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Prevalence of Aggressive and hyperactivity: Results from lead poisoned children in Sudan

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Abstract: Long-term exposure to air lead pollution affects school children behavior and health growth. This study aimed to highlight the expected effect of lead contamination on school children activity and behavior. A total of 161participants, which their ages ranged between 6-17 years old, were randomly selected from different cities of Sudan, in which 122 samples were taken as exposed group and 39 as un-exposed (control). Blood lead concentration was determined by NIOSH method using atomic absorption spectrometer. Biochemical parameters were measured in blood serum using standard methods. Data was collected with the aid of writing a questionnaire and analyzed by using SPSS program. Result revealed that the highest lead levels were found in blood serum of children that their school adjacent to high traffic roads with lead levels enough to affect children activity and behavior. In general, higher lead levels were found to be in male rather than female. The study suggested that children schools should be built far from high traffic roads.

Keywords: scavengers**,** lead intoxication**,** aggressive, hyperactivity.

INTRODUCTION

Classically, "lead poisoning" or "lead intoxication" has been defined as exposure to high levels of lead typically associated with severe health effects[1]. The amounts of lead in the blood and tissues, as well as the time course of exposure, determine toxicity[2].The US Centers for Disease Control and Prevention and the World Health Organization state that a blood lead level of 10 µg/dl or above is a cause for concern; however, lead may impair development and have harmful health effects even at lower levels, and there is no known safe exposure level[3,4],. The effect of lead on children's cognitive abilities takes place at very low levels(less than 5 µg/dl)[5] , There is apparently no lower threshold to the dose-response relationship (unlike other heavy metals such as mercury). Reduced academic performance has been associated with lead exposure even at blood lead levels lower than normal so the risks of lead exposure are not based on theoretical calculations. They are well known from studies of children themselves and are not extrapolated from data on laboratory animals or high-dose occupational exposures[6].

Behavior scores were based on lengthy questionnaires filled out by teachers and parents. For every increase of 10 micrograms per deciliter of blood, children scored about five points worse on a 100-point scale that measures "externalizing" behavior problems, such as aggression and acting out[7].

Even blood lead concentrations as low as 5 µg/dl, once thought to be a “safe level”, may result in decreased intelligence in children, behavioral difficulties and learning problems[7] In1995, eighteen million children under the age of 10 lived in areas in the United States with air quality that did not meet federal standards National surveys estimate that more than 3 million children 6 years of age and younger have lead poisoning. This number represents almost one out of every six children younger than age 7. In Illinois, more than 5,000 children were found to have lead poisoning[8] in 2008.Children and adolescents of the scavengers and poor families who live close the waste sites may participate actively in these activities to recuperate metals, and sometimes children look for lead to smelt and make sinks to sell. Smoke from the open burning of waste may pollute the air and transport lead for long distances, thus reaching communities settled kilometers away from the sources. In some cases, waste may be used as a cheap combustible material to cook or to heat the inside of homes, or around them. Lead is also emitted into the air by incinerators, crematoria, and cement kilns that are old or not well controlled; they pollute the air of entire communities. The WHO air quality guidelines for Europe state that the annual average lead level in air should not exceed 0.5 µg/m3 (WHO, 2000)[7]. So the objective of this study is to evaluate the effects of lead in children within different age, sex and school location to show how lead would effect to central nervous system through activity and behavior of exposed children.

MATERIAL &METHOD

Materials: To assess the effect of lead poisoning on studied children this carried out by blood lead level estimation as the main parameters .This study also involved questioner information’s related to lead toxicity’s such as sex and age, location of the house, activity of children and behavior. Sample size was 161 as exposed children and 39 samples as control which distributed in 5 cities in Sudan. All samples were collected during October and November 2013.

Method for lead estimation by Analytical Method for Atomic Absorption Spectroscopy

BC-5 Analysis of serum and plasma: lead Scope: This method was described and determined of lead in serum and plasma. Samples were diluted by de ionized water. The analysis was performed against standards which prepared in glycerol to approximate the viscosity characteristics of the diluted samples.

Normal serum levels 10-20µg/dl

Normal serum levels 0.001-0.002mg/dl

Typical Analytical Procedure lead of Sample

Preparation of sample: for determination of lead in serum, the samples were diluted with deionized water by 1:5 respectively.

Analysis: the concentration of lead was determined by using the conditions listed in the″ Standard Conditions″ section. Lead standards were prepared by diluted the lead stock standard solution, described in the″ Standard Conditions″ for lead, with 5% (v/v) glycerol. A 5% (v/v) glycerol solution was used as blank solution [9.]

Table 1: Standard Atomic Absorption Condition for lead:

Wavelength Slit	**Relative Noise**	**Characteristic concentration**	**Characteristic concentration**	**linear Range**
(nm)	(nm)	(mg /l)	(mg/dl)	(mg/l)
203.9	0.7	0.018	0.001	0.9
307.6	0.7	79.0	0.0035	0.9

1. Recommended Flame; air-acetylene, oxidizing (lead, blue)
2. Data obtained with standard nebulizer or impact lead will typically provide a 2-3x sensitivity improvement.
3. Characteristic concentration with a N2O-C2H2 flame at 203.9 nm: 0.084 mg/l.
4. Table contains HCL data. EDL sensitivity values approximately the same.

Table 2: Standard Flame Emission Conditions for lead:

Wavelength(nm)	**Slit(nm)**	**Flame**
203.9	0.3	Nitrous oxide-acetylene

Stock Standard lead was about 500 mg which Dissolved in 0.500g of lead metal in minimum volume Solution of (1+1) HCL and diluted to liter with 1% (v/v) HCL light Sources , both Electrode less Discharge Lamps (EDLs) and Hollow Cathode lamps were available for lead. EDLs provided greater light output and longer life than Hollow Cathode Lamps. For lead, both EDLs and Hollow Cathode Lamps provided approximately the same sensitivity and detection limit.

RESULTS

This study found that in table (1) Pb level was significantly higher under male exposed children (3.15µg/dl) than that under female exposed children (2.72µg/dl). Increment in Pb level for male was compared to female exposed was about 15.8%. On the other hand, student who lived in houses contact with the main road had higher mean of Pb (3.03 µg/dl) than that who lived away from the main road, but with no significance difference. Pb level for exposed was increased with age of, exposed children when 14-17 year had a significantly higher of Pb as compared to 6-9 year and 10-13 year. The percentage of increment was about 4.5%, .also **Table (**3) showed that lead was significantly affected to behavior and activity, It was significantly higher under students who characterized as moderate (2.98 µg/dl) and aggressive (3.05 µg/dl) than that who were silent behavior (2.87 µg/dl). Also Pb level was significantly higher under children who very active (3.05 µg/dl), followed by those who were moderate active (2.91 µg/dl) and finally who were inactive (2.63 µg/dl).

Table (3): Level of Pb as affected by Gender, House location, Age, Activity and Behavior of studied children**.**

Gender	Male	Female	d.f	S±E	t.value	sig
Pb levelµg/dl	3.15	2.72	159	0.09	4.69	**
House location	Main road	Away from road				
Pb levelµg/dl	3.03	2.90	159	0.10	1.31	ns
Age	6-9	10-13	14-17			
Pb levelµg/dl	b 2.68	ab:2.79	a:3.19	0.22		
activity	V.active	moderate	In.active			
Pb level; µg/dl	a: 3.05	ab :2.91	b 2.63	0.18		
behavior	silent	aggressive	medium			
Pb levelµg/dl	a : 2.87	a :3.05	b:2.98	0.19		

ns: no significant different,* :significant at 0 .01 level of probability;*Mean with in rows which having similar letters are not significantly different at 0.05 level of probability according to DNMRT

DISCUSSION

Children look for lead to smelt and make sinks to sell. Smoke from the open burning of waste may pollute the air and transport lead for long distances, thus reaching communities settled kilometers away from the sources. In some cases, waste may be used as a cheap combustible material to cook or to heat the inside of homes, or around them (WHO, 2000)[8].

Children live in home close to main street smelt high amount of lead from air (3.03µg/dl) rather than children whom live away from street (2.9 µg/dl) and males (3.15µg/dl) are generally more affected than females (2.72µg/dl) as they are stay long period of time in playground, for this the opportunity for lead exposed is increase and increase chance for poisoning. Lead intoxication" has been defined as exposure to high levels of lead typically associated with severe health effects[4]. The amounts of lead in the blood and tissues, as well as the time course of exposure, determine toxicity[8]. .So toxicity of lead is increase

with increase age (3.19µg/dl) in 17 year while lead level in 6 year was (2.68µg/dl) because it absorbed directly through gastrointestinal tract and deposited in bone for increase lead load. This study found that lead affected children activity and behavior of exposed (V.active=3.05µg/dl, medium activity=2.91 µg/dl and inactive=2.63 µg/dl), affected to behavior by increase aggressiveness (3.05),this reflect the ability of lead to substitute for polyvalent cations (particularly divalent cations, such as calcium and zinc, the consequence of this binding allow different biologically significant processes, including energy metabolism, ionic conduction, intercellular and intracellular signaling, protein maturation and genetic regulation, membrane ionic channels and signaling molecules seem to be one of most relevant molecular targets that contribute to lead neurotoxicity; the developing central nervous system is particularly susceptible.The US Centers for Disease Control and Prevention and the World Health Organization state that a blood lead level of 10 µg/dl or above is a cause for concern; however, lead may impair development and have harmful health effects even at lower levels, and there is no known safe exposure level [3,4] , The effect of lead on children's cognitive abilities takes place at very low levels(less than 5 µg/dl)[5], The US Centers for Disease Control and Prevention and the World Health Organization state that a blood lead level of 10 µg/dl or above is a cause for concern; however, lead may impair development and have harmful health effects even at lower levels, and there is no known safe exposure level[3,4]. The effect of lead on children's cognitive abilities takes place at very low levels(less than 5 µg/dl)[5] , as lead exert it is effects and cause neurological disturbance in spite of lower level than 5µg/dl, The US Centers for Disease Control and Prevention and the World Health Organization state that a blood lead level of 10 µg/dl or above is a cause for concern; however, lead may impair development and have harmful health effects even at lower levels, and there is no known safe exposure level[3,4]. The effect of lead on children's cognitive abilities takes place at very low levels(less than 5 µg/dl)[5].

CONCLUSION AND RECOMMENDATIONS

Some social status associated with exposed children such as age, sex, house and school location, behavior and activity were significantly affected by concentration of lead in blood although it is lower level than 5 µg/dl. The study recommended that children schools should be built far from high traffic roads.

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