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Increased First Trimester Serum Uric Acid as A Predictor of Gestational Diabetes Mellitus

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ABSTRACT

The gestational period of diabetes type 2 (GDM) is a serious condition that can harm both mothers and newborns throughout pregnancy. **Objective:** To determine if elevated first-trimester serum uric acid levels lead to gestational diabetes mellitus onset during pregnancy. **Methods:** A comparative cross-sectional study was conducted between November 2023 and April 2024 at Niazi Medical and Dental College in Sargodha. The study sample consisted of 139 pregnant women separated into two groups: those exhibiting and those absent diabetes in women. The researchers employed independent t-test and Chi-square statistical methods to evaluate age and BMI data, as well as diabetes familial histories and delivery history. **Results:** Gestational diabetes mellitus patients had higher serum uric acid levels compared to pregnant women without Gestational diabetes mellitus ($p<0.001$). This study found that uric acid levels above 4.5 mg/dL increased the likelihood of abnormal fasting glucose values by 74.5% ($p<0.001$). Women with high uric acid levels had a 40% higher risk of developing Gestational diabetes mellitus (OR: 1.40; 95% CI: 1.10-1.80; $p=0.02$). **Conclusions:** It was concluded that women who have gestational diabetes mellitus display increased serum uric acid concentrations during their first trimester. Monitoring serum uric acid levels presents an opportunity to detect susceptible pregnant women with gestational diabetes in the early stages, allowing for quick implementation of preventive measures that promote maternal and fetal health.

INTRODUCTION

During pregnancy, women can develop Gestational Diabetes Mellitus (GDM), which causes different glucose intolerance levels to appear in mothers. Both mother and baby face severe health dangers from Gestational Diabetes Mellitus because it increases the occurrence of cesarean sections alongside shoulder dystocia, along with fetal growth problems and birth defects. Medical authorities identify this condition as a worldwide health threat while media publicity enhances its impact, which leads to additional deaths of mothers and newborns [1]. The most recent investigations have concentrated on the association between blood uric acid and premature births, finding signs of gestational diabetes and the effects of metabolic diseases on serum uric acid concentrations. The usual physiologic levels of serum uric acid vary from 2 to 6.5 mg/dl. Pregnancy-demanding modifications to the glomerular filtration rate frequently result in decreased levels of fetal uric acid. Scientific research demonstrates that elevated serum uric acid shows strong links to insulin resistance and likely serves as an essential factor that leads to diabetes mellitus development, according to studies [2, 3]. Xanthine oxidase activates because of

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cytoimmunologic factors and placental hypoxia to produce greater levels of oxidative stress and uric acid during purine metabolism. Elevated levels of uric acid in the blood in pregnant women are linked to developing insulin resistance and metabolic syndrome, implying that it may operate as a GDM risk factor alongside preeclampsia [4, 5]. The buildup of uric acid in pregnant women damages insulin-producing β-cells and causes insulin signaling impairment as well as endothelial dysfunction, which leads to worse vascular health while simultaneously impairing glucose metabolism [6, 7]. Complete prevention of type 2 diabetes requires early clinical interventions for women who have GDM since these women face elevated future type 2 diabetes risks [8-10]. Pregnancy-related gestational diabetes mellitus is more likely to occur in women with elevated blood uric acid levels in the first trimester.

This study aims to determine whether higher levels of blood uric acid in the first trimester were linked to the onset of gestational diabetes mellitus later in pregnancy.

METHODS

A comparative cross-sectional study was conducted in the Department of Gynecology and Biochemistry at Niazi Medical and Dental College in Sargodha for a six-month study from November 2023 to April 2024. Convenience sampling was employed to recruit pregnant women who matched the inclusion criteria. Inclusion criteria were any pregnant woman who was not diabetic and was less than 12 weeks pregnant in her first trimester. Renal illness, hypertension, liver disease, gout, smoking, and alcohol use are all exclusion factors. A cross-sectional study's sample size was typically calculated by estimating a proportion (such as GDM prevalence) with a predetermined degree of precision. The formula in this case was n= Z2. P. (1-P)/E2, where n is the sample size, Z is the confidence level (1.96 or 95%), P is the estimated proportion (0.20 or 20%), and E is the margin of error (0.05 or 5%). The required sample size was n=139, divided into two groups: GDM (69) and Non-GDM (70). Venous blood samples were taken from pregnant ladies whose gestational age was less than 12 weeks. A colorimetric approach with a detection limit of 0.2–20 mg/Dl and an automated biochemical analyzer (Cobas C 501 analyzers) were used by the laboratory technician of the institution to assess the serum uric acid levels following centrifugation. Between weeks 24 and 28 of pregnancy, these women had to have an oral glucose tolerance test (OGTT). Following an overnight fast of 8–10 hours, fasting blood sugar levels were assessed. Then, 75 grams of oral glucose dissolved in either plain or lime water were given to the patient to improve compliance. According to ADA guidelines, the venous sample is measured and evaluated for GDM after a fast of one or two hours. The Institutional Review Board (IRB) approved this study with IRB numbers (IRB/NM&DC/61). The objectives, methodology, possible hazards, and advantages of the study were explained to each participant, who also gave written informed consent. SPSS version 21.0 was used for data processing. Using the independent t-test and Chi-square, categorical and continuous factors like age, BMI, family history of diabetes, and parity were represented. The chi-square test was used to measure blood uric acid levels in the first trimester for both the GDM and non-GDM groups. Using logistic regression, the odds ratio of GDM in blood uric acid levels is displayed. An indication of a significant value was p<0.005.

RESULTS

Women diagnosed with GDM maintained an average age of 30.2 ± 6.1 years, different from the non-GDM patients who averaged 27.8 ± 5.2 years (p<0.04). The individuals in the GDM group maintained higher BMI compared to other patients (28.1 ± 3.9 kg/m^2 vs. 24.5 ± 3.6 kg/m^2); (p<0.01). Diabetes existed in 45.8% of women with GDM but only affected 12.8% without the condition (p<0.001). A statistical link (p=0.03) existed between multiple pregnancies and GDM since GDM group members faced stronger prevalence rates (58.3% compared to 31.4%) (Table 1).

Table 1: Comparing Demographic Variable Mean Between Two Groups (GDM vs. Non-GDM)

Variables	GDM Group (n=69)	Non-GDM Group (n=70)	p-Value
Age (Years)	30.2 ± 6.1	27.8 ± 5.2	0.04*
BMI (kg/m^2)	28.1 ± 3.9	24.5 ± 3.6	<0.01**
Family History of Diabetes	22 (45.8%)	13 (12.8%)	<0.001***
Parity (Multiparous)	28 (58.3%)	32 (31.4%)	0.03*

The percentage of GDM individuals who had levels of uric acid in their blood <3.5 mg/dL was 17.4%, while it reached 42.9% among women without GDM. At uric acid levels between 3.5 and 4.5 mg/dL, the risk of GDM was evenly distributed between the two groups (36.2% and 35.7%, respectively). A statistically significant correlation (p<0.001) exists between elevated uric acid levels (>4.5 mg/dL) and GDM because GDM women (46.4%) experienced this condition much more often than non-GDM women (21.4%). Research shows that women with higher than 4.5 mg/dL uric acid levels face a higher possibility of developing GDM (Table 2).

Table 2: Evaluation of Serum Uric Acid Category

Serum Uric Acid Category (mg/dL)	GDM (n=69)	Non-GDM (n=70)	Total (n=139)	p-Value
<3.5 mg/dL	12 (17.4%)	30 (42.9%)	42 (30.2%)	<0.0001***
3.5-4.5 mg/dL	25 (36.2%)	25 (35.7%)	50 (36.0%)	<0.0001***
>4.5 mg/dL	32 (46.4%)	15 (21.4%)	47 (33.8%)	<0.0001***

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For every year of age, the independent analysis found that the risk of Gestational Diabetes Mellitus increases by 5% per year (p=0.03; odds ratio (OR)=1.05). A higher BMI is a significant risk factor for GDM since it increases the risk of GDM by 20% for every unit rise (OR 1.20, p<0.001). GDM is substantially more likely to develop in those with a family history of diabetes (OR=3.50, p<0.001). During the first trimester, the chance of having GDM increases when uric acid levels rise above normal (OR=1.40, p=0.02)(Table 3).

Table 3: Serum Uric Acid as a Predictor of GDM

Variables	Odds Ratio (OR)	95% CI	p-Value
Age (Years)	1.05	1.01-1.10	0.03*
BMI (kg/m^2)	1.20	1.10-1.35	<0.001**
Family History of Diabetes	3.50	1.90-6.45	<0.001***
Serum Uric Acid (mg/dL)	1.40	1.10-1.80	0.02*

The GDM group exhibited elevated glucose levels compared to non-GDM participants according to results from the two-sample t-test in fasting states and hours one and two (p<0.001). All GDM patients failed the glucose tolerance test (GTT) according to a Chi-square analysis, which was strongly linked to GDM diagnosis (p<0.001)(Table 4).

Table 4: Evaluating Differences in Glucose Tolerance Test Results

GTT Time Point	GDM Group (n=69)	Non-GDM Group (n=70)	p-Value
Fasting Glucose (mg/dL)	96.5 ± 12.3	84.2 ± 10.5	<0.001**
1-Hour Glucose (mg/dL)	182.4 ± 24.8	142.7 ± 19.4	<0.001**
2-Hour Glucose (mg/dL)	158.6 ± 22.1	115.3 ± 18.8	<0.001**
GTT Pass (n, %)	0 (0%)	65 (92.9%)	<0.001**
GTT Fail (n, %)	59 (100%)	5 (7.1%)	0.001

Women with serum uric acid levels below 3.5 mg/dL showed abnormal fasting glucose results among 23.8% of participants. Similarly, 76.2% had normal glucose levels, 50% with intermediate uric acid values presented abnormal glucose results, and 74.5% showed high levels of abnormal glucose results. The data showed that of all the examined women, 74.5% presented abnormal fasting glucose measurements with levels greater than 4.5 mg/dL. This correlation reached statistical significance with an Extremely Low p-value of 0.001. The analysis showed 11.9% women exhibited abnormal glucose levels (<3.5 mg/dL) but 40% and 68.1% showed abnormal readings between 3.5–4.5 mg/dL and >4.5 mg/dL respectively during 1-hour GTT interventions and these results had a statistically significant correlation (p=0.003). Of the studied women, 63.8% presented with abnormal glucose values at 4.5 mg/dL or higher at the 2-hour measurement period, while uric acid levels were closely associated with this outcome (p=0.001)(Table 5).

Table 5: Serum Uric Acid and Its Association with Abnormal GTT Results in Pregnant Women

Serum Uric Acid Category (mg/dL)	Abnormal Fasting GTT	Normal Fasting GTT	p-Value	Abnormal 1-Hour GTT	Normal 1-Hour GTT	p-value	Abnormal 2-hour GTT	Normal 2-Hour GTT	p-value
n (%)									
<3.5 mg/dL	10 (23.8%)	32 (76.2%)	<0.001**	5 (11.9%)	37 (88.1%)	0.003 **	4 (9.5%)	38 (90.5%)	0.001**
3.5-4.5 mg/dL	25 (50%)	25 (50%)	0.001**	20 (40%)	30 (60%)		18 (36%)	32 (64%)	0.001**
>4.5 mg/dL	35 (74.5%)	12 (25.5%)	0.001**	32 (68.1%)	15 (31.9%)		30 (63.8%)	17 (36.2%)	0.001**
Total (n=139)	70 (50.4%)	69 (49.6%)	0.001**	57 (41%)	82 (59%)		52 (37.4%)	87 (62.6%)	0.001**

DISCUSSION

In order to determine the main factors determining the prevalence and risk of gestational diabetes mellitus (GDM), the study uses demographic analysis, which reveals notable differences between those with and without GDM. The mean age of the women in the GDM group was 27.8 ± 5.2 years, which is in line with earlier studies showing that older mothers are more likely to develop GDM because their insulin resistance deteriorates with age [11, 12]. The healthcare practice demands attention to maternal age when providing prenatal care programs because older pregnant women should receive early screening tests [13]. BMI levels directly affected insulin resistance through obesity, which serves as a main factor for GDM development. Weight management, along with dietary counselling, should become a necessity to prevent GDM risk [14]. The presence of diabetes in family members functioned as a significant risk factor during pregnancy, so healthcare providers should recognize its importance by initiating screenings followed by lifestyle interventions to reduce GDM risk [15]. The case for additional monitoring of these patient groups is supported by the fact that women with higher parity have a higher risk of gestational diabetes due to alterations in their metabolism between pregnancies [16]. This study discovered that out of all participants, high serum uric acid levels were present in 46.4% of cases, yet only 21.4% did not have diabetes, which makes uric acid a potential tool to identify early signs of GDM along with enabling timely preventive measures [17]. The findings are also in line with past research that indicates age, body mass index, family history, and elevated blood uric acid levels are the main indicators of risk for diabetes during pregnancy.The odds of having GDM

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increase by 5% for each year that a mother's age increases. This finding is in line with research that indicates impaired glucose metabolism and insulin resistance are closely linked to older maternal ages. The substantial correlation between obesity and diabetes during pregnancy was further highlighted by the discovery that BMI greatly increased the likelihood of developing GDM, with probabilities rising by 20% for every unit increase in BMI [18]. Women with relatives with a diagnosis of diabetes were three times more likely to get gestational diabetes than those without a family background ($p<0.001$). This strong link emphasizes the importance of family history in identifying high-risk individuals and offering early intervention [19]. Additionally, the uric acid odds ratio revealed that for every unit rise in blood uric acid levels, the risk of developing GDM increased by 40% ($p=0.02$). Because of this connection, high uric acid could be a good sign of gestational diabetes [20]. Oxidative stress and systemic inflammation, which are key factors in the development of insulin resistance and diabetes mellitus during pregnancy, have been connected to elevated uric acid levels. Serum uric acid can be used as a biomarker in standard prenatal care, which shows promise for identifying women at risk of GDM early and providing opportunities for preventive treatments. It is also evident that additional research is required to examine the associations between uric acid and the development of diabetes mellitus. Uric acid is a significant prognostic marker for diabetes, as evidenced by the correlation between blood uric acid levels and postprandial glucose tolerance test (GTT) results. Women with serum uric acid levels greater than 4.5 mg/dL exhibited significantly higher rates of abnormal GTT results, with 74.5% showing abnormal fasting GTT results, 68.1% exhibiting abnormal 1-hour GTT results, and 63.8% having abnormal 2-hour GTT results ($p<0.001$). These findings suggest that hyperuricemia contributes to impaired glucose metabolism during pregnancy, likely through mechanisms such as insulin resistance and increased oxidative stress [21].

CONCLUSIONS

It was concluded that elevated blood uric acid significantly predicts GDM, at higher levels corresponding to a greater likelihood of abnormal GTT results.

Authors Contribution

Conceptualization: MFJ
Methodology: A, SJ, FS
Formal analysis: A, NN
Writing review and editing: MFJ, SJ, FS, TM, NN

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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REFERENCES

[1] McIntyre HD, Catalano P, Zhang C, Desoye G, Mathiesen ER, Damm P. Gestational Diabetes Mellitus.Nature Reviews Disease Primers.2019Jul;5(1):47.doi:10.1038/s41572-019-0098-8.

[2] Ye W, Luo C, Huang J, Li C, Liu Z, Liu F. Gestational Diabetes Mellitus and Adverse Pregnancy Outcomes: Systematic Review and Meta-Analysis. British Medical Journal.2022 May; 377. doi: 10.1136/bmj-2021-067946.

[3] Sweeting A, Wong J, Murphy HR, Ross GP. A Clinical Update On Gestational Diabetes Mellitus. Endocrine Reviews.2022Oct;43(5):763-93.doi:10.1210/endrev/bnac003.

[4] Simmons D, Immanuel J, Hague WM, Teede H, Nolan CJ, Peek MJ *et al.* Treatment of Gestational Diabetes Mellitus Diagnosed Early in Pregnancy.New England Journal of Medicine.2023Jun;388(23):2132-44.doi:10.1056/NEJMoa2214956.

[5] Anastasiou E, Farmakidis G, Gerede A, Goulis DG, Koukkou E, Kourtis A *et al.* Clinical Practice Guidelines On Diabetes Mellitus and Pregnancy:II.Gestational Diabetes Mellitus.Hormones.2020Dec;19(4):601-7.doi:10.1007/s42000-020-00193-y.

[6] Lewandowska M, Więckowska B, Sajdak S. Pre-Pregnancy Obesity, Excessive Gestational Weight Gain, and the Risk of Pregnancy-Induced Hypertension and Gestational Diabetes Mellitus. Journal of Clinical Medicine. 2020Jun; 9(6):1980.doi:10.3390/jcm9061980.

[7] Laredo-Aguilera JA, Gallardo-Bravo M, Rabanales-Sotos JA, Cobo-Cuenca AI, Carmona-Torres JM. Physical Activity Programs During Pregnancy Are Effective for the Control of Gestational Diabetes Mellitus. International Journal of Environmental Research and Public Health.2020 Sep; 17(17): 6151. doi:10.3390/ijerph17176151.

[8] Kouhkan A, Najafi L, Malek M, Baradaran HR, Hosseini R, Khajavi A *et al.* Gestational Diabetes Mellitus: Major Risk Factors and Pregnancy-Related Outcomes:A Cohort Study.International Journal of Reproductive BioMedicine.2021Oct;19(9):827.doi:10.18502/ijrm.v19i9.9715.

[9] Modzelewski R, Stefanowicz-Rutkowska MM, Matuszewski W, Bandurska-Stankiewicz EM. Gestational Diabetes Mellitus—Recent Literature Review.Journal of Clinical Medicine.2022Sep;11(19):5736. doi: 10.3390/jcm11195736.

DOI: https://doi.org/10.54393/pjhs.v6i3.2692

[10] Moon JH and Jang HC. Gestational Diabetes Mellitus: Diagnostic Approaches and Maternal-Offspring Complications. Diabetes and Metabolism Journal. 2022 Jan; 46(1): 3-14. doi: 10.4093/dmj.2021.0335.

[11] Nguyen HH, Tran PH, Nguyen KT, Tran AV, Tran SK, Tran CM *et al.* Predictive Value of Microalbuminuria, Systolic Blood Pressure, and Serum Uric Acid Levels for Preeclampsia/Severe Preeclampsia in Gestational Hypertensive Patients.Clinical and Experimental Obstetrics and Gynecology. 2024Nov;51(12):259.doi: 10.31083/j.ceog5112259

[12] Lewandowska M. Gestational Diabetes Mellitus (GDM) Risk for Declared Family History of Diabetes, in Combination with BMI Categories.International Journal of Environmental Research and Public Health. 2021 Jun; 18(13): 6936. doi: 10.3390/ijerph18136936.

[13] Amiri FN, Faramarzi M, Bakhtiari A, Omidvar S. Risk Factors for Gestational Diabetes Mellitus: A Case-Control Study. American Journal of Lifestyle Medicine. 2021 Mar; 15(2): 184-90. doi: 10.1177/1559827618791980.

[14] Ali N, Aldhaheri AS, Alneyadi HH, Alazeezi MH, Al Dhaheri SS, Loney T *et al.* Effect of Gestational Diabetes Mellitus History On Future Pregnancy Behaviors: The Mutaba'ah Study. International Journal of Environmental Research and Public Health.2021 Jan; 18(1): 58. doi: 10.3390/ijerph18010058.

[15] Yue C, Ying C, Li X. Elevated Serum Uric Acid Is Associated with Gestational Diabetes Mellitus: An Observational Cohort Study. The Journal of Clinical Endocrinology and Metabolism.2023Jul;108(7):e480-6. doi: 10.1210/clinem/dgac760.

[16] Ghanei A, Mohammadzade G, Gholami Banadkoki M, Meybodi AE. The Predictive Role of Serum Uric Acid Levels Before Pregnancy in the Development of Gestational Diabetes Mellitus.Diabetology International.2024Jan;15(1):123-9.doi:10.1007/s13340-023-00662-w.

[17] Xilifu N, Zhang R, Dai Y, Maimaiti M, Li Z, Yang J *et al.* Uric Acid and Risk of Gestational Diabetes Mellitus: An Observational Study and Mendelian Randomization Analysis. Reproductive Biology and Endocrinology. 2024 Aug; 22(1): 108. doi: 10.1186/s12958-024-01278-8.

[18] Nikparast A, Rahmani J, Bagheri R, Mohammadpour S, Shadnoosh M, Wong A *et al.* Maternal Uric Acid Levels and Risk of Gestational Diabetes Mellitus: A Systematic Review and Dose-Response Meta-Analysis of Cohort Studies Including 105,380 Participants. Journal of Diabetes Investigation.2023 Aug; 14(8): 973-84. doi: 10.1111/jdi.14022.

[19] Guo M, Lu J, Yu X, Hu X, Hou W, Pang S. The Protective Role of Serum Uric Acid Against Premature Membrane Rupture in Gestational Diabetes:A Cross-Sectional Study. BioMed Central Endocrine Disorders.2021 May; 21(1): 95. doi: 10.1186/s12902-021-00736-3.

[20] Duo Y, Song S, Zhang Y, Qiao X, Xu J, Zhang J *et al.* Relationship Between Serum Uric Acid in Early Pregnancy and Gestational Diabetes Mellitus: A Prospective Cohort Study. Endocrine.2024Mar; 83(3): 636-47. doi: 10.1007/s12020-023-03544-y

[21] Lin Q, Zhang Z, Meng Q, Xie Y, Liu Z, Hu C *et al.* Effects of Different Dietary Patterns During Pregnancy On Birth Outcomes and Glucose Parameters in Women with Gestational Diabetes Mellitus: A Systematic Review and Meta-Analysis. Primary Care Diabetes.2023Aug; 17(4): 287-308. doi: 10.1016/j.pcd.2023.04.005.

[22] Pang TT, Zhou ZX, Li PS, Ma HT, Shen XY, Wan YC *et al.* Associations of Early Pregnancy Serum Uric Acid Levels with Risk of Gestational Diabetes and Birth Outcomes: A Retrospective Cohort Study. BioMed Central Endocrine Disorders.2023 Nov; 23(1): 252. doi: 10.1186/s12902-023-01502-3.