Journal of Coastal Development
Volume 4, Number 1, October 2000 : 7 - 11

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

THE POTENTIAL NEGATIVE IMPACT OF AIR LEAD POLLUTION ON CHILD DEVELOPMENT A PRELIMINARY STUDY IN TAMBAKLOROK, SEMARANG

By: Amin Husni
Medical Faculty, University of Diponegoro
e-mail: husnia@idola.net.id

ABSTRACT

A review about potential negative impacts of air lead pollution especially on child development, based on a result of a cross sectional study conducted in Tambaklorok-Semarang, an area with a very high air lead pollution, is reported.

Subjects in the study were mothers who have lived more than three years in the area and their infants. The subjects' characteristics, including age, height, weight, lead blood concentration (Pb-blood), Hemoglobin (Hb), and the infants' developmental score were measured. The air lead concentration was measured for comparing to the air lead concentration reported by a previous research.

Re-measurement of the Pb-air in August 1999 in Tambaklorok had a similar result with the Pb-air measured in August 1996 that was 100 times higher than that in a non-polluted Pb-air area.

Statistical analysis showed that there was no significant correlation between the child Pb-blood and Maternal Pb-blood, child's age, child's Hb, child's nutritional status that was calculated using Mass Body Index, and child development score, respectively.

It seemed that child development was not influenced by the air lead exposure. The children were suffering from anemia, but there was no significant correlation between the child Pb-blood and the child Hb.

Keywords: lead-air, lead-blood, child development

I. INTRODUCTION

Lead (Pb) pollution has became a big problem in many countries, such as in Europe, the United States, and also in developing countries (**Bertollini et al., 1996; Cory-Slechta, 1996**). The sources of environmental Pb pollution are family housing , e.g. samples of paint and dust, and the broader environment, which comes from industries and industrial products (**Ginot et al., 1995; Flegal, Smith, 1995**).

The central nervous system seems to be the primary target organ suffering from the negative impact of Pb pollution (**Cory-Slechta, 1996**). The brain during the developmental period is more susceptible to the Pb-pollution than adult (**Winneke et al., 1996**), it is clearly understood that children are more at risk than adult people (**Cory-Slechta, 1996**).

In Indonesia, there has been no studies on the negative impact of the Pb pollution on health, especially on child development. In the mean time lead pollution has occurred and is still going on. Referring to the result of a study reported by **Browne et al., (1999)**, Tambaklorok village, a coastal area in the Municipality of Semarang , has a very high air lead concentration.

A review of the potential negative impact of air lead pollution on child development as a preliminary study in Tambaklorok will be presented in this paper.

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

II. MATERIAL AND METHOD

A cross sectional study was conducted in RT = Rukun Tetangga (Neighborhood Associations) 12, 13, 14, 15, and 16 of Tambaklorok village - Tanjung Mas, Semarang Municipality.

The locations are impoverished slum neighborhoods of Semarang located in the coastal area between the new port development zone, an electrical power generating station and the industrial development zone. A large portion of the population is fishermen who rely on the harvesting of marine biota for food and income. This community was identified as potentially the most exposed to the heavy metals in the city due to its location (**Browne et al., 1999**).

Fifty women who have lived for more than three years in the area and their children were examined. The data from the subjects include the maternal characteristics (age, height, weight, concentration of plumbum in blood / Pb-blood, and Haemoglobin / Hb) and the child characteristics (age, height, weight, Pb-blood, Hb, and developmental score). The air lead concentration was measured for a comparison with the air lead concentration reported by Browne et al. previously.

Maternal and child Pb-blood were measured from blood serum using Atomic Absorption Spectrometer (AAS), Shimadzu Hollow Cathode Lamp Pb for AA-6401F, done by Micronutrient Laboratory Medical Faculty, University of Diponegoro. Air lead (Pb-air) with air sample was collected through High Volume Sampler and was measured using AAS Perkin Elmer 3110, conducted by *Balai Penelitian dan Pengembangan Industri Badan Penelitian dan Pengembangan Industri dan Perdagangan Departemen Perindustrian dan Perdagangan RI di Semarang* (Research and Development Unit of the Agency of Industrial and Commercial Research and Development , Ministry of Industry and Commerce in Semarang).

Child development was measured using the Munchen Development Function Diagnostic test.

III. RESULT

3.1. Air lead

Measurement of Pb-air in 1996 on a 24-hour air sampling conducted by **Browne et al. (1999)** found extremely high air lead levels. The 14-day average was 8.41 in ug/m^3 with a maximum of 16.5 ug/m^3 during the dry season (in the first two weeks of August). During the rainy season, the 5-day average was 10.85 ug/m^3 with a maximum of 18.03 ug/m^3. Airborne lead levels at Tambaklorok exceeded national and international standards on every day sampled. Airborne lead levels of this magnitude have not been reported in Indonesia previously. The Pb-air average at Tambaklorok was 100 times higher than the average of air lead concentration in the Purworejo-Bonang, Demak District.

Re-measurement of Pb-air conducted in August 1999 found a smaller magnitude. But it should be noted that the re-measurement did not collect air sample for 24 hours continuously; rather, the air sampling was done within three separate periods : in the morning, in afternoon, and at night within one day, with the magnitude of 0.0006, 0.0001, and 0.0122 (in mg/m^3) respectively. The night air lead level in Tambaklorok was still 100 times higher than in Purworejo.

3.2. Subjects' characteristics

The subjects' characteristics are described in the following table.

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

Table 1. Maternal and child characteristics

Characteristics	Maternal	Child
Number of subjects	50	50
Age	(Month) Mean: 9 SD: 5	(Year) Mean: 25 SD: 7
Sex : male/female	-	30 / 20
Height (Cm)	Mean: 63 SD: 9	Mean: 154 SD: 4
Weight (Kg)	Mean: 7 SD: 3	Mean: 53 SD: 6
Pb-blood (ug/dl)	(n=44) Mean: 40.5691 SD: 7.4109	(n=50) Mean: 42.4394 SD: 9.4741
Hb (g%)	(n=47) Mean: 12.4741 SD: 1.4753	(n=49) Mean: 10.1891 SD: 1.5041
Development score	- -	Mean: 2.41 SD: 7.28

3.3. Statistical analysis

There were no significant correlation between the child Pb-blood and Maternal Pb-blood (p=0.880), child's age (p=0.309), child's Hb (p=0.105), child's nutritional status which was calculated using Mass Body Index (p=0.312), and child development score (p=0.244), respectively.

Similar result was found from regression test of child development score as the outcome (dependent variable) and the factors: child Pb-blood, maternal Pb-blood, child's age, child's sex.

There were no significant correlation between maternal Pb-blood and maternal Hb (p=0.223), and maternal nutritional status which was calculated using the Mass Body Index (p=0.298).

IV. DISCUSSION

It was known that the lowest observed effect of level Pb-blood (<15-15 ug/dl) in pre-natal and post-natal might produced deficit in neurobehavioral development (Bayley and McCarthy Scales) and electrophysiological changes (**Fleming, 1994**). **Berthollini et al. (1996)** stated that it was wise to assume that there was no safety threshold of Pb exposure on children since there was no a certain safety threshold for a low Pb exposure which create neurobehavioral disturbance effects. The Pb-blood in this study represented Pb in the blood serum; the mean of child Pb-blood in Tambaklorok was 42.4394 u/dl. Considering that there was no significant correlation between the child Pb-blood and the maternal Pb-blood in one hand and the mean child Pb-blood which was higher than the mean maternal Pb-blood on the other hand, it was assumed that child Pb-blood was strongly influenced by the air lead exposure rather than the maternal Pb-blood. With regard to the statements and the condition mentioned above, it was predicted that the Pb-air exposure, which was represented by the child Pb-blood, might influence the child development in Tambaklorok.

It was postulated that motor developmental outcomes might be used as the most sensitive indicators of lead's adverse effects on the central nervous system as they are probably less confounded with social factors than cognitive and academic outcomes

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

(**Dietrich, 1993**). Based on the postulate, this study assessed the child development using Munchen Development Function Diagnostic test that observed mostly on motor function. As described in Table 1 the children who included in this study had 9 months mean of age with the SD was 5 (months); it meant that the children were mostly infant. In infancy, the motor function is a phenomenon that is easily observed. The Munchen Development Function Diagnostic test's result showed there was no developmental delayed among the infants. The result of this study seemed similar with the result of a cross sectional study conducted by **Wolf et al. (1994)** which shown that there was no correlation between Pb-blood concentration and child development. But it should be noted what the reliability of the Munchen Development Function Diagnostic test for measuring infant motor development. It was assume that there is another reliable test, i.e. the Milani Comparetti Motor Development Test.

The principal manifestation of the effect of lead on the haematopoietic system is anemia but this occurs only with high level of exposure that is rarely seen today. Lead affects the haem and globin synthesis and on erythrocyte formation and function (**WHO, 1995**). It has been mentioned that Tambak-lorok had a very high Pb-air concentration, which the airborne lead level of this magnitude have not been reported in Indonesia previously.

It was possible that the high air lead level affected the haematopoietic system among the mother and children lived in that area. The mean of maternal Haemoglobin/ Hb (12.4741 g%) was higher than the mean of child Hb (10.1891 g%). The magnitude of the mean maternal Hb was close to the normal lower limit. The mean child Hb showed that the children tended to suffer from anemia. Statistical tests showed that there was no significant correlation between Pb-blood and Hb. Other factors influencing haem and globin synthesis should be investigated further.

V. SUMMARY

With regard to an inconsistence reported results of researches on the impact of lead exposure on child development and a fact that there was a region with a very high air lead concentration, a preliminary study had been conducted in Tambaklorok-Tanjung Mas, Semarang Municipality to predict the potential negative impact of air lead pollution on health. Considering the research results' done by Winneke **et al., (1996), Cory-Slechta, (1996), Berthollini et al. (1996)**, and **Dietrich, (1993)** the study focused on the relationship between lead exposure and child development, especially the child motor development.

Re-measurement of the Pb-air in August 1999 in Tambaklorok had a similar
result with the Pb-air measured in August 1996 , that was 100 times higher than a non-polluted Pb-air area.

Statistical analysis showed that there were no significant correlation between the child Pb-blood and Maternal Pb-blood, child's age, child's Hb, child's nutritional status which was calculated using Mass Body Index, and child development score , respectively.

There were no significant correlation between the maternal Pb-blood and maternal Hb, and maternal nutritional status which was calculated using the Mass Body Index .

It seemed that child development was not influenced by the air lead exposure. The children were suffering from anemia, but there was no significant correlation between the child Pb-blood and the child Hb.

With this preliminary study as a starting point, a further, longitudinal study will need to be performed.

ISSN: 1410-5217
Accredited: 69/Dikti/Kep/2000

BIBLIOGRAPHY

Bertollini, R., Dora, C., Krzyzanowski, M., and Stanner, D. (1996)

Bertollini R, Dora C, Krzyzanowski M, Stanner D.1996. Evironment and Health 1. Overview and Main European Issues. **WHO Regional Publications, European Series**; No.68EEA Environmental Monograph, No. 2.

Browne, D.R., Husni, A., Risk, M.J.(1999)

Browne DR, A-Husni, Risk MJ. 1999. Airborne Lead and Particulate Levels in Semarang, Indonesia and Potential Health Impacts. **The Science of the Total Environment;** 227: 145-54.

Cory-Slechta-DA.1996. Legacy of Lead Exposure: Consequences for the Central Nervous System. **Otolaryngol-Head-Neck-Surg.** Feb; 114(2): 224-6.

Dietrich KN, Berger OG, Succop PA. 1993. Lead Exposure and the Motor Developmental Status Urban Six-Year-Old Children in the Cicinnati Prospective Study. **Pediatrics;** Feb; 91(2): 301-7.

Flegal AR, Smith DR. 1995. Measurements of the Environmental Lead Contamination and Human Exposure. **Rev-environ-Contam-Toxicol;** 143:1-45.

Ginot L, Peyr C, FontainA, et al. 1995. **Screening for Lead Poisoning in Children Measuring Lead Levels in Hausing:** A Study in the Paris Region.

Fleming SW. 1994. **Scientific Criteria Document for Multimedia Environmental Standards Development – Lead.** Ministry of Environment and Energy, Ontario.

WHO. **Environmental Health Criteria 165. Inorganic Lead.** Geneva. 1995.

Winneke G, Lilienthal H, Kramer U. 1996. The Neurobehavioral Toxicology and Teratology of Lead. **Arch-Toxicol-Suppl;** 18: 57-70.

Wolf AW, Jimenez E, Lozoff B. 1994. No Evidence of Developmental Effects of Low Level Lead Exposure in a Developing Country. **J-Dev-Behav-Pediatr;** Aug; 15 (4): 224-31.