COMPARATIVE STUDY BETWEEN SERUM CALCIUM AND MAGNESIUM LEVELS IN PRE ECLAMPSIA VERSUS NORMAL PREGNANCY

By

Mohammed Gamal Mohammed El-Maghraby[1]*, Abd El-Monaem Mohammed Zakarya[2], Mahmoud Abd EL-Latif Hashish[3], and Adel Aly El-Boghdady[2]

[1]Obstetrics and Gynecology resident at Kafr El-Shiekh General Hospital, Egypt

[2]Obstetrics and Gynecology Department, Faculty of Medicine, Al-Azhar University, Egypt

[3]Clinical Pathology Department, Faculty of Medicine, Al-Azhar University, Egypt

*Corresponding author: Mohammed Gamal Mohammed El-Maghraby

Mobile: +201002974648, **E-mail:** marwanelmaghraby2019@gmail.com

ABSTRACT

Background: Numerous clinical studies had clarified the alliance between preeclampsia and disturbances in maternal biochemical macronutrients, involving serum calcium (Ca+2) and magnesium (Mg+2). Up till now, there is an escalated concern in benefitting from nutritional approach in the preeclampsia management with respect to calcium and magnesium supplementation.

Aim of the work: To assess serum levels of calcium and magnesium in pregnant females who suffered from pre-eclampsia in comparison with normal pregnant ladies.

Patient and methods: This study was a case-control one that recruited 100 pregnant women (50 pregnant preeclampsia cases and 50 normal pregnant females) from obstetrics clinics of Kafr El-Sheikh General hospital and El-Sayed Galal Hospital of Al-Azhar University after the 20th week of gestation during the period of research from February 2020 to December 2020 for estimation off serum calcium and magnesium.

Results: The mean serum calcium level in the control group was 8.99 ± 0.52 mg/ dl and mean serum magnesium level was 2.21 ± 0.3 mg/ dl both were higher than those in the patients group as the mean serum Ca+2 was 8.05 ± 0.51 mg / dl and mean serum Mg+2 level was 1.86 ± 0.25 mg / dl (P<0.001). The present study showed that calcium had significantly higher diagnostic accuracy than magnesium to differentiate normotensive pregnant women from preeclamptic pregnant women. ROC curve showed that the optimum cut off for calcium was 8.55 (mg/dL) with sensitivity of 80 % and specificity of 84%, PPV of 83.3%, NPV of 80.8%. Calcium had largest area under the curve (AUC= were 0.898; CI :(0.840-0.956) (P<0.001), indicating its importance for predicting preeclampsia. While the cut off value of magnesium was less than 2.15(mg/dL), the sensitivity was 88%, specificity was 60%; an area under the ROC curve (AUROC) 0.806(95% CI: 0.721-0.891). In addition, ROC curve showed the optimum cut off for serum calcium was 8.15 (mg /dL) for predicting adverse outcome of pregnancy with sensitivity 60.6% and specificity 86.6%; an area under the ROC curve (AUROC) 0.792(95% CI: 0.701-0.883). While the cut off value of serum magnesium was less than 1.945(mg/dL), the sensitivity was 69.7%, specificity was 67.2% %; an area under the ROC curve (AUROC) 0.726(95% CI: 0.618-0.834).

Conclusion: Both serum calcium and serum magnesium in preeclamptic pregnant women were lesser in comparison to their healthy pregnant counterparts. These outcomes support the postulation that there is a cause- consequence liaison between hypocalcaemia and hypomagnesaemia as potential etiologic factors incriminated in of preeclampsia pathogenesis.

Key words: Preeclammpsia, Calcium, Magnesium.

INTRODUCTION

Preeclampsia, tagged as a syndrome of theories, is a recognized health challenge with devastating foeto-maternal consequences. It has been with numerous postulations suggested to unravel its aetiopathogenesis *(Fasanu et al., .2020).*

It is a multisystem disorder that affects 2- 8% of pregnant females and it is a profound complication of pregnancy characterized by new onset of hypertension with significant proteinuria after 20 weeks' gestation *(Shah, 2020).*

It is the third most common cause of maternal death worldwide. Developing countries are more adversely affected as 20–80% of increased maternal mortality is associated with pre-eclampsia *(Eze et al., 2020).*

Since the pathogenesis of preeclampsia has not been fully elucidated, the search for predictive markers and preventive strategies remains an unfulfilled issue *(Lakshmy et al., 2018).*

Even though a multitude of novel for example; serum placental growth factor (PIGF), soluble fms-like tyrosine kinase 1, and soluble endoglin have been determined to aid as initial predictors of preeclampsia. Also, serum calcium and magnesium may be applicable and cost-effective predictors for preeclampsia since the beginning of pregnancy *(Aslam et al., 2020).*

Deficiencies in mineral constituents as calcium, magnesium, zinc, etc., have been documented to cause remarkable health troubles for women of reproductive age, particularly in developing countries attributable to inadequate dietary intake. The risk of deficiency is augmented thru pregnancy owing to exaggerated requirements for various nutrients by the growing fetus *(Tavana and Hosseinmirzaei, 2013).*

It has been hypothesized that oscillations in maternal serum ions may be the instigating cause of elevated blood pressures in preeclampsia. Dietary deficiency of mineral ions has been displayed to have a deleterious effect on the both maternal and fetal health and may be possibly complicated by preeclampsia *(Darkwa et al., 2017).*

Once more, nutritional deficiency role in the pathogenesis of preeclampsia has been highlighted. Numerous clinical studies have focused on the association between preeclampsia and deficiences in maternal biochemical macronutrients, comprising calcium and magnesium with an increasing concern in the management of preeclampsia via nutritional approach especially calcium and magnesium supplementation *(Ugwuja et al., 2016).*

Hence fore, this study aimed to assess serum levels of calcium and magnesium in pregnant females who suffered from pre-eclampsia in comparison with normal pregnant ladies.

PATIENTS AND METHODS

This study was a case-control one that recruited 100 pregnant women (50 pregnant preeclampsia cases and 50 normal pregnant females) from obstetrics clinics of Kafr El-Sheikh General hospital and El-Sayed Galal Hospital of Al-Azhar University after the 20th week of gestation during the period of research from February 2020 to December 2020 for estimation of serum calcium and magnesium. Inclusion criteria were

maternal age between15-45 years, gestational age after the 20th week of gestation. Prreclampsia cases were diagnosed according to the American College of Obstetrics and Gynecology (ACOG) with systolic blood pressure ≥ 140mmhg and or diastolic blood pressure ≥ 90 mm hg after 20th week of gestation on two occasions each 6 hours apart *(ACOG, 2019).* written eonsents were obtoined fren the patiens.

Exclusion criteria: Maternal systemic disorder; chronic hypertension, diabetes mellitus, chronic kidney disease (CKD), ischemic heart disease (IHD), history of immunosuppression intake, history of previous poor pregnancy outcomes (intrauterine growth retardation, recurrent abortions), history of smoking, any disease recognized to disturb serum calcium or magnesium e.g renal disease, known digestive disorders or, known thyroid or adrenal disease, eating disorders, antenatal vitamin or mineral supplementation.

The elected patients were subjected to detailed history taking complete general, abdominal examination and ultrasonographic examination. Then, about 5 ml of venous blood was collected once from both study group and control group by anticubital vein-puncture, using a sterile disposable syringe, without using elastic band tourniquet half of the amount collected were transferred immediately into commercially prepared concentration of Ethylene Di-amine Tetra-acetic Acid (EDTA) containers. The remaining half was allowed to clot and the serum was obtained by centrifugation at 3000 rpm for 10 minutes or the remaining investigations including serum calcium, magnesium concentrations estimation using Atomic Absorption Spectrophotometer.

Statistical analysis:

Statistical analyses of data were carried out using SPSS version 23. Shapiro – Wilks test was used to test normal distribution of variables. Numerical data were expressed as mean ± standard deviation or median and range. Categorical data were summarized as percentages. The significance for the difference between groups was determined by using two-tailed Student's t test. Also Qualitative variables were assessed by chi-squared χ^2test. The probability (P) values of ≤0.05 were considered statistically significant indicated. The Receiver Operating Characteristic (ROC) was constructed to obtain the most sensitive and specific cutoff value for serum Ca^{+2} and Mg^{+2}. menn- whitny U test wes used to eowpere data thet were not norwally distr. Butad.

RESULTS

Overall, 100 pregnant women were recruited in this study during the period of research from February 2020 to December 2020 to obstetrics clinic of Kafr El-Sheikh General hospital and El-Sayed Galal Hospital of Al-Azhar University. All eligible cases were recruited after the 20th week of gestation. They were divided into 2 groups: 50 controls and 50 pregnant women who developed preeclampsia with systolic blood pressure ≥ 140 mmHg and/ or diastolic blood pressure ≥ 90 mmHg after 20th week of gestation on two occasions each 6 hours apart.

The mean age of patients group was 29.92 ± 7 years while it was 29.72 ± 4.51

years in control group. There were no statistically significant differences in the mean age of both studied groups (P=0.866).

Also, these results indicated that there was no statistically significant difference between all studied groups according to body mass index, gravidity, and parity (P>0.05).

Additionally, there was a significant difference between the two studied groups with regards to blood pressure both systolic and diastolic which increased with the occurrence of preeclampsia (P<0.001). The results showed that the average systolic blood pressure among cases was found to be 159.8 mmHg compared with 113.6 mmHg among controls. Furthermore, average diastolic blood pressure was found to be 103.12 mmHg among preeclampsia cases compared with 70.8 mmHg among controls.

In preeclampsia group, thirty-four (68%) delivered by Cesarean section whereas sixteen cases delivered vaginal (32%). A significantly higher occurrence of Cesarean section in the preeclamptic group than in the control group (P=0.026). Also, there was a significant difference between the two studied groups with regards to appearance of protein in urea which increased in patients with preeclampsia (P<0.001). All control cases hadn't have proteinuria whereas, in preeclampsia group, Sixteen (32%) of the cases showed proteinuria level ranged from (+1 - +2), whereas 34 (68%) of them showed a level ranged from (+3-+4).

It was observed that in preeclampsia cases, the mean gestational age at delivery was significantly lower than that in the controls (33.58 ± 3.82 vs 36.94±2.21, P <0.001). Furthermore, patients with preeclampsia had significantly lower mean birth weights for the neonates compared to controls (1671.4 ± 670.8 g vs

3297 ± 339.2 g (P<0.001). Among the control group all babies were of weight more than 2.5kg whereas 72% of newborns to preeclampsia mothers had weight less than 2 kg, 26% were of weight 2 - 2.5 kg and remaining babies (2%) were more than 2.5 kg weight **(Table1)**.

Among the study group 44% had Intra Uterine Growth Retardation (IUGR) babies, 6% had intra uterine fetal death (IUFD), 10% developed eclampsia and. 2% developed HELLP syndrome. Among the control group, 8% has IUGR babies, 8% had PPROME, and 2% had Intra Uterine death **(Table1)**.

The results showed that there was statistically significant decrease in the hemoglobin levels platelets count as well as leucocytes count among cases with preeclampsia compared to that of controls (12.14 ±1.2 (g/dL) vs. 12.63 ± 1.3 (g/dL); P=0.05) & (219.337 ± 74.56 (×103/ μL) vs. 276.72 ± 52.88 (×103/ μL); P<0.001) and (8536.5± 3118.3/ μL vs. 11542.8± 2357 / μL; P < 0.001).While, there was no significant difference in the mean value of RBCs between studied groups (P> 0.05) **(Table1)**.

The current study also showed that the mean serum albumin level was significantly higher in control cases (3.46± 0.3) (g/dL) compared to that detected among patients (3.34± 0.4) (g/dL); (P=0.05).

Regarding calcium and magnesium levels, the results showed progressively increase in the mean serum calcium and magnesium levels in control cases compared to PE cases (8.99 ± 0.52 mg/dL vs. 8.05 ± 0.51 mg/dL) and (2.21 ± 0.3 mg/dl vs. 1.86 ± 0.25 mg/dL) respectively. The present study showed that the mean serum calcium and magnesium level in the study group who developed preeclampsia were lower than the control group who remained normotensive (P<0.001), which is statistically significant **(Table 1)**.

Table (1): Demographic data and biochemical parameters of the patients and controls

Variables \ Groups	Preeclampsia Group (n=50)	Healthy Controls (n=50)	P-value
Age(Yrs.)	29.92 ± 7	29.72 ± 4.51	0.866
BMI at enrollment	27.97 ± 6.8	27.38 ± 3.3	0.577
Gravidity	2.78 ± 1.48	2.7 ± 1.66	0.8
Parity	0.28 ± 0.57	0.26 ± 0.44	0.846
Systolic Blood Pressure (mmHg)	159.8 ± 20.25	113.6 ± 9.9	<0.001**
Diastolic Blood Pressure (mmHg)	103.12 ± 11.6	70.8 ± 6.7	<0.001**
Gestational age at delivery (weeks)	33.58 ± 3.82	36.94±2.21	<0.001
Mode of delivery. Vaginal	16(32%)	28(56%)	0.026*
Cesarean section	34(68%)	22(44%)	
Appearance of proteinuria None	0(0%)	50(100%)	0.001**
1-2	16(32%)	0(0%)	
3-4	34(68%)	0(0%)	
Birth weight [g]	1671.4 ± 670.8	3297 ± 339.2	<0.001**
Complications None	25(50%)	45(90%)	<0.001**
IUGR	22(44%)	4(8%)	
PPROM	0(0%)	4(8%)	
HELLP	1(2%)	0(0%)	
Eclampsia	5(10%)	0(0%)	
IUFD	3(6%)	1(2%)	
Hemoglobin (g/dL)	12.14 ±1.2	12.63 ± 1.3	0.05*
RBCs count (×10⁶/ µL)	4.02 ± 0.645	4.08 ± 0.319	0.586
Leukocytes count (/ µL)	8536.5± 3118.3	11542.8± 2357	<0.001**
PLT (×10³/ µL)	219.337 ± 74.56	276.72 ± 52.88	<0.001**
Albumin (g/dL)	3.34 ±0.4	3.46 ± 0.3	0.05*
Serum Calcium(mg/dL)	8.05±0.51	8.99± 0.52	<0.001**
Serum Magnesium (mg/dL)	1.86 ± 0.25	2.21 ± 0.3	<0.001**

Values are expressed as mean ± standard deviation or n (%) unless otherwise specified;

BMI — body mass index; PLI _ Platelets

 - *: $P \leq 0.05$, **: $P \leq 0.01$.

The present study demonstrated that serum calcium is positively correlated with gestational age, birth weight, and platelets count (r=0.374, P=0.001 & r=0.610, P<0.001 & r= 0.383, P<0.001). However, it was negatively correlated systolic blood pressure, diastolic blood pressure, proteinuria, WBCs, and fetal complication (r=-0.629, P<0.001 r=-0.653 & P<0.001, r=-0.652 & P<0.001, r= -0.327, & P=0.001 & r=-0.426, P<0.001).

On the other hand, serum magnesium is positively correlated with birth weight, and platelets count (r=0.419, P=0.001 & r= 0.278, P=0.001) whereas it was negatively correlated systolic blood pressure, diastolic blood pressure, proteinuria, fetal complications, and maternal complications (r=-0.554, P<0.001 & r=-0.553, P<0.001 & r=-0.482, P<0.001 & r= -0.288, P=0.004 & and r=-0.212, P=0.034) **(Table 2)**.

Table (2): **Correlation of serum calcium and magnesium levels and other parameters of all studied cases**

Electroeytes Parameters	Calcium (mg/dl)		Magnesium (mg/dl)	
	r	P-value	r	P-value
Age	-0.027	0.790	-0.054	0.596
Gestational age	0.374	0.001***	0.192	0.056
Birth weight	0.610	<0.001***	0.419	0.001***
Gravidity	0.052	0.606	0.00	0.997
Parity	-0.045	0.659	-0.08	0.430
BMI(Kg/m^2)	0.015	0.881	0.059	0.561
Route of delivery	-0.172	0.086	0.061	0.544
Systolic Blood pressure	-0.629	<0.001***	-0.554	<0.001***
Diastolic Blood Pressure	-0.653	<0.001***	-0.553	<0.001***
Albumin	0.029	0.776	0.157	0.118
Proteinuria	-0.652	<0.001***	-0.482	<0.001***
Hemoglobin	0.160	0.112	0.106	0.295
WBCs	-0.327	0.001***	-0.184	0.067
Platelet count	0.383	<0.001***	0.278	0.001***
RBCs	-0.056	0.580	-0.042	0.676
Fetal complications	-0.426	<0.001***	-0.288	0.004**
Maternal complications	-0.159	0.114	-0.212	0.034*

The present study showed that calcium had significantly higher diagnostic accuracy than magnesium for differentiate normotensive pregnant women from preeclamptic pregnant women. ROC curve showed that the optimum cut off for calcium was 8.55 (mg/dL) with sensitivity of 80 % and specificity of 84 %, PPV of 83.3 %, NPV of 80.8 %. Calcium has largest area under the curve (AUC= were 0.898; CI: (0.840-0.956) (P<0.001), indicating its importance for predicting preeclampsia (Table 3 and Figure 1). While the cut off value of magnesium was less than 2.15(mg/dL), the sensitivity was 88%, specificity was 60% %; an area under the ROC curve (AUROC) 0.806(95% CI: 0.721-0.891).

Table (3): **Diagnostic values of serum calcium and magnesium for differentiate normotensive pregnant women from preeclamptic pregnant women**

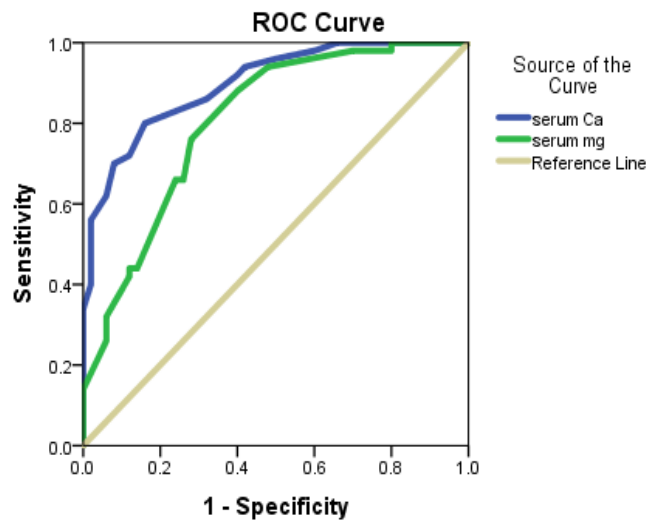|	Cutoff	Sensitivity	Specificity	PPV	NPV
Calcium (mg/dL)	8.55	80%	84%	83.3%	80.8%
Magnesium (mg/dL)	2.15	88%	60%	68%	83.3%

Figure (1): ROC curve of serum calcium and magnesium for discriminating normotensive pregnant women from preeclamptic pregnant women

Table (4) and **Figure (2)** illustrate the ROC plots to assess the diagnostic efficiency of serum calcium and magnesium for predicting poor outcome of pregnancy. ROC curve analysis showed that calcium had significantly higher diagnostic accuracy than magnesium in predicting outcome of pregnancy.

ROC curve showed the optimum cutoff for serum calcium was 8.15(mg /dL) for predicting adverse outcome of pregnancy with sensitivity 60.6% and specificity 86.6%; an area under the ROC curves (AUROC) 0.792(95% CI: 0.701-0.883). While the cut off value of serum magnesium was less than 1.945(mg/dL), the sensitivity was 69.7%, specificity was 67.2% %; an area under the ROC curve (AUROC) 0.726 (95% CI: 0.618-0.834).

Table (4): Diagnostic values of serum calcium and magnesium for predicting outcome of pregnancy

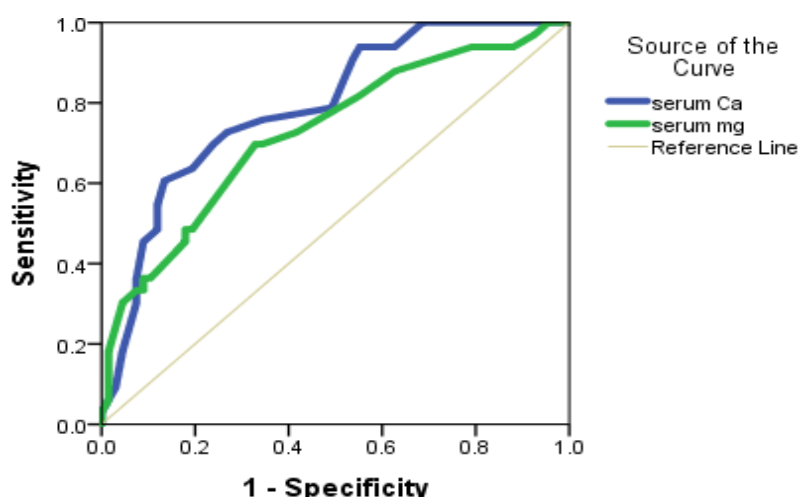|	Cutoff	Sensitivity	Specificity	PPV	NPV
Calcium (mg/dL)	**8.15**	**60.6%**	**86.6%**	**69%**	**81.7%**
Magnesium (mg/dL)	**1.945**	**69.7%**	**67.2%**	**51.1%**	**81.8%**

MOHAMMED G. EL-MAGHRABY *et al.,*

Figure (2): ROC curve of serum calcium and magnesium (mg/dL) for predicting outcome of pregnancy

DISCUSSION

Regarding serum calcium and magnesium, the mean serum calcium level in the control group were highes thon those in the baherto groyb

The present study demonstrated that serum calcium is positively correlated with gestational age, birth weight, and platelets count. However, it was negatively correlated systolic blood pressure, diastolic blood pressure, proteinuria, WBCs, and fetal complication. On the other hand, serum magnesium is positively correlated with birth weight, and platelets count, whereas it was negatively correlated systolic blood pressure, diastolic blood pressure, proteinuria, fetal complications, and maternal complications.

The present study showed that calcium had significantly higher diagnostic accuracy than magnesium for differentiate normotensive pregnant women from preeclamptic pregnant women. Calcium has largest area under the curve indicating its importance for predicting preeclampsia.

In addition, ROC curve showed the optimum cutoff for serum calcium and magnesiun for predicting adverse outcome of pregnancy.

Calcium plays a crucial part in the function of the vascular smooth muscles. Variation of plasma calcium concentration leads to elevated blood pressure. Moreover, magnesium acts as co-factor for several enzymes and is involved in peripheral vasodilatation. A number of studies displayed that blood calcium and magnesium have a relaxant influence on the blood vessels of pregnant women *(Mittal et al., 2014)*.

The findings of lower levels of serum calcium and magnesium in women with pre-eclampsia is in tandem with previous studies *(Kanagal et al., 2014*; *Onyegbule et al., 2014*; *Olusanya et al., 2015*; *Ugwuja et al., 2016*; *Aslam et al., 2020* and *Okoror et al., 2020)*. The tendency for occurrence of maternal hypocalcemia during pregnancy has been authenticated

for decades. Over the pregnancy course, total calcium tends to diminute and more significant decrease ids reported in pre-eclampsia *(Indumati et al., 2011)*.

Changes in serum calcium levels are concomitant with blood pressure alteration. During the third trimester, around 200 mg of calcium per day is deposited in the fetal skeleton via the placenta pregnancy and thru this period, maternal excretion of the urinary calcium is doubled. Diminutions in serum calcium level provotes the release of rennin and parathyroid hormones that trigger increase in the intracellular calcium concentration in vascular smooth muscle cells. This stimulates vasoconstriction as well as increased peripheral vascular resistance, augmenting the raised blood pressure. Consequently, aberrations in calcium homeostasis may make a contribution to the abnormal vasculopathy that has been already established in preeclampsia *(Aghade and Bavikar, 2017)*.

In agreement to our results also, *Tavana and Hosseinmirzaei, 2013* found that the serum magnesium in pre-eclampsia cases was significantly less than the control group that consisted of normal pregnant women

Furthermore, multitude of research works have reported a decrease in serum magnesium levels as a probable etiology of preeclampsia *(Jain et al., 2010*; *Roberts et al., 2010*; *Akinloye et al., 2013* and *Ugwuja et al., 2016)*. This evidence is reinforced by the effectiveness of magnesium sulfate therapy for prophylaxis and treatment of preeclampsia/eclampsia allied seizures *(Darkwa et al., 2017)*.

Magnesium, a fundamental intracellular cation, contributes to neurotransmission and peripheral vasodilation. At the sub-cellular level, magnesium acts as an indispensable cofactor in the ATPase activation thus controling metabolic regulation of energy-dependent cytoplasmic and mitochondrial pathways and regulating oxidative-phosphorylation processes. Moreover, it controls contractile proteins, modulates transmembrane transport of ions like calcium, sodium, and potassium, , and influences DNA and protein synthesis *(Ugwuja et al., 2016)*.

In accordance to our results, also novel work conducted by *Okoror et al., 2020* reported a statistically significant elevation in the prevalence of hypocalcemia among pre-eclampsia cases contrasted to the controls. A potential justification for this finding is the elevated intracellular calcium that ensues after low serum calcium with resultant vasoconstriction and elevated blood pressure *(Goulopoulou and Webb, 2014)*.

Okoror et al., 2020 found also a negative correlation between serum calcium and blood pressure and positive correlation between serum magnesium and calcium in their study.

There are no well-established policies for the preeclampsia prevention. Particular studies have shown that dietary calcium supplementation seemed to be applicable in downgrading the risk of preeclampsia occurence *(Aghade and Bavikar, 2017)*.

A meta-analysis done in the developing country shows that calcium supplementation during pregnancy is used to prevent pregnancy-induced hypertension disorder and its

complication. Another systemic review evidenced that low dose calcium supplementation *(Imdad et al., 2011* and *Hofmeyr et al., 2014).*

The recommended dietary allowance in the USA recommends that pregnant women should take 1 to 1.5 gms of calcium daily for pre-eclamptic complication prevention. Milk, soy milk, yogurt, cheese and vegetables like cabbage, broccoli, almonds, sardine and salmon with bones and calcium fortified orange juice are good sources of calcium. The daily requirement of magnesium is about 350mg/day. Foods rich in magnesium include whole grains, nuts and green vegetables. Green leafy vegetables are particularly good sources of magnesium. The limitation of our study was that a detailed dietary assessment of the subjects was not done. Pregnant women in developing countries should be encouraged to consume food rich in calcium and magnesium. If the intake is less than the recommended dose, a supplement can be given *(Kanagal et al., 2014).*

Nonetheless, *Chukwunyere et al.,*

(2020) in contrary to the current work, showed non-significant difference between the mean serum calcium level in normotensive pregnant women, in gestational hypertensions, and .

Darkwa et al., 2017 also observed no statistically significant dissimilarity in mean entire serum calcium and magnesium levels of pre-eclamptic females when paralleled to normal pregnant women (p=0.092), and they mentioned that hypomagnesemia and hypocalcemia as etiopathologic factors in the development of preeclampsia are not a

universal finding in literature. Numerous research work from different regions across the globe have reported varying results concerning the role of these trace elements in the etio- pathogenesis of preeclampsia *(Jain et al., 2010*; *Farzin & Sajadi, 2012* and *Akinloye et al., 2013).*

Golmohammad Lou et al. in (2008) have disputed about the role of calcium and trace elements in high blood pressure, particularly, pre-eclampsia. They explicated that, although slightly lesser, there was no significant discrepancy was found in calcium and magnesium concentrations between women with pre-eclampsia and their normal healthy counterparts.

This however, was slightly debatable as magnesium supplementation during pre-eclampsia and seizures treatment had shown to avert calcium-dependent arterial vasoconstriction and may antagonize the surge in intracellular calcium concentration. A Cochrane review simultaneously with WHO recommendations on pre-eclampsia and eclampsia prevention and management and consistently reinforced that these minerals supplementation in pregnancy is allied to significant reduction in the pre-eclampsia risk *(Hofmeyr et al., 2010*; *Hofmeyr et al., 2014* and *Ephraim et al., 2014).* Therefore, exemptions to the consensus that decreased serum calcium and magnesium levels exist in preeclampsia cases may not be still justified and need further research works.

CONCLUSION

Both serum calcium and serum magnesium in preeclamptic pregnant women were lesser in comparison to their healthy pregnant counterparts. These

outcomes support the postulation that there is a cause- consequence liaison between hypocalcaemia and hypomagnesaemia as potential etiologic factors incriminated in of preeclampsia pathogenesis.

Ethical approval: Approval of ethical committee was obtained from quality education assurance unit, Faculty of Medicine, Al-Azhar University Egypt.

Conflict of interest: The authors declare that they have no conflicts of interest.

REFERENCES

1. **ACOG Practice Bulletin No. 202. (2019):** Gestational Hypertension and Preeclampsia. Obstetrics and Gynecology. 2019; 133: e1–25.

2. **Aghade SM, Bavikar JS. (2017):** Comparative Study of Serum Calcium in Preeclampsia and Normal Pregnancy at Government Medical College and Hospital, Aurangabad City, India. Indian journal of Medical Biochemistry. 21(2):147-150.

3. **Akinloye O, Oyewale O, Oguntibeju OO. (2013):** Evaluation of trace elements in pregnant women with pre-eclampsia. African Journal of Biotechnology. 9(32):5196–5202.

4. **Aslam F, Hayat I, Zakir FA, Haider SS, Nisa SU, Nisa SU. (2020):** Comparative analysis of serum calcium and magnesium as a better predictor in cases of mild and severe pre-eclampsia. The Professional Medical Journal. 27(08):1722-1727.

5. **Chukwunyere CF, Awonuga DO, Olunuga TO, Udenze IC. (2020):** Comparison of serum calcium level in hypertensive and normotensive pregnant women. Nigerian Journal of Medicine. 29(4):555-560.

6. **Darkwa EO, Antwi-Boasiako C, Djagbletey R, Owoo C, Obed S, Sottie D. (2017):** Serum magnesium and calcium in preeclampsia: a comparative study at the Korle-Bu Teaching Hospital, Ghana. Integrated blood pressure control. 10:9-15.

7. **Ephraim RK, Osakunor DN, Denkyira SW, Eshun H, Amoah S, Anto EO. (2014):** Serum calcium and magnesium levels in women presenting with pre-eclampsia and pregnancy-induced hypertension: a case–control study in the Cape Coast metropolis, Ghana. BMC pregnancy and childbirth. 14(1):1-8.

8. **Eze SC, Ododo NA, Ugwu EO, Enebe JT, Onyegbule OA, Eze IO, Ezem BU. (2020):** Serum selenium levels of pre-eclamptic and normal pregnant women in Nigeria: A comparative study. Plos one. 15(8):e0238263.

9. **Farzin L, Sajadi F. (2012):** Comparison of serum trace element levels in patients with or without pre-eclampsia. International Journal of Research in Medical Sciences 2012;17(10):938–941.

10. **Fasanu AO, Kolawole OO, Isawumi AI, Bello NO, Atiba AS. (2020):** Effect of calcium on preeclampsia among pregnant women in Osogbo, South Western Nigeria. International Journal of Modern and Alternative Medicine Research.; 7 (2020): 8-16.

11. **Golmohammad Lou S, Amirabi A, Yazdian M, Pashapour N. (2008):** Evaluation of Serum Calcium, Magnesium, Copper, and Zinc Levels in Women with Pre-eclampsia. The Iranian Journal of Medical Sciences. 33 (4): 231-234.

12. **Goulopoulou S, Webb RC. (2014):** The symphony of vascular contraction: How smooth muscle cells harmony to signal increased vascular resistance in hypertension. Hypertension. 63:e33–e39.

13. **Hofmeyr GJ, Lawrie TA, Atallah AN, Duley L, Torloni MR. (2014):** Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. Cochrane Database Systemic Reviews. 2014, 6:1-10.

14. **Hofmeyr GJ, Lawrie TA, Atallah AN, Duley L. (2010):** Calcium supplementation during pregnancy for preventing hypertensive disorders and related problems. Cochrane Database Systemic Reviews. 2010, 8:1-10.

15. **Imdad A, Jabeen A, Bhutta ZA. (2011):** Role of calcium supplementation during pregnancy in reducing risk of developing gestational hypertensive disorders: a meta-analysis of studies from developing countries. BMC public health. 11(3):1-3.

16. **Indumati V, Kodliwadmath MV, Sheela MK. (2011):** The role of serum electrolyte in pregnancy-induced hypertension. Journal of Clinical and Diagnostic Research. 5:66–69.

17. **Jain S, Sharma P, Kulshreshtha S, Mohan G, Singh S. (2010):** The role of calcium, magnesium, and zinc in pre-eclampsia. Biological Trace Element Research. 133(2):162–170.

18. **Kanagal DV, Rajesh A, Rao K, Devi UH, Shetty H, Kumari S, Shetty PK. (2014):** Levels of serum calcium and magnesium in pre-eclamptic and normal pregnancy: A study from Coastal India. Journal of clinical and diagnostic research: JCDR. 8(7):OC01 –OC04.

19. **Lakshmy SR, Praveenkumar M, Shobana U, Thasleem Z. (2018):** Uterine artery Doppler: changing concepts in prediction and prevention of PE and FGR. Journal of Fetal Medicine.5 (2):93-105.

20. **Mittal S, Shaikh MK, Thakur R, Jain D. (2014):** Comparison of serum calcium and magnesium levels between preeclamptic and normotensive healthy pregnant women. International Journal of Reproduction, Contraception, Obstetrics and Gynecology.3:959-962.

21. **Okoror CE, Enabudoso EJ, Okoror OT, Okonkwo CA. (2020):** Serum calcium-magnesium ratio in women with pre-eclampsia at a tertiary hospital in Nigeria. International Journal of Gynecology & Obstetrics. 149(3):354-358.

22. **Olusanya A, Oguntayo AO, Sambo AI. (2015):** Serum levels of calcium and magnesium in pre-eclamptic-eclamptic patients in a tertiary institution. Italian Journal of

Gynaecology and Obstetrics . 27:101–110.

23. **Onyegbule OA, Meludu SC, Dioka CE, Udigwe GO, Udo JN, Ezidigboh AN, Osakue N. (2014):** Comparison of serum levels of calcium and magnesium among preeclamptic and normotensive pregnant women at Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria. International Journal of Research in Medical Sciences. 2(2):404-408.

24. **Roberts JM, Myatt L, Spong CY, Thom EA, Hauth JC, Leveno KJ, Pearson GD, Wapner RJ, Varner MW, Thorp Jr JM, Mercer BM. (2010):** Vitamins C and E to prevent complications of pregnancy-associated hypertension. New England Journal of Medicine. 362(14):1282-1291.

25. **Shah S. (2020):** Hypertensive Disorders in Pregnancy. Obstetric and Gynecologic Nephrology. 4:11-23.

26. **Tavana Z, Hosseinmirzaei S. (2013):** Comparison of maternal serum magnesium level in pre-eclampsia and normal pregnant women. Iranian Red Crescent Medical Journal. 15(12):1-10.

27. **Ugwuja EI, Famurewa AC, Ikaraoha CI. (2016):** Comparison of serum calcium and magnesium between preeclamptic and normotensive pregnant Nigerian women in Abakaliki, Nigeria. Annals of medical and health sciences research. 6(1):33-37.

دراسة مقارنة بين مستويات الكالسيوم والماغنسيوم في حالات تسمم الحمل مقابل الحمل الطبيعي

محمد جمال محمد المغربي ، عبد المنعم محمد زكريا , محمود عبداللطيف حشيش , عادل علي البغدادي2

قسمي التوليد وأمراض النساء والباثولوجيا الاكلينيكية, كلية الطب، جامعة الأزهر

خلفيــة البحـــث: أوضـحت العديـد مـن الدراسـات الاكلينيكيـة حتـى الآن العلاقــة بـين ارتفـاع ضـغط الـدم المصـاحب للحمـل والاضـطرابات فـي العناصـر الغذائيـة والمعـادن لـدي الأم، والتـي تشـمل الكالسـيوم والمغنيسـيوم فـي الـدم، وهنـاك اهتمـام متزايـد بشـأن الاسـتفادة مـن التغذيـة السـليمة فـي إدارة تسـمم الحمـل فيمـا يتعلـق بمكمـلات الكالسيوم والمغنيسيوم.

الهـدف مـن البحـث: تقيـيم مسـتويات الكالسـيوم والمغنيسـيوم فـي الـدم لـدى النسـاء الحوامل اللواتي تعانين من تسمم الحمل بالمقارنة مع النساء ذات الحمل الطبيعي.

المريضـات وطـرق البحـث: شـملت هـذه الدراسـة 100 امـرأة حامـل (50 حالـة تسـمم الحمـل و 50 سـيدة زوات حمـل طبيعيـة) مـن عيـادات التوليـد بمستشـفى كفـر الشـيخ العـام ومستشـفى السـيد جـلال بجامعـة الأزهـر بعـد ذلـك. الأسـبوع العشـرين مـن الحمـل خـلال فتـرة البحـث مـن فبرايـر 2020 إلـى ديسـمبر 2020 لتقدير مسـتويات الكالسـيوم والمغنيسيوم في الدم.

النتـائج: كـان متوسـط مسـتوى الكالسـيوم فـي الـدم فـي المجموعـة الضـابطة 8.99 ± 0.52 مجـم/ ديسـيلتر, وكـان متوسـط مسـتوى المغنيسـيوم فـي الـدم 2.21 ± 0.3 مجـم/ ديسـيلتر ، وكـان كلاهمـا أعلـى مـن النسـب الموجـودة فـي مجموعـة المرضـى حيـث كـان متوسـط مسـتوى الكالسـيوم فـي الـدم 2 8.05 ± 0.51 مجـم/ ديسـيلتر ومتوسـط مسـتوى المغنيسـيوم فـي الـدم 1.86 ± 0.25 مجـم/ ديسـيلتر. وأظهـرت الدراسـة الحاليـة أن الكالسـيوم كـان لـه دقـة تشخيصـية أعلـى بكثيـر مـن المغنيسـيوم للتمييـز بـين النسـاء الحوامـل المصـابات بارتفـاع ضـغط الـدم والنسـاء الحوامـل الأصـحاء. وكـان الحـد الأمثـل لقيمـة القطـع للكالسـيوم كـان 8.55 (مجـم/ ديسـيلتر) مـع حساسـية 80٪ وخصوصـية 84٪، قيمـة تنبؤيـة إيجابيـة 83.3٪ وقيمـة تنبؤيـة سـلبية، 80.8٪، ممـا

يشـير إلــى أهميتـه للتنبـؤ بتسـمم الحمـل. بينمـا كانـت القيمـة المقطوعـة للماغنيسـيوم أقـل مـن 2.15 (ملجــم/ ديســيلتر)، كانـت الحساســية 88٪، وخصوصــية 60٪، بالإضــافة إلــى ذلـك، أظهـر منحنــى روك أن الحـد الأمثـل لكالسـيوم الـدم كـان 8.15 (مجـم/ ديسـيلتر). للتنبــؤ بالنتــائج السـلبية للحمـل مـع حساسـية 60.6٪ وخصوصـية 86.6٪. بينمــا كانـت القيمــة المقطوعـة لماغنيسـيوم الـدم أقـل مـن 1.945 (مجـم/ ديسـيلتر)، كانت الحساسية 69.7٪، وكانت الخصوصية 67.2٪.

الإســتنتاج: كــان متوسـط مسـتويات كــلا مـن الكالسـيوم والمغنيسـيوم فـي الـدم فـي النسـاء الحوامـل المصـابات بتسـمم الحمـل أقـل بالمقارنـة مـع نظيـراتهن الحوامـل الأصـحاء. وتـدعم هـذه النتــائج الافتـراض بـأن هنـاك علاقـة سـبب ونتيجـة بـين نقـص كالسـيوم الـدم و نقـص ماغنسـيوم الـدم كعوامـل مسـببة محتملـة متضـمنة فـي التسـبب في تسمم الحمل.

الكلمات الدالة : تسمم الحمل , الكالسيوم , الماغنسيوم .