OPEN AIMJ ORIGINAL ARTICLE

Maternal Serum Level of Vitamin D and the Incidence of Preeclampsia

Obstetrics & Gynecology

Abdelsalam Mohamed Abdelsalam Youssef [1,*] M.B.B.Ch, Hossam Al-Din Hussein Kamel Salem [2] MD, Abdelsattar Mohamed Ebrahim Farhan [2] MD and, Tarek Abd Elkareim Eldahshan [3]MD.

Corresponding Author:

Abdelsalam Mohamed Abdelsalam Youssef

Abdo_peace@hotmail.com

Received *for publication March 07, 2022;* ***Accepted*** *August 31, 2022;* ***Published online*** *August 31, 2022.*

doi: *10.21608/aimj.2022.125332.1865*

Citation: *Abdelsalam M. , Hossam A. and Abdelsattar M.et al. Maternal Serum Level of Vitamin D and the Incidence of Preeclampsia. AIMJ. 2022; Vol.3-Issue8 : 88-93.*

[1]Resident of Obstetrics and Gynecology Department, El Galaa Teaching Hospital, Egypt.

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

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

ABSTRACT

Background: After 20 weeks of pregnancy, preeclampsia is a state marked by hypertension and proteinuria. affecting 2-8% pregnancy worldwide and is the major factor of maternal and foetal morbidity and death.

Aim of the work: To discover whether preeclamptic women had greater vitamin D deficiency than normotensive pregnant women.

Patients and methods: This research involved 90 pregnant women. Obstetrics and Gynecology and Clinical Pathology Departments of Bab-Elshaeria University Hospital, Faculty of Medicine, Al-Azhar University, and Galaa Teaching Hospital collaborated in the study.

Results: Between the two groups, there was no statistically substantial variance in vitamin content. D in PET group and normal group with p-value = 0.073; also the table shows that the percentage of patients with The normal group had a higher optimal level (33.3%) than the PET group (15.6%), with a significant difference between the two groups.

Conclusion: Vitamin D deficiency and its mechanism of development is correlated to the slowly progression of preeclampsia and needs to be subjected to more research. In terms of vitamin D deficiency, there was no statistically substantial variance between the normal and PET groups.

Keywords: *Preeclampsia; proteinuria; pregnancy; vitamin D deficiency.*

Disclosure: *The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.*

Authorship: *All authors have a substantial contribution to the article.*

INTRODUCTION

Preeclampsia is a pregnancy-related disease characterised by hypertension and proteinuria after 20 weeks of pregnancy that affects 2–8% of all pregnancies globally and is the leading factor of maternal and foetal morbidity and death. It is a prominent cause of maternal death in affluent countries, accounting for up to 16% of all maternal deaths. 1 It's a multisystem condition characterized by high blood pressure before or after 20 weeks of pregnancy, proteinuria of more than or equal to 300 mg/24 hours, or systolic blood pressure of more than 30 mmHg, or diastolic blood pressure of more than 15 mmHg. 2 Vitamin D deficiency has been linked to the development of preeclampsia, according to Wei et al. Preeclampsia, gestational diabetes mellitus, and intrauterine growth restriction are all conditions that can occur during pregnancy. are three of the most common causes of pre-eclampsia. , and preterm birth have all been linked to vitamin D deficiency during pregnancy. 4 Branno et al., 5 have discovered a link between vitamin D intake and other pregnancy outcomes. Vitamin D insufficiency in pregnant women has been frequently observed in a number of nations. 6 Maternal vitamin D may be influenced by several factors: diet, supplementation, sun exposure, skin pigmentation, and genetics. [7]

Considering the abnormal trophoblastic invasion Liu et al. [8] by increasing inflammation, vitamin D deficiency is likely to contribute to the development of preelcmapsia. The aim of the research was to discover out if vitamin D deficiency is more prevalent in preeclamptic women compared to normotensive pregnant women.

This study aimed to to see if vitamin D insufficiency is more common in preeclamptic women than in normotensive pregnant women.

PATIENTS AND METHODS

This research involved 90 pregnant women.

Obstetrics and Gynecology and Clinical Pathology Departments of Bab-Elshaeria University Hospital, Faculty of Medicine, Al-Azhar University, and Galaa Teaching Hospital collaborated in the study.

Preeclamptic and non-preeclamptic patients were separated into two groups, each with 45 cases.

Inclusion criteria (Delimitations): Nulliparous women, singleton pregnancy, aged from 18-40 and gestational age from 32-40 weeks.

Exclusion criteria (Limitations): Women with rheumatoid arthritis, parathyroid disease, renal or hepatic malfunction, metabolic bone disease, diabetes, impaired absorption, and systemic lupus erythematosus, as well as women who have had multiple pregnancies, have a history of taking medications that affect bone, vitamin D, or calcium metabolism in the previous six months, such as antiepleptics, theophylline, or antitubercular drugs.

Preeclamptic group (patient's group) based on: Blood pressure: After 20 weeks of pregnancy, two blood pressure readings of higher than or equal to 140 mmHg systolic and greater than or equal to 90 mmHg diastolic must be taken four hours apart at least (Roberts et al., 2013). Proteinuria is defined as a 24-hour protein excretion of 300 mg or greater.

Non preelcamptic group (control group): All of them are hypertensive, with a blood pressure of less than 140/90 and no proteinuria.

Consent: A written informed consents were taken from all subjects (patients & controls) of two groups after full demonstration of steps and significance of this study.

Methods: All cases in the previously mentioned two groups were subjected to:

History: Full history was taken from all subjects

Examination: General examination: Vital signs: Pulse: counted in one complete minute, blood pressure measurement using Mercury sphygmo-manometers, temperature, yellowish discoloration of the sclera (in day light) and Lower limb edema (by pressure at the ankle and lower tibia against bone). Abdominal examination: Inspection for shape, pigementaton and scars. fundal level, fundal grip and pelvic grip. Obstetric ultrasound examination: Trans-abdominally to certify: Gestational age, number of fetuses, amniotic fluid index is a measurement of the amount of amniotic fluid (by the four quadrant technique) , IUGR (measured by biparietal diameter, femur length, and head circumference/absentia circumference ratio), and defined as birth weight less than the 10th centile for gestation and placental location.

Laboratory investigations: Urine analysis was done to detect proteinuria by dipstick screening test, Some of the tests available are CBC, All of these tests, as well as liver and kidney function testing, are indicated.... and both liver kidney functions are performed on automated response 920 analyzer.

Estimation of Vitamin D in maternal blood: Vitamin D assay: enzyme immunoassay test kit was used to detect and screen: All samples for 25(OH) Vitamin D (total) in human serum and plasma by using special antibodies to capture both 25 hydroxyvitamin D3 and D2. This test is used to detect the total 25(OH) vitamin D concentration in human blood and plasma, which can help with the diagnosis of vitamin D deficiency.

Status of 25(OH) vitamin D and expected values: In recent literature, the following classification ranges for 25(OH) vitamin D statues have been proposed.

Statistical Analysis: The data was collected, edited, coded, and input into IBM SPSS software version 23. (Statistical Package for Social Science). Non-parametric data was represented by the median with inter-quartile range, whereas quantitative data with a parametric distribution was represented by the median, standard deviations, and ranges (IQR). Qualitative features were also represented using numbers and percentages.

RESULTS

Age (yr)	Normal group	PET group	Test value	P-value	Sig.
	No. = 45	No. = 45			
Median ± SD	27.04 ± 4.84	29.51 ± 5.96	-2.155•	0.034	S
Ranges	19 – 39	17 – 42			
Median (IQR)	27 (23 – 30)	28 (26 – 33)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
•: Independent t-test
*PET preeclampsia pregnant women.

Table 1: In terms of maternal age, the normal and PET groups are comparable:A statistically significant variance was discovered. Among normal group and PET group regarding to age with p-value = 0.034. Table (1)

Platelet count ($\times 10^9$/L)	Normal group	PET group	Test value	P-value	Sig.
	No. = 45	No. = 45			
Median ± SD	225.84 ± 62.30	194.24 ± 73.87	2.194•	0.031	S
Ranges	134 – 370	63 – 302			
Median (IQR)	205 (180 – 280)	200 (130 – 260)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
•: Independent t-test
*PET preeclampsia pregnant women.

Table 2: In terms of platelet count, there is a comparison between the normal and PET groups.
In terms of platelets, there was a statistically significant variance among the normal and PET groups. count with p-value = 0.031. Table (2)

		Normal group No. = 45	PET group No. = 45	Test value	P-value	Sig.
Vitamin. D	Median ± SD	22.21 ± 9.35	18.49 ± 8.43	1.984•	0.050	NS
	Range	8.1 – 36	7.8 – 34			
	Median (IQR)	21 (13.21 – 31)	21 (10 – 23.21)			
Normal vitamin D level (> 20 ng/ml)		15 (33.3%)	7 (15.6%)	3.850	0.051	NS
Vitamin D Deficient (Abnormal) (< 20 ng/ml)		30 (66.7%)	38 (84.4%)			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; •: Independent t-test

Table 3: A comparison of vitamin D levels and the proportion of patients with normal and abnormal (deficient) levels was made between the normal group and the PET group.

There was no statistically significant variance in the level of vitamin D in PET group and normal group with p-value = 0.073; also the table shows that the percentage of patients with optimum level was found to be greater in the normal group (33.3%) than in the PET group (15.6%), with a substantial variance between the two groups with p-value = 0.049; the percentage of patients with insufficiency vitamin D level was found to be higher in the PET group (42.2%) than in the normal group (20.0%), With a p-value of 0.023, there was a statistically substantial variance between the two groups; however, there was no statistically substantial variance between the two groups in terms of vitamin D defici percentage of patients with deficient vitamin D level with p-value = 0.671. Table (3)

	Vitamin D	
	r	P-value
Age	0.032	0.833
GA (wk)	-0.017	0.911
Systolic blood pressure	0.043	0.781
Diastolic blood pressure	-0.023	0.880
Platelet count	-0.082	0.594
AST	-0.303*	0.043
ALT	-0.191	0.208
Serum creatinine level	-0.011	0.945
Proteinuria gm/24 H	-0.132	0.387
Fetal weight	0.175	0.249

Table 4: Correlation between vitamin D levels and the other variables investigated

Apart from a substantial negative association between vitamin D level and AST level, there was no statistically substantial correlation between vitamin D level and the other examined parameters among the studied cases.. Table (4)

		Vit. D Mean ± SD	Range	Test value	P-value	Sig.
Mode of delivery	NVD	16.51 ± 7.81	8.25 – 31.00	-1.137•	0.264	NS
	C.S.	19.71 ± 8.38	8.10 – 33.57			
Visual	No	17.32 ± 9.94	8.10 – 34.00	-0.497•	0.622	NS
	Yes	18.83 ± 8.08	7.80 – 34.00			
Headache	No	20.65 ± 10.93	8.10 – 34.00	0.975•	0.335	NS
	Yes	17.80 ± 7.51	7.80 – 33.57			
Epigastric pain	No	19.44 ± 9.61	7.80 – 34.00	0.637•	0.527	NS
	Yes	17.80 ± 7.57	8.10 – 34.00			
Urine analysis (dipstick)	+	23.88 ± 10.54	8.68 – 31.00	0.985••	0.382	NS
	++	18.39 ± 9.27	7.80 – 34.00			
	+++	17.24 ± 6.00	8.10 – 23.28			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
•: Independent t-test; ••: One Way ANOVA test

Table 5: Relation of vitamin D level with mode of delivery, symptomatic findings and urine analysis (dipstick)

There was no substantial relationship found between vitamin D level and mode of delivery, visual, headache, epigastric pain and urine analysis with p-value = 0.264, 0.748, 0.226, 0.548 and 0.424 respectively. Table (5)

		Deficiency vitamin D <20 ng/ml No. = 19	insufficiency vitamin D 21- 30 ng/ml No. = 19	Optimum vitamin D level >30 ng/ml No. = 7	Test value	P-value	Sig.
Age	Mean ± SD	29.32 ± 6.71	29.79 ± 5.05	29.29 ± 6.97	0.034•	0.966	NS
	Range	17 – 41	24 – 42	21 – 39			
Mode of delivery	NVD	9 (47.4%)	8 (42.1%)	2 (28.6%)	0.741*	0.690	NS
	C.S.	10 (52.6%)	11 (57.9%)	5 (71.4%)			
GA (wk)	Mean ± SD	35.95 ± 1.68	36.37 ± 1.21	37.57 ± 1.62	3.045•	0.058	NS
	Range	33 – 39	33 – 38	36 – 41			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; •: Independent t-test

Table 6: Comparison between patients with deficient, insufficient and optimum vitamin D level regarding demographic data and characteristics

There was no substantial relationship found between vitamin D level and demographic data of the studied patients. Table (6)

		Deficiency vitamin D <20 ng/ml	insufficiency vitamin D 21- 30 ng/ml	Optimum vitamin D level >30 ng/ml	Test value	P-value	Sig.
		No. = 19	No. = 19	No. = 7			
Systolic blood pressure	Median ± SD	153.16 ± 10.57	156.84 ± 12.50	148.57 ± 13.45	1.327•	0.276	NS
	Range	140 – 180	140 – 180	130 – 170			
Diastolic blood pressure	Median ± SD	101.58 ± 8.34	101.05 ± 8.09	98.57 ± 10.69	0.318•	0.730	NS
	Range	90 – 120	90 – 110	90 – 110			
Platelet count	Median ± SD	205.16 ± 63.67	183.00 ± 84.01	195.14 ± 76.83	0.417•	0.662	NS
	Range	100 – 300	63 – 302	100 – 301			
AST	Median (IQR)	30 (20 - 40)	24 (14 - 40)	21 (15 - 22)	3.109ǂ	0.211	NS
	Range	10 – 65	10 – 98	10 – 30			
ALT	Median (IQR)	13 (11 - 21)	12 (11 - 18)	11 (9 - 15)	1.720ǂ	0.423	NS
	Range	7 – 45	6 – 83	6 – 15			
Serum Creatinine level	Mean ± SD	0.96 ± 0.16	1.02 ± 0.16	0.94 ± 0.08	1.116•	0.337	NS
	Range	0.7 – 1.3	0.9 – 1.4	0.9 – 1.1			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
•: Independent t-test; ‡: Mann Whitney test

Table 7: Comparison between patients with deficient, insufficient and optimum vitamin D level regarding blood pressure, liver and kidney function

There was no statistically substantial relation found between vitamin D level and blood pressure, liver function and kidney function of the studied patients. Table (7)

		Deficiency vitamin D < 20 ng/ml	insufficiency vitamin D 21- 30 ng/ml	Optimum vitamin D level > 30 ng/ml	Test value	P-value	Sig.
		No. = 19	No. = 19	No. = 7			
Symptoms	Visual	14 (73.7%)	16 (84.2%)	5 (71.4%)	0.802*	0.670	NS
	Headache	15 (78.9%)	16 (84.2%)	3 (42.9%)	4.941*	0.085	NS
	Epigastric pain	11 (57.9%)	13 (68.4%)	2 (28.6%)	3.330*	0.189	NS
proteinuria gm/24 H	Median (IQR)	1250 (450 - 1825)	624 (425 - 3100)	525 (450 - 555)	1.115ǂ	0.573	NS
	Range	409 – 4000	409 – 4000	409 – 4000			
Urine analysis (dipstick)	+	1 (5.3%)	1 (5.3%)	2 (28.6%)	7.764*	0.100	NS
	++	12 (63.2%)	9 (47.4%)	5 (71.4%)			
	+++	6 (31.6%)	9 (47.4%)	0 (0.0%)			
Fetal weight	Mean ± SD	2.62 ± 0.50	2.65 ± 0.44	2.87 ± 0.53	0.739•	0.483	NS
	Range	1.8 – 3.5	1.7 – 3.5	1.7 – 3.2			

P-value >0.05: Non significant (NS); P-value <0.05: Significant (S); P-value< 0.01: highly significant (HS)
*:Chi-square test; •: Independent t-test; ‡: Mann Whitney test

Table 8: Comparison between patients with deficient, insufficient and optimum vitamin D level regarding symptoms, proteinuria, urine analysis and fetal weight

There was no statistically substantial correlation found between vitamin D level and symptoms, proteinuria, urine analysis and fetal weight. Table (8)

DISCUSSION

The aim of our study was to find out if vitamin D deficiency is more prevalent in preeclampsia women compared to normotensive pregnant women, in addition to confirming if there is a relation between serum maternal level of vitamin D and development of preeclampsia. This study was held in Galaa Teaching Hospital and Bab El Shaareya University Hospital in pararrel.

Measurement of Vitamin D status is determined by its circulating form, 25-hydroxyvitamin D which is considered optimum when level above 30ng/mL. A level between 21 and 30 ng/mL is considered insufficient and deficient if less than 20 ng/mL. [9]

In this study; measurement of serum vitamin D in normotensive pregnant patients was compared to preeclampsia group and were found to be with no significant statistically difference between both groups with calculated means ± SD were 22.21 ± 9.35, 18.49 ± 8.43. The calculated p value was 0.050, despite that the level of vitamin D was less in preeclampsia group cases than normotensive cases.

Several studies have examined such association and relation between maternal serum vitamin D in normotensive pregnant patients in relation to preeclampsia group but the results are fluctuating between agreement and confliction. In agreement to our results; Powe et al. USA [10] which is a nested case control study recruited on 39 preeclampsic women and 131 normotensive pregnant women i.e.: there was no substantial correlation between vitamin D and Preeclampsia is the progression of pre-eclampsia.Vitamin D in the bloodstream is almost fully attached to vitamin D binding protein, which doubles during pregnancy.. Total vitamin D levels were similar in cases and controls (P=0.435). We

should respect that we select our cases without measurement of vitamin D binding receptors, and increase in vitamin D binding protein may be an explanation to our results.Also Ringerose et al. [11] A case-control study was done on preeclampsic women (n=78) and normotensive pregnant women (n=109). Serum vitamin D was measured in all participants. Both cases and controls were more likely to be vitamin D deficient with (p=0.002). On the same hand, Yu et al. UK [12] serum vitamin D raw values in PE and controls vitamin D levels (P = 0.231). And in our study both cases preeclampsia women and controls had vitamin D deficient, which may be related to decrease of vitamin D in diet, less exposure to sun rays, increase in vitamin D binding protein with pregnancy as well as it may be due to demographic distribution. In agreement to our result; Gidlof et al. Sweden [13] Is a nested case-control study on 39 preeclampsia and 120 non-preeclampsic controls there was vitamin D deficiency < 20 ng/mL in PE and controls (p = 0.1). Anderson et al. USA [14] did prospective study as case control study on 48 pregnant women 11 pregnant women was later diagnosed as preeclampsic women (p = 0.22). [(85)]In agreement with our results; Fernandez- Alonzo et al. Spain [15] the relation between vitamin D and preeclampsia was no significant with p value = 0.91 so. The third-trimester vitamin D levels were measured in a subset of women (n=148).

In contrast to our results; Abedi et al., Iran [16] There were 59 pre-eclamptic pregnant women and 59 healthy pregnant women in this case-control research. Pre-eclampsia shows a statistically significant link to vitamin D deficiency. Iranian women's serum vitamin D levels appear to be low as a result of their unique lifestyle. And the same case control study was done at (2015) in Iran by Mohaghegh et al.[17] with (p = 0.001). i.e: there was significant between vitamin D and preeclampsia. He recruited 41 preeclampsic and 50 normotensive healthy women. Although Iran has the same life style as ours with the same diet intake, so we can need more studies on larger number of cases to Determine whether there is a link between vitamin D and preeclampsia.Pashapour et al. [18] In Urmia, Iran, researchers conducted a case-control study on Preeclamptic women (n = 80) had lower total vitamin D levels than healthy control women, according to a study of 80 preeclamptic women and 80 healthy pregnant women. According to these findings, there was a statistically substantial link between vitamin D insufficiency and preeclampsia. However, this result is against our study, but it may be due to using chemiluminescence for measuring vitD level.

And against our study; Benachi et al. In France, 83 cases of preeclampsia were matched with 319 controls in a nested case-control study.

High vitamin D levels throughout the third trimester were linked to a lower risk of preeclampsia (p = 0.008).

We should respect that difference in society, life style and diet which are the main risk factors that are responsible for the great effect of variation of results from one study to another.

CONCLUSION

Vitamin D deficiency and its mechanism of development is correlated to the slowly progression of preeclampsia and needs to be subjected to more research. In terms of vitamin D deficiency, the variance between the normal and PET groups was not statistically significant.

Conflict of interest : none

REFERENCES

1. Nzelu D, Dumitrascu-Biris D, Nicolaides KH, Kametas NA. Chronic hypertension: first-trimester blood pressure control and likelihood of severe hypertension, preeclampsia, and small for gestational age. *American Journal of Obstetrics and Gynecology*. 2018; 218(3):337-e1.
2. O'Callaghan K, Kiely M. Systematic review of vitamin D and hypertensive disorders of pregnancy. *Nutrients*. 2018; 10(3):294.
3. Wei SQ, Audibert F, Hidiroglou N, Sarafin K, Julien P, Wu Y, et al. Longitudinal vitamin D status in pregnancy and the risk of pre- eclampsia. *BJOG: An International Journal of Obstetrics & Gynaecology*. 2012; 119(7):832-9.
4. Jenkinson C. The vitamin D metabolome: An update on analysis and function. *Cell Biochemistry and Function*. 2019; 37(6):408-23.
5. Brannon PM. Vitamin D and adverse pregnancy outcomes: beyond bone health and growth. *Proceedings of the Nutrition Society*. 2012; 71(2):205-12.
6. Singla P, Parkash AA, Lal H, Nanda S. Benefits of vitamin D supplementation in pregnancy for prevention of preeclampsia. *Int J Pharm Biol Sci*. 2012;2:144-50.
7. Khaing W, Vallibhakara SA, Tantrakul V, Vallibhakara O, Rattanasiri S, McEvoy M, et al. Calcium and vitamin D supplementation for prevention of preeclampsia: A systematic review and network meta-analysis. *Nutrients*. 2017; 9(10):1141.
8. Liu NQ, Kaplan AT, Lagishetty V, Ouyang YB, Ouyang Y, Simmons CF, et al. Vitamin D and the regulation of placental inflammation. *The Journal of Immunology*. 2011; 186(10):5968-74.
9. Ross AC, Taylor CL, Yaktine AL, Del Valle HB. IOM (Institute of Medicine): Dietary Reference Intakes for Calcium and Vitamin D. *Washington, DC*; 2011.
10. Powe CE, Seely EW, Rana S, Bhan I, Ecker J, Karumanchi SA, et al. "First trimester vitamin D, vitamin D binding protein, and subsequent preeclampsia. *Hypertension*. 2010 :758–63
11. Ringrose JS, PausJenssen AM, Wilson M, Blanco L, Ward H. *Wilson TWClin Invest Med*. 2011 Jun 1:E147-54.
12. Yu CK, Ertl R, Skyfta E, Akolekar R, Nicolaides KH, et al. "Maternal serum vitamin D levels at 11-13

weeks of gestation in preeclampsia". *J Hum Hypertens.* 2013; 115–8.

13. Gidlof S, Silva AT, Gustafsson S, Lindqvist PG. Vitamin D and the risk of preeclampsia—*a nested case-control study*. 2015:904–8.
14. Anderson CM, Ralph JL, Johnson L, Scheett A, Wright ML, Taylor JY, et al. First trimester vitamin D status and placental epigenomics in preeclampsia among Northern Plains primiparas. 2015: 10–15.
15. Fernández-Alonso R, Suárez-Álvarez J, Muñiz J. Imputación de datos perdidos en las evaluaciones diagnósticas educativas. [Imputation methods for missing data in educational diagnostic evaluation]. *Psicothema*. 2012; 24, 167–75.
16. Abedi A, Khatib Shahidi C, Chataigner K, Niknami N, Eskandari M, Kazempour A, et al. Excavation at Kul Tepe (Hadishahr) North-Western Iran, 2010: First Preliminary Report. *Ancient Near Eastern Studies.* 2014; 51, 33-165.
17. Mohaghegh Z, Abedi P, Dilgouni T, Namvar F, Ruzafza S. The relation of preeclampsia and serum level of 25-hydroxyvitamin D in mothers and their neonates: a case control study in Iran. *Hormone and Metabolic Research.* 2015; 47(04):284-8.
18. Pashapour S, Golmohammadlou S, Behroozi-Lak T, Ghasemnejad-Berenji H, Sadeghpour S, Ghasemnejad-Berenji M. Relationship between low maternal vitamin D status and the risk of severe preeclampsia: A case control study. *Pregnancy hypertension.* 2019; 15:161-5.