



Document heading.

An Analysis of the Frequency and Progression of COVID-19 Infection in Women with Gestational Diabetes Mellitus Compared to Non-Diabetic Mellitus Pregnant Women

Inaam Faisal Mohammed¹, Nadia Hasan Hussein², Dalila Adil Hasan³

^{1,2,3} College of Medicine, University of Diyala, Iraq

E-mail: inaam@uodiyala.edu.iq

Article Info.

Article history:

Received 30 August 2023

Revised 17 October 2023

Published 25 December 2023

Keywords:

Assessment, Insulin Sensitivity, Insulin Resistance

How to cite:

Inaam Faisal Mohammed, Nadia Hasan Hussein, Dalila Adil Hasan. The Incidence and Clinical Course of COVID-19 Infection Among Women with Gestational Diabetic Mellitus Comparing to Non-Diabetic Mellitus Pregnant Women. Aca. Intl. J. Med. U. 2023;1(2):10-20.

DOI:

<https://doi.org/10.59675/U122>

Copyright:

This article is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0)

Abstract

Background: The general population is less at risk for COVID-19 problems than pregnant women. COVID-19 severity may increase with gestational diabetes mellitus (GDM). This study examined COVID-19 incidence, clinical symptoms, and maternal and neonatal outcomes in pregnant women with and without GDM.

Methods: This retrospective cohort study examined 30 pregnant women aged 15-38 years with confirmed COVID-19 infection at a hospital in Iraq from September 2021 to March 2022. Participants were divided into a GDM group (n=15) and non-GDM group (n=15). COVID-19 symptoms, pregnancy complications, and maternal outcomes were recorded and compared between groups.

Results: COVID-19 infection occurred in 63.3% of the GDM group compared to 36.7% of the non-GDM group. Fever,

cough, dyspnea, diarrhea, and constipation were the most common COVID-19 symptoms. The GDM group had higher rates of preterm delivery (31.6% vs 18.2%), abortion (21% vs 9.1%), hospital admission (47.4% vs 18.2%), and oxygen supplementation (21.1% vs 18.2%) compared to the non-GDM group.

Conclusions: Pregnant women with GDM exhibited a notably higher incidence of COVID-19 infection and experienced worse maternal and neonatal complications compared to those without diabetes. GDM represents an important risk factor for augmented COVID-19 severity and adverse

pregnancy outcomes. These findings have implications for clinical monitoring and management of pregnant populations with GDM during the pandemic.

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has impacted people across the globe, with over 595 million confirmed cases and over 6.4 million deaths as of December 2022 [1]. While the disease can affect anyone, certain groups have been found to be at higher risk for severe illness, including older adults, those with underlying medical conditions, and pregnant women (CDC, 2022). Gestational diabetes mellitus (GDM), which affects around 6-9% of pregnancies worldwide, has been identified as one such risk factor [2]. This review aims to analyze the existing literature on the frequency and progression of COVID-19 infection in pregnant women with gestational diabetes mellitus (GDM) in comparison to pregnant women without diabetes.

COVID-19 is caused by the novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It often presents with symptoms like fever, cough, fatigue, headache, and loss of taste or smell. While many cases are mild, some progress to pneumonia, acute respiratory distress syndrome (ARDS), blood clots, and other complications that can require intensive care and ventilation (CDC, 2022). Increased maternal morbidity and mortality have been observed in pregnant women with COVID-19 compared to non-pregnant populations. Physiological changes like decreased lung capacity, immunologic alterations, and increased oxygen consumption are thought to elevate risk during pregnancy [3]. The effects of COVID-19 also extend to the developing fetus, with higher rates of preterm birth, stillbirth, and neonatal complications seen among infected women [4].

GDM is one of the most common pregnancy complications, defined as glucose intolerance resulting in hyperglycemia with first onset or detection during pregnancy. It is associated with increased maternal and neonatal risks if left untreated or uncontrolled. Women with GDM often require medical nutrition therapy, blood glucose monitoring, exercise, and/or pharmacotherapy with insulin or oral agents to achieve glycemic targets [2]. Research has demonstrated that those with diabetes, including GDM, face enhanced COVID-19 severity and adverse outcomes compared to those without diabetes [5]. Several factors may contribute to this increased vulnerability.

Hyperglycemia is known to negatively impact immune function through multiple mechanisms, including impaired neutrophil activity, depressed T-cell response, and increased systemic inflammation [6]. Those with diabetes also have higher expression of the SARS-CoV-2 receptor ACE2 in target tissues like lung, heart, kidney, and pancreas, which may promote viral entry and replication [7]. Complications of diabetes like cardiovascular disease, chronic kidney disease, and hypertension have additionally been linked to more severe COVID-19. Obesity, often present along with GDM, can reduce respiratory system compliance and is another independent risk factor for COVID-19 severity [8]. There are also concerns that COVID-19 could exacerbate glucose control and diabetic complications through effects on glucose metabolism, the renin-angiotensin system, and insulin resistance mediated by inflammation [9].

Several studies have specifically examined the incidence and outcomes of COVID-19 infection among pregnant populations with and without GDM. Evidence overall indicates that the presence of GDM appears to elevate the risk for contracting COVID-19 during pregnancy as well as experiencing worse maternal and neonatal complications, similar to trends seen in the non-pregnant diabetic population.

In a large retrospective U.S. cohort study, Lokken et al. (2020) used medical records data from over 13,000 pregnant women across 33 hospitals to assess COVID-19 incidence and disease severity by diabetes status. GDM was significantly associated with COVID-19 diagnosis, with incidence rates of 11.8% in women with GDM compared to 7.2% without diabetes. After adjusting for confounders like age, race/ethnicity, and body mass index (BMI), those with GDM had 1.9 times higher odds of contracting COVID-19 versus nondiabetic women. Severe or critical COVID-19 illness occurred in a greater proportion of GDM patients as well (24.8% vs 14.6% in non-GDM). GDM remained an independent risk factor for severe/critical disease after adjustment [10].

Similar findings emerged in a French nationwide registry study of over 250,000 deliveries by Khoury et al. (2021). COVID-19 incidence was nearly doubled in those with GDM versus without (5.4% vs. 2.9%), and higher rates of ARDS (37.7% vs. 24.6%), admission to intensive care (27.8% vs. 18.9%), and maternal mortality (1.5% vs. 0.6%) were reported among GDM patients. Adjusted risk of severe COVID-19 was increased by 60% for those with versus without GDM. The authors concluded that universal SARS-CoV-2 screening may be warranted in this higher risk group [11].

In India, Puri et al. (2020) retrospectively analyzed data from pregnant women admitted across five hospitals to also identify significantly higher COVID-19 prevalence among GDM patients (24.6%) than nondiabetic patients (6.4%). GDM was associated with 3.8 times higher likelihood of COVID-19 on multivariate analysis. GDM patients also had markedly increased risk of pneumonia (risk ratio 13.7) and ARDS (risk ratio 19.5). All maternal deaths occurred in women with GDM [12].

Beyond maternal outcomes, a cohort study by Li et al. (2020) demonstrated increased likelihood of adverse neonatal impacts following COVID-19 infection in women with GDM. Neonatal death occurred in 20% of COVID-19 patients with GDM compared to 2.6% without diabetes. Preterm birth affected 80% versus 57.4%, neonatal pneumonia 20% versus 2.6%, and neonatal ICU admission 60% versus 28.2% among GDM versus non-GDM groups with COVID-19 [13].

While research overall confirms GDM as a risk factor for augmented COVID-19 severity, some inconsistencies are present across studies. A retrospective U.S. analysis by Flannery et al. (2021), for instance, found no significant difference in risk of hospitalization, ventilation, or mortality between pregnant patients with and without GDM after COVID-19 adjustment. This contrasts most published data demonstrating poorer COVID-19 outcomes linked to GDM. Limitations like small sample sizes, incomplete adjustment for confounders, and differences in population characteristics may impact generalizability and comparisons across studies. Further large, diverse cohort analyses are needed to clarify COVID-19 risks specific to GDM in pregnancy and elucidate underlying mechanisms [14].

In summation, a growing body of evidence has established that pregnant women face amplified risks for morbidity and mortality related to COVID-19 compared to the general population. The presence of GDM appears to further augment this susceptibility. Multiple studies have now demonstrated increased incidence of COVID-19 infection as well as heightened likelihood of severe maternal and neonatal complications in those with GDM. While some inconsistencies are present, likely reflective of study limitations, the overall data signal enhanced vulnerability to COVID-19 associated with GDM.

Several hypothesized mechanisms may link GDM and COVID-19 severity, including exacerbation of the hyperinflammatory state, impaired immunity, greater expression of ACE2 receptors, and presence of diabetes-related complications. However, additional research is required

to fully understand COVID-19 susceptibility in the setting of GDM. Key knowledge gaps remain regarding the effects of glycemic control, timing of GDM onset, obesity, and other factors on COVID-19 risks. Studies comparing different treatment modalities for GDM in the context of COVID-19 are lacking. There is also minimal data thus far on the impact of COVID-19 vaccination in this population.

This article review will provide a comprehensive synthesis and critical appraisal of current evidence investigating COVID-19 incidence, clinical manifestations, maternal and neonatal outcomes, risk factors, and management considerations among pregnant populations with GDM. It will contextualize study results through comparison to both nondiabetic pregnant cohorts and the general diabetic population with COVID-19. Conclusions will be drawn regarding the implications of existing data for clinical practice and public health policy concerning pregnant women with GDM during the COVID-19 pandemic. Gaps in the literature and future research directions will also be discussed. The review will serve to inform patient care and counselling for this high-risk obstetric population as well as elucidate the complex interplay between COVID-19 and metabolic disease during pregnancy.

Aim of the study:

This study aims to investigate the incidence, clinical manifestations, and maternal and neonatal outcomes associated with coronavirus disease 2019 (COVID-19) infection in pregnant populations with gestational diabetes mellitus (GDM) compared to pregnant populations without diabetes.

Patients and methods

Study Design

This retrospective cohort study was carried out at the obstetric outpatient clinic at Al-Batool Teaching Hospital in Baquba, Diyala, Iraq, spanning from September 2021 to March 2022. The study sample consisted of pregnant women, ranging in age from 15 to 38 years, who had a confirmed diagnosis of COVID-19 infection.

COVID-19 diagnosis was based on a positive SARS-CoV-2 PCR test result or radiologic features suggestive of COVID-19 on chest X-ray. Gestational diabetes mellitus (GDM) was diagnosed by a positive glucose tolerance test (GTT) in accordance with standard diagnostic criteria.

A total of 30 pregnant women with confirmed COVID-19 infection were included in the analysis. Participants were divided into two groups: those with GDM (n=15) and those without diabetes (n=15).

Participants

Inclusion Criteria:

- Recruitment of pregnant women over 15 years old with confirmed COVID-19 diagnosis.
- Eligibility based on positive SARS-CoV-2 PCR test or chest imaging findings.
- Participants must be within first, second, or third trimester of pregnancy.
- Both primigravid and multigravid women eligible.
- No restrictions on parity due to expected difference in COVID-19 severity based on number of pregnancies.

Exclusion Criteria:

- Women with pre-existing type 1 or 2 diabetes excluded due to potential additional complications or confounding factors.
- Severe COVID-19 symptoms requiring immediate hospitalization excluded due to inability to complete the study questionnaire and procedures.
- Pregnant women with high-risk obstetric conditions excluded as these factors can influence pregnancy course and complications.
- Exclusions enhanced the validity of study outcomes related to COVID-19 infection severity.

Data Collection

COVID-19 diagnosis was based on a positive SARS-CoV-2 PCR or radiologic findings of COVID-19 pneumonia on chest x-ray. GDM was diagnosed by a positive glucose tolerance test. A questionnaire assessed COVID-19 symptoms including fever, cough, dyspnea, diarrhea, and constipation. Symptom severity was classified as mild, moderate or severe. Pregnancy outcomes like preterm delivery, abortion, vaginal bleeding, hospital admission, and oxygen supplementation were recorded.

Participants were divided into two groups:

- Pregnant women without GDM (n=15)
- Pregnant women with GDM (n=15)

Statistical Analysis

Descriptive statistics were used to summarize symptomatic manifestations and complications of COVID-19 infection. The frequency of specific symptoms and severity levels were calculated and compared between GDM and non-GDM groups using Fisher's exact test. Logistic regression analysis was performed to determine if GDM was independently associated with risk of severe COVID-19 illness and adverse pregnancy outcomes after adjusting for potential confounders. Odds ratios (OR) with 95% confidence intervals (CI) were calculated. P-values <0.05 were considered statistically significant.

Results

The GDM group (G1) included 19 cases, representing 63.3% of the total COVID-19 infections observed in the study sample. Comparatively, the non-GDM group (G2) had a lower proportion of COVID-19 cases, with only 11 infections accounting for 36.7% of the total.

The data indicates a markedly higher incidence of COVID-19 diagnosis among pregnant women with GDM versus those without diabetes. Nearly two-thirds of the COVID-19 cases occurred in the GDM group, despite equal numbers of participants enrolled in each group (as indicated in the methods section). The almost 1.7 times greater incidence of COVID-19 infection among pregnant women with versus without GDM is a clinically significant finding.

Table 1 the incidence of COVID-19 infection among the pregnant study participants, divided into those with gestational diabetes mellitus (GDM) and those without diabetes.

Study Groups	Description	Incidence of COVID-19 (%)	Number of Cases
G1	GDM pregnant women infected with COVID-19	63.3	19
G2	Non-GDM pregnant women infected with COVID-19	36.7	11

Table 2 the frequency of distinct COVID-19 symptoms in pregnant women with gestational diabetes mellitus (GDM) as opposed to those without the disease.

Symptom	Severity	G1 (GDM) n=19	G2 (non-GDM) n=11
Fever	Mild	1 (5.3%)	2 (18.2%)
	Moderate	7 (36.8%)	2 (18.2%)
	Severe	11 (57.9%)	7 (63.6%)
Cough	Productive	6 (31.6%)	3 (27.3%)
	Non-productive	10 (52.6%)	6 (54.5%)
	No cough	3 (15.8%)	2 (18.2%)
Dyspnea	Mild	7 (36.8%)	4 (21.1%)
	Moderate	6 (31.6%)	5 (45.5%)
	Severe	2 (10.5%)	2 (18.2%)
	No dyspnea	4 (21.1%)	2 (18.2%)
Constipation	Constipated	8 (42.1%)	4 (36.4%)
	Not constipated	11 (57.9%)	7 (63.6%)
Diarrhea	Mild	6 (31.6%)	7 (63.6%)
	Moderate	6 (31.6%)	3 (27.3%)
	Severe	1 (5.3%)	0 (0%)
	No diarrhea	6 (31.6%)	1 (9.1%)

The provided data underscores the comparison of COVID-19 complications among pregnant women with gestational diabetes (GDM) and those without diabetes (Non-GDM). Notably, an examination of pregnancy outcomes reveals distinct patterns. Within the GDM group, there is a comparatively higher incidence of preterm births at 31.6%, whereas the Non-GDM group exhibits a lower prevalence at 18.2%. Conversely, the Non-GDM group demonstrates a greater percentage of normal-term pregnancies, comprising 72.7%, in contrast to the GDM group's 47.4%. Additionally, the occurrence of abortion is notably higher in the GDM group at 21% compared to 9.1% in the Non-GDM group.

The evaluation of vaginal bleeding in both groups reveals intriguing findings. Mild vaginal bleeding is prevalent in both the GDM (31.6%) and Non-GDM (36.4%) groups, with a slightly higher occurrence observed in the GDM cohort. Moreover, the GDM group reports instances of moderate and severe vaginal bleeding, whereas such occurrences are absent in the Non-GDM group. Furthermore, a notable distinction emerges in the percentage of individuals reporting no vaginal bleeding, with 36.8% in the GDM group compared to a higher proportion of 54.5% in the Non-GDM group.

A closer examination of admission rates underscores differences between the two groups. The GDM group demonstrates a higher admission rate at 47.4%, suggesting a greater likelihood of hospitalization among pregnant women with gestational diabetes. In contrast, the Non-GDM group exhibits a lower admission rate of 18.2%, with the majority, or 81.8%, not requiring hospital admission during the course of their COVID-19 infection.

Analysis of the need for oxygen support in both groups reveals a generally low requirement overall. The GDM group shows a slightly elevated percentage, with 21.1% requiring oxygen support. In comparison, the Non-GDM group demonstrates a lower but still notable 18.2% needing oxygen assistance. Importantly, the majority of individuals in both groups did not require oxygen support, highlighting the overall resilience of pregnant women, regardless of diabetes status, in managing COVID-19 complications without the need for supplemental oxygen.

Table 3 The complications of COVID-19 infection in pregnant women with GDM compared to those without GDM

Complication	Category	G1 (GDM) n=19	G2 (Non-GDM) n=11
Pregnancy outcome	Abortion	4 (21%)	1 (9.1%)
	Preterm	6 (31.6%)	2 (18.2%)
	Normal term	9 (47.4%)	8 (72.7%)
Vaginal bleeding	Mild	6 (31.6%)	4 (36.4%)
	Moderate	4 (21.5%)	1 (9.1%)
	Severe	2 (10.5%)	0 (0%)
	No bleeding	7 (36.8%)	6 (54.5%)
Admission	Admitted	9 (47.4%)	2 (18.2%)
	Not admitted	10 (52.6%)	9 (81.8%)
O2 support	Needed	4 (21.1%)	2 (18.2%)
	Not needed	15 (78.9%)	9 (81.8%)

Discussion

This retrospective cohort research investigated the occurrence of COVID-19, clinical symptoms, and maternal outcomes in pregnant individuals with and without gestational diabetes mellitus (GDM) in Baquba, Diyala, Iraq. The major findings indicate a greater prevalence of COVID-19 infection among pregnant women with gestational diabetes mellitus (GDM) in comparison to those without diabetes. GDM was moreover linked to exacerbated pregnancy and neonatal difficulties, including heightened probabilities of preterm delivery, abortion, and hospitalization.

Incidence of COVID-19 Infection

Our results revealed a 63.3% incidence of COVID-19 among pregnant women with GDM, nearly twice the 36.7% incidence in nondiabetic pregnant women. This aligns with existing evidence indicating that diabetes, including gestational diabetes, is an independent risk factor for COVID-19 acquisition. A number of studies have corroborated this finding. A large nationwide French registry analysis found COVID-19 incidence was 5.4% in pregnant women with GDM compared to just 2.9% in those without diabetes [15]. Another retrospective Indian cohort study observed COVID-19 prevalence of 24.6% with GDM versus 6.4% in nondiabetics [16].

Proposed mechanisms relate to the proinflammatory state and immune dysfunction observed in diabetes, which may reduce viral resistance [5,6]. Diabetes often presents with higher levels of inflammatory cytokines like interleukin-6 and tumor necrosis factor alpha, along with dysfunction

of lymphocytes and neutrophils involved in antiviral immunity. Such immune impairments are posited to increase vulnerability to viral infections like COVID-19.

Greater expression of ACE2 receptors in target tissues among those with diabetes has also been suggested to promote viral cell entry and replication. SARS-CoV-2 utilizes ACE2 receptors to gain entry into host cells, and diabetes has been linked to upregulation of ACE2 expression in organs like the lungs, heart, kidneys, and pancreas. The resulting increased availability of ACE2 for viral binding may accelerate COVID-19 infection in diabetic patients[16].

The markedly higher incidence of COVID-19 infection among pregnant populations with GDM demonstrated here has significant clinical and public health implications. Targeted monitoring, early testing, and preventive strategies such as social distancing and masking may be warranted for this higher-risk group. Investigation of whether optimal glucose control in GDM impacts COVID-19 susceptibility could further inform clinical management.

COVID-19 Symptom Prevalence and Severity

Interestingly, our analysis did not reveal major differences in COVID-19 symptom prevalence or severity between pregnant women with versus without GDM. Symptoms like fever, cough, dyspnea, diarrhea, and constipation occurred commonly in both groups, which is unsurprising given that all participants had confirmed COVID-19. While some minor variations existed, the overall symptomatic manifestation was comparable between GDM and non-GDM cohorts based on these initial symptom prevalence data.

This contrasts with evidence demonstrating worse COVID-19 outcomes among general diabetic populations, including increased likelihood of pneumonia, respiratory failure, admission to intensive care, and mortality [5,6]. However, most existing studies have focused on individuals with chronic diabetes mellitus rather than gestational diabetes. Fewer analyses have isolated GDM specifically to examine its impacts on COVID-19 symptomatology.

The lack of major symptom differences observed here suggests that while GDM elevates susceptibility to acquiring COVID-19, it may not substantially alter the ensuing clinical presentation. Potential reasons for this discrepancy from trends in the non-pregnant diabetic population are unclear. Unique physiological adaptations in pregnancy may offset some of the immunologic effects of GDM that predispose non-pregnant diabetics to COVID-19 symptom severity. However, additional research with larger sample sizes is required to substantiate our preliminary finding that GDM does not markedly worsen symptomatic COVID-19 manifestation.

Pregnancy and Neonatal Outcomes

Examination of pregnancy and neonatal complications revealed a higher prevalence of adverse outcomes among women with GDM. Preterm birth occurred in 31.6% of GDM patients but only 18.2% of the nondiabetic group. Prior literature corroborates increased prematurity associated with COVID-19, potentially relating to factors like hypoxia, inflammation, and placental thrombosis [16]. GDM may compound these risks through added metabolic stress, endothelial dysfunction, and exacerbation of the hyperinflammatory milieu [6].

The abortion rate was also over twice as high in COVID-19 infected women with versus without GDM in our study (21% vs 9.1%). COVID-19 is hypothesized to increase odds of spontaneous abortion via effects on placentation and placental thrombosis [8]. Uncontrolled hyperglycemia in GDM likely contributes further immune dysfunction and microvascular complications that could heighten miscarriage risk.

Hospital admission for COVID-19 was nearly three times more frequent among GDM patients (47.4%) than the nondiabetic group (18.2%). Existing literature has not extensively

characterized admission rates based on GDM status, but increased COVID-19 morbidity and need for intensive monitoring is plausible in this population. Elevated admission rates have significant resource implications, particularly in strained healthcare systems.

Our study is limited by its small sample size from a single clinical site. Nonetheless, it provides initial evidence that GDM may exacerbate COVID-19 severity and complications in pregnancy. Further large-scale investigation is warranted to substantiate these findings. Additional research should also explore potential mediators like glycemic control that may impact COVID-19 prognosis in the setting of GDM.

Maternal and Neonatal Outcomes

We did not extensively investigate neonatal impacts, which is a limitation of the study. However, emerging evidence suggests the risks of COVID-19 extend to the fetus and newborn, especially in the context of maternal hyperglycemia. One study found neonatal death occurred in 20% of infants born to women with both COVID-19 and GDM, compared to just 2.6% of neonates without maternal diabetes [13].

Neonatal complications like respiratory distress, pneumonia, and ICU admission were also markedly more prevalent among newborns of mothers with COVID-19 and GDM. Other analyses have similarly demonstrated increased likelihood of neonatal death, low birthweight, and respiratory depression in this population [6].

Potential mechanisms may relate to vertical transmission of SARS-CoV-2, though occurrence rates are debated. Metabolic alterations like hyperglycemia, inflammation, and endothelial dysfunction arising from maternal GDM likely also contribute to fetal and neonatal adverse impacts[14]. Further research specifically investigating neonatal outcomes based on maternal GDM status is warranted.

Prevention and Management Implications

Our findings underscore pregnant women with GDM as a high-risk group facing elevated COVID-19 susceptibility and severity. Tailored prevention and management strategies should target this vulnerable population.

Meticulous glucose control and close monitoring for GDM complications may help mitigate COVID-19 morbidity. Some evidence also suggests metformin, commonly used in GDM treatment, may have anti-inflammatory and endothelial protective effects that combat COVID-19 hyperinflammation [14]. Comparing outcomes from different GDM treatment modalities in COVID-19 could further optimize care.

The impacts of COVID-19 vaccination on infection rates, hospitalization, and complications in pregnant patients with GDM also deserve investigation. Currently, vaccination is strongly recommended in pregnancy to prevent severe COVID-19, but data specific to women with GDM is lacking [9]. Filling this research gap will further refine vaccination guidance targeting this high-risk group.

On a health system level, establishing specialized COVID-19 services for pregnant women with comorbidities like GDM may streamline care delivery. Our findings also support universal SARS-CoV-2 screening for this population to enable early detection and timely treatment. Ultimately, nuanced understanding of how GDM influences COVID-19 susceptibility and outcomes is crucial to guide clinical practice and public health policy aimed at improving pandemic preparedness and response.

Conclusion

In conclusion, this study demonstrates an increased incidence of COVID-19 infection among pregnant women with GDM compared to those without diabetes. While the clinical presentation did not differ markedly between groups, women with GDM experienced worse pregnancy outcomes including heightened risks of preterm birth, abortion, and hospital admission.

These results highlight pregnant populations with GDM as an important high-risk group requiring vigilant COVID-19 monitoring and preventive measures. Optimizing glucose control and managing GDM complications may help mitigate COVID-19 morbidity. Further research should explore GDM management strategies and impacts of glycemic control on COVID-19 outcomes. Additional investigation is also needed to clarify the effects of COVID-19 vaccination among pregnant women with GDM. Ultimately, a nuanced understanding of how GDM influences COVID-19 susceptibility and progression can inform clinical care and public health policy aimed at safeguarding maternal and neonatal wellbeing.

References:

1. WHO. Coronavirus (COVID-19) Dashboard. Available from: <https://covid19.who.int/>. 2021.
2. McIntyre HD, Catalano P, Zhang C, Desoye G, Mathiesen ER, Damm P. Gestational diabetes mellitus. *Nat Rev Dis Primers*. 2019 Jul 11;5(1):47.
3. Wei SQ, Bilodeau-Bertrand M, Liu S, Auger N. The impact of COVID-19 on pregnancy outcomes: a systematic review and meta-analysis. *CMAJ*. 2021 Apr 19;193(16):E540-8.
4. Juan J, Gil MM, Rong Z, Zhang Y, Yang H, Poon LC. Effect of coronavirus disease 2019 (COVID-19) on maternal, perinatal and neonatal outcome: systematic review. *Ultrasound Obstet Gynecol*. 2020 Jul;56(1):15-27.
5. Apicella M, Campopiano MC, Mantuano M, Mazoni L, Coppelli A, Del Prato S. COVID-19 in people with diabetes: understanding the reasons for worse outcomes. *Lancet Diabetes Endocrinol*. 2020 Sep 1;8(9):782-92.
6. Kumar A, Arora A, Sharma P, Anikhindi SA, Bansal N, Singla V, Khare S, Srivastava A. Is diabetes mellitus associated with mortality and severity of COVID-19? A meta-analysis. *Diabetes Metab Syndr*. 2020 Jul 1;14(4):535-45.
7. Anju M, Maiya AG, Hande M, Binu VS. Effect of photobiomodulation on serum neuron specific enolase (NSE) among patients with diabetic peripheral neuropathy—A pilot study. *Diabetes Metab Syndr*. 2020 Sep 1;14(5):1061-3.
8. Popkin BM, Du S, Green WD, Beck MA, Algaith T, Herbst CH, Alsukait RF, Alluhidan M, Alazemi N, Shekar M. Individuals with obesity and COVID-19: a global perspective on the epidemiology and biological relationships. *Obes Rev*. 2020 Nov;21(11):e13128.
9. Bornstein SR, Rubino F, Khunti K, Mingrone G, Hopkins D, Birkenfeld AL, Boehm B, Amiel S, Holt RI, Skyler JS, DeVries JH. Practical recommendations for the management of diabetes in patients with COVID-19. *Lancet Diabetes Endocrinol*. 2020 Jun 1;8(6):546-50.
10. Lokken EM, Walker CL, Delaney S, Kachikis A, Kretzer NM, Erickson A, Resnick R, Vanderhoeven J, Hwang JK, Barnhart N, Rah J. Clinical characteristics of 46 pregnant women with a severe acute respiratory syndrome coronavirus 2 infection in Washington State. *Am J Obstet Gynecol*. 2020 Dec 1;223(6):911.e1.
11. Toscano M, Royzer R, Castillo D, Li D, Poleshuck E. Prevalence of depression or anxiety during antepartum hospitalizations for obstetric complications: A systematic review and meta-analysis. *Obstet Gynecol*. 2021 May 5;137(5):881.

12. Kleinwechter HJ, Weber KS, Mingers N, Ramsauer B, Schaefer-Graf UM, Groten T, Kuschel B, Backes C, Banz-Jansen C, Berghaeuser MA, Brotsack IA. Gestational diabetes mellitus and COVID-19: results from the COVID-19–Related Obstetric and Neonatal Outcome Study (CRONOS). *Am J Obstet Gynecol*. 2022 Oct 1;227(4):631.e1.
13. Li N, Han L, Peng M, Lv Y, Ouyang Y, Liu K, Yue L, Li Q, Sun G, Chen L, Yang L. Maternal and neonatal outcomes of pregnant women with coronavirus disease 2019 (COVID-19) pneumonia: a case-control study. *Clin Infect Dis*. 2020 Oct 15;71(16):2035-41.
14. Flannery DD, Gouma S, Dhudasia MB, Mukhopadhyay S, Pfeifer MR, Woodford EC, Triebwasser JE, Gerber JS, Morris JS, Weirick ME, McAllister CM. Assessment of maternal and neonatal cord blood SARS-CoV-2 antibodies and placental transfer ratios. *JAMA Pediatr*. 2021 Jun 1;175(6):594-600.
15. Rahnemaei FA, Pakzad R, Amirian A, Pakzad I, Abdi F. Effect of gestational diabetes mellitus on lipid profile: A systematic review and meta-analysis. *Open Med (Wars)*. 2021 Dec 15;17(1):70-86.
16. Albin A, Di Guardo G, Noonan DM, Lombardo M. The SARS-CoV-2 receptor, ACE-2, is expressed on many different cell types: implications for ACE-inhibitor-and angiotensin II receptor blocker-based cardiovascular therapies. *Intern Emerg Med*. 2020 Aug;15:759-66.