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DETERMINING THE LEVEL OF LEAD IN SOIL SAMPLES AND ITS HEALTH IMPLICATIONS FOR CHILDREN

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Abstract
Lead is a toxic material that may damage the environment and leads to major health issues, especially in children, due to its cumulative toxic nature and adverse effects on several bodily systems. High concentrations of the element of lead were found in certain soil samples, which had health implications on children by determining the level of lead in the students' blood samples in those schools. It was observed that there is a correlation between high concentrations of lead in soil samples taken from indoor gardens in schools and the high amount of lead in the blood samples of the students at those schools. Lead concentrations were measured by using a flame Atomic Absorption Spectrophotometer.

Keywords: lead, soil, blood, flame Atomic Absorption Spectrophotometer, toxic

Introduction

Lead is a heavy, gray-blue metal with a low melting point and is easily malleable and laminated. It could be blended with other metals to make alloys. Lead is used for these properties for thousands of years. It is also widely used now in many products, such as the manufacture of batteries, dyes, the manufacture of glass, ammunition, and radiation-protective clothing. The chemical symbol for lead is (Pb), the atomic number is 82, the atomic weight is 2,207, the density is 34.11, and the melting point is 46,327 Celsius. According to the Organization for Cooperation and Development, lead accounts for 0.0013% of the earth's crust (Amiri, et al., 2022). Metallic lead is found in dyes, dirt, and dust. The colors of organic lead vary, where the most common color is white, which is the carbonate of lead, (yellow lead), is lead chromate, and lead monoxide. The red lead is the tetraoxide lead (Nag, 2022).

Without a blood lead test, it might be challenging to identify a lead overdose in the body. A person may be healthy and have no symptoms despite having high levels of lead. Symptoms usually do not appear until a great deal of lead accumulate in the body and cause lead poisoning. Symptoms of lead poisoning in children are growth retardation, poor academic achievement and learning difficulties, low intelligence, increased aggressive behavior in the child, loss of appetite, fatigue and lethargy, abdominal pain, and diarrhea (Yang, 2022). Children are extremely vulnerable to lead poisoning. The child's body is more receptive to lead than the adult person by 4-5 times, in addition to the child's innate curiosity to explore the world around him, in addition to putting his hand in his mouth. (Obeng, 2021). This may result in exposure to lead-contaminated items. Lead affects a child's nervous system, including the developing brain. This results in lowering the child's intelligence and behavioral changes, in addition to poor attention and lower educational achievement and academic performance.

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Water pipes could be the main sources of child exposure to lead (Aslam, 2021). They contain toxic lead particles that may be released into tap water. There are some types of paints that contain high levels of lead, which expose the child to the risk of lead poisoning in the event that it peels off the walls and the child catches and eats it, and the dust contaminated with lead. Inhaling lead-contaminated dust or particles resulting from burning lead-containing materials, as well as vehicle exhaust, are sources that expose a child to the risk of lead poisoning. Some inexpensive children's toys may contain lead and food preservation containers, where certain preserved and canned foods are sold in containers made of materials that contain lead (Alengebawy, 2021).

Lead is a toxic metal which is naturally existed in the earth's crust. Using lead extensively has caused widespread environmental pollution, human exposure and main public health issues in several areas of the world. Smelting, manufacturing and recycling activities, mining, and continued use of leaded paint and gasoline by some countries are all significant sources of environmental pollution. More than three-quarters of the lead over the globe can be consumed for making lead-acid automobile batteries (Van Thin, 2021).

Nonetheless, lead is also employed in several other products, like dyes, paintings, soldering, tainted glass, crystalware, ammo, glazed ceramics, jewelry, toys, certain cosmetics and conventional medics. Potable water transported with lead pipes or those pipes connected to lead solder could include lead. The majority of the lead employed for commercial purposes in the world comes from recycling processes. Particularly, young kids are exposed to the toxic impacts of lead and can suffer serious and permanent adverse health effects, especially those harming brain and nervous system. Lead results in long-term harm to adults, such as a greater risk of high blood pressure and kidney disease. For instance, high levels of lead were found in some types of kohl (a black paint placed on the eyelashes) and in certain conventional medics employed in countries like India, Mexico and Vietnam. Therefore, consumers ought to be careful to purchase and employ products that are subject to quality control and audits. When lead gets into the human body, it would be distributed to body parts such as the brain, kidneys, liver and bones. The organs of teeth and bones store lead in the body, where it accumulates with passing time (Nas, 2018).

Lead in the bones can pass into the blood during the period of pregnancy, which also make the fetus vulnerable. Malnourished kids are more possibly vulnerable to be lead poisoning, since their bodies take up more lead if they are deficient in other nutrients like calcium. The infants, especially, the youngest ones including developing fetuses, and the poor are more vulnerable. Lead has severe repercussion for a child's health. When exposed to great levels, lead damages the brain and central nervous system, causing coma, convulsions, and even death. Infants, who recover from acute lead poisoning, may develop intellectual disability and behavioral disturbances. It is now known that exposure to lead at lower levels does not cause any obvious symptoms. It is not known if there is a safe concentration of lead in the blood. Blood lead concentrations as low as 5 mcg/dL may be related with lower astuteness, behavioral troubles, and learning issues in children (Kumar, et al., 2020).

It is encouraging to note that the effective removal of leaded gasoline in several countries had led to an instrumental reduction in the blood lead concentration levels in the population. Leaded fuels are no

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longer used in cars and trucks anywhere in the world (Zafar et al., 2020). However, more efforts still need to be conducted to remove lead color. Yet, only 41% of states have strict legal controls on lead paint (Damstra, 1977).

The Institute for Health Metrics and Evaluation estimates that in 2019 exposing to lead caused 900,000 mortalities worldwide as a result of long-term health effects. Low-income and middle-income countries bore the brunt. The institute also assesses that in 2019 lead exposure caused 62.5% of the worldwide burden of intellectual disability, 8.2% of the worldwide burden of cardiac disease due to hypertension, 7.2% of the worldwide burden of ischemic cardiac diseases and 5.65 % of the worldwide burden of stroke (Degryse, 2007).

This study aims at measuring the levels of lead in the soil in different schools of Baghdad and the areas located on the outskirts of the governorate, which can reflect the extent of lead contamination in these areas. This study also compares the main and secondary streets in terms of the percentage of lead in their soil, as well as the soil of school gardens for children's toys.

2- The Practical Section

2-1- Collecting, preparing and examining soil samples

Five soil samples were collected from the indoor gardens of five primary schools in Baghdad (A1, A2, A3, A4, and A5). Five soil models were taken from the main streets leading to these schools (B1, B2, B3, B4, and B5), and five soil models were taken from the secondary streets leading to these primary schools (C1, C2, C3, C4, and C5). The concentrations of lead were evaluated in the 15 soil models.

Sample collection method:

A small amount of soil is taken with a clean metal spoon and put the forms in clean, airtight bags. The sample code and all information related to the sample taken is written on each bag.

Equipment and materials used

Flame Atomic Absorption Spectrophotometer is used in this study to detect the concentrations of lead in the samples of soil taken from various places in Baghdad. It was measured at a wavelength of 217 nm after operating the device and calibrating it by taking its highest absorbance by calibrating the automatic screw in the device. The prepared standard solutions are passed over the atomic absorption device via the auto-injector, which needs 2 ml of the solution. Then the prepared soil samples are passed. Concentration values are shown (Shetaya et al., 2018).

The materials used are: nitric acid, dilute chloric acid, distilled water and lead solutions.

Preparing soil samples for examination

1. The sample was dried in an oven at 105°C
2. Grinding the sample manually
3. Sifting the sample
4. Weighing half a gram of the dried soil sample

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5. Digesting the sample
6. Filtrating the solution
7. Measuring the concentration of lead in the prepared samples using a flame atomic absorption spectrophotometer (Shetaya et al., 2018).

2-2-Measuring the amount of lead in the blood

Ten blood samples were taken from the aforementioned primary school students to measure the amount of lead. Care should be taken when collecting, storing, transporting, and handling the sample. The injection site must be cleaned well and all equipment and tools must be clean. Blood is taken from the students intravenously (venous blood) and then the flame Atomic Absorption Spectrophotometer was used. This method uses a flame consisting of air and acetylene to separate lead into atoms at temperatures up to (2100-2400). The analysis is repeated two or three times to ensure the accuracy of the measurement and to determine the exact percentage of lead in the blood samples taken. Lead concentration determination unit in blood is micrograms per deciliter (Lanno et al., 2019).

Results and Discussion

3-1- Concentrations of lead in the soil of indoor gardens for primary schools

No	Concentration of lead (ppm)	Sample code
1	110	A1
2	303	A2
3	150	A3
4	316	A4
5	176	A5

Table (1): shows the concentrations of lead in soil samples taken from indoor gardens in 5 schools in Baghdad.

It is clear from the values mentioned in Table (1) that the concentrations of lead are extremely high, especially in sample 2 and 4. These gardens are located in schools at remote residential areas away from the center of Baghdad. It is located on the outskirts of the city and is characterized by the presence of environmental pollution with lead element. Thus, it is not safe for children to play with it. The Environmental Protection Agency has deemed the hazardous concentration of lead in public parks to be 400 ppm. The maximum acceptable value of lead concentration in garden soil is 140 ppm. (Lanno et al., 2019).

Only the first sample within the acceptable limit is noticed. The park with code A1 is in a well-serviced residential area. This garden has a very large area suitable for cultivation. This confirms that there is a relationship between agriculture and the concentration of lead in the soil. One of the sources of lead contamination is made by painting schools and buildings inside and out. Moreover, painting playgrounds, games and furniture that the child may touch while he is at school could also be a source

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of pollution. Paint materials containing lead result in the formation of dust contaminated with this element.

3-2- Lead concentrations in the main streets leading to these schools

No	Concentration of lead in soil (ppm)	Sample code
1	152	B1
2	110	B2
3	230	B3
4	115	B4
5	240	B5

Table (2) shows the concentrations of lead in soil samples taken from the main streets leading to the relevant schools.

It is clear from the table that the concentrations of lead in the soil samples in the main streets are too high. This is due to the momentum of traffic, large number of cars, and toxic gases emitted from them. It appears in the table that the lead element in the two regions (A3, A5) is higher than the other regions. This is due to the fact that these streets are in industrial and densely populated areas, as well as the high pollution rate, the presence of dust, and the low level of services. The percentage of lead in the blood is considered normal if it does not exceed 5 micrograms / deciliter. According to what we see, the percentage of lead contamination is too high.

3-3- Concentrations of lead in the secondary streets of the main streets

No	Concentration of lead (ppm)	Sample code
1	60	C1
2	40	C2
3	22	C3
4	26	C4
5	55	C5

Table (3) shows the concentrations of lead in soil samples taken from secondary streets in Baghdad

We notice from the numbers of concentrations mentioned in Table (3) that the concentrations of lead in the secondary streets are much lower than the concentrations of lead in the main streets due to the lack of traffic momentum. The number of cars passing through the main streets is double that of those passing by the secondary streets, in addition to dust pollution and environmental pollution due to the presence of industrial stores. These are all sources of lead contamination.

3-4- Amount of lead in blood samples

Table (4) shows the amount of lead in 10 blood samples of school students whose ages range between 6-12 years.

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No	Lead concentration µg/dL
1	3.2
2	4.1
3	3.2
4	3.4
5	5.2
6	5
7	5.1
8	2
9	3.3
10	1.22

It becomes obvious from these concentrations that there are high percentages of lead. The normal level of lead in the blood is no more than 5 micrograms per deciliter. High concentrations appeared in students of schools whose gardens and indoor yards have unacceptable concentrations of lead, namely (A2,A4).

Conclusions and Recommendations

Workshops and seminars should be held to introduce the extent to which lead is detrimental to children and adults. Thus, children's gardens should be kept away from the main streets crowded with cars. High concentrations of lead does not reach children through dust pollution with this toxic element. The concentration of lead in soil and dust near residential areas should be evaluated, and it should be avoided from farming in areas near the main streets. It is also necessary to conduct periodic examinations of children, as it is easy to transfer the element of lead through dirt, dust, plastic toys, and others. We note that the areas far from the city center contain a high percentage of lead. There is a relationship among the concentrations of lead in the soil and traffic congestion. The use of lead paint and colored glass should be eliminated and the percentage of lead in drinking water should not exceed 15 micrograms per liter (Lanno et al., 2019).

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