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ORIGINAL RESEARCH

The Effect of Aqueous Lead Acetate Exposure on Systolic and Diastolic Blood Pressure in Adult Male Wistar Rats

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Abstract:

Introduction: Metal's long-term exposure can to significant problems. Environmental exposure to lead is very prevalent and it causes a wide range of health hazards.

Aims: The aim of the study was to investigate the effect of lead acetate exposure on systolic and diastolic blood pressure in adult male Wistar rats.

Materials and Methods: The aqueous lead acetate at dose of 2ml/kg body weight was administered for 21 days. 20 male Wistar rats weighing between 180-200g were distributed into two groups, (control and lead treated). Control group received normal food and water; treated group received 2ml/kg body weight of lead acetate.

Results: Oral administration of aqueous lead acetate at the dose of 2ml/kg body weights decreased systolic and diastolic blood pressure though not significantly ($p>0.05$). This is due to acute toxicity i.e. low lead exposure.

Conclusion: The result of the present study showed that low-level exposure to lead acetate might not affect systolic and diastolic blood pressure due to short-term duration of exposure which might imply that individuals should minimize their continuous exposure to lead acetate as this can contribute to gradual onset of hypertension and to avoid chronic effect of lead on body system generally.

To Keywords: Lead Acetate, Systolic Blood Pressure, Diastolic Blood Pressure

All co-authors agreed to have their names listed as authors.

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1. INTRODUCTION

Lead is a metal and despite its numerous industrial uses, it has no biologic role in the human body [1]. It affects multiple systems and causes a wide range of health insults. The effects of lead on the metabolic state and haematological, neurological and reproductive systems have been confirmed [2]. Because of extensive lead usage, this then leads to a public health concern, especially in developing countries.

Lead salts have always existed in the earth's crust, more so, lead itself has scarcely been found in the body of human before industrialization and therefore, its effects were not identified until then. Today, lead majorly is known as an industrial pollutant, whose levels in the earth surface can be increased by activities such as production and burning fossil fuels. [3]. Consuming food or water that is contaminated by lead, breathing air that is lead-polluted or even skin contact with lead can transmit the element to human body. Individuals in contact with lead in the workplace are also at risk by their contaminated instrument and equipment. The effects of lead contamination may differ according to contact dose and duration, age, career, general health and lifestyle [4].

Exposure to lead in general population occurs primarily via ingestion but inhalation contributes to the lead body burden, and it is the major contributor for workers in lead acid battery (LAB) occupations that were exposed to lead fumes during manufacturing, smelting and recycling of batteries. The routes of exposure to inorganic lead among battery technicians include ingestion or inhalation of lead particles or through transdermal absorption of organic alkyl lead [4]. The ingestion route of exposure is common among the lead acid battery technicians. Ahmed et al. [5] stated from their research that 88% of exposed battery technicians had their meal at the workplaces on a regular basis of at least one meal per day which indicates that significant regular exposure to lead particles does occur through ingestion. According to Pogacean and Pop [6], lead from hands of the workers can contaminate food and cigarettes if the hands are not properly washed before the meal [7].

The second route is inhalation; this occurs during cutting, torch to melt leaded solder. Heat is generated with vapours, inhalation of small lead particles, dust and fumes take place during these processes. The small size allows the body to absorb it quickly and creating the potential for severe acute lead poisoning. Wani et al. [8] The transdermal exposure is the third route in which lead particles penetrate through the skin in a situation where there are no protective clothing facilities at the workplaces. Haider and Qureshi [9] stated that breaking battery or recycling exposes battery technicians to lead particles, not only do batteries contain lead plates. According to Shaik et al. [10] in their research, they concluded that absorbed lead particles binds to erythrocytes (red blood cell) and could be stored for an extended period of time in mineralizing tissues like teeth and bones, and then released again into the bloodstream causing most of the toxic effects in the body. The lead contaminants that stored in bones account for more than 95% of the lead burden in adults [10].

Some studies reported a correlation between lead exposure and changes in blood pressure. Navas-Acien et al. [3] conducted a study in 2007 and found that exposure to lead and increased lead accumulation in the blood could increase the blood pressure, although these changes were low [2]. A study by Cheng et al. [11] at Harvard University showed that the respiratory exposure to lead increased blood pressure even at low concentrations. Most researchers believe that by doubling the level of lead in the blood, the blood pressure increases. Occupational exposure limit for 8-hour respiratory exposure to lead and its inorganic component is 50 micrograms per cubic meter according to the Iran Occupational Health Technical Committee [11].

Hypertension (high blood pressure) is a condition or state in which the force of the blood against the artery walls is too high. High blood pressure is classified as primary hypertension or secondary hypertension. About 90-95% of cases are primary, defined as high blood pressure due to nonspecific lifestyle and genetic factors [12]. Lead exposures have been shown to be related with increased blood pressure and risk of hypertension Poulter et al. [12]. Environmental lead exposure is a possible causative factor in respect to increased blood pressure and hypertension, but studies at low-level exposure are scarce, and results not consistent. Therefore, the aim of the present study was to examine the association between lead exposure and blood pressure (systolic and diastolic blood pressure) in adult male Wistar rats; on whether low-level exposure to lead might cause hypertension (high blood pressure) or hypotension (low blood pressure).

2. MATERIALS AND METHOD

2.1 Experimental Animals

Twenty adult male Wistar rats weighing 180-200g were obtained from the animal unit facility of the Department of Physiology (Olabisi Onabanjo University, Remo campus, Ikenne-Remo, Ogun State, Nigeria). The animals were kept in groups of four, five (5) rats per cage and they had free access to water and standard rat diet. The rats were fed with pelletized animal care feed and water ad-libitum. They were allowed to acclimatize with their new environment for 14 days.

2.2 Preparation of Aqueous Lead Acetate

Lead acetate was obtained from Biochemistry Department, Olabisi Onabanjo University, Sagamu, Nigeria. The method of Uwikor et al. [13] was modified for the preparation of aqueous solution of Lead acetate. 1.7g of the powdered lead acetate was dissolved in 210ml of distilled water for 48 hours.

2.3 Procedure for Systole and Diastole Blood Pressure

Staessen et al., [14] method of blood pressure measurement was taken by trained personnel following all established procedure. Readings can be affected by the positions and physiological condition of the subject.

1. Select the appropriate size cuff based on the rat's arm circumference
2. Attach cuff to the blood pressure monitoring device. For situations when a two tube with a clamp is being used as a one tube cuff, be sure to close the clamp tightly to cut off the air flow into the unused tube. Position the cuff on the upper arm a few centimeters above the antecubital fossa with the artery symbol over the brachial artery.
3. Wrap the cuff securely and press the hook and look fasteners together to secure the cuffs. The index edge of the cuff should fall within the recommended range area.
4. Choose a smaller size cuff when index edge falls in the used smaller cuff area. Select a larger cuff when the index edge falls in the used larger cuffs. For neonatal cuffs, check to see if the index edge is in the range area before securing the hook and loop.
5. Take blood pressure in the normal manner. For electronic and automated monitoring, be sure to follow the monitor manufacturer's instructions.

2.4 Experimental Procedure

The aqueous lead at dose of 2ml/kg body weight was administrated for 21 days. 20 male Wistar weighing between 180-200g were distributed into two groups, (control and lead treated). The Control group received normal food and water; treated group received 2ml/kg body weight of lead acetate orally with the aid of oral cannula.

2.5 STATISTICAL ANALYSIS

All calculation was done using the SPSS-V25.0 statistical software package for the analysis of the data. The data was presented as mean ± standard error of mean (SEM) and statistical analysis carried out using the student's t-test. Values were considered to be of statistical significant when $p < 0.05$.

3. RESULTS

Table 1: Effect of Lead Exposure On Systolic Blood Pressure of Adult Male Wistar Rats

Groups	Mean ± SEM (mmHg)	P-Values
Control	122.07±5.97	
Lead treated (2ml/kg body weight)	102.07±7.79	0.51

Non-significant ($p>0.05$) when compared with control. n=20 *$p<0.05$ is significant.

As shown in table 1, there was a non-significant decrease ($p>0.05$) in systolic blood pressure of Wistar rats administered with 2ml/kg dose of aqueous lead when compared to control

Table 2: Effects of Lead Exposure On Diastolic Blood Pressure of Adult Male Wistar Rats

Groups	Mean ± SEM (mmHg)	P-Values
Control	93.52±5.56	0.85
Lead treated (2ml/kg body weight)	78.96±7.33	

Non-significant ($p>0.05$) when compared with control. n=20 *$P<0.05$ is significant.
As shown in table 2, there was a non-significant decrease ($p>0.05$) in diastolic blood pressure of Wistar rats administered with 2ml/kg dose of aqueous lead when compared to control.

4. DISCUSSION

Metals long-term exposure can lead to significant problems. This research showed that oral administration of aqueous lead at the dose of 2ml/kg body weights in male Wistar rats for 21 days caused a non-significant decrease ($p>0.05$) in systolic and diastolic blood pressure.
Environmental exposure to lead is ubiquitous. This poses a common public health problem, particularly in terms of effects on the central nervous system in children. In adults, exposure to lead has been evaluated as a possible causative factor of increased blood pressure (BP) or hypertension, in occupationally exposed individuals as well as in the general population [15, 16].
In this study the short term exposure in conjunction with low exposure of lead acetate results to a non-significant decrease in blood pressure. However, in contrast to our study Yao et al. [17] concluded that continuous lead pollution in the environment causes high blood lead levels among local residents. Blood lead levels are positively associated with both systolic blood pressure and diastolic blood pressure increases among adults aged 20-44 years. A recent review by the United States of America National Toxicology Program (NTP) [16] on the effects of low-level of Lead acetate found that the available epidemiological studies and animal studies provide sufficient evidence that lead exposure is associated with increased BP,

but not for low-level exposure i.e. dose to lead (<50µ mg/L) [17]. The results obtained here were in conformity with this study that oral administration of aqueous lead acetate at the dose of 2ml/kg body weights in male Wistar rats for 21 days caused a non-significant decrease ($p>0.05$) in systolic and diastolic blood pressure which means that low-level exposure to lead does affect with a reduction in blood pressure and continuous high exposure may increase blood pressure.

5. CONCLUSION

In conclusion, the findings of this study showed that low-level exposure to lead might not affect systolic and diastolic blood pressure which implies that individuals are to minimize continuous exposure to lead as this can contribute to onset of hypertension and to avoid chronic effect of lead on body system generally.

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7. COMPETING INTERESTS

There is no competing interest in this study.

8. AUTHORS' CONTRIBUTION

Ifabunmi Osonuga and Olusoji Oyesola designed the research and conducted the experimental work. Ogunlade Albert managed data collection and experimental work. Baliqis Olukade performed data analysis and Samuel Olalekan edited the manuscript

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