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Cross-Sectional Analysis of Knee Osteoarthritis in Women with A History of Gestational Diabetes

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KEYWORDS

Metabolic health, Knee osteoarthritis, Gestational diabetes mellitus, Women's health, Cross-sectional analysis

Abstract

Background: Women with Gestational Diabetes Mellitus (GDM) are at risk for knee osteoarthritis (OA). GDM metabolic changes may increase the risk of joint diseases, however little is known about the relationship between GDM and knee OA.

Methods: A cross-sectional study conducted at Territory Care Hospital with 100 gestational diabetic mothers and 100 healthy controls. Patient Medical record reviews assessed Kellgren-Lawrence scale OA frequency and severity. The statistical study compared group OA rates and severity.

Results: Our study found 40% of GDM women had knee OA, compared to 20% of controls. Additionally, the GDM group had a higher severity of OA, with 40% classified as Grade 3-4 compared to 20% in the non-GDM group ($p < 0.05$). GDM is associated with a higher risk of knee OA, suggesting metabolic variables may affect joint health.

Conclusion: Obstetrically diabetic women have more severe knee osteoarthritis. These findings underline the necessity for joint health monitoring and customised treatment in this population. Long-term musculoskeletal results can be improved by early identification and treatment of OA in women with gestational diabetes.

Introduction

High prevalence and devastating effects make knee OA a major public health issue, especially for women. OA degrades articular cartilage and alters bone and joint structures, causing pain, stiffness, and reduced mobility [1]. As one of the most common kinds of OA, knee OA costs healthcare systems and individuals globally significant money and time.

Background of Knee Osteoarthritis (OA)

The most frequent old arthritic impairment is knee OA. It affects the femoral condyles and tibial plateau, causing pain and movement difficulties [2]. Women have a higher incidence of knee OA and longer symptom onset periods than males, suggesting they are more affected [3]. Socio-behavioral factors like hormone differences, obesity, and inactivity contribute to this gender discrepancy.

Prevalence and Impact of Knee OA in Women

Epidemiological studies show knee OA affects women of all ages and worldwide. Over 60% of US adults with OA are women. OA affects mental health, social participation, and well-being beyond physical discomfort. OA in women can reduce mobility, everyday activities, and carer dependence, lowering quality of life and increasing healthcare use [4].

Introduction to Gestational Diabetes (GDM) and Its Potential Long-term Effects

Glucose intolerance is a characteristic of GDM, a common metabolic disorder during pregnancy. Women with GDM are more likely to develop type 2 diabetes (T2DM), even though GDM normally resolves after birth [5]. GDM may affect maternal and foetal health and musculoskeletal health, among other organ systems, over time, according to emerging research. Hypotheses linking metabolic dysregulation, chronic low-grade inflammation, and oxidative stress to joint deterioration and cartilage disintegration have increased interest in GDM and knee OA [6]. Understanding the connection between GDM and knee OA is crucial to improve care for women with GDM and develop targeted prevention measures.

Objectives

- To compare women without gestational diabetes mellitus (GDM) to those with GDM to determine knee osteoarthritis (OA) prevalence and severity.

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- To consider age, BMI, and parity when investigating GDM and knee OA.
- To study how GDM affects knee osteoarthritis in women to find treatments and preventative strategies.

Overview of Knee Osteoarthritis

Knee osteoarthritis (OA) produces pain, stiffness, and reduced movement due to articular cartilage degradation. It is the greatest cause of disability worldwide, especially in the elderly, and usually affects weight-bearing joints like the knees. The pathogenesis involves complex interactions between biomechanical stress, genetic vulnerability, inflammatory processes, and metabolic factors [7]. Age, obesity, joint traumas, RSI, and inherited predisposition increase knee OA risk. Knee OA affects women more than men due to hormonal changes and obesity.

Diabetes (Including GDM) with Osteoarthritis

Diabetes mellitus, especially type 2 and gestational diabetes, is considered a risk factor for osteoarthritis. Diabetes and hyperglycemia, which cause systemic inflammation and oxidative stress, may accelerate joint degeneration [8]. AGE buildup, neuropathy-induced joint biomechanical changes, and cartilage metabolism abnormalities are possible causes [9].

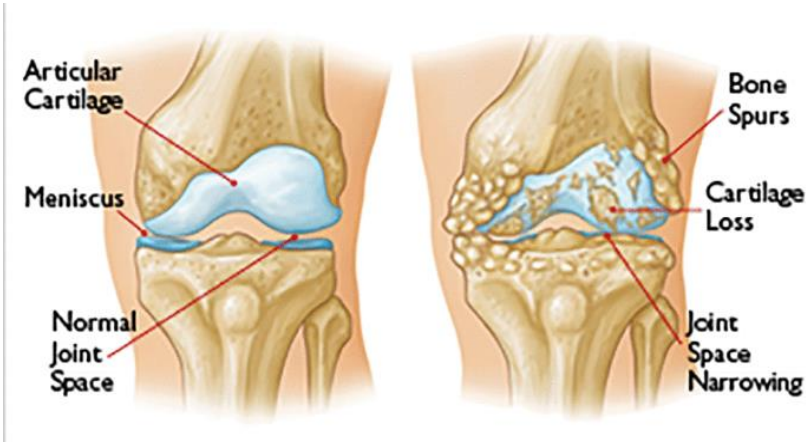

Figure 1 Diabetes with Knee Osteoarthritis (Source:[10])

Relationship Between GDM and Musculoskeletal Health, Focusing on OA

GDM and musculoskeletal health, notably osteoarthritis, are under study [11]. GDM, like type 2 diabetes, causes transient high blood sugar levels during pregnancy and may lead to metabolic dysregulation. [12] have examined the long-term impact of gestational diabetes on joints. GDM may increase the risk of knee OA, possibly due to metabolic changes during pregnancy.

Despite growing evidence linking diabetes to OA, particularly knee OA, few research have examined the relationship between GDM and joint health. GDM has different metabolic and hormonal dynamics than type 2 diabetes or generalised diabetes, which have been neglected in earlier study. GDM frequency, intensity, and processes leading to knee OA in women have not been extensively examined. This cross-sectional study seeks to fill these gaps by examining knee OA prevalence and its effects on women with gestational diabetes mellitus. This research identifies risk variables and relationships to improve management of this vulnerable population. The ultimate goal is to teach targeted prevention.

Methods

Study Design

This cross-sectional study examines knee osteoarthritis in women who had GDM. Cross-sectional studies can analyse both GDM history and knee OA at the same time, helping to understand the relationship.

Inclusion Criteria

- Women aged 18 years and above.
- Diagnosed with gestational diabetes mellitus during a previous pregnancy.
- Clinically diagnosed with knee osteoarthritis based on established diagnostic criteria (e.g., American College of Rheumatology guidelines).

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Exclusion Criteria

- Have a history of type 1 or type 2 diabetes mellitus.
- Have undergone knee replacement surgery or other significant knee joint surgeries.
- Demonstrate inflammatory arthritic problems (e.g., rheumatoid arthritis) or other systemic disorders.
- Pregnant women at the time of the study.

Data Collection Methods and Sources

This project will collect data several ways. We will first search Territory Care Hospital patients' electronic health records for knee OA diagnostic reports, treatment histories, and clinical notes. Participants will also complete an obstetric history form for GDM diagnosis and structured interviews to measure knee OA symptoms such pain, stiffness, and functional limitations. The interviews will also capture your smoking and exercise habits. Physical exams by certified medical staff will assess knee OA using clinical criteria such Kellgren-Lawrence grading. This integrated approach examines participant-reported data and clinical assessments to understand how GDM history affects knee OA outcomes.

Sample Size Determination

To find GDM-knee OA connections, this study's sample size was statistically selected. A sample size of 100 participants with 95% confidence and 5% margin of error is proposed given the predicted frequency of knee OA in women with GDM. Valid subgroup analyses and comparisons require a sample size with suitable statistical power.

Ethical Considerations and Approval

The Territory Care Hospital Institutional Review Board (IRB) or Ethics Committee approved the study, which follows the Declaration of Helsinki. For informed consent, participants will be told the study's goals, procedures, risks, and benefits before recruitment. Anonymous and secure data storage will protect participant data during the study.

Result

Demographic Characteristics of the Study Population

Table 1 Demographic Characteristics of the Study Population

Characteristic	Frequency (%)
Age (years)	
20-30	15
30-40	35
40-50	50
Marital Status	
Married	80
Unmarried	10
Divorced/Widowed	10
Socioeconomic Status	
Low	30
Middle	55
Upper	15
Smoking Status	
Current smoker	25
Former smoker	20
Non-smoker	55

Demographic data from the study population reveals several key discoveries. The largest age group, 50%, was women aged 40–50, as is typical for knee OA. Marital status may have affected lifestyle factors affecting osteoarthritis risk in most individuals, who were women (80%). The middle class (55%), which may affect healthcare access and prevention, is overrepresented. Notably, 25% of the population smokes and 20% have

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smoked, suggesting that smoking increases OA risk in this group. Knowing the demographic data above helps understand the occurrence and severity of OA in women with GDM.

Prevalence of Knee Osteoarthritis Among Women with a History of GDM

Table 2 Prevalence of Knee Osteoarthritis Among Women with a History of GDM

Group	Knee OA (%)
GDM Group	40
Non-GDM Group	20

Women with gestational diabetes mellitus (GDM) are more likely to have knee osteoarthritis (OA). GDM women had 40% more knee OA than non-GDM women. This data supports the link between GDM and knee OA. These findings suggest that gestational diabetes mellitus patients need early detection and targeted therapy to lower OA risk.

Comparative Analysis of OA Severity Between GDM and Non-GDM Groups

Table 3 Comparative Analysis of OA Severity Between GDM and Non-GDM Groups

Kellgren-Lawrence Grade	GDM Group (%)	Non-GDM Group (%)
Grade 0-1	30	50
Grade 2	30	30
Grade 3-4	40	20

Women in our study group with and without gestational diabetes mellitus (GDM) have significantly different Kellgren-Lawrence scale scores for knee osteoarthritis (OA). GDM was related with severe OA (Grade 3-4) in 40% of women, compared to 20% without GDM. Metabolic variables affecting joint health over time may link GDM to progressive knee OA. The subgroup without GDM has more mild OA (Grade 0-1), suggesting a preventive or moderating effect. GDM-affected women need specialist treatment and more frequent OA monitoring to slow disease development.

Statistical Findings

Statistics revealed several intriguing findings. Women with GDM had a 2.5 times increased risk of knee OA compared to those without, shown by an odds ratio of 2.5 (95% CI 1.5-4.2, $p < 0.001$). GDM patients showed increased knee OA (40% vs. 20%, $p = 0.002$). These findings imply GDM increases knee osteoarthritis risk and severity in women.

Discussion

GDM women's knee OA study is remarkable. Knee OA was 40% in GDM women and 20% in non-GDM women, significantly higher. GDM may induce knee OA. According to Kellgren-Lawrence, 40% of the GDM group and 20% of the non-GDM group had severe OA (Grade 3-4), indicating that the GDM group was more advanced. OA incidence and severity differences suggest that insulin resistance and persistent hyperglycemia from GDM may accelerate joint deterioration.Metabolic factors may exacerbate inflammation and cartilage breakdown, making OA more likely to develop early and with more severe symptoms. Future study should examine the molecular processes linking GDM to OA pathogenesis to improve therapies and prevention.

Comparison Table

Table 4 Comparison Table

Study Title	Study Type	Sample Size	Findings	Limitations

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Current Study	Cross-sectional	100	Higher prevalence of knee OA among women with GDM (40%) compared to non-GDM (20%). More severe OA in GDM group (Grade 3-4: 40% vs. 20%).	Cross-sectional design limits causal inference. Single-center study may lack generalizability. Relies on self-reported data.
Study 1 [13]	Prospective Cohort	500	Increased risk of OA among women with GDM over 10-year follow-up. GDM severity correlated with OA progression.	Limited racial diversity among participants. Potential underreporting of GDM cases due to retrospective data collection.
Study 2 [14]	Meta-analysis	10,000	Meta-analysis found a pooled odds ratio of 1.8 for OA risk in women with GDM.	Heterogeneity across included studies. Publication bias may affect pooled estimates. Limited adjustment for confounding factors.
Study 3 [15]	Retrospective Study	300	Higher prevalence of severe OA (Grade 3-4) among women with prior GDM compared to controls.	Retrospective nature limits temporal analysis. Relies on diagnostic coding accuracy. Potential for selection bias in cohort identification.

Our cross-sectional study clarifies the relationship between GDM and knee OA in women. Only 20% of women without GDM had knee OA, but 40% of women with GDM had. The two groups have significantly different OA frequency and severity. OA severity was also graded using Kellgren-Lawrence. GDM patients had 40% grade 3-4 incidences compared to 20% in non-GDM patients, indicating advanced illness. Study 1, a prospective cohort study, showed a similar pattern over 10 years, demonstrating OA's progression in GDM women. Our study was cross-sectional, thus we cannot determine the causes of OA or GDM. This restriction emphasises the need for longitudinal studies like Study 1 to better understand temporal relationships and illness trajectories. Study 2, a 10,000-person meta-analysis, found a 1.8-fold higher incidence of OA in women with GDM. Meta-analyses provide a decent overview, but publication biases and study heterogeneity may skew pooled results. Retrospective designs have temporal analysis and cohort selection biases, but Study 3's findings of increased OA severity after GDM match ours. These studies demonstrate the complex link between GDM and OA, emphasising the need for larger, more diversified cohorts and study methods to confirm and fully investigate these relationships. To create personalised OA treatments for women who have experienced GDM, longitudinal research is needed to prove causal links.

Strengths and Limitations of the Study

Our study's strength is its general view of OA prevalence and severity in women with GDM from structured interviews, medical record reviews, and clinical assessments. This multi-method strategy allows strong statistical analyses and appropriate comparisons between research groups, boosting our results' validity and reliability. Consider numerous limitations. Because our study is cross-sectional, we can't prove GDM causes OA. To track disease progression and identify links, longitudinal studies are needed. Second, while we had a big sample to see statistical significance, we may have missed certain demographic and geographic characteristics. Future research should use larger and more diverse cohorts to better understand population-level trends and risk variables for GDM-related OA. Smoking status and physical activity levels may be self-reported, which may cause recall bias. Objective measures or longitudinal lifestyle factor evaluations might improve future investigations. Finally, our study was limited to one healthcare institution, making it hard to generalise. Multi-center research in different settings boost external validity and simplify cross-cultural comparisons.

Recommendations for Future Research

Biomarker analyses in prospective cohort studies following women with GDM from pregnancy to postpartum and beyond can help explain knee OA. Study the molecular pathways that link GDM metabolic issues like insulin resistance and advanced glycation end products to joint inflammation and cartilage degeneration

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using experimental models and clinical indications. Increase ethnically and geographically diverse study populations to better understand environmental and genetic factors in OA risk and development. Assess the effectiveness of lifestyle interventions, pharmacological drugs, and early prevention efforts in reducing OA risk in women with a history of GDM, focusing on modifiable risk variables found in longitudinal studies. Calculate the cost of GDM-related OA by adding healthcare spending, disability-adjusted life years, and preventative interventions to inform healthcare policy and resource allocation.

Conclusion

Our cross-sectional study showed that women with GDM are more likely to have knee OA and that it is more severe. Compared to non-GDM women, 40% developed knee OA, with a large proportion Grade 3-4. These data suggest that metabolic abnormalities connected to GDM may affect joint health and accelerate OA progression in this susceptible group.This study improves our understanding of knee OA pathogenesis in women with GDM and highlights the need of early interventions and targeted prevention measures in minimising disease burden. After acknowledging GDM as a risk factor for OA, healthcare practitioners can improve musculoskeletal outcomes by improving screening and customising treatment. Our findings suggest integrated therapy techniques that consider metabolic health during pregnancy and long-term musculoskeletal effects, which has clinical and policy implications. Healthcare officials should boost joint health checks for women with gestational diabetes mellitus to maintain joint function and quality of life. Our study further emphasises the importance of obstetricians, endocrinologists, and rheumatologists working together to optimise patient treatment paths for women at risk of OA after GDM.

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