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Lead and Cadmium Levels In Blood of Pregnant Women in Assiut Governorate; Do They Have A Role in Preeclampsia?

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Abstract Preeclampsia (PE) represents a major cause of morbidity and mortality in mother, fetus and infant in many parts of the world. In Egypt, the prevalence of PE is 10.7% in a community based study while, in hospital based studies it ranged from 9.1% to 12.5% of all deliveries.

High blood lead and cadmium levels were associated with adverse pregnancy outcomes including preeclampsia. So, the aim of this study was to evaluate the relationship between lead and cadmium blood levels in pregnant females and preeclampsia in Assiut Governorate.

This cross sectional study was done in Maternal Health Hospital, Assiut University in a period of sixth months from August 2013 to January 2014. The study included 80 pregnant women were suffering from preeclampsia (preeclampsia group) and another 50 healthy pregnant women as (control group). Blood and cadmium levels were detected in the venous blood of the cases.

There were variations in blood lead and cadmium levels among different age groups with increase in level as age increase. Urban residence was significant risk factor for preeclampsia and also associated with high lead and cadmium levels in blood; Significant correlation was found between preeclampsia and low educational level and this was associated with high blood lead and cadmium levels .Smoking of the husband was associated with low blood lead of their wife's in comparison to non-smokers.

Preeclampsia occurred in both primiparous and multiparous women and this was associated with relatively high blood lead and cadmium level, also the risk of preeclampsia significantly increases in women with previous preeclampsia. History of previous preeclampsia was associated with relatively high level of blood lead and cadmium. 25% of cases had family history of preeclampsia in comparison with 4% among control. This finding was associated with increase in blood lead and cadmium level. Contamination of water supply, paint use at houses, living near busy street and exposure to motor car exhaust and grinding wheat had been found to be one of the important sources of exposure to lead and cadmium.

In conclusion: high blood lead and cadmium levels are significant risk factors for preeclampsia due to exposure to different sources lead and cadmium.

Introduction

Preeclampsia (PE) is a multisystemic disorder of pregnancy which affects between 2–8% of pregnancies worldwide (WHO, 2011). Affecting about 5% of all pregnancies, preeclampsia is the most common cause of maternal and perinatal mortality and morbidity (Wathe´n et al., 2006).

Endothelial cell dysfunction appears to be a central feature in the pathophysiology of preeclampsia (Servitje and Lopez, 2012). At present, the etiology of preeclampsia remains unknown. As a result, preventative measures and screening tools are lacking, treatments are directed at the management of overt clinical manifestations, and delivery remains the only definitive cure (Bell, 2010).

Lead (pb) is one of the most extensively studied reproductive toxicants. Blood lead levels

increase during pregnancy, from 24 weeks of gestation until delivery, because of increased gastrointestinal absorption and an increase in bone turnover in this period (Yazbeck et al., 2009). Placental blood lead levels at or even below 10 μg/dL were associated with adverse pregnancy outcomes (Motawei et al, 2013).

Human exposure to lead occurs through various sources like leaded gasoline, industrial processes such as lead smelting and coal combustion, lead-based paints, lead containing pipes or lead-based solder in water supply systems, battery recycling, grids and bearings, etc. (Flora et al., 2012).

Cadmium (cd) is used industrially to manufacture electro-plates, batteries, alloys and fuels. The increasing industrial use of Cd causes soil, air and water contamination (Hamden et al., 2008). Kolusari et al., 2008 reported that the level of serum cadmium significantly increased in women suffering from preeclampsia.

Aim of the Work

1- Demonstrate the pattern and relationship between lead and cadmium blood levels in pregnant females and preeclampsia.
2- Provide a set of recommendations for minimizing the toxicological health hazarders of lead and cadmium.

Patients and Methods

This cross sectional study was done in Maternal Health Hospital, Assiut University for a period of six months from August 2013 to January 2014. The study included 80 pregnant women suffering from preeclampsia (PE) and another 50 healthy pregnant women as (control group). Their age ranging from 18 to 40 years old. The sociodemographic data (age, residence, educational level ,occupational hazards of the patient and her husband), their use of tobacco (active or passive), their food habits especially(fish, canned foods and seafood), medical and clinical data were collected from all women, based on personal interview and medical reports at the clinic and all these data were included in a questionnaire.

Inclusion Criteria

1- All cases of preeclampsia admitted to the hospital above 20 weeks of gestation with normal blood pressure during the first 20 weeks of gestation.
2- Control group include healthy pregnant women above 20 weeks of gestation who were coming to the hospital for antenatal care without any complications of pregnancy.

Exclusion Criteria

Previous history of metabolic disorders, renal disease, diabetes mellitus or hypertension to prove that the exposure to heavy metals (lead and or cadmium) is the primary cause of Preeclampsia.

Research Ethics

The Ethics Committee of Assiut University and the Gynecology department approved the study.

1- Informed consent in written form was taken from all women.
2- The study objectives were explained to all women and the collected data (names, nature of disease and any information about the cases) were kept confidential and for the purpose of scientific research only and all intervention procedures was taken by sterilized and safe maneuvers.

All the women who had high lead and cadmium levels were advised and given the special treatment.

Statistical Analysis of the Results

The obtained data of the present study were collected and entered by Microsoft Excel 2010 program.

All data were tabulated. SPSS (Statistical package for social science) version (20.0) statistical software was used for statistical analysis. Numerical variables were expressed as mean ± standard deviation (SD).

Results

The current study included 80 pregnant women suffering from preeclampsia (preeclampsia group) and another 50 healthy pregnant women as (control group). Their age ranged from 18 to 40 years old.

Table (1): Demographic characters and predisposing factors in the preeclamptic group and the control group.

As regard to age, no significant difference (P=0.091) was found between preeclampsia cases and control group in both age group (≤19 years) and (20 - ≤ 29 years) but significant difference was found between the preeclamptic group and control group in age group (30≥ years) (P=0.011).

As regard the residence, urban residence was significant risk factor for preeclampsia (P=0.001).

As regard the educational level, significant correlation was found between preeclampsia and low educational level (P=0.012).

Significant difference was observed between preeclampsia and smoking when compared with control group (P=0.042).

Obesity was a significant risk factor for preeclampsia, where 47.5% of preeclampsia cases were overweight (statistically insignificant P=0.075) and 36.3% of preeclampsia cases were obese (statistically significant P=0.050).Moreover, preeclampsia was significantly common among primiparous women (P=0.001).

Preeclampsia in previous pregnancy and family history of preeclampsia were another risk factors for occurrence of preeclampsia, and significant difference was found between the preeclamptic group and control group (P=0.035 and 0.001 respectively).

As regard the effect of preeclampsia on the fetus, infant died after labor (within 2-4 days) in 35% of women who had a history of preeclampsia in previous pregnancies among the preeclamptic group in comparison with 65% who had healthy infant.

As regard the history of chronic hypertension and gestational diabetes, 10% of preeclampsia group had history of chronic hypertension before pregnancy and this was statistically significant (P=0.026).

According to Silva et al., 2008, .All women participating in this study were classified according to their educational level into:

- Low: no education, primary school, lower vocational training, intermediate general school or 3 years or less at general secondary school.
- Mid high: higher vocational training.
- High: university degree.

BMI: body mass index

According to Bhattacharya et al.,2007, all women participating in this study were classified according to body mass index (Kg/m2) into:

- Normal : BMI of 20 – 24.9 Kg/m2
- Overweight : BMI of 25 – 29.9 Kg/m2
- Obese : BMI of 30 –≥ 34.9 Kg/m2

Table (2): Classification of preeclampsia group according to severity.

57.5% mild preeclampsia, 38.7% severe preeclampsia, 1.25% eclampsia with convulsions, 1.25% HELLP syndrome and 1.25% severe preeclampsia with concealed hemorrhage.

HELLP syndrome: the simultaneous occurrence of hemolysis (lactate dehydrogenase 600 U/L), increased liver enzymes (serum aspartate aminotransferase and alanine aminotransferase 70 U/L) and low platelets (100 - 109/L).

HELLP syndrome is defined as hemolysis (microangiopathic), elevated liver enzymes (liver dysfunction), and low platelets (thrombocytopenia).

Table (3): Assessment of the dietary habits (before and during pregnancy) among the preeclamptic group and control group.

Significant difference was found between the preeclamptic group and control group as regard drinking milk and eating cheese (P=0.022, 0.017) respectively. (Cheese which made at home or sold in the supermarket).

Table (4): Subgroup analysis according to sources of exposure to heavy metals.

Show significant difference between the preeclamptic group and the control group as regard low risk occupation of their husband (P=0.020), paint use in houses (P=0.001), exposure to motor car exhaust (P=0.014), eating fish (P=0.021), eating sandwiches in plastic bags (P=0.003) and grinding wheat using recent mill (P=0.001).

Table (5) and figure (1): The level (mean±SD) of heavy metals (whole blood lead and cadmium) among the preeclamptic group and the control group.

Show significant increase in blood lead level among the preeclamptic group (P value=0.001) when compared with the control group. Moreover cadmium level was significantly higher in the preeclamptic group (P value=0.017) when compared with the control group.

Table (6): The level (mean± SD) of whole blood lead among different preeclamptic groups.

Blood lead level was high in severe preeclampsia and HELLP syndrome when compared to mild preeclampsia, eclampsia with convulsions and severe preeclampsia with concealed hemorrhage but non- significant difference (P=0.691).

Table (7): The level (mean± SD) of whole blood cadmium among different preeclamptic groups.

Blood cadmium was high in mild and severe preeclampsia than other types but non-significant.

Table (8): The relation between demographic characters and predisposing factors among the preeclamptic group and blood lead and cadmium levels (mean±SD).

Show variation in blood lead level among different age groups but non-significant (P=0.926), also in blood cadmium level there was variation among different age groups but non-significant (P=0.257).As regard the residence, urban areas were associated with high blood lead and cadmium levels but non-significant [P = 0.621and 0.468 respectively] when compared to rural areas.

Low educational level was associated with high blood lead and cadmium level but this increase was non-significant. Furthermore, smoking was associated with high blood cadmium levels and also, non-significant.

Blood lead level was high among primiparous women while blood cadmium level with higher among multiparous women but this effect was non-significant.

Women who had history of preeclampsia in previous pregnancy were associated with low level of blood lead in comparison to those who had no history (statistically insignificant P=0.935) while blood cadmium was higher in those having history of preeclampsia in previous pregnancy (statistically insignificant P=0.099).

Blood lead level was high in women without history of chronic hypertension (non-significant P=0.355) while blood cadmium was high in women with history of chronic hypertension (significant P=0.001).

Table (9): The relation between lead and cadmium levels and possible sources of exposure among the preeclamptic group.

Blood lead level was high in women with low risk occupation of their husband, living near busy street, having paint in their houses, grinding wheat in recent mill, exposure to motor car exhaust (non-significant) and eating sandwiches in loaded journals (significant, P=0.032).Blood cadmium level also, high in women with low risk occupation of their husband, living near busy street, having paint in their houses,

eating fish and grinding wheat (non-significant). Cadmium also, high in women eating sandwiches in loaded journals and exposed to motor car exhaust (significant, P=0.014 and 0.047 respectively).

Table (10): The relation between lead and cadmium levels and dietary habits among the preeclamptic group.

Blood lead level was low among women drinking milk, eating cheese and taking calcium supplement. While high among those taking iron supplements.

Table (1): Demographic characters and predisposing factors in the preeclamptic group and the control group.

		Control		Preeclampsia		P. value	OR
		No.	%	No.	%		
Age	≤19 years	4	8	2	2.5	0.414	0.5
	20 - ≤ 29 years	32	64	47	58.8	0.091	1.5
	30≥ years	14	28	31	38.8	0.011*	2.2
Residence	Rural	27	54	28	35	0.893	1.0
	Urban	23	46	52	65	0.001**	2.3
Educational level	High	4	8	2	2.5	0.414	0.5
	Mid-high	2	4	7	8.7	0.096	3.5
	Low	44	88	71	88.8	0.012*	1.6
Passive smoking		30	6	48	60	0.042*	1.6
BMI	Normal	10	20	13	16.3	0.532	1.3
	Overweight	24	48	38	47.5	0.075	1.6
	Obese	16	32	29	36.3	0.050*	1.8
Parity	Primiparous	5	10	36	45	0.001**	7.2
	Multiparous	45	90	44	55.0	0.236	2.4
History of pre-eclampsia in previous pregnancy		2	4	9	11.3	0.035*	4.5
Family history of preeclampsia		2	4	20	25	0.001**	10.0
Is the fetus is affected by preeclampsia	Infant died after labor (within 2-4 days)	1	50	7	35	0.118	7.0
	Healthy infant	1	50	13	65	0.012*	13.0
	His. of chronic hypertension bef.pregnancy	0	0	8	10	0.026*	NA
Gestational diabetes		1	2	4	5	0.345	4.0

*P value related to Chisquare test, *Statistically significant at the 0.05 level,** Statistically significant at the 0.01 level, OR(odds ratio)-NA (not applicable).*

Table (2): percent of preeclampsia groups according to severity.

Preeclampsia	No.	%
	80	*100*
Mild preeclampsia	46	*57.5*
Severe preeclampsia	31	*38.7*
Eclampsia with convulsions	1	*1.25*
HELLP syndrome	1	*1.25*
Severe preeclampsia with concealed hemorrhage	*1*	*1.25*

Mild preeclampsia: *a systolic blood pressure of >140 mmHg or a diastolic blood pressure >90 mmHg and proteinuria with a urine dipstick of ≥ 1+ or ≥300 mg per 24 hours.*

Severe preeclampsia: *sustained systolic BP ≥160 mmHg or diastolic BP ≥ 110 mmHg while on bed rest and severe proteinuria (urinary protein excretion of ≥3.5 g per 24 hours or urine dipstick results of ≥3+ [300 mg per 24 hours].*

Table (3): Assessment of the dietary habits (before and during pregnancy) among preeclampsia group and the control group.

	Control		Preeclampsia		P. value	OR
	No.	%	No.	%		
Protein intake once per day	50	100.0	80	100.0	NA	1.6
Drinking milk	35	70.0	57	71.3	0.022*	1.6
Eating cheese	46	92.0	72	90.0	0.017*	1.6
Calcium supplement	29	58.0	45	56.3	0.063	1.6
Iron supplement	31	62.0	47	58.8	0.070	1.5

*NA (not applicable),OR(odds ratio), *Statistically significant at the 0.05 level*

Table (4): Subgroup analysis according to sources of exposure to heavy metals.

	Control		Preeclampsia		P. value	OR
	No.	%	No.	%		
Occupation						
High risk	5	10	9	11.3	0.285	1.8
Moderate risk	0	0	1	1.3	0.405	NA
Low risk	45	90	70	87.5	0.020*	1.6
Tap water running in houses	50	100	80	100	NA	1.6
Paint use at home	34	68	57	71.2	0.001**	1.7
Living near busy street	16	32	22	27.5	0.330	1.4
Exposure to motor car exhaust	6	12	18	22.5	0.014*	3.0
Eating fish	46	92	71	88.8	0.021*	1.5
Eating canned food	24	48	30	37.5	0.414	1.3
Eating sandwiches						
loaded Journals	6	31.6	14	25.9	0.366	2.3
Plastic bags	13	68.4	38	70.4	0.003**	2.9
White paper	0	0	2	3.7	0.096	NA
Grinding wheat	33	66	53	66.3	0.001**	1.6
Recent mill	18	54.5	36	67.9	0.001**	2.0
Old mill	15	45.5	17	32.1	0.401	1.1

Table (5): The levels (mean±SD) of heavy metals whole blood lead and cadmium) among the preeclamptic group and the control group.

	Control			Preeclampsia			P. value
	Mean	SD	95%CI	Mean	SD	95%CI	
Pb(ug/dl)	103.1	34.4	92.8:113.4	140.6	60.9	126.5:154.7	0.001**
Cd(ug/dl)	0.398	0.881	0.358:0.438	1.132	2.46	1.019:1.245	0.017*

*CI : Confidence Interval, Pb(lead), Cd(cadmium),*Statistically significant at the 0.05 level, ** Statistically significant at the 0.01 level.*

Table (6): The levels (mean± SD) of whole blood lead among different preeclamptic groups.

		Pb(ug/dl)		P. value
preeclampsia	**No. (%)**	**Range**	**Mean ± SD**	
Mild preeclampsia	46(57.5%)	43.3 - 242.3	134.9+44.1	0.691
Severe preeclampsia	31(38.7%)	80.8 - 488.8	152.9+82.1	
Eclampsia with convulsions	1(1.25%)	106.3 - 106.3	106.3+0	
HELLP syndrome	1(1.25%)	144.3 - 144.3	144.3+0	
Severe preeclampsia with concealed hemorrhage	1(1.25%)	103.8 - 103.8	103.8+0	

P value related to Chisquare test

Table (7): The levels (mean± SD) of whole blood cadmium among different preeclamptic groups.

		Cd(ug/dl)		P. value
Preeclampsia	**No.(%**	**Range**	**Mean ± SD**	
Mild preeclampsia	46(57.5%)	0 - 17.21	1.27±2.84	0.957
Severe preeclampsia	31(38.7%)	0 - 9.95	1.03±1.95	
Eclampsia with convulsions	1(1.25%)	0 – 0	0±0	
HELLP syndrome	1(1.25%)	0 – 0	0±0	
Severe preeclampsia with concealed hemorrhage	1(1.25%)	0.54 – 0.54	0.54±0	

P value related to Chisquare test

Table (8): The relation between demographic characters and predisposing factors among the preeclamptic group and blood lead and cadmium levels (mean±SD).

		pb(ug/dl				cd(ug/dl)			
		Mean	**SD**	**P. value**	**95%CI**	**Mean**	**SD**	**P. value**	**95%CI**
Age	≤19 years	152.0	26.5	0.926	136.8-167.2	1.008	1.050	0.257	0.907-1.109
	20 - ≤29 years	138.7	49.2		124.8-152.6	0.761	1.174		0.685-0.837
	≥30 years	142.8	77.5		128.5-157.1	1.703	3.638		1.533-1.873
Residence	Rural	136.0	78.8	0.621	122.4-149.6	0.858	1.040	0.468	0.772-0.943
	Urban	143.1	49.3		128.8-157.4	1.280	2.956		1.152-1.407
Educational level	High	113.8	99.7	0.821	102.4-125.2	0.138	0.159	0.609	0.124-0.151
	Mid-high	142.6	37.4		128.4-156.9	0.428	0.470		0.385-0.471
	Low	141.2	62.4		127.1-155.3	1.229	2.593		1.106-1.352
Smoking	Smoker	133.6	36.4	0.204	120.2-146.9	1.225	2.783	0.681	1.103-1.348
	Not smoker	151.3	85.1		136.1-166.4	0.992	1.911		0.893-1.091
Parity	Primiparous	137.4	51.6	0.431	123.7-151.1	0.890	1.534	0.063	0.801-0.979
	Multiparous	135.1	51.5		122.9-151.5	1.85	2.720		1.12-2.43
History of pre-eclampsia in previous pregnancy	+ve history	141.6	47.2	0.935	127.5-155.8	2.814	5.646	0.099	2.533-3.096
	No history	143.7	72.9		129.4-158.1	0.948	1.816		0.853-1.043
Family history of preeclampsia	+ve history	157.4	64.4	0.155	141.7-173.2	2.160	4.167	0.003*	1.944-2.376
	No history	135.0	59.1		121.5-148.5	0.789	1.427		0.71-0.868
History of chronic hypertension before pregnancy	+ve history	120.8	46.1	0.355	108.8-132.9	4.404	5.778	0.001**	3.963-4.844
	No history	142.8	62.2		128.6-157.1	0.768	1.450		0.691-0.845
Gestational diabetes	+ve	128.9	63.9	0.695	116-141.8	5.806	7.711	0.001**	5.226-6.387
	-ve	141.3	61.1		127.1-155.4	0.886	1.665		0.797-0.974

**Statistically significant at the 0.05 level, ** statistically significant at the 0.01 level, CI: Confidence Interval*

Table (9): The relation between blood lead and cadmium levels and possible sources of exposure among the preeclamptic group.

		pb(ug/dl				cd(ug/dl)			
		Mean	**SD**	**P. value**	**95%CI**	**Mean**	**SD**	**P. value**	**95%CI**
Occupation	High risk	125.8	27.4	0.423	113.3-138.4	0.294	0.301	0.528	0.265-0.324
	Moderate risk	77.8	0.0		70-85.6	0.375	0.000		0.338-0.413
	Low risk	143.4	63.7		129.1-157.8	1.250	2.609		1.125-1.375
Paint use in houses	No paint	138.6	83.3	0.851	124.7-152.5	0.653	0.899	0.272	0.588-0.719
	Paint	141.5	50.0		127.3-155.6	1.325	2.844		1.192-1.457
iving near busy street	Yes	150.6	54.9	0.373	135.5-165.6	1.672	3.849	0.229	1.505-1.839
	No	136.9	63.0		123.2-150.6	0.927	1.666		0.834-1.02
Exposure to motor car exhaust	Yes	157.7	62.5	0.178	141.9-173.5	2.141	4.405	0.047*	1.927-2.355
	No	135.7	60.0		122.1-149.3	0.839	1.430		0.755-0.923
Eating fish	Yes	137.9	47.6	0.269	124.1-151.7	1.203	2.586	0.474	1.082-1.323
	No	161.9	127.3		145.7-178.1	0.574	0.926		0.517-0.631
Eating canned food	Yes	133.7	47.7	0.433	120.3-147.1	0.626	0.721	0.156	0.563-0.689
	No	144.8	67.7		130.3-159.3	1.435	3.033		1.292-1.579
Eating sandwiches	Loaded journals	174.3	0.0	0.032*	156.9-191.7	5.250	0.001	0.014*	4.725-5.775
	Plastic bags	*144*.6	57.2		130.1-159.1	1.200	3.145		1.08-1.32
	White paper	147.5	45.9		132.7-162.2	1.918	3.594		1.726-2.11
Grinding wheat	Recent mill	137.2	47.8	0.039	123.5-150.9	1.275	2.059	0.615	1.148-1.403
	Old mill	111.6	25.3		100.4-122.7	1.710	4.220		1.539-1.881

**Statistically significant at the 0.05 level, ** statistically significant at the 0.01 level*

Table (10): The relation between blood lead and cadmium levels and dietary habits among the preeclamptic group.

	pb(ug/dl				cd(ug/dl)			
	Mean	**SD**	**P. value**	**95%CI**	**Mean**	**SD**	**P. value**	**95%CI**
Drinking milk								
Yes	138.8	49.2	0.678	124.9-152.7	1.226	2.732	0.593	1.104-1.349
No	145.1	84.3		130.6-159.6	0.898	1.629		0.808-0.988
Eating cheese								
Yes	137.0	47.9	0.114	123.3-150.7	1.190	2.569	0.526	1.071-1.31
No	173.0	131.3		155.7-190.3	0.604	1.005		0.543-0.664
Calcium supplement								
Yes	139.8	51.5	0.892	125.8-153.8	1.363	3.017	0.345	1.226-1.499
No	141.7	71.9		127.5-155.9	0.835	1.458		0.752-0.919
Iron supplement								
Yes	141.3	48.8	0.908	127.2-155.4	1.353	2.957	0.341	1.217-1.488
No	139.7	75.6		125.7-153.7	0.817	1.483		0.735-0.899

*P value related to Chisquare test, *Statistically significant at the 0.05 level,** Statistically significant at the 0.01 level*

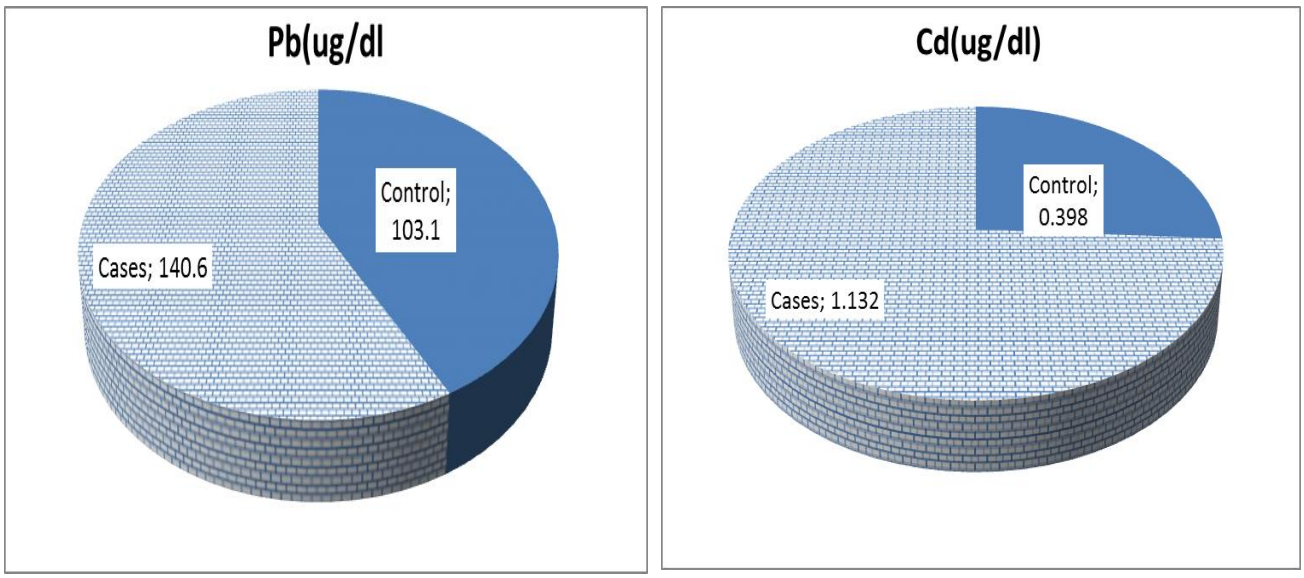

Figure (1): The mean levels of heavy metals (whole blood lead and cadmium) among the preeclamptic group and the control group.

Discussion

Preeclampsia is a multisystem disorder that remains a major cause of maternal and fetal morbidity and death. In developing countries where access to health care is limited, preeclampsia is a leading cause of maternal mortality causing an estimated >60,000 maternal deaths worldwide per year (Young et al., 2010). In Egypt, the prevalence of PE is 10.7% in a community based study. While, in hospital based studies it ranged from 9.1% to 12.5% of all deliveries (El-Moselhy et al., 2012).

The aim of this study is to evaluate the relationship between lead and cadmium blood levels in pregnant females and preeclampsia.

The results of the current study revealed significant increase in blood lead level among the preeclamptic group (P value=0.001 when compared to the control group. These findings were in keeping with the results of Rothenberg., et al 2002 who found a significant positive association between BLL and elevated blood pressure in pregnant females. These findings also in agreement with Motawei ., et al 2013, EL-Moselhy et al.,2012 who attributed the remarkably high BLLs found in participants of their study to the high prevalence of environmental pollution in many developing countries including Egypt and also, mobilization of lead from bone during pregnancy results in a significant gestational increase in maternal BLLs. Yazbeck et al.,2009 reported that the risk of pregnancy induced hypertension increases with increasing absolute values of mid-pregnancy blood lead in a "dose–response" pattern. All these findings suggest that high blood lead level may be one of the causal factors of preeclampsia.

Blood lead level has been reported to be increased in pregnant than in non-pregnant women, because of bone remodeling (Tellez-Rojo et al., 2004). In pregnancy, bone lead released into the blood varies from subject to subject, but there is an estimated 20.0% increase in blood lead (Gulson et al., 2003, EL-Moselhy et al., 2012).

The results of the current study also revealed that cadmium level was significantly higher among the preeclamptic group (P=0.017) when compared to the control group and this finding was in agreement with the results of studies done by Kolusari et al.,2008 .

In the current study, the preeclamptic group was classified into mild preeclampsia (57.5%), severe preeclampsia (38.7%), and eclampsia with convulsion (1.25%), HELLP syndrome (1.25%) and severe preeclampsia with concealed hemorrhage (1.25%).

Blood lead level was high in severe preeclampsia, HEELP syndrome and in mild preeclampsia when compared with other types but non-significant difference (P=0.691).Furthermore blood cadmium was high in mild and severe preeclampsia and also, statistically non-significant. This means that as metal level increase disease severity also, increases. This finding was in keeping with Motawei et al., 2013, in their study in Dakahlia, Rothenberg et al., 2002 in their study in Los Angeles prenatal care clinics between who found a significant positive association between blood lead level and elevated blood pressure in pregnant females.

In the present study, non-significant difference (P=0.091) was found between the preeclamptic group and control in age group (20 - ≤ 29 years), while statistically significant difference (P=0.011) was found between the preeclamptic group and control in age group (30≥ years). This finding was in agreement with Assis et al.,2008, Klitzman et al.,2002 who have reported that a higher age above 30 years is an important risk factor for hypertension in pregnancy especially in developed countries. The result of this study were also in keeping with Tebeu et al.,2011,

Lamminpää et al.,2012 who found that women with advanced age had approaching twice the risk of developing preeclampsia whether they were primiparous or multiparous.

Nationwide US data suggest that the risk of preeclampsia increases by 30% for every additional year of age past 34. Young maternal age did not seem to affect the risk of developing preeclampsia (Duckitt and Harrington,2005).

In the current study, there was variation in blood lead and cadmium level among different age groups with increase in level as age increase but this increase was non-significant, this can be explained by cumulative properties of these metals and this may explain why incidence of preeclampsia increase as age increase. This finding was in agreement with Rabinowitz, 1991 who said that, in the case of chronic exposure, elevated blood lead levels might persist for years, with large amounts of lead deposited in bone and so, some of lead's toxic effects are proportional to cumulative exposure and also, in keeping with Silbergeld, 1991 who found that women older than 30 years had significantly higher levels of breast milk lead than women between 20 and 30 years of age. Schwartz et al.,2003 who reported that cadmium levels in the body accumulate with age as only a minute part of the body burden (0.01–0.02%) is excreted per day.

In the current study, urban residence was a significant risk factor for preeclampsia (p value=0.001) and also associated with high lead and cadmium level in blood (insignificant) in comparison with rural residence and this may explain the high incidence of preeclampsia in urban residence. This finding was in agreement with Semczuk and Semczuk-Sikora,2001 who found a slight increase of blood lead content in pregnant women from urban agglomerations .This also in accordance with EL-Moselhy et al.,2012 who explain this finding by the presence of heavy traffic in urban areas which represents a source of lead exposures and also using leaded gasoline especially in developing countries.

In the current study significant correlation was found between preeclampsia and low educational level (P=0.012) and this was associated with high blood lead (95%CI=127.1-155.3) and cadmium level(95%CI=1.106-1.352).This finding was in agreement with Tebeu et al.,2011 who reported that illiteracy was associated with about 2-fold risk for presenting hypertensive disorder in pregnancy. These finding also in agreement with Silva et al.,2008 who reported that women with relatively low levels of education had a higher risk of gestational hypertension than women with a high educational level and explained this by unequal distributions of known risk factors for gestational hypertension across educational levels, particularly by the higher rates of overweight and obesity and the relatively high blood pressure levels at enrolment found in lower educated women. In our population the low school level is associated indirectly with precocious marriage and limited access to health care, including family planning.

The present study show a significant correlation between preeclampsia and passive smoking in comparison with control group (P=0.042) and this was associated with high blood cadmium level but non-significant and this may explain the strong association between smoking and cadmium toxicity. This finding was in agreement with Hogervorst et al.,2007 who reported that tobacco smoke and polluted air are additional sources of exposure to cadmium and also, in agreement with Gallagher and Meliker,2010 who reported that smoking is associated with increased cadmium levels because cigarettes contain cadmium taken up by the tobacco plant and smokers have approximately twice the cadmium body burden of nonsmokers.

In this study, smoking of the husband was associated with low blood lead of their wife's in comparison to non-smokers among the preeclamptic group but statistically insignificant [(P=0.204) this may be due passive exposure of women to tobacco. Croute et al.,2000 , Willers et al.,2005 reported that the levels of respirable particles of lead and cadmium increase in rooms with poor ventilation. Smokers (active) have much higher blood cadmium concentrations and somewhat higher lead concentrations in blood. Further, an association between blood lead and environmental tobacco smoking exposure has been reported. As tobacco contains heavy metals, this finding may be due to the contamination of house dust by cigarette ash and smoke (Rosalie et al., 2014).

In the present study, significant association was found between preeclampsia and increasing body mass index (P=0.050) , not only obese women but also overweight women have a markedly increased risk for preeclampsia compared with women with a normal BMI so, obesity is a strong risk factor for pregnancy complications and preeclampsia. This in agreement with, Baeten et al.,2001, Duckitt and Harrington,2005 Bhattacharya et al.,2007, who found a strong association between increasing BMI and pregnancy induced hypertension and also found a significantly lower risk of preeclampsia in underweight women. Sebire et al.,2001 also found a significantly lower risk of preeclampsia in underweight women. Bdeglrd et al.,2000 also found that high maternal weight was positively associated with the risk of preeclampsia .

In the current study, preeclampsia was significantly common among primiparous in comparison with control group. This finding was in agreement with Bdeglrd et al.,2000 who found that nulliparous women were at increased risk of preeclampsia compared to parous women. This finding also, in keeping with Tebeu et al.,2011 who did find multiparity as a risk factor for hypertension in pregnancy. Blood lead level was high in primiparous when compared to multiparous among the preeclamptic group but this increase was non-significant. This finding was in contrast with Yazbeck et al.,2009 who

observed high levels of blood lead in multiparous women of their study and so, an increase in the frequency of pregnancy induced hypertension in this group.

As regard multiparous women, the risk of preeclampsia in this study was found to be significantly increased in women with history of preeclampsia in previous pregnancy in comparison with control (P=0.035).This finding was in agreement with Raijmakers et al., 2004 who found that the risk of preeclampsia markedly increases in women with previous preeclampsia this also, in keeping with Duckitt and Harrington,2005 who found that women who have preeclampsia in a first pregnancy have seven times the risk of preeclampsia in a second pregnancy.The result of this study, however, are in contrast with Li and Wi ,2000 who said that preeclampsia is predominately a condition of the first birth and the risk decreases substantially among multiparous women.

In the current study, history of preeclampsia in previous pregnancy was associated with relatively high level of blood lead but non-significant. This finding can be explained according to Brown and Margolis,2012 by, lead persists in bone for decades, as bone stores are mobilized to meet the increased calcium needs of pregnancy and lactation, women and their infants might be exposed to lead long after external sources have been removed.

In the current study, history of preeclampsia in previous pregnancy was associated also with high blood cadmium level but non-significant. An explanation for this according to Kjellstromt, 1979, is that women in many age groups had higher tissue cadmium concentrations than men. Whether the higher values for women are the result of higher cadmium intakes per unit body weight, higher absorption rates or lower excretion rates is not known.

In this study, statistically significant difference was found between the preeclamptic group and the control as regard the family history of preeclampsia. This finding was in agreement with Duckitt and Harrington, 2005 who reported that family history of preeclampsia nearly triples the risk of preeclampsia. This finding was associated with increase in blood lead and cadmium level (P=0.155, 0.003 respectively), this may be due to exposure to the same risk factors (e.g. smoking, residence, illiteracy, drinking contaminated water and low educational level).

Recommendations:

1- Heavy metal testing of pregnant women and women of childbearing age (in particular lead and cadmium) might prove a useful strategy towards early identification and possible prevention of some portion of these problematic birth outcomes
2- Women with risk factors for preeclampsia should have a more frequent antenatal care for monitoring and evaluation of their conditions. Environmental, nutritional and behavioral interventions are indicated for pregnant women to prevent exposures of the women, and fetus to environmental pollutants.
3- Adequate dietary intake is essential for pregnant women. Increasing efforts to prevent iron deficiency anemia in pregnant women is of great importance to reduce the prevalence of elevated blood lead level.
4- Smoking cessation and a strict policy of environmental lead and cadmium exposure control can bring great benefits to the pregnant women. There is also, a substantial need to improve methodology that investigates the associations between lead and cadmium exposure and unfavorable pregnancy outcomes.
5- Further researches are needed for better understanding of medical and demographic risk factors of preeclampsia. Further studies in different areas and among different population in Egypt are needed to investigate this great health problem.

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الملخص العربي

نسبه الرصاص والكادميوم فى دم بعض السيدات الحوامل بمحافظه اسيوط: هل لها دور فى تسمم الحمل؟

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يمثل تسمم الحمل سببا رئيسيا للاعتلال والوفيات في الأم والجنين و الرضع في أجزاء كثيرة من العالم.و في مصر بلغ معدل انتشار تسمم الحمل١٠,٧% في دراسة مجتمعية في حين تراوح المعدل بين ٩,١% إلى ١٢,٥% من جميع حالات الولادة في دراسة بالمستشفي.وقد ارتبط ارتفاع مستويات الرصاص والكادميوم في الدم بمشكلات صحية مرتبطة بالحمل وأهمها تسمم الحمل.

و قد هدفت هذه الدراسة إلي تقييم العلاقة المحتملة من التعرض البيئي لكل من (الكادميوم والرصاص) وتسمم الحمل.وقد أجريت هذه الدراسة في مستشفى صحة المرأة جامعه أسيوط وهي دراسة مقطعيه تتضمن ٨٠ مريضه تم تشخيصهن على أنهن حالات تسمم حمل و ٥٠ حاله أخرى حامل لا تعاني من تسمم الحمل كمجموعه ضابطه.كشفت نتائج هذه الدراسة أن مستويات عالية من الرصاص والكادميوم توجد في دم السيدات اللاتي يعانين من تسمم الحمل. وقد وجد إن هناك تباين في مستوى الرصاص والكادميوم في الدم بين مختلف الفئات العمرية. كما وجد إن الإقامة في الحضر مرتبطة بوجود نسب عالية من الرصاص والكادميوم في الدم. كما أظهرت نتائج البحث ايضا ارتباط كبير بين تسمم الحمل وانخفاض المستوى التعليمي و قد كان ذلك مرتبطا بارتفاع مستويات الرصاص والكادميوم في الدم. كما وجد ارتباط كبير بين تسمم الحمل وزيادة الوزن أو السمنة مما يعنى إن السمنة عامل خطر قوي لمضاعفات الحمل وخاصة تسمم الحمل. كما أظهرت البيانات التي تم الحصول عليها من التاريخ المرضى ان تسمم الحمل كان أكثر حدوثا بين النساء البكرية ومتكررة الولادات وقد كان ذلك مرتبطا بنسب عاليه للرصاص والكادميوم في الدم. وقد وجد أيضا إن سكري الحمل وارتفاع ضغط الدم المزمن من العوامل التي تزيد من حدوث تسمم الحمل وقد ارتبط ذلك بوجود نسب عاليه من الرصاص والكادميوم في الدم.عمل الزوج في الصناعات المرتبطة بالرصاص والكادميوم يشكل خطر كبير على الزوجة الحامل فالأزواج المعرضين للخطر قد يعرضون زوجاتهم للرصاص والكادميوم في ملابسهم التي يحملونها إلى منازلهم. أيضا من المصادر المختلفة للتعرض للمعادن تلوث إمدادات المياه كما إن استخدام الطلاء في المنازل يعتبر مصدرا هاما من مصادر التعرض للمعادن الثقيلة. وأيضا وجد إن السيدات اللاتي تقيمن بالقرب من شارع مزدحم وتتعرض لعوادم السيارات والمحركات من أهم مصادر التعرض للمعادن الثقيلة.

التوصيات:اختبار المعادن الثقيلة للسيدات الحوامل والنساء في سن الإنجاب (لا سيما الرصاص والكادميوم) قد تكون استراتيجية مفيدة نحو الكشف المبكر والوقاية من التسمم المزمن بالمعادن الثقيله.منع فقر الدم بسبب نقص الحديد لدى النساء الحوامل له أهمية كبيرة للحد من ارتفاع مستوى الرصاص في الدم.زياده حملات التوعيه للاقلاع عن التدخين يمكن أن يحقق فوائد كبيرة للنساء الحوامل. وهناك حاجة إلى مزيد من الأبحاث والدراسات في مختلف محافظات مصر للتحقيق في هذه المشكلة الصحية العظيمة وتحديد عوامل الخطر.

وقد خلص البحث الي ان وجود مستويات عالية من الرصاص والكادميوم فى دم السيدات الحوامل يعد من العوامل المؤدية الي تسمم الحمل.

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