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Original Article

The impact of COVID-19 infection on postpartum depression, anxiety, and comorbidity of conditions among pregnant women

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Abstract: Objective: To investigate the impact of COVID-19 infection on postpartum depression, anxiety, and the presence of comorbid conditions among pregnant women. Methods: Postpartum women were recruited into this study between November 2020 and February 2023 and the demographic characteristics were surveyed using a Demographic Questionnaire, while depression and anxiety symptoms were evaluated with the EPDS and GAD-7, respectively. Multivariate Logistic regression was used to analyze the independent and interactive effects of COVID-19 infections on postpartum depression, anxiety, and comorbid depression and anxiety. Results: 2,683 postpartum women were studied, with a mean age of 28.93 ± 3.80 years. Of these women, 14.8% developed depression, 21.4% anxiety, and 11% had both depression and anxiety. A total of 85.1% reported pre-pregnancy COVID-19 infection, while 37.0% reported infection during pregnancy. Compared to uninfected counterparts, women with pre-pregnancy COVID-19 infection showed elevated risks of depression (1.74-fold), anxiety (1.76-fold), and comorbid depression and anxiety (2.14-fold) (P<0.05). During pregnancy, COVID-19 infection was associated with increased depression risk (1.64-fold), anxiety risk (2.21-fold), and comorbid risks (1.89-fold) (P<0.05). Notably, those infected twice during pregnancy faced even higher risks, with depression risk increasing by 2.45-fold, anxiety risk by 2.61-fold, and an increased comorbid risk by 2.37-fold (P<0.05). Additionally, women with pre-pregnancy infections alone exhibited increased risks of depression (1.84-fold), anxiety (2.21-fold), and comorbid depression and anxiety (2.19-fold) (P<0.05). Similarly, women infected only during pregnancy faced elevated risks, with the highest risks observed in those with both pre- and during-pregnancy infections. Conclusion: The study provides clear evidence of the negative impact of COVID-19 infections on postpartum mental health, emphasizing the need for heightened attention and intervention strategies to safeguard women's mental wellbeing during this critical period.

Keywords: COVID-19 infection, postpartum depression, anxiety, comorbid depression and anxiety, pregnant women

Introduction

Postnatal depressive symptoms and anxiety, significant mental health concerns among women, encompass a wide range of emotional and behavioral manifestations that frequently manifest following childbirth [1, 2]. These symptoms, characterized by feelings of profound sadness, persistent anxiety, and a loss of interest in daily activities, can have devastating consequences for the mother's overall well-being, as well as her ability to bond and nurture her newborn [3, 4]. The global prevalence of postnatal depression and anxiety has emerged as a pressing issue, affecting a substantial proportion of women during the vulnerable postpartum period [5, 6]. Postpartum depression and anxiety are complex conditions with multiple contributing factors. Firstly, hormonal changes play a crucial role. After childbirth, a woman's body experiences a significant drop in estrogen and progesterone levels, which can disrupt the neurotransmitter systems in the brain, particularly affecting serotonin levels and leading to mood disturbances [7, 8]. Secondly, psychological factors are of great significance. The transition to motherhood brings about various challenges. New mothers may face feelings of inadequacy, stress related to caring for a newborn, and concerns about the baby's health [9].

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Additionally, a history of mental health issues such as depression or anxiety before pregnancy increases the susceptibility to postpartum depression and anxiety. Social factors also contribute to these conditions. Lack of social support, isolation, and marital problems can exacerbate postpartum mood disorders [10]. In some cases, cultural expectations and pressures on new mothers can add to their stress levels [11]. Finally, biological predispositions and genetic factors may increase the likelihood of developing postpartum depression and anxiety [12]. Some women may have an inherent genetic vulnerability that predisposes them to these conditions.

The emergence of the COVID-19 pandemic has introduced a novel dimension to the already complex landscape of mental health [13]. The widespread disruption caused by the pandemic, including social isolation, economic instability, and heightened anxiety surrounding health and safety concerns, has exacerbated the risk of postnatal depressive symptoms and anxiety among women [14, 15]. Pregnant women, particularly those in the approaching or ongoing postpartum period, are at an elevated risk of experiencing these negative psychological effects [4, 16, 17].

Against this backdrop, the present study delves deeper into the impact of COVID-19 infection on the incidence of postnatal depressive symptoms and anxiety among pregnant women, aiming to contribute significantly to the evolving understanding of mental health during the pandemic. By comprehensively assessing the prevalence and influencing factors of postnatal depression and anxiety within the context of COVID-19, we seek insights into the unique challenges confronted by these women. Our focus on the postpartum period, a crucial juncture for women's mental wellbeing, endeavors to offer valuable perspectives on the specific needs and obstacles faced by this vulnerable group. Ultimately, the findings may guide the development of targeted support systems and intervention programs, effectively alleviating the detrimental effects of postnatal depressive symptoms and anxiety on women's health, overall well-being, and their capacity to nurture their newborns during this vital time.

Material and methods

Research participants

After obtaining approval from the Hospital Ethics Committee (Ethical Approval No. 2020-72), parturient women who delivered at the Chinese People's Liberation Army General Hospital from November 2020 to February 2023 were selected as the research participants.

Inclusion criteria: 1. Age: 18 years or older. 2. Ability to Understand and Respond: Participants must be capable of comprehending and responding accurately to the questionnaire. 3. Informed Consent: Participants must provide informed consent and voluntarily participate in the study. 4. Delivery Status: Delivered a live birth during the study period.

Exclusion criteria: 1. Neonatal Death: Experienced neonatal death within the first month postpartum. 2. Severe Congenital Diseases: Infant was diagnosed with severe congenital diseases. 3. Maternal Conditions: Presence of severe maternal health conditions that could potentially confound the results, such as chronic mental illness, severe physical disability, or life-threatening illnesses. 4. Incomplete Data: Inability to complete the questionnaire due to language barriers, cognitive impairments, or other reasons.

Complications of depression and anxiety and assessment methods

Depression and anxiety during the postpartum period can have serious complications for both the mother and her infant. For the mother, these complications may include impaired cognitive functioning, increased risk of suicidal ideation, disrupted sleep patterns, and diminished quality of life [3, 6]. Additionally, depression and anxiety can negatively impact the mother's ability to bond with and care for her newborn, potentially leading to inadequate maternal care and attachment issues [2]. For the infant, complications associated with maternal depression and anxiety may include poor feeding practices, increased risk of infection, and delayed cognitive and emotional development [18, 19].

To assess depression and anxiety symptoms in our study, we utilized two validated scales: the

Edinburgh Postnatal Depression Scale (EPDS) and the Generalized Anxiety Disorder 7-item Scale (GAD-7). By utilizing these scales, we were able to systematically assess the prevalence and severity of depression and anxiety among our study population.

Research tools

① Demographic Questionnaire: This questionnaire was self-designed and encompassed factors such as age, educational level, household registration location, occupation, housing conditions, and medical payment methods. ② Obstetric Variable Questionnaire: This questionnaire was also self-designed and encompassed variables such as parity, whether the delivery was full-term, delivery method, use of labor analgesia, postpartum hemorrhage, postpartum infection, whether the child was a test-tube baby, newborn gender, newborn birth weight, family history of mental illness, personal history of mental illness, pregnancy health issues (including hypertension, diabetes, endocrine diseases, and other issues during the current pregnancy), whether the newborn's gender met expectations, feeding methods. ③ Edinburgh Postnatal Depression Scale (EPDS): EPDS is the most commonly used self-rating scale for postpartum depression [20, 21]. The revised EPDS had a Cronbach's α coefficient of 0.76 and a content validity of 0.933. It consists of 10 items, with each item scored from 0 to 3, resulting in a total score of 30. A higher score indicates a greater possibility of depression. Score of ≥10 on the EPDS or a choice of suicidal tendency in item 10 was considered as a positive indication of postpartum depressive symptoms. ④ Generalized Anxiety Disorder 7-item Scale (GAD-7). This scale is simple, easy to operate, and has good reliability and validity [22]. It can be used for screening and assessing anxiety symptoms in pregnant and postpartum women [23]. In this study, the reliability of the scale was 0.90, and the validity was 0.92. The scale consists of 7 items, with each item scored on a 4-point scale (not at all = 0 points, some days = 1 point, more than half the days = 2 points, nearly every day = 3 points).

Criteria for assessment

A parturient woman with an EPDS score of ≥9 is considered to have depression [24]. A GAD score of ≥5 is considered to indicate anxiety [25]. If a parturient woman has both an EPDS score of ≥9 and a GAD score of ≥5, she is assessed as having comorbid depression and anxiety.

Data collection method

The researchers explained the purpose and significance of this study to the pregnant women, and guided them to independently complete the questionnaire within 30 minutes after obtaining informed consent. The researchers checked the questionnaires to ensure that they were filled out completely and promptly supplemented any missing information. A total of 2,978 questionnaires were distributed in this study, and 2,683 valid questionnaires were recovered, with an effective recovery rate of 90.09%.

Statistical methods

SPSS 25.0 was employed to conduct statistical analysis on the collected data. Quantitative data were presented as mean ± standard deviation, while count data were described using percentages (%). Demographic characteristics and other categorical variables were summarized using frequencies and percentages. Continuous variables such as age were described using mean and standard deviation. Chi-square tests were applied to compare categorical variables between groups. Multivariate binary logistic regression analysis was utilized to investigate the independent effects of COVID-19 infection before pregnancy and during pregnancy on depression, anxiety, and comorbid depression and anxiety. Covariates significantly associated with depressive or anxious symptoms in the univariate analysis (e.g., urban-rural status, annual household income, alcohol consumption during pregnancy, pregnancy intention, use of assisted reproductive technology, and history of mental illness) were adjusted in the model. For the frequency of COVID-19 infection during pregnancy, trend tests were performed on different combinations of odds ratios (ORs) to assess whether there existed a dose-response relationship between the frequency of COVID-19 infection and the risks of anxiety, depression, and comorbid depression and anxiety. In analyzing interactions, the additive model was adopted to evaluate the interaction between COVID-19 infection before pregnancy and during pregnan-

cy on postpartum depression, anxiety, and comorbid depression and anxiety. Specifically, the additive model leveraged parameter estimates and covariance matrices from the multivariate logistic regression model to calculate the relative excess risk due to interaction (*RERI*), attributable proportion (*AP*), synergy index (*SI*), and 95% confidence intervals (CIs). If the 95% CI of RERI and AP encompassed 0 or the 95% CI of SI included 1, there was considered to be no additive interaction between the two factors. All analyses were considered statistically significant at $P<0.05$.

Results

Comparison of demographic characteristics between postpartum women with depression and anxiety

Table 1 presents the demographic characteristics of the 2,683 postpartum women surveyed, with ages ranging from 18 to 55 years, encompassing a diverse age spectrum. Notably, the highest proportion of participants (44.8%) fell within the age bracket of 25 to 29 years. Furthermore, the majority of participants reported abstinence from alcohol consumption, with a remarkable 91.8% identifying as non-drinkers. Pertaining to reproductive methods, the study revealed that the majority (97.2%) of the women did not undergo assisted reproductive technology, indicating a preponderance of natural conceptions. With regards to pregnancy intention, the approach of "letting nature take its course" prevailed, comprising 73.5% of the surveyed women. It was observed that 37.0% of the women contracted the virus during pregnancy, whereas a higher proportion of 87.2% reported having been infected prior to pregnancy. Four distinct annual family income brackets were identified: <50,000 yuan, 50,000-100,000 yuan, 110,000-200,000 yuan, and >200,000 yuan. The highest concentration of participants fell within the 50,000-100,000-yuan bracket (37.7%), whereas the lowest proportion was observed in the >200,000-yuan bracket (8.8%). It is noteworthy that a significant proportion of the participants (56.7%) were unemployed during pregnancy.

Statistically significant differences were observed between the groups in terms of depression, specifically concerning urban-rural residence, annual family income, COVID-19 infection status during and prior to pregnancy, alcohol consumption during pregnancy, pregnancy intention, use of assisted reproductive technology, and history of mental illness ($P<0.05$). Additionally, notable differences were detected in the distribution of age, urban-rural residence, COVID-19 infection status, alcohol consumption during pregnancy, pregnancy intention, utilization of assisted reproductive technology, and adverse pregnancy and childbirth history among the groups exhibiting postpartum anxiety, comorbid depression, and anxiety ($P<0.05$). These findings highlight the profound impact of COVID-19 on depression and anxiety among postpartum women, necessitating further investigation and intervention strategies.

The independent effects of pre-pregnancy and pregnancy COVID-19 infection on postpartum depression and anxiety

Utilizing a multivariate Logistic regression analysis, the status of pre-pregnancy and pregnancy COVID-19 infection were treated as independent variables, while postpartum depression, anxiety, and comorbid depression and anxiety served as dependent variables. The results, summarized in **Table 2**, indicate that both pre-pregnancy and pregnancy COVID-19 infections are associated with the risk of developing postpartum depression, anxiety, and comorbid depression and anxiety, regardless of whether confounding factors are adjusted for (Depression OR = 1.740, 95% CI 1.193-2.538; Anxiety OR = 1.757, 95% CI 1.272-2.427; Comorbid Depression and Anxiety OR = 2.140, 95% CI 1.344-3.406).

Furthermore, a dose-response relationship was observed between the frequency of COVID-19 infection during pregnancy and the risk of developing depression, anxiety, and comorbid depression and anxiety ($P<0.05$). After adjusting for confounding factors in the depression group and comorbid depression-anxiety group, compared with women who did not contract COVID-19 during pregnancy, those who contracted COVID-19 twice during pregnancy had a 1.452-fold (OR = 2.452, 95% CI 1.760-3.418) and 1.367-fold (OR = 2.367, 95% CI 1.621-3.455) increased risk of developing postpartum depression and comorbid depression-anxiety, respectively. In the anxiety group, after adjusting for confounding factors, compared with women who never contracted COVID-19

Table 1. Demographic characteristics of postpartum women with different levels of depression and anxiety

Features	Depression				Anxiety				Comorbidity of Depression and Anxiety			
	No (*n* = 2286)	Yes (*n* = 397)	X^2	*P*	No (*n* = 2110)	Yes (*n* = 573)	X^2	*P*	No (*n* = 2387)	Yes (*n* = 296)	X^2	*P*
Age/Years			6.992	0.072			11.342	0.010			8.737	0.033
<25	334	78			307	105			351	61		
25-29	1028	174			931	271			1068	134		
30-34	709	112			665	156			743	78		
≥35	215	33			207	41			225	23		
Urban-Rural Classification			4.188	0.041			27.147	<0.01			4.891	0.027
Urban	1320	251			1181	390			1380	191		
Rural	966	146			929	183			1007	105		
Annual Family Income			18.416	<0.001			1.822	0.610			6.603	0.086
<50,000 yuan	434	104			413	125			469	69		
50,000-100,000 yuan	854	158			795	217			893	119		
110,000-200,000 yuan	783	113			712	184			805	91		
>200,000 yuan	215	22			190	47			220	17		
Education Level			3.436	0.180			19.549	<0.001			5.228	0.073
Junior high school and below	733	135			724	144			787	81		
High school/secondary vocational school	532	104			498	138			553	83		
College degree and above	1021	158			888	291			1047	132		
Occupation During Pregnancy			3.337	0.068			<0.001	0.980			1.247	0.264
Unemployed	1281	242			1198	325			1346	177		
Employed	1005	155			912	248			1041	119		
Pre-pregnancy COVID-19 infection			7.442	0.006			9.856	0.002			9.660	0.002
No	309	34			292	51			322	21		
Yes	1977	363			1818	522			2065	275		
COVID-19 Infection During Pregnancy			37.621	<0.001			78.892	<0.001			32.747	<0.001
Uninfected	1490	201			1426	265			1548	143		
Once	605	133			522	216			630	108		
Twice	191	63			172	82			209	45		
Alcohol Consumption During Pregnancy			13.129	0.001			24.085	<0.001			14.152	<0.001
Non-drinker	2116	346			1964	498			2207	255		
Occasional drinker	159	48			135	72			168	39		
Frequent drinker	11	3			11	3			12	2		
Pregnancy Intention			21.492	<0.001			25.081	<0.001			20.510	<0.001
Unplanned pregnancy	569	143			513	199			601	111		
Planned pregnancy	1717	254			1597	374			1786	185		

Assisted reproduction			5.479	0.019			6.997	0.008			6.616	0.010
No	2230	379			2061	548			2328	281		
Yes	56	18			49	25			59	15		
History of Mental Illness			4.111	0.043			1.288	0.256			1.236	0.266
No	2276	392			2100	568			2375	293		
Yes	10	5			10	5			12	3		
History of Adverse Pregnancy and Childbirth			3.538	0.060			10.308	0.001			4.548	0.033
No	1981	330			1841	470			2068	243		
Yes	305	67			269	103			319	53		

Table 2. Multivariate logistic regression analysis of the association between COVID-19 infection status and postpartum depression and anxiety [OR (95% CI)]

COVID-19 Infection Status	Depression		Anxiety		Comorbid Depression and Anxiety	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Pre-pregnancy COVID-19 infection						
No	1	1	1	1	1	1
Yes	1.669 (1.151-2.419)	1.740 (1.193-2.538)	1.644 (1.202-2.248)	1.757 (1.272-2.427)	2.042 (1.290-3.231)	2.140 (1.344-3.406)
COVID-19 Infection During Pregnancy						
Uninfected	1	1	1	1	1	1
Once	1.630 (1.284-2.069)	1.639 (1.286-2.090)	2.131 (1.737-2.614)	2.213 (1.791-2.734)	1.856 (1.422-2.422)	1.888 (1.439-2.477)
Twice	2.445 (1.774-3.369)	2.452 (1.760-3.418)	2.455 (1.831-3.291)	2.609 (1.918-3.549)	2.331 (1.618-3.357)	2.367 (1.621-3.455)
P-trend	<0.01	<0.05	<0.05	<0.01	<0.05	<0.05

Note: Model 1: Unadjusted model; Model 2: Depression adjusted for urban-rural status, annual household income, alcohol consumption during pregnancy, pre-pregnancy COVID-19 infection, COVID-19 infection during pregnancy, pregnancy intention, assisted conception, and history of mental illness; Anxiety adjusted for age, urban-rural status, educational level, alcohol consumption during pregnancy, pre-pregnancy COVID-19 infection, COVID-19 infection during pregnancy, pregnancy intention, assisted conception, and history of adverse pregnancy outcomes; Comorbid depression and anxiety adjusted for age, alcohol consumption during pregnancy, pre-pregnancy COVID-19 infection, COVID-19 infection during pregnancy, pregnancy intention, assisted conception, and history of adverse pregnancy outcomes.

during pregnancy, those who contracted COVID-19 once during pregnancy had a 1.213-fold (OR = 2.213, 95% CI 1.791-2.734) increased risk of postpartum anxiety, while those who contracted COVID-19 twice during pregnancy had a 1.609-fold (OR = 2.609, 95% CI 1.918-3.549) increased risk of anxiety.

The interactive effects of smoking and passive smoking during pregnancy on postpartum depression and anxiety

As shown in **Table 3**, comparisons were made between individuals uninfected with COVID-19 both pre-pregnancy and during pregnancy, serving as the reference group. Pre-pregnancy COVID-19 infection and pre-pregnancy COVID-19 infection combined with COVID-19 infection during pregnancy were associated with the risk of postpartum depression and comorbid depression and anxiety (depression OR = 1.845, 95% CI 1.067-3.190, $P<0.05$; comorbid depression and anxiety OR = 2.196, 95% CI 1.100-4.384, $P<0.05$). In the additive model, the 95% CIs of RERI and AP for both the depression group and the comorbid depression and anxiety group did not include 0, and the 95% CI of SI did not include 1, suggesting an additive effect of pre-pregnancy and pregnancy COVID-19 infections on postpartum depression and comorbid depression and anxiety.

For anxiety, pre-pregnancy COVID-19 infection and pre-pregnancy COVID-19 infection combined with COVID-19 infection during pregnancy were significantly associated with postpartum anxiety ($P<0.05$). The independent effect of pre-pregnancy COVID-19 infection was 2.213 (95% CI 1.340-3.654), and the independent effect of COVID-19 infection during pregnancy was 3.415 (95% CI 1.832-6.367). The interaction effect between these two factors and smoking history was 4.725 (95% CI 2.853-7.826). In the additive model, the 95% CIs of RERI and AP did not include 0, and the 95% CI of SI did not include 1, indicating an additive effect of COVID-19 infection during pregnancy and pre-pregnancy on postpartum anxiety.

Discussion

Explanation of the significance of the study results and comparison with previous studies

The present study provides clear evidence of the negative impact of COVID-19 infection on postpartum depression, anxiety, and their comorbidity among pregnant women. Our findings revealed that both pre-pregnancy and during-pregnancy COVID-19 infections significantly increased the risks of developing depression, anxiety, and comorbid depression and anxiety. Specifically, women with pre-pregnancy infections exhibited a 1.74-fold increased risk of depression, 1.76-fold increased risk of anxiety, and 2.14-fold increased risk of comorbid depression and anxiety. Similarly, women infected during pregnancy had heightened risks, with even more pronounced elevations among those infected twice. These findings underscore the vulnerability of pregnant women to mental health disorders amidst the COVID-19 pandemic.

Stuart et al. (1998) reported depression rates of 23.3% at 14 weeks and 18.7% at 30 weeks postpartum, while anxiety rates were 8.7% and 16.8%, respectively [18]. These studies underscore the importance of routine screening for both anxiety and depression during the postpartum period, as symptoms may persist or develop later. Our findings, which indicate a 14.8% prevalence of depression, 21.4% prevalence of anxiety, and 11% prevalence of comorbid depression and anxiety among postpartum women studied during the COVID-19 pandemic, suggest a potential increase in the incidence of these mental health issues compared to the non-COVID-19 period. This is further supported by the observed elevated risks associated with both pre-pregnancy and during-pregnancy COVID-19 infections.

Our findings are consistent with previous research that has documented the negative psychological impact of the pandemic on pregnant and postpartum women worldwide [26-28]. However, our study contributes to the existing body of knowledge by specifically examining the role of COVID-19 infection in the development of postpartum depression and anxiety. Moreover, by assessing the risks associated with both pre-pregnancy and during-pregnancy infections, our results provide a more nuanced understanding of the temporal dynamics of this association.

Exploration of possible mechanisms or causes

Several potential mechanisms may explain the increased risks of postpartum depression

Table 3. The interactive effects of pre-pregnancy and pregnancy COVID-19 infections on postpartum depression and anxiety [OR (95% CI)]

COVID-19 Infection Status	Quantity of individuals	Depression		Anxiety		Comorbid Depression and Anxiety	
		Quantity of individuals	OR	Quantity of individuals	OR	Quantity of individuals	OR
Uninfected both pre-pregnancy and during pregnancy	208	15	1	18	1	9	1
Pre-pregnancy infections	1483	186	1.845 (1.067-3.190)	257	2.213 (1.340-3.654)	134	2.196 (1.100-4.384)
			P = 0.0283		*P* = 0.0019		*P* = 0.0257
During-pregnancy infections	135	19	2.108 (1.031-4.308)	33	3.415 (1.832-6.365)	13	2.337 (0.970-5.629)
			P = 0.0410		*P* = 0.0001		*P* = 0.0584
Pre- and during-pregnancy infections	857	177	3.349 (1.931-5.809)	265	4.725 (2.853-7.826)	141	4.354 (2.180-8.698)
			P<0.0001		*P*<0.0001		*P*<0.0001
RERI		0.406 (0.183-1.061)		0.102 (0.073-0.267)		0.821 (0.582-1.061)	
AP		0.121 (0.012-0.323)		0.023 (0.005-0.061)		0.161 (0.101-0.372)	
SI		0.869 (0.756-0.978)		0.632 (0.393-0.961)		1.479 (1.083-2.068)	

Note: RERI: Relative Excess Risk of Interaction, AP: Attributable Proportion due to Interaction, SI: Synergy Index.

and anxiety among COVID-19-infected women. Firstly, the psychological stress associated with the pandemic, including fear of contracting the virus, social isolation, and economic uncertainty, can contribute to heightened anxiety and depressive symptoms [15, 29, 30]. This psychological burden may be particularly severe for pregnant women, who are often already experiencing emotional vulnerability during this life stage [31].

Secondly, the physical effects of COVID-19 infection, such as severe respiratory symptoms and other comorbidities, can further compromise women's mental health [32]. Pregnant women infected with COVID-19 may also face increased risks of adverse pregnancy outcomes, including preterm birth and low birth weight, which are known to be associated with postpartum depression and anxiety [33, 34].

Moreover, our findings suggest that repeated infections may exacerbate the negative psychological effects. This may be attributed to the cumulative impact of repeated exposure to the virus, as well as the ongoing stress associated with the pandemic.

Suggestions for future research and improvement directions

While our study has provided valuable insights into the impact of COVID-19 infection on postpartum depression and anxiety, there are still several avenues for future research. Firstly, longitudinal studies are needed to track the long-term mental health outcomes of COVID-19-infected pregnant women and their infants [35, 36]. This will help to better understand the persistence and severity of these disorders over time.

Secondly, future research should explore the role of other potential confounding factors, such as the presence of pre-existing mental health disorders, social support systems, and access to mental health services. These factors may influence the development of postpartum depression and anxiety and should be taken into account when interpreting the results of similar studies [37-39]. Additionally, it would be beneficial to investigate the effectiveness of various intervention strategies for mitigating the negative impact of COVID-19 on postpartum mental health. This may include the development of tailored support systems and psychological interventions tailored to the unique needs of pregnant and postpartum women during the pandemic.

Summary of main findings and conclusion

In conclusion, our study has provided clear evidence of the negative impact of COVID-19 infection on postpartum depression, anxiety, and their comorbidity among pregnant women. We found that both pre-pregnancy and during-pregnancy infections significantly increased the risks of these disorders, with even higher risks among those infected twice. The results highlight the need for heightened attention and intervention strategies to safeguard women's mental wellbeing during this critical period.

While our findings contribute to the growing body of knowledge on the intersection of mental health and the COVID-19 pandemic, it is important to acknowledge the limitations of our study. These include the potential for recall bias in self-reported data, as well as the inability to establish causal relationships due to the cross-sectional nature of our analysis. Future research should address these limitations and continue to explore the complex interplay between COVID-19 infection and postpartum mental health outcomes.

Disclosure of conflict of interest

None.

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