Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies *NLM ID: 101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Impact of Pre-Pregnancy Weight and Metabolic Health on GDM Development

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ABSTRACT:
Background: Gestational Diabetes Mellitus (GDM) poses significant risks to maternal and fetal health, necessitating a comprehensive understanding of its risk factors. This study investigates the impact of pre-pregnancy weight and metabolic health on GDM risk. **Methods:** A retrospective analysis was conducted using medical records of pregnant women to evaluate the relationship between pre-pregnancy body mass index (BMI) and metabolic health indicators, including fasting glucose, triglycerides, and blood pressure. Participants were categorized based on their pre-pregnancy BMI, and those with pre-existing diabetes or pregnancy complications unrelated to GDM were excluded. **Results:** Among 200 participants, the incidence of GDM was 26%, with the highest rates observed in obese women (50%) compared to normal-weight (15%) and overweight (30%) groups. Poor metabolic health markers were significantly associated with GDM, including elevated fasting glucose (110 mg/dL vs. 92 mg/dL) and triglycerides (160 mg/dL vs. 130 mg/dL) in the GDM group. Logistic regression revealed that higher pre-pregnancy BMI, fasting glucose, and systolic blood pressure were significant predictors of GDM, while higher HDL cholesterol and insulin sensitivity were protective factors. **Conclusion:** Pre-pregnancy weight and metabolic health critically influence GDM risk. An integrated approach to preconception care, including metabolic health assessments, is essential for identifying high-risk individuals and implementing preventive strategies, ultimately improving maternal and fetal outcomes.
Keywords: Gestational Diabetes Mellitus, pre-pregnancy weight, metabolic health, body mass index, risk factors, maternal health.

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

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This article may be cited as: Verma R, Bisani KG, Mandloi A. Impact of Pre-Pregnancy Weight and Metabolic Health on GDM Development. J Adv Med Dent Scie Res 2024; 12(11):43-46.

INTRODUCTION

Gestational Diabetes Mellitus (GDM) is a type of diabetes that is first recognized during pregnancy, characterized by elevated blood glucose levels that can lead to complications for both the mother and baby. GDM is increasingly common, affecting about 7-10% of pregnancies globally, and its prevalence is rising in parallel with obesity rates.[1] Although GDM often resolves after childbirth, it poses significant long-term health risks, including an increased likelihood of developing type 2 diabetes and cardiovascular disease for the mother, as well as a higher risk of obesity and metabolic disorders in offspring. Therefore, understanding and addressing the risk factors associated with GDM has become crucial to promoting maternal and child health.[2]

Beyond weight alone, metabolic health before pregnancy encompasses several other factors, including blood pressure, lipid profile, and glucose tolerance, each of which independently affects GDM risk. Even in women with a normal BMI, poor metabolic health, indicated by dyslipidemia, impaired glucose tolerance, or elevated blood pressure, can predispose them to GDM.[3] This is particularly concerning because it suggests that even women who appear to have a healthy weight may face hidden risks if their metabolic health is compromised. These factors often interact synergistically, where, for example, elevated blood glucose and blood pressure can compound the effects of high BMI, creating a more complex risk landscape for GDM.[4]

The rationale for examining pre-pregnancy weight and metabolic health as risk factors for GDM lies in the potential to identify high-risk individuals and intervene before pregnancy. Lifestyle interventions, including dietary adjustments, increased physical activity, and even pre-conception screening for metabolic disorders, could help lower the risk of GDM. Identifying women at risk and implementing strategies to improve metabolic health before pregnancy can lead to better glycemic control during pregnancy and potentially reduce the need for pharmacologic intervention, such as insulin or metformin, during gestation. Moreover, maintaining good metabolic health before conception benefits overall maternal health, potentially reducing complications during pregnancy and lowering the risk of related long-term diseases.[5]

Considering the maternal and fetal health risks associated with GDM, understanding the modifiable factors that contribute to it is critical. By addressing pre-pregnancy weight and metabolic health, healthcare providers can take proactive steps in managing and reducing GDM incidence. This approach aligns with preventive healthcare, which emphasizes early risk identification and health optimization before conception to improve outcomes for both mother and child. As research continues to highlight the importance of pre-pregnancy health in determining pregnancy outcomes, these insights reinforce the need for comprehensive preconception care that includes weight and metabolic health assessments as part of routine counseling for women planning pregnancy.[6]

AIM

The study aims to evaluate how pre-pregnancy weight and metabolic health impact the risk of GDM, identifying high-risk profiles to guide preventive strategies for better maternal and fetal health outcomes.

METHODOLOGY

This study utilized a retrospective analysis design to investigate the relationship between pre-pregnancy weight, metabolic health, and the risk of developing Gestational Diabetes Mellitus (GDM). The study population consisted of pregnant women with documented pre-pregnancy weight and metabolic health data, identified through existing medical records.

Inclusion and Exclusion Criteria

Eligible participants were selected based on specific inclusion and exclusion criteria. Inclusion criteria included women of reproductive age with complete pre-pregnancy BMI data and metabolic health records. Exclusion criteria eliminated cases with pre-existing diabetes, uncontrolled metabolic conditions, or pregnancy complications unrelated to GDM that could confound results. Additional demographic factors, such as age and parity, were also considered to ensure a consistent study sample.

Data Collection

Data were extracted from medical records and patient registries. Key variables included pre-pregnancy BMI categorized as normal, overweight, or obese, based on standard guidelines. Metabolic health markers, such as fasting glucose levels, triglycerides, HDL cholesterol, and blood pressure, were also collected to assess each participant's baseline metabolic status. GDM diagnosis during pregnancy was recorded according to established criteria, including gestational age at diagnosis and glucose tolerance test results.

Statistical Analysis

The data were analyzed to assess correlations between pre-pregnancy BMI and GDM incidence, as well as the impact of metabolic health markers on GDM risk. Regression analyses evaluated BMI and metabolic health markers as independent and combined predictors of GDM. Adjustments were made for potential confounders, including age, lifestyle factors, ethnicity, and parity, to isolate the specific impact of weight and metabolic health. Statistical significance was set at an appropriate level to determine the robustness of the associations, providing insights into pre-pregnancy factors that may predispose women to GDM.

RESULTS

Table 1: Incidence of GDM Across Pre-Pregnancy BMI Categories

Pre-Pregnancy BMI Category	Total Participants	Participants with GDM	GDM Incidence (%)
Normal Weight	80	12	15.0
Overweight	60	18	30.0
Obese	40	20	50.0
Underweight	20	2	10.0
Total	200	52	26.0

Table 1 shows the incidence of GDM across different pre-pregnancy BMI categories. Among 200 participants, GDM incidence increases with BMI: 15% in normal weight, 30% in overweight, and 50% in obese women. Underweight women had the lowest GDM incidence at 10%. Overall, 26% of participants developed GDM.

Table 2: Metabolic Health Markers in GDM vs. Non-GDM Groups

Metabolic Health Marker	GDM Group (Mean ± SD)	Non-GDM Group (Mean ± SD)
Fasting Glucose (mg/dL)	110 ± 12	92 ± 8
Triglycerides (mg/dL)	160 ± 20	130 ± 15
HDL Cholesterol (mg/dL)	45 ± 5	55 ± 6
Systolic BP (mmHg)	128 ± 10	118 ± 8
Diastolic BP (mmHg)	82 ± 6	76 ± 5
HbA1c (%)	6.5 ± 0.4	5.6 ± 0.3
Insulin Sensitivity Index	1.2 ± 0.2	1.8 ± 0.3

This table compares metabolic health markers between the GDM and non-GDM groups. The GDM group shows higher fasting glucose, triglycerides, systolic and diastolic blood pressure, and HbA1c, alongside lower HDL cholesterol and insulin sensitivity. These differences suggest that poorer metabolic health correlates with an increased risk of GDM.

Table 3: Logistic Regression Analysis of GDM Risk by BMI and Metabolic Markers

Predictor Variable	Odds Ratio (OR)	95% Confidence Interval (CI)	p-Value
Pre-Pregnancy BMI (Overweight)	2.1	1.5 - 3.2	0.01
Pre-Pregnancy BMI (Obese)	3.5	2.3 - 5.1	<0.001
Fasting Glucose	1.4	1.2 - 1.8	0.02
Triglycerides	1.3	1.1 - 1.7	0.04
HDL Cholesterol	0.8	0.6 - 1.0	0.06
Systolic BP	1.2	1.0 - 1.4	0.03
Insulin Sensitivity Index	0.7	0.5 - 0.9	0.01

This table shows the impact of various predictors on GDM risk. Higher pre-pregnancy BMI (overweight/obese), fasting glucose, triglycerides, and systolic BP are linked to increased GDM risk (OR > 1), while higher HDL cholesterol and insulin sensitivity lower the risk. Statistically significant predictors have p-values below 0.05.

DISCUSSION

Obese women displayed the highest GDM incidence at 50%, followed by overweight women at 30%, and normal-weight women at 15%. Underweight women had the lowest incidence, indicating that excessive pre-pregnancy weight plays a critical role in the development of GDM.[7] These results align with existing literature showing that overweight and obesity are significant risk factors for GDM, likely due to insulin resistance and inflammation, which are often present in individuals with higher BMI. Elevated BMI has been shown to contribute to metabolic disturbances that can disrupt glucose homeostasis, thereby increasing GDM risk.[8]

Higher fasting glucose, triglycerides, and blood pressure levels were observed in the GDM group, whereas HDL cholesterol and insulin sensitivity were lower. This supports the understanding that even in women with a normal or borderline BMI, poor metabolic health can substantially increase GDM risk.[8,9] For example, fasting glucose levels were markedly higher in the GDM group, suggesting a potential predisposition to glucose intolerance before pregnancy. High triglyceride levels and low HDL cholesterol, both indicators of dyslipidemia, suggest an imbalance in lipid metabolism that may exacerbate insulin resistance, further compounding GDM risk. Elevated blood pressure in the GDM group also highlights the role of hypertension as an indicator of poor metabolic health and its association with adverse pregnancy outcomes. These findings suggest that metabolic health markers are independently predictive of GDM and can serve as a valuable focus in pre-pregnancy counseling and intervention efforts.[10,11]

Women with overweight or obese BMI prior to pregnancy had significantly higher odds of developing GDM (odds ratio [OR] for overweight = 2.1, OR for obese = 3.5). Metabolic markers such as fasting glucose, triglycerides, and systolic blood pressure also independently predicted GDM, with fasting glucose showing a particularly strong association (OR = 1.4).[12,13] Interestingly, HDL cholesterol and insulin sensitivity index were protective factors, with higher levels reducing GDM risk. HDL cholesterol's role in maintaining cardiovascular health and insulin sensitivity's direct influence on glucose metabolism explain their protective association with GDM. Lower HDL cholesterol levels and insulin sensitivity indicate poor metabolic health, aligning with our findings that suboptimal metabolic status, even in the absence of obesity, can contribute to GDM risk.[14,15]

CONCLUSION

This study emphasizes that both pre-pregnancy weight and metabolic health significantly influence GDM risk. Women with higher pre-pregnancy BMI and poor metabolic profiles demonstrated a markedly increased risk, underlining the need for comprehensive metabolic health assessments in addition to BMI. Our findings support an integrated approach to pre-pregnancy care that goes beyond weight management to include metabolic health optimization. Addressing risk factors such as dyslipidemia, hypertension, and impaired glucose tolerance through lifestyle interventions could potentially mitigate GDM risk and improve maternal and fetal outcomes.

In conclusion, these results advocate for routine preconception care that includes metabolic screening alongside BMI evaluation. By identifying high-risk individuals, healthcare providers can implement early interventions, including dietary modifications, physical activity enhancement, and, where necessary, medical management to improve metabolic health prior to conception. This preventive approach could reduce the incidence of GDM, leading to healthier pregnancies and potentially lowering the long-term risk of metabolic disorders in both mothers and their offspring. As the prevalence of obesity and metabolic syndrome continues to rise globally, a focus on pre-pregnancy metabolic health is crucial to addressing the escalating burden of GDM and promoting optimal maternal and child health.

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