BLOOD LEAD LEVELS IN KENYA:
A CASE STUDY FOR CHILDREN AND ADOLESCENTS IN SELECTED AREAS OF NAIROBI AND OLKALOU, NYANDARUA DISTRICT

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DEDICATION

This work is dedicated to the Optimal Health of all Children in Kenya and a safer Environment to all.

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1 INTRODUCTION

The content of this report focuses on data developed on completion of a research on blood lead levels carried out in Nairobi and Olkalou from March to October 2005.

Global concerns over lead intoxication have drastically grown in respect to public awareness over the associated adverse health effects. In developed countries, acute and occupational exposure has greatly been reduced and focus is being directed toward chronic exposure to low levels of environmental lead. The major source of environmental lead contamination is attributed to burning of leaded petrol. Other sources of environmental lead exposure are burning of paper products, discarded rubber, battery casings and painted wood for cooking and heating, releases from industries involved in iron and steel production, lead-acid-battery manufacturing, burning of solid lead-containing waste, plastics and cigarette smoke (*ATSDR 1997*). Lead poisoning occurs when people are exposed to lead and chemicals that contain lead, breathing air, taking drinks such as water and milk, eating foods such as fruits, vegetables, meats, grains and seafood, swallowing or touching dust or dirt that contains lead. A previous study on the levels of lead in Nairobi, Kenya, reported high levels of lead far much above the WHO standard in soil and foodstuffs within the Central Business Districts of Thika and Nairobi and along the Nairobi -Thika Highway (table 1) (Mutuku J. and UNEP 2003).

Table 1 Lead levels in Nairobi

SUBSTANCE ANALYSED	MEAN LEAD LEVELS		WHO STANDARD	UNITS
	NCBD*	TCBD*		
Soils	265,918	133,790	110	µg/kg
Kale	5,053.6	2,243.0	300	µg/kg
Maize	1,948.1	1,352.0	200	µg/kg
Milk	46.0	44.4	20.0	µg/L

*** Nairobi Central Business District * Thika Central Business District.**

World wide, elevated blood lead levels are particularly a problem among the socially and economically deprived persons. Poor people are more likely to live in substandard and overcrowded housing, be near industries and heavy traffic, exposed to lead dust brought home by lead workers, nutritionally deprived and therefore more vulnerable to lead poisoning (*Tong et al. 2000*).

1.1 Toxicokinetics of Lead

Factors that determine the toxicity of lead to an individual exposed to the metal include:-dose and duration of exposure, mode of contact, and other chemicals one is exposed to, age, sex, diet, lifestyle and state of health (*ATSDR 1997*). Low dietary intake of calcium, iron deficiency, zinc, and ingestion on an empty stomach also enhances absorption of lead in the gastrointestinal tract (*Goyer 1996*). More than 90% of lead particles deposited in the respiratory tract are absorbed to the systemic circulation. Absorption through the gastrointestinal tract varies with the nature of lead compound. Adult human absorb about 10-15% of ingested lead, whereas children absorb up to 50% of ingested lead. Inorganic lead is not efficiently absorbed through the skin but organic lead compounds such as those used in gasoline are well absorbed through this route (*Kosnett 2001, EPA 1990*). Lead absorbed from

the respiratory or intestinal tract is bound to erythrocytes and distributed to other compartments such as soft tissue and bone. The largest compartment is the bone marrow where 94% of the total body lead burden in adults and about 74% in children is deposited. The half-life of bone lead is more than twenty years. The concentration of blood lead changes rapidly with exposure and its half-life is 25-28 days. Apart from the bone marrow, other soft tissue that take up lead include; kidney, liver, muscle and gonads. Lead also crosses the placenta and poses potential hazard to the foetus. Lead is not metabolized in the body but conjugated to glutathione and excreted primarily in the urine. Lesser amounts are excreted through sweat, skin hair, nails, bile and breast milk. About 99%of the amount of lead taken into the adult body will leave in waste in a couple of weeks but only about 32% of the lead taken into the body of a child will leave in the waste. Under conditions of continued exposure, not all lead that enters the body will be eliminated, and this may result to accumulation of lead in the tissues notably bone. In patients with high bone lead burden, slow release from the skeleton may elevate blood lead concentration for years after exposure ceases and pathological high bone turnover states such as hyperthyroidism or prolonged immobilization may result in frank lead intoxication (*Kosnett 2001, ATSDR 1997*).

1.2 Impact of Lead Poisoning on Children

The potential for adverse effects of lead exposure is more heightened in children than adults. This is attributed to;

1. Intake of lead per unit body weight, which is higher in children than adults,
2. Pica. Young children often place objects in their mouths, resulting in dust and soil being ingested and possibly an increased intake of lead and

3. Developing organs and systems. Children's growth rate is rapid and deposition of lead in the developing tissue is increased (*WHO 1995, Mushak 1992, Tong 1999*).

A blood test is done to evaluate the concentration of lead in blood that determines an individual's exposure to harmful levels. The higher the test result, the more lead in the system and the more potential danger there is to health. The Centres for Disease Control (CDC) defined blood lead levels of 10 micrograms per decilitre of blood as toxic. This action level was established as evidence accumulated that serious consequences occur in infants and young children at levels greater than 10 micrograms per decilitre. There is currently no lead level that is safe for infants and young children (*CDC 2005, CDC 1991, EPA 1990, Schirnding et al. 1991*). Epidemiological studies of children show that those exposed to lead, at even low levels may have a lower IQ, learning disabilities, behavioural abnormalities and kidney damage. Cognitive and growth defects may also occur in infants whose mothers are exposed to lead during pregnancy (*WHO 1991, Tong 1998*). Neuropsychological manifestations have been reported to be largely irreversible despite measures to reduce intoxication to previously exposed children (*Tong 1998*). Recent studies have clearly indicated an association between blood lead levels below 10 μg/dl and adverse health effects ranging from cognitive function, neurological function, dental carries, growth retardation and onset of puberty levels (*CDC 2005, Canfield et al. 2003, Lanphear et al. 2000, Moss et al. 1999*). Lead intoxication is slowly progressive and difficult to detect. Irritability, stomach-ache, diarrhoea, colic, distractibility and lethargy are all symptoms of progressive lead accumulation.

1.3 Global Approach on Lead Poisoning

Various countries have carried out studies to determine public exposure to lead within urban centres and specified sites *(Luo et al. 2003, Mathee et al. 2002, Ponka 1998*). Initial studies carried out in south Africa in the early 1980s and 1990s indicated that large numbers of urban south African children had been exposed to unacceptable levels of environmental lead *(Schirnding et al. 2001).* The studies has contributed a lot in formulation of policies and regulations in reduction and prevention of lead exposure as well as setting baselines that act as references in evaluation of the impact of measures put in place. World wide, the reduction of lead in petrol or total eradication of leaded gasoline in several states has been instituted as the principal measure to guard against lead intoxication (*Luo et al 2003, Schirnding et al. 2001, CDC 1991*). The international action plan for preventing lead poisoning provides guidelines toward achieving an environment free of lead. Recommended initial step of action include:-

i. Completion of the worldwide phase out of leaded gasoline;

ii. Assessing the problem which entails –

- collection of data on population's blood lead levels;
- occupational health and safety;
- environmental contamination and
- Industrial regulation.

iii. Setting priorities so as to coordinate the activities of controlling hazards from current uses.

iv. Raise public awareness on:-

- dangers of lead,

- available substitute,
- how to protect themselves and families and
- elements of prevention and how to engage in the programs.

The Kenyan Government had been in the pipeline towards eradication of leaded fuel and Kenya is set to implement a total phase-out of leaded petrol by January 1st 2006. However, public awareness on lead intoxication is very low and has not been an issue of much concern within the medical circles. Many medical conditions that could be as a result of lead intoxication are largely misdiagnosed and/or mismanaged. As measures are being instituted to combat the problem, the magnitude of the problem is not known. The approach towards allocation of resources and priority areas need to be established and guided by scientific data. Such measures should be measurable. Improvement to Public health and delivery of health services will be action oriented towards achieving global goals.

2. STUDY OBJECTIVES

The objectives of this research were to:

i. Determine blood lead levels (BLL) in selected areas of Nairobi and in Olkalou, Nyandarua district;

ii. Compare the reported blood lead levels (BLL) between the urban and rural populations;

iii. Establish factors that influenced the observed blood lead levels in individuals within the two populations.

3. METHODOLOGY

This were cross sectional, analytical studies of blood lead levels and factors that influenced the observed levels at selected areas in Nairobi and the rural town of Olkalou. City Council of Nairobi Health Centres at Kariobangi North, Babadogo and Waithaka and an informal school at Pumwani were the principal sites for sampling in Nairobi. The Olkalou district hospital served as the comparatives sample recruitment site for study subjects in the region. Random sampling was done for those present and willing to participate in the study on the day selected for fieldwork in the respective areas.

3.1 Questionnaire Administration

A standard explanation (annexure 1), as well as consent seeking from the participating children, parents and/or guardians was done. All adults were also briefed through the standard way developed. Oral consent was registered from each participant in the presence of a member of the research team. A structured questionnaire, designed to yield information from each participant on his or her age, sex, health and place work and/or residence was administered in either Kiswahili or English. Client identification slips were issued to all consenting individuals, which facilitated results notification to the subjects.

Photograph 1 Questionnaire administration

3.2 Collection of Blood Samples

Capillary blood samples were obtained from participating children and collected in heparinized capillary tubes from Manienfeld, Germany. Qualified Medical Laboratory Scientific Officers registered with the Kenya Medical Laboratory Technicians and Technologists Board collected all samples. The standard procedure (*NCCLS 1992*) for obtaining capillary blood samples was followed. The capillary tubes were filled and the sample in the capillary tube was collected using a calibrated fifty microlitres micropipette and mixed with a kit supplied treatment reagent. Appropriate labelling of the sample/treatment reagent preparations was done and sample dispatched for analysis.

Photograph 2 Collection of blood samples

3.3 Blood Lead Level (BLL) Determination

Lead concentration was determined using a LeadCare ® Blood Lead Testing System and LeadCare ® Blood Lead Test Kit manufactured by Environmental Science Associates (ESA), Chelmsford, USA. This analyser uses Anodic Stripping Voltammetry Principal of Analyses of blood lead levels.

Analysis of blood samples collected from all study areas within Nairobi were done at the Department of Clinical Chemistry Laboratories at The University of Nairobi, College of Health Sciences based at the Kenyatta National Hospital Nairobi, Kenya. Blood lead level determination for the rural town of Olkalou was done at the Districts Hospital Laboratory. Running high and low controls with every batch of samples analysed ensured quality assurance and control. All the results obtained for the controls were confirmed to be within the expected control ranges.

3.4 Waste Disposal

All medical wastes such as used swabs and gloves were collected into appropriately labelled disposable bags. Sharps objects such as needles and lancets were put into disposable biological waste containers and sealed as per the manufacturers' instructions. The bags and containers were then dispatched to appropriate service providers for incineration.

3.5 Ethical Considerations

Research activities commenced upon approval by the Kenyatta National Hospital Ethics and Research Committee vide Ref: KNH-ERC 01/2572. Further approval was obtained from the MOH Nairobi City Council, Ref: PHD/MOH/E.3 VOL 1(30). These approvals were communicated to all head of stations or departments that were concerned. The Ministry of Health, Kenya, Division of Non-Communicable Diseases collaborated in this research, Ref: research/NCD/05.

3.6 Response Rates

The response to the study and objectives was overwhelming. This was attributed to the public awareness created in all areas of study prior to commencement of study's activities. However, there was a concern over testing for the human immunodeficiency virus (HIV) as well as fear to infection from contaminated pricking needles or lancets. These concerns were addressed by satisfactory explanations and assurance that no testing for HIV will be done and sterile non-used sharps and consumables will be used. No participant was coerced to take part in the study. Any of the participants whose blood lead levels required medical attention was referred to a physician for follow-ups.

3.7 The Study Area/Study Population

The study on blood lead levels was conducted in five areas within Nairobi and one in Olkalou (Annexure 2). Most of the recruitment was done within health facilities since they served as suitable catchments site for selected regions. Four study sites in Nairobi were coded as E1-E4 and were meant to establish environmental exposure, while one was coded as OC for determination of occupational exposure.

Olkalou, a rural town in Nyandarua district of Central Province, served as a covariate for all areas and was designated CA. A total of 308 subjects participated. Children and adolescents (ages 3-20) made up 40.9% of the study population (table 1).

Table 2 Study area/population

CODE	STUDY AREA	TOTAL NUMBER OF SUBJECTS	NO OF SUBJECTS AGE 2-20
E1	Kariobangi north estate	90	36
E2	Babadogo estate	46	26
E3	Waithaka estate	52	19
E4	Pumwani	30	30
OC	Ziwani Jua Kali works	35	5
CA	Olkalou	55	10
	TOTAL	**308**	**126**

3.8 Statistical Analysis

Principal goals of the statistical analysis were to compare the blood lead levels obtained in all study areas in Nairobi to those obtained in Olkalou. All data was entered by EPI-INFO6-EPED statistical system. Statistical analysis was done using Graphpad instant tm version2.04. ANOVA and Tukey Kramer multiple comparison tests were used to compare associations between study areas.

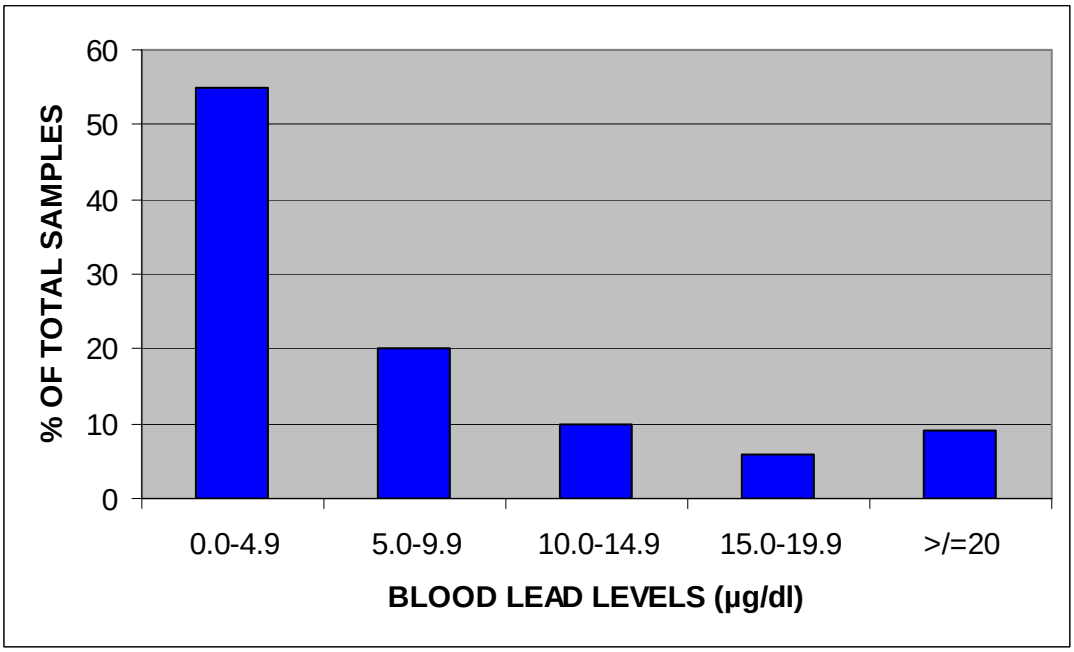
4. RESULTS

4.1 BLOOD LEAD LEVELS IN THE TOTAL SAMPLE

4.1.1 Blood Lead Levels Distribution in the total sample

Blood lead levels distribution in the total sample was skewed to the left. A major contribution to this observations was the lumping together of levels obtained from all areas for both adults and children. While 55 % of the total sample had levels equal to or below 4.9µg/dl**,** 25% had levels above the action level of 10µg/dl. 20% of the population had levels ranging 5.0 to 9.9µg/dl (figure 1).

Figure 1 Percentage distribution of blood Lead Levels (µg/dl) in the total sample



Further analysis of the results by study area indicates that blood lead concentrations in the total sample ranged from 0.4 to over 65 µg/dl of blood, the higher limit of the analyzer. The highest levels were recorded at Ziwani Jua kali works where a blood lead level of over 65 µg/dl was recorded. In areas that were meant for assessment of environmental

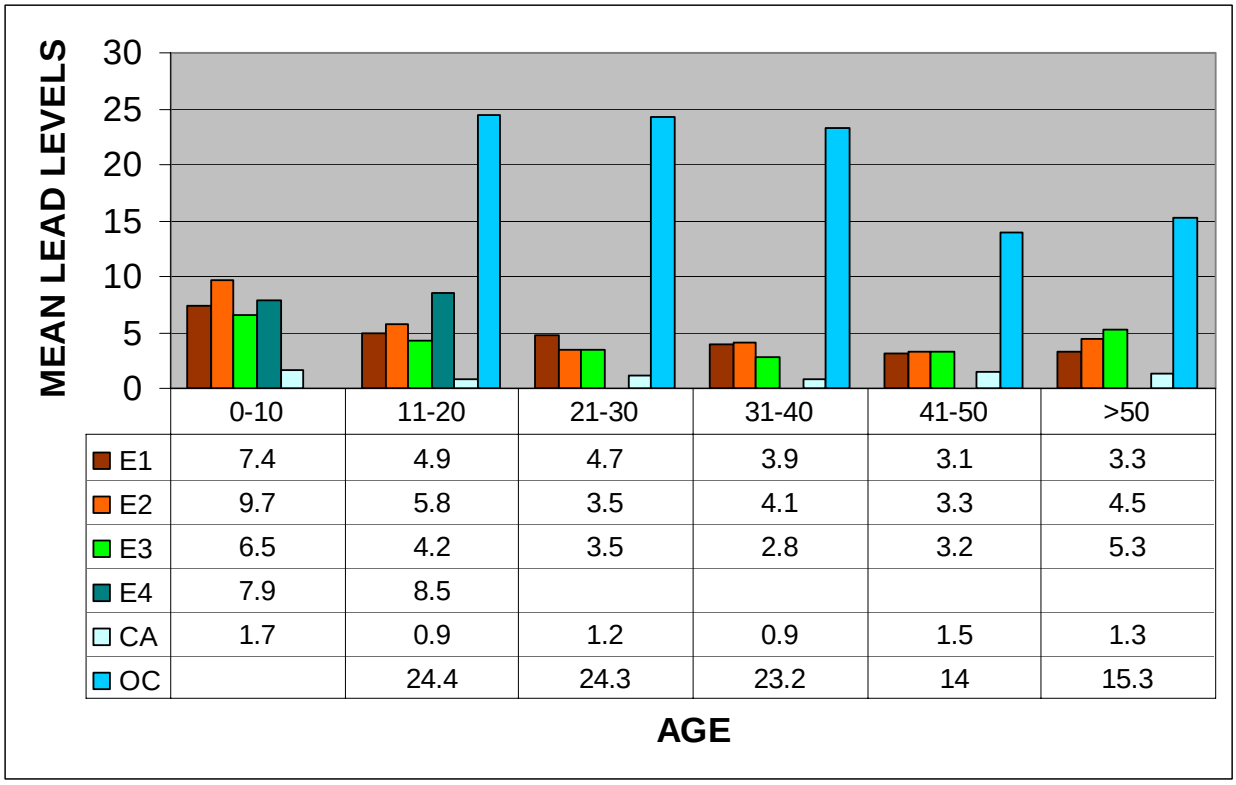
exposure, levels of 22.0, 21.8 and 20.3µg/dl were recorded at Kariobangi North, Babadogo and Pumwani in that order. The mean blood lead levels for the study areas in Nairobi (excluding Ziwani), was highest in Pumwani area at 8.3µg/dl. The lowest blood lead levels concentrations were recorded at Olkalou with a mean of 1.3µg/dl, minimum of 0.4µg/dl and a maximum of 4.1µg/dl. Further observations on the general blood lead level concentrations are as tabulated in table 3.

Table 3 Blood lead levels (µg/dl) by study area

REGION	N	MEAN	MODE	SD	MIN	MAX	%≥10µg/dl
KARIOBANGI NORTH	90	5.0	2.7	3.6	1.4	22.0	10.0
BABA DOGO	46	5.8	3.6	4.1	1.5	21.8	15.2
WAITHAKA	52	4.1	2.7	2.7	1.4	13.0	5.8
PUMWANI	30	8.4	8.3	3.8	3.5	20.3	30.0
ZIWANI JUA KALI	55	22.3	21.2	13.4	5.8	65.0	89.1
OLKALOU	35	1.3	0.8	0.9	0.4	4.1	0.0
TOTAL	**308**	**8.0**	**3.5**	**9.4**	**0.4**	**65.0**	**25.0**

The population within Nairobi exhibited higher blood lead levels than those in Olkalou for both adults and children. However, with an exception of those occupationally exposed, in relation to age the highest mean of blood lead levels concentration was noted in the younger population below or equal to 10 years of age. Blood lead levels were observed to decrease with an increase in age. From figure 2, it can be deduced that the occupationally exposed as compared to the environmentally exposed had persistent high levels with their mean being 24.4µg/dl for those equal to or above 20 years of age.

Figure 2 Mean blood lead level (µg/dl) concentrations by age



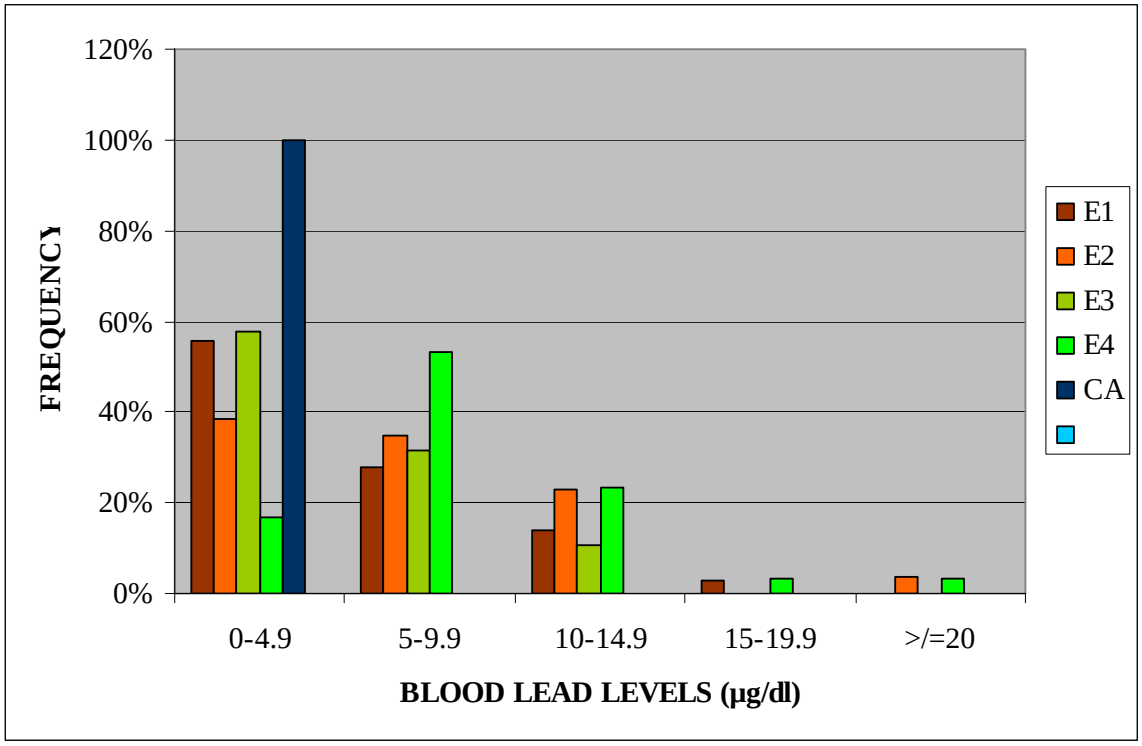
	0-10	11-20	21-30	31-40	41-50	>50
E1	7.4	4.9	4.7	3.9	3.1	3.3
E2	9.7	5.8	3.5	4.1	3.3	4.5
E3	6.5	4.2	3.5	2.8	3.2	5.3
E4	7.9	8.5				
CA	1.7	0.9	1.2	0.9	1.5	1.3
OC		24.4	24.3	23.2	14	15.3

4.2 BLOOD LEAD LEVELS FOR CHILDREN AND ADOLESCSENTS

4.2.1 Percentage blood lead level distributions in individuals' between 0-20 years

All blood lead levels obtained at Olkalou (CA), for children and adolescents were a 100% between 0 and 4.9µg/dl. In Nairobi, 23% in study area E2 and E4 had levels above 10µg/dl. 14% and 11% in E1 andE3 respectively had levels above 10µg/dl.

Figure 3 Percentage blood lead level distributions in individuals' between 0-20 years



4.2.2 Blood Lead Levels by Study Area

4.2.2.1 Blood lead levels in E1 to E4 and Olkalou

Proximity to the Central business district of Nairobi was major influence in the observed levels in children. Highest levels of blood lead concentrations were noted in school going children at Pumwani in Nairobi. The mean blood lead level at Pumwani was 8.3µg/dl and the highest level in this area was 20.3µg/dl. 30% of the children had levels above10µg/dl. Actual values obtained for five of the children were 20.3, 15.3, 12.9, 12.4 and 11.9 all in µg/dl. The lowest level at Pumwani was 3.5µg/dl. Although the mean for E4 was 1.5 micrograms per decilitre higher than E1 and E2, there was no significant difference ($p>0.05$) between the E1, E2 and E4 samples.

There was significance difference ($p<0.05$) in values obtained in E1, E2, E4 and those obtained in Olkalou. Minimum and maximum levels in E1 and E2 were 1.5 to 21.8 respectively as compared to CA where the max and minimum were 3.8 and 0.4 respectively.

The sample at E3 (Waithaka) had the highest concentration of low levels in children and adolescents in Nairobi. The mean in this sample was 5.1 micrograms per decilitre while the maximum and minimum were 13.0 and 1.4 respectively. There was no statistical significance between this area and other areas in Nairobi ($p>0.05$) that were designated for assessment of environmental exposure.

Table 4 Blood lead levels in E1 to E4 and Olkalou

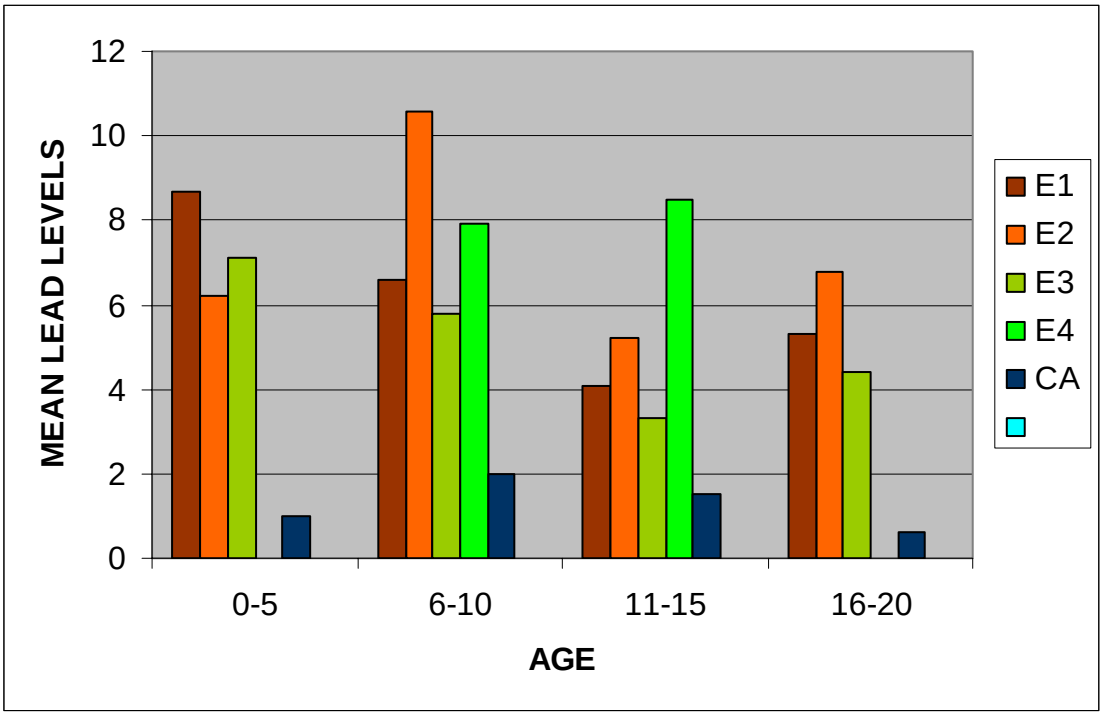
AREA OF STUDY	N	MEAN	MODE	SD	%>10µg/dl	%.5µg/dl	MIN Pb LEVEL	MAX Pb LEVEL
KARIOBANGI NORTH	36	6.3	4.5	3.7	17.0	44.0	2.1	16.5
BABADOGO	26	7.3	3.6	4.8	27.0	62.0	1.5	21.8
WAITHAKA	19	5.1	3.2	3.4	10.0	40.0	1.4	13.0
PUMWANI	30	8.4	8.3	3.8	30.0	83.0	3.5	20.3
OLKALOU	10	1.5	0.8	1.0	0.0	0.0	0.4	3.8

4.2.2.1.1 Blood lead levels by age sets

Previous studies in other parts of the world have indicated an observed trend of blood lead levels reduction by age. However within our setup and considering levels obtained from the environmental assessment areas (i.e. E1, E2, E3 and E4) within Nairobi, high concentration of levels between 5-10µg/dl were noted in the age set 6-10 years. There is no general observation that encompasses the whole group (ages 0-20 years) can be given since different study areas show individual trend of blood lead levels. This can be

attributed to the number of subjects per age set which in most of the areas was of no statistical significance. A bigger sample would provide a better observation on the relationship between age and blood lead levels.

Figure 4 Blood lead levels by age sets



4.2.2.2 Blood lead levels at Ziwani Jua kali (OC)

Only five of the study subjects whose blood lead levels were determined in this region were equal to or below 20 years. This group had a mean of 24.4µg/dl and the actual levels obtained were 35.6, 22.1, 15.7, 27.0 and 21.7µg/dl. The levels were significantly high when compared to other study areas in Nairobi and Olkalou ($p<0.05$).

Table 5 blood lead levels in Ziwani

AREA OF STUDY	N	MEAN	MODE	SD	%>10µg/dl	MIN Pb LEVEL	MAX Pb LEVEL
ZIWANI JUA KALI	5	24.4	N/A	7.4	100.0	15.7	35.6

4.2.3 Blood lead levels by sex

Males within the age group exhibited higher levels than females in all areas studied (table 6)**.** Majority of the males had levels of 8.3µg/dl with a minimum of 0.6µg/dl and a maximum of 35.6µg/dl as compared to females who had a mode of 4.5µg/dl with levels ranging from 0.4µg/dl -21.7µg/dl.

Table 6 Blood lead levels (µg/dl) by sex

	MEAN	**MIN**	**MAX**	**MODE**
MALE Pb DATA	9.1	0.6	35.6	8.3
FEMALE Pb DATA	5.7	0.4	21.7	4.5

5. DISCUSSION

5.1 Environmental Lead Exposure

This study has shown that there is significant exposure to high levels of environmental lead in Nairobi. Major source of poisoning in the urban area can be attributed to the use of lead in petrol. Although unleaded petrol is available in the country, many motorist still prefer leaded petrol against unleaded since availability of the later is only within the urban centres but lack as one goes to the rural areas.. The contribution by non-petrol sources should not be ignored and an evaluation of all sources should be done. The high blood lead levels noted in children calls for immediate intervention to tackle the problem.

As children are at a higher risk than adults due to their increased uptake and still developing body systems, more emphasis should be directed toward Children's health. Due to the low social economic status, most of the people rescinding in the urban areas, may be having serious adverse effects associated with lead intoxication. As per the latest report by NEPAD, poverty levels in Kenya are alarmingly high. Poor living conditions, low social economic status, high prevalence of communicable diseases such as HIV and respiratory infections and non-communicable diseases such as diabetes, hypertension etc, heightens the generals population susceptibility to environmental toxins. People living in slums within the industrial area are at very high risks of lead intoxication.

5.2 Occupational Lead Exposure

Numerous activities involving lead and its products are carried out within the Jua kali. These activities include spray painting, panel beating, metal cutting and welding as well as motor vehicle mechanics. Most of the spray painting is done within a building put up with the assistance of UNIDO and UNDP. Training for young artisans is also carried out within the same building. As the building is lacking in enough ventilation, air purification equipment and workers do not take preventive measures, most of the highest levels were noted amongst the spray painters. Workers awareness about lead in these areas is lacking and no monitoring or regulation is done. Many individuals under 20 years of age are involved in these activities as a form of earning a living. Occupational lead exposure to the underage aggravates the problem further as the young ones are prone to development of organ and systems failure at an early age. Those not directly involved in lead associated activities but spend most of their time in this areas exhibit high levels of blood lead indicating high environmental exposure within the vicinities. As well as developing

regulations and policies to guard against lead exposure in the work place, measures should also be put in place to ensure children are not engaged in occupations that put them at high risk levels.

6. CONCLUSION

The selection of the study areas within the Kenyan capital did not target areas of low or high blood lead levels and hence the levels can not be said to represent the highest or lowest within the region. However, the study has indicated that public lead exposure within Nairobi is at a level that calls for immediate attention. Many people could be suffering from complications due to lead poisoning than can be envisaged. Those whose blood lead levels had been determined to require medical attention within the framework of this study should be traced and treatment and/or follow up done.

Since the number of study subjects and area studied could not give a general picture for the whole population in Nairobi, an extensive screening programme should be instituted. This should cover areas such as slums within the industrial area, Industries using lead in their manufacturing processes as well as low and high income areas. An environmental assessment should be carried out to determine the contribution of particular sources of public lead exposure. Many more Children within other major urban centres could be in danger of high lead levels in the environment and such a study should be extended to such areas.

Leaded petroleum had been identified as the largest source of lead poisoning all over the world and the Millennium Development Goals adopted at the World summit on Sustainable Development (WSSD) held in Johannesburg 2002, recommends immediate phase out of leaded petrol in all parts of the world. Although Kenya is set to go unleaded on January 2006, the level of public awareness needs to be raised to achieve the desired goals. Apart from speeding up the complete phase out of leaded gasoline in our country, focus should also be directed towards other sources of environmental lead such as releases from industries involved in iron and steel production, lead-acid-battery and paint manufacturing, burning of solid lead-containing waste, plastics and cigarette smoke. Health care service providers should be equipped with diagnostic facilities and knowledge to appropriately attend to the problem medically. Interdisciplinary approach, bringing together the Ministries of Health, Environment and Housing, National Environment Management Authority, children welfare organisations and all other concerned authorities is recommended.

By institutionalization of lead poisoning prevention strategies, much will be achieved in:-

- Social development, by protection of generations of children who are an integral part for future intellectual, social and economical resource.
- Promote sustainability by protection of vulnerable groups,
- Meeting pressing health and environmental challenges,
- Developing human and social resources and
- Revitalizing communities.

7. CAPACITY DEVELOPMENT

The data will be useful in determining areas of focus for allocation of resources required for creating public awareness, placement of monitoring units, treatment and management of lead poisoning and future research activities. The research result is set to be used by the Ministry of Health in formulation of policies and regulations on lead exposure and preventive measures. Presentation of the proposal to carry out the just concluded study to the Ministry of Health, Division of Non Communicable Diseases, prompted the mandate of a working group on road safety extended to the prevention of vehicular source of lead poisoning and collaboration in this study. This study has generated a lot of interest within medical circles and has set a precedent towards management of/and further research on lead intoxication. Many professional colleagues have indicated interest on investigating on various effects of lead toward human health and especially on children.

8. FUTURE WORK

An objective to determine Sub clinical Nephrotoxicity attributed to lead exposure within the context of the completed research had been approved and will be implemented on acquisition of funds. Future work should include determination of blood lead levels in relation to Social economical status, Nutrition and levels of trace elements such as zinc, iron, calcium and magnesium. A study to determine neuropsychological and cognitive development in respect to lead levels will go along way in determining the status within our setup and the need for provision of special education to the affected children. Presently, proposals to carry out Public Health awareness and Prevention Programmes in the work place as well as the determination of the effects of lead intoxication on Haematological Indices are being prepared.

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ANNEXURE 1: EXPLANATION TO CLIENT

PUBLIC LEAD EXPOSURE: ASSESSMENT OF THE CURRENT STATUS IN NAIROBI, KENYA.

EXPLANATION TO CLIENT

Dear Parent/Guardian/Mr/Ms,

You and/or your child are being requested to take part in a medical research. Note that: -

i. Participation is voluntary.
ii. You are permitted to withdraw from the study at any time.
iii. In case you need more information on the study, you are free to ask any question.

Lead is the most abundant of the heavy metals. Some natural and manufactured substances contain lead. Environmental exposure to lead is attributed to release from burning of leaded petrol and industrial activities. Individuals involved in activities such as welding, panel beating, radiator repair and scrap metal recycling are occupationally exposed to lead. High blood lead levels are toxic to almost all parts of the human body. Children are at a bigger risk to lead poisoning than adults. Even low levels in children will cause impairment in cognitive (IQ) and Neuropsychological development, learning disabilities, behavioural abnormalities and gastrointestinal problems. In adults, lead poisoning causes damage to the brain resulting to irritability, poor memory and concentration problems, kidneys, blood system etc. High blood pressure, fertility problems (loss of libido in men) muscle and joint pains have been attributed to high lead exposure. In pregnant women, lead can be transferred to the foetus, which results to high lead levels in the foetus and consequent adverse affects to foetal health. Miscarriage occurs at times.

Purpose of the Study: This study is meant to determine blood lead levels and participation of you or your child will highly be appreciated.

Procedure to be followed: A Questionnaire will be administered to you and/or accompanying child. A blood sample will be taken by finger prick for measurement of blood lead levels. No other tests will be done on the sample and sterile pricking devises will be used.

Risks and discomfort: Taking of a blood sample from you will be the only discomfort to be experienced. The procedure for taking the blood sample will be explained to you. Any prolonged bleeding at the site of skin puncture will be prevented by standard medical procedures.

Benefits: If your levels of Pb will be found to be dangerously high, appropriate medical intervention and further management will be facilitated. The results will be published and act as a guide to blood lead levels in the community and allocation of resources to prevent and reduce lead exposure.

Confidentiality: You are assured of confidentiality and records will be kept securely. Your name will not be used in any way while processing information. Codes will be used instead.

ANNEXURE 2: MAP OF STUDY AREA (NAIROBI AREAS AND OL KALOU, NYANDARUA DISTRICT)