Lead and Cadmium In The Breast Milk of Lactating Mothers Living In Hilla City, Babylon, Iraq, During The Year 2012

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Abstract

Background In the last decades, the continued efforts of scientists to measure environmental pollutants in human milk is important for defining the true toxic contribution t of these chemicals to public health, human milk is considered to be one of the most important biota to be monitored for the presence of toxic heavy metals.

Objectives

Determining of lead and cadmium concentrations in 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 out on milk expressed by a randomly selected (68) apparently healthy lactating mothers , 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 Lead and Cadmium using atomic absorption. A structured questionnaire was used to report the demographic variables. Weights and heights were measured to calculate the Body Mass Index.

Results

Means and the standard deviations of the mother's ages and their Body Mass Index were 26.17±6.49 and 27.78±3.79 respectively. This study revealed that the mean concentrations of Lead and Cadmium in the human milk were (25.9±18.4 ppb) (5.6±1.77 ppb) respectively which were remarkably high as compared with the concentrations reported by other studies done in other countries. The study shows that there were a statistically significant association between the high concentrations of lead and cadmium and the followings associates ; living in urban regions ,living near highways , living near industrial regions , drinking river or tap water , being younger(<3oyears of age) or heaver in weight and being cigarettes smokers . The prevalence rates of lactating mothers with abnormal concentrations of Cadmium and Lead were 100%and 93% respectively indicating the serious environmental pollution in Hilla city.

Conclusion

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

Keywords Cadmium, lead, breast milk, lactating women, Hilla city, Babylon, Iraq

الخلاصة

تحديد تركيز الرصاص و الكادميوم ، في حليب الأمهات المرضعات في العراق– محافظة بابل –مدينة الحلة لعام ٢٠١٢.

خلفية البحث

من عقود خلت يحاول العلماء قياس المعادن الثقيلة والملوثات البيئية الأخرى في الحليب البشري لكونها عوامل مرتبطة بالصحة العامة للفرد والمجتمع أن الحليب البشري يعتبر احد أهم مؤشرات الرصد الحيوي لوجود العناصر الثقيلة الملوثة والسامة.

أهداف البحث

تحديد وقياس الرصاص و الكادميوم قي الحليب ألبشري للأمهات المرضعات و توضيح علاقة الارتباط بين تركيز هذه العناصر وعوامل مختلفة، إضافة لتحديد نسبة الأمهات ذوات الحليب عالي التركيز في هذه العناصر ألثقيلة أ.

طريقة العمل

هذه دراسة مستعرضة لحليب ٦٨ من المرضعات المتطوعات السليمات من الناحية الصحية والمراجعات لمستشفى الولادة والأطفال في مدينة ألحلة للفترة من منتصف شباط إلى نهاية نيسان عام ٢٠١٢، جمعت عينات الحليب وحللت باستعمال جهاز الامتصاص ألذري لاكتشاف وقياس المعادن ألثقيلة ، أعدت ورقة استبيان لتسجيل المتغيرات ألمعتمدة و تم قياس طول ووزن ألمشاركات لتحديد مؤشر كتلة الجسم .

النتائج

بينت ألدراسة ان الوسط الحسابي والانحراف ألمعياري لأعمار وكتل الجسم للمشاركات (٢٦.١٧±٦.٤٩ و٢٧.٧٨±٣.٧٩)على التوالي.

أن متوسط تركيز الرصاص (ppb 18.4±25.9) و الكادميوم (ppb 1.77±5.6)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 التركيز للرصاص والكادميوم والسكن في المناطق الحضرية وقرب الشوارع العامة و المناطق ألصناعية وشرب الماء من ألأنهر و مياه الإسالة إضافة لصغر عمر المرضعة (اقل من ٣٠سنة)وزيادة وزنها، وظهر ارتباط إحصائي معنوي ومهم ($p0.05$) بين تدخين السكائر وزيادة تركيز هذين العنصرين في حليب المشاركات.

كان معدل المرضعات اللواتي لهن زيادة غير اعتيادية في تركيز الكادميوم و الرصاص،١٠٠%، و٩٣%على ألتوالي ، مما يؤشر وجود تلوث خطير بهذه المعادن في بيئة مدينة الحلة.

الاستنتاجات

حليب الأمهات المرضعات ملوث بالمعادن الثقيلة السامة الرصاص و الكادميوم وهنالك حاجة ماسة لدراسات وطنية واسعة وجهود يجب أن تبذل لرصد ألملوثات بيولوجيا والسيطرة على التلوث البيئي محليا.

Introduction

Human milk is the natural and superior food for infants containing the optimal composition to meet their nutritional needs (WHO, 2006).

Human milk is usually the only source of food for infants during the first four to five months of their live (Condon 2005, Rahimi et al. 2009) and it is the ideal way of nurturing infants, though it can be a source of exposure to toxicants. The presence of heavy metals in human milk has special interest due to their toxicity (Esquinas et al.

2009) . 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),and cadmium (Cd). 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 (landrigan et al. 2002) A number of potentially toxic metals such as Pb, Hg and Cd have been reported in Breast milk monitoring studies, and their mean values in human milk vary in a wide range(Francesco et al.2008) . Each metal is distributed in a characteristic way between the
milk fractions. Cd and pb are of considerable interest due to their toxicity and widespread use (Abdel-Ghani et al.2007, Gueu et al.2007, Karbassi et al .2008, Samarghandi et al.2007). Although Pb is perhaps the most publicized and well known of the pediatric metal intoxicants(Nickerson, 2013) ,4is. Many studies indicate that (Pb) and (Cd) exposure may alter bone development through both direct and indirect mechanisms, increasing the risk of osteoporosis later in life (Yang et al.2013).
Lead is an old environmental metal which is presented everywhere and lead poisoning is an important health issue in many countries (Mehrpou,2013) An increased level of Pb in human breast milk and plasma could be explained because of continuous exposure to the polluted environment. Hence, the infants are expected to have higher intake of Pb through mother's milk and therefore, are exposed to potential health related issues based on Pb levels and associated toxicity, which is of a serious concern to the society and needs to be addressed (Isaac et al.2012) Lead levels in human breast milk and drinking water samples from different exposure situations can give information on the correlation between water and milk levels(Raafat et al.2013) .
Few discussions have been held on the magnitude and potential risk associated with exposure from the consumption of breast milk (Kobayashi et al.2010) The phasing out of lead from gasoline has resulted in a significant decrease in blood lead levels in children during the last two decades (Tuakuila et al.2013) . Cadmium emissions have increased dramatically during the 20th century, one reason being that cadmium-containing products are often dumped together with household waste.
Cigarette smoking is a major source of cadmium exposure. In non-smokers, food is the most important source of cadmium exposure. Recent data indicate that adverse health effects of cadmium exposure may occur at lower exposure levels than previously anticipated(Järup 2003).

Subjects and methods:

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

Breast milk samples were collected on1-6 weeks postpartum from the respondent lactating mothers who volunteered to participate in this study, their informed consents were 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 were discarded, and only the midstream flow was collected.

Ten (10) milliliter of milk were 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 were determined by the graphite furnace atomic absorption spectrometry.

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 o f 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 high ways (street) were considered as dwellers near 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 were 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 were measured and the body Mass Index (BMI) was calculated according to the following equation : Weight in Kilograms / (Height in meter)^2

Statistical Analysis

Using SPSS version / 17 statistical software, Both statistical analysis and tabulation were carried out. Data were summarized as means (X) and standard deviation (SD). Differences were analyzed using Student's t test and Analysis of Variance (ANOVA-one way) for comparison between groups . Differences were considered as statistically significant at values $P< 0.05$.

Results

Table (1) clarifies variables of base line characteristics of the study group , the means and the standard deviations(SD) of the women age and their BMI were 26.17±6.49 and 27.78±3.79 respectively.. Table (2) reveals that Pb and Cd concentrations increased significantly among unemployed mothers ($p\leq0.05$).

Table (3) shows that the concentration of Pb was significantly higher in urban region ($p\leq0.05$). Table (4) reveals that the concentrations of these heavy metals 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 ($p\leq0.05$).

The association of Body Mass Index with heavy metals concentrations in the milk of lactating mothers was evident in table (5), over weight was associated significantly with the increment in Pb concentration ($p\leq0.05$) .

Living near industrial area has been associated with the contamination of breast milk with heavy metals, this associations was presented in table (6), living near industrial areas was associated significantly ($p\leq0.05$) with high concentrations of Cd, and Pb. Table (7) shows that tap water and river water consumption was significantly

associated with high level s of these heavy metals. Table (8) reveals the association of smoking with heavy metals concentrations, results show that smoking mothers have high concentration of (Cd and Pb) in their milk at significant level ($p \leq 0.05$). Table (9) shows that the concentrations of Pb in the milk were at high levels in lactating mothers (below 30 years) . Table (10) 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 (1) shows the prevalence rates of mothers with abnormal concentrations of (Pb, and Cd) in their milk.

Results

Table (1) Distribution of means and Standard Deviations of Age Body Mass Index and Number of cigarettes smoked per day of lactating mothers .

Variable	**Mean±SD***	**CV****
Age (year)	26.17±6.49	24.79
Body mass index	27.78±3.79	13.64
Number of cigarette	12.00±1.85	15.41

*SD: Standard deviation ** CV: Coefficient of variation.

Table (2) Concentration of heavy metals (µg/L) in lactating mother's milk by their working conditions (occupation)

Working	No	%	Cd	Pb
Employed (means & SD)	8	11.8	9.44±0.59	29.88±6.68
House wive (means & SD)	60	88.2	5.51±1.27	21.95±9.21
t-calculated			2.4	2.38

Table (3) Concentration of heavy metals (µg/L) of lactating mother's milk according to place of residency

Place of residency	No	%	Cd	Pb
Urban	32	47	5.19±0.73	31.65±22.19
Rural area	36	53	6.26±2.58	19.59±13.66
t-calculate			*2.40	*2.3

*$p<0.05$

Table (4) Concentration of heavy metals (µg/L) in lactating mother's milk by place of resident near highways

Place of residency	No	%	Cd	Pb
Urban	32	47	5.19±0.73	31.65±22.19
Rural area	36	53	6.26±2.58	19.59±13.66
t-calculate			*2.40	*2.3

*p<0.05

Table (5) Concentration of heavy metals (µg/L) in lactating mother's milk according to their body mass index

BMI	No	%	Cd	Pb
Normal weight	16	23.5	6.15±0.48	11.13±3.25
Over weight	33	48.5	5.64±0.25	29.09±3.81
Obesity	19	28	4.98±0.10	20.96±2.81
f-calculated			3.053*	5.58*

*p<0.05

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

Table (6) Concentrations of heavy metals (µg/L) in lactating mother's milk according to living near industrial areas

Area	No.	%	Cd	Pb
Industrial area	22	42.4	9.23±2.08	38.64±35.52
Normal area	46	67.5	5.24±0.52	16.19±9.14
t-calculated			*2.1	*2.65

*p<0.05

Table (7) Concentration of heavy metals (µg/L) in lactating mother'smilk by types of drinking water

Drinking water	No	%	Cd	Pb
Tap water	43	63.3	8.97±0.24	30.54±3.87
bottle water	18	26.5	5.73±0.52	15.90±2.57
River water	7	10.2	6.21±0.48	30.88±4.33
f- calculated			0.23	2.75

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

Table (8) Heavy metals concentrations (cd and pb) in human milk according to smoking habit

Smoking	No	%	Cd	Pb
Smoker mothers	8	11.8	9.58±2.85	54.79±27.97
Nonsmoker mothers	60	88.2	5.07±0.41	22.08±12.80
t-calculated			4.649*	3.311*

*p<0.05

Table (9) Concentration of heavy metals (µg/L) in lactating mother's milk according to age

Age (year)	No.	%	Cd	Pb
16-20	12	17.6	5.28±0.129	32.35±7.01
21-25	21	30.9	5.28±0.4	25.0±3.48
26-30	20	29.4	5.20±0.15d	32.99±5.20
31-35	7	10.3	5.18±0.20	14.05±0.99
36-40	8	11.8	7.68±1.25	16.26±5.44
f-calculated			3.37	1.79

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

Table (10) Comparison between heavy metals concentration of the current study and studies in other countries

Country	Pb(µg/L)	Cd(µg/L)	Reference
Turkey	14.6	2.8	Turn, *et al* (2001)[39] Cinar, *et al* 2011[22]
Iran	10.39	2.44	Rahiemi, *et al* (2009)[3]
Saudi Arabia	3.9	1.9	Kinsara and Farid (2004)[36]
Greece	0.48	0.19	Leotsinidis, *et al* (2005)[23]
Swedish	0.5-0.9	0.05-0.07	Halen,*et al* (1995)[38]
India	1.9	0.09	Tripathl, *et al* (1999)[37]
Egypt	1.7-5.92	0.638-2.56	Moussa, (2011)[29]
Present study(Iraq)	25.9±18.40	5.60±1.77	Hasan , et al (2012)

Table (11) Prevalence rate of women with abnormal concentrations of heavy metal in their milk

Heavy metals	Total	abnormal	(%)
Cd	68	68	(100)
Pb	68	63	(93)

Discussion

By their spread speed in biosphere and increasing concentrations heavy metals are considered to be among the most hazardous pollutants (Dizaji1 et al.2012) The almost ubiquitous presence of some metal pollutants, especially cadmium and lead،in the environment facilitates their entry into the food chain, water and air, thus increasing the hazard of human and animal health(Licata et al. 2004). In this study the working conditions were positively associated with the presence of high levels of (Pb, and Cd) in the milk of employed mothers. This may be due to persistent exposure to those environmental pollutants in extensive way during transportation in addition to the role of high concentrations of these metals in the working environment (Salman et al. 2007).

This study shows a significantly high concentration levels of Pb and Cd in the breast milk of mothers living in urban districts, this finding is similar to the finding of Cinar *et al* (2011) who measured some Heavy metals in Turkish lactating mother's milk. Milk of lactating mothers living near highway streets had high concentrations of heavy metals as compared to mothers living far from these streets , this finding agreed with the findings of other studies(Leotsinidis et al. 2005 , khter and Madany, 1993) this can be explained. Street dusts and top roadside soils in urban area are indicators of heavy metal contamination from atmospheric deposition. Road dust, particularly the fine particle, can be absorbed by human through ingestion, inhalation, and dermal absorption.

In today's urban area, road dust has been disturbed severely by human activities. As a result, the components of road dust in cities are significantly affected by anthropogenic pollutants. Pb, Cr, Zn, Cd, and other toxic metals will continue to accumulate in urban environment due to their non-biodegradability and long residence time, thus they are known as ''chemical time bombs(Fatlawi and Al-Alwani, 2012) Key heavy metals are thereby Pb from leaded gasoline, Cu and Cd from car components, tire abrasion, lubricants industrial and incinerator emissions(khter and Madany, 1993) .

In this study living of lactating mothers near industrial areas was associated significantly with high concentration of heavy metals in their milk this finding is inconsistent with the findings of other researchers in Iran Goudarzi *et al* (2012) recorded high level of Ag, Cd and Pb in human milk of lactating mothers resident near industrial areas in Isfahan, Singh *et al* (2010) clarified that heavy metals concentrations increased in human milk via dietary intake of food stuff from the west water , so the vegetables growing in the vicinity of an industrial area causes increased in Cd, Cu, Zn, Cr and Pb concentration in different parts of these vegetables that reflect high level of these metals in human milk(Farooq et al. 2009). In Egypt Cd and Pb concentrations increased in densely and industrial area(Moussa 2011).

This study shows a positive association between increasing body weight and high level of lead concentration in the breast milk. Increasing in lead concentration in over weight correlated with fat content of human milk(Sim and McNeil, 1993). The concentration of these metals were significantly low in the milk of mothers who used

to drink bottled water as compared to the concentrations in the milk of mothers who used to drink river water or tap water this may indicate that both tap and rivers waters are seriously polluted with these toxic metals ,a local study showed that un treated waste water effluent from Al- Hilla textile big factory leads to increase the Pb concentrations in Hilla River more than permissible limits in rivers water(Hilla river is the main source of tap water in Hilla city).

Also, the Hilla textile factory effluent effects on the distribution of heavy metals concentrations with the distance along the river downstream the effluent outfall by a gradually increasing in the concentrations of heavy metals that is found in the effluent(Al-Zubiadi 2012) Increased Cd and Pb levels in human milk in this work were positively and strongly associated with cigarette tobacco smoking, this finding agreed with the findings of many studies carried out in different countries(Al-Zubiadi 2012, Esquinas et al. 2011 , Ursinyova et al. 2005)

The mean of Pb in milk of lactating mothers was significantly higher in women aged less than 30 years this finding agreed with the finding of other studies(Ursinyova et al. 2005, Ettinger et al. 2004) On the contrary younes his associates reported that the lead concentration was significantly lower in milk of young age mothers (<20years) (younes et al. 1995)

The results of this study show that the cadmium and lead concentration in milk samples obtained from healthy women in Hilla city were remarkably higher than the levels reported from other developed and developing countries (Kinsara et al. 2004, Tripathi et al. 1999, Hallén et al. 1995, Turan et al. 2001). All milk samples were contaminated with Cd while 93% of the samples have abnormal unaccepted concentrations of lead, this finding brings the attention to address our environment pollution.

Conclusion

This study examined the presence of heavy metals in breast milk, and analyzed the relationship between heavy-metal content and potential epidemiologic variables. Our results are the first to furnish information on these contaminants in the breast milk of Iraqi women living in Hilla city.

Cd and Pb concentrations in human milk were remarkably high compared to the levels reported internationally Living in urban areas, near high ways, and near industrialized areas as well as drinking tap water and cigarette smoking and body were the main factors related to high Pb and Cd levels in breast milk.

Our results entail the need to survey these pollutants in milk and to reinforce the need to strengthen national programs to reduce heavy metals environmental pollution, the pollution status is expected to increase in the coming years; avoidance of unhealthy behaviors such as smoking during pregnancy by effective planned health education is strongly needed.

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