Determination of Nickel Concentration in the Breast Milk of Lactating Mothers Living In Hilla City, Babylon, Iraq

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Abstract

Background

Human milk is the only source of food for infants during the first four to five months of their life. Some chemicals compood can be transferred from the body stores and from blood into the breast milk of a lactating mother.

Objectives

To determining and measurements of Nickel leval the human milk and to identify the associations of certain potential variables with the concentrations of these heavy metals.

Subjects and Methods

This is a cross sectional study carried included a milk test by a randomly selected (68) women apparently healthy lactating women, who attended Babylon Maternity & children hospital in Al – Hilla city during the period mid of February through the end of April, 2012. Breast milk was collected and analyzed to detect and measure Nickel using atomic absorption. A questionnaire paper was preparedto recored the demographic variables. Weights and heights were measured to calculate the Body Mass Index.

Results

This study revealed that the mean concentrations of Nickel in the human milk was (23.83±15.57 ppb) which was remarkably high as compared with the concentrations reported by other studies done in other countries. The study shows that there was a statistically significant association ($p<0.0s$) between the high concentrations of Nickel and the followings associates ; living in urban regions ,living near highways , living near industrial regions and drinking river or tap water, being younger (<3oyears of age) or heaver increase weight and being cigarettes smokers. The prevalence rates of lactating mothers with abnormal concentrations of was 99%and 93% respectively indicating the serious environmental pollution in Hilla city.

Conclusion

Breast milk of lactating mothers in Hilla city is abnormally contaminated with; Nickel this public health problem need to be addressed.

1- Introduction

Environmental factors increasing gain importance in public health. Children are affected more than adults from environmental deterioration and harmful effects. Children's exposure to environmental hazards may cause permanent damage and will continue during adulthood, Over the past century, there has been an increasing awareness throughout the world of the health and developmental risks associated with environmental exposure to toxic metals, such as, lead (Pb), mercury (Hg), cadmium (Cd), Iron (Fe), and Nickel (Ni). While exposure to toxic levels of any of these environmental contaminants may result in impaired health in adults, the toxicological effects of these metals are often more devastating in the developing central nervous system and general physiological systems of children [1]. Although Pb is perhaps the most publicized and well known of the pediatric metal intoxicants, environmental pollution in different country or regions, even in rural areas may adversely affect to human life .Air currents, mixing of water sources with metals, the use of leaded gasoline, lead pipes in drinking water transport, and traditional methods of food storage containers in rural sector can make the world more risky in terms of environmental pollution [2].

On the other hand, human milk is also a unique biological matrix for monitoring certain environmental contaminants because it can provide exposure information about both the mother and the breastfed infant through a non-invasive method of collection. Human milk is considered to be one of the most important biota to be monitored for the presence of Persistent Organic Pollutants (POPs). Better understanding of our exposure to harmful environmental chemicals will help us better to manage such chemicals by eliminating or reducing pollutions emissions of such toxic materials or by limiting their presence in the air, food, and water supply[3].

2- Subjects and methods

breast milk samples was collected and analyzed from (68) apparently healthy mothers , started from the mid of February through the end of April, 2012.

Breast milk samples was collected on1-6 weeks postpartum from the respondent lactating mothers who volunteered to participate in this study, their informed consents was obtained after explaining to the objectives and the methodology of this work. Before the self manually expressing milk using a conventional breast pump; the breast was washed by deionized water (distilled water) to avoid contamination with environmental heavy metals, the first few drops was discarded, and only the midstream flow was collected.

Ten (10) milliliter of milk was collected in sterile polypropylene tubes, samples were immediately transferred to a special cooling box with thermometer (temperature of the ice containing box -18 to -21C°).

The samples were transferred for analysis to the chemical laboratory of the chemical department in the college of science – Babylon University and stored in the deep freeze at -30C°, .The concentrations of cadmium and lead was determined by the graphite furnace atomic absorption spectrometry calibration curve was performed by prepared known concentration of Ni with absorbance (nm) of atomic absorption (fig.1).

A questionnaire was used to collect information about the following variables:

Age, occupation, Place of residency near industrial regions (less than 200 meter radius) to the following industrial areas; (districts of car repairing , battery re-charging and repairing workshops, radiator repairing shops, automobile exhaust tubes repairing districts, Arc welding workshops; as well as living near industrial factories).

1- Mothers living within or less than 200 meter radius from highways (street) was considered as dwellers near the street.

2- The questions included information about the history of types of drinking water (Tap, Bottled, or drinking from rivers).

3- Questions about cigarette smoking habits was included in the structured questionnaire, the smokers in this study are women who were currently smoking at the time of collecting data or they had quitted smoking within the last six months. 4 women mentioned that their husbands are smokers (passive smokers) are also included in the smoking group, none of the smokers mentioned that they smoke water pipe (Shisha).

4- Height and weight of mothers was measured and the body Mass Index (BMI) was calculated according to the following equation : Weight in Kilograms/ (Height in meter)^2 [4].

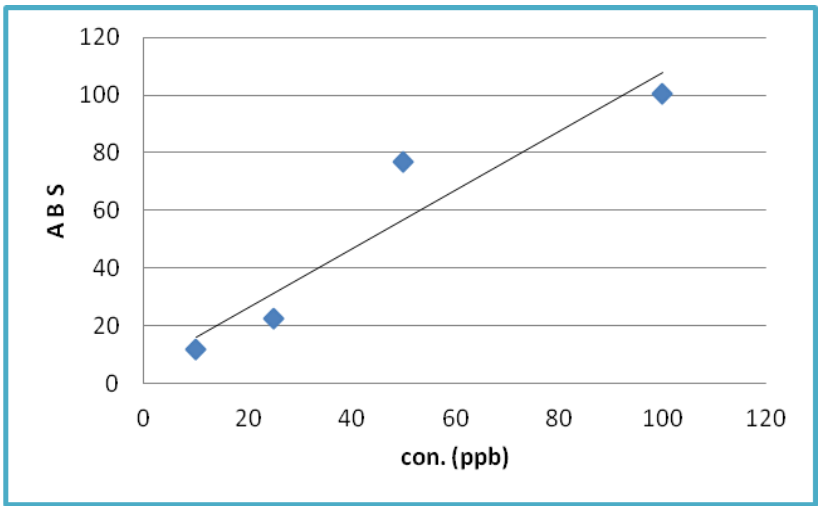

Figure (1) calibration curve of Ni at 232 nm in atomic absorption

3- Statistical Analysis

Using SPSS version / 17 statistical software, Both statistical analysis and tabulation was carried out. Data was summarized as means (X) and standard deviation (SD). Differences were analyzed using Student'st test and Analysis of Variance (ANOVA-one way) for comparison between groups. Differences were considered as statistically significant at values P< 0.05.

4- Results

Table (1) shows that the concentration of Nickel was significantly higher ($p < 0.05$) in rural region ($p \leq 0.05$). Table (2) reveals that the concentrations of this heavy metal increased in lactating mother's milk who are living near highways as compared to those living far away from these streets, this difference is statistically significant ($p \leq 0.05$).

The association of Body Mass Index with heavy metal concentrations in the milk of lactating mothers was evident in the table (3), obesity was associated significantly with the increment in Ni concentration ($p \leq 0.05$).

Living near industrial area has been associated with the contamination of breast milk with heavy metal, this association was presented in table (4), living near industrial areas was associated significantly ($p \leq 0.05$) with high concentrations of Ni. Table (5) shows that tap water and river water consumption was significantly associated with high levels of this heavy metal. Table (6) reveals the association of smoking with heavy metal concentration, the results show that smoking mothers have ahigh concentration of (Ni) in their milk at significant level ($p \leq 0.05$). Table (7) shows that the concentrations of Ni in the milk was at high levels in lactating mothers. Table (8) shows that the concentrations of heavy metals in the milk of the current study were remarkably higher as compared to the concentrations reported by other researchers in other countries. Table (9) shows the prevalence rates of mothers with abnormal concentrations of (Ni) in their milk.

Table (1) Distribution of means and standard deviations of age body mass index and number of cigarettes smoked per day of lactating mothers .

Table (1) Concentration of heavy metal Ni (µg/L) of lactating mother's milk according to place of residency

Place of residency	No	%	Ni
Urban	32	47	24.95 ±19.55
Rural area	36	53	30.81 ±16.59
t-calculate			*2.40

*P<0.05

Table (2) Concentration of heavy metal Ni (µg/L) in lactating mother's milk by place of resident near streets.

Place of street	No	%	Ni
Near street	32	47	31.59±17.41
For away street	36	53	25.3±18.89
t-calculate			*2.5

Table (3) Concentration of heavy metal Ni (µg/L) in lactating mother's milk according to their body mass index

BMI	No	%	Ni
Normal weight	16	23.5	20.29±3.98
Over weight	33	48.5	24.87±2.72
Obesity	19	28	29.56±5.17
f-calculated			1.58*

*p<0.05

Table (4) Concentrations of heavy metal Ni (µg/L) in lactating mother's milk according to living near industrial areas

Area	No.	%	Ni
Industrial area	22	42.4	30.99±12.98
Normal area	46	67.5	24.31±13.40
t-calculated			*2.09

*p<0.05

Table (5) Concentration of heavy metal Ni (µg/L) in lactating mother'smilk by types of drinking water

Drinking water	No	%	Ni
Tap water	43	63.3	26.15±2.31a
bottle water	18	26.5	17.4±2.43b
River water	7	10.2	22.12±5.42c
f- calculated			6.27

Mean ±SE different letters refer to significant between groups at (p≤0.05) (ANOVA- one way)

Table (6) Heavy metals concentrations (Ni) in human milk according to smoking habit

Smoking	No	%	Ni
Smoker mothers	8	11.8	47.5±20.05
Nonsmoker mothers	60	88.2	20.68±11.89
t-calculated			3.23*

*p<0.05

Table (7) Concentration of heavy metal Ni (µg/L) in lactating mother's milk according to age

Age (year)	No.	%	Ni
16-20	12	17.6	30.27±2.99a
21-25	21	30.9	20.82±4.67b
26-30	20	29.4	29.14±1.89a
31-35	7	10.3	50.97±4.49c
36-40	8	11.8	11.92±5.11d
f-calculated			7.35

Mean± SE, different letters refer to significant at (p≤0.05) between groups (*ANOVA*-one way)

Table (8) Comparison between Ni concentration of the current study and studies in other countries

Country	Cd(µg/L)
Turkey	3
USA	15
Present study (Iraq)	23.83±15.57

Table (9) Prevalence rate of women with abnormal concentrations of heavy metal Ni in their milk

Heavy metal	Total	abnormal	(%)
Ni	68	45	66

Discussion

In this study the concentrations of Ni in the breast milk of Iraqi lactating mothers are high. This finding reflected the severity of local environmental pollution with the studied heavy metals (Ni).

In comparison with other studies in the neighboring countries and other countries , our results show a significant increase in the concentrations of the studied heavy metal which bring our attention to a serious hazardous environmental problem which may affect on the health of Iraqi mothers and their children.

Our study revealed differences of heavy metals concentrations in lactating mother's milk in urban and rural area , Ni and Fe was higher in rural. Cinar *et al* (2011) measured some heavy metals in Turkish lactating mother's milk they found similar results [5].

The concentration of Nickel in human milk in rural area was higher than urban area, this may be because this metal can exist in soils in several forms: inorganic crystalline minerals or precipitates, complexed or adsorbed on organic cation surfaces or on inorganic cation exchange surfaces, water-soluble, free-ion or chelated metal complexes in soil solution [6], [7], and [8]. Nickel may present a major problem in land near towns or even in agricultural land receiving wastes such as sewage sludge. Its content in soil varies in a wide range from 3 to 1000 mg/kg [6], [9], and [10].

Milk of lactating mothers living near highway streets had high concentration of heavy metals as compared to mothers living far from the streets , this finding is in consistent with the finding of other studies [11], [12] this can be explained. Street dusts and top roadside soils in urban area are indicators of heavy metal contamination from atmospheric deposition. The source of Ni and Cr in street dust is believed to be due to corrosion of cars [13], [14]; and chrome plating of some motor vehicle parts [15] respectively.

Streets are densely regions by different vehicles and cars that cause air pollution, Components and quantity of street dust are environmental pollution indicators especially in big cities. Street dust is generally composed of car exhaust gas originated particles and wind-transported particles. Heavy metals, which are found in street dust, such as Pb, Cd and Ni are significant for environmental pollution. According to the kind of vehicle in traffic, quantity and type of heavy metals vary in street dust that effected on minerals in human milk; blood and tissue such as accumulate Pb in bones, blood, urine and milk especially during pregnancy and postpartum [16].

In this study living of lactating mothers near industrial area was associated significantly with high concentration of Ni in their milk. In turkey other researchers found increased in Ni and Cd in city center to 3, and 31 ppb respectively, Pb and Fe also increased in city center and in industrial areas [17]. Singh *et al* (2010) clarified that heavy metals concentrations increased in human milk via dietary intake of foodstuff from the weste water [18], so the vegetables growing in the vicinity of an industrial area causes increased in Cd, Cu, Zn, Cr and pb concentration in different part of these vegetable that reflect high level of these metals in human milk [19].

Ni is increasing related to weight or BMI this is may be due to excessive meal intake that containing Ni results from food processing methods apparently add to the nickel levels already present in foodstuffs via: 1. Leaching from nickel-containing alloys in food processing equipments made from stainless steel; 2. the milling of flour; 3.catalytic hydrogenation of fats and oils by use of nickel catalysts [20]. Rich food sources of nickel include oatmeal, dried beans and peas, nuts, dark chocolate and soya products, and consumption of these products in larger amounts may increase the nickel intake to 900 µg/person/day or more [21].

Nickel levels in some vegetables and fruits, in fruit and vegetable juices, in wine and cocktails were within the limits of standards [22],[23] similarly, nickel contents in instant coffee brands, in some natural ground coffees, coffee beans and coffee infusions did not exceed the allowable concentration values stated in relevant Polish regulations. However, a significant relationship was observed between the levels of the nickel in coffee infusions and coffee beans [24],[25]. The concentrations of nickel in bee honey, confectionery products, dry herbs, tea leaves and granulated tea were also below the corresponding allowable values [26] ,[27].

In this study the concentrations of (Ni) in the human milk of lactating mothers drinking tap and river water were high significantly increased, this may result from contamination of river water by the chemical west from industrial plant or from using herbicide, insecticide in high rate, study of Iraqi rivers especially in Euphrates show increased in heavy metals like Pb, Ni concentrations [28]. According to WHO study drinking water generally contains Ni at concentration less than 10 ppb consumed daily of 1.5 L of water and a level of 5-10 microgram\L, the mean daily intake of Ni from water for adults would be between 7.5 and 15 microgram [29].

In the present study 8 of lactating mothers were smokers, this bad habit cause increasied in heavy metal level in their milk. Ni levels raised in smoking lactating mother's milk because the tobacco is considered as Ni source, it has been estimated that each cigarette contains Ni in a quantity of 1.1 to 3.1 µg and about 10-20% of Ni inhaled is present in the gaseous phase, according to some researchers Ni in tobacco smoke may be present in the form of nickel carbonyl, a form which is extremely hazardous to human health[29]. Stjanovic and Nikic (2005) detected Ni concentration in smoking and non-smoking mothers blood, placenta, serum, urine and milk they found high Ni concentration in smoking mothers than non-smoking mothers [30].

Aknowledgement

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CONFLICT OF INTERESTS

There are no conflicts of interest.

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الخلاصة

خلفية البحث

يعد حليب الانسان المصدر الوحيد كغذاء للرضع خلال اول اربعة او خمسةاشهر من حياته. بعض المواد الكيميائية قد تنتقل من خزنها في الجسم او من الدم الى حليب الثدي للام المرضعة.

أهداف البحث

تحديد وقياس مستوى النيكل قي الحليب ألبشري للأمهات المرضعات ومعرفة علاقة الارتباط بين تركيز هذا العنصر بعض العوامل المختلفة, إضافة لتحديد نسبة الأمهات ذات التركيز العالي من هذا العنصر الثقيل في الحليب عالي التركيز في هذا العنصر الثقيل أ.

طريقة العمل

تضمنت هذه الدراسة المستعرضة فحص حليب ٦٨ من المرضعات المتطوعات السليمات من الناحية الصحية والمراجعات لمستشفى الولادة والأطفال في مدينة ألحلة للمدة من منتصف شباط إلى نهاية نيسان عام ٢٠١٢، جمعت عينات الحليب وحللت باستعمال جهاز الامتصاص ألذري لقياس المعادن ألثقيلة ، أعدت ورقة استبيان لتسجيل المتغيرات ألمعتمدة و تم قياس طول ووزن ألمشاركات لتحديد مؤشر كتلة الجسم .

النتائج

أن متوسط تركيز النيكل كان (23.83±15.57)الحليب الأمهات المرضعات أعلى بشكل كبير من التركيز ألتي توصلت أليها دراسات عالمية أخرى .وسجلت ألدراسة وجود علاقة إحصائية معنوية مهمة ($P\leq0.05$) بين زيادة تركيز النيكل والسكن في المناطق الحضرية وقرب الشوارع العامة والمناطق ألصناعية وشرب الماء من ألأنهر و مياه الإسالة إضافة لصغر عمر المرضعة (اقل من ٣٠سنة) وزيادة وزنها, وظهر ارتباط إحصائي معنوي ($P\leq0.05$) بين المرضعات المدخنات وزيادة تركيز هذا العنصر في حليب المشاركات.

كان معدل المرضعات اللواتي لهن زيادة غير اعتيادية في تركيز النيكل،٩٩%، مما يؤشر وجود تلوث خطير بهذا المعدن في بيئة مدينة الحلة.

الاستنتاجات

نستنتج من خلال دراستنا ان حليب الأمهات المرضعات ملوث بمعدن النيكل وهنالك حاجة ماسة لدراسات وطنية واسعة وجهود يجب أن تبذل لرصد ألملوثات بيولوجيا والسيطرة على التلوث البيئي محليا.

الكلمات الدالة: تحديد تركيز النيكل، حليب الأمهات المرضعات في مدينة الحلة, بابل, العراق.