Research paper

COVID-19 affects psychological symptoms of pregnant women indirectly by increasing their maternal concerns

Hongguang Chen [a,1], Yusong Zou [b,1], Hui Shi [b], Hongyan Ma [b], Wenyang Huang [b], Shuzhen Wang [b], Junli Lu [b,*]

[a] Peking University Sixth Hospital (Institute of Mental Health), Key Laboratory of Mental Health, Ministry of Health (Peking University), National Clinical Research Center for Mental Disorders (Peking University Sixth Hospital), Beijing 100083, China
[b] Beijing Chaoyang Hospital, Capital Medical University, Beijing 100020, China

ABSTRACT

Background: Pregnant women themselves are at higher risk for psychological symptoms. The impact of ongoing COVID-19 may increase the risk. However, it is uncertain whether COVID-19 affects pregnant women's psychological symptoms directly or indirectly being mediated.
Methods: This survey was conducted in four obstetrics and gynecology hospitals in Beijing from February 28, 2020, to April 26, 2020. Pregnant women who visited the antenatal-care clinic were mobilized to finish the online questionnaires, including the Generalized Anxiety Disorder 7-Item Scale, Patient Health Questionnaire-9, Connor-Davidson resilience scale, and Insomnia Severity Index.
Results: A total of 828 pregnant women were included in the analysis. The estimated self-reported rates of anxiety, depression, insomnia, and any of the three were 12.2 %, 24.3 %, 13.3 %, and 33.1 %, respectively. Mediating effect analysis showed that pregnant women's response to COVID-19 was not directly associated with psychological symptoms but indirectly through the mediating effect of maternal concerns, which accounted for 32.35 % of the total effect. Stratified analysis by psychological resilience showed that women's attitude toward COVID-19 (OR, 2.68, 95 % CI: 1.16–6.18) was associated with a higher risk of psychological symptoms in those with poor psychological resilience.
Limitations: The study was a non-probability sampling survey, and the causal relationship between maternal concerns and psychological symptoms could not be determined due to the study's design.
Conclusions: Under public health emergencies such as COVID-19, routine antenatal care should still be prioritized, and concerns related to childbirth-related caused by such emergencies should also be addressed, especially for those with weak psychological resilience.

1. Introduction

The COVID-19 epidemic in 2020 has brought significant changes to people worldwide. Various uncertainties at the beginning of the outbreak also increase the risk of adverse psychological reactions such as anxiety and depression. As a particular group, pregnant women themselves are at higher risk for psychological symptoms due to related physio- and psychological changes. Coupled with the outbreak of COVID-19, the risk may increase. It is especially true for pregnant women who are tested positive for COVID-19. Evidence showed that

pregnant women who reported testing positive for COVID-19 were significantly more likely to report depressive symptoms than women who tested negative ($P = 0.027$) or who were never tested. It was reported that 29.6 % of pregnant women reported depressive symptoms after the declaration of the COVID-2019 epidemic, slightly higher than 26.0 % reported before the epidemic declaration (Wu et al., 2020; Wu et al., 2021). Studies also indicated that maternal depression could affect child outcomes through altered placental function, epigenetic changes in the child, and stress reactivity (Dean et al., 2018; Herba et al., 2016).

The impact on delivery and fetus after being infected with COVID-19

---

further aggravated pregnant women's psychological burden and pressure during pregnancy (Villar et al., 2021). In addition to the common psychological symptoms, some studies also reported a high prevalence of maternal concerns, representing the most reported symptom in pregnant women (Akgor et al., 2021; Biaggi et al., 2016). Furthermore, there was a complex interaction between maternal concerns and common psychological symptoms (Storksen et al., 2012). Previous studies focused on investigating the psychological problems of pregnant women during the epidemic of COVID-19, but few studies explored the role of maternal concerns between COVID-19 and psychological symptoms. Therefore, it is still unknown whether the COVID-19 epidemic directly affects pregnant women's anxiety and depression symptoms or whether it is mediated by increasing maternal concerns.

2. Method

2.1. Study design

A cross-sectional study was conducted in four obstetrics and gynecology hospitals in Beijing from February 28, 2020, to April 26, 2020. During the period, all pregnant women who visited the antenatal care clinic were mobilized to finish the questionnaire using the online platform ("SurveyStar"). Subjects with self-reported records of schizophrenia, schizophrenic affective disorder, paranoid psychosis, bipolar disorder, mental disorders caused by epilepsy, mental retardation with mental disorders, and non-local household registration were excluded. Electronic informed written consent was obtained from all respondents before the data collection. The Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences approved the study.

2.2. Measurements

2.2.1. Sociodemographic data and others

Sociodemographic data included age, nationality, occupation, marital status, and education. Pregnancy-related information involved gestational week, number of pregnancies, number of deliveries, and maternal concerns (questions such as "Do you have pregnancy- and childbirth-related concerns?"). Data on 'family support' referred to whether husband and wife live together and the time of being taken care of in a day. The information on pregnant women's response to COVID-19 was gathered by asking: "Do you accept the current COVID-19 epidemic?". Furthermore, information on the history of somatic diseases was also collected.

2.2.2. Generalized Anxiety Disorder 7-Item (GAD-7) Scale

This scale was used to screen for anxiety symptoms and evaluate the severity, consisting of 7 items. There were four degrees for each item (0-not at all; 1-some of the time; 2-more than half the time; 3-nearly every day). The GAD-7 score ranged from 0 to 21. The higher the total score was, the more serious the anxiety symptoms presented. For example, the total score of 0–4 was rated as no anxiety, 5–9 rated as mild anxiety, 10–14 rated as moderate anxiety, and 15 or more rated as severe anxiety. The scale has been proven to have good validity and reliability and is widely used in the epidemiological investigation (Gong et al., 2021).

2.2.3. Patient Health Questionnaire-9 (PHQ-9)

This scale was used to screen for depressive symptoms and evaluate the severity, consisting of 9 items. There were four degrees for each item (0-not at all; 1-some of the time; 2-more than half the time; 3-nearly every day). The PHQ-9 score ranged from 0 to 27. The higher the total score was, the more serious the depressive symptoms presented. For example, the total score of 0–4 was rated as no depression, 5–9 rated as mild depression, 10–14 rated as moderate depression, 15–19 rated as moderate to severe depression, and 20 or more rated as severe depression. The scale has been proven to have good validity and reliability and is widely used in the epidemiological investigation (Sidebottom et al.,

2012).

2.2.4. Connor-Davidson Resilience Scale (CD-RISC)

The scale consisted of 10 items and was used to evaluate the level of psychological resilience, each with 0–4 points. The higher the score was, the higher the level of psychological resilience appeared. The cut-off value of 25.5 was selected as the classification standard, with a total score of ≥26 as having good psychological elasticity, and ≤25 was considered poor. The scale has been proved to have good validity and reliability and is widely used in the epidemiological investigation (Yu et al., 2011; Zhang et al., 2021).

2.2.5. Insomnia Severity Index, ISI

The ISI scale consisted of 7 items, each with 0–4 points, and was used to screen for insomnia symptoms and evaluate the severity. The total score range was 0–28 points; the higher the score was, the more severe the rated insomnia symptoms. For example, the total score of 0–7 was rated as no insomnia, 8–14 rated as mild insomnia, 15–21 rated as moderate depression, and 22 or more rated as severe insomnia. The scale has been proven to have good validity and reliability and is widely used in the epidemiological investigation (Bastien et al., 2001; Wang et al., 2020).

2.3. Statistical analyses

The detection rate described the proportion of cases with psychological symptoms, and the chi-square test compared the characteristic distribution of the detection rate. The bootstrap method calculated the detection rate's 95 % confidence intervals (CI). Nonconditional binary logistic regression analysis was employed to screen factors associated with psychological symptoms and calculate its 95 % CI. Sobel Test was used to screen the mediator variable and evaluate the significance of mediation in this study. The Sobel test estimates the statistical significance of indirect effect in mediation analysis (Sobel, 1982, 1986). The Sobel-Goodman tests aimed to test whether a mediator carries the influence of an independent variable (IV) to a dependent variable (DV). A variable may be considered a mediator to the extent to which it carries the influence of a given IV to a given DV. In general, mediation can occur when the IV significantly affects the mediator, the IV significantly affects the DV in the absence of the mediator, and the mediator has a significant unique effect on the DV. The effect of the IV on the DV shrinks upon the addition of the mediator to the model. Statistical tests were two-tailed with $P < 0.05$, and data were analyzed by STATA 14.0 (StataCorp, College Station, Texas, USA).

3. Results

3.1. Detection rates of psychological symptoms and their distributions

After excluding 8 cases with incomplete information, 828 pregnant women were included, with an average age of 31.4 (SD, 4.0) years. The detection rates of cases with anxiety symptoms, depression symptoms, insomnia symptoms, and any of them were 12.2 % (95 % CI, 10.6 %–14.0 %), 24.3 % (95 % CI, 21.2 %–27.6 %), 13.3 % (95 % CI, 10.9 %–16.1 %) and 33.1 % (95 % CI, 30.2 %–36.1 %) respectively, but most of them appeared mild. Significantly higher proportions of self-reported psychological symptoms were found in pregnant women with short gestational week, history of somatic diseases, maternal concerns, and poor psychological resilience ($P < 0.05$, see Table 1).

3.2. Factors associated with psychological symptoms through logistic regression

Both univariate (OR, 1.83, 95 % CI: 0.90–3.72, see Table 2) and multivariate (OR, 1.55, 0.72–3.37) logistic regression showed that the variable ″Subjectively accepts the epidemic or not ″ was not found to be

Table 1

Self-reported psychological symptoms among 828 pregnant women.[a]

Variables	N	Detection rate % (95 % CI[b])
Subjectively accepting the epidemic		
No	32	46.9 (31.7–62.6)
Yes	796	32.5 (29.8–35.4)
Age		
<35 years	676	34.2 (31.0–37.4)
≥35 years	152	28.3 (21.5–36.3)
Education level		
Junior college degree or below	289	32.2 (27.5–37.2)
Bachelor's degree or above	539	33.6 (29.5–37.9)
Annual household income		
Less than 80,000 RMB	182	39.0 (33.1–45.2)
80,000–300,000 RMB	481	31.8 (28.3–35.5)
More than300,000 RMB	165	30.3 (23.8–37.8)
Nationality		
Non-Han nationality	62	32.3 (21.1–45.9)
Han nationality	766	33.2 (29.8–36.7)
Marital status		
Unmarried or divorced	15	53.3 (27.6–77.4)
Married	813	32.7 (29.3–36.4)
Gestational week		
<12 weeks	217	40.1 (33.3–47.3)*
>12 & <28 weeks	192	32.3 (26.9–38.2)
≥28 weeks	419	29.8 (26.1–33.8)
Number of pregnancies		
1st pregnancy	447	32.9 (28.8–37.2)
2nd and above	381	33.3 (29.5–37.5)
Number of deliveries		
1st delivery	584	34.4 (30.0–39.1)
2nd and above	244	29.9 (24.4–36.1)
History of somatic diseases		
Yes	180	39.4 (32.4–46.9)*
No	648	31.3 (27.6–35.3)
Live with husbands		
No	43	39.5 (25.4–55.7)
Yes	785	32.7 (29.5–36.2)
Time took care of in daily life		
No or little time	225	36.4 (29.6–43.9)
Most of the time	603	31.8 (28.2–35.7)
Maternal concerns		
Yes	254	49.2 (43.0–55.4)***
No	574	26.0 (22.7–29.5)
Psychological resilience		
Poor	137	55.5 (46.5–64.1)***
Good	691	28.7 (25.3–32.2)

* *P* < 0.05.
*** *P* < 0.001.

[a] Sample size of 828 achieved 94.5 % power to detect a difference of 0.037 (when compared with other survey results in the same period, the least difference in anxiety symptoms was selected as the effect value to estimate the sample size) using an exact two-sided test with a significance level (alpha) of 0.05.

[b] 95 % CI, 95 % confidence interval.

Table 2

Factors associated with psychological symptoms examined in the univariate and multivariate logistic model.

Variables	Unadjusted OR (95 % CI)	*P* value	Adjusted OR (95 % CI)	*P* value
Subjectively accept the epidemic, no	1.83 (0.90–3.72)	0.095	1.55 (0.71–3.37)	0.267
Age, ≥35 years	0.76 (0.52–1.12)	0.165	0.68 (0.44–1.07)	0.095
Education level, Junior college degree or below	0.94 (0.69–1.27)	0.683	0.97 (0.68–1.39)	0.881
Annual household income, 80,000–300,000 RMB	1.07 (0.73–1.57)	0.719	1.06 (0.69–1.65)	0.783
Annual household income, <80,000 RMB	1.47 (0.94–2.30)	0.090	1.57 (0.93–2.65)	0.094
Nationality, non-Han nationality	0.96 (0.55–1.67)	0.885	0.93 (0.51–1.68)	0.802
Marital status, unmarried or divorced	2.35 (0.84–6.55)	0.102	1.81 (0.60–5.45)	0.288
Gestational week, >12 & <28 weeks	0.71 (0.47–1.07)	0.102	0.82 (0.53–1.27)	0.373
Gestational week, ≥28 weeks	0.64 (0.45–0.90)	0.009	0.64 (0.44–0.94)	0.024
Number of pregnancies, 1st pregnancy	0.98 (0.73–1.31)	0.892	0.83 (0.54–1.26)	0.374
Number of deliveries, 1st delivery	1.23 (0.89–1.70)	0.210	1.22 (0.75–1.98)	0.431
History of somatic diseases, yes	1.43 (1.01–2.01)	0.041	1.45 (0.99–2.11)	0.054
Live with husbands, no	1.34 (0.72–2.52)	0.358	1.28 (0.65–2.50)	0.477
Time took care of in daily life, no or little time	1.23 (0.89–1.69)	0.211	1.16 (0.82–1.64)	0.408
Maternal concerns, yes	2.76 (2.03–3.76)	<0.001	2.51 (1.80–3.49)	<0.001
Psychological resilience, poor	3.10 (2.13–4.51)	<0.001	3.23 (2.16–4.83)	<0.001

Table 3

Mediation effect tests by Sobel-Goodman analysis.

	Coefficient	SE	*P*
Sobel	0.047	0.018	0.010
Goodman-1	0.047	0.018	0.011
Goodman-2	0.047	0.018	0.009
Indirect effect	0.047	0.018	0.010
Direct effect	0.098	0.082	0.230
Total effect	0.145	0.083	0.080
Proportion of total effect mediated (%)	32.3		

significantly associated with psychological symptoms. Instead, having maternal concerns (OR, 2.51, 95 % CI: 1.80–3.49) and poor psychological resilience (OR, 3.23, 95 % CI: 2.16–4.83) were associated with psychological symptoms among pregnant women. The item "Subjectively accept the epidemic or not" was found to be associated with maternal concerns in both univariate (OR, 2.67, 95 % CI: 1.31–5.44, data not shown) and multivariate (OR, 3.07, 95 % CI: 1.43–6.58) analysis.

3.3. Mediation effect of maternal concerns between COVID-19 and psychological symptoms

Based on the noticed association between COVID-19 and psychological symptoms, Sobel-Goodman's analysis was employed to explore the mediation effect of maternal concerns on COVID-19 and psychological symptoms. Sobel test of mediating effect showed that mediating effect was valid with *P* < 0.05 (see Table 3). The proportion of the total mediated effect was 32.3 %.

3.4. Association between COVID-19 and psychological symptom

Given the association between psychological resilience and psychological symptoms and the mediate effect, stratified logistic regression by psychological resilience was performed in two models, with one (Model 1) including maternal concerns and the other (Model 2) not. In model 1, negative response to COVID-19 (OR, 2.16, 95 % CI: 0.91–5.13, see Table 4) was potentially associated with psychological symptoms in pregnant women with poor psychological resilience. In model 2, negative response to COVID-19 (OR, 2.68, 95 % CI: 1.16–6.18) was significantly associated with psychological symptoms in pregnant women with poor resilience. However, in both models, the association was not found in cases with good psychological resilience.

4. Discussion

This study was among the few studies using mediating effect analysis to explore the impact of COVID-19 on psychological symptoms in

Table 4

Associations between COVID-19 and psychological symptoms stratified by psychological resilience.

Variables	Model 1[a]				Model 2[b]			
	Good psychological resilience		Poor psychological resilience		Good psychological resilience		Poor psychological resilience	
	OR (95 % CI)	P	R (95 % CI)	P	OR (95 % CI)	P	OR (95 % CI)	P
Accept the epidemic, no	0.35 (0.06–2.03)	0.244	2.16 (0.91–5.13)	0.082	**0.46 (0.08–2.55)**	**0.376**	**2.68 (1.16–6.18)**	**0.021**

[a] Adjusted by age, education level, annual household income, nationality, marital status, gestational week, number of pregnancies, number of deliveries, history of somatic diseases, live with husbands or not, time took care of in daily life, maternal concerns. Multivariate logistic regression was performed stratified by psychological resilience.

[b] Adjusted by age, education level, annual household income, nationality, marital status, gestational week, number of pregnancies, number of deliveries, history of somatic diseases, live with husbands or not, time took care of on daily life. Multivariate logistic regression was performed stratified by psychological resilience.

pregnant women. Findings showed that COVID-19 did not directly affect pregnant women's psychological symptoms but indirectly through the mediating effect of maternal concerns. The birth of a child seems to be a distressing experience associated with an increase in the mother's vulnerability to developing affective disorders, primarily perinatal anxiety, and depression. In this study, the detection rates of both anxiety and depression symptoms appeared higher than in Wu's study (9.8 % and 6.9 %) (Wu et al., 2021) and Zhou's study (6.8 % and 5.3 %) (Zhou et al., 2020), but lower than those of other studies performed during COVID-19 (Cameron et al., 2020; Lebel et al., 2020; Wu et al., 2020) epidemics. The difference in detection rates might be related to local disparities in the survey area, epidemic situations during the study period, and tools used for the investigation. Consistent with the results from other studies (Ahmad and Vismara, 2021), mild cases appeared predominantly. As a particular group, pregnant women also reported a high prevalence of maternal concerns in addition to common psychological symptoms. Prior to the COVID-19 epidemics, studies reported that 10–30 % of pregnant women had maternal concerns (O'Connell et al., 2019; Onchonga et al., 2020; Toohill et al., 2014). A longitudinal study involving 120 couples found that women reported increasing worries toward the final stage of pregnancy, with 25 % to 30 % describing being preoccupied with caring for an infant postpartum (Leckman et al., 2004). Self-reported rate of maternal concerns in this study was higher than that of most studies before COVID-19 but lower than that of most studies after COVID-19 (Ahmad and Vismara, 2021), which may be related to the mildness of the epidemics noticed in Beijing. It was recognized that the elevated depression and anxiety symptoms during the COVID-19 epidemic were significantly associated with COVID-19-related concerns but with varieties, including concerns on health conditions of the baby and their own, worries about the mistreatment of care during pregnancy, and being socially isolated (Lebel et al., 2020). The present study results were in line with those of previous studies, which have shown that women with maternal concerns were at higher risk of developing psychological symptoms (Vismara et al., 2021).

COVID-19 aggregates the worries of pregnant women, including pain and process of delivery, maturity of the fetus, and risk of infection to babies and themselves by COVID-19. Notably, prenatal anxiety was also a predictor for postpartum depressive symptoms (Cheng et al., 2021). In addition, pregnant women's psychological health may affect fetal neurobehavioral development and child outcomes. It was reported that prenatal environmental exposures, including maternal psychological state–based alterations in utero physiology- can have sustained effects across the lifespan (Kinsella and Monk, 2009; Leckman et al., 2004). Animal models have also provided evidence that prenatal stress was associated with offspring's neuropsychiatric disorders, including anxiety, depression, and autism spectrum disorders (Chen et al., 2020).

The impact of the COVID-19 on the social life of the general population is multifaceted, but more on pregnant women in maternal speaking. Given the unique situation of this particular group, under the sudden exposure to public health emergencies such as COVID-19. Programs on routine antenatal care should still be prioritized but added on

contents related to emergencies such as COVID-19 during pregnancy and childbirth. Meanwhile, pregnant women with poor psychological resilience were more likely to develop psychological symptoms that deserved more social and psychological support during the epidemic. In practice, pregnant women should be screened for psychological symptoms in the antenatal clinics of obstetrics and gynecology hospitals, with symptoms-positive ones provided by necessary psychological support and intervention programs. Unfortunately, face-to-face psychological intervention cannot be carried out due to the epidemic; network-based remote psychological intervention might be a better option.

4.1. Limitations

Several limitations of the study should be taken into consideration. First, we used a non-probability sample survey instead of a random sample survey due to the limitation during the COVID-19 epidemic, cautiously extrapolating the results. Second, the survey tools used in this study were only available for those self-reported psychological symptoms but not psychological disorders. In addition, the causation between maternal concerns and psychological symptoms was still unclear as of the design of the study.

5. Conclusions

We found that the self-reported rates of anxiety, depression, and insomnia among pregnant women were high during the COVID-19 epidemic. COVID-19 did not directly affect the psychological symptoms of pregnant women but indirectly through the mediating effect of maternal concerns. During public health emergencies such as COVID-19, more attention should be paid to pregnant women's specific concerns, especially those with weak psychological resilience. Since the influence of COVID-19 epidemics on psychological symptoms of pregnant women stays complex, longitudinal studies are warranted to promote standardized screening and intervention guidelines in supporting pregnant and postpartum women pre-and post- the COVID-19 epidemics. In the meantime, special attention should also be paid to the long-term effect of maternal mental health on child development.

CRediT authorship contribution statement

Honggguang Chen, Yusong Zou and Junli Lu planned the study. Hui Shi, Hongyan Ma, Wenyang Huang, and Shuzhen Wang took part in data collection and quality control. Hongguang Chen, Yusong Zou, and Junli Lu carried out data analysis and interpretation; Hongguang Chen and Yusong Zou drafted the manuscript. Finally, all authors revised it and gave final approval of the version to be published. All authors certify that they have participated sufficiently in this work. Each author

certifies that this material has not been submitted to or published in any other publication. All authors approved the final version of the manuscript.

Conflict of interest

The authors declare that they have no conflicts of interest to this paper.

Acknowledgments

References

Ahmad, M., Vismara, L., 2021. The psychological impact of COVID-19 pandemic on women's mental health during pregnancy: a rapid evidence review. Int. J. Environ. Res. Public Health 18.

Akgor, U., Fadiloglu, E., Soyak, B., Unal, C., Cagan, M., Temiz, B.E., Erzenoglu, B.E., Ak, S., Gultekin, M., Ozyuncu, O., 2021. Anxiety, depression and concerns of pregnant women during the COVID-19 pandemic. Arch. Gynecol. Obstet. 304, 125–130.

Bastien, C.H., Vallieres, A., Morin, C.M., 2001. Validation of the insomnia severity index as an outcome measure for insomnia research. Sleep Med. 2, 297–307.

Biaggi, A., Conroy, S., Pawlby, S., Pariante, C.M., 2016. Identifying the women at risk of antenatal anxiety and depression: a systematic review. J. Affect. Disord. 191, 62–77.

Cameron, E.E., Joyce, K.M., Delaquis, C.P., Reynolds, K., Protudjer, J.L.P., Roos, L.E., 2020. Maternal psychological distress & mental health service use during the COVID-19 pandemic. J. Affect. Disord. 276, 765–774.

Chen, H.J., Antonson, A.M., Rajasekera, T.A., Patterson, J.M., Bailey, M.T., Gur, T.L., 2020. Prenatal stress causes intrauterine inflammation and serotonergic dysfunction, and long-term behavioral deficits through microbe- and CCL2-dependent mechanisms. Transl. Psychiatry 10, 191.

Cheng, C.Y., Chou, Y.H., Chang, C.H., Liou, S.R., 2021. Trends of perinatal stress, anxiety, and depression and their prediction on postpartum depression. Int. J. Environ. Res. Public Health 18.

Dean 3rd, D.C., Planalp, E.M., Wooten, W., Kecskemeti, S.R., Adluru, N., Schmidt, C.K., Frye, C., Birn, R.M., Burghy, C.A., Schmidt, N.L., Styner, M.A., Short, S.J., Kalin, N.H., Goldsmith, H.H., Alexander, A.L., Davidson, R.J., 2018. Association of prenatal maternal depression and anxiety symptoms with infant white matter microstructure. JAMA Pediatr. 172, 973–981.

Gong, Y., Zhou, H., Zhang, Y., Zhu, X., Wang, X., Shen, B., Xian, J., Ding, Y., 2021. Validation of the 7-item Generalized Anxiety Disorder scale (GAD-7) as a screening tool for anxiety among pregnant Chinese women. J. Affect. Disord. 282, 98–103.

Herba, C.M., Glover, V., Ramchandani, P.G., Rondon, M.B., 2016. Maternal depression and mental health in early childhood: an examination of underlying mechanisms in low-income and middle-income countries. Lancet Psychiatry 3, 983–992.

Kinsella, M.T., Monk, C., 2009. Impact of maternal stress, depression and anxiety on fetal neurobehavioral development. Clin. Obstet. Gynecol. 52, 425–440.

Lebel, C., MacKinnon, A., Bagshawe, M., Tomfohr-Madsen, L., Giesbrecht, G., 2020. Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. J. Affect. Disord. 277, 5–13.

Leckman, J.F., Feldman, R., Swain, J.E., Eicher, V., Thompson, N., Mayes, L.C., 2004. Primary parental preoccupation: circuits, genes, and the crucial role of the environment. J. Neural Transm. (Vienna) 111, 753–771.

O'Connell, M.A., Leahy-Warren, P., Kenny, L.C., O'Neill, S.M., Khashan, A.S., 2019. The prevalence and risk factors of fear of childbirth among pregnant women: a cross-sectional study in Ireland. Acta Obstet. Gynecol. Scand. 98, 1014–1023.

Onchonga, D., MoghaddamHosseini, V., Keraka, M., Varnagy, A., 2020. Prevalence of fear of childbirth in a sample of gravida women in Kenya. Sex Reprod. Healthc. 24, 100510.

Sidebottom, A.C., Harrison, P.A., Godecker, A., Kim, H., 2012. Validation of the Patient Health Questionnaire (PHQ)-9 for prenatal depression screening. Arch. Womens Ment. Health 15, 367–374.

Sobel, M.E., 1982. Asymptotic confidence intervals for indirect effects in structural equation models. Sociol. Methodol. 13, 290–312.

Sobel, M.E., 1986. Some new results on indirect effects and their standard errors in covariance structure models. Sociol. Methodol. 16, 159–186.

Storksen, H.T., Eberhard-Gran, M., Garthus-Niegel, S., Eskild, A., 2012. Fear of childbirth; the relation to anxiety and depression. Acta Obstet. Gynecol. Scand. 91, 237–242.

Toohill, J., Fenwick, J., Gamble, J., Creedy, D.K., 2014. Prevalence of childbirth fear in an Australian sample of pregnant women. BMC Pregnancy Childbirth 14, 275.

Villar, J., Ariff, S., Gunier, R.B., Thiruvengadam, R., Rauch, S., Kholin, A., Roggero, P., Prefumo, F., do Vale, M.S., Cardona-Perez, J.A., Maiz, N., Cetin, I., Savasi, V., Deruelle, P., Easter, S.R., Sichitiu, J., Soto Conti, C.P., Ernawati, E., Mhatre, M., Teji, J.S., Liu, B., Capelli, C., Oberto, M., Salazar, L., Gravett, M.G., Cavoretto, P.I., Nachinab, V.B., Galadanci, H., Oros, D., Ayede, A.I., Sentilhes, L., Bako, B., Savorani, M., Cena, H., Garcia-May, P.K., Etuk, S., Casale, R., Abd-Elsalam, S., Ikenoue, S., Aminu, M.B., Vecciarelli, C., Duro, E.A., Usman, M.A., John-Akinola, Y., Nieto, R., Ferrazi, E., Bhutta, Z.A., Langer, A., Kennedy, S.H., Papageorghiou, A.T., 2021. Maternal and neonatal morbidity and mortality among pregnant women with and without COVID-19 infection: the INTERCOVID Multinational Cohort Study. JAMA Pediatr. 175, 817–826.

Vismara, L., Sechi, C., Neri, M., Paoletti, A., Lucarelli, L., 2021. Maternal perinatal depression, anxiety, fear of birth, and perception of infants' negative affectivity at three months. J. Reprod. Infant Psychol. 39, 532–543.

Wang, W.J., Hou, C.L., Jiang, Y.P., Han, F.Z., Wang, X.Y., Wang, S.B., Ng, C.H., Jia, F.J., 2020. Prevalence and associated risk factors of insomnia among pregnant women in China. Compr. Psychiatry 98, 152168.

Wu, F., Lin, W., Liu, P., Zhang, M., Huang, S., Chen, C., Li, Q., Huang, W., Zhong, C., Wang, Y., Chen, Q., 2021. Prevalence and contributory factors of anxiety and depression among pregnant women in the post-pandemic era of COVID-19 in Shenzhen, China. J. Affect. Disord. 291, 243–251.

Wu, Y., Zhang, C., Liu, H., Duan, C., Li, C., Fan, J., Li, H., Chen, L., Xu, H., Li, X., Guo, Y., Wang, Y., Li, X., Li, J., Zhang, T., You, Y., Li, H., Yang, S., Tao, X., Xu, Y., Lao, H., Wen, M., Zhou, Y., Wang, J., Chen, Y., Meng, D., Zhai, J., Ye, Y., Zhong, Q., Yang, X., Zhang, D., Zhang, J., Wu, X., Chen, W., Dennis, C.L., Huang, H.F., 2020. Perinatal depressive and anxiety symptoms of pregnant women during the coronavirus disease 2019 outbreak in China. Am. J. Obstet. Gynecol. 223, 240 e241–240 e249.

Yu, X.N., Lau, J.T., Mak, W.W., Zhang, J., Lui, W.W., Zhang, J., 2011. Factor structure and psychometric properties of the Connor-Davidson Resilience Scale among Chinese adolescents. Compr. Psychiatry 52, 218–224.

Zhang, X., Mo, Y., Yan, C., Li, Y., Li, H., 2021. Psychometric properties of two abbreviated Connor-Davidson resilience scales in Chinese infertile couples. Qual. Life Res. 30, 2405–2414.

Zhou, Y., Shi, H., Liu, Z., Peng, S., Wang, R., Qi, L., Li, Z., Yang, J., Ren, Y., Song, X., Zeng, L., Qian, W., Zhang, X., 2020. The prevalence of psychiatric symptoms of pregnant and non-pregnant women during the COVID-19 epidemic. Transl. Psychiatry 10, 319.