ORIGINAL ARTICLE

Risk for probable post-partum depression among women during the COVID-19 pandemic

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Abstract

The aim of the current study was to assess the risk for post-partum depression among women delivering during the COVID-19 pandemic as compared to the risk among women delivering before the COVID-19 pandemic. A cohort study was performed among women delivering singletons at term which were recruited in the maternity wards of the Soroka University Medical Center. Recruitment was done during the COVID-19 strict isolation period (March 18 and April 29, 2020). Women delivering during the COVID-19 pandemic completed the Edinburgh Postnatal Depression Scale (EPDS), and the results were compared to women delivering at the same medical center before the COVID-19 pandemic. Multivariable logistic regression models were constructed to control for potential confounders. A total of 223 women who delivered during the COVID-19 strict isolation period were recruited. Women delivering during the COVID-19 pandemic had *lower* risk of having a high (> 10) or very high (≥ 13) EPDS score as compared with women delivering before the COVID-19 pandemic (16.7% vs 31.3%, $p = 0.002$, and 6.8% vs 15.2%, $p = 0.014$, for EPDS ≥ 10 and EPDS ≥ 13, respectively). These results remained similar in the multivariable logistic regression models, for both EPDS score ≥ 10 and EPDS score ≥ 13, while controlling for maternal age, ethnicity, marital status, and adverse pregnancy outcomes (adjusted OR 0.4, 95% CI 0.23–0.70, $p = 0.001$ and adjusted OR 0.3, 95% CI 0.15–0.74, $p = 0.007$ for EPDS score > 10 and > 13, respectively). In our population, delivering during the COVID-19 pandemic was independently associated with *lower* risk of post-partum depression.

Keywords COVID-19 · Depression · EPDS · Post-partum

Introduction

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first recognized in December 2019 in Wuhan, the capital of China's Hubei province [https://covid19.who.int/region/euro/country/il; https://www.gov.il/en/departments/news/?OfficeId=104cb0f4-d65a-4692-b590-94af928c19c0&skip=0&limit=10; https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200121-sitrep-1-2019-ncov.pdf?sfvrsn=20a99c10_4]. The disease has since spread worldwide, resulting in the ongoing coronavirus pandemic (Borges do Nascimento et al. 2020). In January 2020, it was recognized by the World Health Organization (WHO) as a major public health concern. As a result of this expeditious epidemic, governments and public health authorities urgently needed guidance and actionable information on effective public health interventions in order to protect the public health.

A sudden outbreak of a disease may pose threat to the mental health of affected people (Maunder et al. 2003).Previous epidemiological studies that assessed mental health among the survivors of the 2003 SARS epidemic have found higher rates of depression, anxiety, panic attack, psychomotor excitement, psychotic symptoms, delirium, and even suicidal tendency among the survivors (Maunder et al. 2003). Unavailability of a vaccine, unpredictability of the situation, and quarantine for indefinite period of time have all been associated with

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stressful feelings, which have been found to increase common mental health problems such as anxiety and depression (Dar et al. 2017). Moreover, the overflow of information about the COVID-19 epidemic on social media also triggers anxiety that may lead to extreme behavior and even suicidal ideations (Goyal et al. 2020).

To date, little has been published regarding mental health problems due to outbreak of COVID-19 and mass isolation. A Chinese study has recently assessed the mental health status of Chinese people from Hubei province during the COVID-19 pandemic. The study demonstrated higher rates of anxiety, depression, and alcohol consumption among the people of Hubei province during the COVID-19 pandemic (Ahmed et al. 2020). A cross-sectional study demonstrated that people with suspected COVID-19 symptoms had higher risk for depression and lower health-related quality of life (Nguyen et al. 2020). Another cross-sectional study, which assessed the risk for depression among pregnant women hospitalized during the COVID-19 pandemic, demonstrated that women hospitalized at the high-risk pregnancy unit during the COVID-19 strict isolation period were not at increased risk for depression, as compared to women hospitalized before the COVID-19 pandemic (Sade et al. 2020). One particular group that might be negatively affected by the pandemic is pregnant women and women during the post-partum period, since stress and anxiety are also thought to have a significant effect on pregnancy outcomes (Baibazarova et al. 2013; Avraham et al. 2020). Nevertheless, scarce data exist regarding maternal post-partum depression and anxiety during the COVID-19 pandemic.

Pregnancy and the post-partum period are susceptible times for onset or relapse of mental illness, with depression and anxiety being the most common psychiatric disorders during these periods (Pavlov et al. 2014; Hermon et al. 2019). The estimated prevalence of post-partum unipolar major depression varies widely, depending upon the population studied, whether post-partum depression was assessed in the community or in clinical settings and whether depression was identified through self-report measures or clinical interviews (Norhayati et al. 2015). Although debatable, accumulating data suggest depressive symptoms have a profound negative impact on pregnancy and post-partum period (Yedid Sion et al. 2016; Howard et al. 2014).

With little existing published data, specifically focusing on post-partum depression among women delivering during the COVID-19 pandemic, and in light of its potential adverse effect on both the mother and the infant, we aimed to assess the incidence of increased risk for post-partum depression in women delivering during the COVID-19 pandemic as compared with the incidence of increased risk for post-partum depression among women delivering before the COVID-19 pandemic.

Materials and methods

COVID-19 in Israel

The first Israeli cases of coronavirus were diagnosed on February 21st among local citizens in contact with tourists from western Pacific and returning travelers. According to the WHO report from May 12, 16,526 cases have been diagnosed in Israel since then. In late February, aiming to minimize person-to-person transmission, the Israeli Ministry of health has recommended that all citizens returning from eastern countries stay quarantined for 14 days following their return. These recommendations have since been extended, to comprise all citizens returning from abroad. Since March 12th, the early childhood, school systems, and higher education programs have closed down, and since then, public transportation and social isolation have progressively been restricted. These early restrictions resulted in low rates of exposure and very low rates of mortality through COVID 19. Since March 2020, the Israeli Ministry of health has been using satellite information and cellular phone location, to identify people that should be quarantined due to being in close proximity with diagnosed cases. These people received automated text messages informing them to monitor themselves for possible symptoms, to stay quarantined, and to contact a health care provider in case any symptoms occur.

Population and setting

Eligible women were healthy women who had been confined during lockdown, with a singleton pregnancy, who delivered a healthy baby at term (more than 37 gestational weeks), at the maternity ward of the Soroka University Medical Center (SUMC), the sole medical center in the southern part of Israel (the Negev region). In the Negev, reside two societies, Jewish and Bedouin Arabs, which have different cultural and sociodemographic characteristics. The Bedouin minority is a Muslim community, which suffers from an indigent economic base. The Bedouins are generally abiding in small towns scattered throughout the desert; however, a transition to a more urbanized way of living has been seen in the past two decades. The Bedouin tradition attributes great importance to familial and tribal cohesiveness and to fertility. Consanguineous marriages are common (approximately 40% of all marriages are between first cousins and another 20% between more remote family relatives). Like all Israeli citizens, Bedouins are covered by National Health Insurance and receive maternal and child preventive services, including prenatal and postnatal care (Abu-Ganem et al. 2012; Sheiner et al. 1998). Recruitment and data collection were done during the COVID-19 strict isolation period, between March 18 and April 29, 2020. Women who delivered between November 2016 and April 2017, before the COVID 19 pandemic, served as the comparison group. SUMC, located in southern Israel, is the largest country birth center, with > 17,000 births a

year in recent years. The study was approved by the SUMC IRB Committee (IRB approval # 0079-20-SOR).

Study design

A cohort study was performed. Women delivering during the COVID-19 pandemic were compared to historic unexposed group delivering singletons at term, at the same medical center, before the COVID-19 pandemic (Mazor et al. 2019). Each woman was recruited and participated at a single time point (fixed estimate of time). Women were approached by the research team on day 2 post-partum and were invited to participate, following an oral and written explanation on the study course and purpose. Eligible women were asked to complete the Edinburgh Postnatal Depression Scale (EPDS) questionnaire. Every day during the time frame of the study, the research team handed out self-reported questionnaires to all women who met the inclusion criteria. All hospitalized women were approached. Each woman from both the exposed and the comparison group answered questions regarding her socioeconomic state, obstetrical history, current pregnancy course, and completed the EPDS questionnaire during hospitalization at the maternity ward. This screening test, established by Cox et al. in 1987 (Cox et al. 1987), was developed for diagnosing pregnant and post-partum women who are at high risk for depression. This questionnaire is widely used based on the American College of Obstetrics and Gynecology (ACOG) recommendations (Committee Opinion No 2018).The questionnaire consists of 10 self-completed questions regarding mood in the past week. The scores in each question are summed, and a final score of < 10 is defined as low risk for depression. A score of ≥ 10 defines a person at risk for depression and a score of ≥ 13 defines a person at higher risk for depression (Cox et al. 1987). Positive suicidal ideation was defined as any positive answer to question number 10 ("The thought of harming myself has occurred to me") in the EDPS questionnaire. Background variables assessed included maternal demographic and pregnancy data, as well as delivery course and immediate outcome. Data were collected in a cross-sectional format.

Statistical analysis

Statistical analysis was performed using SPSS version 23.0. Comparison of continuous variables was performed using Student's t test and chi-square test was used to examine differences in the distribution of categorical variables. Multivariable logistic regression models were constructed to examine the relationship between the independent and dependent variables, while adjusting for confounding. The strategy for model building was as follows: Background characteristics were compared between the study groups (exposed and unexposed women). Variables associated with the exposure (i.e., were different between the study groups) were suspected as confounding variables, and they were tested in the multivariable models, to determine whether they are also associated with the outcome variable, and are therefore possibly confounding the association between the exposure and the outcome. A suspected confounding variable included the marital status. Maternal age and ethnicity are both variables with clinical significance. Ethnicity in our study population represents social, cultural, educational, and religious differences between the groups, which have been known to affect EPDS scores (Abu-Ganem et al. 2012; Sheiner et al. 1998). Interactions between the independent variables and outcome were examined. No interactions between the independent variables and exposure were found.

Results

A total of 223 women who delivered during the COVID-19 strict isolation period, and 123 women who delivered before the COVID 19 pandemic, were included in the study.

Table 1 summarizes maternal demographic features and pregnancy outcomes of both groups. Mean maternal age was comparable between the groups (29.1 ± 5.1 vs 28.3 ± 5.0 for mother delivering during and before the COVID-19 pandemic, respectively, $p = 0.816$), as was ethnicity and gravidity. No significant differences were noted between the groups in terms of pregnancy course and outcome, including complication rates (gestational diabetes and preeclampsia) and neonatal characteristics.

Maternal possible depression score is presented in Table 2. Women delivering during the COVID-19 pandemic had *lower* risk of having a high (≥ 10) EPDS score compared to women delivering before the COVID-19 pandemic (16.7% vs 31.3%, $p = 0.002$). Likewise, women delivering during the COVID-19 pandemic had *lower* risk of having a very high (≥ 13) EPDS score compared to women delivering before the COVID-19 pandemic (6.8% vs 15.2%, $p = 0.014$). Rates of positive suicidal ideations (according to question number 10 in the EPDS questionnaire) were comparable between the groups (0.5% vs 0.9%, $p = 0.621$).

Using multivariable logistic regression models, controlling for maternal age, ethnicity, marital status, and adverse pregnancy outcomes, delivering during the COVID-19 pandemic was independently associated with lower risk for maternal possible depression according to both EPDS score ≥ 10 and EPDS score ≥ 13 (adjusted OR 0.4, 95% CI 0.23–0.70, $p = 0.001$ and adjusted OR 0.3, 95% CI 0.15–0.74, $p = 0.007$ for EPDS score ≥ 10 and ≥ 13, respectively (Table 3).

Discussion

Principal findings

Our study demonstrated lower risk of depression among women who delivered during the strict isolation period of

Table 1 Maternal demographic features and pregnancy outcomes of study population

Characteristic		Delivery during the COVID-19 pandemic $n = 223$ (%)	Delivery before the COVID-19 pandemic $n = 123$ (%)	p value
Maternal age, years (mean ± SD)		29.1 ± 5.1	28.3 ± 5.0	0.816
Ethnicity	Jewish	53.4	58.8	0.345
	Bedouins	46.6	41.2	
Marital status	Married	90.6	79.1	0.003
	Other	9.4	20.9	
Gravidity	1	16.1	19.1	0.779
	2–4	57.0	55.7	
	≤ 5	26.9	25.2	
Parity	1	24.7	24.3	0.001
	2–4	42.6	60.9	
	≤ 5	32.7	14.8	
Fertility treatments		3.1	7.0	0.106
Gestational diabetes mellitus		4.0	5.0	0.708
Preeclampsia		2.2	0.0	0.112
Newborn sex	Male	49.7	50.4	0.766
	Female	50.2	49.6	
Birth weight, g (mean ± SD)		3297.3 ± 406.1	3273.4 ± 376.0	0.474
Gestational age at birth, weeks (mean ± SD)		39.4 ± 1.0	39.4 ± 0.9	0.816

the COVID-19 pandemic compared to those delivering before the pandemic. These findings were significant regardless of background characteristics or pregnancy complications.

Results

In recent years, there has been growing research into the psychopathological consequences of collectively experienced traumatic events including floods, hurricanes, earthquakes, and pandemics, with depressive disorders most studied after disasters (Maunder et al. 2003; Ahmed et al. 2020; Nguyen

Table 2 EPDS results among women in the immediate post-partum period delivering during and before the COVID-19 pandemic

	Delivery during the COVID-19 pandemic $n = 223$ (%)	Delivery before the COVID-19 pandemic $n = 123$ (%)	p value
Total EPDS score ≥ 10	16.7	31.3	0.002
Total EPDS score ≥ 13	6.8	15.2	0.014
Suicidal ideations (according to question number 10 in EPDS questionnaire)	0.5	0.9	0.621

et al. 2020; Sade et al. 2020; Baibazarova et al. 2013; Avraham et al. 2020; North and Pfefferbaum 2013). Most studies reported elevated rates of depressive and other mental disorders not only among individuals who directly experienced traumatic events linked to the disaster but also among the general population who were living in the area when the disaster occurred (North and Pfefferbaum 2013; Foa et al. 2006). From an academic point of view, several theories may explain the association between natural disaster and mental health problems. The first is that natural disasters may lead to consequential negative life events such as death of a family member or loss of employment. The second concerns the immediate traumatic exposure to the natural disaster that may be both life-threatening and frightening (Perkonigg et al. 2000).

Studies performed following both natural disasters and non-natural disasters such as times of war and terror demonstrated higher rates of adverse pregnancy outcomes including delivering newborns with low birth weight, preterm births, and other adverse outcomes associated with the psychological stress (Wainstock et al. 2014; Engel et al. 2005; Buzaglo et al. 2012) or depression (Hermon et al. 2019; Yedid Sion et al. 2016). Most research has focused on investigating pregnancy outcomes associated with collectively experienced traumatic events (Dancause et al. 2011; Nugent et al. 2011). However, less is known regarding emotional consequences of exposure of pregnant and post-partum women to a major disaster.

Table 3 Multivariable logistic regression models for the association between timing of delivery and EDPS score ≥ 10 and ≥ 13

	Model 1 EDPS score ≥ 10			Model 2 EDPS score ≥ 13		
	Adjusted OR	95%CI	p value	Adjusted OR	95%CI	p value
Delivery during the COVID-19 pandemic (vs delivery before the COVID-19 pandemic)	0.4	0.23–0.70	0.001	0.3	0.15–0.74	0.007
Maternal age (years)	1.0	1.00–1.12	0.023	1.1	1.05–1.23	0.001
Ethnicity (Jewish vs. Bedouin)	0.5	0.30–0.98	0.045	0.4	0.18–0.92	0.031
Marital status (married vs not married)	1.2	0.53–2.82	0.633	1.2	0.38–4.08	0.708
Adverse pregnancy outcomes*	0.9	0.28–2.95	0.889	0.3	0.04–3.26	0.391

*Adverse pregnancy outcomes include preeclampsia and gestational diabetes mellitus

One study conducted in Nepal investigated the risk and protective factors for clinically significant symptoms of antenatal common mental disorders among women who experienced the 2015 Nepal earthquakes during pregnancy (Khatri et al. 2018).Using the EPDS score, the authors found higher risk for clinically significant mental disorders among pregnant women who experienced the earthquake. Having an encouraging partner and income-generating work were found to be protective factors against common mental disorders among pregnant women experiencing the earthquake (Buzaglo et al. 2012).

Harville et al. examined the influence of Hurricane Katrina on mental health in a group of post-partum women from southern Louisiana (Harville et al. 2009).The authors concluded that the overall rates of depression and PTSD did not seem to be higher than in studies of the general population (Harville et al. 2009). The same group concluded that many pregnant and post-partum women are resilient from the mental health consequences of disaster, and even perceive benefits after a traumatic experience (Harville et al. 2010).

Clinical implications

Our study demonstrated *lower* rates of depression during the immediate post-partum period among women delivering during the COVID-19 pandemic. There are several possible explanations for the negative association between delivery during the strict isolation period of the COVID-19 pandemic and maternal depression seen in our study. First, since the study was performed during the strict quarantine, mothers gained greater support from close family members. Many significant others did not go to work or worked from home, which allowed them the opportunity to better support the women. Families stayed at home together, which increased family cohesiveness. Since the virus spreads primarily through droplets, and due to its high contamination potential, the Israeli Ministry of health allowed an earlier discharge from maternity

ward post-partum. It is reasonable to assume that shorter hospital stay would be associated with lower risk for post-partum depression (Brockington 2004). Second, the extent of exposure to the adverse consequences may play a critical role in the emotional response to a disaster (Fergusson et al. 2014). Even though large societies have been socially isolated in order to contain the virus spread throughout the southern part of the country, the extent of contamination was lower compared to other parts of the country. Another possible explanation for the lower rates could be that women did not have to go out into society and confront day to day realities. The lower rates may also be explained by relief of the women that their infant was healthy. Finally, many disaster victims do not develop short- or long-term psychopathology (Bonanno et al. 2006). As was noted previously, many people are resilient after terrible events, and even the worst events may have a positive side (Harville et al. 2010). It is known that a close maternal-fetal attachment buffers post-partum symptoms of anxiety, partially mediated through post-partum bonding and partnership satisfaction (Matthies et al. 2020), and the pandemic era might increase such bonding. Resilience from the mental health consequences of a disaster has been demonstrated among pregnant and post-partum women, and has been associated, among other things, with having a partner (Khatri et al. 2018; Harville et al. 2009). Our study found significant difference in the marital status between the two populations, a factor which may partially explain the lower prevalence of depression among women who delivered during the COVID-19 pandemic, although this has been controlled for in the multivariable model.

Research implications

More studies should be done in order to shed some more light on the association between delivering during the COVID-19 pandemic and post-partum depression as well as to assess the prevalence of anxiety and other mental disorders among post-
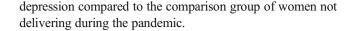
partum women during the COVID-19 pandemic. One specific matter of interest will be to assess late-onset post-partum depression, 6–12 months after the end of the isolation period.

Strengths and limitations

Strengths of the study include the use of standardized mental health instrument and a systematic recruitment of an unselected population. However, our study has several limitations. There is reason to believe that natural disasters may lead to an increased risk for mental health problems due to both the immediate impacts of the disaster and consequential life events experienced following the disaster and that adequate assessment of disaster exposure must take all of these into consideration. There is a growing literature that suggests it is important to assess both categorical and dimensional aspects of mental disorders particularly as there may be individuals who display symptoms of disorder (including impairment) and experience significant distress but whose symptoms do not meet diagnostic criteria. Another limitation concerns post-event non-traumatic stressors. Our study assessed the women during the COVID-19 pandemic. As post-event non-traumatic stressors are associated with the risk of depression, elevated prevalence of depression after disasters does not rest on the experience of specific traumatic events. Rather, it may rest on elevated exposure to stressors in the post-disaster context (Kessler 1997). Moreover, leading theories about the emergence of depression emphasize that depression often occurs following repeated stressors or feelings of hopelessness, but the study window is limited and occurs at the onset of the pandemic. It may not be enough time for depression to develop. Nevertheless, the study's main purpose was to assess risk for depression, rather than depression itself. As our study occurred at the onset of the pandemic, more studies should be taken in the future during later outbreaks of the COVID-19 pandemic. Another limitation of our study relates to the possible seasonality effects on the studied association, since exposed and unexposed were recruited in different season, due to the COVID-19 exposure window. Finally, when using the EPDS to screen for post-partum depression, investigators should realize that the instrument does not exclusively reflect the risk for post-partum depression, as a positive result at an early stage of the post-partum period may be associated with post-partum blues rather than depression. Nevertheless, as both, the exposed and the control groups, were given in the EPDS questionnaire on the same day post-partum, we would expect same rates of association with post-partum blues.

Conclusion

In conclusion, our study found that post-partum women delivering during the COVID-19 pandemic have *lower* risk for depression compared to the comparison group of women not delivering during the pandemic.

Data availability All authors report that all data and materials support their published claims and comply with field standards**.**

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments. The study was approved by the SUMC IRB Committee (IRB approval # 0079-20-SOR).

Consent to participate Informed consent was obtained from all individual participants included in the study. Verbal informed consent was obtained prior to the interview.

Consent to publish The authors affirm that human research participants provided informed consent for publication of the manuscript.

Code availability Non applicable

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