Original article

The Effectiveness of Vitamin D , Succimer and Safety Precaution Measures in Regulation of Elevated Blood Lead in Fuel Station Workers.

Makloph MG[1], Mohamed Masoud[2]

[1]Department of Forensic medicine and Clinical toxicology, Faculty of medicine, Fayoum University.[2]Department of public health, Faculty of medicine, Fayoum University.

ABSTRACT

Background: Continuous exposure to air polluted with the vapor of lead (in leaded gasoline) by the workers in petroleum stations without following safety measures, results into elevated level of inorganic lead in blood of those workers and put them at increased risk of toxicity through exposure to lead and its products. The aim of the present study is to measure concentration of lead in blood of fuel station workers. **Subject and methods**: Lead in blood was measured through lead care of blood testing system and lead care of blood testing kits, and confirmed by using Atomic Absorption Spectrophotometry(AAS) for confirmation and checking quality of measuring and repeat measuring of lead concentration in blood of workers with blood lead conc.> 50 µg/dl. This study took two approaches: a case-control approach in which 76 Petroleum station workers and age-matched control participants were included, and an experimental approach in which the effect of various types of lead decreasing agents was investigated after

Corresponding author:

Mohammed makloph

dr_mmakloph@yahoo.com

giving medications and taking certain precautions. **RESULTS** : blood lead conc in petroleum station workers was higher than normal ,so by using interventions, Such as giving vit, D, lead chelating agents(Succimer) and certain safety precautions (mask, gloves, boot, cap, special clothes and regular skin cleaning and well balanced calcium enriched food) show effectiveness in control and regulation of blood lead level. **Conclusion:** From the current study it was concluded that following safety measures, receiving succimer , and vit, D supplementation helped in decreasing elevated blood level in fuel station workers.

Key words: Lead, Petrol, Vit, D, Abstinence, Succimer, Vapor.

I-INTRODUCTION:

Lead is the most available metal in the earth crust and Lead poisoning has remained a global public health issue, particularly in developing countries. Toxicity of lead from exposure has been recognized years ago with the oldest published reports dated since prehistoric times (Shilu, 2000).

Lead poisoning is caused by ingesting contaminated water from lead-filled pipes in homes, or inhalation of airborne lead particles by workers (at lead mines and smelters), gasoline station workers are now commonly exposed to lead in their fuel stations as well. (Agency for Toxic Substances and Disease Registry, 2007).

The developed countries have formulated regulatory bans on leaded fuel, resulting in lower blood lead levels among their citizens (Muntner et al., 2005).

Residents of developing countries continue to have high blood lead levels due to a lack of regulatory laws prohibiting the use of leaded fuel, as well as a lack of education and awareness about the dangers and hazards of lead poisoning (World Health Organization, 2015).

The WHO now considers a higher level of blood lead to be 40 µl /dl and necessitate treatment. Subclinical and clinical effects of plumbism may occur at levels lower than 50µg/dl (Sang et al., 2008).

Lead toxicity has a wide rang of effects on living tissues due various mechanisms of action, such a the fact that it is a divalent cation that competes with calcium for receptors and affects signaling (Prasenjit et al., 2017).

Treatment of lead poisoning could be accomplished through the use of oral chelating agent, such as Succimer (2,3 dimercaptosuccinic acid), which results in a decrease in lead levels and, as a result, a decrease in lead poisoning (Abbasi et al., 2003).

The present study aimed at detecting the effect of following safety measures (mask, gloves, boots, cap, special clothes and calcium enriched food), receiving succimer and vit, D supplementation in control and regulation of blood lead conc. among fuel station workers.

II-Subjects and methods

2.1 Study design

This study took two approaches: a case-control approach in which 76 Petroleum station workers and age-matched control participants were included, and an experimental approach in which the effect of various types of lead decreasing agents was investigated. The current study lasted six months, from April 2019 to September 2019.

2.2 Study sample

The workers were selected at random from four petrol filling stations in Fayoum city. The control participants were chosen at non-random from nearby areas on the assumption of a low risk of lead vapor exposure.

Workers of fuel station with more than 5 years of work who are between the ages of 25 and 40 are eligible for inclusion in the study after signing written informed consent. We exclude those who refuse to participate, beyond the age limit and live beside factories or in polluted area and chronic ill patients or handicapped.

Regarding the control group they were age matched with the same socioeconomic level of the exposed subjects, with low risk of exposure to polluted environment with lead away from factories and in rural agricultural area, not diseased or treated of chronic illness. They were selected non-randomly by quta sampling from their residence.

2.3 Data collection

Every participant was given a questionnaire in order to determine the length of time they had been exposed to lead vapors, and Demographic Data and smoking habits of each participant in the study.

A blood sample(with its all precautions regarding sampling, transfer and refrigeration) was collected from each individual who agreed to participate in the study, 50 µl of whole blood collected in heparinized capillary tube by pin pricking tip of finger after cleaning of the skin as a screening for all subjects then 5ml venous blood withdrawn for confirmation, as the apparatus has the capacity of detection until 50-100 µl/dl.

The collected sample was taken to the lab of Fayoum University Hospital to be analyzed for blood lead levels using the lead care of blood testing system & lead care of blood testing kits by the same laboratory technician each time, the used kits are specific for measuring lead in fresh whole blood by quantitative assessment. Atomic absorption spectrophotometry (AAS) was used as an apparatus for measuring lead level in blood taking into consideration internal quality control and external quality assessment.

Subjects with high blood lead level(greater than 50 µg/dl) were classified into 4 groups ,each formed of Eight subjects:

1-Group A, was given Active form of vitamin D (Calciferol)10,000 international units daily (250mcg/ml), each 1mcg equaling 40 international units, was given orally for one month to those with high blood lead levels, then blood lead levels were measured again using the same precaution(Harjit et al, 2017).

2-Group B, Subjected to one-week period of not working and follow safety measures(cap, glove, mask, boots, special clothes and regular skin cleaning) for a month then measuring blood lead levels.

3-Group C, given lead decreasing agent oral capsule (Succimer) 10mg/kg 3times per day for 5 days then 10mg/kg twice per oral capsule for 14 days, then measuring blood lead level again with taking into consideration the same precautions(Sally, 2009).

4-Group D, one-week period of no work, follow safety measures, given succimer and active form of vit, D for

one month then remeasure of blood lead.

.4 Statistical analysis

The collected data were organized, tabulated, and statistically analyzed using social science statistical package (SPSS Inc, version 22). The mean and standard deviation (SD) of quantitative data were computed. When appropriate, the independent-t test for comparing between exposed and non-exposed , dependent-t test(paired sample t-test) was used as a test of significance after intervention . Categorical data were presented as frequencies and percentages; chi-square tests were performed for categorical nominal variables as age and smoking habit.

Ethical consideration

The Fayoum Faculty of Medicine Research Ethical Committee approved this study according to the declaration of Hilsinki. The study was carried out after explaining the objectives of the study. All participants in the study provided verbal and written consent, and each individual had the right to refuse or accept participation in the study.

III- RESULTS

This study included 76 petroleum station workers and age-matched control participants from nearby areas. In terms of age and smoking habits , by using chi square there was no statistically significant difference between station workers and control group (p=0.941), as seen in Table 1.

Lead concentration was significantly higher in Petroleum station workers than control (56.05 ± 20.33 vs. 14.32 ± 6.59), with highly significant P-value(p<0.0001),as seen in Table 2.

Lead concentration(in group A subjects) decreased after vitamin D administration (56.05 ± 20.33 to 47.57 ± 22.03), but it was not a statistically significant P-Value (p=0.472), by using (paired sample t-test as a test of significance).as seen in Table 3.

Table 1: Age distribution of study participants (exposed workers and control group) by the independent-t test.

Age groups	Petroleum station workers (N=76)		Control (N=76)		P-value
	N	%	N	%	
25-29	26	34.2%	24	31.6%	0.941
30-34	20	26.3%	21	27.6%	
35-39	30	39.5%	31	40.8%	
Smoking	68	89.5%	33	43.4%	0.078
Total	76	100%	76	100%	

N: number of cases

Table 2: Lead concentration in fuel station workers in comparison to control groups by using independent t-test with 2 tailed significance.

	Petroleum station workers (N=76)	Control (N=76)	P-value
	Mean ± SD		<0.0001**
Lead level in blood	56.05 ± 20.33	14.32 ± 6.59	

**Highly significant; N: number of cases

Table 3: Lead concentration according to measures taken in workers with lead concentration above 50 µg/dl after vitamin d administration.

Group A	**Mean ± SD**
Lead at beginning	56.05 ± 20.33
After vitamin D	47.57 ± 22.03
P-value	0.472
Number	8
Period of treatment	One month

Table 4: Lead concentration after certain interventions to workers with lead concentration above 50 µg/dl .

	Group B	Group C	Group D	P-value
	Mean ± SD			
Lead level	53.71 ± 7.40	44.97 ± 11.05	32.55 ± 7.05	<0.0001**
Number	8	8	8	

**Highly significant

From the above table Workers' lead concentrations were found to be lower than before after Abstinence and follow safety measures(respiratory mask, cap, special clothes, gloves and boot) (Group B)(53.71 7.40) and after Lead decreasing agents (Group C) (44.97 11.05) while after follow safety measures + lead decreasing agents and vit, D(Group D) (32.55 7.05) with highly significant P-value (<0.0001) by using paired sample t-test, as seen in Table 4 and Figure 1.

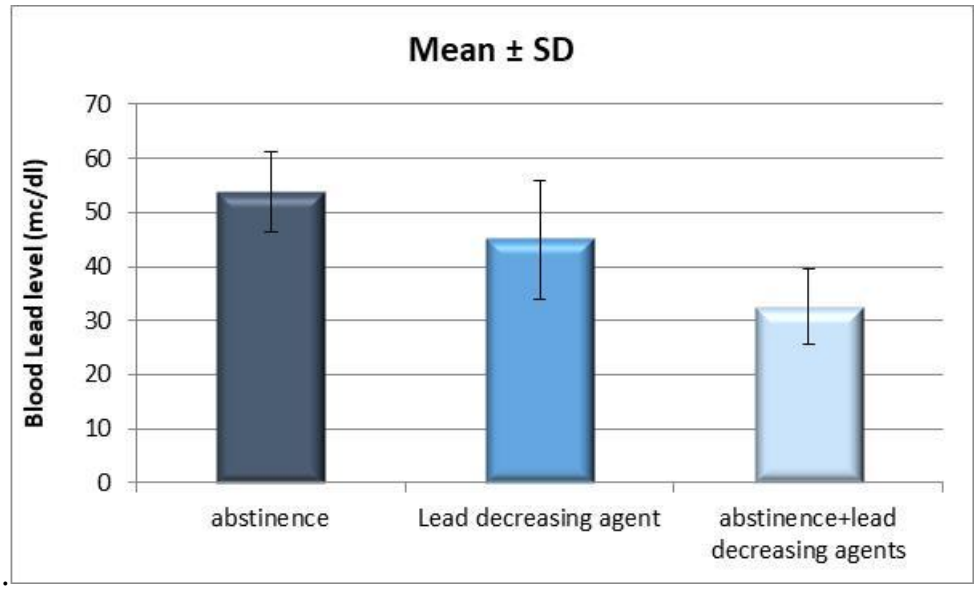

Figure 1: Lead concentration in workers(previously was above 50 µg/dl) after abstinence and follow safety measures later, lead decreasing agents and both.

By using simple linear regression. There was a statistically significant positive correlation between work duration and lead concentration in workers blood where spearman correlation coefficient was strong and

positive(r=0.818), with highly significant P-value(p<0.0001) as the lead level in blood increase by the length of the period in the fuel station as seen in Figure 2.

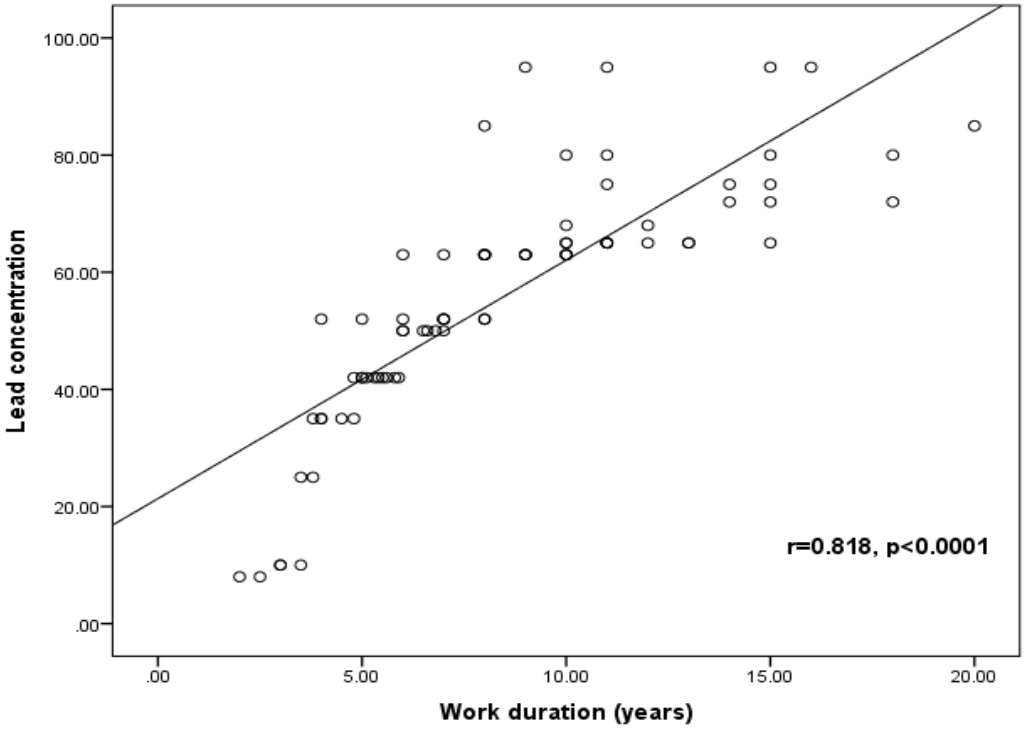

Figure 2 : Relation between lead conc. and work duration in a simple linear regression.

IV-DISCUSSION

Lead is one of the oldest known toxic substances that causes environmental hazards to patients worldwide by affecting various body organs such as the brain, bone, blood, and gastrointestinal tract. Various workers, such as those in gas stations, paint shops, and garages, are at a higher risk of exposure (Johnson et al., 2009).

We concluded in the current study that the mean blood lead level was higher in exposed individuals in fuel workers than in non-exposed workers, which was also found by(Al-Rudainy , 2010) in his study done in Albasra at the Republic of Iraqui, and (Nuwayhid , 2001) in his study in Beirut.

In the current study, exposed workers had higher blood lead levels than non-exposed adult workers. The elevated level of lead in the blood of exposed workers could be due to inhalation of airborne leaded vapor from a polluted environment at work due to a lack of

awareness of self-protection equipment and body clothes, or it could be due to absorption through the skin due to dehydration and neglection of skin cleaning the same was found by (Al-Rudainy , 2010) in his study in Albasrh.

The current study showed that the longer the exposure time of workers to leaded vapor at the work station along years, the more higher the blood lead level, this was in accordance with those found by(Al-Rudainy , 2010) and (Mirsad et al., 2010).

Several factors affect lead absorption and hence lead level in blood such as, iron , calcium , zinc and vitamins such as Vit,D and K. Vit, D act be dual mechanism as it affect calcium absorption and also lead affect metabolism of vit,D in body.(Anca , 2019)

The present study showed that regulation of exposure to lead vapor will result in decrease blood lead level in exposed workers, the same was found in the study done by (Jina et al., 2014) , (Trachtenbarg , 1996), And (Apotoli , 1998).

Succimer (DMSA) is a potent chelating agent more efficient than EDETA , which act on disulfide linkage chelating lead from blood and replenish bone store and taken orally leading to decrease in the blood lead level so it is commonly used in plumbism(Sally, 2009).

The present study showed that by using succimer as a chelating agent is highly significant for controlling blood lead level , the same was found in the study done by (Abbasi et al., 2003) and (Sally, 2009) where they found that by using oral chelating agent, we can control the blood lead level and reduce its concentration in the blood .

By follow up of subjects in the present study No symptoms of acute exacerbation of lead toxicity after usage of chelating agent(Succimer) for elevated blood lead level, the same was found in the study done by (Sally, 2009) except some cases shown constipation, controlled weakness and headache.

The current study found that the longer the duration of exposure to leaded vapor without protective clothing and equipment, the higher the blood lead level, which was consistent with the findings of (Al-Rudainy , 2010) and (Mason , 2005).

V- CONCLUSION

Elevated blood lead levels among workers in petroleum stations resemble health hazards and potentially subject them to dangers, necessitating regulating laws and measures to control and regulate the elevated level of lead in blood, improving workers' quality of life and preventing later health hazards with all of their consequences and effects. The current study concluded that the effect of following safety measures(mask, gloves, boots, cap, special clothes) , receiving succimer , and Vit D supplementation are effective in control and regulation of blood lead conc. among fuel station workers.

Recommendation

Follow safety measures for all workers in fuel station.

Calcium and vit D supplementation are advisable for workers.

Periodic investigation for lead and lead chelating agents is necessary for higher level even without complain.

Conflict of interest

the author declare that there is no conflict of interest.

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فعالية فيتامين (د) ، و مخلبيات الرصاص(سكسيمر) وتدابير السلامة في تنظيم ارتفاع نسبة الرصاص في الدم لدى العاملين في محطة الوقود.

-محمد مخلوف١ –محمد مسعود

١ قسم الطب الشرعي والسموم الإكلينيكية-كليه الطب-جامعه الفيوم ٢ -قسم الصحة العامة - كليه الطب-جامعه الفيوم

الملخص العربى

مقدمه البحث: يؤدي التعرض المستمر للهواء الملوث ببخار الرصاص (في البنزين المحتوي على الرصاص) من قبل العاملين في محطات البترول دون اتباع تدابير السلامة إلى ارتفاع مستوى الرصاص غير العضوي في دماء هؤلاء العمال ويزيد من خطر السمية من خلال التعرض للرصاص. ومنتجاتها.

الهدف من البحث: دراسه تأثير إعطاء فيتامين د وعوامل مخلبية للرصاص (سوكيمر) واحتياطات أمان معينة (قناع وقفازات وحذاء وقبعة وملابس خاصة و تنظيف الجلد المنتظم) لمعرفة مدى فعاليتها في التحكم في مستوى الرصاص في الدم وتنظيمه.

الطرق والوسائل: . اتبعت هذه الدراسة نهجين: نهج التحكم في الحالات الذي تم فيه تضمين ٧٦ عاملاً في محطة البترول ومشاركين في الضبط المطابق للعمر ، ونهج تجريبي تم فيه التحقق من تأثير أنواع مختلفة من عوامل خفض الرصاص بعد إعطاء الأدوية واتخاذ بعض الاحتياطات. من قبل العمال.

وقد شملت الدراسة:

١.-البيانات الديمغرافية الاجتماعية: وتشمل البيانات المتعلقة بالعمر التدخين والسكن.

٢.-الفحوص المعملية: قياس نسبه الرصاص في دماء العاملين بمحطات الوقود.

٣-اعطاء فيتامين د ومخلبيات الرصاص ووسائل الوقاية لمجموعات بحثيه وإعادة قياس نسبه الرصاص.

تم تدوين البيانات الشخصية وكذلك نتائج الفحوص المعملية والعلاج . وتم عمل تحليل إحصائي للمعطيات.

النتائج: من الدراسة الحالية استنتج أن اتباع تدابير السلامة ، تناول مكملات مخلبيات الرصاص succimer ، و فيتامين د ساعد في خفض مستوى الدم المرتفع في عمال محطة الوقود.

التوصيات: توصي الدراسه بالاتي:

١-تباع إجراءات السلامة لجميع العاملين في محطة الوقود.

٢-يُنصح العمال بمكملات غذائيه مثل تناول الكالسيوم وفيتامين د.

٣-الفحص الدوري للرصاص و اعطاء ادويه لتقليله في حال تعدي النسبه المسموح بها حتى بدون شكوى