Incidence of gestational diabetes mellitus before and after the Covid-19 lockdown: A retrospective cohort study

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Abstract

Aim: To evaluate whether the first Covid-19 lockdown for Italian citizens (March to July 2021) might have altered the incidence of gestational diabetes mellitus (GDM).

Methods: A retrospective single-center study in a tertiary referral center. Primary outcome was the incidence of GDM among pregnant women. GDM incidence, from June 11, 2019 to December 4, 2020, was compared by dividing the study time as follows: from the beginning of the study to before Covid-19 lockdown (from June 11, 2019, to March 9, 2020) and lockdown period (from March 10, 2020, to December 4, 2020). GDM was diagnosed with a 75-g, 2-h oral glucose tolerance test (OGTT) at 24–28 gestational weeks.

Results: Concerning 1295 women, GDM incidence increased during the lockdown period (9.3% vs. 3.4%, $p < 0.001$). Higher pregnancy weight gain with an increased body mass index (BMI) at the delivery was reported during the lockdown (31.3 vs. 28.4 kg/m^2, $p = 0.02$ and mean weight gain of 9.3 vs. 6.6 kg, $p = 0.007$). There was no difference in other comorbidity incidence and OGTT values between the two groups.

Conclusions: Pregnant women during the Covid-19 lockdown might have experienced higher BMI and pregnancy weight gain with increased GDM diagnoses. This may be related to physical limitations and emotional distress experienced during the lockdown. However, evidence is limited due to restricted study duration and random variations of outcomes across time. More studies are needed to understand the dietary patterns and the physical activity changes during the Covid-19 lockdown and its impact on fetal outcomes.

Key words: Covid-19, diabetes gestational mellitus, gestational diabetes, lockdown, pregnancy, pregnancy outcomes, SARS-CoV-2.

Introduction

Gestational diabetes mellitus (GDM) is a common disease that typically affects around 5.8% (1.8–22.3%) in European pregnancy.[1] GDM is described as glucose intolerance resulting in hyperglycemia that was diagnosed for the first time during the pregnancy.[2–4] At present, screening for GDM is principally based on the risk factor approach evaluation.[5] The gold standard screening is based on a 75-g oral glucose tolerance test (OGTT) between 24 and 28 weeks of gestation. However, high-risk pregnancies, particularly with a prior GDM pregnancy history, are tested early, between 16 and 18 weeks. A positive screening result if a single OGTT value is over the cut-off. The multicentric trial Hyperglycemia and Adverse

Pregnancy Events (HAPO) tested the OGTT validity.[6] Other research described a direct relationship between maternal glucose levels and fetal macrosomia.[7–9] Fetal macrosomia is correlated to more induction of labor rate and an improved risk of intrapartum traumatic lesions and asphyxia.[10–12] Having satisfactory blood glucose levels in GDM reduces maternal and fetal morbidity and reduces the antenatal cardiotocography need.[13–15] It has been reported that diabetes control was not satisfactory during the Covid-19 pandemic lockdown.[16] Kirchengast and Hartmann analyzed the lockdown period (March to July 2021) in Austria and noted a higher gestational weight gain during the lockdown months but did not investigate the GDM incidence.[17] Different studies explored the Covid-19 disease impact on pregnancy and remarked the association with increased risks of preeclampsia, preterm birth, and other adverse pregnancy outcomes,[18–21] but more data are needed to understand the changes that the lockdown restrictions might have had on pregnancy and obstetric care. The Italian lockdown began in March and ended in June 2020, with critical impacts on social life and physical activity.[22,23] Therefore, we decided to examine the GDM incidence in our institution before and after the Covid-19 lockdown periods.

Methods

This was a retrospective single-center study performed in a tertiary-care referral center of the University of Campania "Luigi Vanvitelli," Naples, Italy. Between June 2019 and December 2020, consecutive patients with a singleton low-risk pregnancy were followed from the first obstetrical examination (6–9 gestational weeks) to term delivery. Term delivery was defined as a vaginal or cesarean delivery at a gestational age of at least 37 weeks, dated by a woman's last menstrual period and confirmed during first trimester ultrasound screening. Women were subdivided in two cohorts based on two-time intervals as follows: before the Covid-19 lockdown (from June 11, 2019 to March 9, 2020) and during or after the lockdown period (from March 10, 2020 to December, 42 020).

During the lockdown period, the universal testing for SARS-CoV-2 was performed on all women hospitalized in the study site maternity department. Women with pregestational type I or II diabetes, patients affected by Covid-19 as well as women with other pathologies that could impact the physiological puerperium or postnatal adaptation were excluded.

Concerning the number of patients needed to assess the primary outcome, according to available literature, assuming two unbalanced groups, a sample size of 656 patients achieves 95% of the power with a significance level of 5% to detect a minimum difference of 10% of the anticipated GDM incidence between the two cohorts.

Maternal demographic characteristics, clinical, obstetric, and surgical history, labor and delivery data with neonatal anthropometrical and clinical features were abstracted from patients' charts and evaluated by three researchers (Giuliana Narciso, Ligia Gliubizzi, and Irene Iavarone).

Co-primary outcomes were the incidence of GDM, body-mass index (BMI) at the delivery, and mean weight gain.

The GDM diagnosis was made in accordance with previously published criteria and in line with national guidelines.[24–26] GDM is usually diagnosed following the screening made with the one-step procedure with a 75-g, 2-h oral glucose tolerance test (OGTT).[4] The 75-g, 2-h OGTT was administered at 16–18 weeks' gestation in high-risk GDM pregnancies (previous GDM, first-trimester fasting glucose 100–125 mg/dL, BMI ≥ 30 kg/m^2), while OGTT was recommended at 24–28 weeks' gestation for the pregnant with a risk factor (maternal age $\geq$ 35 years, BMI ≥ 25 kg/m^2, prior fetal macrosomia, prior GDM with a negative screening at 16–18 weeks, first degree relative with T2DM, high-risk ethnicity). GDM was diagnosed when a single OGTT value reached or exceeded the normal cut-off (fasting value, 92 mg/dL; 1-h value, 180 mg/dL; or 2-h value, 153 mg/dL). BMI was measured for each patient during the hospitalization for labor. It was calculated using the standardized formula (weight/height^2) and categorized as normal weight (18.50–24.99), overweight (25.00–29.99), and obese if ≥ 30 kg/m^2 (according to the World Health Organization criteria). Weight was measured using an electronic scale while an adult stadiometer was used for evaluating the patient's height. Mean weight gain (kg) was evaluated as the difference between the weight measured at first obstetric examination (6–9 weeks of gestation) and weight measured during the hospitalization for labor.

Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) v. 20.0 (IBM Inc.,

TABLE 1 Comparison of maternal and pregnancy characteristics between the prepandemic period and lockdown period

Maternal characteristics	Prepandemic period ($n = 696$)	Lockdown period ($n = 599$)	p-Value
Age, mean (95% CI), years	36.3 (34.6–38.0)	34.5 (33.2–35.9)	0.10
BMI, mean (95% CI), kg/cm^2	28.4 (26.4–30.5)	31.3 (29.9–32.8)	0.02*
Pregestational weight, median (IQR), kg	66.8 (60.8–72.7)	73.0 (68.4–77.6)	0.09
Weight gain during pregnancy, mean (95% CI), kg	6.6 (5.0–8.2)	9.3 (8.0–10.7)	0.007*
Nulliparity, no. (%)	13 (54.2)	34 (60.7)	0.58
Gestational age, median (IQR), weeks	38.2 (37.1–39.0)	38.6 (38.2–39.0)	0.22
Race/ethnicity, no. (%)			
White	13 (54.2)	36 (64.3)	0.39
Afro-Carribean	2 (8.3)	2 (3.6)	0.37
Asian	7 (29.2)	13 (23.2)	0.57
Mixed race	2 (8.3)	5 (8.9)	0.93
Conception			
Assisted reproduction	3 (12.5)	2 (3.6)	0.13
Spontaneous	21 (87.5)	54 (96.4)	0.13
GDM incidence	24 (3.4)	56 (9.3)	<0.001*

Abbreviations: BMI, body mass index; CI: confidence interval; GDM, gestational diabetes mellitus. and *$p < 0.05$.

TABLE 2 Comparison of the maternal comorbidities between prepandemic period and lockdown period

Outcomes	Prepandemic period	Pandemic period total	p-Value
Comorbidities, no. (%)			
PROM	2 (8.2)	8 (14.3)	0.46
P-PROM	1 (4.2)	3 (5.4)	0.82
Pregestational diabetes	0 (0.0)	2 (3.6)	0.35
Gestational hypertension	2 (8.3)	8 (14.3)	0.46
Preeclampsia	0 (0.0)	0 (0.0)	
Multiple pregnancy	0 (0.0)	0 (0.0)	
Stillbirths	0 (0.0)	0 (0.0)	
Fetal growth restriction	2 (8.2)	1 (1.8)	0.16
Smoking in pregnancy	2 (8.3)	6 (10.7)	0.74

Abbreviations: PROM, premature rupture of membranes; P-PROM, preterm premature rupture of membranes.

Armonk, NY, USA). Data were shown as median with 95% confidence intervals (CI) or number (percentage). In addition, a chi-square test was conducted for categorical variables and t test for comparison of means of the two groups. All the analyses were performed using a two-sided model, considering a normal distribution as appropriate. Multiple logistic regression was performed to identify factors that were associated with the incidence of the primary outcome of interest. p-Value less than 0.05 was considered statistically significant.

Ethics statement

Ethical approval was waived by the Institutional Review Board (IRB) since the study was classified as a hospital audit of current clinical practice. We carried our research according to the Helsinki Declaration of 1975.

All the pregnant women signed a written informed consent before undergoing any study-specific procedure.

Privacy of the participants of this research was maintained for all the study period. Written informed consent to publication was signed by every woman of this study.

Results

There were a total of 1295 women and subsequent singleton births during the study period divided as follows: 696 in the prepandemic period and 599 in the lockdown period. There were no significant differences in maternal characteristics, including age, pregestational weight, nulliparity, delivery gestational age, ethnicity, and mode of conception (Table 1). The incidence of GDM was significantly higher during the

TABLE 3 Comparison of the maternal OGTT values between prepandemic period and lockdown period

	Prepandemic period	Pandemic period	p-Value
OGTT, value. mean (95% CI)			
0′	102.1 (88.5–115.7)	90.7 (87.0–94.5)	0.23
60′	178.2 (145.8–210.7)	181.6 (168.5–194.6)	0.82
120′	151.7 (126.5–176.9)	147.1 (132.3–162.0)	0.28

Abbreviation: OGTT, 75-g oral glucose tolerance test;

TABLE 4 Multivariate analysis of factors related to increased number of gestational diabetes mellitus diagnosis

Variables	Prepandemic period HR (95% CI)	p-Value	Pandemic period HR (95% CI)	p-Value
BMI				
>25 kg/m^2	1.54 (1.03–1.86)	0.04	1.85 (1.11–2.36)	0.03
Pregnancy weight gain				
>9 kg	1.77 (1.21–2.04)	0.03	1.91 (1.20–2.47)	0.03

Abbreviations: BMI: body-mass index; CI: confidence interval; HR: hazard ratio.

lockdown period (56/599, 9.3% vs. 24/696, 3.4%, $p =$ <0.0001) than before the pandemic (Table 1). The BMI at the delivery was significantly higher during the lockdown period (31.3 kg/m^2, 95% CI, 29.9–32.8) than in the prepandemic period (28.4 kg/m^2, 95% CI, 26.4–30.5, $p =$ 0.02, Table 1). In addition, the mean weight gain during the pregnancy was significantly higher during the lockdown period (9.3 kg [95% CI 8.0–10.7] vs. 6.6 kg [95% CI 5.0–8.2], $p =$ 0.007, Table 1). There were no differences regarding the maternal comorbidities between the two groups (Table 2). In addition, we evaluated the OGTT values between the two groups. There were no significant differences between women who delivered before and during the lockdown period at 0 (102.1 mg/dL [95% CI, 88.5–115.7 mg/dL] vs 90.7 [87.0–94.5], $p =$ 0.23), 60 (178.2 mg/dL [95% CI, 145.8–210.7 mg/dL] vs. 181.6 mg/dL [95% CI, 168.5–194.6 mg/dL], $p =$ 0.829), and 120 min (151.7 mg/dL [95% CI, 126.5–176.9 mg/dL] vs. 147.1 mg/dL [95% CI, 132.3–162.0 mg/dL], $p =$ 0.28) (Table 3). Moreover, multivariate variable analysis showed that BMI over 25 kg/m^2 and a pregnancy weight gain over 9 kg were factors associated with GDM incidence both in the prepandemic and pandemic periods (Table 4).

Discussion

This study showed a plausible increased rate of GDM diagnosis in the time interval concerning the Covid-19 lockdown and subsequent months. The Italian national policy to restrict the Covid-19 infection was rigorous, and outdoor physical activity was strictly limited.[27] The increased pregnancy weight gain during the lockdown period has resulted in a higher BMI at the delivery.[28] These two findings may be related to the increased rate of GDM (Table 4).[29] Other possible explanations include the change in women's physical activity due to lockdown conditions.[30] Many researchers analyzed the Covid-19 lockdown effect on the dietary patterns and physical activity in non-pregnant women affected by type 2 diabetes mellitus. Ruiz-Roso et al. showed an increase in sugary food and snack consumption associated with a high rate of physical inactivity during the Covid-19 lockdown.[31] In another Indian study, type 2 diabetes mellitus patients had an HBA1c level higher during the lockdown period.[32] Additional studies evaluated lockdown's negative impacts on the glucose regulation for GDM and type 2 diabetes mellitus.[33–35] Ghesquière et al. investigated the glycemic balance in GDM patients by practicing capillary blood sugar tests, and the authors noted a lower diabetes control during the Covid-19 pandemic lockdown.[16] An Indian review about the pandemic effects observed how the travel restriction had caused an increase in snack and meal frequency, correlated with reduced physical activity.[36] Justman et al. evidenced a significant reduction of routine obstetric screenings during the pandemic time.[37] At the same time, another study examined the lockdown impact on the depression rate during the postpartum period.[38] Limitations of this research include its retrospective nature, single-center setting, short-time frame (18 months), and partial population agreement to the GDM screening (based on the risk

factors presence/absence). Several studies evidenced the link between weight gain, diabetes, and lockdown for nonpregnant patients. Pellegrini et al. underlined changes in weight and nutritional habits in obese adults, and additional studies explored the lockdown consequences on the psychological sphere.[39–41] Nonetheless, literature data on GDM susceptivity due to Covid-19 lockdown is still lacking, and our study represents a first approach to evaluate such issue.

However, this study shows several limitations that should be considered. First, the study duration, although reporting the outcomes related to a specific time interval (the first Italian lockdown for Covid-19), is limited to 18 months only, and the differences in weight gain and GDM incidence could be influenced by random variation of evaluated data across time. Second, it is evident that GDM diagnosis has increased in the past 20 years due to a more accurate screening of pregnant women.[1] Moreover, an increasing trend of weight gain and obesity has been observed for the European population. For this reason, the results of this study might also be interfered multiple confounders (higher maternal BMI, increased maternal age, and increased number of GDM diagnoses).[2] An additional limitation is the impossibility to compare the GDM incidence in the lockdown period to the same time interval for the previous year due to the unavailability of data regarding the incidence of GDM before April 2019 in our institution. Moreover, as a retrospective analysis of medical charts, the common limitations related to the study design should be acknowledged, including the possibility of selection and misclassification biases, as well as the inferior level of evidence when compared to prospective or randomized studies, which may affect external and internal validity of the findings.

In conclusion, a plausible increased incidence of GDM together with a higher weight gain was found in pregnant women during Covid-19 lockdown rather than before. However, due to the limitations of the study methodology, additional research is needed to understand the relationship between dietary patterns, physical activity changes, and GDM onset due to Covid-19 lockdown restrictions.

Conflict of interest

The authors declare that they have no competing interests.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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