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The Association of Maternal Food Intake and Blood Lead Levels in Pregnant and Their Newborns

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Abstract

Although dietary intake of pregnant is supposed to have beneficial effects on development of infants, it may be harmful for fetal growth and development since specific food is a common source of toxicants including heavy metal. The purpose of this study was to investigate the association of maternal food intake and mid-pregnancy and their newborns blood lead levels. Pregnant women of 18-20 weeks of gestation were recruited from prenatal clinic in Seoul, Cheonan and Ulsan. In 422 pregnant women, dietary intake during pregnancy was assessed by a 24-hour recall method. Blood sample from pregnant (18-20 wks) and their cord blood at delivery were collected. Blood leas levels were analyzed by atomic-absorption spectrometry methods. Pregnant blood lead levels whose meat and meat products intake were in the highest quartile was significantly higher compared to the lowest quartile. Maternal meat and meat products intake was positively correlated maternal blood lead level (r=0.120, P=0.014). After adjusting for age, maternal blood lead level was positively correlated with their newborn blood lead level (r=0.303, P=0.030). As maternal food intake effects on blood lead levels of pregnant, careful regulation of food intake during pregnancy is perceives to be important in order to bring about desirable pregnancy outcomes.

Keywords: Pregnant, Food intake, Blood lead level, Newborn

In earlier decades with widespread use of lead in gasoline, in paint, in canned foods for solders and these materials provided the overwhelming contribution of lead in blood[1]. The price paid for such exposures was also very high. Some individuals experienced acute, symptomatic lead poisoning (blood lead levels generally greater than 40 μg/dL), and many others experienced significantly impaired function-manifesting as, for example, declines in intelligence quotient among children and increases in blood pressure and declines in renal function among adults[2]. Diet is still considered a significant contributing factor to blood lead levels[1].

Studies from several countries including France, Sweden, and Mexico in women with lead exposures ranging from low to high generally support the concept that blood lead increases during pregnancy[3-5]. It has been suggested that lead exposure of pregnant women should be related with pregnancy hypertension, spontaneous abortion, and offspring nervous system disorders such as encephalopathy and neuropathy, and that it would be associated to cognitive development and growth in fetus[6-8]. A child's lead burden begins before birth with lead transferred from maternal circulation[9] and increases rapidly in the first few years of life, as its own exposure to environmental lead increases[10]. Fetal lead exposure could be induced by the maternal stores (skeletal) and/or maternal environment including food intakes[11,12]. Food is an important source of maternal and fetal exposure to lead[13].

There has been no studies about the relationships of maternal food intake of pregnant and blood lead level of pregnant and their newborns to our knowledge. Therefore, in this study, we carried to determine the

Table 1. General characteristics of maternal subjects and their newborns.

	Mean±SD
Maternal (n=422)	
Age (years)	32.6±4.1[1)]
Weight (kg)	60.3±8.9
Height (cm)	161.1±4.9
BMI (kg/m²)	23.2±3.2
Newborn (n=270)	
Gestational age (weeks)	39.1±1.5
Birth weight (g)	32.7±4.5
Birth height (cm)	50.9±2.7

[1)]Values are mean±SD

Table 2. Blood lead level of maternal subjects and their newborns (μg/dL).

	Maternal subjects (n=422)	Newborns (n=55)
Blood lead level(μg/dL)	1.60±0.77[1)]	0.98±0.61

[1)]Values are mean±SD

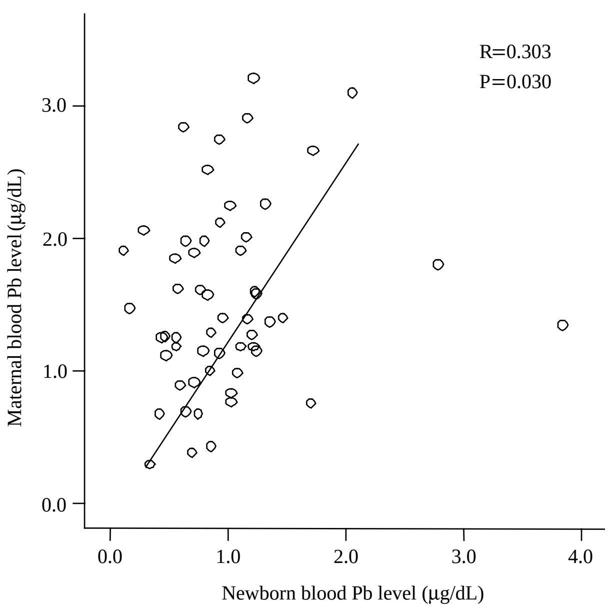

Figure 1. Correlation between blood lead levels of maternal and newborn. Data were adjusted by the age of maternal subjects. We observed a significant correlation of blood lead level between maternal subjects and their newborns by using partial correlation analysis ($P<0.05$).

association of maternal food intake and blood lead levels in pregnant and their newborn.

General characteristics of the pregnant women and

Table 3. Food intake of maternal subjects during mid-pregnancy.

Food group (g)	Maternal intake (n=422)
Meat and meat products	74.0±85.1[1)]
Fishes and shellfish	56.6±63.2
Eggs and egg products	21.5±29.1
Milk and milk products	143.9±171.5
Total animal food	296.0±193.8
Cereals and cereal products	266.1±107.6
Potatoes and starch products	57.4±123.9
Vegetables	225.2±136.2
Fruits	376.8±324.3
Seaweeds	5.4±14.8
Mushrooms	6.1±15.2
Beans and bean products	47.4±80.5
Nut, seeds and products	6.8±20.4
Sugar and sugar products	7.9±11.1
Fats and oils	8.9±6.8
Total plant food	1055.1±387.2
Others	74.5±107.1
Total	1379.0±434.4

[1)]Values are mean±SD; which were calculated by CAN pro 3.0 program

newborns are presented in Table 1. Mothers had mean age of 32.6±4.1 y, weight of 60.3±8.9 kg, height of 161.1±4.9 cm and BMI of 23.2±3.2 kg/m². Newborns had mean gestational age of 39.1±1.5 weeks, weight of 32.7±4.5 kg, and height of 50.9±2.7 cm.

Blood lead levels of maternal and newborn showed in Table 2. Maternal blood lead Levels were 1.60±0.77 μg/dL and were significantly higher than newborn levels: 0.98±0.61 μg/dL.

The correlation coefficient between blood lead level of maternal and newborn was presented in Figure 1. After adjusting for age, maternal blood lead level was positively correlated their newborn blood lead level (r=0.303, P=0.030).

Descriptive statistics for maternal and newborn blood lead level analyses are presented in Table 2. The means±SD of maternal blood lead level and newborn lead were, respectively, 1.60±0.77 μg/dL and 0.98±0.61 μg/dL. As indicated in Table 3, in subjects, the average of total daily food intake during pregnancy was 1,379.0±434.4 g/day and the average of maternal meat and meat products intake was 107.7±83.1.

Maternal meat and meat products intake were divided into quartile: 25th percentile=10.0 g, 50th percentile=45.0 g, 75th percentile=110.8 g. As shown in Figure 2, blood lead levels of mothers whose meat

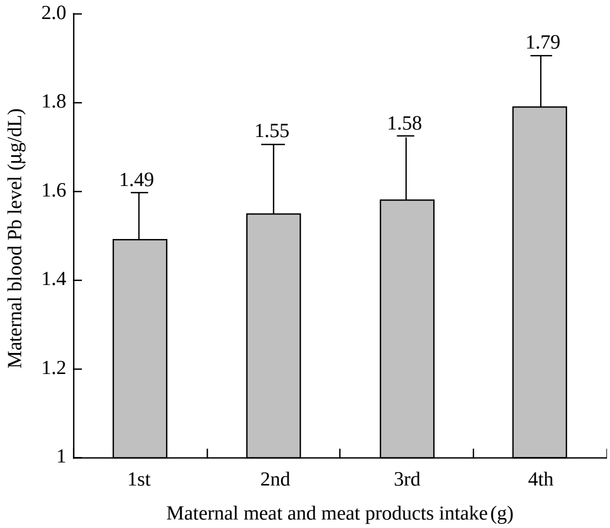

Figure 2. Association between meat and meat products intake and blood lead levels in maternal subjects. We classified maternal subjects to 4 groups according to their meat and meat products intake. This figure shows the significant difference of blood lead level according to their meat and meat products intake using by one-way ANOVA and Duncan's multiple analysis ($P<0.05$).

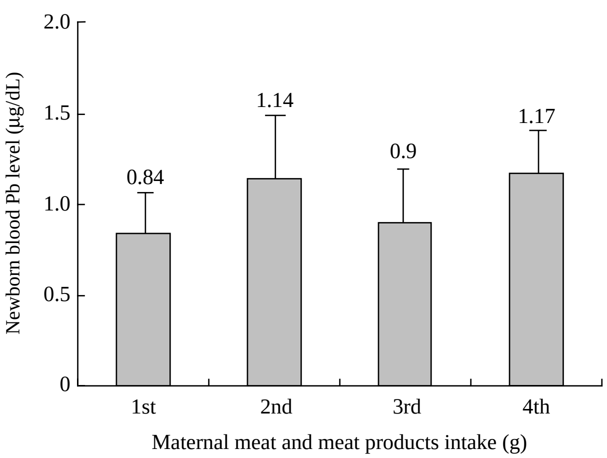

Figure 3. Association between maternal meat and meat products intake and blood lead levels in newborn. We classified maternal subjects to 4 groups according to their meat and meat products intake. However, we failed the significant differences according to maternal meat and meat products intake.

and meat products intake were in the lowest quartile were significantly lower than in the highest quartile. We did not find significant associations between maternal meat and meat products intake and blood lead of newborn (Figure 3).

Table 4. Pearson correlation coefficients between maternal food intake and blood lead levels of themselves and their newborns.

Food group (g)	Blood lead level	
	Maternal subjects (n=422)	Newborns (n=55)
Cereals and cereal products	−0.022[1)]	−0.076
Potatoes and starch products	−0.021	0.151
Sugar and sugar products	−0.050	−0.105
Beans and bean products	−0.075	−0.008
Nut, seeds and products	0.080	0.045
Vegetables	0.016	0.066
Mushrooms	0.042	−0.025
Fruits	−0.051	−0.020
Meat and meat products	0.120*[2)]	0.073
Eggs and egg products	−0.079	0.069
Fishes and shellfish	−0.065	−0.056
Seaweeds	−0.044	0.220
Milk and milk products	−0.093	−0.039
Fats and oils	0.017	0.138
Beverages	0.045	0.153
Seasonings	0.041	−0.020

[1)]Correlation coefficient
[2)]*$P<0.05$

The Pearson's correlation coefficient between maternal dietary and blood lead level of maternal and their newborns was presented in Table 4. In the all subjects, Maternal meat and meat products intake was positively correlated maternal blood lead level ($r=0.120$, $P=0.014$). The correlation showed different pattern by newborn blood lead level. The meat and meat products intake during pregnancy was not significantly correlated newborn blood lead level.

Discussion

The purpose of this study was to investigate the association of maternal food intake and blood lead levels in maternal and their newborns.

In this study we found that maternal meat and meat products intake were associated blood lead level. Meat is a commonly consumed food in Korea. Meat has a high content of protein and fat. Variations in dietary protein and fat content have been reported to affect the fraction of lead absorbed[14,15]. Cuadrado *et al*.[16] showed that meat and meat products were one of the most important food groups for total intake of lead, contributing 11-21%, in the region of Spain where the study was performed. As total meat intake by the population in the Canary Islands was 78 g/day and total meat product intake was 25.9 g/day[17], the daily intake of lead due to the consumption of meat and meat products is 0.296 μg/day (2.072 μg/week) and 0.155 μg/day (1.082 μg/week) respectively[18].

Rice (usually served boiled) is a main energy source for daily life in Korea. Daily boiled rice consumption was 412.6 g for pregnant subjects. It was possible to calculate lead intakes from boiled rice by multiplying the lead (2.96 ng/g) content of boiled rice by the amount of boiled rice consumed. The lead intake via boiled rice, out of the total daily lead intake, accounted for 7.8% in pregnant subjects[19]. In relation to this, it is well established that there are notable differences in both food consumption and food contamination by metals or other contaminants among different regions and countries[20].

In the present study we also found newborn blood lead level was positively correlated with blood lead level of pregnant subjects that after adjusting for age. Three results are consistent with the findings of other study[21]. Chunhong Wang *et al*. found that lead levels in newborn blood were significantly correlated with those in their mothers. It is obvious that lead could freely pass the placenta even at a substantially lower level[22]. It was showed that maternal lead levels of 80-100 μg/L might affect the IQ, hearing and growth, and that levels below 50 μg/L could cross the placenta into the fetus. It is suggested that a higher blood lead level of maternal might have an ad adverse effect on pregnancy outcome[23].

In conclusion, we found that blood leas levels of pregnant were affected by meat and meat products intake. And the blood leas levels were positively correlated with their newborns blood leas levels. To our knowledge, this report is the first population-based study to establish such an association. Studies with larger sample sizes in there aspects should be done in the future.

Methods

Study Subjects

The subjects of this study were 422 pregnant women, recruited from a medical examination center in Seoul, Cheonan and Ulsan from August 2006 to February 2007. During a patient's first visit to our hospital, the aim and method of this study, as well as its usefulness, were explained. We investigated general characteristics, food and nutrition intakes and blood profiles. None of the participants had renal or hepatic disease, diabetes mellitus, and heart disease or were on prescription medications.

Measurements

Dietary intake during pregnancy was investigated by 24-hr recall method. For this, experienced, well-trained interviewers instructed respondents to recall and describe all foods and beverages they had consumed over the past 24 hr. Subject record was convert household portions to gram. The dietary food intakes analysis of the records was quantified using a computer aided nutritional analysis program (CAN 3.0, Korean Nutrition Society, Seoul, Korea).

Blood samples were drawn by a trained technician or nurse using standard venipuncture. Blood lead levels were measured using atomic absorption spectrophotometry.

Statistical Analysis

All analysis was performed by using SPSS program (version 12.0). The results are presented as mean ± standard deviation. When statistically significant effects were demonstrated, one way ANOVA and Duncan's post hoc comparison test was used to examine the differences use among dietary food intake groups. To demonstrate the association of maternal dietary intakes with blood lead levels in pregnant women and their newborns, *P* values for trend analysis by Pearson's correlation coefficient analysis was conducted. Partial correlation adjusted by maternal age was used to evaluate the significance between blood lead level of pregnant and their newborn blood lead level. In all statistical tests, P values of <0.05 were considered significant.

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