CHAPTER III

PROPOSAL

Measurement of Blood Lead (PbB): A Method to Analyse the Lead Poisoning Among Public School Children of Kathmandu Valley and Gorakhkali Municipality of Gorkha, Nepal

3.1. Introduction

Gasoline, paint, water pipes, housewares, decorations, power plant scrubbers and lead acid batteries etc. are the main sources of lead. Lead lasts forever in the environment because it is dispersed into food, beverages, air, soil, dust and water. (ASTDR, 1992). Children of all races and ethnic origins are at risk of lead poisoning. The blood lead levels once considered safe are now considered hazardous, with no known threshold. It impairs the learning ability of children, damage to kidneys, liver and nervous system. In addition to renal diseases, it also affects to reproductive, cardiovascular, immune and gastrointestinal systems.

Among the above mentioned various sources, Kathmanduits are faced with the motor-vehicle emitted lead pollutant. A total of 110,000 vehicles of Kathmandu valley more than 95,000 vehicles are run by petrol. The supplied petrol is leaded and untill now there has been no restriction to the use of such fuels. They are using 87 octane which contains about 0.58 gm Pb/lit of fuel. The Tetraethyl Lead (TEL) $(C2H5)4$ Pb is an anti knocking additive to gasoline in internal combustion engine of the vehicles. Since Pb is not used in the combustion process, it is released into the atmosphere as air borne lead particulates through the exhaust. (NESS, 1995)

Because of low and middle socio-economic status of the parents of public school children, they could not paint their house and most of the public schools are built by the combination of brick and mud. They paint school by local white and red color mud. Besides, there are no power plant within the Kathmandu Valley. Pipe water is another source of Lead pollutant but in case of Kathmandu Valley, because of lack of sufficient water supply, water is supplied within certain specific time. There is no more chance of water to remain long time in pipe. Hence I found motor-vehicles as a major source of lead pollutant.

An effective method of lead level measurement is blood lead (PbB/dl) and the most vulnerable group are children, pregnant women and women of child bearing age. Even the small doses of lead can slow development and make children less intelligent. (ATSDR, 1992)

The average blood lead level in the U.S. population is below 10 μg/dl, down from an average of 16 μg/dl (in the 1970s), the level before the legislated removal of lead from gasoline. A blood lead level of 10 μg/dl is about 3 times higher than the average level found in some remote populations. The levels defining lead poisoning have been progressively declining. Currently, the concensus level of concern for children is 10 to 14 μg/dl. Effects on stature have been reported to begin at levels as low as 4 μg/dl , the present limit for accurate blood lead measurement. No safe level has yet been found for children. Even in adults, effects are being discovered at lower and lower levels as more sensitive analyses and measures are developed. So the level of lead in the body, especially in children is important to measure.(ATSDR, 1992)

According to the number of petrol using vehicles and the quality of fuel, there might be a serious problem of lead (Pb) in the Kathmandu valley of Nepal. It follows that an assessment of air quality in Kathmandu valley and the prevalence rate of blood lead level in children must be made, in order to develop appropriate intervention strategies to this serious problem.

3.2 Health Effects of Lead (pb)

When lead enters the body, it is treated like calcium because the body can't tell the difference between the two. Lead interferes with the manufacture of heme, the oxygen-carrying part of hemoglobin in red blood cells. After several weeks, lead leaves the bloodstream and is absorbed by bone, where it can continue to accumulate over a lifetime.

The effects of lead poisoning typically do not show up until youngsters start school. Those exposed to lead early in life often can not concentrate and can be more easily excited and upset. Their short term memories are poorer; their reaction time slower and their hearing is impaired. In long term studies, children who suffered early lead poisoning were six times more likely than others to have learning disabilities and seven times more likely to drop out of high school. children lead levels at 12, 24 and 72 months of age can determine their entire academic future. (ASTDR, 1992)

Lead consumption in childhood can mean a lower IQ and impairment in reading, writting, math, visual and motor skills, language, abstract thinking and concentration. Children may also suffer irritability, insomnia and anemia. It also impairs children's growth.The major health effects of lead can be listed as follows: (ASTDR, 1992) and table 3.1 illustrates the different levels of blood lead where these health effects occur.

1. Lead affects primarily the peripheral and central nervous systems, the blood cells and metabolism of vitamin D and calcium.

2. Lead also causes reproductive toxicity, neurologic deficits,as well as other effects caused by lead poisoning may be irreversible.

3. Effects in children generally occur at lower blood lead levels than in adults, the developing nervous system in children can be affected adversely at blood lead levels of less than 10 μg/dl .

4. It inhibits several enzymes that are critical to the synthesis of heme.

5. It interferes with a hormonal form of vitamin D , which affects multiple processes in the body, including cell maturation and skeletal growth.

6. Lead induced chronic renal insufficiency may result in gout.

8. The first signs of lead poisoning in children are neurobehavioural problems that adversely affect class room behaviour and social interaction,

Table - 3.1: Effects of Inorganic Lead on Children and Adults - lowest observable adverse effect levels

Children	Lead Concentration in Blood (µg pb/dl)	Adults
Death	150	
	100	Encephalopathy
Encephalopathy, Nephropathy, Frank Anemia, colic		Frank Anemia Decreased Longevity
	50	Decreased hemoglobin synthesis
Decreased hemoglobin synthesis	40	Peripheral Neuropathies Infertility men, Nepropathy,
Decreased Vitamin D Metabolism	30	Increases systolic blood pressure Men, Decreases hearing acuity,
		Increases Erythrocyte Protoporphyrin (Men),
Decreases nerve conduction velocity,	20	
Increases Erythrocyte Protoporphyrin, Decreases vitamin D metabolism, Developmental toxicity,		Increases Erythrocyte Protoporphyrin (women)
Decreases IQ, Hearing and Growth,	10	Increases hypertension,
Transplacental Transfer		

Adapted from ATSDR, Toxicological Profile for Lead (1989),

The number of U.S. federal standards and regulations reflect the extent to which lead is considered a public health problem. In some cases, the lead levels are mandated; in others, they are only recommended standards. Table 3.2 describes the standard of lead level set by various agencies with focus on blood, air, water, food and paint. Table 3.3 describes the various blood lead concentration to the children and required intervention.

Table 3.2: Standards and Regulations for Lead

Agency*	Focus	Level	Comments
CDC	Blood	10 μg/dl	Advisory; level of concern for children†
OSHA	Blood	50 μg/dl	Regulation; medical removal from exposure,
OSHA	Air	50 μg/m3 30 μg/m3	Regulation; PEL§ (General industry) Action level
ACGIH	Air	150 μg/m3	Advisory; TLV/TWA ¶ (Under revision)
EPA	Air	1.5 μg/m3	Regulation; 3-month average,
CDC (NIOSH)	Air	100 μg/m3	REL**
EPA	Water	15 μg/l	Action level
FDA	Food	100 μg/day	Advisory
CPSC	Paint	600ppm (0.06%)	Regulation; by dry weight

* ACGIH= American Conference of Governmental Industrial Hygienists;
CDC= Centres for Disease Control;
CPSC= Consumer Product Safety Commission;
EPA= Environmental Protection Agency;
FDA= Food and Drug Administration;
NIOSH= National Institute for Occupational Safety and Health;
OSHA= Occupational Safety and Health Administration.

† If many children in the community have blood lead levels >10μg/dl, communitywide interventions (primary prevention activities) should be considered by appropriate agencies.

§ PEL (Permissible Exposure Limit) : The employer shall assure that no employee is exposed to lead at concentrations >50 μg/m3 of air averaged over an 8-hour period.

¶ TLV/TWA (Threshold Limit Value / Time Weighted Average): The time-weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed,day after day, without adverse effect.

**REL(Recommended Exposure Limit): Air concentration to be maintained so that worker blood lead remains <0.060mg/100g of whole blood.

3.3. Cause of High Lead Exposure to Children

Childrens are more vulnerable to lead poisoning because their habits of putting their hands in their mouth, play in dirt and eating non-food objects. In addition, children absorb more lead than adult because sometimes they are deficient in iron which increases their tendency to absorb more lead. In certain geographic areas, iron deficiency is common in children 9 to 24 months of age. Since the iron and calcium deficiencies are known to enhance the absorption of lead, it is specially important to assess the nutritional status of young children. The urban child is at a higher risk because of the higher level of environmental pollution. The children of the poor, who live in the oldest houses with lead ladden walls in the worst state of repair and who tend to have additional nutritional deficiency, are at the greatest risk of all. The incidence of lead poisoning is highest among the urban children of the lowest socio-economic class. (ATSDR, 1992)

3.4. Prevention and Treatment Methods from Lead Poisoning

Lead poisoning is preventable. To prevent the children from lead poisoning their hands must be cleaned before they eat, not to use the lead crystal ware, not to buy canned foods that are lead - soldered and not to allow children to eat paint chips. Lead poisoning can be eradicated. To eradicate lead poisoning, the following four point effort and intervention mentioned as in table 3.3. is required.

1. Establishment of national surveillance for children with elevated blood levels of lead,
2. Phase out of leaded fuel, elimination of leaded paint and contaminated dust in housing,
3. Reduction of children's exposure to lead in water , food, air ,soil and places of play,
4. An increase in community program for the prevention of childhood lead poisoning,

Table - 3.3: Interpretation of Blood Lead Test Results and Follow up Activities: Class of Child Based on Blood Lead Concentration

Class	Blood Lead Concentration	Comment
I	≤ 9	A child is not considered to be lead poisoned.
IIA	10-14	The presence of many children (or a large proportion of children) with blood lead levels in this range should trigger communitywide childhood lead poisoning prevention activities. Children in this range may need to be rescreened frequently.
IIB	15-19	A child should receive nutritional and educational interventions and more frequent screening. If the blood lead level persists in this range, environmental investigation and intervention should be done.
III	20-44	A child should receive environmental evaluation and remediation and a medical evaluation. Such a child may need Pharmacologic treatment of lead poisoning.
IV	45-69	A child needs both medical and environmental interventions, including chelation therapy.
V	≥ 70	A child with this class of lead poisoning is a medical emergency. Medical and environmental management must begin immediately.

Source - ATSDR, Case Studies in Environmental Medicine, Lead Toxicity,Sep,1992 .

Page - 15.

The treatment process for lead poisoning from the body is called chelation. To insert an intravenous tube containing chelating drugs into children's arm takes about 20 minutes. If intravenous tube does not lower the lead level, an oral chelating drug should have to take twice a day for six months. (Dianne,1992)

Treatment would be effective before too much damage. Drugs binds to the metal in the blood stream, allowing it to be flushed out in the urine. The drug of choice has been calcium - disodium EDTA, but it is usually administered intravenously over several days in a hospital. The Food and Drug Administration (U.S.) has approved for use in children an oral drug called DMSA, which does not require hospitalisation. But medical treatment can not substitute for a safe environment. Prevention is the key. (ASTDR, 1992)

3.5.Objectives

3.5.1. General Objectives of the Study,

To determine the Lead (Pb) exposure among school children living in Kathmandu valley and Gorakhkali municipality of Gorkha, Nepal.

3.5.2. Specific Objectives of the Study,

3.5.2.1 To determine the blood lead level (PbB/dl) of public school children age 6-10 of Kathmandu valley (most polluted area of Nepal) and pollution free area i.e.Gorakhkali municipality of Gorkha, Nepal.

3.5.2.2. To determine the Lead (Pb) concentration in ambient air of exposed area,

3.5.2.3. To compare the blood Lead (Pb) level between exposed and non-exposed area,

3.6. Study Methodology

Cross sectional study design is the simplest form of an observational study. It is based on a single examination of cross section of population at one point in time - the results of which can be projected to the whole population. It is also known as prevalence study. There will be two study groups / areas for this cross sectional study - one is exposed and other is non exposed to the lead (Pb) pollutant. The sample will be taken from both areas to measure the blood lead. For this purpose education level, income level, knowledge, practice and feeding behaviour of the parents and childrn's details- age, sex, grade will be observed.

To plan, execute, analyse and publicise this project an expert committee will be organised. This committee will consisted with the representatives from various expert agencies, universities, ministries and departments.

3.6.1. Target Population

Lead is most harmful to children. So the children of age 6-10 who are studying in the public schools of Kathmandu valley are chosen as the study population. City children with low socio-economic status are more affected than the rural, high socio-economic family and adults, because they are exposed to more lead in high lead containing air. (ATSDR, 1992)

3.6.2 Sampling

3.6.2.1 Exposed area

To measure the blood lead level of children in the exposed area, 770 children will be selected from three districts of Kathmandu valley. The number of children distribution in three districts of Kathmandu valley is described in table 3.4. From Kathmandu, Lalitpur and Bhaktapur 4, 2 and 1public schools will be randomly selected respectively. These are all districts situated within a valley where the study population are homogeneous in terms of climate, socio-economic status and exposure to the air pollution. The description of these three district's number of students (Grade 1-5) is illustrated in table 3.4.

Table- 3.4: Distribution of Students by Grade in Kathmandu valley,

Districts	Kathmandu	Lalitpur	Bhaktapur	Total
Grade 1	37,736	18,738	11,398	67,872
Grade 2	22,575	11,303	5,683	39,561
Grade 3	20,583	9,390	4,995	34,968
Grade 4	18,555	8,263	4,700	31,518
Grade 5	16,733	7,342	3,714	27,789
Total	116,182	55,036	30,490	201,708

Source: Ministry of Education, Culture and Social Welfare (1992)

Among the 201,708 children of Kathmandu valley, the sample size is determined by the following strategy. The formula for sample size determination is as follows:

Where, P = Proportion of children who have PbB/dl >10, where p is set to be 0.5

Q = 1-P; d = Acceptable error,

95 % Confidence Interval, $Z\alpha = 1.96$ (Two tail)

Acceptable error = 5 %

$$n = Z_\alpha^2 pq / d^2$$

n = (1.96)2 (50) (50) / (5)2 = 768

Hence the sample size is determined to be 770 children from both exposed and non-exposed group.

3.6.2.2. Non-exposed area

To compare the prevalence of lead poisoning in exposed area blood lead level of children in a non-exposed area, Gorakhkali municipality of Gorkha, Nepal will be measured.

I have selected Gorakhkali municipality of Gorkha district, Nepal as a non-exposure area to the lead containing air pollution. This municipality is situated on the southern face of a hill and 140 km. western side of Kathmandu valley. It takes about 6 hours to drive from Kathmandu. It is spread over 200 sq.km. area. The total population of this municipality is about 10,000 and their major occupation is agriculture. Among the total about 70 % are in agriculture, 20 % are in business and 10 % are in service.

Within the municipality, only 30 km. road are paved and remaining 50 km. road are earthern. About half of the municipality area have supplied electricity. I select this municipality because there are no major source of lead pollutant. To measure the blood lead level of non-exposure area, children will be selected from grade 1-5 of 7 local public schools as mentioned in table 3.5. One hundread ten students of grade 1-5 of each 7 schools will again selected randomly.

Table-3.5: Distribution of sample student in Gorakhkali municipality

Municipality	Total no. of school	Sample school	Grade	Sample student	Sample student
Gorakhkali		A	1-5	5 x 22	110
		B	1-5	5 x 22	110
		C	1-5	5 x 22	110
		D	1-5	5 x 22	110
		E	1-5	5 x 22	110
		F	1-5	5 x 22	110
		G	1-5	5 x 22	110
Total		7			**770**

3.6.2.3. Characteristics of Public School

Public schools in both exposed and non-exposed area are run by government. Normally in public school, children entered in grade 1 at the age of 6 and are of middle socio-economic status. In the exposed area, Kathmandu valley, most of the public school are located near busy road, however in non-exposed area, schools are not linked by motorable roads.

3.6.3 Sampling Method

Multistage sampling will be applied to select the sample from the population. At first all the public schools of Kathmandu valley (districtwise) will be listed in alphabetical order and, then, numbered. By using a table of random numbers, 7 schools-4, 2, and 1 for Kathmandu, Lalitpur and Bhaktapur respectively will be randomly selected. Secondly, the selected 7 school's all of the children in grades 1-5 will be listed alphabetically and, then, number. I determined 7 school as sample because of easiness to select the schools proportionately from the various 3 districts of Kathmandu valley. At the second stage, twenty-two children in each grade in each school will, then, be selected using a table of random numbers.

In each school, in each grade, all students will be listed in alphabetical order and, then numbered. At first all children of a particular grade will numbered with random numbers of random table. It is not sure that all the selected children do agree to participate.Those who do not have pre-requisite criteria and are not interested to participate, will be excluded. Among the remained children numbered with random number of random table, the required 22 children, who wish to participate in this project will be taken for sample. This procedure will be applied both in exposed and non-exposed area. Table 3.6 illustrates the procedure of sampling in exposed area.

Table-3.6: Sample of children exposed area

Districts of Kathmandu valley	Total children of grade 1-5	Student proportion (%)	No. of sample school	Student x grade x school	Total no. of sample student
Kathmandu	116,182	57.60	4	22 x 5 x 4	440
Lalitpur	55,036	27.30	2	22 x 5 x 2	220
Bhaktapur	30,490	15.12	1	22 x 5 x 1	110
Total	201,708	100 %	7	22 x 5 x 7	770

3.6.4 Variable to be measured

The best screening and diagnostic test for lead poisoning is a blood lead level. It reflects lead's dynamic equilibrium between absorption, excretion and

and hard tissue compartments. It is the most widely accepted and commonly used measure of lead exposure. (ATSDR, 1992)

3.6.5 Pre-requisite or characteristics for the sample population

3.6.5.1 Children should have to be aged 6-10.

3.6.5.3. They should have been lived in the Kathmandu valley since the last 6 months,

3.7. Summary of Proposed Activities

To Receive Consent from Parents to Take out and Measure the Blood Lead Level (PbB/dl)

The parents of each of the children in each school who were selected by random sampling will be approached to obtain their written consent (Appendix A.1) for both permission to obtain a blood sample from their child and to administer a questionaire.

To implement questionaire to parents about their children

After obtaining consent, the parents will be asked to complete a questionaire about background information, past health history of child, socio-economic, physical facilities, children's historical background and behaviour, nutrition and children's individual background. (Appendix A).

Blood lead level (pbB/dl) measurement in both exposed and non-exposed area

The blood of the samples of target population both exposed and non exposed will be measured with the assistance of lab technician. This measurement will be performed in the same month. To store the blood samples, an icebox or refrigerator will be required and to avoid the contamination special test-tube (free iron tube) will be used. About 2 m.l. blood will be taken from selected sample children. Through the syringe, the blood will take out and it will kept in tube until it's measurement.

Analysis of data collection

Details of parent and children will be taken by using the questionaire of Appendix A and it will be kept like Appendix E. After blood lead level measurement of the sample children, their individual record will be kept as Appendix A No. 7. Besides the lead contained air pollution, lead exposure might be affected by age, sex, family socio-economic status and location of house and school. Both in exposed and non-exposed area, I will develop and use the following example tables to analyse the blood lead level.

A. Proportion of children with elevated blood lead levels by grade of child. (For each school)

Grade	Total	Children with <10µ g/dl PbB	Children with > µg/dl PbB	Proportion (Ratio)
1				
2				
3				
4				
5				
Total				

B. Proportion of children with elevated blood lead levels by gender and grade of child

Gender	Grade	Total no. of children	PbBwith <10µg/dl	PbB with >10µg/dl	Proportion
Boys	1				
	2				
	3				
	4				
	5				
Girls	1				
	2				
	3				
	4				
	5				
Total		770			770

C. Analysis of Total Sample Children

Blood Lead Level	>10µg/dl % of total	<10µg/dl % of total	Total
Urban	a	b	770
Rural	c	d	770
Total	a+c	b+d	1540

D. Estimation of Risk,

Relative Risk,

The estimation of disease risk associated with exposure is obtained by an index known as “Relative Risk’ (RR) or “Risk Ratio”, which is defined as the ratio between the incidence of disease among exposed persons and incidence among non-exposed. (Park, 1994)

Relative Risk = Incidence among exposed / Incidence among non-exposed

= a / a+b x c+d /c

The answer shows the risk of blood lead level with > 10 μg/dl in exposed area in comparision with non-exposed area.

Odd Ratio

Odds ratio is a measure of the strength of the association between risk factor and outcome. It is closely related to relative risk.

Odds Ratio = ad / bc

The answer shows the degree of risk of having higher blood lead level with 10μ g / dl in exposed area.

E. Description of Blood Lead Level by Various Variables

		Children with PbB < 10μg/dl		Children with PbB > 10μg/dl	
Variable	Total children	Number	% of total	Number	of total
Gender					
Age (6-9)	154 from each				
Grade (1-5)	154 from each				
Urban	770				
Rural	770				
Parent's Occupation					

F. Chi-square Test

The most important nonparametric test is the chi-square ($\chi 2$) test, which is used for testing hypothesis about nominal scale data. It is basically test of proportions: the question being asked is whether the proportions of observations falling in different catagories differ significantly from the proportions what would be expected by chance. This test would show whether this difference in proportion is too large to be expected by chance.

The formula for Chi-square is, $\chi 2 = \Sigma(O-E)2 / E$

Where, O = Measured value of blood lead level,

E = Total no. Of children of particular school x Total no. Of children having blood lead level > or < 10μg/dl / Grand total

Schools	A	B	C	D	E	F	G	Total
No. Of children PbB >10μg/dl								
No. Of children PbB <10μg/dl								
Total	110	110	110	110	110	110	110	770

Publicise the exposure of lead level by comparing blood lead level between exposed and non-exposed area,

After measurement, analysis and interpretation of family background, children's details and blood lead level (PbB/dl) of children in both exposed and non-exposed area, the actual exposure of lead pollutant and it's health effects will be made public. To plan, execute, analyse and publicise the result of blood lead level measurement an expert committee will be organised with the representation of various expert agencies, universities, ministries and departments.

Different level's intervention is required in different exposure level of lead pollutant which is mentioned in Table-3.1.,3.2., and 3.3. This study will determine the exposure level and health effects to the children of Kathmandu valley.

3.8. Schedule of activity,

All the activities about the blood lead measurement in exposed and non-exposed children will be performed as set schedule. This study will be started from 14 April, 1998. It's a new year (2055 B.S) in Nepal. The program will be run as mention in the following table. This project will be completed within 4 months duration.

Table-3.4

Date	Particulars	Activities	Participants
14April, 1998	Sample selection	Listing of Public schools, Random selection of sample	Researcher and Research Assistant
17April, 1998	Invitation to selected sample parents with their children in exposure area,	Introduce to each other, Clearify about the program's objectives, reasons and importance, Recording the details of participants.	Researcher, Research Assistant, Lab Technicians, Recorders and Children
18-27, April, 1998	PbB Measurement in Exposure area,	Blood Lead level measurement of children and recording,	Researcher, Research Assistant, Parents, Children, Lab technician. and Recorder
28-30 April, 1998	Sample selection and invite to selected children with their parents	Listing of all public school of non exposure area, i.e. Gorakhakali municipality of Gorkha, Invitation to selected children with their children,	Researcher, Research Assistant, Lab Technicians, Recorders and children
1-10May,1998	Blood Lead measurement in non-exposure area.	Blood Lead level measurement of children and recording,	Researcher, Research Assistant, Lab Technician, Recorder.
11-12August, 1998	Data analysis, interpretation and report preparation,	Review, discussion and report preparation,	Researcher, Research Assistant,
13 August, 1998	Report Presentation of pbB/dl Measurement,	Publicise the report.	Researcher and Research Assistant

3.9. Budget for the Proposed Study

There is an organised Central Health Laboratory under the Ministry of Health. The necessary equipment, i.e., computer, PbB measurement machine, slide, motor-vehicle and manpower will be utilised from this laboratory to measure the blood lead level of children. Hence, the budget is required only in terms of compensation to the children, lab technicians, recorder, peon and report preparation. The details of the budget for proposed study is as follows.

Table - 3.5 In Rupees.

Particulars	Unit	Days	Rate	Total	Remarks
Lab Technician.	2	10	300.	6,000.	Measurement of PbB in non - exposed grp.
Recorder	1	10	300.	3,000	
Lab Technician	2	10	300.	6,000	Exposed grp. blood lead measurment.
Recorder	1	10	300.	3,000.	
Peon	1	120	100.	12,000	Liasion Office
Compensation to children	1,600	1	50.	80,000	Exposed and non-exposed area
Liasion office assistant	1	120	150.	18,000	For data entry
Researcher	1	120	400.	48,000	
Questionaire printing	1,600	-	10.	16,000	
Supplies					
Tube	1,600	-	20.	32,000	
Syringe	1,600	-	20.	32,000	
Report preparation and stationary	-	-	-	15,000	
Miscellaneous	-	-	-	30,000	
Total				311,000	

The required equipments to measure the PbB, Lab technician and transportation facilities will be managed from the Central Health Laboratory, Department of Health Services.

3.10. Evaluation

By the analysis of all measurement, information and data the level of lead in the blood and its impact will be evaluated. Blood lead concentration below or equal to 9 μ g/dl is not considered to be lead poisoned. The concentration below or equal to 19 μ g/dl to the children nutritional and educational interventions and if the blood lead level is found higher than 20μg/dl to the children, then the children should receive environmental evaluation, intervensions and management. After the result of average blood lead level of children, the actual exposure level of lead pollutant and required interventions will be make public.

REFERENCES

Agency for Toxic Substances and Disease Registry, (Sept.,1992). Case studies in environmental medicine, Lead Toxicity. U.S. Department of Health and Human Services, Public Health Services.

Beaglehole, R., Bonita, R. & Kjellstrom, T. (1993). Geneva: Basic epidemiology. World Health Organization.

Central Bureau of Statistics. (1996). Nepal living standard survey report. Kathmandu:

Central Bureau of Statistics. (1988). Statistical pocket book. Kathmandu:

Central Bureau of Statistics. (1990). Statistical pocket book. Kathmandu:

Central Bureau of Statistics. (1992). Statistical pocket book. Kathmandu:

Central Bureau of Statistics. (1994). Statistical pocket book. Kathmandu:

Central Bureau of Statistics. (1996). Statistical pocket book. Kathmandu:

Central Bureau of Statistics. (1995). Statistical year book of Nepal. Kathmandu:

David, E.G. & Jeffrey, L.L. (1989). Respiratory effects of outdoor air pollution. Air Pollution. Post Graduate Medicine. vol.86(5),111-118.

Department of Road (1990). Nepal road statistics. Kathmandu:

Department of Road (1994). Nepal road statistics. Kathmandu:

Department of Road (1995). Nepal road statistics. Kathmandu:

Department of Transport management. Unpublished records about vehicle registration. Kathmandu:

Faculty of Engineering, C.U.,(1994). Air emission database for vehicles and industry in Bangkok metropolitan region. Pollution Control Department, Minisry of Science, Technology and Environment. Final Report.

Henry,G.J. (1992). Health effects of air pollution: A review of clinical studies. Occupational Lung Diseases. Pulmonary and Critical Care Medicine Division, Department of Medicine,University of California. Los Angels: vol.13(2), 201-214.

Kelvyn, S. & Leo, H. (1993). Options for Australian air quality goals for oxides and sulphur. Environment Protection Office, Department of Environment and Land Management. Public Review Document. Adelaide, south Australia:

Lawrence, J.F., (1992). Human health effects of air pollution. Environmental Health Perspective. 100, 45-56.

Lipfert, F. W. (1994). Air pollution and community health: A critical review and data source book. Van Nostrand Reinhold. New York:

Michael, A. & Tom, V. (1991). Ambient air pollution and respiratory disease. The Medical Journal of Australia. Department of Social and Preventive Medicine,Monash medical School, Alfred Hospital, Prahran: vol.154, 543-553.

Nepal Environmental and Scientific Services (P) Ltd. (NESS),(1995). Environmental pollution and management. Series - 1, Thapathali, Kathmandu:

Nepal Environmental and Scientific Services (P) Ltd. Ness@mos.com.np. Homepage.

Nepal Law Book Management Committee. (1990). The constitution of the kingdom of Nepal. Kathmandu:

Park, K. (1994). 14th ed. Park's text book of preventive and social medicine. Banarasidas Bhanot, 1167, Premnagar, Jabalpur:

Sergio, P.,( ). Lead Poisoning. p 472-493.

Shahi,G.S. & Phillip, W.S. (1994). Environmental policy options for health: social, political and economic considerations. A Paper Prepared for the Monograph, International Perspectives in Environment and Health. 1-27.

Kavita Sherchan, (21 Sep,1997). Kathmandu Post. Thinking of traffic is enough to give migraine. http://www. info-nepal. com/nhp/news/news.htm. Kathmandu:

Staff Reporter,(June, 1997) The Rising Nepal. Electric vehicles to substitute diesel tempos in Kathmandu. http://www,info- nepal.com/nhp/news/news.htm Kathmandu:

Staff Reporter, (4 June, 1997).The Rising Nepal. Pollution level high in capital. http://www.info-nepal.com/nhp/news/news.htm Kathmandu:

Staff Reporter, (23 July, 1997).The Rising Nepal. Diesel tempos fail test. http://www.info-nepal.com/nhp/news/news.htm Kathmandu:

Staff Reporter. (31 July, 1997). The Rising Nepal. Environmental laws "toothless". http://www.info-nepal.com/nhp/news/news.htm Kathmandu:

Tord, K. & Carlos, C. (1995). Framework for the development of environmental health indicators. World Health Statistics, quarterly 48, 1-10.

United Nations. (1994). Report of the united nations. Expert group Meeting on Population, Environment and Development,1992. New York:

United Nations. (1995). Trends, patterns and implications of rural - urban migration in India, Nepal and Thailand. Economic and Social Commission for Asia and the Pacific. New York: