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RESEARCH ARTICLE

ASSOCIATION OF MATERNAL BLOOD LEAD LEVELS WITH NEWBORNS BIRTH WEIGHTS.

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Abstract

Background: Elevated blood lead levels during pregnancy are of particular concern because lead freely crosses the placenta from 12th week of gestation. The birth weight at delivery is a strong predictor of neonatal health outcomes.

Aim: 1-to measure blood lead level in pregnant women and its association with newborn's birth weights.
2-to find some of the factors that may be associated with the elevation of the blood lead levels in the pregnant women.

Methods: Cross sectional study was conducted from the 1st April to the 1st October 2015 in the delivery unit of Al-Hilla teaching hospital in Babylon-Iraq on 127 pregnant women attending the chosen hospital for delivery and their newborns.Blood samples were collected and transported with careful techniques to the toxicology center of the medical city in Baghdad where analyzed. Newborn's birth weights were measured by mechanical scale balance by trained midwife at the delivery unit. Modified questionnaire were used to collect selected data from participants.

Result:Maternal blood lead levels mean±SD were 10.31±3.41µg/dl. Parity,maternal age and maternal blood lead levels were emerged as significant risk factors for low birth weights by logistic regression. Parity and smoking of household contact was emerged as significant risk factors for elevated maternal blood lead levels by logistic regression.

Conclusion: The studied pregnant women had abnormal elevated blood lead level and there was weak negative significant association between maternal blood lead levels and newborn's birth weights. Primigravida and smokingwas emerged as significant risk factors for elevated lead level.

Introduction:-

Children and pregnant women are the most adversely affected segments of the population from lead exposure(1).During pregnancy, there is high sensitivity to toxic substances and the increased blood lead level (BLL) either endogenous from mobilization of maternal skeletal lead stores or from ambient pollution can seriously threaten the developing fetus and has a devastating effects on the nervous system and calcium dependent

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organs[2].The elevated BLLs during pregnancy are of particular concern because lead freely crosses the placenta from 12th week of gestation, and the lead contents in fetal organs increase with gestational age, so at birth the blood lead concentration in the umbilical cord is close to that of the mother[3] with a fetal to maternal ratio of 0.7-0.9[4].The mechanisms by which lead could have an adverse effects on pregnancy outcomes include impairment of fetal bone growth caused by competition with calcium for deposition into bone [5], reductions in fetal thyroid hormones [6], accumulation of lead in the placenta causing abnormal placental functions and reduced nutrients transfer [7], also the pregnancy itself increase gastrointestinal absorption of lead [8].

The lead has a half-life in bone on the order of years to decades.This realization has prompted greater attention to the importance of reducing lead exposure in girls as well as the consideration of whether pre-pregnancy screening of women for current and prior exposure may be of value for secondary prevention[9].This is especially important in endemic areas of lead contamination in order to protect reproductive health of women and the development of their children [10].

The relationship between maternal blood lead levels and pregnancy out comes, includingmiscarriage, stillbirth, prematurity low birth weight andreduced head circumferences have had inconsistent results in studies[11-17].Several studies were carried out in this concern,some of them found a significant association for example, study done by Xiex G in china 2013[11],another done by Zhu M in New York 2008[12],and study of ChelchowskaM,Ambroszkiewicz J in Poland 2013[13]. Other studies found insignificant association such as study done by Hakeem A in Karachi 2003 [14], Besharati A and Nasseri F in Islamic Republic of Iran 2005[15], study of MirghaniZ,Al-Rhashidi A in Saudi Arabia 2010[16], as well as study done by Rahman A in Kuwait 2012[17].

The birth weight (BW) at delivery is a strong predictor of neonatal health outcomes such as chances of survival, risk of medical complications, and timing for the achievement of development milestones [18] so the association between maternal BLLs and newborn's BWs was investigated in this study. The aims of this study are to measure blood lead levels in pregnant women and its association with newborn's birth weights; and investigate some factors that may be associated with the elevation of the blood lead levels in the pregnant women.

Methods:-

This wasacross sectional study with analytic elementscarriedout in the delivery unit of Al-HillaTeaching Hospital at Babylon Governorate inIraq.The hospital was chosen randomlyfrom all nine hospitals in Babylon which have delivery units. The study was conducted between the 1st April to the 1stJuly 2015.The researcher spent about 4-6 hours per day for 2-3 days per week in the delivery unit collecting data and blood samples from the studied pregnant women. The total sample enrolled in study was 127 women. In order to be included, women should have singleton full term uncomplicated pregnancy and they were without any chronic diseases.

A modified questionnaire form was prepared to collect information regarding age, parity, residence, and occupation of participants and household contacts with lead exposure (such as painters, traffic policemen, battery manufacturing, home renovation, automotive repair). Other information gathered were smoking history of mother and others household contacts,maternal educational level, using lead based cosmetics (Mecca kohl), using folk remedies and pica habit (intentional ingestion of items that people do not normally eat such as soil, dirt, paint, chips, and chalk).

Three milliliters of whole blood was collected from participants by well-trained midwifes after carefully cleaning the skin at the venipuncture site.Thesamples wereputintubes with EDTA (strong anticoagulant).Each tube was shacked several times to mix the EDTA with blood to prevent coagulation and stored in refrigerator.Later on, the tubes were transported in box with dry ice to toxicology laboratory of Baghdad Medical City and were analyzed by trained worker by atomic absorption spectrometry (NovAA,AnalytikJena,Germany,wave length 283.3 nm).

The birth weight was determined using mechanical scale balance by midwifes of delivery unit under the supervision of the researcher.The birth weight was considered normal if it was between (2.5-4.5 kg). Any baby weighted less than 2.5 kg was considered as low birth weight[19].

An official permission was obtained from Babylon health directorate, toxicology center of Baghdad Medical City, and the administration department of selected hospital. The procedure of the study was explained to participants and verbal consents were obtained from them.

Statistical analysis:-

The data were analyzed using statistical package for the social sciences (SPSS version20).Qualitative data were presented as relative frequency and percentage of subjects in each category; while quantitative data were presented as mean ± standard deviation (SD). Pearson correlation coefficient was used to find association between maternal BLLs and newborn's birth weights. Logistic regression was used to find the association between maternal BLLs and certain variables. For all comparisons, two tailed tests were accepted as significant when $p \leq 0.05$.

Results:-

The final sample of study involved 127 pregnant women, all of them from Al-Hilla teaching hospital in Babylon-Iraq. The examinedpregnant women havethe following socio-demographic characteristics (Table1)

Table 1:- Distribution of Pregnant Women According to theStudied Variables

Variables	N	%
Age		
<25	55	43
≥25	72	56
Parity		
Primi	36	28.3
Multi	91	71.7
Residence		
Urban	82	64.5
Rural	45	35.4
Maternal educational level		
Primary or less	35	27.5
Intermediate or secondary	42	33.2
Higher education	50	39.3
Occupation of household contact with lead exposure		
Yes	12	9.4
No	115	90.5
Smoking of household contact		
Yes	74	58.2
No	53	41.7
Kohl use		
Yes	34	26.7
No	93	73.2
Pica		
Yes	18	14.1
No	109	85.8
Folk remedies use		
Yes	63	49.6
No	64	50.3

Regarding the levelsof blood lead among studied pregnant women, Figure1is made to show the findings. Furthermore, the presentation of levels by Pie chart (Figure2) shows that more than one-third of pregnant women had abnormally high level, more than 10 µg/dl.

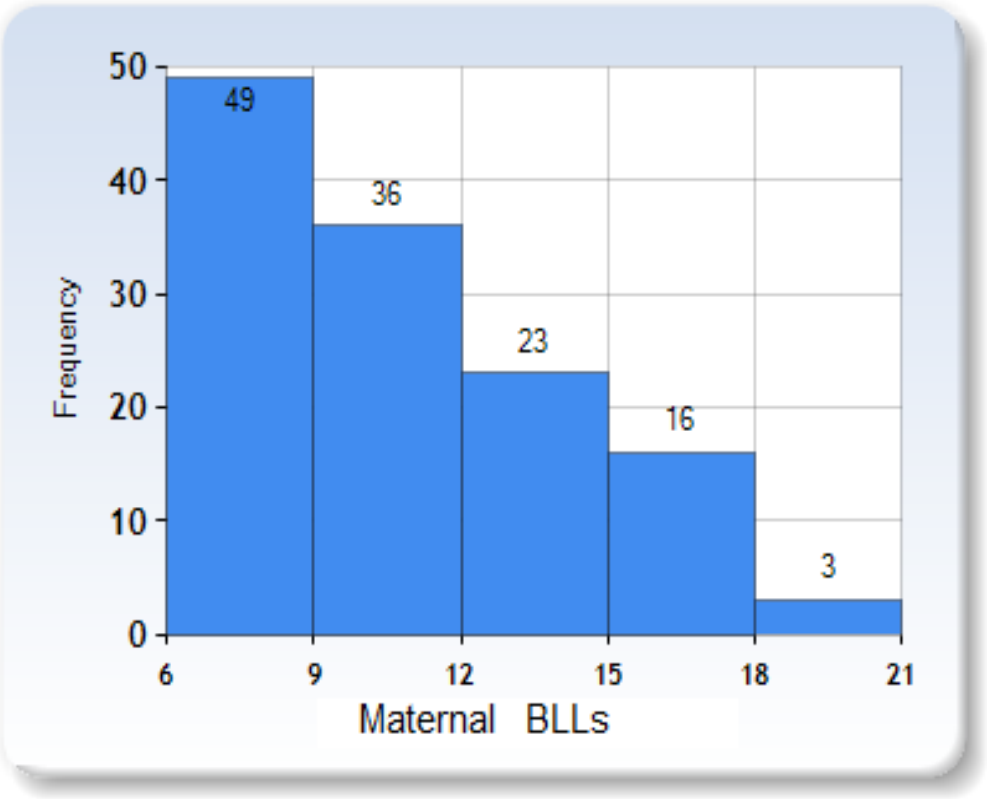

Figure 1:- Levels ofMaternal Blood lead in Study Sample (in µg/dl)

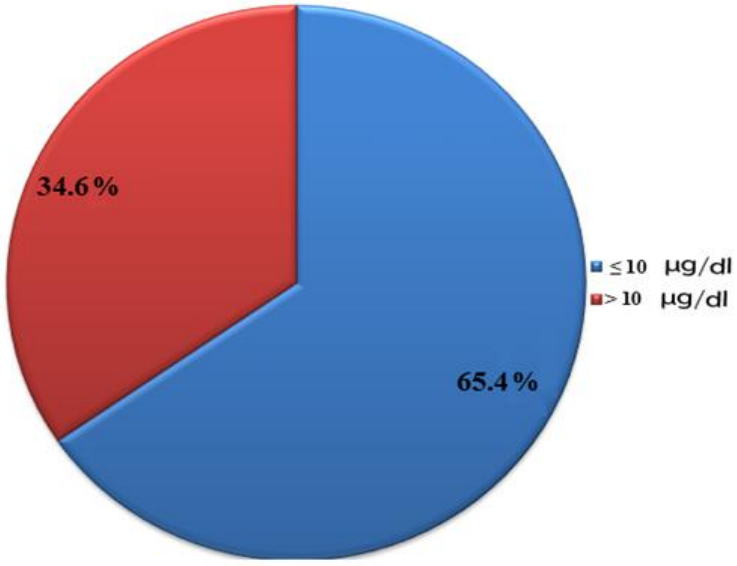

Figure 2:- Distribution of Studied Pregnant women According to Higher Accepted Blood Lead Level

The correlation between maternal BLLs and newborn's BWs was demonstrated in table 2, *r*-value and *p*-value was calculated and there was weak negative significant correlation at $p \leq 0.05$.

Table 2:- Correlation between Maternal Blood Lead Levels and Newborn's Birth Weights

Variables	Mean±SD	*r-value*	*P- value*
Maternal BLLs(µg/dl)	10.30±3.40	-0.257	0.038*
Newborn's BWs(kg)	3.50±0.59		

Simple linear regression model was used for calculation of the regression and the equation is showed in figure3.
Y=3.967-0.045
y=newborn's BWs value.
X=maternal BLLs value.

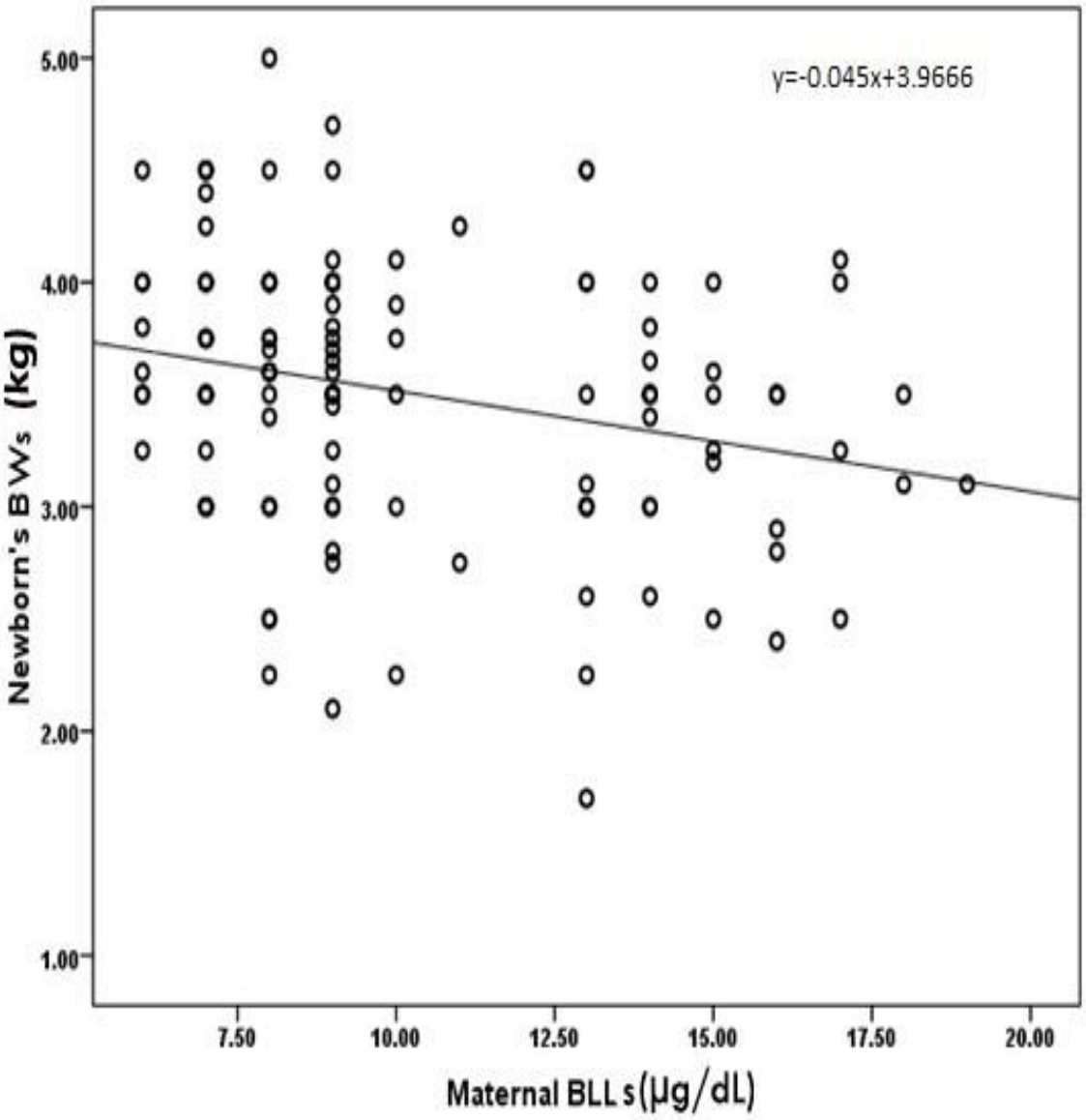

Figure 3:- Scatter Plot of Newborns Body Weights (kg) Against Maternal Blood Lead Levels (µg/dl)

The age, maternal BLLs and parity was emerged as significant factors for low BWs with p-value of 0.025 for age and 0.022 for maternal BLLs and 0.042 for parity,respectively(Table3). When logistic regression was performed to

evaluate selected risk factors of elevated maternal BLLs, only parity and smoking of household contact remained as significant factors for elevated maternal BLLs (Table4).

Table 3: LogisticRegression for Effect of Selected Factors onNewborns Birth Weights.

Variables	Regression coefficient(B)	P-value
Age	12.108	0.025**
Parity		
Primi*		
multi	-3.188	0.042**
Residence		
Urban*		
Rural	-0.921	0.557
Maternal educational level		
Primary or less*		
Intermediate or secondary	-0.1053	0.857
Higher education	0.0586	0.904
Occupation of household contact with lead exposure		
No*		
Yes	9.445	0.064
Smoking of household contact		
No*		
Yes	1.126	0.613
Maternal BLLs		
Accepted*		
Elevated	4.796	0.022**
Pica habit		
No*		
Yes	2.811	0.156
Folk remedies use		
No*		
Yes	-7.789	0.093
Kohl		
No*		
Yes	4.810	0.282

Note:*=referral group, **=significant at p≤0.05.

Table 4:- Logistic Regression for Selected Risk Factors of Elevated Maternal Blood Lead Levels

Variables	Regression coefficient	S.E	P-value
Parity			
Primi*			
Multi	-1.169	0.424	0.006**
Residence			
Urban*			
Rural	0.134	0.397	0.735
Smoking of household contact			
No*			
Yes	0.916	0.400	0.022**
Pica habit			
No*			
Yes	0.329	0.532	0.536
constant	0.008	0.442	0.986

Note: *=referral group, **=significant at p≤0.05.

Regarding relationship between selected risk factors and maternal blood lead levels, parity,residence,pica and smoking of household contact were found to be significantlyassociated(Table5)

Table 5:- Relationship between Selected Risk Factors and Maternal Blood Lead Levels

Variable	Accepted BLLs No.(%)	Elevated BLLs No.	Chi square value	*P*-value
Age				
<25	34(35.94)	21(19.06)		0.464
≥25	49(47.06)	23(24.94)	0.535	
Parity				
Primi	12(23.53)	24(12.47)	22.75	‹0.001
Multi	71(59.74)	20(31.53)		
Residence				0.01
Urban	47(53.59)	35(28.41)	6.602	
Rural	36(29.41)	9(15.59)		
Maternal educational level				
Primary or less	23(22.87)	12(12.13)		0.983
Intermediate or secondary	27(27.45)	15(14.55)	0.032	
Higher education	33(32.08)	17(17.32)		
Occupation of household with lead				
Yes	7(7.84)	5(4.16)		0.591
No	76(75.16)	39(39.84)	0.288	
Smoking of household contact				
Yes	39(48.36)	35(25.64)	12.535	‹0.001
No	44(34.64)	9(18.36)		
Kohl use				
Yes	19(22.22)	15(11.78)	1.839	0.174
No	64(60.78)	29(32.22)		
Folk remedies use				
Yes	37(41.17)	26(21.83)	2.422	0.119
No	46(41.83)	18(22.17)		
Pica				
Yes	8(11.76)	10(6.24)	4.049	0.044*
No	75(71.24)	34(37.76)		

Discussion:-

Lead is accumulative toxicant [20].The American College of Obstetricians and Gynecologists recommends that in any pregnant women with blood lead levels of 5µg/dl or higher, sources of lead exposure should be identified and woman should receive counseling regarding avoidance of further exposure [21].

There is little information about the blood lead concentrations in the Iraqi general population, especially high risk groups such as pregnant women.

In the present study the maternal BLLs mean was 10.31µg/dl which was higher than that reported by other studies such as study done in Karachi by Hakeem A on pregnant women in 2003 where the mean of BLLs was 9.9[14], study done in New York in 2005 by Zhu M *et.al* where maternal BLLs mean was 2.1[11], other study done in Iraq (Mousil city) where the mean was 3.2[22] and study done in Iran in 2005 where the mean of BLLs was 9.9[15].These differences between results of these studies may be due to the differences ingestational age at which blood samples have been taken and methods used for detection of BLLs including commercial kits, atomic absorption spectrometry and inductively coupled plasma mass spectroscopy. Nevertheless, the result of current study still reveals higher level in study sample.

The findings of this study indicated also there was a significant linear weak negative correlation between maternal BLLs and newborn's BWs at delivery with p-value of 0.0038. This was consistent with findings of some studies such as that done in China on pregnant women in 2011[18], study done in New York in 2005[11] and study done in Poland in 2010[12]. However, it was inconsistent with other studies such as study done in Iran in 2005[13], in Saudi Arabia in 2007[14] and in Kuwait in 2009[15].

Several studies that investigate the association of the maternal BLLs with maternal age, but the results of them were controversial, significant association was found in some of them such as study done in Egypt in 2009 an other study done in Oxford in 1997[23,24],but other study done in 2005 on pregnant women in France [22] was like our study found noassociationbetween them (p=0.46) .

This study showed that parity is a significant factor in determination of maternal BLLs with (p=0.006)and that BLLs was decreased by increased parity and similar results was reported in another studies done in France in 2005 and in Egypt in 2009 and in Spain in 2007[22,23, 25] and this results may be explained by the depletion of the maternal lead reserves with subsequent deliveries,however,Rothenberg found a controversial results in his study which is done in Oxford[26] and he demonstrated his results by the changes in the structure of the placenta with each pregnancy that would alter the blood flow and enable a greater transfer of lead with increasing parity.

Alsothis study showed that residence was non-significant predictorfor elevated BLLs (p=0.73) and this conclusion was reached by other studies such as study done in China in 2001 and other study done in Egypt in 2008[27,28],however, another studiesshowedasignificant association between BLLs and residence such as study done in New York in 2002,study done in Canada in 2010,study done in Kinshasa in 2008 on the general population and study done in Nigeria on pregnant women in 2010 [29-31].

Maternal educational level showed no association with BLLsand this results were consistent with some studies[22]which is done in Mousil,Iraq on pregnant women ,but inconsistent with other study done on female smelter workers which are pregnant which indicated that high educational attainment is a risk factor for elevated BLLs[5].

In this study no women was with occupation of lead exposure risk so the association of maternal BLLs with occupation of household contact was investigated and no association was found between them (p=0.59), this results was similar to study done in Canada on pregnant women 2000[32], but differ from other several studies such as study done in Egypt in 2009 and study done in U.S in 2003 [23,33].

Active and passive smoking is associated with increased blood lead levels [33] and tobacco leaves trap both radioactive (pb-210) and non-radioactive (pb-206) lead from the atmosphere on their surface, due to the presence of trichomes[34] and it has been estimated that between 1 to 5 µg/dl of lead could be inhaled from smoking 20 cigarettes per day [32].

In this study there were no smoking pregnant women so the association between smoking of maternal household contact and maternal BLLs was investigated and in agreement with previous studies such as study done in France in 2005 on pregnant women and study done in Oxford in 1997 and another study done in US in 2000[23,24,35] there were significant association between them with p value of 0.022.

Some researcher found a significant association between using folk remedies and elevated BLLs such as study done in Iran in 2005 and other study done in Saudi Arabia in 2001[15,36] ,but we like other studies such as study done in UK on pregnant women [4] found no association between them with p-value of 0.54.

Al-kohl contain up to 50% lead content and may be a potential source of lead poisoning[37] and in this study al-kohl using was non-significant predictor for elevated maternal BLLs with p-value of 0.174 and this results was inconsistent with other study done byAl-AshbanR,AslamM,Shah A on the women in Saudi Arabia in 2004[38] .

Pica is the intentional ingestion of items that people do not normally eat such as soil,dirt,paint chips, chalkthese ingested items may contain an amount of lead [39] .

In this dissertation we found association between pica and elevated maternal BLLs by chi-square but with logistic regression there were no association and this result was consistent with findings of other study which done in Los Angeles on pregnant women in 2001[40], but another studies found association between pica and maternal BLLs such as study done on pregnant women in New York in 2002 [29].

In summary Maternal BLLs was highand 34.6% of the studied pregnant women had abnormal BLLs.Therewas weak negative significant association between maternal BLLs and newborn's birth weights. Primigravida and smokingwas emerged as significant risk factors for elevated maternal BLLs.

Recommendation:-

Further studies may be needed in this subject to develop more comprehensive knowledge about the levels of maternal blood lead and their association with newborn's BWs. Establishment of governmental policies to phasing out the uncontrolled distribution of electricity generators and battery maintenance shops and other sources of lead near the residential neighborhood. Start educational programs about the risk of elevated blood lead levels on the health of pregnant women and their newborn's outcomes.

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