An Investigation on Lead Poisoning Awareness and its Associated Factors among Kabwe Residents Living In High Lead Contaminated Areas.

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ABSTRACT

Background: Lead poisoning is one of the public health concerns globally and locally especially in areas of mining activities. In Kabwe Zambia, there is an elevated risk of lead exposure due to improperly managed lead waste from the former lead mine. It is estimated that 76,000 people in Kabwe Zambia, live in high lead contaminated zones and half of the children in these areas have elevated blood lead levels of about 45 µg/dl which is more than 5 µg/dl prescribed by the World Health Organisation(WHO). Therefore,this justifies the need for investigating lead poisoning awareness in Kabwe Zambia. This study investigated on Lead poisoning awareness and its associated factors among Kabwe residents living in high lead contaminated areas.

Methods: The study used a quantitative cross sectional study design. This study design was opted for so as to collect exposure and outcome variables using a snap shot. 422 households were surveyed using questionnaires in high lead contaminated residential areas of Makululu, Chowa and Kasanda. The sample included Kabwe residents aged 12 to 61 years and above. Quantitative data was analyzed using STATA version 15.0

Results: The results revealed that 82.2% of the participants were aware about lead poisoning while 18.8% were not aware of this lead poisoning.

Conclusion: In conclusion,this study has revealed that those with tertiary education had a high probability of being aware about lead poisoning.**77%** of the participants with tertiary education were aware about lead poisoning.On the contrary, those with low levels of education had little chances of being aware about lead poisoning. Only **48%**of the respondents without education were aware about lead poisoning.Furthermore,the residential area of participants coupled with socio economic status and demographic characteristics had a bearing on lead poisoning awareness. Forinstance,those in planned settlements had a better understanding on lead poisoning as compared to their counterparts in unplanned settlements.

Keywords: Lead poisoning ,awareness, associated factors, Kabwe resident

INTRODUCTION

Lead poisoning is one of the public health concerns globally and locally especially in areas of mining activities.Lead poisoning has fatal consequences such as reduced sperm count, reduced libido,delayed child development, mental retardation and increased blood pressure(hypertension).Lead is a cumulative toxicant that affects multiple body systems and is particularly harmful to young children. All levels of exposure to lead are harmful. Therefore, exposure to lead poses public health concerns that need serious interventions.

Health Effects of Lead

According to (WHO, 2018),elevated blood lead levels if not attended to can damage the brain, kidneys, liver, stomach, nerves and blood cells which may result in anaemia, reduced attention span, reading and learning disabilities, behavioural problems, hearing loss, impaired growth, visual and motor malfunctioning, high blood pressure, coma and convulsions.

Globally,it was estimated that lead exposure accounted for 900 000 deaths and 21.7 million years of healthy life lost (disability-adjusted life years, or DALYs) worldwide due to long-term effects on health. The highest burden is in low- and middle-income countries. It is estimated that lead exposure account for 62.5% of the global burden of developmental intellectual disability whose cause is not obvious, 8.2% of the global burden of hypertensive heart disease, 7.2% of the global burden of ischemic heart disease and 5.65% of the global burden of stroke.Zambia is not exceptional in the fight and problems of lead poisoning like many other countries across the globe. Some studies conducted in Kabwe indicate that 95% of children living in the most affected townships had high blood lead levels of more than 5µg/dl. Approximately 50% of those children had blood lead levels of more than 45 µg/dl(Yabe etal,2015)

Lead poisoning awareness among Kabwe residents.

Given the vulnerability of the public to elevated lead exposure in third world countries,it is important that residents are aware of sources, pathways to lead contamination and measures to mitigate lead poisoning in the residents or community members.Children are at higher risk of lead poisoning due to specific risk behaviour such as playing on bare soil, and relevant hand-to-mouth activity thus their oral uptake is greater. It is therefore important that parents and caregivers be aware of the sources of lead poisoning and remedial measures to reduce lead poisoning in Children. Moreover, children's innate curiosity and their hand-to-mouth behaviour make them swallow lead-coated or lead-containing objects such as contaminated soil or dust. As such, awareness on lead poisoning is very key for implementing measures to reduce the potential risks in children. Furthermore,the World Health Organization has identified lead as one of ten chemicals of major concern needing action by member states to protect the health of children, workers and women of reproductive age in contaminated areas. This study, therefore, sought to investigate lead poisoning awareness and its associated factors among Kabwe residents living in high lead contaminated areas.

METHODS

The study used a quantitative approach. Specifically, the study employed an analytical cross-sectional study design. The design was opted for due to its nature to collect both exposure and outcome variables simultaneously and have a snapshot picture of the frequency and characteristics of the problem at one single point in time to determine the levels of awareness and determinants of lead poisoning in Kabwe lead concentrated areas. As this is an observational study design, no manipulation of the research environment was done and there was no follow-up design of the study

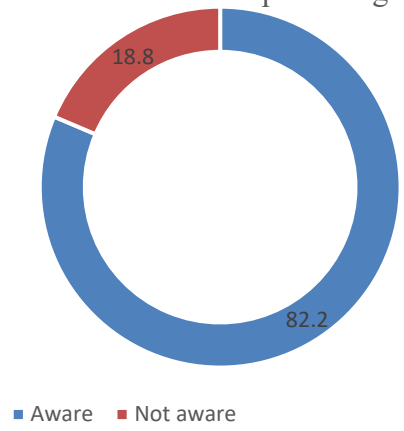
Written informed consent was sought from the participants before being recruited for the study. Interviews were completely voluntary and all participants who consented were assured of confidentiality and anonymity. If unable to read or write his/her name, a witness was present and then the participant used a thumbprint instead of his/ her signature. Screening of study participants was done in line with the inclusion and exclusion criteria prior to signing consent by trained research assistants and principal investigator Ethical clearance was sought from The University of Zambia Bioethics Research Committee before undertaking the study. Permission to conduct the study was also sought from Kabwe District Health Office.

Following written informed consent, a structured questionnaire was administerd to 422 househols from high lead contaminated Townships of Kabwe district namely, Chowa,Kasanda and Makululu. Translation of the research data collection tools (Questionnaires) was done in order to reduce language bias when collecting data therefore questionnaires were done according to the participants' language preference which would be most likely Bemba. Eighty percent **(80%)** of questionaires were translated in Bemba and Twenty percent **(20%)** of questionaires

were done in English. Envisioning that the study was undertaken during the covid19 pandemic some strict adherence to the measures and guidelines of the pandemic were followed and highly taken into consideration which include maintenance of social distance, masking and hand-sanitizing. Data collection tools were pre-tested at Katondo Health Centre to ensure their validity before embarking on the main data collection exercise.primary data collection was done using survey questionnaires.The data collection tool was an exploratory, descriptive and structured questionnaire which consisted of closed- ended and open- questions-ended questions. The questionnaire was divided into the following segments: (a) Demographic and socio economic factors; (b)Information/ knowledge on lead poisoning; (c) Lead exposure factors and (d) Lead poisoning awareness levels.

RESULTS

Figure 1. Percentage Distribution of Lead poisoning Awarenss



The study further intended to understand and establish the coverage or proportion of participants in terms of awareness or knowledge of lead poisoning among the three kabwe residential areas of which 82.2% of the participants were aware about lead poisoning while 18.8% were not aware of this lead poisoning.

Table 1: Baseline characteristics table of Demographics and Lead Poisoning Awareness

Variable		**Aware%**	**Not aware%**	**P-value**
Age	Less than 20 years	(48.00)	(52.00)	0.176z
	21-30	(78.43)	(21.57)	
	31-40	(77.88)	(22.12)	
	50 and above	(83.52)	(16.48)	
Gender	Female	(16.76)	(83.24)	0.312c
	Male	(19.86)	(80.14)	
Level Education	No education	(48.00)	(52.00)	<0.0001*c
	Primary	(78.43)	(21.57)	
	Secondary	(77.88)	(22.12)	
	Tertiary	(83.52)	(16.48)	
	I don't know	(13.94)	(86.06)	
Length of stay	<1 year	(80.00)	(20.00)	0.100
	2-5 years	(80.82)	(17.18)	
	6-10 years	(72.28)	(27.72)	

	Above 10 years	(81.79)	(18.21)	
Residence	Makululu	(84.34)	(19.80)	0.808f
	Chowa	(82.34)	(17.66)	
	Kasanda	(80.20)	(15.66)	
Types of employment	Formal	(79.67)	(20.33)	0.999c
	Informal	(84.76)	(15.24)	

Note:z=ztest, * <0.05(significant), r=Mannwhitneyranksum test, c=chi-squared test, f=fishers exact test

Table1 shows the baseline demographic characteristics bivariate analysis against lead gpoisoning awareness in the aforementioned areas. The table shows no any significant association or differences in terms of age among participants who were aware and those who were not aware. The table shows that those who were aware and less than 20 years were (48%) while those who were not aware were (52%), 21-30 year (78.43%) were aware and (21.57%) were not aware, 31-40 (77.88%) were aware while (22.12%) were not aware, 50 and above (83.52%) were aware and (16.48%) were not aware. According to gender distribution, the majority of males (19.86%) were aware about lead poisoning compared to females 16.76%. according to education, the majority of participants who were significantly aware about lead poisoning were those who went to tertiary education, compared to those who attained secondary education (77.88%), Primary (78.43%) and those who had no education(48%.00) background and this was statistically significant p<0.0001, enough evidence to suggest that there is an association of education and awareness of lead poisoning.

The study also shows that the majority who knew about lead poisoning were participants who stayed more than 10 years(81.79%) in their residence of stay compared to those who stayed 6-10 years (72.28%), 2-5years of stay (80.82% and those less than one year (80%), even though there was no statistical significance p<0.100. in terms of residence the majority of participants who were aware came from makululu compound compared to chowa 82.34% and kasanda 80.20%. p<0.808. type of employment further shows that, the majority of participants who knew about lead poisoning were those in informal employment (84.76%) compared to those in formal employment (79.67%).

Table 2: Socio economic status and awareness on lead poisoning

Variable		**UOR**	**P>z**	**[95% CI]**	**AOR**	**P>z**	**[95% CI**
Age	Age	0.998	0.961	0.927,1.074	0.985	0.773	0.894,1.086
Gender	Male	Ref	Ref	Ref	Ref	Ref	Ref
	Female	2.216	0.026	1.101,4.458	1.499	0.384	0.601,3.737
Education	No education	Ref	Ref	Ref	Ref	Ref	Ref
	Primary	0.97	<0.001	0.83-1.11	1.20	<0.001	1.01-1.40
	Secondary	-0.08	<0.001	-0.20-0.03	1.03	0.126	0.54-1.52
	Tertiary	11.266	<0.001	5.248,24.189	7.062	<0.01	2.511, 19.856
Income	Less 1000	Ref	Ref	Ref	Ref	Ref	Ref
	1000-5000	1.43	0.002	0.62-2.24	0.70	<0.001	0.60-0.81
	>5000	0.293	0.321	0.261,3.302	0.431	0.71	0.005,36.031
Type of employment	Formal	Ref	Ref	Ref	Ref	Ref	Ref

	Informal	3.026	0.001	1.617,5.664	1.145	0.759	0.480,2.733
Residence	Makululu	Ref	Ref	Ref	Ref	Ref	Ref
	Chowa	11.266	<0.001	5.248,24.189	7.062	<0.01	2.511, 19.856
	Kasanda	0.254	<0.001	0.118,0.547	1.001	0.998	0.313,3.201
Number of years of stay	<1 year	Ref	Ref	Ref	Ref	Ref	Ref
	2-5 years	0.562	0.267	0.203,1.553	0.590	0.396	0.175,1.993
	6-10 years	0.354	0.050	0.125,0.998	0.391	0.134	0.114, 1.336

Logistic regression model to predict factors associated with Lead poisoning awareness

Adjusting for other factors, the odds of one having awareness among participants who were significantly higher in participants who attained primary education compared to those who did not attain education (AOR=1.20, 95%CI: 1.01-1.40, p<0.001), secondary education (AOR=1.03, 95%CI: 0.54-1.52), participants who attained tertiary education (AOR=7.06, 95%CI: 2.51-19.85, p<0.001). taking into account number of years of stay, age, the odds of one having awareness among participants who came from chowa(AOR=7.06, 95%CI: 2.511-19.85, p<0.001), as compared to those who came from Makululu,and KasandaAOR=1.001, 95%CI: 0.313-3.20, p<0.998), participants who had income between 1000-5000 kwacha(AOR=1.15, 95%CI:0.480,2.733, p<0.001),, had higher odds as compared to those who got a monthly income of less than 1000 and above 10,000.

Table 3. perceptions of factors leading to lead poisoning in children

Variable		**Aware**	**Not aware**	**P-value**
One can prevent lead poisoning by going to church	True	(84.72)	(15.28)	**0.024***
	False	(77.74)	(22.26)	
Pregnant mother can transfer lead to unborn children	True	(84.29)	(15.71)	**0.113**
	False	(79.45)	(20.55)	
Lead can cause child's brain damage and ability to learn	True	(79.77)	(20.23)	**0.263**
	False	(83.24)	(16.76)	
Prescribed drugs can cause lead poisoning	True	(82.08)	(17.92)	**0.756**
	False	(80.95)	(19.05)	
Environmental contamination is widespread source lead exposure for children	True	(79.89)	(20.11)	**0.414**
	False	(82.63)	(17.37)	
Toy jewelry are risk factors for children lead exposure	True	(82.20)	(17.80)	**0.164**
	False	(70.00)	(30.00)	
Soil and tap exposure are risk factors for children lead exposure	True	(81.37)	(18.63)	**0.765**
	False	(82.28)	(17.72)	
	True	(82.16)	(17.84)	**0.560**

Teaching children washing their hands is good to prevent lead exposure	False	(79.52)	(20.48)	
Lead can be removed by boiling tap water	True	(82.92)	(17.08)	**0.115**
	False	(76.58)	(23.42)	
Fresh fruit is health for children avoiding lead poisoning	True	(83.87)	(16.13)	**0.862**
	False	(89.72)	(10.28)	
Diet with enough protein helps prevent lead poisoning in children	True	(75.89)	(24.11)	**0.235**
	False	(89.00)	(11.00)	

Table 3 Shows the perception about factors influencing lead poisoning in children. Participants were asked whether they perceive it to be true One can prevent lead poisoning by going to church, the majority who were aware said its true (84.72%) were significantly more compared to (77.74%) who said it was false p<0.024. Participants who were aware and said true (84.29%) to the perception of Pregnant mother can transfer lead to unborn children were more than those who said false (79.45%) p<0.113. Participants who were aware and said false (83.24%) that Lead can cause child's brain damage and ability to learnwere more than those who said true (79.77%) p<0.414. participants who were aware and said true (82.20%) that Toy jewelry are risk factors for children lead exposure in children were more than those who said false (70.00%) p<0.164. The table further shows the perception about the effect lead levels in children. Participants were asked whether they perceive it to be true Soil and tap exposure are risk factors for children lead exposure, the majority who were aware said its false (83.47%) were more compared to who said it was true(81.37%) p<0.765. Participants who were aware and said true (84.21%) to the perception of Teaching children washing their hands is good to prevent lead exposure were more than those who said false (76.35%) p<0.115. Participants who were aware and said true (83.87%) that Fresh fruit is health for children avoiding lead poisoning ore than those who said false (89.72%) p<0.862. participants who were aware and said true (89.00%) that Parents who smoke put their children at risk of lead poisoning. It was highlighted that diet with enough protein helps prevent lead poisoning in children (73.24%) p<0.235.

DISCUSSIONS

This study looked at factors associated with lead poisoning awareness among participants from Kasanda, Makulu and Chowa communities in kabwe district of zambia. Some of the factors that showed some significant association with lead poisoning awareness include education background, income and residential area.

The study showed that education was associated with awareness on lead poisoning among participants in kabwe. Those participants who attained higher education, such as secondary or tertiary education were more likely to be aware of lead poisoning as compared to those who did not have any form of education. The study showed that the more you progress with your education the more likely you may get to know and be aware of the lead poisoning. This study agress with the findings of Hauptman et al, (2018) which revealed that it is important to embark on these lead poisoning studies as they bring to light important aspects of health education through preventive counselling and guidance to parents of children presenting with evidence of accurate or chronic lead poisoning. In his study he found that the more people were educated the more they were aware with lead poisoning. (WHO, 2018).

Age did not show any significant association with lead poisoning awareness in the three communities, however, other studies show that those who are older have the high likelihood of knowing about lead poisoning. It is supposed that as a human being grows, they are exposed to knowledge through education and social interaction. Our findings are close with Pure Earth (2016) which highlighted that the knowledge of lead poisoning in Zambia was widely shared after The Copperbelt Environmental Project (CEP) was initiated. The media had publicized the sources of pollution in Kabwe while Project on the Environment in the Copperbelt implemented prevention-focused awareness campaigns.

Another variable that showed significant association was longevity of stay in the area. There was a significant association between awareness and how long participants have stayed in their area. Those who stayed for more than two to five year were more likely to know or be aware of the lead poisoning. Chronic exposure to lead levels has a significant deleterious influence on health, especially in children, according to a study by Shreejha et al. (2020). Preventative measures were found to be the most effective strategy for reducing lead exposure in children. However, awareness, attitudes, and actions around lead exposure are particularly challenging in developing countries.

The study also want to understand some of the perception of how lead poisoning can affect a child, those who perceived that Lead exposure often occurs in children. There was more association between having said they perceive so with awareness of lead poisoning. Participants who believed that Lead exposure often occurs in children were more likely aware of lead poisoning as compared to to those who said they did not believe in that. Yabe et al. (2015) conducted a study that looked at blood lead levels in young children in the townships near the mine. According to the report, community-based initiatives should be launched to inform the impacted communities about the health risks of lead, its sources, and useful strategies for lowering exposure in their homes and neighbourhoods. The study emphasized the need of health education as one of the main components in spreading knowledge of lead poisoning. The study has also reaffirmed the necessity of community-based programs to inform the impacted communities about the health risks of lead, its sources, and useful strategies for lowering exposure in their homes and neighbourhoods. This too may serve as a catalyst for raising awareness in the homes and communities of lead-exposed areas. This study also showed that, despite significant lead exposure and poisoning in youngsters living close to the mine, complete studies are uncommon.

Our study had limitations as most of the participants in Makululu had challenges in terms of literacy, so there were some missing data. Participants became rigid, because they thought the researcher wanted to sell information. The study was costly than budgeted for. Information was difficult to collect due to the time of data collection there was covid19 and there were serious restrictions as such the participants were not free to meet.

CONCLUSION

In conclusion,this study has revealed that those with tertiary education had a high probability of being aware about lead poisoning.On the contrary, those with low levels of education had little chances of being aware about lead poisoning.Furthermore,the residential area of participants coupled with socio economic status and demographic characteristics had a bearing on lead poisoning awareness. Forinstance,those in planned settlements had a better understanding on lead poisoning as compared to their counterparts in unplanned settlements.

RECOMMENDATIONS

- There should be multi-sectorial collaboration, as such , local authority, ministry of health, ministry of community development and ministry of education coming on board to enhance sensitization and put up policies that should reduce lead poisoning in Kabwe district Zambia.
- During child health week conducted by the ministry of health in Kabwe, there should be a package which should be included to screen blood lead levels in under five children and treating them for lead poisoning.
- Community participation in Lead poisoning awareness programmes is key as community members know their challenges well hence can give adequate information useful to reduce lead poisoning.
- Information on lead poisoning in Kabwe should be made available in local language so that a good number of people can acess it.

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