

Investigation and analysis of the concentration of heavy metal elements in breast milk in Ardabil city using Inductively coupled plasma mass spectrometry (ICP-MS)

Abstract

Background: Although breastfeeding for infants has many advantages, breast milk can be an important route of exposure of new born children to toxic substances. Heavy metals are one of the most important environmental toxins that can be transferred to the baby's body during breastfeeding. Increased absorption of heavy metals causes clinical disorders such as respiratory system cancer, skin disorders, anemia, depression, reproductive disorders, heart failure, intestinal disorders, fatigue, reduced immunity, and even death.

Aim: This study aimed to investigate and analyze the concentration of heavy metal elements in the milk of mothers in Ardabil using inductively coupled plasma mass spectrometry (ICP-MS) in 2021.

Methods and materials: This study is a descriptive-cross-sectional type that was conducted in the year 2021 in Ardabil city. The participants in this study were lactating mothers who visited government health centers in Ardabil city. To conduct this study, 10 government health centers were selected. Mothers' age ranged from 19 to 39 years and breast milk samples were collected in 1 to 12 months after delivery. A 25-item questionnaire was used to assess exposure to heavy metals in the environment and food. Breast milk samples were collected from 100 nursing mothers using a special technique designed to minimize the potential of environmental pollution. Inductively coupled plasma mass spectrometry (ICP-MS) to analyze samples and determine the level of heavy metals (Pb, Ca, Hg, Cr, Ni, Ba, Zn and As) and nutrients and microelements (such as Na, K, Ca, Mg, Fe, Mn, Se, Cu, Mo, etc.) were used in breast milk samples. Non-parametric Mann-Whitney U test was used to analyze the data ($p > 0.05$).

Results: The results showed that the average age of the mothers studied was 28.21 ± 5.16 years and the average age of the infants studied in this study was 6.46 ± 3.64 months. The average body mass index in lactating mothers was 26.26 ± 3.73 . According to the results, the highest and lowest average concentrations of metals in breast milk were related to Cu ($803.94 \mu\text{g/L}$) and Cd ($1.87 \mu\text{g/L}$). Also, the highest and lowest average concentrations of nutrients and microelements in breast milk were related to K (490.49 mg/L) and Mo ($0.8 \mu\text{g/L}$). The average concentration of Fe in the milk of mothers aged less than 25 years was higher than that of mothers older than 25 years ($P = 0.001$). The average concentration of As and

Pb in the milk of mothers who used cosmetics is higher than that of mothers who did not use cosmetics ($P=0.036$). There was also a significant difference in the concentration of Ni, K, Fe, and Zn with the consumption of vegetables ($p<0.05$). The level of cadmium in 62% of samples, arsenic in 38% of samples was higher than the limit suggested by WHO.

Conclusion: The results of this study confirmed the presence of mercury, arsenic and lead in all milk samples collected from lactating women in Ardabil city. This indicates that infants are likely to be exposed to high levels of these heavy and toxic elements.

Keywords: Concentration of heavy metals, breast milk, inductively coupled plasma mass spectrometry.