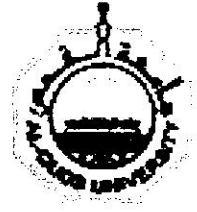




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Occupational Lead Exposure in Battery and Auto-Radiator Workers in Gaza Governorates

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**A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of
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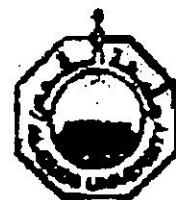
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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

﴿وَقُلْ رَبِّ زِدْنِي عِلْمًا﴾

سورة طه الآية 114

صدق الله العظيم

In the name of Allah, Most Gracious, Most Merciful

﴿But say O my Lord! advance me In Knowledge﴾

The Holy Quran "Ta-Ha, 114"

Truly did Allah, The Highest.

Dedication

“ I would like to dedicate this work with extreme love to my country, my father, mother, brother, sisters, wife and my sons. Thank you all for your genuine love and endless support. This work could not have been achieved without you ”.

Fayeq Ibrahim El-Madhoun

Declaration

I certify that this thesis submitted for the degree of Master is the result of my own research, except where otherwise acknowledged, and that this thesis (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signature



Fayeq Ibrahim Rabah El-Madhoun

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Abstract

Occupational lead exposure is a major public health concern and a serious environmental health problem. The extent of occupational lead exposure remains hazard, whereas there is no previous research conducted in Gaza Governorates. The main aim of this cross sectional study is to determine blood lead level (BLL) in battery and auto-radiator workers as well as to identify risk factors associated with elevated BLL. Data were collected by face to face questionnaire from 126 (65 battery and 61 auto-radiator workers) out of 139 workers in the five Governorates of the Gaza Strip. Clear variations were found in workers knowledge regarding routes of lead exposure, lead accumulation and lead environmental pollution. Despite their high knowledge of personal protective equipment (PPE) both groups rarely used them. Headache, fatigue, irritability, lead line in gingival tissue and concentration difficulties were common symptoms. Prevalence of lead toxicity symptoms associated significantly in auto-radiator workers with increasing work duration. A total of 92 (50 battery and 42 auto-radiator workers) were voluntary accepted to give blood samples for BLL analysis, which was carried out at Environmental Protection and Research Institute (EPRI-Gaza). The mean of BLL for battery workers was higher than 48.18 microgram/deciliter ($\mu\text{g}/\text{dl}$), 86% of worker's BLL was ≥ 25 $\mu\text{g}/\text{dl}$. In auto-radiator workers the mean of BLL was 29.52 $\mu\text{g}/\text{dl}$, 64.3% of them had BLL ≥ 25 $\mu\text{g}/\text{dl}$. BLL was significantly higher in battery workers. A statistically significant positive relationship was detected between BLL and lead smelting, lead battery assembly, lead battery repairing and lead battery recycling workers, whereas BLL was inversely significant in workers who work

only in charging batteries. Significant increase in BLL was observed in workers who worked 60 hours/week rather than those worked 48 hours/week. Workers who reside in the vicinity of their workshops had higher BLL than those live far away, this relationship was only statistically significant in battery workers. BLL was generally found to be relatively lower in workers who used to wear PPE. Statistically significant decrease in BLL was found in battery workers who used to wear gloves and overall and in auto-radiator workers who used to wear work shoes. A relatively higher BLL was found among smokers and chewed gum workers, however it was statistically significant in battery workers who used not to wash their hands before smoking or chewing gum as well as auto-radiator workers who used not to wash hands before eating. Put hands, nails and other objects near mouth, eating in the work site and removing dust from clothes or equipment by blowing or shaking and work in poor clean workshops were found to be statistically significant in both workers. Higher BLL was observed in poor naturally ventilated workshop workers. Headache, fatigue and irritability were the most common lead toxicity symptoms associated significantly with BLL among both groups. Appearance of lead in gingival tissue was associated significantly only in battery workers. Inverse significant relationship was found between BLL and hemoglobin (Hb) and hematocrit (Hct) ratio in both groups. The lowest Hb value and Hct ratio were recorded in workers group who had $BLL \geq 60 \mu\text{g/dl}$. The study contributes in highlighting the major risk factors for implementing strategies that could help in prevention of occupational lead exposure. Great efforts are needed like intervention educational and training programs, health monitoring, good work personal hygiene practices, appropriate PPE, in addition, further researches in this field are strongly recommended.

الملخص العربي

التعرض المهني للرصاص بين عمال البطاريات و رديترات السيارات في محافظات غزة

يعتبر التعرض المهني للرصاص من أهم قضايا الصحة العامة ذات الخطورة على صحة الإنسان والبيئة التي لم يسبق دراستها في محافظات غزة، لذا تهدف هذه الدراسة إلى تسليط الضوء على هذه القضية من خلال تقدير مستوى الرصاص في دم العاملين في ورش البطاريات وتصليح رديترات السيارات في محافظات غزة وتحديد عوامل الخطر المرتبطة بارتفاع مستوى الرصاص في الدم ومن ثم إيجاد طرق للوقاية وتقديم التوصيات اللازمة لتقليل الآثار الصحية الناتجة عن التعرض المهني للرصاص.

تم استخدام الدراسة المقطعية كونها تمكن الباحث من إجراء كافة الاختبارات الوصفية والتحليلية في آن واحد. لقد اشتملت الدراسة على 126 عاملا (65 يعملون في 32 ورشة للبطاريات الرصاصية، و 61 يعملون في 36 ورشة لتصليح رديترات السيارات) وذلك من أصل 139 عاملا وبذلك كانت نسبة الاستجابة 90.6%. وقد تم جمع المعلومات باستخدام استبانة تم تصميمها وفحص مدى ثباتها من قبل محكمين من ذوي الاختصاص، أظهرت النتائج تفاوتاً في درجة معرفة العاملين لطرق التعرض للرصاص، تراكمه داخل الجسم وإحداثه للتلوث البيئي. رغم ارتفاع نسبة الوعي لدى العمال نحو أهمية أدوات الوقاية الشخصية، كان استخدام تلك الأدوات متدنياً بينهم. أظهرت الدراسة وجود أعراض تسمم مصاحبة للتعرض للرصاص من أهمها الصداع، الإجهاد، الإثارة العصبية، خط أزرق في أنسجة اللثة وضعف في التركيز. وجد ان أعراض التسمم بالرصاص كانت مرتبطة بزيادة سنوات العمل، وكان هذا الارتباط ذا دلالة إحصائية بين عمال الرديتر.

تم إجراء اختبار لتقدير الرصاص في دم العاملين الذين وافقوا طوعاً للمشاركة بإعطاء عينات الدم وكان عددهم 92 عاملا ممن شاركوا في تعبئة الاستبيان (50 من اصل 65 عاملا في ورش البطاريات و 42 من اصل 61 عاملا في ورش تصليح رديترات السيارات). وقد أجريت اختبارات فحص الرصاص في الدم في معهد أبحاث وحماية البيئة بغزة.

أظهرت النتائج أن متوسط مستوى الرصاص فى دم عمال البطاريات كان يزيد عن 48.18 ميكروجرام/ديسيلتر، 86% منهم كان مستوى الرصاص لديهم يساوى أو أعلى من 25 ميكروجرام/ديسيلتر. أما عمال الرديتر فقد بلغ متوسط مستوى الرصاص 29.52 ميكروجرام/ديسيلتر، 64.3% منهم كان مستوى الرصاص لديهم يساوى أو أعلى من 25 ميكروجرام/ديسيلتر. كان مستوى الرصاص بين عمال البطاريات أعلى منه بين عمال الرديتر بعلاقة ذات دلالة إحصائية. كان مستوى الرصاص مرتفعا بدلالة إحصائية فى دم عمال البطاريات الذين عملوا فى صهر الرصاص، تجميع البطاريات، تصليح البطاريات وتدوير بطاريات الرصاص، بينما وجدت علاقة ذات دلالة إحصائية عكسية فى مستوى الرصاص فى دم العاملين فى شحن البطاريات فقط. لوحظ زيادة مستوى الرصاص بدلالة إحصائية فى دم العمال الذين عملوا لمدة 60 ساعة/الأسبوع مقارنة مع زملائهم الذين عملوا لمدة 48 ساعة/الأسبوع. لوحظ زيادة فى مستوى الرصاص لدى العمال الذين يقطنون بجوار ورشهم مقارنة بزملائهم الذين يقيمون بعيدا عن الورش وكانت هذه العلاقة ذات دلالة إحصائية بين عمال البطاريات. كان هناك تدرج نسبى فى انخفاض مستوى الرصاص لدى العمال الذين استعملوا أدوات الوقاية الشخصية. لوحظ انخفاض ذو دلالة إحصائية فى مستوى الرصاص فى دم عمال البطاريات الذين كانوا يرتدون القفازات واللباس الواقي أثناء العمل وكذلك الأمر بالنسبة لعمال الرديتر الذين اعتادوا على ارتداء حذاء العمل. أظهرت النتائج ارتفاعا نسبيا فى مستوى الرصاص فى دم العمال المدخنين والذين يمضغون اللبان، كما لوحظ ارتفاعا ذو دلالة إحصائية فى مستوى الرصاص فى الدم بين عمال البطاريات المدخنين الذين لم يعتادوا على غسل أيديهم قبل التدخين وكذلك الأمر بالنسبة للذين لم يعتادوا على غسل أيديهم قبل تناول قطعة جديدة من اللبان، أما عمال الرديتر فقد لوحظ زيادة ذات دلالة إحصائية فى مستوى الرصاص فى دم الذين لم يعتادوا على غسل أيديهم قبل تناول الطعام. أظهرت النتائج علاقة ذات دلالة إحصائية بين ارتفاع مستوى الرصاص فى دم العمال الذين اعتادوا وضع أيديهم، أطرافهم أو أشياء أخرى بجانب فمهم، والذين اعتادوا تناول الطعام داخل مكان العمل، والذين اعتادوا نفض ملابسهم أو أدواتهم أو هزها لإزالة الغبار مقارنة مع زملائهم الذين لم يفعلوا ذلك. لوحظ زيادة ليست ذات دلالة إحصائية فى مستوى الرصاص فى دم العمال الذين عملوا فى ورش رديئة التهوية. وكذلك لوحظ زيادة ذات دلالة إحصائية فى دم العمال الذين عملوا فى ورش ذات مستوى نظافة ردىء مقارنة بزملائهم الذين عملوا فى ورش ذات مستوى

متوسط أو جيد من النظافة. أظهرت النتائج بأن أهم أعراض التسمم بالرصاص والتي ارتبطت بعلاقة ذات دلالة إحصائية مع ارتفاع مستوى الرصاص في دم العاملين كانت الصداع، الإجهاد والإثارة العصبية بينما كان ظهور الخط الأزرق في أنسجة اللثة ذو دلالة إحصائية مع ارتفاع مستوى الرصاص في دم عمال البطاريات فقط. أدى ارتفاع مستوى الرصاص في دم العاملين الى انخفاض ذو دلالة إحصائية في مستوى هيموجلوبين الدم ونسبة الهيماتوكريت، وقد كان ذلك جليا في فئة العمال الذين بلغ متوسط نسبة الرصاص في دمهم يساوى او أكبر من 60 ميكروجرام/ديسيلتر.

لقد ساهمت هذه الدراسة بتسليط الضوء على أهم عوامل الخطر والتي تتطلب تطبيق استراتيجيات من شأنها لعب دور في الوقاية من التعرض المهني لأخطار الرصاص. هناك حاجة لجهود عظيمة للتدخل وتطبيق برامج تدريبية وتنقيفية، برامج صحية، الممارسة الصحية للعمل الجيد، استخدام أدوات الوقاية علاوة على إجراء مزيد من الأبحاث في نفس المجال.

List of Abbreviation

ATSDR	Agency for Toxic Substance and Disease Registry
BAL	British Anti-Lewisite
BLL	blood lead level
CDC	Center for Disease Control and Prevention
CNS	Central nervous system
EDTA	Ethylenediamine tetracetic acid
EP	Erythrocyte protoporphyrin
EPA	Environmental Protection Agency
EPRI	Environmental Protection and Research Institute
FDA	Food and Drug Administration
Hb	Hemoglobin
Hct	Hematocrit
IPCS	International Program on Chemical Safety
MenA	Ministry of Environmental Affairs
µg/dl	Microgram per deciliter
µl	Microlitre
MOE	Ministry of Education
MOH	Ministry of Health
MOL	Ministry of Labor
MOSA	Ministry of Social Affaires
MOT	Ministry of Transportation
NGO's	Non Governmental Organizations
NIOSH	National Institute of Occupational Safety and Health
OLPPP	Occupational Lead Poisoning and Prevention Program
OSHA	Occupational Safety and Health Administration
PCBS	Palestinian Central Bureau of Statistics
PNA	Palestinian National Authority
PPE	Personal protective equipment
SD	Standard deviation
SPSS	Statistical Package for the Social Science
USA	United States of America
WHO	World Health Organization
ZPP	Zinc protopophyrin

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