Original Research Article

Comparative Study of Heavy Metals in Breast Milk of Breast feeding Mothers in Urban and Sub-urban Subjects in Rivers State

Abstract

Breast milk is one fluid that could contain heavy metals and this can be dangerous to the health of breastfeeding baby. The increase in urbanization and industrialization often comes with the increased level of heavy metals in the environment especially in developing countries where environmental protection is poorly managed. The study aimed to compare the heavy metal composition in breast milk in postpartum women in urban and sub-urban areas in Rivers State. The study was conducted among 59 postpartum subjects between 0 and 10days of child delivery in each group. Sampling was done through a simple randomized system. Human breast milk was collected using a manual breast pump. Heavy metals; Lead (Pb), Mercury (Hg) and Mercury (Hg) were assayed using atomic absorption spectrophotometer with their corresponding cathode lambs. Results revealed that the mean differences of the heavy metals assayed between both groups were not significant (p>0.05). This work has shown that heavy metal composition in the breast milk of postpartum women may not vary based on urban and sub-urban settlements.

Keywords: Breast milk, lead, cadmium, mercury, urban, sub-urban

1.0 Introduction

Along the food chain, breastfeeding babies are at the top since they get their food from another human already at the top of the food chain. Therefore, human breast milk contamination is particularly a great concern to the health of a child. Environment is a key factor in the study of living things because environment impacts on the general wellbeing of life. Contamination in breast milk could be due to environmental sources; hence study on environment and living components cannot be underestimated. Some studies demonstrated that heavy metals are higher in formulated milk than the natural human breast milk [1]. Production of milk from cow has been found to not only contain heavy metal but also organic pollutants. Cow feed formulated using fish as source of protein could become a source of heavy metal contamination because most pollutants in the environment wash into the water body, the aquatic lives bio-accumulate them and consequently serve as sources of heavy metal delivery to their consumers which are usually human. Therefore, the use of fish from polluted water body will not only impact on the cow milk but will also impact negatively on the health of babies feed with cow formulated milk. Some reports have eventually shown that levels of heavy metals and other contaminants in cow milk are higher compared to human breast milk [2]. For instance, lead (Pb) level was documented to be higher in infant formula than in human breast milk. In fact, the processes involved in the formulation and in the preparation of ready-to-suck breast milk may have their individual contribution to the milk contamination. It was reported that water used in preparing milk for an infant was contaminated with certain heavy metals [3]. Of course, feeding bottles used in feeding infants could be contaminated in the process of industrial production. Our environment is fast developing, the increase in urbanization and industrialization often come with increased level of heavy metals in the environment especially in developing countries where environmental protection is poorly managed. In recent times, studies have shown an increase in heavy metals level in the environment and the characteristic bioaccumulation tendency of heavy metals along the food chain [4,5,6]. The breast milk is one fluid that could contain heavy metals and this can be dangerous to the health of breastfeeding babies. [7]. Several research works have been done regarding heavy metal presence in breast milk in other parts of the world but little or no work of such has been conducted in this part of the country (Port Harcourt). This study was aimed at comparing the nutrients composition in breast milk in postpartum women in urban and sub-urban areas in Rivers State.

2.0 Materials and Methods

2.1 Study Area

The research study was conducted at health centers in Port Harcourt and Eleme. Port Harcourt is the capital city of Rivers state and it is located in the south-south geopolitical zone of Nigeria. Eleme is a sub-urban area in Rivers State.

2.2 Study Population

The study was conducted among 118postpartum subjects between 0 and 10days of child delivery. The subjects were recruited at the Postnatal Clinic.

Inclusion Criteria

- Subjects registered with the health centre
- Subjects between 0 and 10 days of childbirth
- Subjects between the ages of 18 and 45
- Subjects must be residing within the study areas

Exclusion Criteria

- Unregistered subjects with the health facilities
- Subjects with impaired breast milk production

2.3 Sampling Method

Subject's participation was based on inclusion criteria and written consent provision. Port Harcourt is a metropolis and subjects recruited from this area were categorized as "urban group" while subjects recruited from Eleme area were categorized as "suburban group". In a simple random sampling method subjects were selected using a number system of "1" and "0" such that subjects who picked "1" were admitted and "0" selections were rejected. [8,9]

2.4 Specimen Collection

Breast milk samples were collected with the use of manual breast pump. In the collection room, the subjects were asked to partly undress in a manner that the breast was revealed and then the pump was applied to drain the breast milk. After collection, the milk was transferred to an appropriate container for storage or immediate laboratory analysis.[10]

2.5 Sample Analysis

Methodology for Heavy Metals

Lead (Pb)

Procedure

The plumbing ion was examined by a 283.3nm wave length atomic absorption sample [6]. A slit, air and acetylene gas flow were modified to alter the waves length. Additional parameters were taken into account and controlled as suggested for the instrument. A sufficient time was allowed to stabilize the hollow cathode lamp before aspiring standards for calibrating equipment. The suction tube and system were severely cleansed with distilled water before calibration and aspiration of test sample solution.The plum ion concentration in the sample was further polarised from the conventional diagram of plum ion. The concentration was expressed in mg/l and ppm, adjustments in selectable units were required.

Cadmium Ion

Air and acetylene gas have been adjusted for 229 nm wavelength. Other configurations for the hollow cathode gas instrument provided enough time to stabilize the spectrograph standard and were vacuumed and the result extrapolated from the standard graph.

Mercury (Hg)

Mercury detection, A total of 25 mL of the samples of milk were digested in a semi-closed glass digestive unit using 7mL of HNO3 (Merck, Deutschland) and 7mL of 30% hydrogen peroxide (Merck, H2O2). The volume was adjusted with ddH2O after cooling to 50 mL. Mercury was identified using a mercury/hydride (FIAS 4100, Perkins) weight hollow cathode mercury lamp, operated at wavelengths of 253.7 nm, in all digestions utilizing atomic spectrophotometry cold vapour absorption. For the determination of mercury, the quartz absorption cell was employed.

The sample was determined from the statistical equation below:

$N=((Z_{1-\beta} + Z_{1-\alpha/2})^2 [(R + 1) – p_2(R^2 + 1)]) / p_2(1-R)^2$

Where

N = Sample size

P_1 = proportion in group one

P_2 = proportion in group two

R = risk ratio or relative risk (p1/p2) = 0.3/0.1 = 3(Chen Li, *et al.*, 2016)

Power (β) set at 80% and α set at 5% 0n both sides

$= ((0.84 + 1.96)^2 [(3 + 1) – 0.1(3^2 + 1)] / 0.1(1-3)^2$

= 7.84 [4 – 0.1(9 + 1)] / 0.1(4)

= 7.84 [4 – 1] / 0.4

= 23.52 / 0.4

= 58.8 approximately 59

N = 59 participants per group

2.6 Statistical Analysis

Data entry was done using Ms Excel spreadsheet and then analyzed using SPSS 21.0. Descriptive statistics were done, such as the mean and standard deviation to determine the central tendency and the measure of the spread of each variable. T-test was used to determine the significant difference between studied groups at p<0.05.

Table 1: Comparing heavy metals zinc, lead and mercury

Heavy metal	*urban*	*Sub-urban*	*P-value*	*Remark*
Lead (mg/l)	0.15±0.1	0.07±0.1	0.28	Ns
Cadmium (mg/l)	0.1±0.03	0.0±0.0	0.36	Ns
Mercury (mg/l)	0.01±0.01	0.01±0.01	0.82	Ns

N=128

Ns= none significant

In urban group, Lead level was 0.15±0.1mg/l and 0.07±0.1mg/l in sub-urban group (T-value = 1.2; P-value >0.05). In urban group, Cadmium level was 0.1±0.03% and 0.0±0.0% in sub-urban group (T-value = 0.36; P-value >0.05). In urban group, Mercury level was 0.01±0.01% and 0.01±0.01% in sub-urban group (T-value = 0.82; P-value >0.05).

3.0 Result and Discussion

Lead is one of the heavy metals in nature and there are various sources of this metal in our environment, implying that persons can be exposed to lead toxicity from a variety of sources. The sources of lead in our environment include, automobile air, emissions, paint, gasoline, water distribution system, industrial wastes, lead-containing foods. A study conducted by [6] reported a high presence of lead in Port Harcourt and how the presence of lead in the environment bio-accumulated in living organisms in the environment. Although quite a lot of people ranging from children to adults could be vulnerable to lead poisoning, but pregnant women, lactating women and children are more at risk of lead poisoning [11]. Breastfeeding mothers exposed to lead contamination predispose them to lead (Pb) contamination of their breast milk which may pose more danger to both mother and child [12]. In this study, it was revealed that lead was present in the breast milk of lactating mothers in the urban area (Port Harcourt) and sub-urban area (Eleme) of Rivers State. The level of lead in the breast milk of lactating mothers was higher in the urban area than in the sub-urban area with mean values of 0.15±0.1mg/l and 0.07±04mg/l respectively but this difference was not statistically significant. The increased level of industrial activities in the metropolis could be the reason for the mild increase of lead in breast milk of breastfeeding mothers in the urban area while the reverse could be the case of the level seen in breastfeeding mothers of the sub-urban area. Reports have also shown that lead could cross from the mother's blood into the cord blood and consequently affect the fetus, which will leave the child with threatened health later in future [13]. Owing to the level of lead in breast milk, it could lead to the transfer of lead to the breast-feeding child and pose a more future complication to the child's health.

Cadmium has unknown biological role in humans. This means cadmium has no beneficial relevance in the body. The presence of cadmium in the body is believed to cause lots of toxic effects in the body organs due to loss of protein function as a result of the binding of cadmium to certain proteins in the body. In this study, cadmium was assayed in the breast milk of breastfeeding mothers in urban and sub-urban groups to ascertain the impact of the environment on cadmium composition in breast milk. The study revealed that women in the urban group showed a detectable level of cadmium (0.1±0.03mg/l). Women in the sub-urban group showed no detectable level of cadmium (0.0±0.0mg/l) however, this difference was not statistically significant. This implies that women in the urban area are more at risk of cadmium toxicity than women in the sub-urban. This could be due to the increased industrial activities in the metropolis than in the sub-urban area. The major uses of cadmium are in pigment manufacturing, battery production, metal plating, and plastic production. All of these activities are more situated in the metropolis than in the non-metropolitan areas of the state. Based on the WHO limit (1ug/l) [14], the mean cadmium level of subjects recruited in the urban area was way above the permissible limit. This is supported by a comprehensive review suggesting that the overall estimate of cadmium from many studies is 5.38ug/l [13]. This could be due to the increased black sooth occurrence in Port Harcourt. Cadmium is associated with smoking, thus inhalation of polluted air by smoking or industrial activities may have contributed to the increased cadmium in breast milk.

In this study mercury was measured in the breast milk of postpartum women in urban and sub-urban areas in Rivers State. Results from the urban group revealed a similar result with that of the suburban group 0.01±0.01mg/l. Although these values are low, as compared to the reference values in other biofluids like blood (0-60mg/l), mercury in breast milk could still pose a toxicity threat to the new born baby whose body organs are still developing and as such vulnerable to toxicity effect, more so, when mercury has no known biological function in human. In a study by Vahidinia and his colleagues informed that mercury level in human breast milk was 2.8ug/l in Iran and this level was above the suggested WHO limit (1.7ug/l). This study reported a much higher concentration. Increasing industrial activities with poor industrial waste management may be the contributing cause of high mercury level among breastfeeding mothers in the state.

Conclusion

This work has shown that heavy metal composition in the breast milk of postpartum women may not vary based on urban and sub-urban settlements and this could be due to relatively shared environmental characteristics between both settlements.

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

Consent

As per international standard or university standard, Participants' written consent has been collected and preserved by the author(s).

Recommendation

Studies are encouraged to focus on comparing heavy metals in breast milk between urban and rural settlements.

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