



# Coronavirus Disease 2019 Pandemic-Related Long-Term Chronic Impacts on Psychological Health of Perinatal Women in China

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## Abstract

**Objectives** The coronavirus disease 2019 (COVID-19) pandemic has caused far-reaching changes in all areas of society. However, limited data have focused on the long-term impacts on perinatal psychological health. This study aims to evaluate long-term impacts of COVID-19 pandemic crisis on psychological health among perinatal women and investigate associated factors.

**Study Design** A multicenter, cross-sectional study, the psychological subproject of China Birth Cohort Study (CBCS), was conducted in 2021. Demographic and obstetric characteristics, pregnancy outcomes, psychological status, and COVID-19-pandemic-related factors were obtained. The symptoms of depression, anxiety, and insomnia of participants were assessed by Patient Health Questionnaire, Edinburgh Postpartum Depression Scale, Generalized Anxiety Disorder Scale, and Insomnia Severity Index, respectively. Multivariate logistic regression was used to identify associated factors of adverse psychological symptoms.

**Results** Totally, 1,246 perinatal women were enrolled, with the overall prevalence of depression, anxiety, and insomnia symptoms being 63.16, 41.89, and 44.38%, respectively. Perinatal women who needed psychological counseling and were very worried about the COVID-19 pandemic were 1.8 to 7.2 times more likely to report symptoms of depression, anxiety, and insomnia. Unemployment, flu-like symptoms, younger maternal age, and previous diseases before pregnancy were risk factors for depression, anxiety, or insomnia.

## Keywords

- ▶ anxiety
- ▶ COVID-19 pandemic
- ▶ depression
- ▶ insomnia
- ▶ mental health
- ▶ psychological health
- ▶ perinatal women

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**Conclusion** Our study revealed that the prevalence of perinatal depression, anxiety, and insomnia symptoms was at a high level even 1 year after the pandemic outbreak, implying pandemic-associated long-term psychological impacts on perinatal women existed. Government should not only pay attention to the acute effects of psychological health but also to long-term psychological impacts on perinatal women after major social events.

### Key Points

- The prevalence of perinatal psychological symptoms was at a high level after the COVID-19 outbreak.
- Perinatal women who were very worried about COVID-19 were more often to have psychological symptoms.
- Perinatal women with demands of mental counseling were more likely to report psychological symptoms.

Perinatal women are a unique population, and more susceptible to a mental problem. Approximately 10 to 15% of pregnant women and 20% of postpartum women experience anxiety or depression symptoms.<sup>1</sup> Psychological distress and mental symptoms during pregnancy could increase the short-term and long-term risks for pregnant women and developing fetus.<sup>2-4</sup> Over the recent 2 years, the coronavirus disease 2019 (COVID-19) has rapidly spread across the globe and has affected the lives of most people worldwide.<sup>5</sup> Evidence has shown that during COVID-19 outbreak, it could not only have acute psychological effects on general population<sup>6,7</sup> but also on perinatal women.<sup>8-10</sup>

Pregnant and postpartum women are more susceptible to psychological disturbances, especially during disasters or such global health events.<sup>11</sup> During the COVID-19 epidemic, perinatal women may be more concerned about the health of themselves and their fetus, making it more difficult for them to carry out routine prenatal examinations or delivery, which may increase psychological pressure and problems and even lead to adverse outcomes. The higher rates of cesarean sections were found,<sup>12,13</sup> and the risk of premature rupture of membranes and fetal distress was increased<sup>3</sup> during the COVID-19 epidemic. Several previous studies have investigated the prevalence and risk factors of mental disorders in perinatal women during the COVID-19 outbreak, showing an increased prevalence of psychological symptoms. The number of pregnant women with anxiety was doubled due to the COVID-19 pandemic,<sup>14</sup> and significant symptoms of anxiety and depression substantially elevated.<sup>15</sup> The prevalence of depression was also increased after the declaration of the COVID-19 pandemic,<sup>16</sup> and more than one-third of the pregnant women had depression during the COVID-19 outbreak.<sup>17</sup> Additionally, postpartum women were also reported to have a higher risk of depression, anxiety, and stressor during the COVID-19 pandemic.<sup>10,18-21</sup>

One study conducted by Zeng et al in China revealed that a lower prevalence of perinatal depression, anxiety, and insomnia symptoms was found during the remission phase of COVID-19 immediately after the peak of the pandemic.<sup>22</sup> However, in the year after the outbreak of COVID-19, although the Chinese government achieved the initial success of epidemic prevention and control by taking a variety of

effective prevention and control measures and using vaccination, China still faces great and long-term pressure because the epidemic continues worldwide, the local cases and particularly imported cases still exist in some individual provinces and cities in China, and the duration of COVID-19 in the world is still unknown. Moreover, the lives and behaviors of general population and also perinatal women have been affected for a long time due to the uncertainties caused by COVID-19 which is a significant psychological stressor. Furthermore, there is a lack of studies on the evaluation of long-term impact of COVID-19 epidemic based on the psychological health of perinatal women and the long-term consequences remain unknown and unpredictable. Therefore, the aim of this study is to evaluate the long-term impacts of the COVID-19 epidemic on psychological health including depression, anxiety, and insomnia symptoms in perinatal women and identify the associated socio-demographic, obstetric, and COVID-19-related factors. This may help to know the mental health status of perinatal women after the outbreak of COVID-19 and help to develop effective psychological health measures and interventions to reduce the adverse pregnancy outcomes caused by the long-term impacts of the COVID-19 epidemic.

## Materials and Methods

### Study Design and Participants

A multicenter, cross-sectional study was conducted to investigate the psychological status including depression, anxiety, and insomnia symptoms in perinatal women across 14 provinces in China, which was the psychological subproject of China Birth Cohort Study (CBCS). CBCS is a prospective, longitudinal, national, and megacohort study initiated in 2017.<sup>23</sup> Pregnant women joined the CBCS at 6 to 13<sup>6/7</sup> weeks of gestation and were followed-up till delivery. All of them completed the pregnancy-related questionnaire at enrollment in CBCS. Study subjects in the current study were recruited from the CBCS, and an online questionnaire embedded within our official platform based on WeChat was used to collect psychological and COVID-19-related data between January 20th and February 10th, 2021, 1 year after the peak of COVID-19 outbreak.

The inclusion criteria in this study were (1) women who participated in CBCS; (2) perinatal women (in pregnancy to 1 year after delivery); (3) singleton pregnancy or given birth to one alive newborn after COVID-19 outbreak (January 23, 2020); (4) willing to participate in this psychological study with written informed consent; and (5) WeChat user. The perinatal women who did not complete the questionnaires were excluded. The protocol was approved by the Ethics Committee of Beijing Obstetrics and Gynecology Hospital, Capital Medical University, Beijing Maternal and Child Health Care Hospital.

## Measures

### Demographic and Obstetric Characteristics

Demographic and obstetric characteristics including maternal age, body mass index, education level, occupation, income status, history of chronic diseases, lifestyles, fertilization way, and parity were obtained from an electronic data capturing system of CBCS project in the first trimester of participants. Pregnancy outcomes, such as delivery date, adverse pregnancy outcome, delivery mode, birth weight, fetal gender, 10-minute Apgar's score were recorded at delivery.

### Coronavirus Disease 2019-Related Factors

Information related to the COVID-19 epidemic was collected by self-reported questionnaires. Participants were asked the following questions: (1) Are you worried about maternal and fetal health threatened by COVID-19? (2) Did the COVID-19 epidemic delay your regular perinatal check-ups or infants' vaccination? (3) Did you have flu-like symptoms, including cold, cough, fever ( $>37.3^{\circ}\text{C}$ ), or chest tightness, during pregnancy and postpartum? (4) Do you think it is necessary to receive psychological counseling during pregnancy or after delivery? (5) Do you receive any support from your relatives during prenatal examination and childbirth (only for postpartum women)? (6) Which feeding patterns do you use for the newborn (only for postpartum women)?

### Mental Health Status

The anxiety symptoms of the participants were assessed using the Generalized Anxiety Disorder Scale, which is self-reported and has been translated and confirmed in the Chinese population. A total score of  $\geq 5$  was used as the cutoff point to screen anxiety symptoms.<sup>24</sup> The Patient Health Questionnaire (PHQ-9)<sup>25</sup> was used to evaluate the depression symptoms in pregnant women and postpartum women with less than 6 weeks after delivery, while the Edinburgh Postpartum Depression Scale (EPDS)<sup>26</sup> were used in postpartum women with more than 6 weeks after delivery. A sum score of  $\geq 9$  in EPDS or  $\geq 5$  in PHQ-9 was defined as depression symptoms. The insomnia symptoms were measured using insomnia severity index-7 (ISI-7),<sup>27</sup> and a total score of the scale  $\geq 8$  indicated possible insomniac symptoms.

### Statistical Analysis

Statistical analyses were performed with SAS version 9.2 (SAS Institute Inc, Cary, NC). Continuous variables with normal

distribution in this study were expressed as mean  $\pm$  standard deviation (SD) and compared by *t*-test. Others were described as median (range) and compared by the Wilcoxon rank sum test. The  $\chi^2$  test was used to compare the categorical variables which were expressed as proportions (%), and the Wilcoxon rank sum test was performed to compare the ordinal categorical data. The variables with  $p \leq 0.1$  in the individual prenatal or postnatal univariate analysis (**Supplementary Tables S1 and S2**, available in the online version) were brought into the multivariable logistic regression analysis which was used to identify the independent correlated factors of prenatal depression, anxiety, and insomnia during pregnancy. The associations between risk factors and outcomes were pointed out by odds ratios (ORs) and 95% confidence intervals. The statistically significant differences were presented as  $p \leq 0.05$  with two-tailed tests.

## Results

### Participants' Characteristics

A total of 1,646 eligible women (950 pregnant women and 696 postpartum women) from 14 provinces in China received the invitation successfully and eventually 1,246 participants completed the questionnaires, with 75.7% of the response rate. Of them, 778 women (62.4%) were pregnant including 132 (17.0%), 352 (45.2%), and 294 (37.8%) participants in first, second, and third trimesters of pregnancy, respectively, and 468 (37.6%) were in the postnatal period. The mean age of all participants was 30.7 years ( $SD = 4.1$ ). Most of them had a high education level (undergraduate and above,  $n = 1,088$ , 87.2%) and were still employed after pregnancy ( $n = 940$ , 75.4%). The annual household income of most families ( $n = 729$ , 58.5%) was 50 to 200 thousand yuan ( $\$7,060$ – $28,243$ ). Additionally, most of the participants ( $n = 742$ , 59.6%) were nulliparous and conceived naturally ( $n = 1,180$ , 94.7%). More than 85% of participants reported no previous diseases including heart disease, hypertension, diabetes, or thyroid disease before pregnancy. Moreover, approximately 28.9% ( $n = 360$ ) of women's partners were in the habit of smoking, and similar proportion ( $n = 371$ , 29.8%) of partners drank alcohol. Furthermore, 40.2% of postpartum women gave birth via cesarean delivery. There were 239 males (51.1%) and 229 females (48.9%) newborns, respectively.

During the COVID-19 epidemic, 17.8% ( $n = 222$ ) of the pregnant women declared that they were not accompanied by relatives during the prenatal examination and childbirth. About 8.8% ( $n = 109$ ) of all women stated that their medical appointments and checkups were canceled or rescheduled due to the COVID-19 emergency. Of all the participants, 25.8% ( $n = 322$ ) had flu-like symptoms such as a cold, a cough, or a fever, and nearly half of them ( $n = 333$ , 49.6%) reported that they need psychological counseling or help during the perinatal period. The participant characteristics are presented in **Table 1**. The overall prevalence of anxiety, depressive, and insomnia symptoms were 41.9, 63.2, and 44.4% among perinatal women year after the peak of the COVID-19 outbreak periods in our study, respectively.

**Table 1** Demographic and clinical characteristics of 1,246 perinatal women

Characteristics	Total (n = 1,246)	No depression 459 (36.84)	Depression 787 (63.16)	p-Value	No anxiety 724 (58.11)	Anxiety 522 (41.89)	p-Value	No insomnia 693 (55.62)	Insomnia 553 (44.38)	p-Value
Maternal age (y)	30.66 ± 4.10	31.07 ± 4.05	30.42 ± 4.11	<b>0.0065</b>	30.78 ± 4.11	30.48 ± 4.09	<b>0.2040</b>	30.75 ± 4.10	30.54 ± 4.09	<b>0.3584</b>
Maternal age (y)				<b>0.0051</b>			<b>0.5988</b>			<b>0.6437</b>
≤30	624 (50.08)	206 (44.88)	418 (53.11)		358 (49.45)	266 (50.96)		343 (49.49)	281 (50.81)	
>30	622 (49.92)	253 (55.12)	369 (46.89)		366 (50.55)	256 (49.04)		350 (50.51)	272 (49.19)	
BMI	21.44 ± 3.15	21.55 ± 3.13	21.38 ± 3.16	<b>0.3362</b>	21.40 ± 3.04	21.49 ± 3.30	<b>0.6188</b>	21.40 ± 3.08	21.49 ± 3.24	<b>0.5892</b>
Gestation				<b>&lt;0.0001</b>			<b>&lt;0.0001</b>			<b>&lt;0.0001</b>
First trimester	132 (10.59)	56 (12.20)	76 (9.66)		98 (13.54)	34 (6.51)		93 (13.42)	39 (7.05)	
Second trimester	352 (28.25)	151 (32.90)	201 (25.54)		243 (33.56)	109 (20.88)		228 (32.90)	124 (22.42)	
Third trimester	294 (23.60)	114 (24.84)	180 (22.87)		179 (24.72)	115 (22.03)		151 (21.79)	143 (25.86)	
Postnatal	468 (37.56)	138 (30.07)	330 (41.93)		204 (28.18)	264 (50.57)		221 (31.89)	247 (44.67)	
Maternal education				<b>0.2628</b>			<b>0.2052</b>			<b>0.2161</b>
<College	160 (12.84)	57 (12.42)	103 (13.09)		88 (12.15)	72 (13.79)		86 (12.41)	74 (13.38)	
Undergraduate/college	933 (74.88)	338 (73.64)	595 (75.60)		541 (74.72)	392 (75.10)		514 (74.17)	419 (75.77)	
>Postgraduate or higher	153 (12.28)	64 (13.94)	89 (11.31)		95 (13.12)	58 (11.11)		93 (13.42)	60 (10.85)	
Maternal occupation				<b>0.0002</b>			<b>0.0009</b>			<b>0.0320</b>
Employed	940 (75.44)	374 (81.48)	566 (71.92)		571 (78.87)	369 (70.69)		539 (77.78)	401 (72.51)	
Unemployed	306 (24.56)	85 (18.52)	221 (28.08)		153 (21.13)	153 (29.31)		154 (22.22)	152 (27.49)	
Family annually income (Yuan)				<b>0.0429</b>			<b>0.0719</b>			<b>0.0689</b>
<50,000	104 (8.35)	34 (7.41)	70 (8.89)		56 (7.73)	48 (9.20)		52 (7.50)	52 (9.40)	
50,000–200,000	729 (58.51)	253 (55.12)	476 (60.48)		414 (57.18)	315 (60.34)		398 (57.43)	331 (59.86)	
>200,000	413 (33.15)	172 (37.47)	241 (30.62)		254 (35.08)	159 (30.46)		243 (35.06)	170 (30.74)	
First pregnancy				<b>0.9678</b>			<b>0.8933</b>			<b>0.6162</b>
Yes	742 (59.55)	273 (59.48)	469 (59.59)		430 (59.39)	312 (59.77)		417 (60.17)	325 (58.77)	
No	504 (40.45)	186 (40.52)	318 (40.41)		294 (40.61)	210 (40.23)		276 (39.83)	228 (41.23)	
Fertilization way				<b>0.0795</b>			<b>0.2332</b>			<b>0.1092</b>
Natural pregnancy	1,180 (94.70)	428 (93.25)	752 (95.55)		681 (94.06)	499 (95.59)		650 (93.80)	530 (95.84)	
IVF	66 (5.30)	31 (6.75)	35 (4.45)		43 (5.94)	23 (4.41)		43 (6.20)	23 (4.16)	
Menstrual regularity				<b>0.6607</b>			<b>0.5325</b>			<b>0.9389</b>
Yes	1,015 (81.46)	371 (80.83)	644 (81.83)		594 (82.04)	421 (80.65)		564 (81.39)	451 (81.56)	
No	231 (18.54)	88 (19.17)	143 (18.17)		130 (17.96)	101 (19.35)		129 (18.61)	102 (18.44)	

Table 1 (Continued)

Characteristics	Total (n = 1,246)	No depression 459 (36.84)	Depression 787 (63.16)	p-Value	No anxiety 724 (58.11)	Anxiety 522 (41.89)	p-Value	No insomnia 693 (55.62)	Insomnia 553 (44.38)	p-Value
Diseases before pregnancy				0.1206			0.1733			0.7290
Yes	151 (12.12)	47 (10.24)	104 (13.21)		80 (11.05)	71 (13.60)		82 (11.83)	69 (12.48)	
No	1,095 (87.88)	412 (89.76)	683 (86.79)		644 (88.95)	451 (86.40)		611 (88.17)	484 (87.52)	
Paternal smoking				0.1689			0.2448			0.0555
Yes	360 (28.89)	122 (26.58)	238 (30.24)		200 (27.62)	160 (30.65)		185 (26.70)	175 (31.65)	
No	886 (71.11)	337 (73.42)	549 (69.76)		524 (72.38)	362 (69.35)		508 (73.30)	378 (68.35)	
Paternal alcohol drinking				0.0232			0.2817			0.0159
Yes	371 (29.78)	119 (25.93)	252 (32.02)		207 (28.59)	164 (31.42)		187 (26.98)	184 (33.27)	
No	875 (70.22)	340 (74.07)	535 (67.98)		517 (71.41)	358 (68.58)		506 (73.02)	369 (66.73)	
Family support during prenatal examination/childbirth				0.7413			0.0329			0.6279
Husband	894 (71.75)	330 (71.90)	564 (71.66)		528 (72.93)	366 (70.11)		503 (72.58)	391 (70.71)	
Other relatives	130 (10.43)	51 (11.11)	79 (10.04)		83 (11.46)	47 (9.00)		73 (10.53)	57 (10.31)	
No accompany	222 (17.82)	78 (16.99)	144 (18.30)		113 (15.61)	109 (20.88)		117 (16.88)	105 (18.99)	
Severity of worry about COVID-19				<0.0001			<0.0001			<0.0001
Very worried	136 (10.91)	28 (6.10)	108 (13.72)		37 (5.11)	99 (18.97)		53 (7.65)	83 (15.01)	
Worried	125 (10.03)	36 (7.84)	89 (11.31)		54 (7.46)	71 (13.60)		59 (8.51)	66 (11.93)	
A little worried	424 (35.03)	147 (32.03)	277 (35.20)		247 (34.12)	177 (33.91)		236 (34.05)	188 (34.00)	
Not worried	218 (17.50)	95 (20.70)	123 (15.63)		145 (20.03)	73 (13.98)		133 (19.19)	85 (15.37)	
Not worried at all	343 (27.53)	153 (33.33)	190 (24.14)		241 (33.29)	102 (19.54)		212 (30.59)	131 (23.69)	
Delayed prenatal examinations				0.2009			0.0018			0.2564
Yes	109 (8.75)	34 (7.41)	75 (9.53)		48 (6.63)	61 (11.69)		55 (7.94)	54 (9.76)	
No	1,137 (91.25)	425 (92.59)	712 (90.47)		676 (93.37)	461 (88.31)		638 (92.06)	499 (90.24)	
Flu-like symptoms <sup>a</sup>				<0.0001			<0.0001			0.0017
Yes	322 (25.84)	80 (17.43)	242 (30.75)		147 (20.30)	175 (33.52)		155 (22.37)	167 (30.20)	
No	924 (74.16)	379 (82.57)	545 (69.25)		577 (79.70)	347 (66.48)		538 (77.63)	386 (69.80)	
The need of psychological counseling				<0.0001			<0.0001			<0.0001
Yes	618 (49.60)	146 (31.81)	472 (59.97)		275 (37.98)	343 (65.71)		283 (40.84)	335 (60.58)	
No	628 (50.40)	313 (68.19)	315 (40.03)		449 (62.02)	179 (34.29)		410 (59.16)	218 (39.42)	
Delivery modes <sup>b</sup>				0.9282			0.0888			0.2005
Vaginal delivery	280 (59.83)	83 (60.14)	197 (59.70)		131 (64.22)	149 (56.44)		139 (62.9)	141 (57.1)	

(Continued)

**Table 1** (Continued)

Characteristics	Total (n = 1,246)	No depression 459 (36.84)	Depression 787 (63.16)	p-Value	No anxiety 724 (58.11)	Anxiety 522 (41.89)	p-Value	No insomnia 693 (55.62)	Insomnia 553 (44.38)	p-Value
Cesarean delivery	188 (40.17)	55 (39.86)	133 (40.30)	0.1906	73 (35.78)	115 (43.56)	0.1358	82 (37.1)	106 (42.9)	0.5907
Duration after delivery <sup>b</sup>										
<6 wk	73 (15.60)	27 (19.57)	46 (13.94)		34 (16.67)	39 (14.77)		30 (13.57)	43 (17.41)	
6 wk to 6 mo	222 (47.44)	64 (46.38)	158 (47.88)		103 (50.49)	119 (45.08)		109 (49.32)	113 (45.75)	
>6 mo	173 (36.97)	47 (34.06)	126 (38.18)		67 (32.84)	106 (40.15)		82 (37.10)	91 (36.84)	
Neonatal birth weight <sup>b</sup>				0.0677			0.6338			0.5926
<2,500 g	18 (3.85)	8 (5.80)	10 (3.03)		9 (4.41)	9 (3.41)		8 (3.62)	10 (4.05)	
2,500--4,000 g	419 (89.53)	124 (89.86)	295 (89.39)		182 (89.22)	237 (89.77)		197 (89.14)	222 (89.88)	
≥ 4,000 g	31 (6.62)	6 (4.35)	25 (7.58)		13 (6.37)	18 (6.82)		16 (7.24)	15 (6.07)	
10-min Apgar's score, median (range) <sup>b</sup>	10 (8--10)	10 (9--10)	10 (8--10)	0.8589	10 (8--10)	10 (8--10)	0.5835	10 (8--10)	10 (8--10)	0.8203
Premature infant <sup>b</sup>	20 (4.27)	4 (2.90)	16 (4.85)	0.3421	8 (3.92)	12 (4.55)	0.7407	10 (4.52)	10 (4.05)	0.7992
Fetal gender <sup>b</sup>				0.9234			0.3687			0.8733
Male	239 (51.07)	70 (50.72)	169 (51.21)		109 (53.43)	130 (49.24)		112 (50.68)	127 (51.42)	
Female	229 (48.93)	68 (49.28)	161 (48.79)		95 (46.57)	134 (50.76)		109 (49.32)	120 (48.58)	
Feeding patterns <sup>b</sup>				0.2113			0.0351			0.5191
Breastfeeding	268 (57.26)	85 (61.59)	183 (55.45)		128 (62.75)	140 (53.03)		130 (58.82)	138 (55.87)	
Nonbreastfeeding	200 (42.74)	53 (38.41)	147 (44.55)		76 (37.25)	124 (46.97)		91 (41.18)	109 (44.13)	

Abbreviations: BMI, body mass index; COVID-19, coronavirus disease 2019; IVF, in vitro fertilization.

Note: Bold values are statistically significant.

<sup>a</sup>Including cold, cough, fever (>37.3°C), chest tightness.

<sup>b</sup>Only for postpartum women.

### Univariate Analysis

The univariate analysis was performed to explore the relationship between the symptoms of depression, anxiety, and insomnia and several variables that could influence such relation (–Table 1). The results showed that women who were unemployed, were in the postnatal period, had flu-like symptoms during pregnancy, had needs for psychological counseling, or were worried about maternal and fetal health consequences caused by COVID-19 were more likely to experience symptoms of depression ( $p=0.0002$  for employed and  $p<0.0001$  for others), anxiety ( $p=0.0009$  for employed and  $p<0.0001$  for others), and insomnia ( $p=0.0320$  for employed and  $p<0.0001$  for others). Additionally, younger maternal age and lower income were the risk factors for depression ( $p=0.0065$  and  $p=0.0429$ ), while paternal alcohol use increased the symptoms of depression and insomnia in perinatal women ( $p=0.0232$  and  $p=0.0159$ ). Moreover, no family support during the perinatal period, interruption of routine perinatal examinations, and nonbreastfeeding were related to anxiety symptoms ( $p=0.0329$ ,  $p=0.0018$ , and  $p=0.0351$ , respectively).

### Multivariate Analysis

The regression multivariate analysis for perinatal symptoms of depression, anxiety, and insomnia 1 year after the peak of the COVID-19 epidemic is shown in –Table 2 (pregnant women) and –Table 3 (postpartum women).

Pregnant women, who had a need for psychological counseling, were more likely to report symptoms of depression (OR = 2.663,  $p < 0.0001$ ), anxiety (OR = 2.418,  $p < 0.0001$ ), and insomnia (OR = 1.869,  $p < 0.0001$ ), while the worries, especially for the very worried level, caused by COVID-19 was a significant risk factor for depression (OR = 2.281,  $p = 0.0147$ ), anxiety (OR = 7.219,  $p < 0.0001$ ), and insomnia (OR = 2.297,  $p = 0.0056$ ). Additionally, the symptoms of depression and anxiety observed in unemployed pregnant women were roughly 1.6 times (OR = 1.630,  $p = 0.0098$  and OR = 1.645,  $p = 0.0070$  for depression and anxiety, respectively) more than those in employed ones. The flu-like symptoms for pregnant women in this study were significantly associated with depression and anxiety symptoms (OR = 1.618,  $p = 0.0149$  and OR = 1.699,  $p = 0.0057$  for depression and anxiety, respectively). Moreover, younger maternal age and

<b>Table 2</b> Multiple regression analysis of depression, anxiety, and insomnia symptoms for pregnant women			
Variables	aOR	95%CI	p-Value
<b>Depression</b>			
Maternal age, $\leq 30$ y	1.460	1.064–2.000	<b>0.0191</b>
Unemployed	1.630	1.125–2.360	<b>0.0098</b>
Family annually income (Yuan) <sup>b</sup>			
>200,000	0.705	0.382–1.303	0.2654
50,000–200,000	0.872	0.492–1.546	0.6396
<50,000	Reference		
Diseases before pregnancy	1.860	1.138–3.039	<b>0.0132</b>
Paternal smoking	1.261	0.870–1.828	0.2206
Paternal alcohol drinking	1.452	1.000–2.108	0.0500
<b>Severity of worry about COVID-19</b>			
Very worried	2.281	1.176–4.425	<b>0.0147</b>
Worried	1.571	0.892–2.766	0.1178
A little worried	1.423	0.966–2.096	0.0744
Not worried	0.962	0.614–1.508	0.8671
Not worried at all	Reference		
Flu-like symptoms <sup>a</sup>	1.618	1.098–2.383	<b>0.0149</b>
The need of psychological counseling	2.663	1.938–3.659	<b>&lt;0.0001</b>
<b>Anxiety</b>			
Maternal age, $\leq 30$ y	1.256	0.901–1.748	0.1777
<b>Gestation</b>			
Third trimester	1.599	0.975–2.620	0.0627
Second trimester	1.053	0.645–1.721	0.8362
First trimester	Reference		
Unemployed	1.645	1.146–2.361	<b>0.0070</b>
Diseases before pregnancy	1.471	0.915–2.366	0.1108

(Continued)

**Table 2** (Continued)

Variables	aOR	95%CI	p-Value
Severity of worry about COVID-19			
Very worried	7.219	3.782–13.782	<0.0001
Worried	2.454	1.374–4.383	0.0024
A little worried	1.593	1.038–2.444	0.0331
Not worried	1.183	0.713–1.963	0.5146
Not worried at all	Reference		
Flu-like symptoms <sup>a</sup>	1.699	1.166–2.474	0.0057
The need of psychological counseling	2.418	1.744–3.352	<0.0001
Insomnia			
Gestation			
Third trimester	2.115	1.341–3.334	0.0013
Second trimester	1.202	0.765–1.889	0.4244
First trimester	Reference		
Unemployed	1.287	0.908–1.824	0.1561
Family annually income (Yuan)			
> 200,000	0.751	0.417–1.352	0.3400
50,000–200,000	0.875	0.507–1.510	0.6316
<50,000	Reference		
Paternal smoking	1.365	0.971–1.919	0.0734
Severity of worry about COVID-19			
Very worried	2.297	1.276–4.136	0.0056
Worried	1.589	0.922–2.739	0.0956
A little worried	1.159	0.787–1.708	0.4550
Not worried	0.859	0.542–1.360	0.5167
Not worried at all	Reference		
Flu-like symptoms <sup>a</sup>	1.203	0.839–1.726	0.3139
The need of psychological counseling	1.869	1.377–2.537	<0.0001

Abbreviations: aOR; adjusted odds ratio; CI, confidence interval; COVID-19, coronavirus disease 2019.

<sup>a</sup>Including cold, cough, fever (> 37.3°C), chest tightness.

<sup>b</sup>1 dollar = 6.7 yuan.

**Table 3** Multiple regression analysis of depression, anxiety, and insomnia symptoms for postpartum women

Variables	aOR	95%CI	p-Value
Depression			
Unemployed	2.366	1.323–4.231	0.0037
Neonatal birthweight			
< 2,500 g	0.425	0.149–1.213	0.1098
2,500–4,000 g	Reference		
≥4,000 g	1.927	0.725–5.121	0.1882
Severity of worry about COVID-19			
Very worried	2.871	1.341–6.144	0.0066
Worried	3.050	1.219–7.630	0.0172
A little worried	1.525	0.892–2.607	0.1234
Not worried	1.132	0.584–2.193	0.7127
Not worried at all	Reference		



**Table 3** (Continued)

Variables	aOR	95%CI	p-Value
Flu-like symptoms <sup>a</sup>	1.924	1.163–3.183	<b>0.0109</b>
The need of psychological counseling	3.914	2.518–6.084	<b>&lt;0.0001</b>
<b>Anxiety</b>			
Unemployed	2.262	1.340–3.820	<b>0.0023</b>
Cesarean delivery	1.328	0.877–2.009	0.1798
Nonbreastfeeding	1.479	0.974–2.246	0.0666
<b>Severity of worry about COVID-19</b>			
Very worried	3.913	1.958–7.821	<b>0.0001</b>
Worried	4.534	1.927–10.672	<b>0.0005</b>
A little worried	1.933	1.157–3.230	<b>0.0119</b>
Not worried	1.312	0.693–2.486	0.4045
Not worried at all	Reference		
Without family support during childbirth	1.657	0.968–2.837	0.0656
Medical appointments delayed due to COVID-19	1.239	0.695–2.208	0.4669
Infants' vaccination delayed by COVID-19	1.378	0.682–2.787	0.3715
Flu-like symptoms <sup>a</sup>	1.428	0.909–2.243	0.1221
The need of psychological counseling	3.206	2.110–4.870	<b>&lt;0.0001</b>
<b>Insomnia</b>			
<b>Severity of worry about COVID-19</b>			
Very worried	2.195	1.195–4.033	<b>0.0113</b>
Worried	1.992	0.985–4.030	0.0552
A little worried	1.421	0.879–2.295	0.1514
Not worried	1.590	0.872–2.899	0.1304
Not worried at all	Reference		
The need of psychological counseling	2.321	1.578–3.413	<b>&lt;0.0001</b>

Abbreviations: aOR; adjusted odds ratio; CI, confidence interval; COVID-19, coronavirus disease 2019.

<sup>a</sup>Including cold, cough, fever (>37.3°C), chest tightness.

previous diseases before pregnancy also increased the risk of prenatal depression (OR = 1.460,  $p = 0.0191$  and OR = 1.860,  $p = 0.0132$ ). Furthermore, pregnant women who were in the third trimester were more likely to have insomnia symptoms compared with those in the first and second trimesters (OR = 2.115,  $p = 0.0013$ ).

Postpartum women, similar to pregnant women, who needed psychological counseling and were worried due to COVID-19, were more likely to experience the symptoms of depression, anxiety, and insomnia. In addition, unemployed status was associated with the symptoms of depression and anxiety (OR = 2.366,  $p = 0.0037$  and OR = 2.262,  $p = 0.0023$ , respectively). Different from pregnant women, the flu-like symptoms were only associated with depression symptoms for postpartum women (OR = 1.924,  $p = 0.0109$ ).

## Discussion

To the best of our knowledge, this was the first study to investigate the long-term mental symptoms among perinatal women about 1 year after the peak of the COVID-19 epidemic in China. A total of 1,246 perinatal women were enrolled, with

the overall prevalence of depression, anxiety, and insomnia symptoms being 63.16, 41.89, and 44.38%, respectively. Moreover, the perinatal women who needed psychological counseling and were very worried about the pandemic were more likely to report symptoms of depression, anxiety, and insomnia. Furthermore, unemployment, flu-like symptoms, younger maternal age, and previous diseases before pregnancy were significant risk factors for depression, anxiety, or insomnia.

Previous studies have found that the prevalence of perinatal mental disorders increased obviously during the COVID-19 pandemic.<sup>28</sup> Although the prevalence of perinatal mental symptoms during the peak of the COVID-19 pandemic varies in different studies,<sup>20,29–31</sup> most of them suggested a higher prevalence of perinatal depression and anxiety during this period than before the pandemic.<sup>32–34</sup> A study conducted by Zeng et al in China reported that the prevalence of perinatal depression, anxiety, and insomnia symptoms was decreased during the remission phase of COVID-19 when compared to the phase immediately after the peak of the pandemic.<sup>22</sup> However, our study found that the prevalence of perinatal depression, anxiety, and insomnia symptoms still kept at a high level when the pandemic was

basically controlled 1 year after the peak. The prevalence of perinatal psychological symptoms in Guangzhou study may be just a sudden and acute decrease as the lockdown policy lifted and specific healthcare guidelines released for perinatal women. With a further understanding of COVID-19 and effective measures of prevention and control in China, the fear began subsiding gradually, and the pandemic-related chronic mental symptoms began to appear. In addition, although China has achieved the initial success in epidemic prevention and control, the virus is still spreading rapidly all over the world, resulting in the continuous existence of imported cases and associated local cases in some individual provinces and cities in China. Moreover, the duration of COVID-19 in the world is still unknown, which makes China face the pressure of prevention and control for a long time. In the situation of COVID-19 prevention and control, the lives and behaviors of perinatal women have been affected which might be a significant psychological stressor. Furthermore, the results of the current study in perinatal women were consistent with those demonstrated in the general population, which showed that the prevalence of depression and anxiety symptoms were still at a high level 1 year after the COVID-19 outbreak.<sup>35</sup>

The need for mental health services for the general population rose significantly after the COVID-19 pandemic, especially in young, female, and moderately educated people. Nearly half of the perinatal women needed psychological counseling in our study, and the proportion of psychological counseling needs in the groups with symptoms of depression, anxiety, and insomnia (59.97, 65.71, and 60.58%, respectively) was significantly higher than in the nonsymptom group (31.81, 37.98, and 40.84%, respectively), revealing that perinatal women who needed psychological counseling had a higher prevalence of depression, anxiety, and insomnia symptoms. This is consistent with the previous report showing that depressed mothers have significantly higher needs for psychological rehabilitation guidance than nondepressed mothers.<sup>36</sup> This suggests that it might be necessary to require a survey of psychological needs for perinatal women in pregnancy or postnatal period to identify those with a risk of adverse psychological disorder and, then, provide professional psychological interventions as early as possible to help them alleviate their negative emotions.

Perinatal women were expected to particularly concern about themselves and fetal health, and it was already proved that the fear and worry about COVID-19 of perinatal women were statistically significantly associated with perinatal depression and anxiety during the COVID-19 outbreak.<sup>20,37,38</sup> Similarly, our investigations showed that the scores of depression, anxiety, and insomnia symptoms were high in perinatal women who were very worried about COVID-19 even 1 year after the COVID-19 outbreak. The worries of participants in our study may be mainly due to the COVID-19 imported and associated local cases and the unknown duration of COVID-19.

The association between unemployment and mental health in our study is consistent with previous investigations,<sup>39-42</sup> showing that both pregnant and postpartum

women who were unemployed in our study had a higher risk of depression and anxiety. Housewives or women who were unemployed have less interpersonal communication, less socialization, loneliness, more family conflicts, and greater economic pressure and lower socioeconomic status, which could increase the risk of mental problems during the perinatal period.<sup>43-45</sup> Besides, social interactions reduced during the pandemic, which may have further led to adverse psychological health. Younger maternal age was found to be a risk factor for prenatal depression according to our multivariate analysis, which is consistent with the results shown in previous studies during the peak of the COVID-19 epidemic.<sup>15,16,46,47</sup> This is probably because most new mothers play the main role of caregiver in the family, and younger mothers perhaps lack the experience of caring for a newborn or handling negative emotions.<sup>47</sup>

Previous illness before pregnancy, including diabetes, hypertension, and thyroid dysfunction, was found to increase the risk of prenatal depression in our investigations. This is similar to the research showing that women with complications during pregnancy were more likely to have higher levels of prenatal anxiety.<sup>30,48</sup> The history of these illnesses is believed to increase the risk of pregnancy complications and has the likelihood to affect maternal and fetal health, thus increasing the worries of pregnant women. Therefore, medical workers can provide early screening for pregnant and postpartum women with a history of illness and offer some guidance to help these women increase their confidence.

Previous reports have shown that the general population who presented with specific symptoms, such as coryza, cough, or sore throat experienced a higher level of stress, anxiety, and depression during the COVID-19 pandemic.<sup>6</sup> Another report also demonstrated that persistent fever significantly increased the level of depression in postnatal women during the COVID-19 pandemic.<sup>21</sup> Our findings have the similar results, showing that the flu-like symptoms, including cold, cough, fever, and chest tightness, were significantly associated with the symptoms of prenatal depression and anxiety and postpartum depression. This may be because the people who had these physical symptoms would be quarantined or admitted to the hospital for further examinations during the pandemic period. Especially in case of perinatal women, they may also worry about their baby's health being affected by the flu-like symptoms.

Our multivariate analysis revealed that the women in the third trimester were at a higher risk of prenatal insomnia compared with those in the first and second trimesters, and a similar tendency was found with prenatal anxiety with borderline significant association (OR = 1.599,  $p = 0.0627$ , **Table 2**). This may be due to the body change in late pregnancy, leading to frequent wake-up at the night and affected sleep.

The study from Chongqing China indicated that actively smoking among pregnant women could reduce pressure and bring happiness, leading less likely to mental problems.<sup>39</sup> On the contrary, a previous study on 403 pregnant women from Turkey showed that pregnant women who were smokers had a higher anxiety level.<sup>30</sup> In our study, fewer women were

smoking and drinking during pregnancy, but paternal smoking and drinking were found to increase the symptoms of prenatal insomnia and depression with borderline significant associations (OR = 1.365,  $p = 0.0734$  for the association of smoking and insomnia symptoms and OR = 1.452,  $p = 0.0500$  for the association of drinking and depression symptoms, ▶Table 2).

Previous studies have pointed out that formula feeding is a risk factor for postpartum depression, and women who breastfed did not experience depression, as breastfeeding could increase the mother–infant relationship.<sup>49</sup> In addition, support from family, partner, and friends is crucial for perinatal women to ease negative emotions.<sup>50</sup> In our study, although the risk of anxiety among nonbreastfeeding women and those without family support during childbirth were not significant, the associations were at borderline after adjusting for other associated factors (OR = 1.479,  $p = 0.0666$  for nonbreastfeeding women; OR = 1.657,  $p = 0.0656$  for women without family supports during delivery, ▶Table 3).

## Conclusion

The prevalence of perinatal depression, anxiety, and insomnia symptoms was at a high even 1 year after the COVID-19 pandemic outbreak, implying that the COVID-19 pandemic-associated long-term chronic psychological impacts on perinatal women existed. This suggested that government and health care professionals should not only pay attention to the acute effects of the psychological health but also to the long-term psychological impacts on perinatal women after major social events.

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### Conflict of Interest

None declared.

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