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# LEAD ABSORPTION AMONG ELEMENTARY SCHOOL CHILDREN IN BAGHDAD CITY

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Key Words: Lead, ALAD, Children, Baghdad-Iraq.

امتصاص الرصاص عند طلبة المدارس الابتدائية في مدينة بغداد

الخلاصة :

تهدف هذه الدراسة الى تقيم امتصاص الرصاص مابين اطفال محافظة بغداد لهذا الغرض تم قياس تركيز الرصاص وفعالية انزيم (ALAD) في دم ٦٢٩ طفل من طلاب المدارس الابتدائية . تم اختيار المدارس من اربعة مناطق رئيسية في محافظة بغداد وهي :

١ـ مركز المدينة . ٢ـ اطراف المدينة . ٣ـ مناطق سكنية قريبة من معامل تشتغل بالرصاص . ٤ـ مناطق ريفية .

كما تم قياس الرصاص في هواء تلك المناطق .

اظهرت النتائج ان درجة امتصاص الرصاص عند الاطفال هي ضمن الحد المسموح به عالميا ماعدا منطقة مركز المدينة .

*SUMMARY:-*

*Lead absorption among children living in Baghdad Governorate was evaluated by measuring blood lead level (Pb-B) and -aminolevulinic acid dehydratase activity (ALAD) in 629 elementary school children, from different areas of Baghdad city (1-City center of high traffic density; 2- City districts of random residential areas; 3- Industrial areas of median traffic density and factories dealing with lead compounds; 4- Rural areas of low traffic density). Air lead concentration (Pb-A) also was measured in these areas. The findings clearly indicated that the degree of lead absorption in children living in Baghdad Governorate (except in the center) were still within the permissible limit. While in children living in the center it had exceeded some of the permissible limit.*

## INTRODUCTION:

The problem of increased lead exposure espcially among children, and the problems of environmental pollution from motor vehicles have been widely and extensivly studied[1,2]. Higher Pb-B levels were found in a population near a major free-

way and in inner city children[3,4]. The main important source of lead in the environment is the combustion of petrol containing it as an antiknock agent[5], and over 90% of lead emitted into the air comes from petrol[6]. In addition there are some other industrial sources of lead such as the oil refinary, battery manufacturing factory, paint factories and printing industries.

On checking the literatures issued in Iraq, we could not find any study on Pb-B in Iraqi children whether those living in urban or rural areas. The present communication is the first report on the degree of lead absorption among children living in Baghdad city. This was achieved by the measurement of Pb-B as a direct sensitive indicator[7], ALAD as a biological indicator in evaluating possible exposure to minimal quantities of lead[8], and Pb-A as a strong predicator of blood lead in children[9].

## MATERIALS AND METHODS:

For the purpose of this study Baghdad city has been divided geographically into four areas:

1 – City center which represented an area with a high traffic congestion. 2 – City districts which were chosen in a way to represent different parts of Baghdad residential areas. 3 – Industrial areas which included two districts slected to have the same characteristics of other city districts regarding the traffic density and movement in addition to the factories using lead compounds situated in those areas. 4 – Rural areas which represented an area with extremely low traffic and faraway from the major high ways and with no industrial source of lead pollution.

Six hundred and twenty nine elementary school children were chosen randomly from different school in the areas mentioned above. Owing to the regulations of the Ministry of Education, children registered at any school in Baghdad should their residence in the same area where that school is situated. Therefore these children represented the same residential areas at which these schools were located. Five ml specimens of blood were obtained by venipuncture. The samples were transferred into disposable heparinized tubes for Pb-B and ALAD determinations. Roadside environment air samples were collected for measurement of Pb-A from the same schools investigated, using a sampler with a maximun flow rate of 6 $m^3$/24 hr.

Blood lead analysis was done using Pye Unicam Atomic Absorption Flame Spectrophotometer (AAS)[10]. All samples were run in duplicates and the mean value was takon into consideration. ALAD activity in whole blood was determined by the recommended colorimeteric method of Burch and Siegel[11]. Pb-A measurement was doen by extraction of lead from the Whatman glass fiber filter (GF/A) with 5% nitric acid. Lead concentration in the acid was estimated by direct aspiration into the flame of AAS.

Students t – test was used to find the significance of difference between two means[12]. The correlation coefficient (r) was used to find the correlation between different parameters[13]. F – test was used to compare more than two means[14].

## RESULTS:

The mean values of Pb – B, ALAD with the mean level of Pb – A are presented in Table 1. The hig-

Table 1. Blood lead level, -aminolevulinic acid dehydratase activity for elementary school children with atmospheric lead concentration for Baghdad areas.

| | Pb-B(ug/100ml) | | | ALAD(U/ml RBC) | | Pb-A(ug/m³) | | No. of air sample |
|---|---|---|---|---|---|---|---|---|
| | No | Mean | SD | Mean | SD | Mean | SD | |
| Baghdad center | 220 | 15.8 | 4.5 | 158.6 | 28.4 | 5.8 | 0.77 | 6 |
| Baghdad dist. | 241 | 12.7 | 2.9 | 194.4 | 33.7 | 2.9 | 0.45 | 10 |
| Baghdad hous. | 72 | 12.4 | 2.6 | 186.6 | 24.6 | 2.2 | 0.24 | 2 |
| Baghdad rural | 96 | 8.8 | 2.0 | 246 | 33.4 | 0.4 | 0.06 | 4 |
| All | 629 | 13.1 | 4.1 | 191.6 | 46.3 | 2.8 | 2.03 | 22 |

Significance: center vs. districts P>0.001, center vs. industria P<0.001, center vs. rural P<0.001, districts vs. rural P<0.001, industrial vs. rural P<0.001

ter Pb-B and the lower ALAD were found in children living in Baghdad center. Pb-A was also found to be higher in Baghdad center in comparison with the other districts. The frequency distribution of Pb-B and the frequency distribution of ALAD for these children are presented in Fig. 1 and 2. 53% of the children had Pb-B between 10-15 ug/100 ml, while 47% of them had ALAD between 150-200 u/ml RBC. The correlation between Pb-B and ALAD and the regression equation are demonstrated in Fig. 3. There was a significant negative correlation between ALAD and Pb-B ($r = -0.64$). The mean values of Pb-B and ALAD according to sex and age are presented in Table 2. There was no statistical significant difference between males and females, or between the different age groups.

## DISCUSSION:

The upper acceptable limit for Pb-B (especially for children) has been lowered several times during the last years. Labbe[15] reported a level of 15-20 ug/100 ml as the normal range for children and a level of 40 ug/100 ml as an indication of abnormal exposure. In 1978, the center for Disease Control (CDC) has defined "elevated blood lead level" in children as a confirmed level of 30 ug/100 ml or greater[16]. Chilsolm[8] shared similar opinion and considered a level of 5-29 ug/100 ml as normal. Accordingly, in this study we could find that 4 out of 629 children had elevated Pb-B (<30 ug/100 ml) comprising 0.8% of the total number of children living in Baghdad Governorate, while none of the children showed Pb-B of <40 ug/100 ml. According to the recent statement of the center for Disease Control (CDC) which considered the current definition of an elevated Pb-B level in children as 25 ug/100 ml[17], it was found that 9 out of 629 children had elevated Pb-B levels comprising 1.4% of the total number of children. Eight of them were living in the center comprising 3.6% of 220 children investigated in this area. Only one child out of 241 living in Baghdad districts had elevated Pb-B. None of the children living in Bagh-

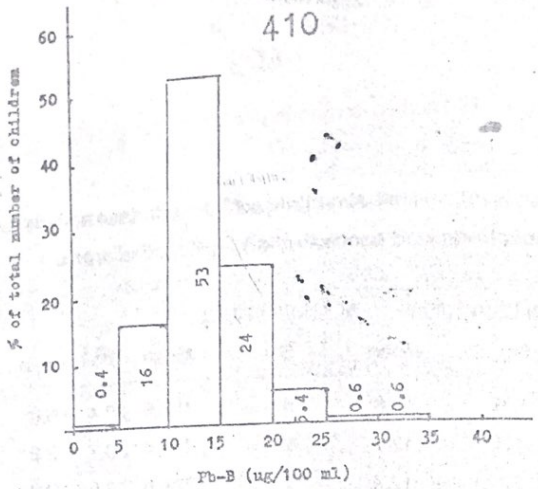


Fig. 1 Frequency distribution of blood lead level for elementary school children in Baghdad Governoraate.

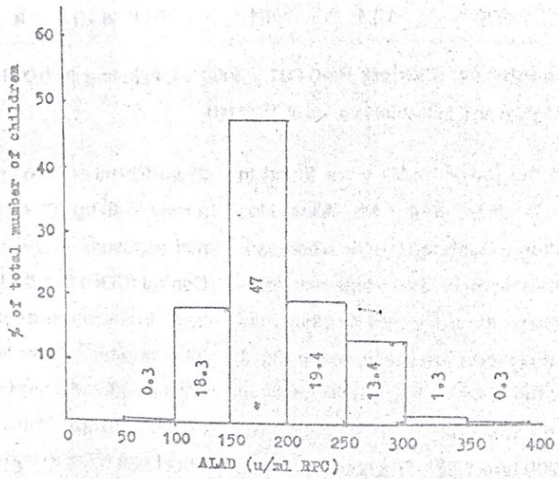


Fig. 2 Frequency distribution of -aminolevulinic acid dehydratase activity for elementary school children in Baghdad Governorate.

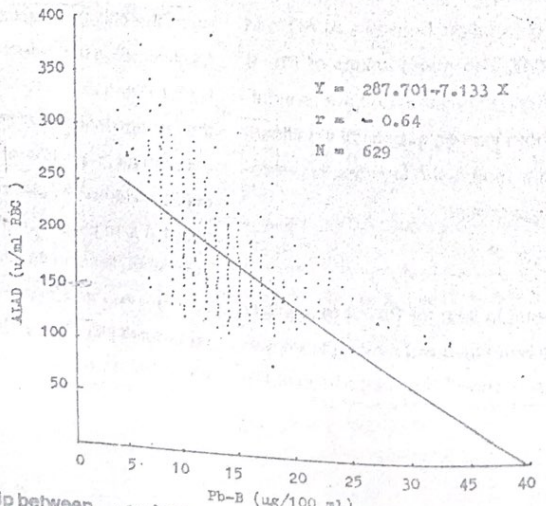


Fig. 3 Relationship between -aminolevulinic acid dehydratase activity and blood lead level for elementary school children.

Table 2. Blood lead level, -aminolevulinic acid dehydratase activity for elementary school children according to age and sex.

| Parameter | No. | Pb-B(ug/100ml) Mean | SD | ALAD (ug/ml RBC) Mean | SD |
|---|---|---|---|---|---|
| Age (years) | | | | | |
| 6 | 85 | 14.0 | 5.7 | 188.5 | 43.2 |
| 7 | 87 | 13.0 | 3.9 | 194.4 | 42.4 |
| 8 | 83 | 12.7 | 4.0 | 189.8 | 48.7 |
| 9 | 85 | 12.7 | 3.4 | 190.5 | 48.9 |
| 10 | 72 | 14.0 | 4.3 | 188.3 | 50.0 |
| 11 | 76 | 12.6 | 3.8 | 198.6 | 45.6 |
| 12 | 88 | 13.1 | 3.2 | 189.2 | 38.8 |
| 13 | 29 | 12.1 | 4.0 | 211.5 | 61.1 |
| 14 | 14 | 15.2 | 3.2 | 163.9 | 15.3 |
| P | | | >0.05 | | >0.05 |
| Sex | | | | | |
| Male | 332 | 13.6 | 4.5 | 188.0 | 45.5 |
| Female | 297 | 12.6 | 3.7 | 195.6 | 46.5 |
| P | | | >0.05 | | >0.05 |

dad industrial areas or rural areas showed elevated Pb–B.

Comparison of the present data with those obtained in other countries revealed that the Pb–B of children living in Baghdad Governorate was generally within the range of low levels (Table 3).

The values of ALAD were correspondent to the Pb–B obtained in these children, as indicated by the inverse correlation between ALAD and Pb–B (Fig. 3). These values were within the normal range reported, except for those children living in the center (below the normal range). This finding confirms that increased exposure exists in the group of the centers.

Regarding lead in air, the upper acceptable limit of atmospheric lead concentration varies according to the characteristics of the studied area whether urban, suburban or rural. The mean Pb–A in Baghdad Governorate was 2.8 ± 2.0. The higher concentration was found in the center. But the levels of Pb–A for the different areas of Baghdad Governorate in general were within the acceptable limit and still less than the levels reported in many large cities (Table 3).

The differences in sex and age are known to have some effect on Pb–B and ALAD, but this effect is a matter of controversy[18]. Our finding showed, no significant differences between the mean Pb–B and ALAD of boys and those of girls. This could be due to the similar activities carried out by both sex

| | | | | | |
|---|---|---|---|---|---|
| d | Present Study | 13.18 | 4.1 | Baghdad -urban- | 3.37 | 1.87 |
| ne[1] | | 10.5 | 3.7 | Present Study | | |
| 20 | | 10.9 | 2.9 | London[26] | 3.2 | - |
| 23 | | 12.3 | 2.7 | Brussles[27] | 2-5 | (Range) |
| a[22] | | 12.5 | | Sofia[28] | 6.3 | |
| | | 16.4 | 7.5 | Seoul[29] | 11.0 | |
| 3 | | 20.8 | 6.9 | Baghdad- rural | | |
| 24 | | 23.5 | 7.8 | Present study | 0.44 | 0.07 |
| dia[25] | | 55.5 | 10.1 | | | |

d or the same level of exposure to air . The absence of a significant differen- and ALAD for the different age groups , could be explained by the fact that children were not included in the samp- nd the age of pica which is incriminated er Pb–B among preschool children[19]. be due to the homogenous sample of estigated with small difference betwe- r and lower limit of age.

it from the above discussion that the ead absorption for children living in overnorate (

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