Journal of College of Education for pure sciences(JCEPS)
Web Site: http://eps.utq.edu.iq/ Email: com@eps.utq.edu.iq
Volume 7, Number 4, December 2017

Estimation of Cadmium and MercuryConcentrations in Milk of Nursing Mothers in Early Stages of Breastfeeding in Al-Muthanna Governorate

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Abstract:

The aim of this study was measuring the concentrations of cadmium and mercury in milk of nursingmothers who living in Al-Muthanna governoratein southern of Iraq, 62 samples of mother's milk were collected after six weeks of birth at the maternity and children hospital in Samawah city, from 13/11/2016 to 23/4/2017. Samples were divided according to living area, job, smoking and age. The average of cadmium and mercury concentrations were (1.09) (0.31) µg/dl respectively, the highest measured values of cadmiumandmercury concentrations were (3.62) and(0.75) µg/dlrespectively. The study showed a significant difference in the rates of cadmium and mercury concentrations of lactating mothers living in urban areas than those who living in rural areas.The rates of cadmium and mercury concentrations for employee and workers mothers were significantly higher than those of non-working mothers.Cigarette smoke had the greatest effect on levels of cadmium and mercury concentrations. These concentrations for lactating mothers who smoked or directly exposed to cigarette smoke were higher thannon-smokers. the study showed a very small increase in concentrations of cadmium and mercury among lactating mothers who are over 25 years than under age of 25 years.

Keywords: Heavy metals, Cadmium, Mercury, Mother's milk, Pollution

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تقدير الكادميوم والزئبق في حليب الامهات المرضعات في المراحل المبكرة من الرضاعة في محافظة المثنى

الخلاصة:

الهدف من هذه الدراسة قياس تراكيز الكادميوم والزئبق في حليب الامهات المرضعات اللواتي يعشن في محافظة المثنى جنوب العراق، حيث تم جمع 62 عينة من حليب الامهات المرضعات بعد مرور فترة اكثر من ستة اسابيع من الولادة في مستشفى النسائية والطفل في مدينة السماوة للفترة 2016/11/13 – 2017/4/23 ، قسمت النماذج حسب منطقة معيشة المرضعات ونوع العمل والعمر والتدخين، واظهرت النتائج ارتفاعا واضحا في تراكيز الكادميوم والزئبق عن تراكيزهما المقاسة في مختلف دول العالم. حيث كانت معدلات تراكيز الكادميوم والزئبق للعينات الكلية (1.09) (0.31) مكغ/دسل على التوالي وكانت اعلى قيمة مقاسة لتركيز الكادميوم (3.62) مكغ/دسل واعلى قيمة لتركيز الزئبق (0.75)مكغ/دسل، واظهرت الدراسة فرق كبير في معدلات تراكيز الكادميوم والزئبق للمرضعات اللواتي يعشن في المناطق الحضرية عن اللواتي يعشن في الارياف، وكانت معدلات تراكيز الكادميوم والزئبق بالنسبة للمرضعات الموظفات والعاملات اعلى وبشكل واضح عن المرضعات الغير عاملات، اما دخان السكائر فكان له الاثر الاكبر على الاختلاف في معدلات تراكيز الكادميوم والزئبق فكانت هذه التراكيز مرتفعة بالنسبة للمرضعات المدخنات او اللاتي يتعرضن بصورة مباشرة لدخان السكائر عن الغير مدخنات.وقد اظهرت الدراسة ارتفاع بسيط جدا في تراكيز الكادميوم والزئبق بين المرضعات اللواتي يبلغن من العمر اكثر من 25 سنة عن اللواتي يبلغن من العمر اقل من 25 سنة.

Introduction:

Mother's milk is considered as the best food for the children because it contains the basic factors to build the immune system of the body, and it is provided the main source of the child's physical and emotional needs as well as provideduseful elements and compounds for his body[1]. Mother's milk differs from formula milk as it supports the nutritional needs of the child because it contains the optimal compoundsrequire in the early stages of growth[2]. Mother's milk is usually considered the only source of infants food in the first four or five months of their lives[3-5]. In the lactation period, the composition of the milk subject to several changes, leads to change in the proportion of elements in addition to change the quantity and quality of proteins, fats and carbohydrates in the milk[6]. Despite the fact that mother's milk is susceptible to poisoning by heavy metals, it remains the best way to feed infants[7]. Mother's milk contains essential and non-essential elements, Cadmium and mercury are considered as non-essential and toxic elements, causing toxicity in the blood and milk even at very low concentrations[8]. Heavy metals that poison mother's milk are Pb, Cd, Hg, Zn, Cr and other minerals[9]. The average presence of these heavy metals in mother's milk varies from one environment to another over a wide range[10]. Every metal of these is distributed among the milk parts, and the most important of the heavy metals are Cd and Pb for their high toxicity[11-14]. In recent years, the environment has been heavily polluted as a result of wars, and increase in industrial, commercial and agricultural activities, as well as irregular population growth, and also due to the flow of sewage and the wrong way of handling waste[15]. The production and refining of petroleum led to another kind of serious pollution of the environment, especially the aquatic environments, which caused great danger to all living organisms, because these pollutants enter the food chain and contaminate blood and mother's milk[16,17]. The concentrations of heavy metals in mother's milk are increased by contaminatedfood, especially near the industrial areas that pollute the irrigation water of the plantations, thus increasing the proportion of heavy metals in milk, including Cd and Hg [18].

The emission of Cd has increased significantly in the twentieth century, the reasons for this increase is represented by containing many cans of products in the house waste hasCd, and smoking cigarettes has a big cause of exposure to increase Cd levels in the body of the smoker, while contaminated food Is the primary source of exposure to Cd for non-smokers, the recent research has shown that the Cd damage on the body can cause much less than previously expected[19]. Kidneys are the main objective of Cd, where Cd associated with small molar mass proteins in the urine, causing damage and enlarge torenal tubules, Other effects of Cd include

disorders of calcium metabolism, hypercalcemia, kidney stones, pregnancy hypertension and Osteoporosis later in the advanced life of the individual[20,21].

Mercury is a world health concern because of its widespread toxic effects in environments containing high or even low concentrations due to its ability to enter the body's biological systems[22]. Infants may exposed to Hg through milk[23]. Mercury and methyl mercury "a form of mercury in milk" expose the individual to neurotoxicity, methyl mercury is classified as a carcinogen belonging to group C[24].

The objective of current study is to estimate the concentration of Cd and Hg in milk of healthy mothers who living in Al-Muthanna governorate southern of Iraq and determine the correlation of these elements with the mother's living area, work, age and smoking effect.

Materials & Methods:

Collection Of Samples:

62 samples of milk were collected from healthy mothers who attended to the maternity and child hospital in the city of Samawah, from different areas of Al-Muthanna Governorate, from 13/11/2016 to 23/4/2017, samples were taken after six weeks of birth by a traditional Breast pump. All samples were kept in polyethylene containers at -10 ° C.

Cd & Hg Estimation:

10 ml of each milk samples were taken,thenmixed with 3 ml of 65% nitric acid $HNO_3$and 3 ml of 30% hydrogen peroxide H_2O_2 , the volume was completed to 20 ml with double distilled water. Cd was measured by Graphite Furnace Atomic Absorption Spectrophotometry (GFAAS), while Hg was measured by Cold Vapor Atomic Absorption Spectrophotometry (CVAAS)[25].

Statistical Analysis:

Using SPSS/22 analysis software to estimate means and standard deviation (SD) for all data were previously measured.

Results:

The concentrations of Cd and Hg in mother's milk were measured for 62 samples which were taken six weeks after the birth of healthy mothers in Al-Muthanna Governorate. The samples were divided according to living area, labor, smoking and age,. The results were as following:

Table (1) refers to the mean and the standard deviation of Cd and Hg concentrations for all taken samples. Table (2) shows the means of heavy metals according to living area (rural and urban), the concentrations of Cd and Hg in mother's milk who living in urban areas are higher than those who living in rural areas.Table (3) shows the means of Cd and Hg concentrations according to labor (employee or housewife),the concentrations of employees mothers carry a higher proportion of heavy metals in milk than housewives.Table (4) shows the effect of smoking on the average concentrations of Cd and Hg in mother's milk, which indicates a big difference in the concentration of Cd for smoker mothers than non-smokers, while Hg concentrations in milk for smokers little higher than non-smokers.Table (5) indicates the effect of ageon the concentrations of Cd and Hgin mother's milk and shows that the concentration of Cd and Hg for mothers over 25 years is slightly higher than those under age of 25 years.

Table (1): The mean and standard deviation of heavy metals concentrations (µg/dl) in all milk samples.

Heavy metals	**Mean ± SD**
Cd	1.09 ± 0.73
Hg	0.31 ± 0.18

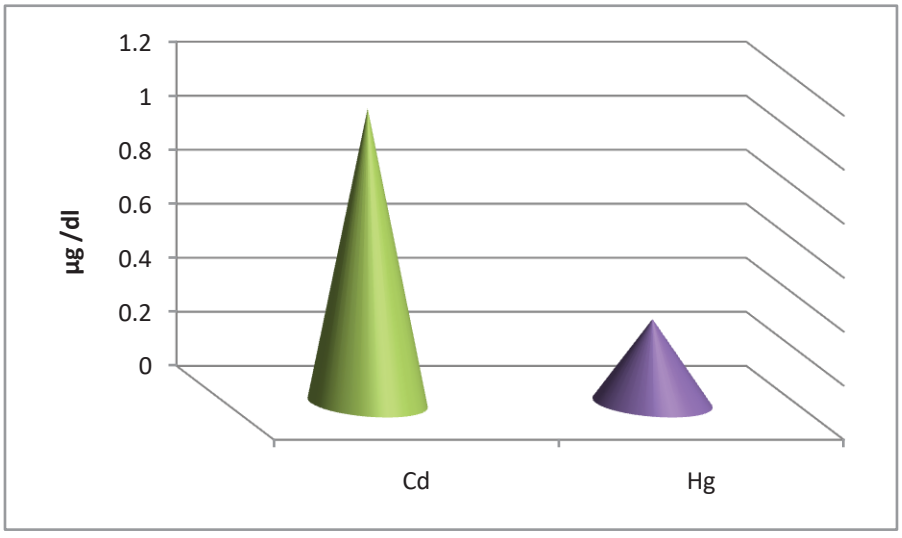

Figure (1): Concentrations of heavy metals in all milk samples.

Table (2): The effect of living area on the average of concentrations of heavy metals (µg/dl) in mother's milk.

Living area	Number of Samples	%	Cd Mean ± SD	Hg Mean ± SD
Rural	34	55	0.92 ± 0.57	**0.28 ± 0.19**
Urban	28	45	1.23 ± 0.87	**0.34 ± 0.18**

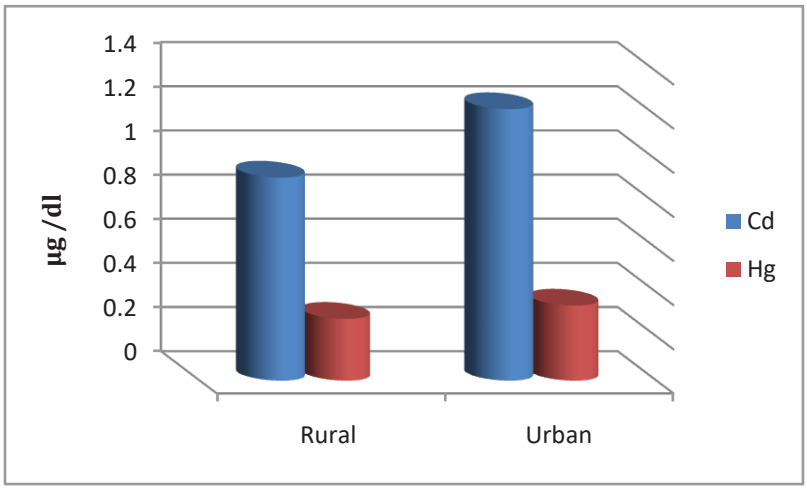

Figure (2): Concentrations of heavy metals in mother's milk according to living area.

Table (3): The effect of labor on average concentrations of heavy metals (µg/dl) in mother's milk.

labor	Number of Samples	%	Cd Mean ± SD	Hg Mean ± SD
Employee	15	24	1.26 ± 0.95	**0.37 ± 0.16**
Housewife	47	76	0.95 ± 0.67	**0.28 ± 0.18**

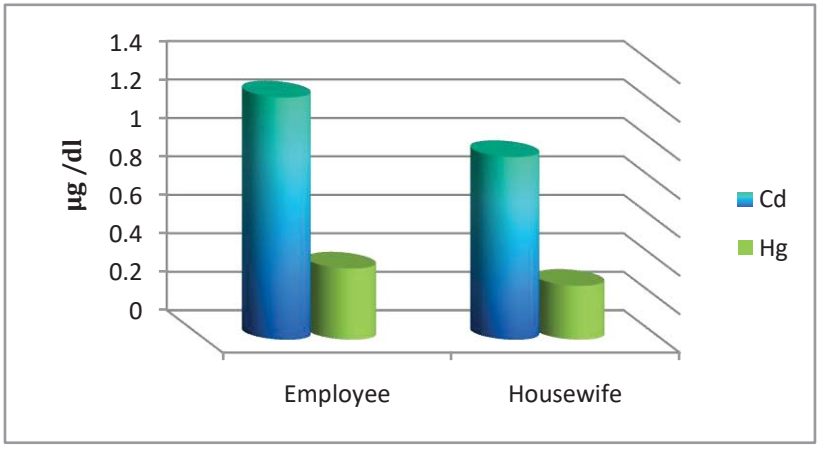

Figure (3): The concentrations of heavy metals in mother's milk according to labor.

Table (4): The effect of smoking on average concentrations of heavy metals (µg/dl) in mothers' milk.

Smoking	Number of Samples	%	Cd Mean ± SD	Hg Mean ± SD
Smoker	5	8	1.49 ± 0.85	**0.39 ± 0.22**
Non Smoker	57	92	0.99 ± 0.72	**0.30 ± 0.18**

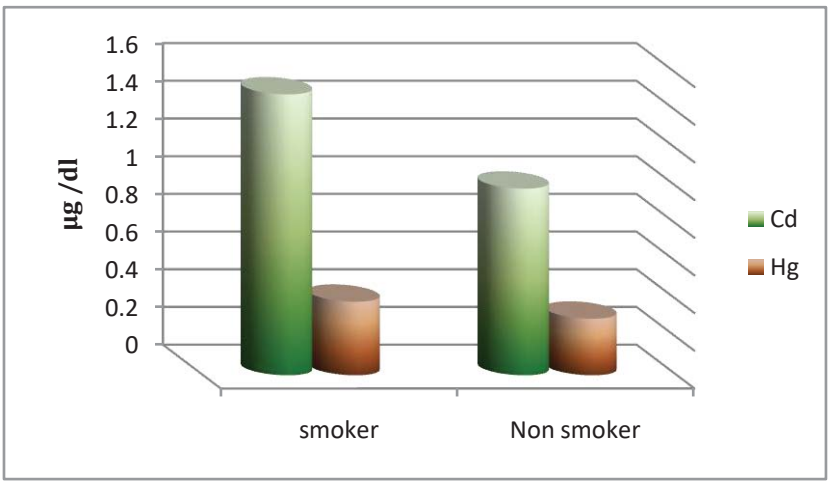

Figure (4): Concentrations of heavy metals in mother's milk according to smoking.

Table (5): The effect of maternal age on average concentrations of heavy metals (µg/dl) in mother's milk.

Age	Number of Samples	%	Cd Mean ± SD	Hg Mean ± SD
< 25	24	38	0.94 ± 0.70	**0.27 ± 0.20**
≥ 25	38	62	1.08 ± 0.77	**0.33 ± 0.18**

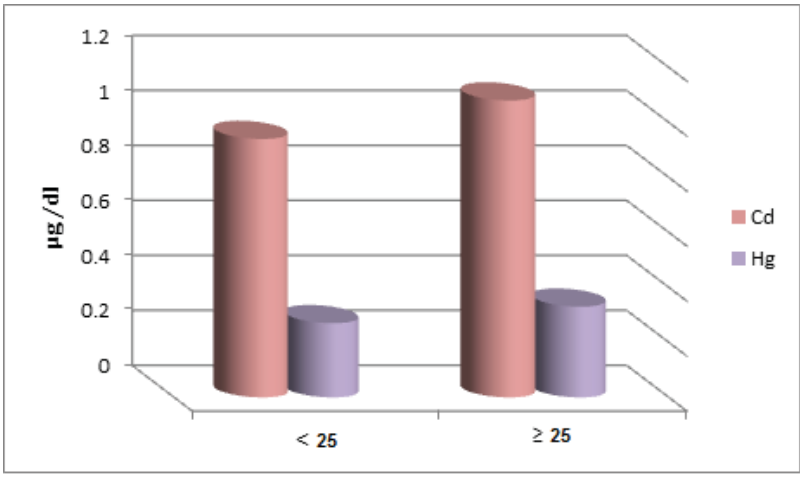

Figure (5): Concentrations of heavy metals in mother's milk by their age.

Discussion:

This study,shows the correlation of the presence of high levels of Cd and Hg in mother's milk with their age, job, living area and smoking especially employeessince this caused by the continuous exposure to environmental pollutants during mobility or in the work environment[26].High concentrations of heavy metals due to their wide spread in the environment, these heavy metals are considered to be one of the most dangerous pollutants in the biosphere[27].

In the present study, high levels of Cd and Hg concentrations in mother's milk living in urban areas are shown. This result is similar to the previous studies[28].This can be attributed to increase of heavy metals pollution near factories, and the large number of cars in urban areas, the urban area also differs from rural with the spread of manufactured pollutants which contains pb, Cd and Hg.They accumulate in urban environments because of its non-degradability[29].The most common cause of pollution is the residues of gaseous vehicles containing heavy metals of Pb and Cd as well as lubricants and tire residues. This leads to a clear difference in concentrations of heavy metals, including Cd and Hg in mother's milk living in urban areas from the rural areas[30].

Cigarette smoke had the greatest effect on levels of cadmium and mercury concentrations. These concentrations for lactating mothers who smoked or directly exposed to cigarette smoke were higher than non-smokers, and this result similar to many previous studies in different countries[3,25,31-33].The concentrations of Cd and Hg in milk varied among mothers according to age and found that mothers over 25 years had a slightly higher heavy metals concentrations than women less than 25 years old.This similar to the results obtained from different studies[3,33,34], however, there are some studies differ in some results[35].

Conclusion:

This study dealt with the presence of heavy metals in mother's milk and the relationship between the concentrations of heavy metals and potential environmental pollutants in Muthanna Governorate in southern of Iraq.The Cd and Hg concentrations in mother's milk were significantly higher than the concentrations of these minerals in many internationally published research.

The main reasons that caused high levels of Cd and Hg in mother's milk is regarded to the environmental pollution of the living area as well as the effect of cigarette smoke. Therefore, we need to reduce these pollutants by strengthening national programs to reduce the environmental pollution of heavy metals, and avoid unhealthy habits such as smoking, especially during pregnancy period.As well as working on the treatment of factories waste such assewage and don't

throw them in the rivers, and awareness raising through health education with specialized government and local programs.

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