

Awareness of Effects of Lead among Kabwe Residents in Zambia

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Abstract – Lead poisoning is also called plumbism and occurs when blood lead levels is equal to or more than 10 micro-grams per deciliter. The world health organisation reports that about 120 million people get exposed to lead and about 99% of the serious cases come from developing countries of which Zambia is not exceptional. The population of developing countries like Zambia is very susceptible to lead poisoning owing to the issues of environmental contamination in some places like kabwe District.

The aim of the study was to assess levels of awareness about the Toxic effects at lead. A descriptive study design was used to carry out the study. Participants were sampled by stratified random sampling technique. Data Collection consisted of a structured questionnaire. The collected data were analyzed and interpreted in terms of objectives using descriptive statistics in SPSS and Excel.

The study reveals that the levels of awareness were inadequate despite staying in an area where lead poisoning exposure is high. This could be the reason for continuous increase in diagnosis of children with lead poisoning. It could also be the reason for continuous building of houses near areas designated as hot spots for lead poisoning.

This study recommends that stake holders such as Ministry of health, local Authority, Zambia Environmental Management Agency (ZEMA) and the community should be collaborating day to day to find ways and means of increasing levels of awareness of the people concerning lead poisoning by using Posters, Radio programs, Television, Door to Door education, Leaflets, Health education for those going to clinics and other strategies possible. Medical doctors, Nursing, clinical officers, Environmental Health and any health and Environmental related programs should put emphasis on making sure that these impart health information and assist the people in the community to be aware of the Toxic effects of lead by means of information dissemination

Keywords – Lead Poisoning, Health Effects, Knowledge, Awareness

I. INTRODUCTION

Lead mining in Kabwe started around 1904 and continued until 30 June 1994 when the mine was temporally shut down. Over the years, the mine has changed ownership several times. Soon after Independence in 1964, the Government of Zambia adopted a nationalization policy. It became the major shareholder in the mining company in 1973 and took full ownership around 1982 through Zambia Consolidated Copper Mines Limited. In 2000, all-state owned mining companies were privatized as a requirement under the Structural Adjustment Program agreed with International Monetary Fund and World Bank.

The Kabwe Mine was sold in 2012 to Berkeley Mineral Resources, which, through its subsidiary Enviro Processing Limited resuscitated mining operations. Rising commodity prices and advances in ore processing technology meant that lead mining had become profitable again. The Zambian Government, through Zambia Consolidated Copper Mines - Investment Holding Limited retained the responsibility to address the environmental liabilities that were a result of the

many decades of unregulated mining. This included rehabilitating and restoring the environment affected by Kabwe mine.

The genesis of this project stems from a 2007 *Time Magazine* article that referenced a Black Smith Institute report on Kabwe's lead pollution. This article listed Kabwe as one of the most polluted places on the planet [1]. In order to understand the seriousness of this claim, context is needed and to provide this context, this report has compared lead poisoning blood levels and effects in the western countries, to those found in Kabwe. The natural blood-lead levels in humans, is approximately 0.0016 µg/dl, but the acceptable normal levels are currently pegged at 10 micrograms per deciliter. People in the United states have been found to generally have normal lead-blood concentrations of less than 10 µg/dl, where as in Kabwe, levels as high as 300 µg/dl were found. "Symptoms of acute lead poisoning occur at concentrations of 20 µg/dl and above, hence resulting in vomiting and diarrhea which further causes muscle spasms and kidney damage. Levels over 10 µg/dl are considered unhealthy and levels in excess of 120 µg/dl can often lead to death.

In Kabwe, concentrations of 300 µg/dl have been recorded in children even though records show that the average lead concentrations in the blood of children ranges between 60 µg/dl and 120 µg/dl." Lead is a cumulative toxicant that affects multiple body systems and is particularly harmful to young children, and when it enters the body, it is distributed to the brain, liver, kidney, nervous system and bones.

In the human body, lead commonly accumulates and stores in the teeth and bones, however, the contamination of the human body to lead is commonly determined and assessed through the testing of blood. Lead is unquestionably one of the most potent neurotoxins, and because of its negligent mining in Kabwe, the town has found its human and environmental health contaminated.

Studies done in children under the age of 7 years in townships around the mine, where blood samples were collected and analyzed using an Inductively Coupled Plasma -Mass Spectroscopy (ICP-MS) showed that all of the sampled children had blood lead levels exceeding 5microgramme per deciliter. Children in these areas could be at serious risk of lead toxicity as 18% of the sampled children in Chowa, 57% in Kasanda and 25% in Makululu had blood lead levels exceeding 65 µg/dl. Eight children had blood lead levels exceeding 150 µg/dl with the maximum being 427.8 µg/dl. A recommendation was made that medical intervention be commenced in the children with blood levels exceeding 45 micrograms per deciliter.

The natural blood-lead level in humans is about 0.0016 µg/dl. In developed countries like the United States, strict enforcement has resulted into lead levels averaging figures below 10 micrograms per deciliter but in Kabwe averages lie between 60 µg/dl and 120 µg/dl. Levels over 10 µg/dl are unhealthy, while levels above 20 µg/dl can cause acute poisoning. whereas levels over 120 µg/dl often result into death [2].

It appears that knowledge level of preventive measures among women of child-bearing age was low at 40.9% despite staying in high lead poisoning exposure residential areas and 89.1% of the respondents having heard of lead poisoning. One mother said that 'when she is pregnant she likes eating soils.' It was also revealed that many people in the area where not aware about lead poisoning preventive measures except those who had someone who is suffering from lead poisoning or had joined a Lead Poisoning Treatment Support Group. From the evidence of this research, the residents in the lead poisoning endemic areas are not knowledgeable about the lead precautionary measures[9].

The background, problem statement, research questions and objectives, scope of the study and significance were covered in chapter one. In this chapter, the literatures relevant to the study are described in more detail in terms of: Lead poisoning, Health effects, Sources of lead poisoning and knowledge studies on lead poisoning in Developed and developing countries.

Globally a number of studies have been conducted to determine absorption, distribution, metabolism elimination and health effects of lead to the body. Lead may enter the human body through ingestion, inhalation or dermal exposure to be absorbed into and transported by the bloodstream, where over 95% of lead is found in red blood cells (RBC), and about 1% in the plasma and serum [4]. Although only a small proportion of lead exist in the plasma, it is considered significant because it acts as a means of distribution to target organs such as kidney, lungs, brain, spleen,

teeth, and bones. As lead can readily substitute calcium, the skeletal system serves as a long-term storage of lead (75% in children and between 90 and 95% in adults). This stored lead can be mobilized from bone to blood and other tissues, especially during periods of altered mineral metabolism such as during pregnancy and lactation. Since inorganic lead, the most predominant form of lead in the environment, is not metabolized, the rate of excretion of lead is low, mostly through urine. Lead may also be excreted with bile through the gastrointestinal tract. An assessment of the rate of decline of lead in the blood indicated that periods of 24.0, 20.9, 14.3, and 9.2 months are required for lead in the ranges of 25–29, 20–24, 15–19, and 10–14 µg/dl respectively are required to decline to less than 10 µg/dl. On the other hand, lead in soft tissues has a mean life-time of 40 days whereas lead in bones has a lifetime of close to 30 years (Anon). The use of chelating agents can enhance lead excretion in urine. This is the basis of lead chelation therapy. The toxicokinetic of lead is affected by a number of metabolic and nutritional factors. For example, strong negative correlations have been observed between calcium and iron. These two elements affect absorption of lead probably because they share common transport mechanisms in the gut. Since Calcium and Iron affect absorption of lead, they are sometimes referred to as ‘effect modifiers’ of lead.

In the United States of America blood lead levels were observed to decline as atmospheric lead declined. There are also many numerous sources of lead that can be termed as ‘miscellaneous sources’ because they are not well documented or characterized. These include crayons, finger paints, jewels[3], cosmetics and fishing sinkers. Occupational sources of lead are not within the scope of the present study except in the cases where parents may bring lead from work through clothes and equipment.

Lead contamination of food can also result from use of contaminated utensils/apparatus for food preparation or storage. As an example, lead-glazed ceramics are an important source of lead contamination in some countries, where a correlation could be found between use of lead-glazed ceramics and Blood lead among women in Mexico.

In South Africa, 48% of paint in public playgrounds in the municipalities of Johannesburg exceeded the reference level of 1 mg/cm³ [8]. Hazardous levels of lead were also found in domestic paint in Nigeria and Cameroon. The presence of lead was also found in medicines in Nigeria, where the use of herbal medicines is reported to result in “lead intakes ranging from 250 µg/day to 27,000 µg/day, which were higher than the Provisional Tolerable Weekly Intake of 25 µg/week of lead that was being used at the time”.

In Nigeria lead was not only found in herbal medicines but also in imported western medicinal syrups (), indicating that both herbal and ‘western’ medicines may be a potential source of lead. Studies have also been conducted on lead in air where, lead concentrations of 1 µg/m³ in air and 3620 mg/kg in dust were found in air in industrial, commercial, park/beach and residential areas of South Africa (Nriagu *et al.*, 1996) and in Ghana, where the air in areas surrounding a battery, an electronic repair, a welding and e-waste recycling workshops, and a waste disposal site exceeded the contemporary World Health Organization standard of 50 µg/m³.

Studies on lead in food in Uganda indicated that vegetables grown along heavily trafficked streets were heavily contaminated with lead, this was possibly due to lead in petrol while in Kenya, fish and vegetables were also found to be contaminated with high levels of lead.

In Zimbabwe, high levels of lead were found in vegetables that were irrigated using mixtures of wastewater and sewage sludge containing high levels of lead. Lead was also found in processed foods. For example, in Nigeria, lead was found in canned and non-canned beverages. There were also studies on lead in other commodities such as toys, crayons and cosmetics. For example, in Nigeria, lead was shown to be present in toys, and in South Africa, lead was present in crayons. In South Africa, levels of lead in lipsticks, lip gloss, and foundation ranged from below detection limit to 73.1 ± 5.2 mg/g, 4.7 to 11.7 ± 2.8 mg/g, and 7.8 to 32.9 ± 1.4 mg/g, respectively, with the majority exceeding the United States Food and Drug Administration (USFDA) maximum permissible concentration of 0.10 mg/g for lead in cosmetics. High levels of lead were also present in cosmetics in Nigeria[11].

These and other studies in Africa confirm the possibility of exposure to lead from these sources among children in Africa. They also confirm that although banning the use of leaded petrol had a significant impact on Blood lead in children, other sources of lead may still remain, and therefore they may warrant further investigation.

Children are exposed to lead from a number of sources, including food (47%), dust and soil (45%), water (6%) and air (1%) [12]. Concentrations of lead in tap water have been shown to be associated blood lead level in many countries . As most sources of water have naturally very low lead levels, drinking water from the source is usually free of lead. Use of lead for soldering pipes and plumbing has in the past been a major source of high lead levels in water. Therefore, water may be contaminated as it is distributed from the water treatment plant through lead water pipes and across lead-soldered joints into homes . As soft, acidic water has the greatest tendency to dissolve lead (plumbosolvency), plumbosolvency is decreased when the pH and water hardness are increased through the addition of lime . Indeed, when lead pipes were still in use it was shown in England that towns that had soft water supplies had the highest water lead concentrations and consequently the highest mean blood lead concentrations . Lead pipes are no longer used for water distribution throughout the world. Food can be a significant contributor to blood lead, contributing as much as 72% of the total daily lead intake . Lead in food can come from environmental contamination of crops through atmospheric deposition, soil or water. Since there are spatial variations in environmental contamination of lead, there can be variations in lead concentrations in foods from different regions of the same country . The variations can also result from the methodological challenges in sampling and dietary exposure assessment.

In addition, food and drink cans soldered with lead-based solder can also be an important source of lead . Lead exposure can also result from paint since lead pigments are often used in domestic and industrial paints. Paint is essentially composed of a binder, pigment and solvent. Binders are usually polymeric substances that are added to the paint to hold the pigment to the surface of the wall. Pigments are used primarily to give the paint its colour and finish, as well as protecting the surface underneath from corrosion and weathering . Common lead-based pigments include white lead, vivid yellow lead chromate, basic lead chromate, lead molybdate, lead carbonate, red lead, leaded zinc oxide, basic lead sulphate, litharge and basic lead silicate. Lead pigments are often preferred to other paint pigments because of their durability and bright colors . Lead compounds may also be added to enamel (oil-based) paints to act as driers (sometimes called drying agents or catalysts). The driers serve as catalysts that speed up the polymerization, and thus make paints dry faster and more evenly . Lead compounds that are commonly used as driers include lead octoate, lead acetate and lead naphthenate. Lead compounds are also sometimes added to paints used on metal surfaces to inhibit rust or corrosion, where the most common of these is lead tetroxide. Children can be exposed to lead when lead-based paints are applied in their environments, where they can be exposed when they play with walls, through dust when they play on the floor and through direct eating of paint chips in a habit known as pica. In this regard, paint flakes make significant contributions to lead in house dust and street dust . Consequently, house dust has been found to be a significant source of blood lead [7]. Lead-based paint is also often applied to children's toys through which children can be exposed to lead via mouthing behavior. Children's toys made of Polyvinyl chloride(PVC) can also contain lead through the use of lead as a stabilizer in PVC. For these reasons, studies on lead in toys in many countries have shown lead levels above permissible limit, which is currently 100 mg/kg in the United States of America. Heavy metals, including lead, are found to be bio accessible from PVC toys . Lead can also be found in air. Sources of lead emissions include traffic , industries and waste combustion , thermal power stations, lead smelters , lead-zinc smelters , copper smelters and mining . Atmospheric concentrations of lead were high in areas where there was use of leaded petrol or industries that dealt with lead, especially mining. However, the most important source of lead in air appears to have been leaded petrol, which is now banned in almost all countries of the world, leading to a significant reduction in atmospheric lead. Internationally, after the introduction of regulations on lead in gasoline, concentrations of lead air have been reported to be reduced to about 0.2 $\mu\text{g}/\text{m}^3$.

Lead ranks as one of the most serious environmental poisons amongst the toxic heavy metals all over the world. Lead poisoning is a serious problem! Lead poisoning whether it is of occupational or environmental origin in human, poses serious, health hazards, especially to young children and may alter virtually all biochemical process and organ system. As early as the second century B.C the symptom of lead poisoning was described by the Greek physician 'Nikander'

Heavy metal pollution is one of the most important problems in Zambia and causes serious effects to humans and animals. In a study done by [5], river and lake sediments and soil samples were collected from a large area of Zambia and analyzed for ten heavy metals (Cr, Co, Ni, Cu, Zn, As, Cd, Pb, Sr and Hg). The results indicated that heavy

metal pollution in Zambia has strong regional differences. Using cluster analysis, the patterns of heavy metal pollution were divided into three major clusters: Kabwe, Copper belt and Lusaka and other areas. Heavy metals on the Copper belt area are transported to downstream areas by the Kafue River. Pollution was also detected in national parks, and Lake Itzhi-tezhi has been polluted with high concentrations of Cu, possibly from mining activities in the upper reaches of the river. However, areas geographically distant from mining beds had only moderate or low heavy metal concentrations, although the concentrations of Pb and Zn were highly correlated with the populations of each town. Findings of the study indicated that heavy metal pollution in Zambia is still increasing, due to human activities, especially mining.

II. THEORETICAL IFRAMEWORK

Theoretical framework plays an important role in guiding the entire process of the research study. This research uses socio-ecological theory that uses components namely: Individual, Interpersonal, Organizational, Community and Policy.

The term Ecology originates in the Biological Sciences and refers to the interrelationships between Organisms and their Environments. Ecological and social-ecological theory of human behavior have evolved over a number of decades in the fields of sociology, psychology, education and health and focus on the nature of people's interactions with their environments.

Environmental health behaviors, including lead poisoning, are thought to be improved when environments and policies support healthy choices, and individuals are motivated and educated to make those choices. Educating people to make environmentally healthy choices when environments are not supportive will not be effective in making behavioral change. The social-ecological theory acknowledges that it takes a combination of both individual level and environmental or policy level interventions to achieve substantial changes in health behaviors, including behavior on the prevention of lead poisoning.

Human behavior is difficult to change especially in an environment that does not support change. In order to increase residents' participation in prevention of lead poisoning, efforts need to focus not only on the behavior choices of each individual but also on factors that influence those choices. The social-ecological theory helps to identify opportunities to promote participation of individuals in prevention of lead poisoning by recognizing the multiple factors that influence an individual's behavior. Efforts to change behavior are more likely to be successful when multiple levels of influence are addressed at the same time(Anon)

A. Components iof ithe iSocial-Ecological iModel

There are four major components of the socio-ecological model as discussed below:

1.1 The individual:

This is at Centre of the social-ecological model. This level includes personal factors that increase or decrease the likelihood of an individual being physically active. Individual factors which influence people's participation include: knowledge, attitudes, behaviors, beliefs, perceived barriers, motivation, level of education, socioeconomic status. Strategies which bring change at the individual level tend to focus on changing an individual's knowledge, attitudes and behaviors. They include education and awareness programs.

1.2 Social environment:

Surrounding the individual in the social-ecological model is the social environment. The social environment comprises the relationships, the culture and the society with whom the individual interacts. The social environment has a significant influence on knowledge of lead poisoning behavior. The social environment includes cultural background, socioeconomic status of the community, institutions and organizations, such as schools, workplaces and community organizations, access to social support networks versus social isolation and so on. Strategies which bring change at the social environment level include community education, support groups, awareness programs, workplace incentives and social marketing campaigns. These are used to promote positive community attitudes and awareness to participation in activities to prevent lead poisoning.

1.3 Physical Environment:

Environmental activities take place in physical environments. Physical environment includes the natural environment and the built (man-made) environment. The built environment provides opportunities for intervention, such as provision of lead pollution prevention services. Strategies focusing on the physical environment usually should be put in place before educational or community awareness initiatives are attempted. Sometimes educational initiatives encourage impossible or unrealistic behavior. For example, media campaigns that encourage people to plant grass in their yards to prevent lead dust will be ineffective in communities where there is no proper water reticulation system. In this case, education and awareness programs are more likely to be effective when preceded by programs for the development of community facilities .

1.4 Policy:

This refers to legislation, regulatory or policy making actions that have the potential to affect lead poisoning activities. These are often formal legal actions taken by local or state governments but also can be informal local policies or rules in settings such as communities or workplaces. Policy includes education policies such as mandating time for environmental education classes, health policies, environmental policies and funding policies.

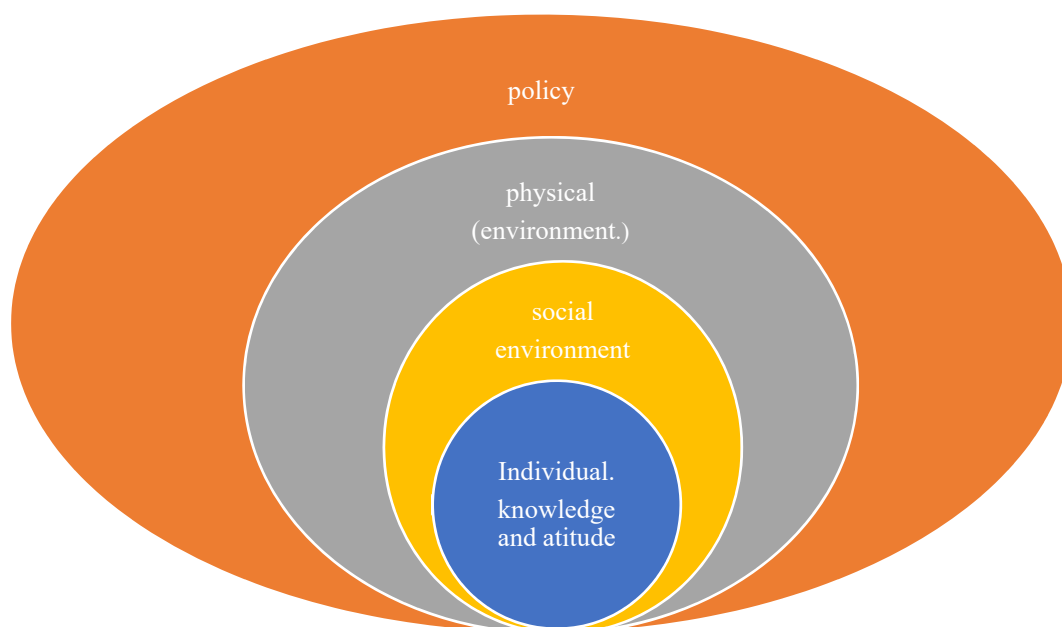


Figure 1.1. Structure of Socio-ecological Model

III. PRESENTATION OF RESULTS

The aim of the research was to assess knowledge on lead poisoning among the Adult population of Chowa, Kasanda and Katondo in Kabwe District in order to identify areas where knowledge is lacking and help effectively direct public health and environmental related programs in Kabwe District.

The specific research question that were used to achieve this aim were;

1. What information do the residents of Kabwe District have on lead poisoning?
2. How is the level of awareness regarding toxic effects of lead poisoning?

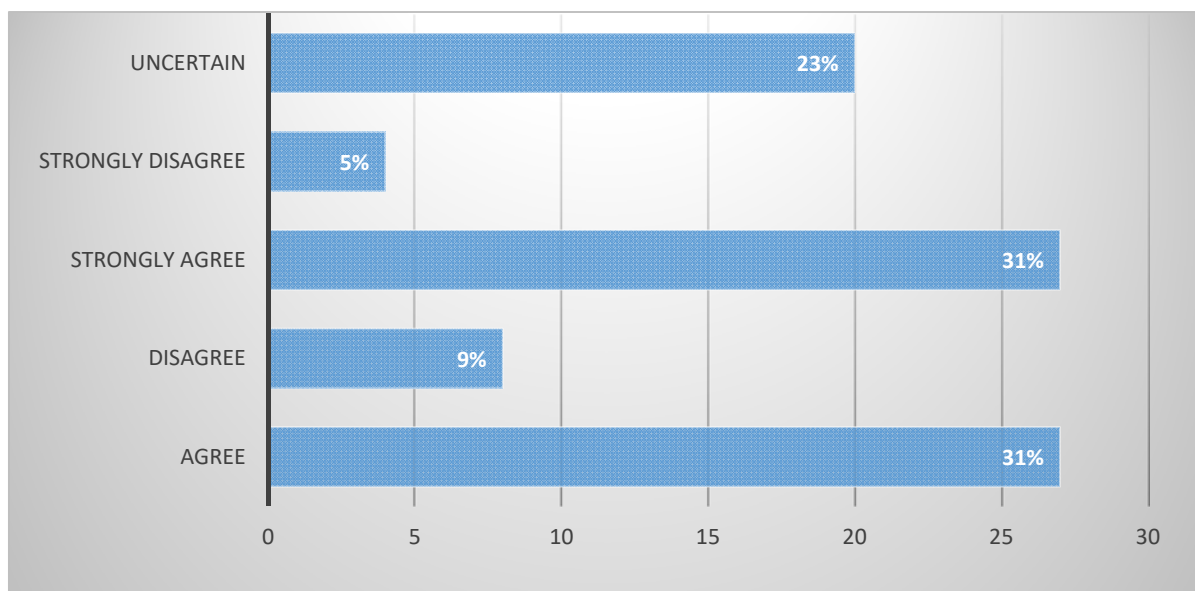


Figure 5.1: Knowledge on Lead Levels in Children Requiring Medical Attention.

Source: Field data, 2018

31% of the respondents strongly agree and another 31% agreed to the fact that children in kabwe have high levels of lead that require medical attention. 23% of the respondents were uncertain and Only 5% of the respondents strongly disagreed to this fact. Considering the level of lead in kabwe the percentage of the respondents agreeing to this fact is still low.

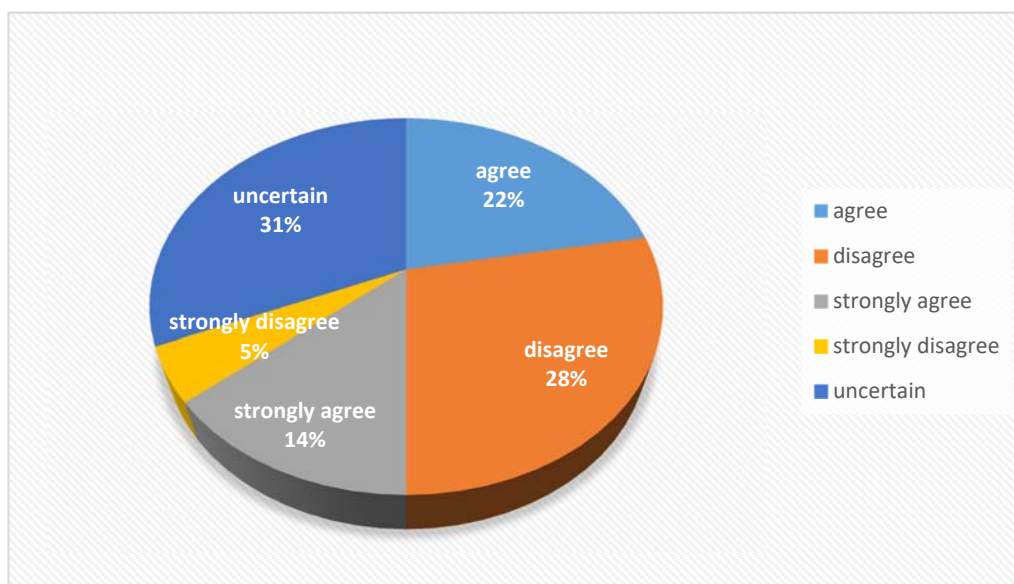


Figure 5.2: Knowledge on Lead Causing Kidney Failure and Hypertension

Source: Field data, 2018

31% of the respondents were uncertain, 28% disagreed to the fact that lead poisoning cause kidney failure and Hypertension.5% Strongly disagreed to this fact.The percentage of the respondents that was uncertain is high. This signifies that there is agent attention to take information to the people about the adverse effects of lead

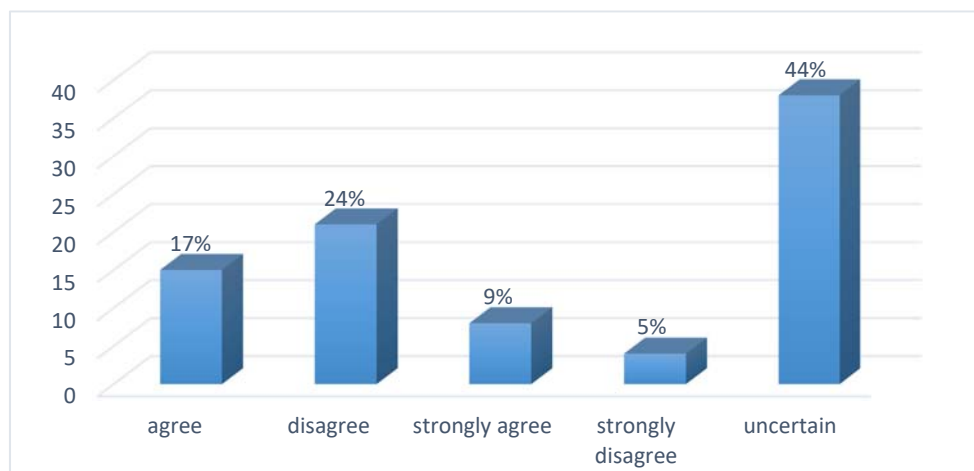


Figure 5.3: Knowledge On Lead Causing Infertility in Both Male and Female

Source: field data ,2018

44% of the respondents were uncertain 24% disagreed and 5% strongly disagreed to the fact that lead causes infertility in both males and females exposed to it and brings about miscarriage in pregnant mothers.As cases of infertility and miscarriage increases among people of child bearing age, a good number of them lack clear knowledge about this matter.

Table5.1: Knowledge on Lead Reducing Intelligence Quotient of Children

		Frequency	Percent	Valid iPercent	Cumulative iPercent
Valid	agree	19	22.1	22.1	22.1
	disagree	6	7.0	7.0	29.1
	strongly iagree	38	44.2	44.2	73.3
	strongly idisagree	2	2.3	2.3	75.6
	uncertain	21	24.4	24.4	100.0
	Total	86	100.0	100.0	

Source: iField idata,2018

42.2% of the respondents strongly agreed to the statement that lead reduces the intelligence quotient of children and affects their performance at school. Only 2.3% strongly disagreed to this fact,24.4% lack clear knowledge and 7% disagree. Though a good percentage agree to this fact, this knowledge has not been translated into change of life style and preventive measures of lead poisoning.

Table5.2: Receiving Education About Lead Poisoning at the Clinic

		Frequency	Percent	Valid iPercent	Cumulative iPercent
Valid	agree	18	20.9	20.9	20.9
	disagree	38	44.2	44.2	65.1
	strongly iagree	5	5.8	5.8	70.9
	strongly idisagree	11	12.8	12.8	83.7
	uncertain	14	16.3	16.3	100.0
	Total	86	100.0	100.0	

Source: Field data, 2018

44.2% of the respondents disagreed to the statement that when they go to the clinic they educate them about lead poisoning. Only 5.8% of the respondents strongly agreed.16.3% were uncertain and 12.8% disagreed. This could be the reason why the residents have little information because a health clinic is an agent of change and a source of information especially related to matters of health.

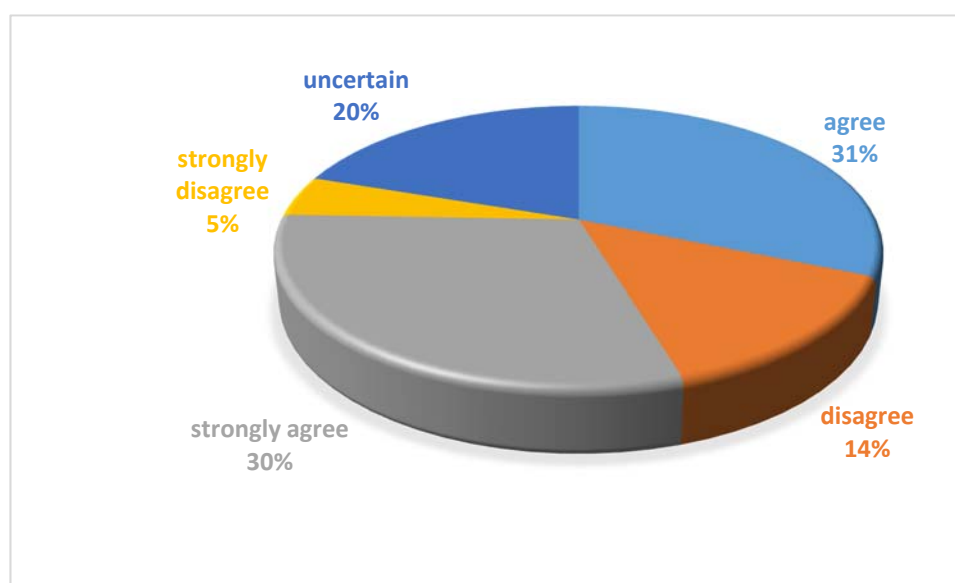


Figure5.4: Knowledge on Chowa, Kasanda and Katondo having high levels of Lead.

Source: Field data, 2018

31% of the respondents agreed to the fact that Chowa, Kasanda and Katondo Townships have high levels of lead.5% of the respondents strongly disagreed to this fact.20% were uncertain and 14% disagree while 5% strongly disagree. In these areas the level of lead is very high and the number of children on treatment has kept on increasing. The knowledge on the level of

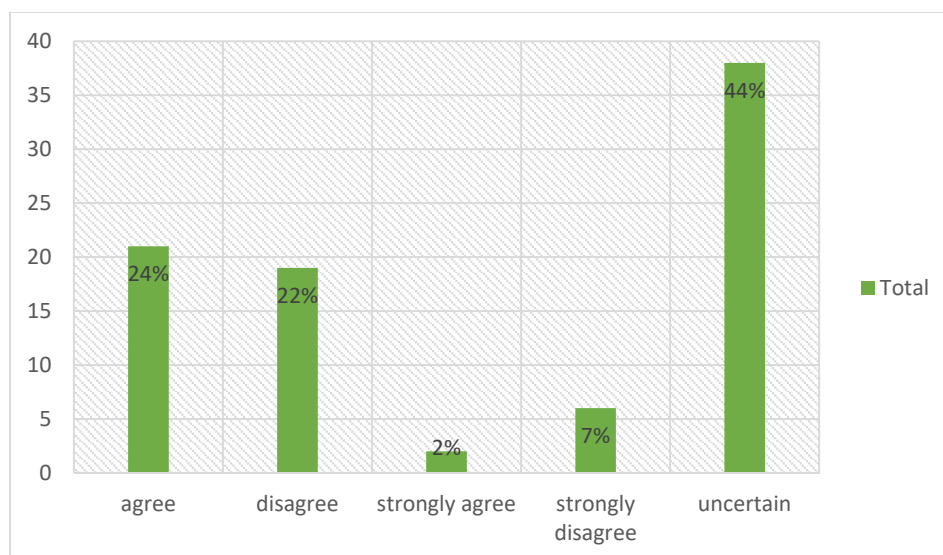


Figure 5.5: Knowledge on effects of lead Resulting into Psychosis

Source: Field data, 2018

44% of the respondents were uncertain about the fact that acute and chronic effects of lead results into psychosis. 24% agree, 22% disagree and 7% strongly disagree only 2% of respondents strongly agreed to this fact. The local health centers and the General hospital in the area has continued to record cases of psychosis. Lead poisoning has never been thought of as one of the causes of psychosis.

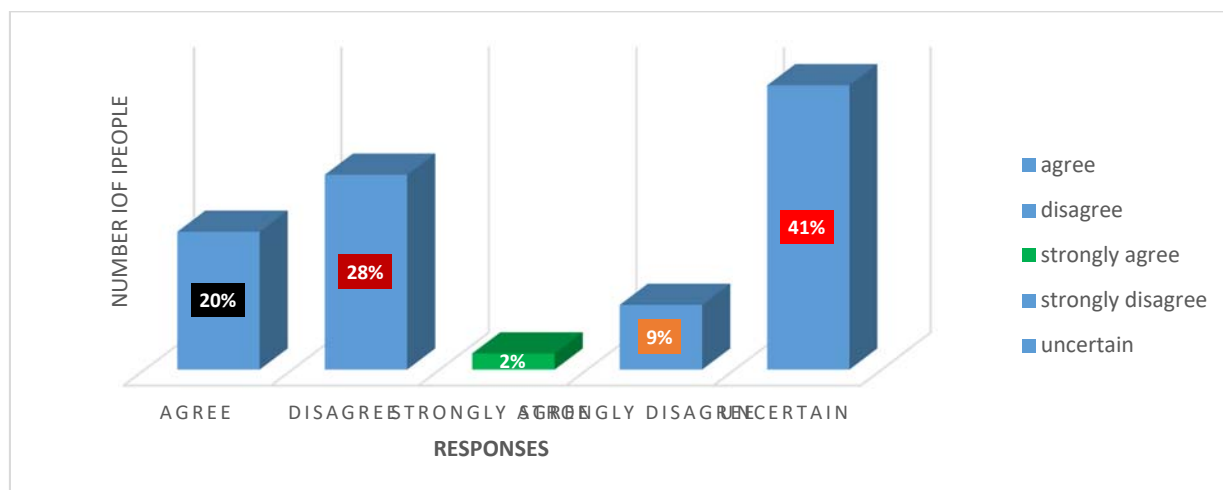


Figure 5.6: Knowledge on Lead Being Carcinogenic

Source: Field data, 2018

41% of the respondents were uncertain about the fact that lead may be carcinogenic, mutagenic or teratogenic, 28% disagree and Only 2% strongly agree to this fact and 9% strongly disagree. Cancers of different types have continued to affect people of Kabwe. There is need to create awareness so that this may help in preventing the cancers that come as a result of lead poisoning in both children and adults.

IV. DISCUSSION OF RESULTS

The study reveals that the residents of Kabwe had knowledge about the levels of lead in the children that require medical treatment. This coincides with the research that was conducted by Schultz in 2014 that revealed that out of

246 children tested for blood lead levels of toxicity eight children demonstrated levels of 150 to 427 µg/dl well above the guidance level of 5 µg/dl [15].

However, what was surprising was the number of participants that were uncertain about this fact, in which uncertain mean lacking clear knowledge or definite opinion when this problem has been going on for almost 100 years now from about 1902 when the mining of lead started to date.

When the respondents were asked about whether lead poisoning could cause kidney failure and Hypertension diseases as per figure 5.2, 31% of the participants were uncertain and the 28% disagreed to this fact. This Research reveals that the majority of residents of Kabwe who were surveyed have inadequate knowledge about lead causing kidney failure and Hypertension disease. By today it is expected that the people know some of the health implications of lead poisoning more especially that they know that the children have high levels of lead that require medical attention. The people who live in Chowa and part of Katondo live near a canal that used to carry waste water from the mine where lead treatment plant used to be and this canal is still a hot spot of lead, during rainy season the canal floods taking lead contaminated water into the nearby homes and during dry season people work up in the morning and start sweeping without protective clothing inhaling a lot of dust that contain lead particles there by taking lead into their bodies. These are some of the people who go to the clinic and are found with hypertension and are prescribed with anti-hypertension. When the people have knowledge about this health implication of lead, the problem could be avoided. Lead however, is a likely cause of hypertension and the residents of Kabwe should know so that they put up measures to prevent lead entering their bodies as prevention should start with the people themselves.

If this is known by the residents it could be used to change their mind set and social behavior where some have even built houses just one meter away from the canal and use the waste water for watering gardens and allow their children to swim in this water that is contaminated with lead.

Moreover, [14] reports that in kidneys, lead causes proximal tubular injury with a characteristic pathology of proximal tubule nuclear inclusion bodies that progress to tubule-interstitial disease and fibrosis. Lead accumulation in the proximal tubule reads to hyperuricemia and gout presumably by inhibiting uric acid secretion and also diminished renal clearance, tubular reabsorption and glomerular filtrate rates When participants were asked about what they know concerning lead causing infertility in both males and females 38 participants representing 44.2% out of the total of 86 were uncertain and 4 representing 4.7% strongly disagreed to this fact, this is shown in figure 5.3. This indicates that the majority of the surveyed population have inadequate knowledge about lead causing such a problem. The community may have some of the family members having problems with infertility and some may even think they have been bewitched and yet the highly cause may be lead poisoning. If the people are made to know about problem such as this one would be prevented and certain costs may be prevented such as frequent visits to the hospital to undertake infertility tests at a cost.

Prior to the sale of the mine in 1994 the baseline data in the environmental impact assessment that was conducted revealed high levels of lead in Kabwe but the information was never disclosed to the residents so that they could have the knowledge about the state of the environment they live in. Lack of this knowledge even made the residents to be going to the slag dump and undertake illegal mining of lead without proper safety measures there by increasing exposure to lead and enhancing the effects that lead has on human beings .There is need to step up efforts on increasing the level of knowledge of the residents of Kabwe on health implications of lead so that proper preventive measures are put in place by the residents themselves rather than waiting for intervention by the government at curative level that may cost the economy of Kabwe District and the country.

On assessing the level of knowledge on the fact that lead reduces Intelligence Quotient, 44.2% of the participants strongly agreed to the fact, 22.1% agreed and only 2.3% strongly disagreed to this fact, this is indicated in table 5.1. This study reveals that the residents of Kabwe Surveyed in this study have knowledge about lead reducing Intelligence Quotient in children and could have detrimental effect on their performance at School. This knowledge may be attributed to the works done by Blacksmith Institute where they facilitated the formation of Kabwe Environmental Rehabilitation Foundation a Non-Governmental Organization that helped to spread the information on how lead poisoning could be prevented. Because of this fact some parents have concentrated on reducing the exposure of lead

to their children and yet even them they are at risk. On this fact, estimates a 2.6-point decrease in Intelligence Quotient for every 10 Pico gram per deciliter. Even low levels of 3 to 8 can cause mild IQ decrease and or attention deficit disorders.

Environmental Education enables the acquisition of Knowledge and makes people change their mind sets and behavior. It helps people to understand their roles regarding an environmental problem such as lead poisoning in Kabwe.[10] reports that environmental education among the people would generate environmental awareness which could result in to the formation of groups concerned with how to protect the environment and avoid or minimize the hazards of environmental pollution and degradation. When the respondents were asked whether they receive education on lead poisoning when they go to the clinic,44.2% of them disagreed 16.3% were uncertain and only 5.8% strongly agreed. This is indicated in table 5.2. This study reveals that when the majority of the sampled population go to the health facilities they are never educated about lead poisoning; this could be the reason why most people do not even know some health implications of lead poisoning. Health facilities should endeavor by all means to provide education on lead poisoning so that the people are made to know about them. The provision of this education should be done by the Nurses, Public health workers, Environmental health personnel, the neighborhood health committees and Clinicians who come into contact with the people almost on daily basis. The non-provision of environmental education in particular concerning lead poisoning may be attributed to among other things, lack of knowledge about health implications of lead in human beings among the health personnel. Some of the participants in the study who are residents of Chowa and Kasanda are health workers and most them expressed ignorance about the implications of lead poisoning.

If the people get the know on health implications of lead poisoning and become willing to solve the environmental problem that come with lead, Chowa, Kasanda and Katondo in Kabwe could be better places to live in.

If understanding of the connection between environmental awareness and education and the people's health are well internalized, people's perception and attitudes towards environmental protection are likely to improve. For the problem that has been affecting people for many years and is still affecting them it is important that they are provided with education about the health implications of lead poisoning so that their knowledge is enhanced. If the residents are made to know that lead poisoning brings about: Hypertension, Infertility, Anemia, kidney failure, Psychosis and reduce Intelligence quotient in children they will be able to intensify on the efforts of prevention and change their life style.

Moreover, this could result into the relocation of some of the residents who are building in very close proximity just one meter away from the mine canal that is heavily polluted with lead. Those who would want to rent houses may not even think of such places. It is surprising to note that some people allow their children to swim in the water found this canal which is a hotspot of lead and some women work up in the morning and start sweeping and raising dust particles of lead in the soil that is around their yards. Some of the residents of these places are likely victims of infertility and hypertension that lead brings about but they do not know. It is therefore important that environmental education is put into good use at the local health centers of Katondo, Kasanda and Chowa.

On assessing if the residents knew that Chowa, Kasanda and Katondo townships having high levels of lead, 31% of the participants agreed,30% strongly agree and 5% strongly disagreed, figure 5.4 indicates this. This study reveals that the majority of the sampled population were aware of the presence of lead in the townships. Because they were aware, they should then be made to know the adverse effects that come with the introduction of lead into the body because people may just know that lead is there but if the health implications are not known they will continue with social behavior that are not good in terms of prevention of lead poisoning. Fear is a very important factor in regulation of social behavior and if the people are told that lead causes death at certain levels they will put up preventive measures that will help them reduce the health implications that come with lead.

Despite knowing lead is present in Kabwe people have continued to get sick and die of it. for almost a century, Kabwe, a city of 300,000 in Zambia, has been highly contaminated with lead from a government owned lead mine and smelter, Zambia Consolidated Copper Mines (ZCCM). Although the mine has been closed since 1994, residents continue to get sick and die from the contamination due to lack of clean-up efforts on the part of the company and the government. The deaths could however, be minimized by increasing the levels of knowledge of the residents on health implications and preventive measures.

Because lead poisoning has been there for almost a century, by today almost every home in the hotspot areas is expected to have information about lead its toxic effects. This study reveals that the number of people who have heard about lead in Kabwe is still low. Out of the 86 participants 32(37.2%) agreed that they have heard about lead poisoning 22 (25.5%) were uncertain and 3(3.5%) strongly disagreed.

The majority of people who indicated that they were uncertain resided in Katondo. This means that there is need to step up efforts to increase awareness through groups, Radio programs, print media, leaflets, health talks at the local health centers.

On assessing the knowledge of people about whether they know lead causes psychosis which means loss of contact with reality: a psychiatric disorder such as schizophrenia or mania that is marked by delusions, hallucinations, incoherence, and distorted perceptions of reality .38(44.2%) participants were uncertain 2 (2.3%) strongly agreed to this fact, as indicated in figure 5.5. This study reveals that the sampled residents of Kabwe have low level of knowledge about lead causing psychosis. On the package for the environmental education it is imperative this is included so that people may intensify on preventive measures. When the residents suffer from conditions that bring delusions, hallucinations and withdraw from reality many of the people think it is cannabis or witchcraft and yet lead poisoning may be the cause. Public health workers, Environmental health workers, nurses and clinicians are supposed to educate the people and include it in their screening procedures. Some of the conditions clinicians deal with are as a result of lead poisoning but they end up giving antibiotics which is a waste of resources and time.

The problem of cancer is one that is developing at a very fast rate. Kabwe is one of the towns which has recorded a number of cervical cancer patients. Genetic disorders and birth defects and some of these problems the people do not the route cause but lead poisoning is one of the contributing factor to such problems. This study reveals that the sampled residents of Kabwe have inadequate knowledge about lead causing these problems. Figure 5.6 indicates that out of 86 participants 35 (40.7%) were uncertain and 24 (27.9%) disagreed to the fact that lead may cause Cancer, Genetic Disorders and birth defects. This lack of knowledge could be attributed to lack of environmental education from the Neighborhood Health Committee, Public health workers, Environmental Health personnel most of whom express ignorance about most of the health effects of lead in Kabwe. There is need however, to incorporate knowledge on lead poisoning in the training programs so that their knowledge is enhanced.

In relation to the projects taking place in the area that relate to lead poisoning , most of the participants expressed ignorance about the efforts that the government through Zambia environmental management agency and other stake holders such as the blacksmith institute are doing in the area such as putting of black soil in some houses in order to prevent lead dust, formation of lead treatment support groups and formation of Kabwe environmental rehabilitation foundation that was formed to help educate the local population about lead poisoning. This could be attributed to the lack of the use of proper channels of communication that could help disseminate information quickly such as the radio, newspapers, posters, flyers and door to door campaigns.

Radio is one of the communication too that play a role in increasing the level of knowledge of the people but when the participants were asked if they head anything on radio about lead poisoning most of them said that there are no programs on the local radio stations concerning lead poisoning. It is the basis for all human interaction for all group functioning. Radio remains a medium in development communication usually employed by the development officers or experts for the dissemination of relevant development messages, especially for rural audience. He further argued that radio can be multi-faceted as among other things, it can serve to pass messages, improve the capability of calling upon and organizing groups and organizations, enlarge the forum for social dialogue, provide effective capability building of the community to raise awareness and knowledge of community issues, bring the people's voice to the higher level of their political structure and mobilize community to tackle issues. This means that radio could be effective in increasing knowledge about lead poisoning.

Radio programs are usually timely and capable of extending messages to the audience no matter where they may be as long as they have a receiver with adequate supply of power. The absence of such facilities as road, light and water are no hindrance to radio. Similarly, such obstacles as difficult topography, distance, time and socio-political

exigencies do not hinder the performance of radio. He further observed, that illiteracy is no barrier to radio messages since such messages can be passed in the audience own language.

Leaflets and other small media fulfil a larger purpose to ensure that a comprehensive source of information on a specific topic was achieved. For instance, as a part of an HIV prevention campaign, different types of small media have the ability to draw service users from initial interest or campaigns, to picking up a leaflet. This enables them to gain more detailed information, to making a decision to seek further interventions, or perhaps to alter their behavior. Written interventions cannot be expected to meet complex social needs or address interpersonal problems. Instead, they are best used to convey information, and to raise awareness. This could be vital in increasing knowledge on lead poisoning among the residents of Kabwe.

Environmental education facilitates the acquisition of knowledge and skills and enables people to change their attitudes towards lead poisoning. It helps people understand the harmful effects of their behaviors and highlight their roles and responsibilities in regard to lead poisoning.

This research reveals that the majority of the participants had no idea on how environmental education could be used to improve preventive measures of lead poisoning in the area. The few participants who had ideas stated the following;

It cannot be thought of achieving a sustainable way of life without an appropriate educational system designed to internalize the principles of sustainability in the life and work of the people.

Knowledge on lead poisoning could be gained through environmental education (EE) and when people have the knowledge and become willing to solve the environmental problem that come with lead poisoning in their locality, then health effects of lead would be reduced. Unfortunately, the Kabwe Municipal Council, the Kabwe Medical Office and other stake holders may not have done enough in educating the people of Chowa, Katondo and Kasanda about lead poisoning, how it could be prevented and some health effects of lead.

V. CONCLUSION

The study was conducted in Chowa, Kasanda and Katondo townships in Kabwe District in order to assess knowledge on lead poisoning among the residents Using both quantitative and qualitative methods, this study revealed a number of issues that should be addressed in the sensitization of the communities that live-in areas containing high levels of lead.

Most of these people live in lead poisoned areas of Chowa, Katondo, Kasanda, Mines and Makululu. Therefore, most of these residents needed knowledge on the health effects of lead and how lead poisoning could be prevented. However, the residents' knowledge was inadequate. By today the knowledge of the people is expected to be high. This study revealed that there is a significance percentage of the Kabwe's population who do not know about the: primary sources of lead, the exposures pathways of lead, some health implications of lead (that include reducing intelligence quotient, effects on the reproduction, effects on the kidneys) and some knowledge on prevention of lead poisoning when the problem has been there for almost a century now. The low levels of knowledge explain why there is high number of children and adults with high blood lead levels in the population that is well above the recommended range of 5 µg/dl to 10 µg/dl of blood lead level. It may also explain why people are building houses in highly lead contaminated areas some of which are one meter away from the canal that is heavily polluted with lead.

Some residents in Katondo, Chowa and Kasanda are involved in the selling of contaminated soil, vegetables, crushed stones and sand.

The reduced levels of knowledge on lead poisoning could be because of not giving the residents enough knowledge on health implications of lead poisoning, sources, how lead enters the body and how it can be prevented.

Even if there was not enough information about prevention of lead poisoning by the residents, 32 out of 86 participants reported having heard about lead poisoning and another 30% believed Chowa, Kasanda and Katondo have high levels of lead. There is need to intensify on increasing the knowledge of the residents of kabwe about lead poisoning, its health implications, sources and preventive measures if Kabwe District is to be a better place.

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