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Blood lead levels in rag-pickers of Kathmandu and its association with hematological and biochemical parameters

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ABSTRACT

Introduction

Lead poisoning is a common health problem in Nepal and there are a limited number of studies on blood lead levels in various population groups. Rag-pickers are those people who visit from house to house to collect the materials that can be recycled and thus earn their livelihood. The present study was designed to evaluate blood lead level (BLL) and its relationship between hematological and biochemical parameters in rag-pickers working in Kathmandu.

Methods

An observational cross-sectional study among 50 rag-pickers working in the selected area of Kathmandu was done in May 2019 after obtaining ethical approval from the Nepal health research council. Capillary and venous blood was drawn from each participant after written consent to measure the BLL, aspartate aminotransferase, alanine aminotransferase, total

bilirubin, creatinine, glucose and to test for a complete blood count. Whole blood was also screened for the presence of hemoglobin variants in cases with abnormal red blood cell indices. Data was analyzed using SPSS (Version 20.0).

Result

All rag pickers were men with mean age of 32.56 ± 12.51 years. The mean BLL among rag-pickers was 11.6 ± 7.23 µg/dL. High eosinophil count was found (8.27 ± 5.49 %) in 27 cases (54%) having no significant association with BLL. The mean BLL was higher (12.89 µg/dL) in a cohort of workers who pick and recycle electronic waste. Beta-Thalassemia trait was seen in four cases, all of them had high BLL. No significant association of BLL with the number of years worked by rag picker was found. Similarly, no significant association of BLL with hematological and biochemical parameters was found.

Conclusion

Rag-pickers working in Kathmandu are at increased risk of lead toxicity. The use of protective gloves, masks, shoes and clothes along with a regular medical examination of this vulnerable group is recommended.

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INTRODUCTION

Lead poisoning is a common health problem in Nepal. The sources of lead exposure in Nepal include the combustion of petroleum products, occupational exposure from paint industry, cosmetics, ayurvedic medication and environmental pollution. A study done in Nepal found that 76% of the tested paints contained lead at concentrations greater than 90 parts per million [1].

A limited number of studies have been conducted to estimate the BLL in various population groups in Nepal. One such study found the mean blood lead level of 20 µg/dl in school children in an industrial area of Nepal [2].

In Kathmandu, there is a significant increase in the generation of solid waste due to the increase in urbanization. These wastes from the house, that can be recycled, are sold to the rag pickers. The purchased commodities are then taken to the collection center where they are processed and are taken to the industrial areas in Nepal as well as in India. This way, rag-pickers contribute to solid waste management in Kathmandu.

The types of waste materials rag-pickers buy are metals, batteries, bottles, old furniture, old electric equipment and papers [3]. These wastes have good resell value. Due to the nature of these waste materials, rag-pickers are at occupational risk of various health hazards. Various studies have been done in neighboring India to identify the health impairments in rag pickers [4, 5].To the best of our knowledge, there is no data in the medical literature about BLL in rag pickers.

Exposure to lead can have various health effects in human beings, including impaired hemoglobin synthesis, chronic damage to the gastrointestinal system, joints, reproductive system, kidneys and nervous system [6, 7]. Children are prone to also developing neuropsychological effects [8].

Given the fact that there are limited studies on blood lead levels in various population groups in Nepal, a study of blood lead level in rag-pickers will help in monitoring and raising awareness.

The current study was done to evaluate blood lead levels in rag-pickers working in the selected area of Kathmandu valley.

The correlation of BLL with various hematological and biochemical parameters was also performed. Monitoring of BLL in this vulnerable group of people could help in planning further clinical studies.

METHODS

Study population

The cross-sectional observational study was carried out in the 50 rag-pickers working in (Balaju) northwest area of Kathmandu. Sample size was calculated using the expression for sample size, i.e., n= 4 pq/l^2 where, p denotes the prevalence of 2.8 % and q as (1-p) for lead toxicity among labourers with total allowable error (l) as 0.05 and standard normal variate as four. [9]. Ethical approval to conduct the study was taken from Nepal Health Research Council (Reg. no. 326/2019) and local government body (ward office) in the selected area. Sample was collected from those participants who were available at the time and venue, mentioned in the formal notice issued to the rag pickers collection centre. Written consent was obtained from each participant before starting the sample collection. The predesigned data collection form was filled up by the investigator after asking a question to the participants and examining them. The form included demographic data such as age, height, weight, the number of years worked as rag pickers and types of waste they were collecting. Similarly, the clinical information in the form included blood pressure and general medical findings, past medical history and smoking/tobacco/alcohol consumption history.

Sample collection

Capillary blood was collected on-site and blood lead level was measured immediately within 30 minutes. Fasting blood, 10 ml in volume (4ml in plain tube, 3ml in fluoride tube and 3 ml in EDTA K2 tube) was collected from the brachial vein under aseptic condition, and then transported to the Samyak Diagnostic Pvt Ltd clinical laboratory within one hour under the condition specified by this accreditated laboratory. This sample was used for the analysis of hematological and biochemical parameters.

Measurement of blood lead

Measurement of BLL was done using the Lead Care II instrument (Magellan Diagnostics Inc., N. Billerica, Massachusetts, USA). Lead care II is a CLIA waived point of care system that relies on electrochemistry to detect BLL in whole blood. After mixing the whole blood with treatment reagent, the red blood cells are lysed and lead is released and collected on sensor by the potential applied from analyzer [10]. After 3 minutes the analyzer measures the amount of lead collected on sensor and displays result in µg/dL [10]. The quality control (QC) in the present study was maintained with two levels of controls provided (Table 1). The target range for QC material was specified by the manufacturer. Value at or above 5 µg/dl was considered as an elevated blood lead level.

Measurement of biochemical parameters

Measurement of various biochemical parameters in rag-pickers were taken in an accredited clinical laboratory of Samyak Diagnostic Pvt Ltd, Kathmandu. All the biochemical analytes were measured using the RX Imola auto-analyzer (Randox Laboratories Ltd).

Table 1 Result of quality control for blood lead

QC level	Result (µg/dL)	Target range (µg/dL)
Level 1	9.9	5.5-11.5
Level 2	25.6	21.6-29.6

Table 2 Biochemical parameters and method of measurement

Analytes	Method of measurement
Plasma glucose	Glucose oxidase-peroxidase method
Serum creatinine	Jaffe's reaction
Serum alanine aminotransferase (ALT)	International federation of clinical chemistry (IFCC) method
Serum aspartate aminotransferase (AST)	IFCC method
Serum total bilirubin	Jendrassik and Grof method

Daily maintenance for this auto analyzer was conducted and internal quality control sample from Bio-Rad was run which were found to be within the acceptable range. The biochemical parameter along with its principal of measurement is shown in Table 2.

Measurement of hematological parameters

2 ml of whole blood was used for complete blood count test which includes hemoglobin, red blood cells, white blood cells, platelets and various red blood cell indices such as MCV, MCH, PCV and MCHC. Sysmex automated hematology analyzer XN 330 (Sysmex, Milton Keynes, UK) was used for this measurement. Two-level control material provided by Randox laboratories was used as internal quality control material which was found within a normal range.

Whole blood was also screened for the presence of hemoglobin variants, in cases with abnormal RBC indices (low hemoglobin, high RBC count with low MCV and MCH), with the use of the *Bio-Rad D10* instrument in variant mode using the principle of ion-exchange high-performance liquid chromatography (HPLC).

Statistical analysis

Data was analyzed using the Statistical Package for Social Sciences (SPSS 20, IBM Corporation, New York, USA). Data were normally distributed. Results were expressed as mean ± standard deviation. Pearson correlation was applied to evaluate the association between hematologic, biochemical parameters and blood lead level. 2-sided P value<0.05 was considered statistically significant.

RESULT

All the participants of this study were men. Baseline characteristics along with laboratory parameters in rag-pickers are shown in Table 3.

The mean value of all the biochemical and hematological parameters in rag picker was in normal range except blood lead level (11.68 ± 7.23µg/dL) and the eosinophil count (8.27 ± 5.49 %) both of which were higher than the normal range. In four workers, who also had very high level of blood lead, screening for hemoglobin variants

Table 3 Baseline characteristics along with biochemical and hematological parameters in rag pickers

Parameters	Mean ± SD	Reference range in men
Age (years)	32.56 ± 12.51	
Number of years worked (years)	9.67 ± 7.30	
BMI (kg/m2)	20.12 ± 3.21	18.5 – 24.9
Systolic blood pressure (mm Hg)	115.51 ± 9.33	120
Diastolic blood pressure (mm Hg)	74.73 ± 8.31	80
Blood lead level (µg/dL)	11.68 ± 7.23	Less than 5
Fasting blood glucose (mg/dL)	83.89 ± 27.64	70 – 100
AST (U/L)	27.64 ± 7.98	17 – 59
ALT (U/L)	25.87 ± 12.09	10 – 45
Creatinine (mg/dL)	0.86 ± 0.11	0.6 – 1.4
Total bilirubin (mg/dL)	0.53 ± 1.53	0.3 – 1.9
Hemoglobin (gm %)	15.48 ± 1.53	13.5 – 16.9
Platelet count (G/L)	158 ± 89	150 - 450
Leukocyte (G/L)	7.24 ± 2.01	4 - 11
Basophil (%)	0.6 ± 0.5	Less than 2
Eosinophil (%)	8.27 ± 5.49	1 – 8
Neutrophil (%)	49.13 ± 8.39	40 – 70
Monocyte (%)	7.96 ± 1.98	2 – 15
Lymphocyte (%)	34.13 ± 8.12	20 - 45
MCV (fl)	82.31 ± 1.1	81.8 – 95.5
MCH (pg)	29.03 ± 1.22	27 – 32.3
MCHC (g/dL)	34.11 ± 1.52	32.4 - 35

Table 4 Types of solid waste collected by the rag pickers

Group	Types of solid waste	Number of rag-pickers collecting these items	Mean blood lead level (µg/dL)
1	Paper and metals only	3 (6%)	7.35
2	Plastic, Metals and Paper	6 (12%)	8.23
3	Plastic, Metals, Paper and Paint containers	11 (22%)	8.47
4	Plastic, Metals, Papers, Paint container and electronic waste	30 (60%)	12.89

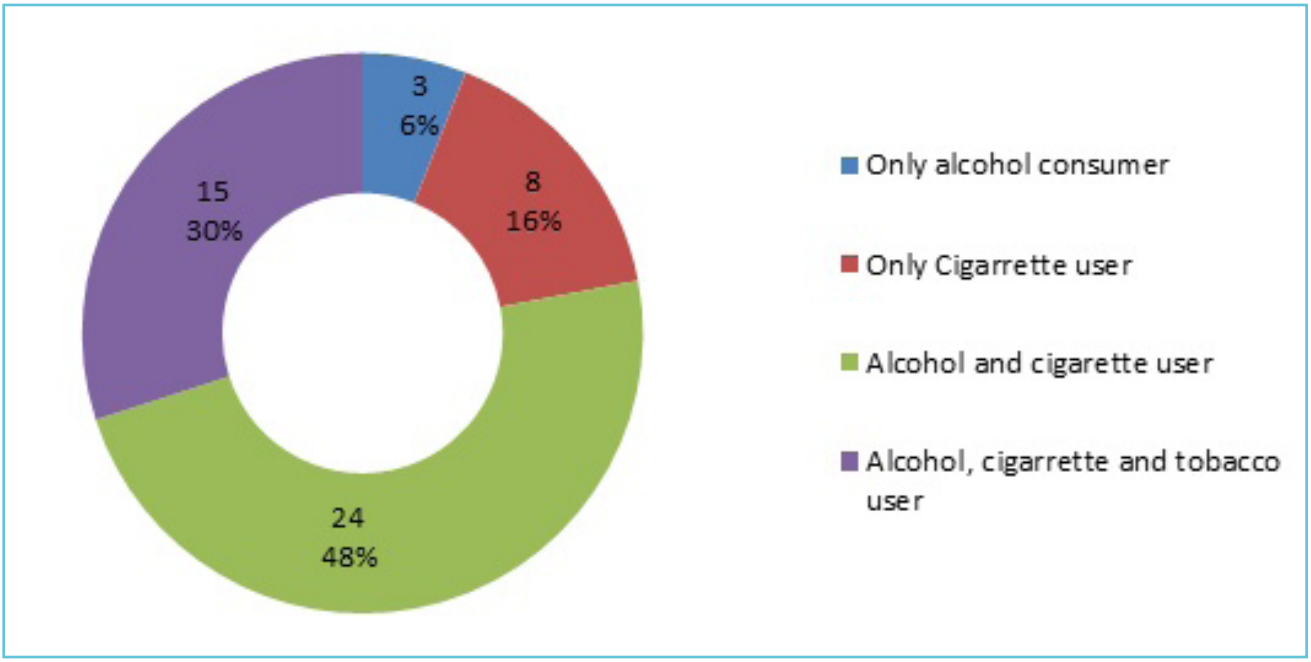
was done because of abnormal red blood cell indices. The minor variant of beta-thalassemia was found in all of them.

Rag-pickers were divided into four groups according to the types of solid waste they are collecting. Mean BLL in each group was calculated as shown in Table 4. None of the workers were found picking only one type of waste.

Smoking, tobacco and alcohol consumption habit in rag-pickers is shown in Figure 1.

When the number of work-years were correlated with the blood lead level using Pearson correlation, no significant association was found (P value=0.556). Similarly, no significant association was found between BLL and other biochemical and hematological parameters.

Figure 1 Pie chart depicting a number of rag-pickers with smoking, tobacco and alcohol consumption habit



DISCUSSION

In this study, the mean blood lead concentration in rag-pickers was found to be higher (11.68 µg/dL) than the cut off value designated by the Centre for Disease Control (CDC). The common items that rag-pickers collect are metals, plastic ware, batteries, paint buckets, tins and glass bottles. It has been reported that metals, household dust and lead-based paints are the potential source of lead exposure [11]. It has also been reported that the majority of rag-pickers in Kathmandu process the collected waste by themselves to get high resell price [5]. This act of processing solid waste possesses a potential risk of lead exposure among rag-pickers because none of these workers use protective clothing.

In the majority of rag-pickers in the present study, high eosinophil count was found. This can be due to allergic skin disease and parasitic infestation from poor hygiene, environmental pollution and overcrowding. High eosinophil count among workers of solid waste management has also been reported from other developing nation [12, 13]. Eosinophilia leads to a potential risk of chronic allergic diseases like dermatitis, asthma, bronchitis, chronic cough in these workers.

All of these workers who had a minor variant of beta-thalassemia were from the tropical part of eastern Nepal or neighboring village in India. In a study published in Nepal, most people with haemoglobinopathies were from tropical region [14]. Our finding is consistent with the report that was published earlier and is important for reproductive age group workers to rule out haemoglobinopathies in their partners that could potentially risk transmission to their newborn children.

The mean platelet count in this study was found to be 158 ± 89 G/L. The low value in mean platelet count is attributed to the intake of non steroidal anti-inflammatory drugs by these workers to relieve their body ache. Thrombocytopenia is also due to alcohol intake by these workers.

The rag-pickers who collect electric appliances along with other commodities were found to have higher mean BLL than the workers who collect only other commodities.

Lead is a major component of electronic equipment such as cathode ray tubes inside computers or television, circuit boards, cables and batteries.

There are a number of studies where significant high BLL was found among residents of electronic waste recycling area [15, 16]. Rag-pickers working in Kathmandu, who collect and process electronic waste, are at increased risk of developing lead toxicity if urgent measures on safe working instructions are not taken.

In the present study, an insignificant association of BLL with biochemical and hematological parameters was found which is attributed to the absence of liver and kidney injury in these workers. A similar finding has also been reported in previous studies [17, 18, 19].

We found the mean BLL of 11.68 µg/dL in rag-pickers sampled in Kathmandu, with the highest value of 38 µg/dL, which is insufficient to derange other laboratory parameters.

It has been found that the heme biosynthesis is decreased and anemia occurs once the lead in the blood reaches the level of 55.0 µg/dL [20]. Renal effects in the form of chronic nephropathy occur at the blood lead level of 60.0 µg/dL [21]. Liver injury in the form of suppression of cytochrome P450 enzyme and an increase in alkaline phosphatase enzyme occur at the blood lead level above 70.0 µg/dL [22,23].

The limitation of the present study is that the concentration of lead in solid waste or in the working environment was not measured. It is essential to investigate the content of lead and other heavy metals in working site of rag-pickers and access the comprehensive health effects in rag-pickers using larger samples.

CONCLUSION

The findings of this study suggest that the rag-pickers working in Kathmandu are at increased risk of lead toxicity and this occupational exposure to lead is attributed to the use of bare hands for processing solid waste. Working instructions with solid waste should be prepared and trained to this vulnerable group.

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Conflict of Interest: The authors declare that there is no conflict of interest in the publication of this manuscript.

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Consent: Written informed consent was obtained from each participant.

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