

# Perinatal depression and anxiety among Chinese women during the outbreak of the COVID-19 Delta variant

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## Research Article

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# Abstract

**Background:** This study aimed to assess the COVID-19 Delta variant impact on the incidence of depressive and anxiety symptoms in pregnant women in Guangdong Province, China, as well as to identify related risk factors.

**Methods:** A three-week, multisite, cross-sectional study was conducted from June to July 2021 to evaluate the mental health status of pregnant women by the Edinburgh Postnatal Depression Scale. Approximately 1,450 women from 25 Guangdong hospitals were included in the study. We employed the Edinburgh Postnatal Depression Scale to assess symptoms of maternal depression and anxiety. Risk factors and relevance rates were analyzed.

**Results:** Pregnant women who were determined to be underweight before pregnancy, primiparous, above 35 years of age, employed full-time, of middle income status, and had comfortable living arrangements were at higher risk of developing depression and anxiety during a COVID-19 outbreak.

**Conclusion:** The occurrence of the COVID-19 Delta variant has increased the risk of mental disorders in pregnant women, which include thoughts of self-harm. Programs designed to address maternal stress as well as isolation such as constructive risk, communication, and providing psychological first aid may be particularly useful to avoid negative outcomes in pregnant women and their fetuses.

## Introduction

The first case of coronavirus disease 2019 (COVID-19) was discovered in Wuhan, Hubei Province, China, on December 8, 2019. The pathogen associated with the disease was identified as severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2). Subsequently, the World Health Organization declared that this viral outbreak was an international public health emergency[1]. On January 20, 2020, the Chinese government released an account on person-to-person COVID-19 transmission and warned that symptomatic individuals are potential sources of infection [2].

Since early 2021, China has struggled to control outbreaks of the virus as it spread across the world. The virus has rebounded from clusters in the country's northeast regions to a second small outbreak in Wuhan, to Beijing, Dalian, and Qingdao. Consequently, numerous cities have been placed under different levels of related lockdown measures.

In July, 2021, Guangzhou was straining to stop an outbreak of the novel Delta variant of COVID-19 that was first identified in India[3]. Delta, also known as B.1.617, is one of the most alarming flare-ups in China since the summer of 2020 because it has a shorter incubation period, faster transmission speed, and higher viral load [4, 5]. Additionally, the variant has proven highly transmissible [6].

There were 190 cases of the Delta variant in Guangdong from May 21, 2021 to June 9, 2021. Authorities in cities with populations of more than 50 million people—such as Guangzhou, Shenzhen, Dongguan, and Zhanjiang—moved swiftly to introduce mass testing and lockdowns[6]. Local governments in high-risk areas adopted strict controls; people in these areas were mandated to quarantine at home. The situation was

controlled a bit differently in medium-risk adjacent areas; people could enter but not leave those areas and gatherings were strictly forbidden. COVID-19 lockdown were implemented and personal activities were closely managed. Multiple rounds of nucleic acid testing were also implemented in these areas, and with greater frequency than in other regions.

Extensive epidemiologic data on the mental health status of the general population have been collected during the COVID-19 outbreak. However, the most effective response to this public health consequence has not been identified to date[2]. Evidence shows that during the early stage of the 2003 SARS outbreak, a wide range of psychiatric morbidities emerged, including persistent depression, panic attacks, anxiety, psychotic symptoms, and suicide[7]. Mandatory contact tracing and quarantines for at least 14 days partly constituted public health responses to the COVID-19 outbreak, which in turn has increased anxiety, depression, and feelings of isolation.

Pregnant women have particularly been vulnerable to anxiety as they are concerned about fetal transmission of the COVID-19 Delta variant [3, 8]. Studies on the mental health status of pregnant women in response to the spread of the new COVID-19 variants are limited [9]. The emergence of a pandemic following years of successful management of the spread of disease has resulted in little research about the impact specifically on pregnant women's mental health. The objectives of the present study were to assess the impact of the spread of the COVID-19 Delta variant on the incidence of depression and anxiety in pregnant women, as well as related risk factors[3–5].

## **Materials And Methods**

### **Study design and data collection**

We conducted a multisite cross-sectional study with the Edinburgh Postnatal Depression Scale (EPDS) to assess the mental health effect of the emergence of the COVID-19 Delta variant on pregnant women. For each survey instrument used in our study, e.g. the Edinburgh Postnatal Depression Scale, licenses were obtained in order to use each survey. This study was conducted between June 14, 2021 and July 5, 2021. The data were collected from the Perinatal and Postpartum Depression Information Collection System that we created [3, 8]. Ethical approval was provided by the institutional review board of The Third Affiliated Hospital of Guangzhou Medical University (Guangzhou, Guangdong, China). Informed consent was provided by all of the participants.

### **Participants**

The participants originated from 25 public hospitals within Guangdong Province, China. During their regular antenatal care visit, the pregnant women were asked to complete a study questionnaire from a trained research assistant. All data were collected using an online survey tool made in China (<https://www.wjx.cn/>). The women completed the questionnaires using a mobile phone to scan the WeChat (Tencent, China) QR code.

An informational leaflet was sent to each woman waiting for a routine antenatal visit or obstetric ultrasound examination in the participating hospitals. It included a brief introduction to the study, instructions regarding the completion of the questionnaire, and the online survey's QR code.

## Questionnaires

The survey included three sections. The first section was comprised of socio-demographic information and obstetric history. The variables included maternal age, height, body weight, gestational age, past obstetric history, current obstetric complications, educational level, occupation, family monthly income, family address, hospital attended for antenatal care, medium used to obtain information (TV, newspaper, and internet), and history of mental disorders.

The second section was designed to capture the women's understandings of the COVID-19 Delta variant and vaccines. There were eight subjective questions and four objective questions, including three subjective questions and two objective questions about the Delta variant as well as five subjective questions and two objective questions about the vaccines. There also were eight subjective questions about their understanding of epidemic prevention policies. There was no correct answer to the subjective questions. The women's understandings about the Delta variant and vaccines were assessed using a five-point Likert scale with scores for each correct answer.

The third section was devoted to the EPDS. The EPDS was used to measure depression and anxiety [10]. The scale has been successfully used for both postpartum depression and perinatal depression [11]. The scale consists of 10 items scored on a 3-point scale; a score of greater than 13 would be clinically relevant [12]. The scale was used to identify feelings during the past seven days to detect possible depression [13]. In addition to depression, we used the EPDS to evaluate anxiety symptoms [10, 14, 15]. The accumulative score of EPDS items 3 to 5 (EPDS-3A) were employed to assess anxiety. When more than two items were left unanswered, the completed questionnaire was deemed invalid and thus not scored. [12] The scale included the following four classes: (0) Almost never, (1) Occasionally, (2) Often, and (3) All the time. Answers with a score of 3 indicated a high level of anxiety/depression [10].

## Statistical analysis

Statistical analysis was conducted using IBM SPSS Statistics 26 (SPSS, Inc., Chicago, IL, USA). We calculated the frequency (n) and percentage (%) of categorical variables. In addition, mean (X) and standard deviation (SD) of the numerical variables were calculated.

In our study, the correlation among scale scores was analyzed using Pearson correlation coefficient. Furthermore, the relationship of numerical variables, area, and pregnancy risk was analyzed using an independent samples *t*-test as well as a one-way ANOVA test. The correlation among various discrete variables, pregnancy risk, and area was assessed using the chi-square test or Fisher's exact test. We also analyzed depression level using a repeated measures ANOVA test. Differences with  $P < 0.05$  were considered statistically significant.

## Results

A total of 1,450 women were approached to participate in the study; 56 of them declined. Therefore, 1,394 pregnant women completed questionnaires that were included in the analysis. A total of 10.8% (150/1394) of the participants lived in places under isolation restrictions. A little more than one-fifth (20.7%) of the participants had high-risk pregnancies.

The obstetric as well as sociodemographic characteristics of the study participants are shown in Table 1. The distribution of demographic characteristics—including age, height, BMI, whether primipara or not, and histories of miscarriage—was different among different groups ( $p < 0.05$ ). In this cohort, 85.7% (1195/1394) of the participants had earned at least a high school diploma. Nearly all of the participants (96.0%) had not been vaccinated. More than two-thirds (68.0%) of their household income was  $\geq 6000$  per month. The participants represented a wide range of occupations; a total of 6.7% of them were public servants, 12.1% were business employees, 26.8% were housewives, and 32.9% were self-employed.

Table 1  
Obstetrics and socio-demographic characteristics of the pregnant women  
The obstetrics and socio-demographic characteristics of the participants in our study.

Variables	Group				Total/Statistics	P
	High-risk Pregnancies With COVID-19 lockdown (n=23)	Low-risk Pregnancies With COVID-19 lockdown (n=127)	High-risk Pregnancies Without COVID-19 lockdown (n=266)	Low-risk Pregnancies Without COVID-19 lockdown (n=978)		
Age (years)	33.00 (6.00)	30.00 (7.00)	33.00 (6.00)	31.00 (6.00)	31.00 (7.00)	<0.001 <sup>a</sup>
Height (cm)	158.00 (5.00)	159.00 (7.00)	160.00 (5.00)	159.00 (7.00)	159.00 (7.00)	<0.001 <sup>a</sup>
BMI (W/H <sup>2</sup> )	24.44 (8.00)	20.40 (3.00)	21.09 (4.00)	20.37 (4.00)	20.50 (4.00)	<0.001 <sup>a</sup>
Primipara (N,%)					9.851	0.020 <sup>b</sup>
Yes	10 (43.5)	43 (33.9)	58 (21.8)	267 (27.3)		
No	13 (56.5)	84 (66.1)	208 (78.2)	711 (72.7)		
History of miscarriage (N,%)					22.651	<0.001 <sup>b</sup>
Yes	18 (78.3)	114 (90.5)	190 (71.4)	794 (81.4)		
No	5 (21.7)	12 (9.5)	76 (28.6)	181 (18.6)		
Education level (N,%)					4.430	0.871 <sup>c</sup>
Middle school	6 (26.1)	16 (12.6)	36 (13.5)	141 (14.4)		
High school	2 (8.7)	21 (16.5)	38 (14.3)	163 (16.7)		
University	15 (65.2)	86 (67.7)	182 (68.4)	636 (65.0)		
Graduate school or above	0	4 (3.1)	10 (3.8)	38 (3.9)		
occupation					14.002	0.301 <sup>b</sup>
housewife	9 (39.1)	28 (22.0)	76 (28.6)	261 (26.7)		
public servant	1 (4.3)	8 (6.3)	19 (7.1)	66 (6.7)		

Note: a, Kruskal-Wallis H test; b,  $\chi^2$  Test; c, Fisher Exact test.

Variables	Group				Total/Statistics	P
	High-risk Pregnancies With COVID-19 lockdown (n=23)	Low-risk Pregnancies With COVID-19 lockdown (n=127)	High-risk Pregnancies Without COVID-19 lockdown (n=266)	Low-risk Pregnancies Without COVID-19 lockdown (n=978)		
Enterprise staff	1 (4.3)	15 (11.8)	31 (11.7)	122 (12.5)		
Employed	9 (39.1)	26 (20.5)	49 (18.4)	214 (21.9)		
Self-employed	3 (13.0)	50 (39.4)	91 (34.2)	315 (32.2)		
Family monthly income (N,%)					4.166	0.654 <sup>b</sup>
<6000	5 (21.7)	40 (31.5)	90 (33.8)	311 (31.8)		
6000-10000	7 (30.4)	41 (32.3)	96 (36.1)	339 (34.7)		
>10000	11 (47.8)	46 (36.2)	80 (30.1)	328 (33.5)		
Hospital for antenatal care (N,%)					12.138	0.154 <sup>c</sup>
Second class maternity and childcare hospital	0	6 (4.9)	10(4.3)	29 (3.3)		
Second class general hospital	2 (9.1)	6 (4.9)	30 (12.9)	105 (12.0)		
Third class maternity and childcare hospital	1 (4.5)	0	4 (1.7)	17 (1.9)		
Third class general hospital	19 (86.4)	111 (90.2)	188 (81.0)	722 (82.7)		
Vaccination (N,%)					2.026	0.534 <sup>c</sup>

Note: a, Kruskal-Wallis H test; b,  $\chi^2$  Test; c, Fisher Exact test.

Variables	Group				Total/Statistics	P
	High-risk Pregnancies With COVID-19 lockdown (n=23)	Low-risk Pregnancies With COVID-19 lockdown (n=127)	High-risk Pregnancies Without COVID-19 lockdown (n=266)	Low-risk Pregnancies Without COVID-19 lockdown (n=978)		
Yes	22 (95.7)	124 (97.6)	258 (97.0)	934 (95.5)		
No	1 (4.3)	3 (2.4)	8 (3.0)	44 (4.5)		
Note: a, Kruskal-Wallis H test; b, $\chi^2$ Test; c, Fisher Exact test.						

When participants were asked about the current COVID-19 outbreak in Guangzhou, 81.4% (1172/1394) of them recognized that it was a new variant of COVID-19 and 80.6% (1124/1394) of them knew that the variant was first found in India. The vast majority of the participants (84.8%) knew that the Delta variant proved different from other strains of COVID-19 because it was significantly more contagious. Of those participants, 88.2% believed that their knowledge of the Delta variant of COVID-19 was useful to help avoid infection. However, approximately only one-tenth (10.4%) of the participants worried about being infected by the variant. Furthermore, more than half of the participants (785/1394, 56.3%) did not think that it would be more serious than the first outbreak of COVID-19 in 2020. Most of the participants (83.9%) agreed that the government had taken extraordinary measures to deal with the emergency.

Despite these understandings about the new variant, more than half of the women (785/1394, 56.3%) had delayed or canceled antenatal visits and prenatal ultrasound examinations. Although only 13.9% (195/1394) of participants believed that the online antenatal visits were useless, only 52.7% of the women accessed these services.

More than two-thirds (1034/1394, 74.2%) of the participants thought that the Delta variant of COVID-19 could be easily transmitted from mother to fetus, whereas only 5.5% thought that it could not. Although the majority (1231/1394, 88.3%) of participants regarded the vaccines as a good way to protect themselves against COVID-19, only 56 (56/1394, 4.0%) of pregnant women had already received a vaccination. Nevertheless, more than half of them (36/56, 64.3%) were vaccinated before pregnancy. Furthermore, less than one-tenth (125/1394, 9.0%) of the participants understood that pregnant women could receive a COVID-19 vaccine. A majority (85.7%) of the participants believed that the vaccine might harm their babies to various degrees; only 24.0% of the women thought that it would be beneficial for them to be vaccinated.

Table 2 shows the comparison of scores on understandings about the COVID-19 Delta variant and vaccines for the different groups of participants. Table 3 illustrates the comparison of the scores on understandings of epidemic prevention policies among the different groups. However, we did not observe any statistically significant differences between groups.

Table 2

Comparison of Pregnancy Risk Status and COVID-19 lockdown measures via Understanding of COVID-19 Delta Variant and Vaccines

The comparison of scores or accuracy about the understanding of the COVID-19 Delta Variant and Vaccines in different groups.

Variables	Group				Total	P
	High-risk Pregnancies With COVID-19 lockdown (n=23)	Low-risk Pregnancies With COVID-19 lockdown (n=127)	High-risk Pregnancies Without COVID-19 lockdown (n=266)	Low-risk Pregnancies Without COVID-19 lockdown (n=978)		
Mean score of subjective questions about Delta variant	9.00 (3.00)	10.00 (3.00)	10.00 (3.00)	10.00 (3.00)	10.00 (3.00)	0.999 <sup>a</sup>
Mean score of subjective questions about vaccine	17.00 (4.00)	16.00 (4.00)	17.00 (5.00)	17.00 (5.00)	17.00 (4.00)	0.981 <sup>a</sup>
Accuracy of objective questions about Delta variant (N,%)	13 (56.5)	86 (67.7)	193 (72.6)	736 (75.3)	7.254	0.064 <sup>b</sup>
Accuracy of objective questions about vaccine (N,%)	4 (17.4)	22 (17.3)	35 (13.2)	196 (20.0)	7.122	0.068 <sup>b</sup>
Note: a, Kruskal-Wallis H test; b, $\chi^2$ Test						

Table 3

Comparison of Pregnancy Risk Status and COVID-19 lockdown measures via Understanding of Epidemic Prevention Policies

The comparison of scores of the N,% understanding of epidemic prevention policies in different groups.

Variables	Group				Total	P
	High-risk Pregnancies With COVID-19 lockdown (n=23)	Low-risk Pregnancies With COVID-19 lockdown (n=127)	High-risk Pregnancies Without COVID-19 lockdown (n=266)	Low-risk Pregnancies Without COVID-19 lockdown (n=978)		
Mean score	26.00 (6.00)	26.00 (7.00)	25.00 (8.00)	25.00 (6.00)	25.00 (7.00)	0.082

A little over one-third (36.1%) of the women had depression with an EPDS score of  $\geq 13$ . There was a statistically significant higher incidence of depression among pregnant women who lived in areas with restrictions on movement due to the COVID-19 outbreak; nearly half (47.3%) of these women showed signs of depression (Table 4).

Table 4  
Comparison of Pregnancy Risk Status and COVID-19 lockdown measures by EDPS Scores

The comparison of EDPS scores in different groups.

Variables	Group				Total	P
	High-risk Pregnancies With COVID-19 lockdown (n=23)	Low-risk Pregnancies With COVID-19 lockdown (n=127)	High-risk Pregnancies Without COVID-19 lockdown (n=266)	Low-risk Pregnancies Without COVID-19 lockdown (n=978)		
EDPS					14.041	0.029
<9	8 (34.8) a,b	31 (24.4) b	83 (31.2) a,b	360 (36.8) a		
9-12	6 (26.1) a	34 (26.8) a	82 (30.8) a	287 (29.3) a		
$\geq 13$	9 (39.1) a,b	62 (48.8) b	101 (38.0) a,b	331 (33.8) a		

Note: Each subscript letter denotes a subset of group categories whose column proportions do not differ significantly from each other at the 0.05 level.

## Discussion

Mental health has been largely affected by the spread of the COVID-19 Delta variant [16]. Pregnant women are very concerned about becoming infected, the scarcity of medical care, and the restrictive measures implemented by local and national governments [17]. This study assessed the association of this major life-threatening public health event with maternal mental health. The assumption that guided this work was that pregnant women would be concerned for their unborn fetuses and themselves. Following the Chinese government's declaration about the COVID-19 Delta variant on May 21, 2021, uncertainty increased dramatically [18, 19]. This study has revealed a significant increase in the occurrence of depressive and anxiety symptoms in pregnant women.

The present study investigated the impact of the spread of the COVID-19 Delta variant on women with high-risk pregnancies or those subjected to lockdown orders and are isolated and those with low-risk pregnancies or not on lockdown orders. Previous studies have shown that depression has several risk factors such as low socioeconomic status, behaviors, and insufficient social support, which could contribute to poor health behaviors [20]. The women in this study were not otherwise at risk of perinatal mental health disorders. Concern for an economic crisis and unemployment due to the COVID-19 pandemic could explain the observed increased risk of depression in middle-class women [21–23]. Conversely, working outside the home further increases concerns of infection and vertical transmission, thereby also resulting in an increased risk of depression and anxiety [24].

Limited or no physical activity has been associated with depressive symptoms irrespective of the presence of epidemics [23]. A meta-analysis has suggested that physical activity imparts a protective effect on mental health of young adults [25]. Even small amounts of exercise (e.g., walking 150 min per week) reduced depressive episodes [26]. These findings suggest that physical activity prevents depression. Programs that support exercise during pregnancy are warranted. During a pandemic, exercising while in isolation or at home may help reduce depression in pregnant women. For example, home-based exercises, including walking extra steps around the house or stairs every few hours may be an essential part of self-isolation guidelines.

## Clinical Implications

High-risk pregnancies have represented a large number of obstetric pathologies, including maternal systemic diseases. Pathologic conditions may have affected anxiety and depression levels among the participants. During the outbreak, pregnant women with healthcare needs in areas where movements were restricted could access online consultations for free. If it was necessary for them to see a doctor in person, they could ask the community staff for help and ambulances would transport them to the hospitals that the government designated. The process, however, proved cumbersome and caused problems for pregnant women. Our study observed an increase in the number of pregnant women with thoughts of self-harm that may result in adverse pregnancy outcomes. The majority of the high-risk pregnancies in this study were the result of gestational diabetes (49.8%) or maternal thyroid disease (18.3%), conditions that require frequent doctor visits.

This study confirmed previous work that identified increased anxiety among women with gestational diabetes. Interventions addressing mental health struggles during pregnancy should be prioritized during any epidemic. Guidelines on psychological crisis intervention particularly for COVID-19 has been released by the National Health Commission of China[27] and mental health issues have always been a concern during pandemics. However, pregnant women have not been considered as a vulnerable population. International recommendations for screening for perinatal depression and anxiety have been issued and prioritized in international public health crises. With isolation and population-based social distancing, psychological services hotlines and online counseling are safe and feasible strategies for managing perinatal mental illness. Women with previous bouts of perinatal depression could be recruited to be trained volunteers who may provide telephone-based peer support. Initiatives like this have been shown to have a preventive effect and could help to address the need for mental health services in the context of limited medical resources.

## Research Implications

Further intervention studies that conduct screening and management of perinatal mental health via virtual care are needed. The SARS experience has revealed that the impact of an infectious disease can be qualitatively differentiated from that of other disasters using at least two methods. First, potential exposure to a contagion warrants social isolation. Interpersonal isolation in an outbreak is associated with (1) using personal protective equipment and implementing physical distance to control further spread of disease, (2) a strong capacity for individuals who are potentially exposed to be able to cope with significant stress, and (3)

the ability of other individuals to avoid, fear, and stigmatize people who have been potentially exposed[2]. Second, pregnant women generally have a greater fear as they are concerned for the safety of their unborn fetuses. Based on the mental health consequences of a major life-threatening outbreak on pregnant women, organizational and personal strategies require further investigation. These could include evidence-based approaches in successful risk communication and providing psychological first aid [9]. Clear communication, together with regular and accurate updates on the outbreak, should be available in a preventive strategy for mental health. Emotional and behavioral responses comprise adaptive response to extraordinary stress. In addition, psychotherapeutic techniques focusing on stress adaptation may be helpful [28]. In any public health emergency, experiencing fear, uncertainty, and stigmatization commonly occur and may influence appropriate mental health interventions.

## Conclusion

This study assessed the mental health status of pregnant women in the COVID-19 Delta variant outbreak. Our results indicated a significant increase in the prevalence of depression and anxiety in high-risk pregnant women after the declaration of the COVID-19 Delta variant outbreak. Extensive studies on perinatal mental health risk factors have been conducted. Here, we find that younger, primiparous women of the middle-income class and were employed full-time are at higher risk of developing depression during the COVID-19 Delta variant outbreak. The most concerning finding was the high percentage of women who had engaged in thoughts of self-harm. Our results indicate that high-risk pregnant women should undergo routine anxiety and depression screening and psychosocial support during the COVID-19 Delta variant pandemic.

## Abbreviations

COVID-19

Coronavirus disease 2019

SARS-Cov-2

Severe acute respiratory syndrome coronavirus 2

EPDS

Edinburgh Postnatal Depression Scale

SD

Standard deviation

ANOVA test

Analysis of variance test

## Declarations

### Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of the Third Affiliated Hospital of Guangzhou Medical University (Guangzhou, Guangdong, China). Written informed consent was obtained from all participants.

## Consent for publication

Not applicable.

## Availability of data and materials

The dataset generated and/or analyzed during this study are available from the corresponding author on reasonable request.

## Competing interests

The authors declare that they have no competing interests.

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## Authors' contributions

CM, LB and LT conceived and designed the study. LB, LX, PH, FT, YS and ZX was responsible for data acquisition, analysis and interpretation. LY and HY drafted the paper. CM, HY and LY contributed by revising the manuscript and providing important input. All authors read and approved the final manuscript.

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