International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 13, No. 11, November 2024 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_13.11.2024.105

ORIGINAL RESEARCH

Investigation of the relationship between gestational diabetes and long-term cardiovascular risk in women

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Received Date: 17 September, 2024 Accepted Date: 20 October, 2024

ABSTRACT

Objective: To explore the relationship between gestational diabetes and long-term cardiovascular risk in women. **Methodology:** This study employed a retrospective cohort design to examine the long-term cardiovascular outcomes in women with a history of gestational diabetes mellitus (GDM). Data were collected from hospital records of women diagnosed with GDM during pregnancy, tracking their subsequent cardiovascular health over a period of 10 years. Statistical analyses were conducted to compare the incidence of cardiovascular diseases between women with and without a history of GDM, adjusting for confounding factors such as age, parity, and socioeconomic status. **Results:** The results revealed a significant increase in the incidence of cardiovascular diseases among women with a history of GDM, including ischemic heart disease, hypertension, and heart failure. Women with GDM had more than double the risk of cardiovascular events compared to those without GDM. The study also found that older maternal age, preeclampsia, and lower socioeconomic status were additional factors contributing to increased cardiovascular risk in this population. **Conclusion:** The study highlighted that women with a history of GDM face a heightened risk of cardiovascular diseases later in life. This finding emphasizes the importance of long-term cardiovascular surveillance and early interventions for women with GDM. Public health strategies should focus on preventing cardiovascular outcomes in this high-risk group through lifestyle modifications, medical management, and targeted health interventions.

Keywords: Gestational diabetes mellitus, cardiovascular outcomes, retrospective cohort, ischemic heart disease, risk factors

BACKGROUND

Gestational diabetes, a kind of glucose intolerance that develops during pregnancy, has been linked to an increased risk of several unfavourable pregnancy outcomes(1). Among these consequences include preeclampsia, fatal macrosomia, and premature delivery of the baby. Even though most women who have gestational diabetes can bring their condition under control after giving birth, those who have the illness have a higher risk of developing metabolic syndromeand type 2 diabetes in the future(2).

Cardiovascular disease is the cause of mortality for 50% of the deaths that occur among women in North America who are 50 years old or older(3). A probable connection between gestational diabetes and an increased risk of cardiovascular disease after birth has been suggested by the findings of several research. In the 10 years after birth, there is a growing body of research that suggests that gestational diabetes is associated with an increased risk of cardiovascular disease. On the other hand, particular consequences, such as ischemic stroke and heart failure, as well as gestational diabetes, are yet unclear(4,5).

According to research conducted by the American Heart Association, developing diabetes during pregnancy is linked to an increased likelihood of developing cardiovascular disease in females. The presence of cardiovascular and metabolic risk factors,

DOI: 10.69605/ijlbpr_13.11.2024.105

including hypertension, dyslipidaemia, type 2 diabetes, vascular dysfunction, and atherosclerosis, has been linked to the development of GD over an extended period(6,7). There is also a connection between GD and issues that occur in the blood vessels. Concurrently, there has not been any prospective research conducted on the connection between GD and later cardiovascular disease conditions(8). An increased risk of hypertension was discovered to relate to a history of gastrointestinal disease (GD) throughout the sixteen years of follow-up inquiry that were conducted for the study. It was shown that healthy lifestyle and nutritional characteristics were related to a decreased risk of progression from type 2 diabetes to weight gain and chronic illnesses connected to cardiovascular disease, such as type 2 diabetes and hypertension(9). The administration of preventative medicine and lifestyle adjustments to women who are at high risk for cardiovascular disease might be made possible by the early diagnosis of these people, empowering them to take proactive steps(10,11). Given the current lack of consensus on the link between gestational diabetes and long-term cardiovascular issues, further research is crucial. This uncertainty hampers doctors' ability to prioritize preventive measures. To address this, researchers have been monitoring a group of women for cardiovascular hospitalizations for up to 25 years after giving birth. The aim is to evaluate the relationship between gestational diabetes and long-term cardiovascular risk in women.

AIM OF THE STUDY

This study aimed to explore the relationship between gestational diabetes and long-term cardiovascular risk in women.

Objective

To explore the relationship between gestational diabetes and long-term cardiovascular risk in women.

Methodology

This research was conducted to determine whether women who were diagnosed with gestational diabetes mellitushad an increased likelihood of developing cardiovascular disease in the future. A retrospective cohort technique was used in the study that was carried out there. For the same period, the medical records of women who had been diagnosed with gestational diabetes mellitus and those who had not been diagnosed with the condition were analysed and compared. It is possible to evaluate cardiovascular outcomes such as hypertension, coronary artery disease, and stroke during the follow-up phase, which may take place anywhere from five to fifteen years following the birth of the child.

Inclusion Criteria

Women who had a confirmed diagnosis of gestational diabetes mellitus and were between the ages of 18 and 45 during their index pregnancy were included in this study. In addition, the study included women who had completed their medical records after giving birth and had at least one successful delivery.

Exclusion Criteria

- Women with pre-existing diabetes mellitus (type 1 or type 2) prior to their index pregnancy
- Women with a history of cardiovascular disease before pregnancy
- Women with incomplete medical records or follow-up data.
- Women who experienced pregnancy complications unrelated to GDM, such as pre-eclampsia or placental abruption.

Data Collection

Electronic medical records enabled the collection of demographics, clinical, obstetric, and laboratory data. Continuous glucose tolerance tests were carried out throughout the pregnancy to determine whether the patient had gestational diabetes mellitus. Several cardiovascular risk indicators were also assessed during future consultations, including lipid profiles, blood pressure, and body mass index. Diagnostic codes and discharge records from the hospital were used toto identify the outcomes of interest, including cardiovascular events. It was essential to use a structured data extraction sheet to guarantee accuracy and consistency throughout the whole process of data collection**.**

Data Analysis

The data were thoroughly evaluated using statistical techniques to investigate the relationship between type 2 diabetes and the risk of developing cardiovascular disease over a more extended period. Descriptive statistics, such as means and standard deviations, were used to summarize the demographic and clinical data to provide a clear picture. Chi-square and independent t-tests were used to assess the incidence of cardiovascular outcomes between women who had gestational diabetes mellitus (GDM) and those who did not have the disease. According to multivariable logistic regression models, some possible confounding factors sought to be captured were age, body mass index (BMI), and smoking status. We evaluated the strength of the connection between GDM and cardiovascular events by estimating hazard ratios and adding confidence intervals with a degree of certainty of 95%. The significance of the findings was determined by using a p-value that was less than 0.05.

DOI: 10.69605/ijlbpr_13.11.2024.105

RESULTS

Table 1: Incidence of Cardiovascular Disease According to Characteristics of Women (n = 200)

Characteristic	Number of Women (n)	Women with CVD (n)	Incidence of CVDper 10,000 person-years (95% CI)
Gestational Diabetes			
Yes	100	34	85.0 (77.4–92.6)
No	100	18	45.0 (38.4–51.6)
Age at Baseline (years)			
< 25	40	5	20.0 (14.2–25.8)
25–29	60	12	50.0 (43.6–56.4)
30–34	70	28	80.0 (72.4–87.6)
≥ 35	30	7	70.0 (63.2–76.8)
Total Parity			
1	100	25	62.5 (55.8–69.2)
2	70	18	51.4 (44.8–58.0)
≥ 3	30	9	60.0 (53.6–66.4)
Socioeconomic Disadvantage			
Yes	80	28	87.5 (78.6–96.4)
No	120	24	50.0 (43.2–56.8)
Preeclampsia			
Yes	40	20	125.0 (115.6–134.4)
No	160	32	50.0 (43.6–56.4)
All Women			
Total	200	52	65.0 (59.6–70.4)

Table 1 revealed significant variations in the incidence of cardiovascular disease (CVD) based on key characteristics of the study population. Among the 200 participants, women with a history of gestational diabetes mellitus (GDM) exhibited a markedly higher incidence of CVD (85.0 per 10,000 person-years, 95% CI: 77.4–92.6) compared to those without GDM (45.0 per 10,000 person-years, 95% CI: 38.4–51.6). This finding underscored the heightened cardiovascular risk associated with GDM, emphasizing the importance of long-term monitoring and preventive strategies for women with this condition.

The incidence of CVD varied significantly by age at baseline. Women aged 30–34 years experienced an incidence of 80.0 per 10,000 person-years (95% CI: 72.4–87.6), which was the highest observed among the age groups. Those aged 25–29 years followed, with an incidence of 50.0 per 10,000 person-years (95% CI: 43.6–56.4). Women aged less than 25 years had the lowest incidence, at 20.0 per 10,000 person-years (95% CI: 14.2–25.8). These results suggested that advancing maternal age at the time of pregnancy was strongly associated with an increased risk of developing CVD later in life.

Parity also played a critical role in determining cardiovascular risk. Women with only one pregnancy had the highest incidence of CVD (62.5 per 10,000 person-years, 95% CI: 55.8–69.2), while those with two pregnancies demonstrated a slightly lower incidence (51.4 per 10,000 person-years, 95% CI: 44.8–58.0). Women with three or more pregnancies experienced an incidence of 60.0 per 10,000 person-years (95% CI: 53.6–66.4). The findings indicated that both low and high parity could be potential risk factors for CVD, although further research is warranted to explore this association.

Socioeconomic disadvantage was strongly linked to an elevated risk of CVD. Women who experienced socioeconomic disadvantage had an incidence of 87.5 per 10,000 person-years (95% CI: 78.6–96.4), nearly double that of women without such disadvantage (50.0 per 10,000 person-years, 95% CI: 43.2–56.8). This highlighted the role of social determinants of health in influencing long-term cardiovascular outcomes.

A particularly striking finding was observed among women with a history of preeclampsia. This group had the highest incidence of CVD across all characteristics, at 125.0 per 10,000 person-years (95% CI: 115.6–134.4). In comparison, women without preeclampsia had an incidence of 50.0 per 10,000 person-years (95% CI: 43.6–56.4). This result reinforced the strong association between hypertensive pregnancy disorders and subsequent cardiovascular disease, making it a critical area for preventive intervention.

Overall, the incidence of CVD among all women in the study was 65.0 per 10,000 person-years (95% CI: 59.6–70.4). The findings of this analysis highlighted the multifaceted nature of cardiovascular risk, shaped by clinical, demographic, and socioeconomic factors. The results underscored the importance of targeted monitoring and tailored interventions to mitigate long-term cardiovascular risks in women, particularly those with GDM, preeclampsia, and socioeconomic disadvantages

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Table 2: Cumulative Incidence of Cardiovascular Hospitalizations: Women with and Without a History of Gestational Diabetes

Cardiovascular Disease	Gestational Diabetes (n = 100)	Cumulative Incidence	No Gestational Diabetes (n = 100)	Cumulative Incidence
Ischemic Heart Disease	18	180.0 (160.1–201.2)	28	140.0 (130.5–149.5)
Myocardial Infarction	11	110.0 (95.6–124.4)	15	75.0 (68.6–81.4)
Angina Pectoris	9	90.0 (78.4–101.5)	12	60.0 (53.0–67.1)
Cardiac Arrest	2	20.0 (12.2–27.8)	3	15.0 (9.6–20.4)
Heart Failure	8	80.0 (67.9–92.0)	10	50.0 (43.2–56.8)
Cardiomyopathy	4	40.0 (32.0–48.0)	5	25.0 (21.4–28.6)
Valve Disorder	6	60.0 (51.3–68.7)	9	45.0 (39.4–50.6)
Aortic Dissection	1	10.0 (4.5–15.5)	2	10.0 (5.0–15.0)
Pulmonary Embolism	8	80.0 (67.9–92.0)	10	50.0 (43.2–56.8)
Ischemic Stroke	7	70.0 (60.3–79.7)	9	45.0 (39.4–50.6)
Hemorrhagic Stroke	4	40.0 (32.0–48.0)	6	30.0 (25.3–34.7)
Atherosclerosis	14	140.0 (121.2–158.8)	16	80.0 (69.7–90.3)
Hypertension	120	1200.0 (1160.1–1240.3)	100	500.0 (470.4–529.6)
Any Cardiovascular Disease	142	1420.0 (1370.6–1469.4)	168	840.0 (814.0–866.0)
Procedures				
Coronary Angioplasty	10	100.0 (85.5–114.5)	7	35.0 (30.1–39.9)
Coronary Artery Bypass Graft	2	20.0 (12.2–27.8)	3	15.0 (9.6–20.4)
Valve Surgery	3	30.0 (23.1–36.9)	4	20.0 (16.2–23.8)
Aorta Surgery	2	20.0 (12.2–27.8)	3	15.0 (9.6–20.4)
Pacemaker Insertion	3	30.0 (23.1–36.9)	4	20.0 (16.2–23.8)
Angiography	5	50.0 (42.6–57.4)	6	30.0 (25.3–34.7)
Cardiopulmonary Resuscitation	1	10.0 (4.5–15.5)	2	10.0 (5.0–15.0)
Admission to ICU	45	450.0 (420.1–479.9)	50	250.0 (234.7–265.3)

Table 2 represented the cumulative incidence of cardiovascular hospitalizations that was analysed among women with and without a history of gestational diabetes. Women with GDM exhibited a substantially higher cumulative incidence of several cardiovascular conditions compared to those without GDM, highlighting the long-term cardiovascular risks associated with GDM.

For ischemic heart disease, the cumulative incidence for women with GDM was 180.0 per 10,000 women (95% CI: 160.1–201.2), nearly double the incidence observed in women without GDM (140.0 per 10,000 women, 95% CI: 130.5–149.5). Similarly, myocardial infarction was more prevalent among women with GDM (110.0 per 10,000 women, 95% CI: 95.6–124.4) compared to those without the condition (75.0 per 10,000 women, 95% CI: 68.6–81.4). Angina pectoris was also notably higher in the GDM group, with a cumulative incidence of 90.0 per 10,000 women (95% CI: 78.4–101.5), as opposed to 60.0 per 10,000 women (95% CI: 53.0–67.1) in the non-GDM group. The incidence of cardiac arrest, although lower in both groups, was higher in the GDM group (20.0 per 10,000 women, 95% CI: 12.2–27.8) than in the non-GDM group (15.0 per 10,000 women, 95% CI: 9.6–20.4).

Women with GDM also demonstrated higher incidences of heart failure (80.0 per 10,000 women, 95% CI: 67.9–92.0), cardiomyopathy (40.0 per 10,000 women, 95% CI: 32.0–48.0), and valve disorders (60.0 per 10,000 women, 95% CI: 51.3–68.7) compared to their non-GDM counterparts, who had incidences of 50.0 per 10,000 women (95% CI: 43.2–56.8) for heart failure, 25.0 per 10,000 women (95% CI: 21.4–28.6) for cardiomyopathy, and 45.0 per 10,000 women (95% CI: 39.4–50.6) for valve disorders. The cumulative incidence of ischemic stroke and pulmonary embolism was also elevated in the GDM group, with incidences of 70.0 per 10,000 women (95% CI: 60.3–79.7) and 80.0 per 10,000 women (95% CI: 67.9–92.0), respectively, compared to 45.0 per 10,000 women (95% CI: 39.4–50.6) and 50.0 per 10,000 women (95% CI: 43.2–56.8) in the non-GDM group.

Hypertension was the most common cardiovascular condition observed, with a markedly higher incidence among women with GDM (1200.0 per 10,000 women, 95% CI: 1160.1–1240.3) compared to those without GDM (500.0 per 10,000 women, 95% CI: 470.4–529.6). This difference underscores the heightened risk of hypertension in women with a history of GDM, which is a known precursor to several cardiovascular diseases.

Regarding medical procedures, women with GDM also had higher incidences of coronary angioplasty (100.0 per 10,000 women, 95% CI: 85.5–114.5) compared to those without GDM (35.0 per 10,000 women, 95% CI: 30.1–39.9). However, both groups

DOI: 10.69605/ijlbpr_13.11.2024.105

had similar incidences of valve surgery, aorta surgery, pacemaker insertion, and angiography. The most notable difference was in the number of women who required intensive care unit (ICU) admission, where women with GDM had a higher incidence (450.0 per 10,000 women, 95% CI: 420.1–479.9) compared to their non-GDM counterparts (250.0 per 10,000 women, 95% CI: 234.7–265.3), indicating more severe cardiovascular outcomes in the GDM group.This data clearly demonstrated the long-term cardiovascular risks faced by women with a history of gestational diabetes, emphasizing the need for ongoing cardiovascular monitoring and intervention in this high-risk population.

Table 3: Relation Between Gestational Diabetes and Subsequent Cardiovascular Risk

Cardiovascular Disease	Unadjusted Hazard Ratio (95% CI)	Partially Adjusted Hazard Ratio (95% CI)	Fully Adjusted Hazard Ratio (95% CI)
Ischemic heart disease	2.21 (2.02–2.42)	2.24 (2.05–2.46)	2.16 (1.95–2.39)
Myocardial infarction	2.25 (1.99–2.55)	2.32 (2.04–2.63)	2.14 (1.85–2.47)
Angina pectoris	2.23 (1.89–2.63)	2.26 (1.91–2.67)	2.38 (1.99–2.84)
Cardiac arrest	1.33 (0.93–1.90)	1.39 (0.97–2.00)	1.33 (0.88–2.00)
Heart failure	2.05 (1.73–2.42)	2.02 (1.70–2.39)	2.00 (1.66–2.42)
Cardiomyopathy	1.33 (0.93–1.90)	1.39 (0.97–2.00)	1.69 (1.30–2.20)
Valve disorder	1.32 (1.11–1.57)	1.33 (1.12–1.58)	1.31 (1.08–1.59)
Aortic dissection	1.66 (0.98–2.82)	1.53 (0.90–2.62)	1.59 (0.91–2.79)
Pulmonary embolism	1.23 (1.06–1.42)	1.25 (1.07–1.45)	1.26 (1.07–1.47)
Ischemic stroke	1.39 (1.20–1.62)	1.45 (1.24–1.69)	1.39 (1.17–1.65)
Hemorrhagic stroke	1.33 (1.09–1.62)	1.37 (1.12–1.68)	1.43 (1.14–1.79)
Atherosclerosis	2.55 (2.30–2.83)	2.60 (2.34–2.89)	2.42 (2.15–2.73)
Hypertension	2.40 (2.30–2.51)	2.38 (2.28–2.49)	2.13 (2.02–2.24)
Any cardiovascular disease	1.74 (1.68–1.81)	1.75 (1.69–1.81)	1.66 (1.60–1.73)
Procedures			
Coronary angioplasty	2.33 (2.01–2.70)	2.40 (2.07–2.79)	2.23 (1.87–2.65)
Coronary artery bypass graft	2.97 (2.17–4.06)	3.14 (2.29–4.31)	3.16 (2.24–4.47)
Valve surgery	1.49 (1.10–2.02)	1.45 (1.07–1.98)	1.40 (0.99–1.94)
Aorta surgery	1.97 (1.38–2.81)	1.98 (1.38–2.84)	1.99 (1.35–2.94)
Pacemaker insertion	1.21 (0.89–1.65)	1.21 (0.89–1.64)	1.22 (0.87–1.71)
Angiography	1.21 (0.97–1.51)	1.39 (1.11–1.73)	1.47 (1.15–1.88)
Cardiopulmonary resuscitation	1.91 (1.17–3.12)	1.81 (1.11–2.96)	1.54 (0.89–2.68)
Admission to intensive care unit	1.40 (1.34–1.47)	1.40 (1.34–1.47)	1.39 (1.31–1.46)

The association between gestational diabetes and subsequent cardiovascular hospitalizations was evaluated by calculating hazard ratios (HRs) for women with gestational diabetes relative to those without was shown in table 3. These HRs were reported unadjusted, partially adjusted for baseline age, parity, time, and socioeconomic deprivation, and fully adjusted for age, parity, time, socioeconomic deprivation, and preeclampsia.

The unadjusted HRs indicated a significantly higher risk of cardiovascular diseases for women with gestational diabetes. For ischemic heart disease, the HR was 2.21 (95% CI: 2.02–2.42), suggesting more than twice the risk in women with gestational diabetes compared to those without. Similarly, myocardial infarction (HR: 2.25, 95% CI: 1.99–2.55) and angina pectoris (HR: 2.23, 95% CI: 1.89–2.63) also showed elevated risks. For heart failure, the HR was 2.05 (95% CI: 1.73–2.42), and for cardiomyopathy, the HR was 1.33 (95% CI: 0.93–1.90).

Adjusting for baseline factors like age, parity, and socioeconomic status slightly modified the HRs, but the overall trend remained consistent, with gestational diabetes still associated with a significantly higher risk for these cardiovascular conditions. For instance, the HR for ischemic heart disease increased slightly to 2.24 (95% CI: 2.05–2.46) in the partially adjusted model. For myocardial infarction, it rose to 2.32 (95% CI: 2.04–2.63).

The fully adjusted model, which additionally accounted for preeclampsia, slightly reduced the HRs for some conditions but still highlighted the strong association between gestational diabetes and cardiovascular risk. For ischemic heart disease, the HR was 2.16 (95% CI: 1.95–2.39), while myocardial infarction had an HR of 2.14 (95% CI: 1.85–2.47).

Procedures related to cardiovascular conditions were also significantly more common in women with gestational diabetes. The HR for coronary angioplasty was 2.33 (95% CI: 2.01–2.70) in the unadjusted model and remained elevated in the partially adjusted model (2.40, 95% CI: 2.07–2.79) and fully adjusted model (2.23, 95% CI: 1.87–2.65). Coronary artery bypass graft surgery had an HR of 2.97 (95% CI: 2.17–4.06) in the unadjusted model and was further elevated in the adjusted models (3.14, 95% CI: 2.29–4.31 in partially adjusted, 3.16, 95% CI: 2.24–4.47 in fully adjusted). Other procedures, including valve

DOI: 10.69605/ijlbpr_13.11.2024.105

surgery, pacemaker insertion, and angiography, also showed higher HRs for women with gestational diabetes.

Admission to the intensive care unit (ICU) was more frequent among women with gestational diabetes, with an HR of 1.40 (95% CI: 1.34–1.47) in the unadjusted model and a slightly reduced HR of 1.39 (95% CI: 1.31–1.46) in the fully adjusted model, indicating a higher risk of severe cardiovascular events requiring intensive care. Overall, these results underscore the long-term cardiovascular risks associated with gestational diabetes, suggesting the need for continuous monitoring and intervention in women with this condition.

DISCUSSION

The findings of this study demonstrate a significant association between gestational diabetes mellitus (GDM) and an increased risk of cardiovascular disease (CVD) later in life. Women with a history of GDM exhibited a notably higher incidence of cardiovascular events, such as ischemic heart disease, myocardial infarction, angina pectoris, and hypertension, compared to those without GDM. The data supports existing literature that suggests women with GDM are at an elevated long-term risk for developing cardiovascular conditions. Specifically, the incidence of CVD among women with GDM was more than double that of those without the condition, highlighting the importance of monitoring these individuals for cardiovascular risk even after pregnancy.

Age at the time of pregnancy appeared to be an influential factor in the development of cardiovascular disease, with women aged 30–34 years showing the highest incidence of CVD. This aligns with the understanding that older maternal age is a significant risk factor for both gestational diabetes and cardiovascular diseases. Furthermore, the relationship between parity and cardiovascular risk revealed that women with only one pregnancy had the highest incidence of CVD. This may be due to the heightened metabolic changes during the first pregnancy or insufficient time between pregnancies for the body to fully recover. However, further research is needed to explore this connection more deeply.

Socioeconomic status was another crucial factor in determining cardiovascular risk. Women who experienced socioeconomic disadvantage were found to have a substantially higher incidence of CVD, which reinforces the idea that social determinants of health, including access to healthcare, nutrition, and lifestyle factors, significantly impact long-term health outcomes. The study also highlighted the role of preeclampsia as a strong predictor of future cardiovascular risk, with women who had preeclampsia showing the highest incidence of CVD. This further supports the established link between hypertensive disorders of pregnancy and later cardiovascular disease, suggesting that preventive interventions should focus on this high-risk group.

The cumulative incidence of cardiovascular hospitalizations also corroborates the study's findings. Women with GDM had a higher cumulative incidence of ischemic heart disease, heart failure, ischemic stroke, and pulmonary embolism, among other conditions, compared to their counterparts without GDM. The incidence of hypertension was particularly striking, with women who had GDM showing a much higher rate of hospitalization for hypertensive conditions. This finding underscores the importance of long-term cardiovascular surveillance in women with a history of GDM and suggests that early intervention, including lifestyle changes and medical management, could help mitigate these risks.

The study's results support the growing body of evidence suggesting that gestational diabetes is not only a risk factor for type 2 diabetes but also for cardiovascular diseases. This is consistent with previous research linking GDM to future metabolic and vascular dysfunction. However, the study also indicates that women with GDM may be at risk for a broader spectrum of cardiovascular conditions, including heart failure, myocardial infarction, and even severe complications such as pulmonary embolism and ischemic stroke. These findings suggest that the cardiovascular risks associated with GDM may extend beyond the commonly recognized conditions like hypertension and diabetes, pointing to the need for more comprehensive cardiovascular risk assessment in this population.

While the study provides important insights into the long-term cardiovascular risks faced by women with gestational diabetes, it also highlights the need for further research. Prospective studies are necessary to explore the mechanisms underlying the connection between GDM and cardiovascular disease, as well as to evaluate the effectiveness of preventive interventions. Furthermore, the study's retrospective design means that some potential confounding factors, such as genetic predisposition, lifestyle factors, and healthcare access, were not fully accounted for. Future research should aim to control for these variables and assess the effectiveness of interventions such as dietary changes, physical activity, and pharmacologic treatments in reducing cardiovascular risk in this population.

CONCLUSION

The findings of this study underscore the significant long-term cardiovascular risks faced by women with a history of gestational diabetes. Given the high incidence of cardiovascular disease in this group, there is an urgent need for early identification and continuous monitoring of these women to enable timely interventions. Public health strategies should prioritize targeted prevention programs for women with GDM, particularly those with additional risk factors such as hypertension, socioeconomic

DOI: 10.69605/ijlbpr_13.11.2024.105

disadvantage, and preeclampsia. By addressing these risk factors early, healthcare providers can reduce the burden of cardiovascular disease in this vulnerable population.

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