Original Research Article

Evaluation of Occupational Lead Exposure in Informal Work Environment in Kenya

Abstract

Lead (Pb) is widely used in the informal sector and much of the exposure levels is through handling, processing, fabrications, burning and disposal of materials containing Pb. Furthermore, Pb bio-accumulate and is highly toxic to human health and is persistent in the environment. This study was therefore designed to evaluate levels of exposure to airborne Pb amongst workers in the informal sector. Airborne Pb was collected using air sampler in 34 production areas (sheds) and two control areas. The concentration of airborne Pb was determined using an atomic absorption spectrophotometer. An empirical survey using questionnaires was also used to evaluate the understanding of airborne Pb and occupational safety and health strategies in place. Nearly 56% of the sheds had airborne Pb concentrations ranging from 1.4μg/m^3 to 126.9μg/m^3. On the contrary, 44.1% of the production areas and control sites had airborne Pb levels below the detectable limit (BDL). The welding works in sheds 11 and 27, and painting activities in shed 6 and 16 had significantly ($p < 0.05$) higher levels of airborne Pb with a mean ± standard deviation (sd) of 126.9 ± 20.1μg/m^3, 117.4 ± 5.2 μg/m^3 and 56.4 ± 3.1 μg/m^3, and 53.6 ± 0.6 μg/m^3, respectively than other operations within the sheds, and the controls areas. These levels in the welding and painting areas also exceeded the US. Occupational Safety Health Act (OSHA) Permissive Exposure Limit (PEL) Time Weighted Average (TWA) of 50 μg/m^3. The study also found that the informal sector workers had limited information about Pb exposure despite the fact that 50.0 % of them had secondary education and 9.4% had primary education. About 62% of these workers were unaware of Pb exposure and related adverse effects and 70.6% of them did not undergo annual medical check-ups. The workers had further no appropriate personal protective equipment that would reduce their exposure to Pb. The study recommends comprehensive awareness and training programs on Pb exposure and occupational safety and health in the informal work environment to prevent associated health effects.

Keywords: Lead exposure; occupational safety and health, informal sector worker, welding, painting

UNDER PEER REVIEW

Introduction

Occupational Pb exposure is still common in developing countries especially amongst workers in the informal sector who come into contact with Pb during their manufacturing processes [1]. In developed countries there is stringent controls, improvements in industrial processes and regulations regarding emission and release of Pb into the environment. On the contrary, in the informal sectors in the developing countries, handling, recycling, manufacturing, use and disposal of materials containing Pb is often unregulated. Exposure to Pb is more prevalent largely in workers in radiator repairs, auto-panel works, welding and fabrication of metals, painting operations, lead battery manufacturing and recovery, soldering, lead mining and smelting, lead alloy production[2–4]. Moreover, in Kenya where the majority of the population work in the informal sector, exposure to Pb is likely to occur.

This is further exacerbated by lack of adequate occupational safety and health measures among workers including information in regard to exposure Pb and associated health effects[5]. The production areas of the informal sector workers are usually unregulated, and located in close proximity to residential areas. In most cases these areas lacks the necessary facilities that assist in reducing exposure to Pb [2–4]. Due to a combination of several factors, Pb containing fumes and dust generated from such operations pose exceptional health effects to both children and workers [1]. High levels of Pb exposure have been linked to damage of almost all organs of the human body, and mainly the central nervous system and kidneys. Moreover it interferes with brain development in children [5,6] This study therefore sought to evaluate the concentration of airborne Pb in the production areas in the informal sector in Kenya.

Methods

Description of the study Area and population

After obtaining the necessary approvals and permits, the study was undertaken between October 2016 and July 2019 to evaluate lead exposure in the informal sector, located approximately 2 km from the Nairobi Central Business District. The sector was started in 1961 with nine detainees who had some skills on metal fabrication[7]. In mid-70s the number of these artisans increased to 350. The sector was characterised by loud noise that was emanating from fabrication of metals using hammers. The artisans were also working in harsh conditions, in open space under the "scorching sun" hence the Kiswahili name "Jua Kali". As a way of support to the artisan, the government constructed three big sheds in 1986

UNDER PEER REVIEW

(Figure 1), which were later subdivided into a total of thirty-seven small sheds. Presently, the sector is one of the largest and densely populated in Kenya with a population of 5000 dominated by clusters of micro (1-3 workers) and small enterprises (4-10 workers) that are located adjacent to each other[8].

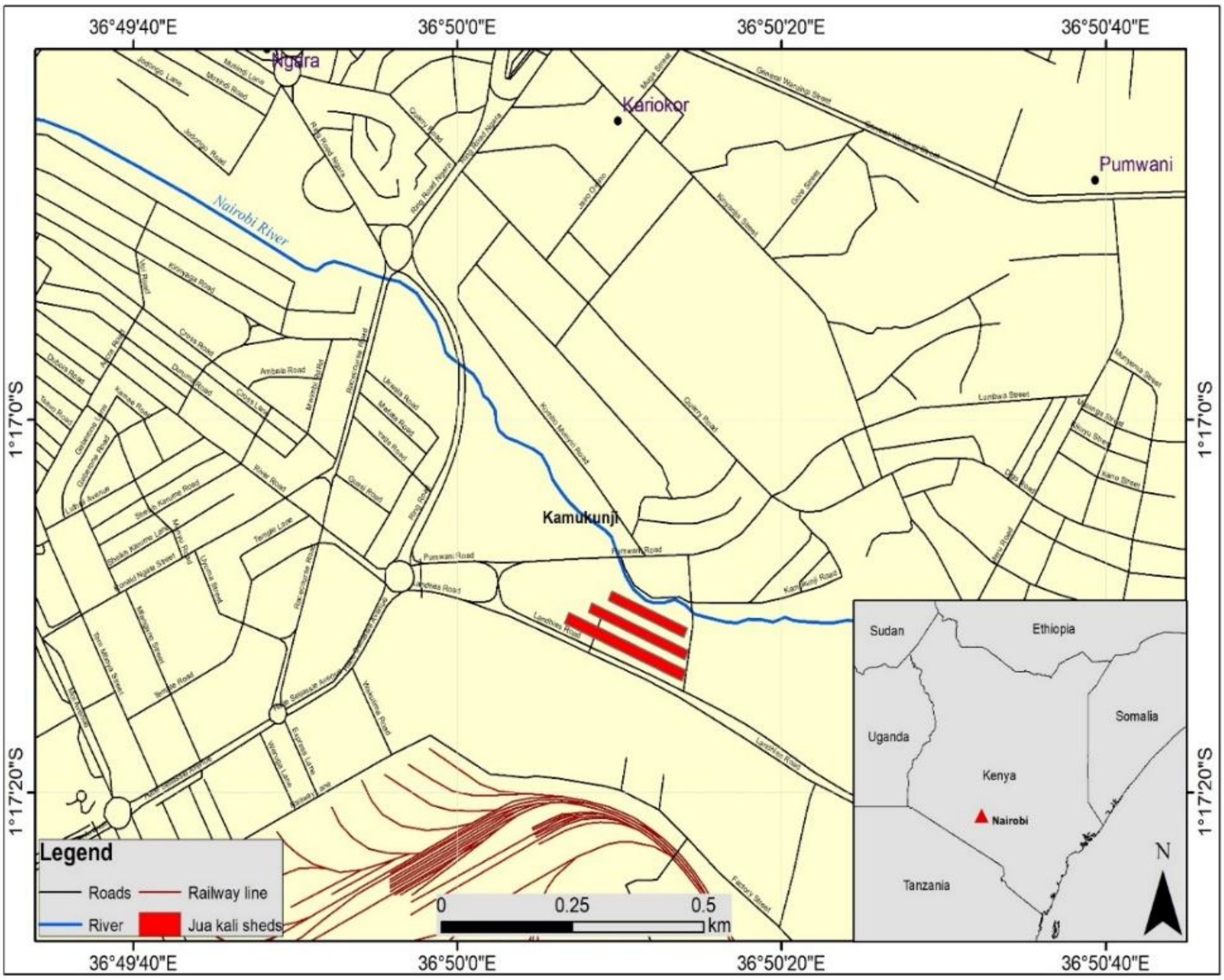

Figure 1: A map showing three big sheds that were later subdivided into 37 small sheds in Kamukunji area Nairobi County

Sampling Sites and Airborne Lead Collection

The airborne lead samples were collected in the thirty-four (n = 34) production areas (sheds) on the basis of activities that were taking place during working hours in accordance with the National Institute of Occupational Safety and Health (NIOSH) USA 7082 and [1]. The collection of airborne Pb samples (n = 34) were categorized as follows: in (i.) twenty-three (n =23) that included 1 to 4, 7 to 9, 12, 13, 15, 18, 19, 20 to 26 and 28 to 31 where fabrications of various metallic items were carried out. (ii.) seven (n = 7) sheds that were 17 and 32 to 37 that involved grinding, heating and soldering activities (), (iii.) two (n = 2) sheds that included 11, and 27 that were mainly carrying out welding activities iv) two (n =2) shed, 6 and 16 that was mainly involved in spray and painting operations.. The airborne Pb samples were also collected in the two control sites that were an open library and open field.

Area airborne Pb was then sampled full-shift in 34 sheds and 2 control production areas during working hours using air sampling pumps. The batteries for the pumps were fully charged prior to sampling, to ensure that the pumps could run a full shift without failure. The cellulose membrane filter paper with diameters of 37 mm and 8μm pore size were used. The sampling apparatus was assembled by placing the filter paper in between the support ring and the cover and the sampling tube (flexible by design) was connected to a pump that was calibrated using a flow meter (rotameter) [9]. Air samples were collected by placing the pumps onto a stand and the sampling head mounted to the workers breathing zone level while the pumps were placed 1m from the ground [9]. The apparatus was set to a flow rate of 2 L/min which was checked periodically during sampling. Upon completion of the sampling process, the filters were then stored in cassette filter holder and transported to the laboratory for further analysis of Pb.

UNDER PEER REVIEW

Sample Digestion and Lead Analysis

The stored filter samples were removed from the filter cassettes using forceps and transferred to clean 50 ml beakers. 3.0 ml of concentrated nitric acid and 1.0 ml of 30 % hydrogen peroxide was then added to each beaker and heated on a hot plate at 140 °C. The samples and blanks were not allowed to dry during the digestion process. These procedures were repeated twice with 2.0 ml concentrated HNO_3 and 1.0 ml of 30 % H_2O_2, each time the volume being reduced to 0.5 ml. After digestion, the beakers were washed with 5.0 ml of 10 % HNO_3 and the sample evaporated to dryness, cooled and the residue dissolved with 1.0 ml concentrated HNO_3. The solution was then filtered and transferred to 10 ml volumetric flask and diluted to the mark. A series of lead metal working standards ranging from 0.25 to 20 μg/ml were then prepared and used to plot a standard calibration curve. The samples were then analysed by aspirating the samples through an Atomic Absorption Spectrophotometer set at a wavelength of 283.nm.

Empirical Survey

The empirical survey was divided into two arms. The first arm gathered information on socioeconomic characteristics of the respondents, while the second arm concentrated on the levels of awareness, perception and understanding of occupational safety and health control measures in regard to airborne lead exposure [10]. This information was obtained using questionnaires and observations. Questionnaires were issued to permanent workers, shed leaders, where long exposure was assumed. Temporal workers were therefore excluded from this study [10].

The questionnaires gathered the following data; gender of the respondent, approximate age, level of education, how long the respondent had worked in the current work place, how many hours worked in a day, knowledge on Pb poisoning, how the respondent attained the knowledge on Pb exposure, and any health and safety measure concerns. In the case of medical history, the following information was captured; whether the respondent undergoes any medical examinations, related to blood pressure or coughs chest pains, if the respondents had noticed any health changes due to the work environment., Observations on the work space ventilation, health aspects, provision of personal protective equipment (PPEs) to the workers and personal hygiene, were further undertaken during the sampling period.

Ethical Considerations

All respondents who volunteered to participate in this study did so with informed consent and were aged 18 years and above.

UNDER PEER REVIEW

Results and Discussion

Lead exposure

Table 1 summarises the airborne lead concentrations in the thirty-four (n = 34) production areas (sheds) of the informal worker environment and two (n = 2) control sites. Figure 2 is the corresponding mean levels of lead in air (LIA) in production areas compared to the US Occupational Safety and Health (OSHA) Permissive Exposure Limit (PEL) of 50 µg/m^3.

Table 1: Mean ± sd Airborne Lead Level for different Operations in the Sheds (n = 34)

Study Areas	n	Sheds	Nature of Work	Mean ± sd (µg/m3)
Production	23	1-4, 7-9, 12,13, 15, 18,19, 20-26, 28-31	Fabrication metallic materials	1.48± 2.8
	7	17, 32-37	Grinding, heating, soldering works	3.0±1.6
	2	6 & 16	Spray and brush painting	55.0 ± 2.0
	2	27& 11,	Welding areas	122.0 ± 46.7
Control	1	Library	BDL	
	1	Open field	BDL	

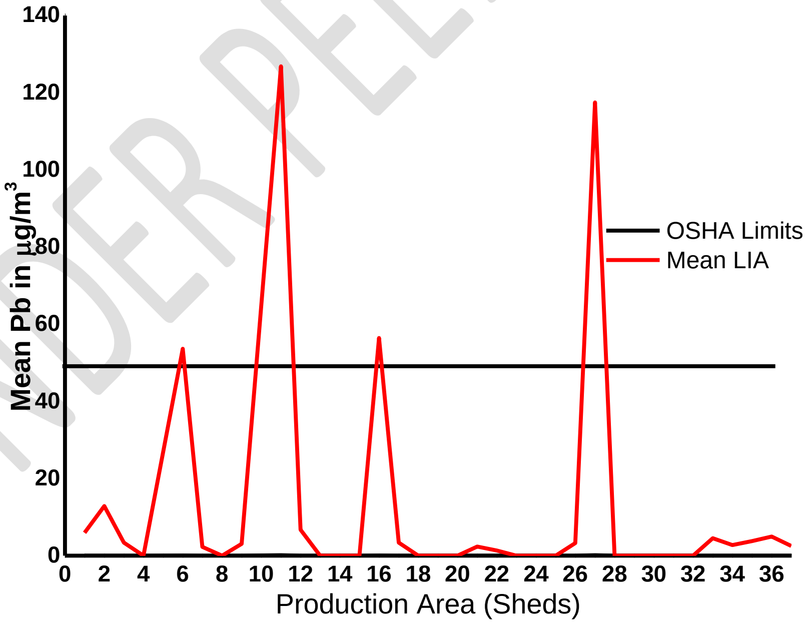

Figure 2: Lead metal concentration of the selected sampling sites compared to the US OSHA limits

From Table 1, the welding works in production areas in sheds 11 and 27 had the highest airborne Pb concentration with a mean ± standard deviation (sd) of 126.9 ± 20.1µg/m^3 and

UNDER PEER REVIEW

117.4 ± 5.2 µg/m^3, respectively, when compared to the other activities in the production areas, and the controls that had values below the detection limit (BDL). These levels in the welding areas also exceeded the US. OSHA PEL of 50 µg/m^3 and were comparable to the levels that were reported by[1]in another welding operation in Industrial Area, Nairobi, Kenya. The high airborne Pb levels observed in the welding areas and with no respiratory protection suggests that welders were likely to have high blood lead levels (BLL). Previous studies done by [1], reported airborne Pb of 126.2±33.2 ug/m^3 in a scrap welding plant. The welders had an average BLL of 40.9 ±7.5 µg/dl that exceeded the American Conference government of Industrial Hygienist (ACGIH) Biological Exposure Indices (BEI) for BLL of 30 µg/dl [11].

The findings [8] have also showed that welders had a mean BLL of 25.3 ±17.8 µg/dl. Other studies have revealed that out of fifty-one welders, six had BLL above 10 µg/dl, while construction workers who were exposed to welding fume, showed detectable levels of lead (Pb), manganese (Mn), cadmium (Cd), nickel (Ni) and arsenic (As) in their toenail clippings of the workers [12,13]. The welders in Shed 11and 27 are therefore likely to have high BLL and suffer from related adverse health effects.

Elevated mean airborne Pb levels of 53.6 ± 0.6 µg/m^3 and 56.4 ± 3.15 µg/m^3 were also found in sheds 6 and 16 where painting works were carried out in the open. None of the painters had respiratory protection equipment to protect them from these exposures. These results are in agreement with those of [1], where the mean airborne values of 76.3 ± 33.2 µg/m^3 were reported in a formal production areas of paint manufacturing plant. Studies done on 84 bridge painters further showed that painters were exposed to airborne Pb during several job tasks performed during the workday, such as sanding, scraping, and blasting [14].

The International Conference on Chemical Management (ICCM) held in 2009, identified Pb paint as an emerging human health and environmental policy issue. It was in this context that UNEP and WHO were tasked to provide leadership and form a partnership with diverse stakeholders to get rid of lead paint and create a healthy and habitable environment[15] . It is out of this effort that the Kenya Bureau of Standard (KEBS) and the technical committee of the East Africa Standard for Paints and Allied Products recently established 90 ppm as the allowable maximum total lead content in paints that should be sold in the East African market[16] . This means that manufacturers should not add leaded materials during the production processes. High airborne Pb levels that were observed during painting in shed 6

UNDER PEER REVIEW

implies that leaded materials are still being used by workers in the informal sector during formulation of paints. Enforcement and comprehensive awareness programs are necessary in this sector to phase out lead in paint.

It should also be noted that in this study, 19 of the selected 34 production areas, representing approximately 56% had Pb concentration ranging from 1.45± 0.1 μg/m^3 to 126.9 ± 20.1μg/m^3. Implying that 4 sheds had Pb in air levels that exceeded the US. OSHA PEL of 50 μg/m^3. On the other hand , the 15 of 34 production areas (sheds, 44.1% and the two control sites had Pb concentration in air below the detectable limit (BDL). The World Health Organization (WHO) and other health authorities have acknowledged the health impacts of Pb even at low level of exposure since Pb persists in the environment, bio accumulate in biological system and highly toxic. The toxic metal is responsible for 674,000 cardiovascular deaths reported annually. WHO estimates that about 99% of people affected by lead poisoning are from developing countries. Lead is absorbed into our bodies through either ingestion, inhalation or dermatological absorption [17]. In workers, the most common route of exposure to Pb is through inhalation from contaminated workplace air [17].

Demographic characteristics of the workers and lead exposure

From Figures 2 and 3, the study considered demographic characteristics (gender and age),of the workers where 67.6% were males while 32.4% were females.

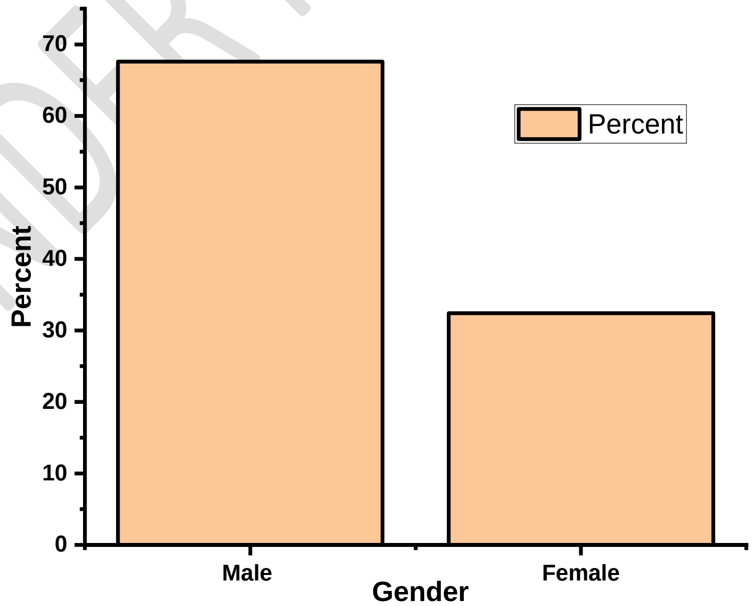

Figure 3: Gender of the respondents

UNDER PEER REVIEW

The activities that were performed by the female workers included painting, cooking, cleaning and selling of the products. Airborne Pb levels where the female respondents were painting in shed 6 was 53.6 ± 0.1 μg/m^3 while sheds 20 and 30 where they carried out general activities the levels were BDL Previous studies done by [12] and[8] reported elevated BLL among painters in the informal sector that could have been contributed to airborne Pb within the working area. In this study, painting was done using brush and spray guns, in the open space and none of the workers had respiratory protection which could have resulted in high BLL of the female workers.

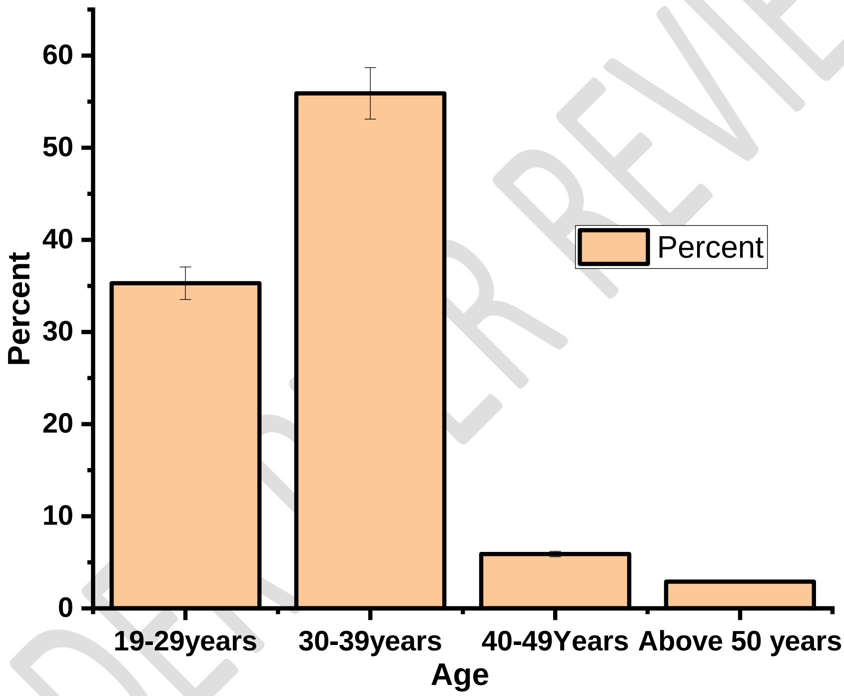

Figure 4: Age of the respondents

It was also observed that the majority of the respondents were aged between 30-39 years, which accounted for 55.9% of the respondents, while 35.3% of the respondents were aged between 19-29 years (Figure 3). However, 5.9 % respondents were aged between 40-49 years, and only 2.9% were aged above 50 years. From these findings, it is clear that the activities and operations of the informal sector are labour intensive and entirely manually hence had limited involvement of workers above the age of 40. Most production workers in sheds 6, 11, 16 and 27, were aged from 19-29 years and 40-49 years, and the airborne Pb levels exceeded the US. OSHA PEL in these production areas. The female workers in shed 6

UNDER PEER REVIEW

that had elevated levels of airborne Pb were of child bearing age of between 30 and 39 years, Pb exposure may be detrimental to their unborn babies and during breast feeding [18].

Level of Education and Knowledge on Lead Exposure

Figure 4 depicts the results obtained in regard to the level of education and knowledge about lead exposure in the work place.

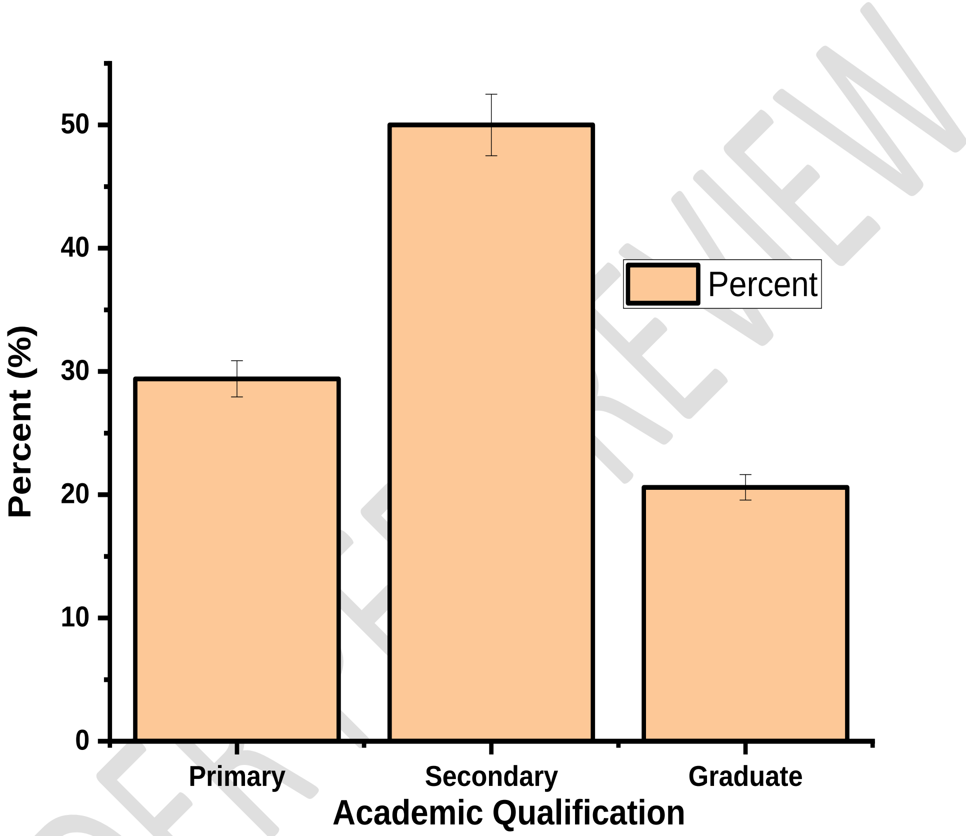

Figure 5: Level of Education and Knowledge on Lead Exposure

The study found that 50% informal workers had secondary education, 29.4% had primary education while 20.6% had high level education. All the respondents who had primary school education had limited information on Pb exposure. It is worth noting from this survey that most of the respondents working in this sector did not acquire formal education as this was not a prerequisite to get employment in this sector. From those who participated in the study, 61.8% did not know about Pb exposure while only 38.2% were aware about Pb exposure. Nevertheless, this percentage is significantly higher than that of [12] where only 6.7% were aware of lead toxicity. Among the 38.2% respondents that had knowledge about Pb exposure, only 8.5% obtained the information through formal training, 23.5% was through friends and

23.5% through electronic media reinforcing the importance of social platform in awareness raising in the informal sector [19,20].

With regard to material safety data sheets (MSDS), most chemicals used in this sector lacked the MSDS hence the workers were not informed about the safety of the chemicals they were handling. It was also observed that most of the workers did not refer to the labels and markings on the containers. This poses a safety and health risk to the workers since some containers had toxic chemicals in powder form where workers may have been exposed to through inhalation[4]. Recycling of painted scrap metals in metal fabrication activities was also a potential source of Pb Exposure. These findings concur with those reported by[4] who observed that recycling of scrap metal resulted in exposure to various toxic chemicals amongst workers in the informal sector. Although the respondents working in areas with high Pb levels had secondary education. Of the four respondents, only two had knowledge about Pb exposure, the other two had limited knowledge about Pb exposure but they were interested in getting more information about Pb exposure and its adverse health effects. Only one shed leader was not interested in further information about Pb exposure, while 44.1% were interested in gaining further information, and thus the need for detailed awareness and training programs in this sector about Pb exposure.

Duration of Exposure and Working Hours

Figure 5 and 6 is about the duration of exposure and number of working hours in the informal sector.

UNDER PEER REVIEW

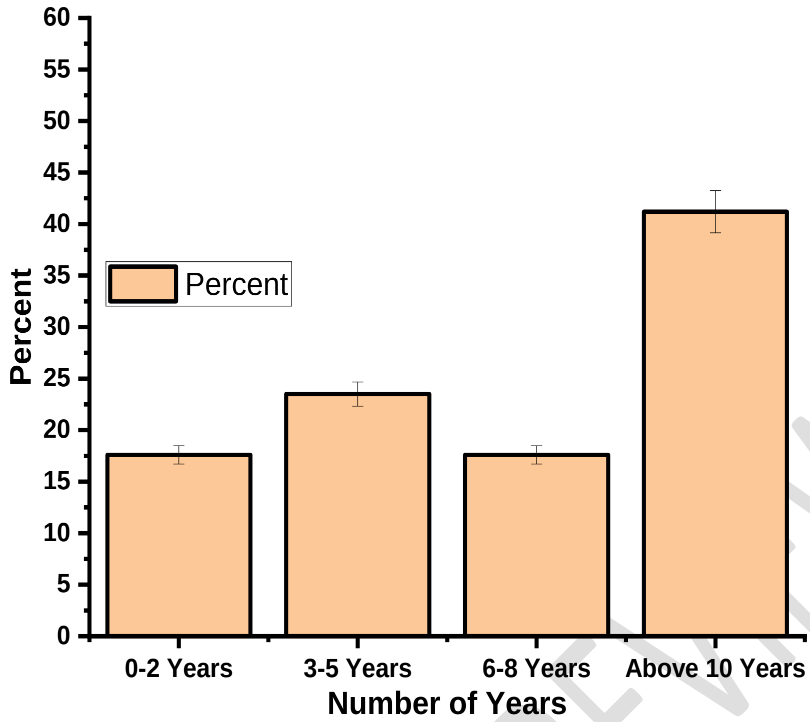

Figure 6: Duration of exposure estimated through number of working years

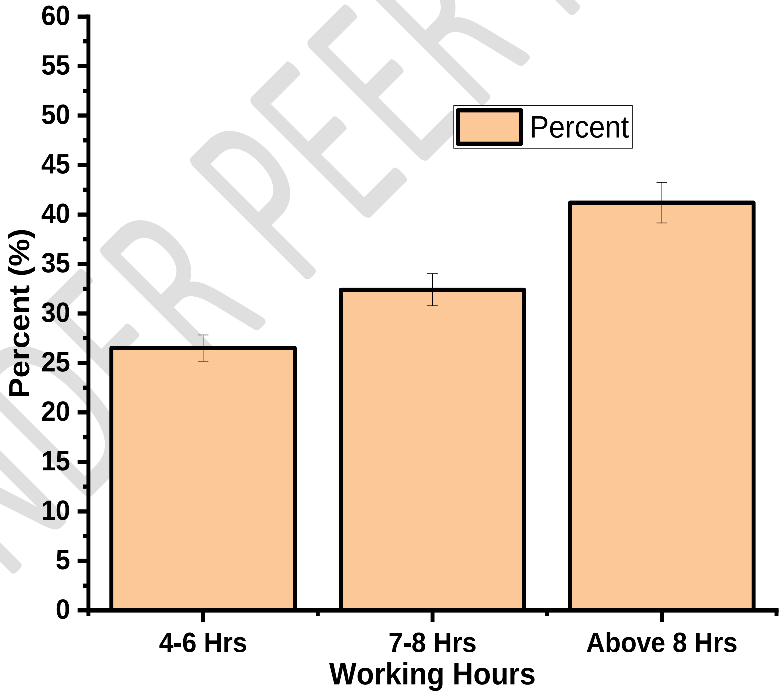

Figure 7: Duration of exposure estimated through number of working hours

UNDER PEER REVIEW

Nearly 41 % of the shed representatives had worked in the sector for more than 10 years and a small proportion of 17.6% had worked for less than 2 years. Two of the female respondents had worked in the area for over 10 years while one had worked for 5 years and more than 8 hours per day. In the sites, sheds 6, 11 and 27 where airborne Pb exposure PEL of 50 ug/m^3

were exceeded, the respondents had worked in these areas for over 10 years while one respondent from shed 6 had worked for 3 years. The respondents in shed 6 and 11 indicated their work shift was more than 8 hours per day and was more than the US OSHA PEL Time Weighted Average (TWA) of 8 hour per day for 5 days in a week. This is a worrying trend, since some researchers revealed a decline in fertility rates in environmentally or occupationally exposed male to Pb over a longer time [21]. It has been reported that long term inhalation of Pb resulted in deposition of Pb in the bone and higher concentration in the blood[21].

Medical Surveillance

The study also established that a high proportion (70.6%) of the respondents did not undergo any medical examination even though they had experienced health effects related to their work environment. A small proportion of the respondent stated that they occasionally visited the health facilities although they were unclear on the nature of illness and the frequency of medical visits. The majority (85%) of these medical visits reported were either because of hypertension or respiratory ailments.

Use of Protective Equipment

It is also worth mentioning that even though 75% of the workers in the informal sector had observed adverse health effects, A large number (70.6 %) of the respondents did not use PPEs against Pb exposure. Only 29.4% stated that they use some PPEs to protect themselves from lead fumes.

Correlation between Airborne Lead Levels and Empirical Survey

Correlation coefficient (r) measures the combined variation between two variables, x and y and it can only take values in the range $-1 \leq r \leq +1$. An r value of – 1 describes a perfect negative correlation and an r value of + 1 indicates a perfect positive correlation while an r value of 0 indicates no linear correlation between the values of x and y [22].

UNDER PEER REVIEW

Table 3: Correlation coefficient matrix for airborne Lead Levels and Empirical survey questions

	Airborne lead levels in the working areas	**Do you undergo medical examination**	**Type of PPEs you use**	**Do you agree with stringent policy formulation?**	**How much do you know about lead exposure?**
Airborne lead Levels in the Working Areas	1				
Do you undergo medical examination	0.069	1			
Type of PPEs you use	0.005	.0. 717**	1		
Do you agree with stringent policy formulation?	-0.134	.0.719**	O.601**	1	
How much do you know about lead exposure?	-0.303	0.292	-0.045	0.274	1

**. Correlation is significant at the 0.01 level (2-tailed).

From Table 3, there is a positive correlation ($0 < r < 1$) between airborne lead, PPE usage, medical examination, and negative correlation between ($0 > r < 1$) airborne lead, policy, and knowledge on lead exposure. There was also a positive correlation between use of PPEs, medical examination and positive correlation between stringent policy and use of PPEs. This observation implies that use of PPEs is highly dependent on the strategies and policies put in place in a given shed as workers will tend to use the PPEs if strict policies are observed. Similarly, it can be observed from the correlation value that the use of PPEs also influences the frequency with which one visits a medical facility. [22]

Conclusion and Recommendation

The production areas (10.8%) of the informal sector had elevated levels of airborne Pb ranging from 53.6 ± 0.6 $\mu g/m^3$ to 126.9 ± 20.1 $\mu g/m^3$ which exceeded the US OSHA PEL TWA of 50 $\mu g/m^3$. Moreover, most respondents were working long hours per day, thereby increasing their exposure levels and hence aggravating the risk of developing complications associated with high Pb exposure. It was also evident that more than 50 % of the workers in the informal sector had limited information about Pb exposure and related health effect. They also had inadequate knowledge on occupational safety and use of appropriate PPEs. Comprehensive awareness and training programs on Pb exposure and occupational safety and health are necessary in the informal work environment to prevent related health effects.

UNDER PEER REVIEW

References

1. Were F, Moturi C, Gottesfeld P, Wafula G, Kamau G, Shiundu P. Lead exposure and blood pressure among workers in diverse industrial plants in Kenya. J Occup Environ Hyg. 2014;11(11):706–715.
2. Odongo OA, Moturi WN, Obonyo MA. Influence of task-based airborne lead exposures on blood lead levels: a case study of informal automobile repair artisans in Nakuru town, Kenya. Environ Geochemistry Heal 2019 427. 2019;42(7):1893–1903.
3. Ngo HTT, Watchalayann P, Nguyen DB, Doan HN, Liang L. Environmental health risk assessment of heavy metal exposure among children living in an informal e-waste processing village in Viet Nam. Sci Total Environ. 2021;763. doi:10.1016/j.scitotenv.2020.142982.
4. Street RA, Mathee A, Tanda S, Hauzenberger C, Naidoo S, Goessler W. Recycling of scrap metal into artisanal cookware in the informal sector: A public health threat from multi metal exposure in South Africa. Sci Total Environ. 2020;699. doi:10.1016/j.scitotenv.2019.134324.
5. International Lead Association. Environmental and social responsibility for the 21st Century. 2014 www.ila-lead.org.
6. Were F. Take the Lead on Lead. UN Environment. 2017.
7. Kenneth King. Jua kali Kenya: change & development in an informal economy, 1970-95. Choice Rev Online. 1997;34(06):34-3425-34–3425.
8. Njoroge G, Njagi E, Orinda G, Sekadde-Kigondu C, Kayima J. Environmental and occupational exposure to lead. East Afr Med J. 2008;85(6):284–291.
9. Maina EG, Gachanja AN, Gatari MJ, Price H. Demonstrating PM2.5and road-side dust pollution by heavy metals along Thika superhighway in Kenya, sub-Saharan Africa. Environ Monit Assess. 2018;190(4):1–11.
10. Kimani PK, Thiong'o GT, Mwangi JK. Water quality as a plausible basis for payment for ecosystem services, the buyer's perspective: Chania River Catchment, Kiambu County, Kenya. Sustain Water Resour Manag. 2020;6(6):1–11.
11. American Conference of Governmental Industrial Hygienists. Documentation of the Biological Exposure Indices (7th Edition). Mercury – Elemental and Inorganic. In: *ACGIH (American Conference of Governmental Industrial Hygienists)*. 2007 https://www.google.com/search?q=ACGIH+(American+Conference+of+Governmenta

UNDER PEER REVIEW

l+Industrial+Hygienists).+2007.+Documentation+of+the+Biological+Exposure+Indices+(7th+Edition).+Mercury+–
+Elemental+and+Inorganic.+ACGIH+Worldwide%2C+1330+Kemper+Meadow+Drive%2C+Cinc. Accessed 13 December 2021.

12. Ashraph JJ, Kinyua R, Mugambi F, Kalebi A. Health effects of lead exposure among Jua Kali (informal sector) workers in Mombasa , Kenya : A case study of the " Express " Jua Kali workers. Int J Med Med Sci. 2013;5(January):24–29.

13. Grashow R, Zhang J, Fang SC, Weisskopf MG, Christiani DC, Cavallari JM. Toenail metal concentration as a biomarker of occupational welding fume exposure. J Occup Environ Hyg. 2014;11(6):397–405.

14. Rodrigues EG, Virji MA, McClean MD, Weinberg J, Woskie S, Pepper LD. Personal Exposure, Behavior, and Work Site Conditions as Determinants of Blood Lead Among Bridge Painters. J Occup Environ Hyg. 2009;7(2):80–87.

15. GAELP. Global Alliance to Eliminate Lead Paint | UNEP - UN Environment Programme. 2011. https://www.unep.org/explore-topics/chemicals-waste/what-we-do/emerging-issues/global-alliance-eliminate-lead-paint. Accessed 20 October 2021.

16. Langat KN. Assessment of Occupational Hazards and their Impacts: A Case Study of Metal Working Jua Kali Sector in Nakuru Town, Kenya. 2020. https://africaneditors.org/journal/JSRE/abstract/59185-137480. Accessed 6 September 2021.

17. Zhang R, Wilson VL, Hou A, Meng G. Source of lead pollution , its influence on public. Int J Heal Anim Sci Food Saf. 2015;2(1):18–31.

18. Rachmat B, Dasuki, Manalu HSP, Elsi E. Blood Lead Levels and their Relationship with Lead in Ambien Air in Children in the Area of used Lead-Acid Battery in Depok City, Indonesia. J Ecophysiol Occup Heal. 2020;20(3&4):145–154.

19. Magidi M, Mahiya IT. Rethinking training: the role of the informal sector in skills acquisition and development in Zimbabwe. Dev South Afr. 2021;38(4):509–523.

20. Musara M, Management CN-AJ of, 2020 undefined. Informal sector entrepreneurship, individual entrepreneurial orientation and the emergence of entrepreneurial leadership. Taylor Fr. 2020;194–213.

21. Lin JL, Huang PT. Body lead stores and urate excretion in men with chronic renal disease. J Rheumatol. 1994;21(4):705–9.

22. Kothari C. *Research methodology: Methods and techniques*. 2004. New Delhi. New Age International Publishers

UNDER PEER REVIEW

https://books.google.com/books?hl=en&lr=&id=hZ9wSHysQDYC&oi=fnd&pg=PA2&dq=research+methodology&ots=1tW9mFgYD3&sig=4DuRblPYrdcL4SBhmYuEL7MBRpM. Accessed 18 September 2021.

UNDER PEER REVIEW