Vitamin D Deficiency among Women Having Gestational Diabetes

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Authors’ contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Objective: To determine the vitamin D deficiency in pregnant women presented at tertiary care Hospital with gestational diabetes.

Methodology: This case control study has been conducted at gynecology department of Liaquat University of Medical and health Sciences, during one year from 2018 to 2019. Women having diagnosed as gestational diabetes, age more than 18 years and equal quantity of non-diabetic pregnant women were included in the study. A 5ml blood sample was taken from each patient and sent to the Hospital diagnostic laboratory to assess the vitamin D level. All the data was collected via self-made proforma. Data was analyzed by using SPSS version 20.

Results: Total 80 women with gestational diabetes and of non-gestational diabetes were studied. Mean age of the women was 34.23±12.3 years and mean gestational age was 29.34±5.7 weeks. Vitamin D deficiency was significantly high in women having gestational diabetes (P=0.0001). There was no difference in vitamin D deficiency according to occupation, residence, SES, booking status and parity.

Conclusion: Vitamin D deficiency was significantly high in women having gestational diabetes as
Keywords: Gestational diabetes; vitamin D; deficiency.

1. INTRODUCTION

Gestational diabetes (GDM), identified as glucose intolerance with initiation or first detection during pregnancy, remains the major cause of childbirth-associated complications [1]. Its incidence is growing worldwide and has approached almost 15%-20% [1,2]. Diabetes in uncontrolled pregnancy raises the likelihood of acquiring T2DM following pregnancy and exposes the progeny to childhood T2DM and obesity in later life [3]. Convincing studies show the involvement of vitamin D deficiencies in insulin resistance pathogenesis and insulin secretion disorders [3]. Vitamin D may affect glucose homeostasis through diverse pathways such as; functional pancreatic modification may be correlated with immune cell infiltrations between glandular cells with subsequent inflammation, or even vitamin D triggers anti-inflammatory effects that may contribute to the revival of physiological secretion of insulin [4,5]. Furthermore, peripheral cell insulin receptor drives endocytosis-mediated receptor filtering calmodulin-dependent intracellular signaling as well as vitamin D improves duodenal uptake and calcium reabsorption in kidney, which is thus essential for insulin-activated intracellular signaling [4,6]. Interaction between the vitamin D pathway molecular receptors and insulin-like growth factor (IGF) could contribute to glucose homeostasis and vitamin D can function indirectly via the elimination of frequent risk factors related to GDM, including obesity [4,7]. In addition, vitamin D provides typical physiological and atypical effects, including regulation of blood sugar [8]. Vitamin D is indeed important throughout pregnancy, for maternal health as well as for the avoidance of adverse outcomes. Vitamin D concentrations rise steadily over the 1st trimester and rise by 100 percent over the 3rd trimester compared to non-pregnant females [8]. Population of all age group in Pakistan, including pregnant females, are subjected to the deficiency of vitamin D [9,10]. GDM is a relatively prevalent disorder among pregnant females globally with major metabolic consequences for mothers and offspring. Vitamin D levels have been proposed to potentially contribute to GDM risk without any reported implications for offspring [4]. Recent evidence indicates that Vitamin D management may enhance glucose tolerance and insulin sensitivity. However, it is not clear if supplementation for vitamin D can prevent GDM from occurring or not [11]. Although, it is necessary to determine the correlation of GDM and high deficiency of vitamin D in the population of Pakistan, [9] and very few studies have been conducted in our population. Therefore, this study has been carried out to evaluate vitamin D deficiency in pregnant women having gestational diabetes.

2. MATERIALS AND METHODS

This case control study has been conducted at gynecology department of Liaquat University of Medical and health Sciences. Study duration was one year from 2018 to 2019. Women having diagnosed as gestational diabetes, age more than 18 years and in equal quantity of non-diabetic pregnant women were included in the study. Women having diabetes before the pregnancy and not willing to participate in the study were excluded. All the women underwent fresh fetal wellbeing ultrasound to assess the gestational age and a 5 ml blood sample was taken from each patient and was sent to the Hospital diagnostic laboratory to assess the vitamin D level. Vitamin D deficiency was categorized as 25(OH)D levels <12ng/ml, 12-20 ng/mL was considered as insufficient and >20 ng/mL was taken as sufficient. All the data was collected via self-made proforma. Data was analyzed by using SPSS version 20. Numerical data was computed as mean and standard deviation. Categorical data was analyzed as frequency and percentage. Chi-square test was applied and a p-value ≤0.05 was taken as significant

3. RESULTS

Total 80 women with gestational diabetes and of non-gestational diabetes were studied. Mean age of the women was 34.23±12.3 years and mean gestational age was 29.34±5.7 weeks. Most of the women 65.0% were un-educated, however 35.0% were educated. Majority of the participants (68.8%) were house wives. 52.5% of women were from rural areas and remaining
women were from urban areas. Booked women were 58.8% and un-booked were 41.2%. Multiparous women were 65.0% and 35.0% were nulliparous. Table 1.

Vitamin D deficiency was found in 27 women, followed by insufficiency in 4 and sufficiency in 9 women out of all 40 women having gestational diabetes. However, in women without gestational diabetes, vitamin D deficiency was in 12 women, followed by insufficiency in 6 and sufficiency in 20 women out 40 women those. Deficiency was significantly high in women having gestational diabetes (P=0.0001). Table 2.

There was no significant difference in vitamin D deficiency according to occupation, residence, SES, booking status and parity; p-values were quite insignificant. Table 3.

### Table 1. Demographic characteristics of the patients =80

| Variables          | Frequency | Percent |
|--------------------|-----------|---------|
| Educational status | Educated  | 28      | 35.0   |
|                    | Un-educated | 52      | 65.0   |
| Occupation         | House wife | 55      | 68.8   |
|                    | Working lady | 25      | 31.2   |
| Residence          | Urban      | 42      | 52.5   |
|                    | Rural      | 38      | 47.5   |
| Socioeconomic status | Poor    | 22      | 27.5   |
|                    | Middle     | 56      | 70.0   |
|                    | Upper      | 02      | 02.5   |
| Booking status     | Booked     | 47      | 58.8   |
|                    | Un booked  | 33      | 41.2   |
| Parity             | Nulliparous | 28      | 35.0   |
|                    | Multiparous | 52      | 65.0   |
| Previous MOD       | SVD        | 42      | 52.5   |
|                    | Caesarean section | 38 | 47.5 |
| Patients age       | (Mean±SD)  | 34.23±12.3 years |
| Gestational age    | (Mean±SD)  | 29.34±5.7 weeks |

### Table 2. Vitamin D level in gestational diabetes and non-diabetes women =80

| Vitamin d level     | Gestational diabetes | P-value |
|---------------------|-----------------------|---------|
|                     | Yes   | No  |       |       |
| Vitamin D deficiency| 27    | 12  | 0.001 |
| Insufficiency       | 04    | 06  |       |
| Sufficiency         | 09    | 20  |       |
| Intoxicant          | 00    | 02  |       |
| Total               | 40    | 40  |       |

### Table 3. Vitamin D deficiency according to occupation, residence, SES, booking status and parity =80

| Variables          | Vitamin d level | Deficiency | Insufficiency | Sufficiency | Intoxication | p-value |
|--------------------|-----------------|------------|---------------|-------------|--------------|---------|
| Occupation         | House wife      | 28         | 7             | 18          | 2            | 0.640   |
|                    | Working lady    | 19         | 7             | 18          | 2            |         |
| Residence          | Urban           | 20         | 3             | 15          | 0            |         |
|                    | Rural           | 20         | 3             | 15          | 0            |         |
| Socioeconomic status | Poor     | 15         | 2             | 5           | 0            | 0.492   |
|                    | Middle          | 23         | 8             | 23          | 2            |         |
|                    | Upper           | 01         | 0             | 01          | 0            |         |
| Booking status     | Booked          | 21         | 08            | 17          | 01           | 0.510   |
|                    | Un booked       | 18         | 02            | 12          | 01           |         |
| Parity             | Nulliparous     | 12         | 6             | 9           | 1            | 0.327   |
|                    | Multiparous     | 27         | 4             | 20          | 1            |         |
4. DISCUSSION

In several studies, vitamin D deficiency has been reported to be highly widespread among various age groups, especially among pregnant females and in young age group [12]. The incidence of gestational diabetes mellitus (GDM) is also growing globally. The correlation between GDM and vitamin D has been widely discussed, but no definite relationship has been identified. This research was therefore planned to address the association between the status of GDM and vitamin D. In this study, females were found to have 34.23±12.3 years of mean age and 29.34±5.7 weeks of mean gestational age. Shahgeheibi S, et al. [13] documented a mean age of 29 ± 6.3 years and 31.3 ± 6.4 years for the placebo group and intervention group, in that order, (P > 0.05).

In our study, there was no significant difference in vitamin D deficiency according to occupation, residence, SES, booking status and parity; p-values were quite insignificant. In contrast to our study, studies undertaken by Rabenberg M, et al. [14] and Rodriguez A, et al. [15] showed a positive correlation between vitamin D and socioeconomic level in both non-pregnant and pregnant women. Another study conducted by Lee MJ, et al. [16] reported that those who had a graduate degree were found to have highest vitamin D deficiency rates (31.5 per cent). Vitamin D deficiency risk factors included gender, urban living, high education, young age, and lack of physical activity.

In present study, Vitamin D deficiency was in 27 women followed by insufficiency in 4 and sufficiency was in 9 women out of all 40 women having gestational diabetes. Deficiency was significantly high in women having gestational diabetes (P=0.0001). In comparison to our study, Zhang MX carried out a meta-analysis on > 9200 females from Chinese community and reported that females with deficiency of vitamin D can possibly acquire GDM [17]. Similar findings were reported by Burris HH et al. [18], based on these observations it may be assumed that, GDM risk may be decreased by improving the status of vitamin D among females. Even more studies are needed to determine the involvement of vitamin D supplementations in this context. However, In contrast to our study, Azzam EZ, et al. [19], reported that no significant variance was observed in Vitamin D concentrations among GDM patients versus control group. Among GDM patients, vitamin D was negatively correlated to HbA1c (p < 0.001), HOMA-IR (p = 0.034) and insulin (p = 0.019). Similar findings were reported by Debnath A, et al. [20], as in their studies vitamin D deficiency was correlated with GDM development. 93% of females were reported to have Vitamin D deficiency. 38.8% (n=21) females were in GDM group and 61.2% (n=33) were in control group. Group-A was found to have significantly low Vitamin D levels as compared to group-B (p-value 0.004). In Group A, all of the females were found to have levels of vitamin D ≤10 ng/mL, whereas in Group B only 37.2% of females had low levels of vitamin D. Females with Severe deficiency of vitamin D (levels below 5-ng/mL) had a risk ratio of 5.647 for GDM development. A negative association was found between the levels of plasma glucose and vitamin D. Zhang Y, et al. [21] also documented that Low levels of vitamin D in blood could raise the risk for GDM. Lacroix et al. [22] studied low vitamin D level in 1st trimester and its correlation with raised gestational diabetes, findings indicated that females with lower levels of vitamin D were at 1.48 folds greater risk for GDM than the females who received supplements of vitamin D (P = 0.04). Contrary to our findings, Farrant et al. [23], reported that there was no correlation between gestational diabetes and vitamin D deficiency, as in their study participants who had vitamin deficiency at the 30th week and they did not found association between increased risk of gestational diabetes, impaired growth of fetus or alteration in neonatal cord plasma insulin secretory profile. However Wei SQ et al[24] observed that the lower maternal vitamin D level during pregnancy may be linked to the increased risk of the pre-eclampsia, gestational diabetes and preterm birth. The biochemical pathway, for developing GDM in children with vitamin D deficiency, can be attributed to the fact that vitamin D improves the transcription of the insulin gene leading to high synthesis of insulin. It also affects secretion of insulin by controlling the levels of intracellular calcium in insulin-sensitive tissues like adipose tissues and muscle. Vitamin D increases insulin resistance by modifying the insulin receptors. Vitamin D deficiency, by promoting inflammation, stimulates insulin resistance and thus, by modulating the effect of vitamin D on the immune system, promotes insulin response.

5. CONCLUSION

Vitamin D deficiency was markedly high in women presented with gestational diabetes as compared to controls. Vitamin D deficiency can
be a risk factor for gestational diabetes. Vitamin D level should be assessed in pregnant women during antenatal care to reduce the risk of gestational diabetes and other feto-maternal morbidity. Nutritional status should be improved in pregnant women. This was a small sample size and single Centre study. Further large sample size and multicenter studies are suggested on this subject.

CONSENT AND ETHICAL APPROVAL

As per university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Hu L, Zhang Y, Wang X, You L, Xu P, Cui X, Zhu L, Ji C, Guo X, Wen J. Maternal vitamin D status and risk of gestational diabetes: A meta-analysis. Cellular Physiology and Biochemistry. 2018;45(1): 291-300.
2. American diabetes association. Standards of medical care in diabetes–2014. Diabetes Care. 2014;37:S14.
3. El-Sagheer GM, Kasem A, Shawky IM, Abdel-Fadeel A. Vitamin D deficiency and gestational diabetes mellitus in Egyptian women. Open Journal of Endocrine and Metabolic Diseases. 2016;6(2):109-19.
4. Rizzo G, Garzon S, Fichera M, Panella MM, Catena U, Schiattarella A, de Franciscis P, Vilos G, Tesarik J, Török P, Grosso G. Vitamin D and gestational diabetes mellitus: Is there a link?. Antioxidants. 2019;8(11):511.
5. Marchetti P. Islet inflammation in type 2 diabetes. Diabetologia. 2016;59:668–672.
6. Xuan Y, Zhao HY, Liu JM. Vitamin d and type 2 diabetes mellitus (d2). J. Diabetics. 2013;5:261–267.
7. Moukayed M, Grant WB. Linking the metabolic syndrome and obesity with vitamin D status: Risks and opportunities for improving cardiometabolic health and well-being. Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy. 2019;12:1437.
8. Cho GJ, Hong SC, Oh MJ, Kim HJ. Vitamin D deficiency in gestational diabetes mellitus and the role of the placenta. American Journal of Obstetrics and Gynecology. 2013;209(6):560-1.
9. Nasir JA, Imran M, Zaidi SA. Pattern of vitamin D among Pakistani pregnant women. J Coll Physicians Surg Pak. 2018;28(3):233-7.
10. Khurshid N, Rafique A, Nisar F. Prevalence of hypovitaminosis D among primigravidas in first trimester of pregnancy. J. Soc. Obstet. Gynaecol. Pak. 2018;8(3):159-163.
11. Dwarkanath P, Thomas T, Joseph S, Thomas A, George S, CN S, Mehta S, Kurpad AV. Relationship of early vitamin D concentrations and gestational diabetes mellitus in Indian pregnant women. Frontiers in Nutrition. 2019;6:116.
12. Holick MF, Binkley NC, Bischoff-Ferrari HA, Gordon CM, Hanley DA, Heaney RP, et al. Evaluation, treatment, and prevention of vitamin D deficiency: An Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(7):1911:30.
13. Shahgheibi S, Farhadifar F, Pouya B. The effect of vitamin D supplementation on gestational diabetes in high-risk women: Results from a randomized placebo-controlled trial. J Res Med Sci. 2016;21:2.
14. Rabenberg M, Scheidt-Nave C, Busch MA, Rieckmann N, Hintzpeter B, Mensink GB. Vitamin D status among adults in Germany–results from the German health interview and examination survey for adults (DEGS1). BMC Public Health. 2015;15:641.
15. Rodriguez A, Santa Marina L, Jimenez AM, Esplugues A, Ballester F, Espada M, Sunyer J, Morales E. Vitamin D status in pregnancy and determinants in a southern European cohort study. Paediatr Perinat Epidemiol. 2016;30(3):217–28.
16. Lee MJ, Hsu HJ, Wu IW, Sun CY, Ting MK, Lee CC. Vitamin D deficiency in northern Taiwan: A community-based cohort study. BMC Public Health. 2019;19(1):337.
17. Zhang MX, Pan GT, Guo JF, Li BY, Qin LQ, Zhang ZL. Review vitamin D deficiency increases the risk of gestational diabetes mellitus: A meta-analysis of observational studies. Nutrients 2015;7:8366e75.
18. Burras HH, Camargo CA. Vitamin D and gestational diabetes mellitus. Curr Diab Rep. 2014;14(1):451.
19. Azzam EZ, El-Aghoury AA, Abd El-naby ES, El-Maadawy SA. Studying the relation between vitamin D deficiency and glycemic state among pregnant women with gestational diabetes. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2019;13(2):1505-9.

20. Debnath A, Gupta M, Jain S, Kumari S, Biswas T, Ray S, Gupta SK. Hypovitaminosis D is associated with gestational diabetes mellitus. Journal of Clinical & Diagnostic Research. 2017;11(10).

21. Zhang Y, Gong Y, Xue H, Xiong J, Cheng G. Vitamin D and gestational diabetes mellitus: a systematic review based on data free of Hawthorne effect. BJOG 2018;125:784–793.

22. Lacroix M, Battista MC, Doyon M, Houde G, Ménard J, Ardidouze JL, et al. Lower vitamin D levels at first trimester are associated with higher risk of developing gestational diabetes mellitus. Acta Diabetol. 2014;51:609-16.

23. Farrant HJ, Krishnaveni GV, Hill JC, Boucher BJ, Fisher DJ, Noonan K, Osmond C, Veena SR, Fall CH. Vitamin D insufficiency is common in Indian mothers but is not associated with gestational diabetes or variation in newborn size. European Journal of Clinical Nutrition. 2009;63(5):646-52.

24. Wei SQ, Qi HP, Luo ZC, Fraser WD. Maternal vitamin D status and adverse pregnancy outcomes: A systematic review and meta-analysis. J Matern Fetal Neonatal Med. 2013;26:889-99.