ORIGINAL ARTICLE

Blood Lead Levels of Pregnant Women from The Klang Valley

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Summary

A study was conducted to compare the blood lead levels of 97 pregnant women warded at the Kuala Lumpur Hospital, according to their ethnicity, residence and place of work. The lead content of venous blood samples was determined with a graphite furnace atomic absorption spectrometer. Blood lead levels of Klang Valley women seem to have decreased from 17.3 µg/dl in 1982 to 7.71 µg/dl in the present study, most probably attributed to the phasing out of leaded gasoline. This level is below the 10 µg/dl recommended by the United States Environmental Protection Agency for the public, even though 27.8 % of them still have blood lead levels that are equal to or in excess of 10 µg/dl. The study shows that certain segments of the population such as Indians (geometric mean = 9.35 µg/dl) and housewives (geometric mean = 9.55 µg/dl) may still experience blood lead levels that are slightly elevated than the rest of the population.

Key Words: Blood lead levels, Pregnancy, Lead toxicity, Environmental health

Introduction

The exploitation of the metal lead by man started some 5000 years ago[1]. Since then it has become highly ubiquitous in all environmental compartments including the living biota. Man has continuously removed lead from its natural reservoir in the earth and spread it around so efficiently, most of it through the combustion of leaded gasoline, such that no person on earth has not been exposed to lead to a certain extent. It was formerly thought that only blood lead levels in excess of 40 µg/dl would be harmful to humans. However it has now been realized that even lower level of 10 µg/dl can produce undesirable health effects such as IQ deficit and neurobehavioral changes in children[2].

Lead toxicity may affect various organs and body systems but it is mainly a neurotoxin[3] and a nephrotoxin[4] and it affects mental development[5]. Women are more sensitive to lead compared to men in terms of δ-aminolevulinate dehydratase (ALA-D) and erythrocyte protophyrin (FEP) inhibition[6]. Furthermore, pregnancy and lactation will cause lead mobilization from the bones into the blood[7]. In fact, lead is a transgeneration toxin whereby mothers will pass lead and its toxic effects to their offsprings[8].

Individuals can be exposed to environmental lead through three major pathways, namely through ingestion, inhalation and dermal contact. The main sources of exposure are therefore through the inhalation of atmospheric lead from leaded gasoline and other industrial emissions, and the ingestion of lead in foods, drinks and dusts. Absorption through dermal contact is however less significant. The main sites of lead deposition are in the bones and teeth. Others include the connective tissues in the brain, liver, kidneys, lung and aorta[1]. Most of the absorbed lead is excreted through the urine and faeces. Some is also excreted through hair, nails and skin desquamation[6].

Even though lead has been widely used in Malaysia for various purposes but mainly as a gasoline additive, very few studies or efforts have been undertaken to monitor the concentration or distribution of this toxic metal in the Malaysian population. Such studies are important to enable us to identify segments of our population that may be at high risk to lead exposure. The main objective of this study is to compare the blood lead levels of pregnant women who delivered at the Kuala Lumpur Hospital according to their ethnicity, residence and place of work.

Materials and Methods

Venous blood samples were obtained from 97 pregnant women who were admitted for delivery at the maternity ward of the Kuala Lumpur Hospital. Quota sampling was used to obtain blood samples from these women by requesting 5 ml of their blood from the doctors who draw the blood, for the period from August 26 to November 26 1996. This was done to minimize disruption in the running of the maternity ward. Only women who have lived for a year or more in Kuala Lumpur or Selangor were finally taken into the sample. A questionnaire interview was then conducted on each of the women to obtain their personal data.

The blood were collected in heparin tubes and kept under refrigeration until analysis. Analysis for blood lead was done at the Biochemistry Division of the Institute of Medical Research, using a Perkin Elmer graphite furnace atomic absorption spectrometer.

Results

The blood lead levels of the 97 pregnant women studied was found to be log-normally distributed, as can be seen from Figures 1 and 2. This finding is consistent with that of another study on blood lead levels among Japanese farmers by Watanabe *et al*[9]. Therefore, geometric mean is also reported here as a measure of central tendency besides the arithmetic mean. Analytical statistical analysis were done on the logarithm of blood lead data.

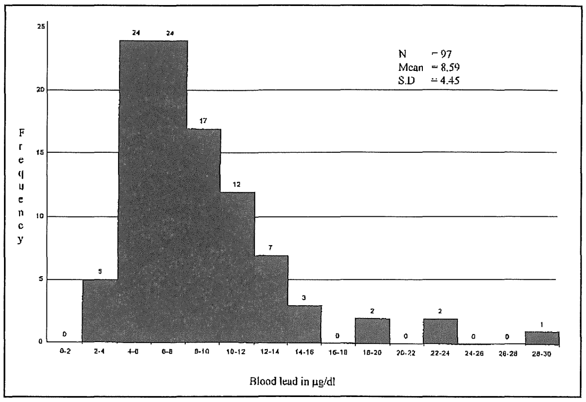

Fig. 1: Blood lead of pregnant women from the Klang Valley

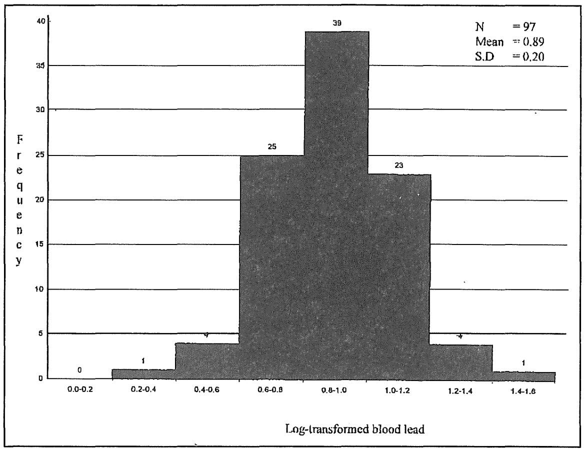

Fig. 2: Log-transformed blood lead data of pregnant women from the Klang Valley

The arithmetic mean blood lead of the 97 women is 8.59 µg/dl while the geometric mean is 7.71 µg/dl, as shown by Table I. As Figure 1 indicates, 27 women (27.8 %) have blood lead levels of 10 µg/dl and above which is presently the blood lead level recommended by the United States Environmental Protection Agency (U.S.E.P.A.) for non-occupationally exposed public[2].

Ethnicity

Table I also gives the geometric mean as well as the arithmetic mean and standard deviation of blood lead levels of the 97 women by their ethnic groups. Even though the ANOVA test shows no significant difference between the blood lead levels of the 3 ethnic groups, the comparison of mean blood lead levels between the Malay and Indian using the Student's t-test is marginally statistically significant (p = 0.04) when the analysis was conducted on the logarithm of blood lead data.

Place of Residence

Table II shows the blood lead levels of 90 of the mothers by their place of residence. Contrary to expectation, mothers living closer to the city centre do not show higher blood lead levels than those in the suburban and rural areas. This may be due to the small sample sizes of the city centre and rural groups, and therefore may not exhibit the true pattern.

Place of Work

Table III gives the blood lead levels of 94 women by their place of work. Through the questionnaire survey, it was ascertained that all these women were not occupationally exposed to lead from their present or previous jobs. As the Table shows, women who work in the office tend to have the lowest blood lead levels. Ironically, the highest blood lead levels are found among housewives, even though the difference between groups is not statistically significant.

Discussion

The overall geometric mean blood lead of 7.71 µg/dl reported here is very much lower than the level of 17.3 µg/dl reported among urban pregnant women in a study in 1982 by Lim *et al*[10]. This may reflect the impact of the introduction of unleaded gasoline in Malaysia in 1992 and the reduction of the lead content of leaded gasoline from 0.84 g/l in 1982 to 0.15 g/l since 1994, on the blood lead levels of our urban population. However, this study indicates that certain individuals in our urban population may still acquire high blood lead levels. The maximum level detected by this study is as high as 29.5 µg/dl, while 27.8 % of them have levels equal to or above 10 µg/dl, which is the safe level recommended by the U.S.E.P.A.

The geometric mean blood lead among Malay women of 7.27 µg/dl reported in this study is however slightly higher than the geometric mean of 4.5 µg/dl reported

Table I
Blood lead levels of pregnant women by ethnicity, Klang Valley, Malaysia, 1996

Race	N	Blood lead (PbB) in µg/dl and [Log_{10} PbB]			
		Range	Geometric mean	Arithmetic mean	Arith. std. dev.
Malay	61	2.03 - 29.48 [0.31 - 1.47]	7.27 [0.86]*#	8.06	4.35
Chinese	19	3.63 - 19.87 [0.56 - 1.30]	7.83 [0.89]*	8.70	4.24
Indian	17	3.62 - 22.44 [0.56 - 1.35]	9.35 [0.97]*#	10.36	4.85
Overall	97	2.03 - 29.48 [0.31 - 1.47]	7.71 [0.89]	8.59	4.45

* *ANOVA : p value = 0.13*
\# *T-test : Malay Vs. Indian (on log10 PbB data) : p value = 0.04*

Table II
Blood lead levels of pregnant women by place of residence, Klang Valley, Malaysia, 1996

Place of Residence	N	Blood lead (PbB) in µg/dl and [Log_{10} PbB] Range	Geometric mean	Arithmetic mean	Arith. std. dev.
City Centre	8	6.35 - 12.51 [0.80 - 1.10]	8.98 {0.95}*	9.27	2.45
City Fringe	27	3.62 - 29.48 [0.56 - 1.47]	8.44 [0.93]*	9.53	5.43
Suburban	51	2.03 - 23.29 [0.31 - 1.37]	7.10 [0.85]*	7.90	3.98
Rural	4	3.50 - 22.44 [0.54 - 1.35]	8.86 [0.95]*	10.96	8.13

* *ANOVA : p value = 0.29*
Missing cases = 7

Table III
Blood lead levels of pregnant women by place of work, Klang Valley, Malaysia, 1996

Place of work	N	Blood lead (PbB) in µg/dl and [Log_{10} PbB] Range	Geometric mean	Arithmetic mean	Arith. std. dev.
Office	22	2.77 - 14.56 [0.44 - 1.16]	6.97 [0.84]*	7.44	2.77
Factory	22	2.03 - 15.28 [0.31 - 1.18]	7.80 [0.89]*	8.61	3.39
Shop/small business	7	4.19 - 12.47 [0.62 - 1.10]	6.47 [0.81]*	7.01	3.13
House	43	4.15 - 29.48 [0.62 - 1.47]	8.47 [0.93]*	9.55	5.55

* *ANOVA : p value = 0.27*
Missing cases = 3

in another study among 49 Kuala Lumpur Malay women in 1995 by Moon *et al*[11]. However, these values are quite close considering the modest sample sizes of both studies.

No published literature was found on the comparison of blood lead levels of the 3 dominant ethnic groups in Malaysia, namely the Malay, Chinese and Indian. This study indicates that mean blood lead level is highest among the Indians and this level is significantly higher than that of the Malays (Table I). Information on environmental lead exposure from this study is insufficient to determine the reason for the slightly higher mean blood lead level among Indians. One possibility is maybe the use of earthernware cooking pots among Indians, as these have been known to contain soil lead which can leach into foods cooked in them. However, further study is needed to confirm this speculation.

Place of residence in proximity to the Kuala Lumpur city centre does not seems to influence blood lead level (Table II). This may be due to the small and unequal sample sizes between the comparison groups. However, this may also be partly due to the lesser influence of atmospheric lead exposure on lead body burden. A study in 1992 clearly showed that atmospheric lead concentration was highest in the city centre (Pudu area) at 462 ng/m^3 and lowest in the rural area (Kg. Sungai Merab) at 30 ng/m^3[(12)]. This study was conducted right after the introduction of unleaded gasoline in Malaysia. Since then, the lead concentration of the atmosphere in the city centre has decreased to around 200 ng/m^3 by 1994[13].

It is most likely that the major portion of an individual exposure to environmental lead now comes from foods, water, dusts and other non-atmospheric sources. Therefore, the location of a person's residence now has a smaller contribution to his lead body burden. This may also be the reason why we are seeing differences in blood lead levels among the ethnic groups, as the differences may reflect contributions from ingestion sources.

This is further supported by the finding that housewives represent the group most exposed to environmental lead (Table III). One explanation for this observation is that housewives may be more exposed to atmospheric and dust lead, depending on the proximity of their houses to major roads and exposure to dust-generating activities or sources such as house cleaning and construction sites.

Husbands' occupation may also influence the blood lead levels of their wives and family members as they may bring back lead from work places on their clothing. However, this factor was not investigated in this study. It may have also influenced the higher blood lead levels observed among the Indians, rural residents and housewives. This should be looked into in future studies on blood lead levels among the public.

In conclusion, we can deduce from this study that the blood lead levels of Klang Valley women have dropped since the 80's due to steps taken to reduce the use of lead in gasoline. However, a significant proportion of our women still have relatively high blood lead levels, generally Indian women and housewives, with levels above the recommended 10 μg/dl. This means that effort to phase out leaded gasoline should continue, while reducing other uses of lead in the environment. The authors would like to recommend that a nationwide study be carried out to monitor blood lead levels in all subgroups of the Malaysian population, and especially in children, whose exposure to lead actually begins during pregnancy because lead crosses the placental barrier. For example in the United States, blood lead monitoring of the population is done as part of their regular national health survey.

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