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Evaluation of the Level of Tungsten in Breast Milk, of Mothers Residing in a Subsistence Community of Fishing and Agriculture, in Lake Chapala, Mexico

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Abstract: Introduction: The aim of this study is to provide data on the evaluation of tungsten in breast milk. Materials and Methods: In this study, a cross-sectional survey design was used to evaluate a community of 950 inhabitants where lactation is practiced by 100% of mothers, with an average time of 12.7 months. It was carried out with the participation of women breastfeeding at that time in the community, 17 census sample, ages between 17 and 49 years, accepted to participate 14 (82%), in the month of June 2017. The analysis was carried out with the inductively coupled plasma mass spectrometry (ICP-MS) model 7900 brand Agilent Technologies. Results: Tungsten or tungsten was found in 100% of the samples of breast milk studied, it was determined minimum 0.026, maximum of 1.746, median 0.0785, DS 0.452, coefficient of variation 1.940. 1µg / L. This unusual finding of Tungsten poses new challenges on environmental pollution and its possible effects on maternal child health, especially in the prenatal stage. Discussion: This study shows in all the mothers studied with which they feed their children milk, they have Tungsten levels. The possible effect on the health of Tungsten absorbed at low doses during lactation is not known. Tungsten should be studied through longitudinal studies of exposure.

Keywords: Tungsten, Human Milk, Hard Metals, Development. Environmental Health

1. Introduction

Increasingly, biomonitoring studies of heavy metals in human milk are useful to study the nature of the dangers and risks to the health of women and their children [1]. Breastfeeding is essential for normal and healthy development; therefore, the study of breast milk is a unique means to explore human contamination because it shows the exposure of the mother that can transfer her child in a vital period for the present and future development of the infant. The monitoring of these substances in breast milk offers an advantage over the monitoring of the environment, because the first one measures the internal dose instead of the exposure dose and takes into consideration the exposure from all sources, absorption routes (intake, inhalation or dermal contact) and different media in which a person develops (example: work / food / home). Although information on environmental chemicals in human milk has been available since the 1970s in the world, knowledge about the subject is relatively recent (Manfred, 1974). Human milk is a unique exposure route for nursing infants, which can be used to obtain information on the levels of environmental chemicals in mothers and the exposure of their children to an environmental chemist in the context where these mothers

live. Biomonitoring data can, under certain conditions, be used to describe potential risks to human health [2]. However, no information was located regarding the ability of tungsten to cross the placenta or enter the breast milk of humans [3].

Tungsten, whose chemical symbol is W, atomic number 74, It is a considerably rare and scarce metal in our planet, one of the least abundant in the earth's crust, being able to be found only in forms of oxides and in a limited number of minerals. It is extremely resistant, having the highest melting point of all metals (3,422°C), as well as the highest strength in fracture stress and great resistance to corrosion, belongs to the group of transition metals and their state usual in nature is solid.

In industrial waste sites, it is more likely to found at higher levels than natural, it can be found in human tissues and body fluids. The specific information on the exposure of children to Tungsten is limited, as for adults in general, small exposures occur by normal food intake and inhalation of air. These exposures may be higher in areas near industrial facilities that manufacture, process, recycle or use tungsten and its compounds. Studies on Tungsten in breast milk, the main food of infants, are virtually non-existent. In 2016, a total of 75 studies published worldwide on metals in breast milk in the world since 2000 were reviewed, the case of Tungsten was not mentioned in any of these studies. [4]

Different studies show that serum Tungsten concentrations in humans are approximately 1-6 μg / L (Bowen 1966, Hartung 1991). In serum concentrations in 15-year-old Swedish adolescents from Uppsala and Trollhättan 0.14 ± 0.2 μg / L, range, < 0.04-1.8 μg / L) were found in the period from 1993 to 1994 (Bránáy et al. 2002a), while the total blood concentrations for this same population group were < 0.2 μg / L (n = 326, < 0.2-0.94 μg / L).

Regarding the relation Tungsten and childhood, in 2003, the National Center for Environmental Health (NSHD) and the Center for Disease Control (CDC) of the US Government, conducted a study on the presence of Tungsten in urine in children to determine the possible link of Tungsten with Leukemia in children who drink water from groundwater wells where there are Tungsten mines in communities of the State of Nevada. The results obtained in Lovelock was; 0.62 (0.50-0.76), Yerington; 1.18 (1.00-1.39) and Pahrump; 0.56 (0.48 - 0.66) 1μg / l, respectively, and in Churchill County 2.31 (1.66 - 3.22) 1μg / l. The presence of W was evidenced in 68% of the participants, with W levels above the 95th percentile of the reference population in the National Health and Nutrition Survey (NHANES) [5]. It is not concluded in this study if tungsten can cause cancer in animals or humans.

The information regarding renal effects of tungsten is scarce because it is not null, the information available in humans is restricted to a temporary renal failure account and subsequent tubular necrosis and anuria in a male subject one day after the accidental consumption of metallic tungsten in a mixture of beer and wine that had been poured into the barrel from which he drank (Marquet et al., 1996). The author estimated that the absorbed dose of tungsten was in the range of 12 mg / kg. The subject recovered completely. The biomonitoring of heavy metals in human milk is justified in places where there are antecedents due to the unusual and significant presence in the last years of infants between 6 and 18 years with terminal chronic renal failure (ESRD).[6]

2. Objective

Evaluate the level of Tungsten in breast milk, in an indigenous subsistence community of fishing and agriculture, in Lake Chapala, Jalisco, Mexico.

3. Materials and Methods

In this study a cross-sectional survey design was used to evaluate in a community of 950 inhabitants, where breastfeeding is practiced by 100% of mothers, with an average time of 12.7 months, the presence of Tungsten in breast milk. The ecosystem inhabited by this population for hundreds of years, is located on a strip of land of 100 meters x 1.5 kilometers between the lake and the mountain where many indigenous communities of Nahua origin have settled. The population lives in an environment of social inequality with respect to other populations of the State of Jalisco. Mothers are mainly engaged in work at home, 95%, actively participate in the planting of corn, beans and chayote, men are engaged in fishing or construction (masons outside the community). The most common local crops are: corn, seasonal bean and chayote (Sechium edule) that they irrigate with water from the lake, their main foods are; corn, beans and fish from Lake Chapala, which they eat 3 to 4 times a week. 95% of households are cooked with firewood, the average weekly family income is approximately 52.63 USD.

The work was carried out with the informed participation of the women lactating at that moment in the community, resulting in 17 (census sample), aged between 17 and 49 years, 14 (82%) agreed to participate, in the month of June 2017. The milk sample was taken in their homes at times agreed upon by the women themselves; sterile bottle labeled with full name and code was delivered, a technique for milk extraction was recommended, requesting a minimum of 20 ml. The samples were preserved in freezing for further analysis. The analysis of metals in breast milk was carried out with the inductively coupled plasma mass spectrometry (ICP-MS) model 7900 model Agilent Technologies. The samples were treated with deionized water and nitric acid trace metal (3: 2 volume) and to eliminate all the organic part a microwave oven was used, brand CEM model Mars X; obtaining a liquid with non-metallic and metallic elements of each sample.

4. Results

Participants were women who were breastfeeding (n = 14), with an average age of 18 years (min 17, max 35). The age distribution is; 3 of 17 years (21.5%), 4 of 19 years (28.6%), 2 of 20 years (14.3%) and of 22, 26, 32 and 35 years, one (7.1%), is shown in Table 1.

Table 1. *Maother's age participants from Agua Caliente. Poncitlán, Jalisco, Mexico.*

Edad	Número	%
17	3	21.5
19	4	28.6
20	2	14.3
21	1	7.1
22	1	7.1
32	1	7.1
35	1	7.1
Total	14	100.0

Tungsten was found in 100% of the milk samples studied, a maximum concentration of 1,746 was determined, minimum 0.026, DV 0.452, median 0.0785, 1µg / L, the foregoing is observed as a whole in Table 2.

Table 2. *Determination of Tungsten in breast milk (ug / L) In nursing mothers at Agua Caliente. Poncitlan, Jalisco, México. 2017.*

Sample / Mom	Mg / L
1	1.746
2	0.491
3	0.172
4	0.129
5	0.118
6	0.069
7	0.088
8	0.058
9	0.041
10	0.033
11	0.03
12	0.026
13	0.229
14	0.049
MEDIAN	0.0785
SD	0.452
MIN	0.026
MAXIM	1.746

5. Conclusions

Although breastfeeding of infants is recommended globally, the fact that maternal toxic metal stores are mobilized into breast milk implies infants, whose mothers live and work in mining communities, are at risk of multiple exposure to mining related toxic metals, such as Lead (Pb), Mercury (Hg), Cadmium (Cd) and Arsenic (As), through breast milk intake, in addition to in utero exposure [7]. Milk production is inextricably linked to the environment, since animal exposure to polluted cattle fodder and water is heavily dependent on human activities [8]. The concentration of metals in urban and rural mothers samples was investigated and the maximum concentrations were found in urban mothers simples; This indicates the concentration of metals in the human breast milk [9]. Milk samples collected from lactating females at early morning have high amount of lead, cadmium, cobalt, nickel and copper as compared to that of milk samples collected after two hours [10]. The concentrations of tungsten in samples of breast milk have not been reported [11]. Breast milk monitoring studies of persistent and toxic environmental contaminants are of primary importance for carrying out an adequate risk assessment at the actual levels of human exposure and represent a major source of information on infant perinatal exposure [12]. Estimates of exposure levels posing minimal risk to humans (MRLs) have not been made for tungsten. An MRL is defined as an estimate of daily human exposure to a substance that is likely to be without an evident risk of adverse effects (noncarcinogenic) over a specified duration of exposure. MRLs are derived when reliable and sufficient data exist to identify the target organ (s) of effect or the most sensitive health effect (s) for a specific duration within a given route of exposure. MRLs are based on noncancerous health effects only and not on carcinogenic effects. MRLs can be derived for acute, intermediate, and chronic duration exposures for inhalation and oral routes. An appropriate methodology does not exist to develop MRLs for dermal exposure [13]. There is emerging evidence that tungsten has toxic health effects (13). The estimation of health risks due to specific environmental hazards is fundamental for the protection of human health and the environment. The role of Tungsten as a relatively new metal in the study of environmental health is not well understood or studied to estimate and manage it as a hazard or exposure factor that may adversely affect health.

Its exposure levels have not been sufficiently studied to be considered a risk in the general population and maternal and child even less, however there are studies that relate it to autism [14], other studies simply report that their finding in humans should pay attention to thoroughly investigate the possible toxic effects and their mechanisms involved in Tungsten metal or Tungsten ions in health [15], other authors raise the importance of elucidating the possible health effects of Tungsten [13], and others relate it to stroke, as referred to in the National Survey of Health and Nutrition Examination (NHANES), states that in urinary Tungsten determinations in 8,614 individuals, high urinary concentration is associated with stroke, concluding that Individuals with higher concentrations of tungsten in the urine are twice as likely to suffer a stroke, hypothesizing that the pathway resulting from exposure to Tungsten may involve oxidative stress [16]. The presence and level of Tungsten in 100% of the milk samples studied, shows that the exposure is not due to direct industrial exposure, but has come out of that industrial context, to occur involuntarily and persistently in women's milk that have no relation with the production and industrial use of the metal. Now we can consider it as a metal associated with the ecosystem where they live, the women studied have little or little territorial mobility, the population is inserted and receives water from the Lerma-Chapala basin, a basin linked to the industrial process of the State of Mexico, Guanajuato, Michoacán and Jalisco. (Figure 1)

The levels found have an important variation between the milk samples, a minimum and a maximum that goes from 0.026 to 1.746, with a median of 0.0785 µg / L, an important

variability that surely corresponds to the pressure (production, consumption or release of the milk or environment exposure), as well as involuntary exposure, absorbed dose, and the excretion capacity by the Tungsten Milky Way.

Figure 1. *Location of the community of Agua Caliente, municipality of Chapala, Jalisco, México.*

This study shows that all mothers have Tungsten in the milk with which they feed their infants, their presence and demonstrated concentrations require characterizing the risk of ingesting this route Tungsten, even more when there are no historical data of the dose response. The possible effect should be studied in the future surely through longitudinal studies. Biomonitoring data will also help scientists plan and conduct research on exposure and health effects.

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