

Lead in Breast Milk of Nursing Mothers Working in Agricultural Farms

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ABSTRACT

Aim: To detect lead in breast milk of mothers working in agricultural farms adjacent to Bahawalpur, Pakistan.

Study design: Descriptive study

Methods: This study was conducted in the Physiology and cell biology department of, University of Health Sciences (UHS), Lahore after obtaining consent from ethical review board of UHS, Lahore. Total 91 lactating female farm workers were selected for this study who had been working in the farm for one year in last three years. Five to six ml of breast milk was obtained from each lady. Samples underwent the process of dry digestion at 500°C for 4 hours. White ash obtained was mixed with deionized solution and inductively coupled plasma spectroscopy was used to detect the lead levels in milk samples of nursing mothers

Results: Out of 91 samples, lead levels were detected in 42 samples (46.15%). The mean (mean±SD) values of milk lead (n=42) were 781.49±1034.33µg/l. Family history of intellectual disability was significantly associated with milk concentrations of lead ($p = 0.046$).

Conclusion: Present study concludes that the level of milk lead is found to be considerably higher in nursing mothers working in agricultural farms as compared with the levels reported by others from different countries.

Key words: Inductively coupled plasma spectroscopy, lead, breast milk, graphite Furnace Atomic Absorption Spectrometry technique

INTRODUCTION

Lead, a widely distributed metal¹ enters into body through inhalational and gastrointestinal route.² Organic lead absorbs well through the skin.³ Inhalation of lead compounds in workers of different occupation is very common. Lead particles larger than 2.5µm particles deposit in ciliated epithelium of nasopharynx, trachea and bronchi and swallowed in esophagus.⁴ In children, absorption of lead is higher (40–50%) as compared to adults (3–10%) through gastrointestinal route. After absorption lead generally makes its way to bone. Half-life of organic lead is 30 days. It stays in bones for nearly 27 years. Lead is excreted from body through urine and feces. Higher levels in women during pregnancy and lactation may be because it is also released from bone with calcium.⁵ Lead exposure can be harmful to developing fetus. After birth lead may do more harm to central nervous system of growing children⁶ especially during the first three years of life. In early age blood brain barrier is not developed properly which may allow lead to pass into immature brains⁷.

WHO acceptable levels of lead in drinking water are 10µg/parts per billion (ppb)¹. In breast milk recommended levels are 2-5 µg/L⁸. Though much work has been done in past on detection of lead in breast milk and blood in world yet in Pakistan this area was not explored. Farm workers of Bahawalpur are exposed to pesticides, insecticides and weed killers which may contain lead⁹.

Present study was designed with the purpose of awareness and prevention of mothers and children of Southern Punjab from the deleterious effects of lead. Lead in breast milk of mothers was determined for this purpose. Another objective was to observe the association between milk lead levels and quantitative variables, i.e., history of abortion, infant death, birth defects and family history of intellectual disability.

METHODOLOGY

This descriptive study was performed after approval by ethical and review committee in Physiology Department, University of Health

Sciences (UHS), Lahore. Sample size in our study was 91 which was comprised of lactating farm workers residing permanently in rural areas adjoining Bahawalpur. Ladies who were selected for study had been working in farms for one year in last three years. Those ladies who were metal chelators. The ladies who were taking drugs like EDTA and DMSA etc., and drugs that can increase basal metabolic rate were excluded. Tobacco and weed smokers were also included. Information was entered on a proforma after informed consent. Demographic information like age, address, history of abortion/malformed baby, family history of intellectual disability, number of years working at farm etc., were recorded.

Breast milk samples were collected with the help of local lady health visitors. Five to six milliliter of breast milk from each lady was collected in sterile polyethylene lead free tubes that were sealed and stored at -80 °C till analysis.

Before performance of tests samples were brought to room temperature. The dry digestion of measured samples of breast milk was done at 500°C for four hours in a muffle furnace till the milk was converted into a white colored ash.¹⁰ The ash formed was then dissolved in deionized water to make 25 ml solution. This solution was used for analysis. For final analysis, Inductively Coupled Plasma Spectroscopy (ICP) technique was used to quantify lead in breast milk samples. The instrument used was Optima 2100-DV, Perkin Elmer. Standard solutions of lead with different concentrations of 25, 50, 75 and 100 ppb were prepared. Prepared standard solutions and diluted samples of breast milk were subjected to ICP-OES at wavelength of 220.353 nm for lead. The readings of milk samples were multiplied with different dilution factors to get the final results.

Statistical analysis: The data was analyzed by using IBM-SPSS version 20. Shapiro-Wilk's statistics were applied to check distribution. Mean±SD was given for normally distributed quantitative variables. Median (IQR) was given for non-normally distributed quantitative variables. Frequencies and percentages were given for quantitative variables. Mann Whitney U test was applied for comparison of lead levels between two groups. Statistically significant value was ≤0.05.

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RESULTS

Participants' mean age was 25.55±4.91 years. Out of total 91 women, 37(40.66%) had positive history of single or more abortions; 17(18.68%) had positive history of infant death; 11(12.09%) had positive family history of some birth defect; 29(31.87%) had positive family history of intellectual disability.

Table 1: Frequency of participants with detectable lead levels and mean values along with WHO permissible values of lead in breast milk

| Total samples | Lead levels in milk samples of nursing mothers | | | |
|---------------|--|---|-----------------|------------------------------|
| | Number of participants with detectable lead levels | Frequency of participants with detectable lead levels | Mean ± SD(µg/L) | WHO permissible values(µg/L) |
| 91 | 42 | 46.15% | 781.49±1034.33 | 2 – 5 µg/L ⁸ |

Table 2: Comparison of milk lead between groups on the basis of family history of intellectual disability.

| Parameter | Family history of intellectual disability | | p-value |
|----------------------------------|---|-----------------------------|-------------|
| | Present (n=13) | Absent (n=29) | |
| Milk lead (µg/L) Median (IQR) | 11.66 (1.32 – 795.02) | 706.14 (43.26 – 1497.40) | 0.046* a |

^a p-value is obtained by Mann whitney U test

*p-value ≤ 0.05 = statistically significant

Table 3: Lead levels in breast milk from different countries

| Area | Breast milk levels reported by workers | Reference |
|--------------|---|---|
| Pakistan | 781.49±1034.33 µg/L | Present study |
| Lebanon | 18.17±13.31(1.38-62.61) µg/L | Bassil et al., 2018 ⁽³⁵⁾ |
| Malaysia | 0.046µg/L | Ong et al., 1985 ⁽³¹⁾ |
| China | 0.4747µg/L | Li et al., 2000 ⁽³²⁾ |
| Russia | 0.277µg/L | Kulkybaev et al., 2002 ⁽³³⁾ |
| U.K | 9.77µg/L | Kovar et al., 1984 ⁽³⁰⁾ |
| India | 22.3±18.5 µg/L | Sharma and Pervez, 2005 ⁽³⁶⁾ |
| U.S.A | 3-26 7µg/L | Rye et al., 1983 ⁽²⁷⁾ ; Rockway et al 1984 ⁽²⁸⁾ ; Sowers et al., 2002 ⁽²⁹⁾ |
| Ghana | 4.8 (<LOD-32) µg/L | Bentum et al., 2010 ⁽²⁶⁾ |
| Turkey | 391 (R: 4.35-1020) 20.6 (<LOD-1515) µg/L | Gürbay et al., 2012 ⁽³⁸⁾ Orün et al., 2011 ⁽³⁷⁾ |
| Saudi Arabia | 37.3(1.2-490) µg/L | Al-Saleh et al., 2003 ⁽³⁴⁾ |

DISCUSSION

Our study revealed mean lead levels 781.49±1034.33µg/l in the breast milk of females working in farms of rural areas adjacent to Bahawalpur. Kovar *et al*¹¹ used AAS technique to detect lead in breast milk of un exposed females living in urban areas as 9.7µg/l. Ong *et al* reported lead concentrations of 0.046µg/L in Malaysian women by using GF-AAS technique¹².

A researcher group from Russia detected the lead in breast milk sample as 0.27µg/l¹³. Another study from Saudi Arabia reported the lead levels of 31.671µg/L in breast milk of un exposed lactating mothers.¹⁴ Li *et al*¹⁵ reported 0.474µg/d of lead levels in breast milk in un exposed Chinese women from Shanghai. The mean concentration of lead in breast milk of 12 exposed occupationally women was 12 times higher than un exposed population (52.7 ppb)¹⁵.

Our study showed higher mean lead levels in breast milk of exposed women of Bahawalpur than any other population (Table 1). Most of the research references given in discussion above are from un exposed population occupationally. Exposed population was that of Li *et al*¹⁵ from China. Though sample size was small yet this population had 12 times higher "lead" levels in their breast milk as compared to the controls.

Current study showed seven times higher lead levels in breast milk of mothers working in farms than Chinese exposed women serum "lead". Table 3 gives details of lead in milk and blood samples reported earlier from different countries

It cannot be said with certainty that higher lead levels detected in our exposed population were because of exposure as control samples were not used in our study. In test population, 54% of milk samples had almost no lead levels detected. The

Lead levels were estimated in breast milk (n=91) samples. Lead was detected in 42 samples (46.15%) of breast milk out of 91 samples. The mean (mean±SD) values of milk lead (n=42) were 781.49±1034.33µg/l. Family history of intellectual disability was significantly associated with milk concentrations of lead (p=0.046)

amounts reported in our results are from 46% of the milk samples in which lead levels were detected. In occupationally exposed rural population of Bahawalpur, guidelines should be made regarding breast feeding to prevent the children from adverse effects of lead. Attempts shall be made to increase the goal-oriented resources towards public awareness about the problem and thus finding a workable solution of this serious public health issue.

CONCLUSION AND RECOMMENDATION

Present study concludes that the level of milk lead is found to be considerably higher as compared with the levels reported by others from different countries. Lead free insecticide/pesticide should be provided to the farmers. Preventive measures should be adopted by the farm workers and they should be educated for the prevention of lead poisoning. Same kind of studies may be planned to conduct on children residing this region of Punjab.

Conflict of interest: None

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