duration of exposure and blood lead levels for printing press ($p < 0.01$), radiator repairing ($p < 0.01$), battery repairing ($p < 0.01$), and

gasoline power generator ($p < 0.05$) workers groups. While, there was non-significant correlation between the age and blood lead levels in the workers and control groups.

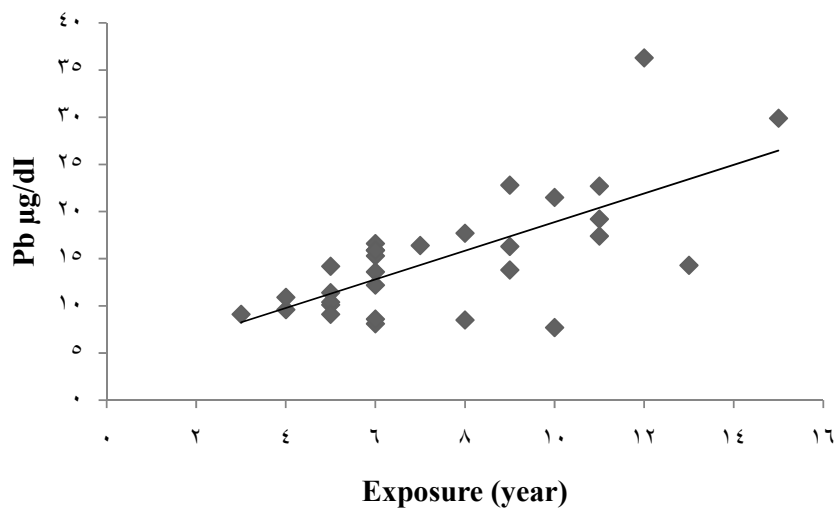


Figure 1. Correlation coefficient between blood lead levels and duration of exposure in printing press worker group

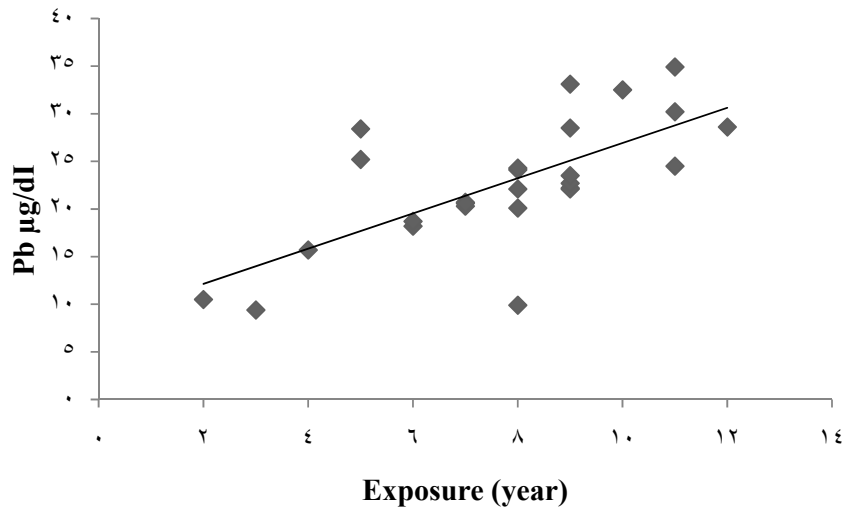


Figure 2. Correlation coefficient between blood lead levels and duration of exposure in radiator repairing workers group.

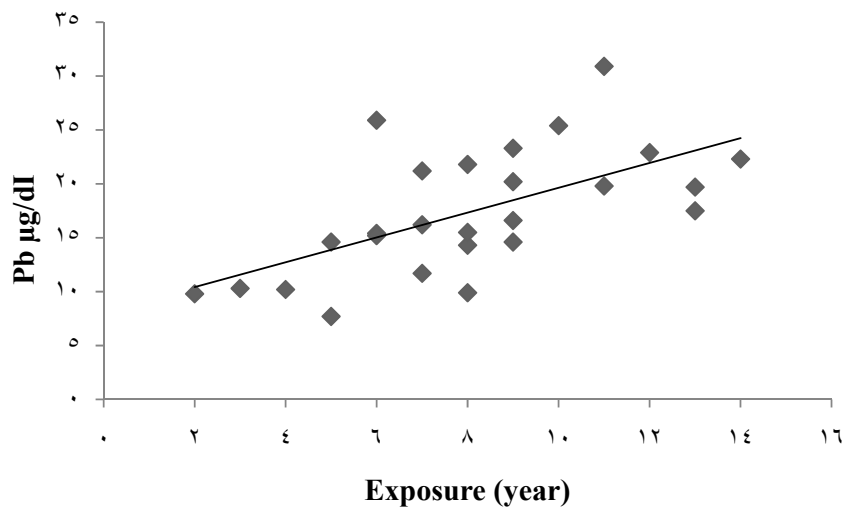


Figure 3. Correlation coefficient between blood lead levels and duration of exposure in battery repairing workers group.

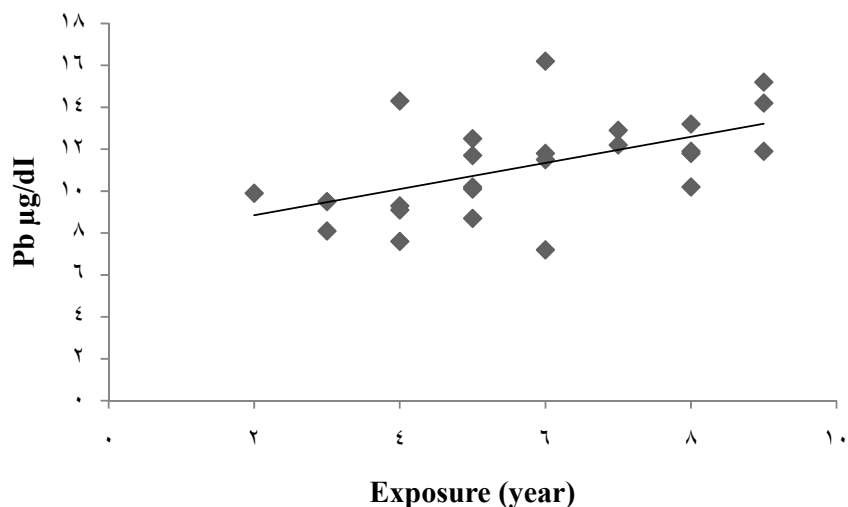


Figure 4. Correlation coefficient between blood lead levels and duration of exposure in gasoline power generator workers group.

Discussion

In general, the standard analysis of blood lead levels performed in laboratories around the world remains the most useful index of recent exposure¹¹. The US centers for disease control and prevention intervention level reported a higher blood lead levels if it is $\geq 10 \mu\text{g/dL}$, and considered a cause for public health concern¹².

This survey documented occupational lead contamination from elevated blood lead levels in Erbil city among workers in work places with materials containing lead.

The significant difference between blood lead levels in control group, radiator, and battery repairing workers leaves little doubts that regular exposure to lead during their work is associated with increased blood lead levels. This give us that these workers exposed to lead during their working by inhalation, dermal contact (without using gloves) and ingestion from lips and contaminated hands. Similar were reported by many workers¹³⁻¹⁴.

A significant difference was found between blood lead levels in male control workers and radiator workers. This is because some of the workers had been exposed in the past to lead during mixing preparing of ink and hand link with lead ovens and old machines. Some others workers exposed to lead through hand link and preparing of color inks. This result is inconsistency with the results reported by others^{15,16,17}.

There was insignificant difference in mean blood lead levels between control and gasoline power generator workers groups. This result is in agreement with Al-Dosky et al.¹⁸, who were indicated that gasoline power generator workers exposed to lead didn't constitute a great health problem. While Al-Shayeb and Bounessah¹⁹ reported that gasoline combustion represent the source of 94.8% of the total lead in the atmosphere.

A significant correlation was found between blood lead level and duration of exposure in printing presses, radiators and batteries repairing workers. These result

are consistent with other studies^{2,24,25}. While, the duration of exposure in gasoline power generator workers showed non-significant correlation with blood lead levels, because most of these workers are not fixed in their working place during the operation of these generators.

All working groups show non-significant correlation between ages and blood lead levels, as the individuals who included in this study were adult not children or elderly.

In conclusion, blood lead levels were elevated in printing, battery, radiator repairing workers. Blood lead levels correlated with duration of lead exposure in printing, battery, and radiator workers, but not with their ages.

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