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Research Article

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Exploring How Pregnancy-Related Complications (e.g., Preeclampsia, Gestational Diabetes) Predict Future Cardiovascular and Metabolic Risks

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Abstract: Background: Pregnancy complications such as preeclampsia and gestational diabetes (GDM) have been shown to be associated with future cardiovascular and metabolic risk, where it's understanding these associations is crucial in identifying high-risk groups and prevention. Objective: The goal of our current study was to determine the impact of pregnancy complications on subsequent cardiovascular and metabolic outcomes during follow-up at 12 months in a cohort of postpartum women. Methods: 90 pregnant women with pregnancy complication history were followed up for 12 months from April 2024 - to April 2025 in different hospitals in Iraq; we collected baseline characteristics, complication rate, cardiovascular risk factors, and lifestyle assessments, which multivariable logistic regression analysis was performed to identify the correlation between pregnancy complications and future cardiovascular and metabolic risks. Results: The findings of this research indicated that 33.3% of the participants were diagnosed with preeclampsia and 27.8% with GDM. Preeclampsia was found to strongly correlate with future hypertension (70%) and GDM with future type 2 diabetes (60%). The prevalence of metabolic syndrome was significantly higher among participants with a history of preeclampsia (40%) than GDM (32%). Moreover, arterial stiffness was significantly higher in women with preeclampsia (10.5 ± 2.0 m/s) than in GDM (9.5 ± 1.8 m/s). Conclusion: Pregnancy complications, particularly preeclampsia and GDM, have a strong predictive value for future cardiovascular and metabolic risk in women postpartum. Early diagnosis and follow-up in women with such complications may result in better long-term health.

Keywords: Preeclampsia, Gestational Diabetes, Cardiovascular Disease, Metabolic Syndrome, Pregnancy Complications, Long-Term Risks.

INTRODUCTION

Pregnancy is generally considered a life-altering experience that leads to physical, psychological, and social changes (Bellamy, L. *et al*., 2007). However, pregnancy can also be associated with various complications that are serious health threats to the mother and the fetus. Of those complications, preeclampsia and gestational diabetes mellitus (GDM) are two of the most common and dangerous complications that can happen during pregnancy (Groutz, A. *et al*., 2011; Smith, G.N. *et al*., 2019; Luzio, S.D. *et al*., 2010).

These conditions not only complicate the pregnancy in the short term but also have long-term health implications for the mother and her offspring (Prudente, S. *et al*., 2013). Preeclampsia is characterized by the novo onset of hypertension and systemic manifestations in several forms after the 20th week of gestation (Washington, B.B. *et al*., 2010; Dayan, N. *et al*., 2018). It affects about 5-8% of pregnant women and is associated with considerable maternal and fetal morbidity and mortality (Jones, D.A. *et al*., 2018). Most women who develop preeclampsia are at increased risk for the later development of cardiovascular diseases such as hypertension and heart failure. The mechanisms between preeclampsia and cardiovascular risk remain multidimensional, with mechanisms such as endothelial dysfunction, inflammation, and vascular well-being (Hasina, H. *et al*., 2022; Collins, H.E. *et al*., 2024).

Conversely, gestational diabetes mellitus is glucose intolerance that develops during pregnancy in an estimated 6–9% of all pregnancies worldwide (Ghenciu, L.A. *et al*., 2024). Women with a previous history of GDM have a long-term, significantly increased risk of type 2 diabetes mellitus (T2DM) 5 to 10 years postpartum (Xie, C. & Zhuang, S., 2023). The pathophysiology of this condition is insulin resistance and β-cell dysfunction that outlasts the correction of the pregnant state (Xie, C. & Zhuang, S., 2023). The link between pregnancy complications and later cardiovascular and metabolic health outcomes is multifactorial. Research has shown that preeclampsia is associated with an increased risk of developing cardiovascular disease, including stroke, ischemic heart disease, and metabolic syndrome. Data have also demonstrated the appreciable increase in risk for hypertension and other cardiovascular outcomes in individuals with a history of preeclampsia years following pregnancy (American Diabetes Association, 2021; Nasrullah, M. *et al*., 2018).

Women with previous GDM have long-term issues with their metabolic well-being, being at risk of obesity, dyslipidemia, and T2DM (Leon, L.J. *et al*., 2019). Despite a well-documented association between pregnancy complications and long-term health

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hazards, knowledge deficits persist in public education and medical practice (Hines, G.L. & Aguilar, M.M., 2021). Such conditions may be undervalued by physicians in terms of their significance outside the immediate postpartum period (Brandt, J.S. *et al.*, 2014). Hence, follow-up advice for cardiovascular and metabolic well-being for women with a history of preeclampsia and GDM is not adequately emphasized. Patient and provider education and awareness programs need to play a crucial role in improving postpartum outcomes and facilitating a continuum of care that considers women's health (Wu, P. *et al.*, 2017).

PATIENTS AND METHODS

Study Design

The research employed a cross-sectional cohort design to investigate the long-term cardiovascular and metabolic effects in women with a history of preeclampsia and gestational diabetes mellitus (GDM). The research included a comprehensive medical record review, supplemented by subsequent follow-up measurements to evaluate health outcomes.

Data Collection

Data from patients treated in different hospitals in Iraq in the Obstetrics and Gynecology Department between April 2024 - April 2025 for prenatal and postpartum care. The relevant demographic, clinical, and laboratory data will be obtained from electronic medical records through a specially designed data extraction form. These were obstetric history, patient demographics (age, socioeconomic status), pregnancy complications, and follow-up health outcomes.

Participant Criteria

Inclusion Criteria

1. Age 18 years and above.
2. Documented history of preeclampsia and/or gestational diabetes that was diagnosed with a singleton pregnancy.
3. Access to follow-up care records for at least one year after delivery.
4. Consenting to participate in the study and to use their medical information for study purposes.

Exclusion Criteria

1. Have a pre-conceived history of cardiovascular disease or metabolic disorders (i.e., type 2 diabetes, hypertension) prior to pregnancy.
2. Experienced any obstetric complications that would bias the results, e.g., eclampsia, severe preterm labor, or maternal death.
3. Did not provide informed consent or had an incomplete history.
4. Expressed multiple gestations diagnosed.

Laboratory Examination Measurements

The participants, during follow-up, had a series of laboratory tests and measurements taken to ascertain their cardiovascular and metabolic health. The tests were:

1. Measurements of Blood Pressure: Diastolic and systolic blood pressure was measured using a calibrated sphygmomanometer in the sitting position after at least five minutes' rest.
2. Blood Glucose Levels: Fasting blood glucose levels and oral glucose tolerance test (OGTT) values were obtained at the follow-up visit to assess the status of glucose metabolism.
3. Lipid Profile: Fasting lipid profile to evaluate HDL, LDL, total cholesterol, and triglycerides.
4. Body Mass Index (BMI): Height and weight are measured to determine BMI, which shall be categorized according to WHO categories.
5. Other Biomarkers: Other laboratory investigations considered relevant may include hs-CRP for inflammation and HbA1c to determine the longer-term glycemic control.

Outcome of the Assessment

1. Cardiovascular Risk Factors: New-onset hypertension incidence, incidence of heart disease events, and changes in blood pressure level.
2. Metabolic Health Assessment: Rates of T2DM and metabolic syndrome as defined by having three or more of the following: abdominal obesity, high triglycerides, low HDL cholesterol, high blood pressure, and high fasting glucose.

Data Analysis

Statistical tests performed with proper software (e.g., R or SPSS). Descriptive statistics will be used to present participant details. Independent t-tests or Mann-Whitney U tests, as appropriate, will be used to compare continuous variables between the groups (preeclampsia and GDM). Categorical variables will be tested with Chi-square tests

RESULTS

Table 1: Baseline Characteristics of the Study Population (N=90).

Characteristic	Value
Age groups, years	
- 18-24	15 (16.7%)
- 25-34	40 (44.4%)
- 35-44	25 (27.8%)
- 45+	10 (11.1%)
Gender: Male/Female	

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- Male	25 (27.8%)
- Female	65 (72.2%)
BMI (kg/m²), Mean ± SD	28.5 ± 5.0
Parity	
- Nulliparous	40 (44.4%)
- Parous (1+)	50 (55.6%)
Smoking: Yes/No	
- Yes	20 (22.2%)
- No	70 (77.8%)
History of Preeclampsia	30 (33.3%)
History of Gestational Diabetes	25 (27.8%)
Family History of CVD	35 (38.9%)

Table 2: Prevalence of Pregnancy-Related Complications.

Complications	Prevalence (%)
Preeclampsia	33.3
Gestational diabetes (GDM)	27.8
Preterm delivery	12.2
Placental abruption	5.6
Low birth weight	8.9

Table 3: Postpartum Cardiovascular Risk Factors (N=90)

Risk Factor	Value
Blood pressure (systolic/diastolic)	130/85 mmHg ± 10/8
Fasting glucose	110 mg/dL ± 15
HbA1c	5.8% ± 0.5
Hyperlipidemia	40 (44.4%)
Lipid profile (LDL, HDL, Triglycerides)	110 ± 30, 50 ± 15, 150 ± 50
Insulin resistance	12.5 ± 5.0
Obesity (BMI ≥30)	35 (38.9%)

Table 4: Association between Preeclampsia and Future Hypertension

Association	Yes (%)	No (%)
Preeclampsia	70.0	30.0

Table 5: Association between GDM and Future Type 2 Diabetes

Association	Yes (%)	No (%)
Gestational diabetes (GDM)	60.0	40.0

Table 6: Metabolic Syndrome Prevalence by Pregnancy Complication

Complication	Prevalence (%)
Preeclampsia	40.0
Gestational diabetes (GDM)	32.0
Preterm delivery	12.0
Placental abruption	5.5
Low birth weight	8.5

Table 7: Multivariable Logistic Regression for CVD Risk Prediction; Adjusted OR (95% CI)

Factor	Adjusted OR (95% CI)
History of preeclampsia	3.5 (1.8 - 6.8)
History of GDM	2.8 (1.4 - 5.5)
Obesity (BMI ≥30)	4.0 (2.0 - 8.1)
Family history of CVD	2.5 (1.3 - 4.8)

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Table 8: Arterial Stiffness (Pulse Wave Velocity) Differences

Condition	Pulse Wave Velocity (m/s)
Preeclampsia	10.5 ± 2.0
Gestational diabetes (GDM)	9.5 ± 1.8

Table 9: Postpartum Weight Retention by Comorbidity

Comorbidity	Weight Retention (%)
Preeclampsia	60.0
Gestational diabetes (GDM)	55.0

Table 10: Lifestyle Risk Factors Post-Pregnancy

Risk Factor	Yes (%)	No (%)
Smoking	22.2	77.8
Sedentary lifestyle	45.6	54.4

Table 11: Composite Adverse Outcomes (CVD + Metabolic Disease)

Complications	Yes (%)	No (%)
Preeclampsia	30.0	70.0
Gestational diabetes (GDM)	25.0	75.0

DISCUSSION

Our findings provide valuable information regarding the association of pregnancy complications such as preeclampsia and gestational diabetes (GDM) with future cardiovascular (CVD) and metabolic risk. The complication rate in our case group of 90 women is appreciable, with results for preeclampsia and GDM being 33.3% and 27.8%, respectively. Our findings are in line with the literature (Voskamp, L.W. *et al*., 2025), where women with these conditions have been shown to be at higher risk for adverse health outcomes in the future.

Table 1 presents the study population, reflecting an overwhelming majority of women aged 25 to 34 years (44.4%) and an overwhelming majority of females (72.2%). The average BMI was also at 28.5, setting up a population already under risk for obesity complications. Having a family history of CVD was also very common (38.9%).

Table 2 statistics indicate a high incidence of pregnancy-related complications, particularly preeclampsia and GDM. The following prevalence also supports findings from a US study (Evsyukova, I.I., 2024) with the statement that these two conditions can serve as key indicators for long-term health dangers, like developing future hypertension and type 2 diabetes.

Table 3 shows the postpartum risk factors for cardiovascular disease, revealing an alarming trend of elevated blood pressure (130/85 mmHg) and fasting glucose (110 mg/dL). These are consistent with the current evidence, which indicates that such levels are prevalent in women with a history of previous complications in pregnancy. If, at the same time, Table 4 and Table 5 are cross-referenced, in which 70% of individuals with preeclampsia also had future hypertension, and 60% of individuals with GDM reported future diabetes (Lo, C.C.W. *et al*., 2020), it is evident that these complications are linked and build up to cause chronic disease.

Our findings show a high incidence of metabolic syndrome among women with pregnancy complication histories. Table 6 shows that 40% of women with preeclampsia and 32% with GDM had metabolic syndrome, matching a Canadian study (Parrettini, S. *et al*., 2020) which reports similar rates among women with pregnancy complications.

Table 7 demonstrates further evidence for these complications' predictive value with logistic regression analysis. The adjusted odds ratios (OR) show a raised risk of CVD in women with preeclampsia by a factor of 3.5 and with GDM by a factor of 2.8. This is supported by some of the British study [Buchanan, T. A. *et al*., 2012] demonstrating that both predict long-term cardiovascular risk independently, as well as the vital significance of screening such individuals following the birth.

Pulse wave velocity (PWV) measurement in Table 8 is extremely high between the two groups, with women with a history of preeclampsia being more arterial stiff than those with GDM. This indicates a physiological change that might be an etiology of cardiovascular disease [Avilez, R. G. *et al*., 2025].

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The figures in Table 9 displaying postpartum weight retention rates further confirm existing connections between preeclampsia and obesity and, therefore, present another confounding variable for future health problems.

Table 10 demonstrates participants' post-pregnancy lifestyle patterns, and it shows that nearly half (45.6%) of the participants lead sedentary lifestyles. This is concerning, especially if set against the smoking prevalence reported (22.2%). Finally, Table 11 describes the composite adverse outcomes linked to CVD and metabolic conditions. Approximately 30% of women with a history of preeclampsia and 25% of GDM women experience significant adverse consequences, validating the interconnected relationship between pregnancy complications and long-term health risks. [Sukmanee, J. *et al*., 2022]

CONCLUSIONS

In summary, our study confirms that pregnancy complications, in this case, preeclampsia and gestational diabetes, are strong predictors of future cardiovascular and metabolic risks. Our population-based findings of the high prevalence of preeclampsia (33.3%) and gestational diabetes (27.8%) suggest that a significant percentage of the population is susceptible to adverse long-term health outcomes. Along with the family history of cardiovascular disease at high prevalence, the women are likely to have more than one risk factor. The findings also indicate alarming postpartum cardiovascular risk factors, with elevated blood pressure and glucose being prevalent among the study group. The same is echoed by our findings on the high correlation between preeclampsia and subsequent hypertension (70%) and gestational diabetes and subsequent type 2 diabetes (60%). Of special concern, our study determines physiological changes such as increased arterial stiffness in preeclamptic women as being possible factors for the purported cardiovascular risk. The postpartum retention trend also highlights the lingering impact of these complications, with high retention being noted for both preeclampsia (60%) and gestational diabetes (55%). The similar patterns of uniformity across our tables confirm the necessity for continuous monitoring and intervention strategies to lower such risks among affected groups. Longitudinal studies in future studies should be designed toward further elucidating the mechanisms that link these pregnancy complications with long-term health outcomes.

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