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Anxiety and depression among perinatal women during the long-term normal prevention of COVID-19 pandemic period in China: a cross-sectional study

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Abstract

Background COVID-19 has increased the probability of occurrence of maternal anxiety and depression in pregnant women. However, there is limited research on anxiety and depression among pregnant women during the long-term normal prevention of COVID-19 pandemic period. This study aimed to examine the anxiety and depression and influencing factors among perinatal women during the long-term normal prevention of COVID-19 pandemic period in China.

Methods A cross-sectional survey was designed. A total of 1338 pregnant women were studied. The prenatal anxiety and depression were assessed by the Self-rating Anxiety Scale (SAS) and the Self-rating Depression Scale (SDS), respectively. Postnatal depression was assessed by the Edinburgh Postpartum Depression Scale (EPDS) in 10–14 days after delivery. The data analysis was processed by SPSS9.0. Descriptive analysis was expressed by mean and standard deviation. The counting data were expressed by percentage, χ^2 test, multiple linear regression and binary logistic regression.

Results The incidence of prenatal anxiety (SAS score ≥ 50) was 27.95% (374 cases), prenatal depression (SDS score ≥ 0.5) was 34.01% (455 cases), and postpartum depression (EPDS score ≥ 0.5) was 25.04% (335 cases). Both the prenatal SAS score ($r = 0.635$, $P < 0.001$) and prenatal SDS score ($r = 0.738$, $P < 0.001$) were related to postpartum depression. Pregnant women who were younger than 35 years, in middle household income, lower education level, underweight before pregnancy, primiparous, and fear of being infected were at increased risk for developing anxiety and depression during the long-term normal prevention of COVID-19 pandemic.

Conclusions The incidences of postpartum depression among perinatal women during the long-term normal prevention of COVID-19 pandemic period were a little lower than those during the COVID-19 outbreak period, but still higher than those before the COVID-19.

Keywords Anxiety, Depression, Perinatal, Pregnant women, COVID-19, Long-term normal pandemic prevention

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Introduction

Coronavirus disease of 2019 (COVID-19) was a highly contagious respiratory tract infection disease caused by Severe Acute Respiratory Syndrome Coronavirus type 2 (SARS-CoV-2) resulting in a global pandemic status [1, 2]. Shortly after been recognized, the outbreak of COVID-19 was declared a public health emergency of international concern by World Health Organization [3]. The COVID-19 pandemic had profound effects on health-care systems, societal structures, and the world economy. Due to the characteristics of strong infectivity, large number of infected persons, high proportion of early critical cases and high mortality rate, COVID-19 caused people severe physical and mental trauma, especially to perinatal pregnant women [4–6].

Pregnancy, as a vulnerable population, is a particularly vulnerable time when psychological distress can have negative consequences for both mother and baby. Since women tend to report higher symptoms of anxiety and depression during disease outbreaks than men, pregnant women during the COVID-19 pandemic may be especially affected [7, 8]. Pregnant women in the perinatal period were often accompanied by a series of physiological and psychological changes. Pregnant women may be of a particular concern, as anxiety has been described as a common psychological problem during pregnancy [9]. Postpartum depression was considered to be one of the most common psychiatric complications of childbirth and was a major cause of maternal mortality worldwide. Prenatal anxiety and depression symptoms may also cause changes in physical activity, nutrition, and sleep, which in turn affect maternal mood and fetal development. Anxiety and depression during pregnancy increased the risk for miscarriage, preterm birth, lower birth weight, lower Apgar score, and fetal death [10]. Children of mothers who experienced high stress and depression during pregnancy are more likely to have cognitive and behavioral problems, and are at higher risk for later mental health problems [11, 12]. Thus, pregnant women, as a group, may be more likely to experience elevated depressive symptoms in response to the pandemic than are non-pregnant women, and among pregnant women, those who experience more severe stress and adversity may be at highest risk [13].

In recent years, maternal anxiety and depression during the perinatal period has been one of the key issues that obstetrics and gynecology and psychiatric medical staff focused on [14]. During the COVID-19 pandemic, nationwide lockdowns, disruption of health-care services, and fear of attending health-care facilities also affected the wellbeing of pregnant people and their babies. These increased the probability of occurrence of maternal anxiety and depression [15, 16]. There has been plenty of studies on the anxiety and depression among

pregnant women during the outbreak of COVID-19 [17]. Previous research showed that anxiety and depression of pregnant women from US, Europe, Türkiye, and China would increase during the outbreak of COVID-19 [18–21]. Generally, anxiety and depression symptoms in pregnancy typically affect between 10 and 20% of pregnant individuals [7]. In China, pregnant women during COVID-19 outbreak had significantly higher rates of depressive symptoms (29.6%). The main risk factors for developing depressive and anxiety during the outbreak included underweight before pregnancy, primiparous, younger than 35 years, employed full time, in middle income category, and with appropriate living space were at increased risk symptoms [22]. In the early phase of the COVID-19 outbreak, pregnant individuals in Canada are experiencing substantially elevated anxiety and depression symptoms that are significantly related to COVID-19 specific worries about threats to their own lives, their baby's health, not getting enough prenatal care, and social isolation [7]. Women who were pregnant in the San Francisco during the pandemic were nearly twice as likely to have possible depression than were matched women who were pregnant prior to the pandemic [23]. After the outbreak period of COVID-19, it entered a long-term normal prevention of COVID-19 pandemic period, which means an ordinary long-term normal state of pandemic prevention and control for a long period of time (several months or several years). In the long-term normal prevention period people can basically return to long-term normal life and work while taking protective measures. There were 3 different COVID-19 situations in China, i.e. the COVID-19 outbreak period (3 months from 2019 winter), the long-term normal prevention period (3 years from 2020 spring) and release the lock down and strict control (from 2022 December). The long-term normal prevention period lasted the longest time (nearly 3 years) and it greatly affected people's life and mental health. Therefore, we chose this survey time period. However, there is limited research on the anxiety and depression among pregnant women during the long-term normal prevention of COVID-19 pandemic period. Therefore, it is urgent to explore the mental health and risk factors of depression among perinatal women during the long-term normal prevention of COVID-19 pandemic period in China.

In this study, a questionnaire survey was conducted to investigate the anxiety and depression among perinatal women, to clarify the main factors of the depression and provide effective treatment suggestions. It was helpful to provide strategies and reference for clinical intervention to reduce the depression of pregnant women during the long-term normal prevention of COVID-19 pandemic period. The highlight of this study included that this study examined the anxiety and depression of pregnant women

and the corresponding risk factors during the long-term normal prevention of COVID-19 pandemic period. It not only studied the prenatal anxiety and depression, but also explored the postnatal depression. It filled up the gap that most research focused on the COVID-19 outbreak period and few reported the mental health of pregnant women during the relatively long-term normal prevention of COVID-19 pandemic period.

Methods

Participants

A total of 1338 pregnant women hospitalized to our hospital for delivery from January 1 to June 30, 2022 were selected as the research subjects. Inclusion criteria: ① be able to complete the questionnaire; ② prenatal examination indicators are normal; ③ no infection of COVID-19; ④ volunteer to participate in this survey. Exclusion criteria: ① severe pregnancy complications or comorbidity, repeated abortion, high-risk pregnancy; ② patients diagnosed with COVID-19; ③ with mental disorders and poor communication ability; ④ with depression before pregnancy, severe sleep apnea syndrome and sleeping pill dependence; ⑤ patients with past or present history of substance use.

Questionnaire survey

This was a cross-sectional study through a self-administered questionnaire [24]. The questionnaire survey was used to investigate the related factors affecting maternal psychological status. The anonymous survey questionnaire was designed with three sections to collect data regarding: (1) background demographic, pregnancy status; (2) attitudes towards COVID-19; (3) anxiety and depression status. The content of the questionnaire was reviewed and pretested by professors in psychiatry and obstetrics.

Demographic characteristics of participants

The demographic characteristics of the participants included in this questionnaire were developed by the research panel, which was composed by multidisciplinary specialists in obstetrics and psychiatry, including clinical doctors and psychologist. In addition, some authoritative research results and references were consulted [25, 26]. The demographic data of participants mainly included gestational age, place of residence, education level, annual family income, occupation, body mass index (BMI), parity (nullipara or multipara), gestational week, ways of conception, delivery mode, severe pain during delivery, comorbidity and complication (including gestational hypertension, gestational diabetes, intrahepatic cholestasis and cervical disease), sleep quality, family support, worrying side effects of prenatal chest CT examination on fetal development, fear of disrupted the

scheduled pregnant inspection, worrying about difficulty in hospitalization, fear of being infected COVID-19, fear of losing the job position after delivery, and knowledge of COVID-19, and so on.

Prenatal anxiety and depression

The prenatal anxiety was assessed using Zung' Self-rating Anxiety Scale (SAS)[27], which consisted of 20 items with 1, 2, 3 and 4 points for each item. The total raw score, i.e. the sum of each item, ranged among 20–80 points. The standard score was calculated using the total raw score multiplied by 1.25. A standard score < 50 points was not considered anxiety. A standard score ≥ 50 indicated anxiety status, i.e. standard scores of 50–59, 60–69 and ≥ 70 were considered mild, moderate and severe anxiety, respectively. The anxiety was more serious with the increasing standard score. The prenatal depression was evaluated by Zung' Self-rating Depression Scale (SDS)[27]. The scale consisted of 20 items, each of which was assigned 1, 2, 3 and 4 points, and the total score of the items was 20–80 points. The depression severity degree was measured by the value of total score of each item divided by 80. It was considered as no depression when the total score was less than 0.5. It was considered depression only when the total score was 0.5 or above.

Postpartum anxiety and depression

Edinburgh Postnatal Depression Scale (EPDS) was used to evaluate postpartum depression symptoms within 10–14 days after delivery [28]. The scale included 10 sub-items, with scores of 0, 1, 2 and 3 points for each item, with a total score of 0–30 points. The total score with more than 13 points was diagnosed as postpartum depression, and the higher the score, the more serious postpartum depression.

Data analysis

The data statistical analysis was processed by IBM SPSS Statistics for Windows, version 19 (IBM Corp., Armonk, N.Y., USA). Descriptive analysis was expressed by mean and standard deviation. The counting data were expressed and analyzed by percentage, χ^2 test, multiple linear regression and binary Logistic regression. Pearson linear correlation analysis was used to analyze the correlation between the two variables. $P < 0.05$ mean the difference was statistically significant [29].

All factors related to pregnant women's background and their attitude towards COVID-19 were selected as independent variables. Multivariate linear regression analysis was used to determine the effect of these factors on the anxiety and depression status [30].

Ethical consideration

The study protocol was approved by the Ethics Committee of the Affiliated Hospital of Qingdao University, China. Relevant guidelines were followed to ensure that the study was voluntary and confidential. The informed consent was obtained with completing the questionnaire.

Table 1 Demographic and obstetrics characteristics of participants (n = 1338)

| Characteristics | Mean ± SD or N (%) |
|---|-------------------------|
| age (years) (Mean ± SD) | 27–32 (31.50 ± 3.48) |
| < 35 | 1148 (85.80) |
| ≥ 35 | 190 (14.20) |
| place of residence | |
| urban areas | 1046 (78.18) |
| rural areas | 292 (21.82) |
| education level | |
| high school or below | 188 (14.05) |
| university | 857 (64.05) |
| post-graduate | 293 (21.90) |
| annual family incomes (RMB) | |
| low (< 100,000) | 409 (30.57) |
| middle (100,000–400,000) | 696 (52.02) |
| high (> 400,000) | 233 (17.41) |
| employment | |
| employed | 990 (73.99) |
| unemployed | 348 (26.01) |
| BMI median (range (kg/m ²)) | 20.5 (19.2–22.8) |
| < 18.5 | 128 (9.57) |
| 18.5–23.9 | 968 (72.35) |
| ≥ 24 | 242 (18.09) |
| parity | |
| primiparous | 948 (70.85) |
| multiparous | 390 (29.15) |
| gestational week, | |
| ≥ 38 | 1221 (91.26) |
| < 37 | 117 (8.74) |
| ways of conception | |
| natural | 1230 (91.93) |
| assisted reproductive technology | 108 (8.07) |
| delivery mode | |
| vaginal | 616 (46.04) |
| cesarean | 722 (53.96) |
| severe pain during delivery | 663 (49.55) |
| comorbidity and complication | 107 (8.00) |
| poor family support | 639 (47.76) |
| poor sleep quality | 617 (46.11) |
| worrying side effects of prenatal CT | 893 (66.74) |
| fear of disrupted the scheduled pregnant inspection | 700 (52.32) |
| worrying about difficulty in hospitalization | 438 (32.74) |
| fear of being infected COVID-19 | 1016 (75.93) |
| fear of losing the job position after delivery | 710 (53.06) |
| lack of knowledge of COVID-19 | 715 (53.43) |

Results

Participants' demographic characteristics

A total of 1338 parturient women were included in this study. The majority of the pregnant women were with age of younger than 35 (85.80%), university degree (64.05%), a middle annual family income (52.02%), BMI between 18.5 and 23.9 kg/m² (64.87%), nullipara (70.85%), Spontaneous pregnancy (91.93%), and with good family support (68.98%). The detailed demographic and obstetrics characteristics of the participants was presented in Table 1.

Correlation between prenatal anxiety/depression and postpartum depression

During the long-term normal prevention of COVID-19 pandemic period, the incidence of prenatal anxiety was 27.95% (SAS ≥ 50, 374 cases), prenatal depression 34.01% (SDS ≥ 0.5, 455 cases), and postnatal depression 25.04% (EPDS ≥ 13, 335 cases). The correlation analysis between prenatal anxiety/depression and the occurrence of postpartum depression showed that the higher the prenatal SAS score was, the higher the risk of postpartum depression was. A significant positive correlation was found between prenatal anxiety and postpartum depression ($r=0.635$, $P<0.001$). In addition, the higher the prenatal SDS score, the higher the risk of depression. There also existed a significant positive correlation between prenatal depression and postnatal depression ($r=0.738$, $P<0.001$), which was shown in Table 2.

Related risk factors for prenatal anxiety and depression

We explored risk factors for prenatal anxiety and depression during the long-term normal prevention of COVID-19 pandemic. Compared with pregnant women without prenatal anxiety (SAS < 50), women were at increased risk for prenatal anxiety if they were those who with (1) an age younger than 35 years, (2) an education of below high school, (3) a low annual household income, (4) a BMI of less than 18.5 kg/m², (5) a parity of nullipara, (6) an assisted reproductive technology, (7) pregnancy complications, (8) a delivery mode of cesarean, (9) severe pain, (10) poor sleep quality, (11) poor family support, (12) worrying about the adverse impact of prenatal chest CT examination, (13) fear of disrupted the scheduled pregnant inspection, (14) worrying about difficulty in hospitalization, (15) fear of being infected COVID-19, (16) fear of losing the job position after delivery, and (17) shortage of knowledge of COVID-19. Those who had fever, cough, diarrhoea or symptoms of suspected infection were more likely to have anxiety than healthy women.

Compared with pregnant women without prenatal depression (SDS < 0.5), women at higher risk for depressive symptoms included those with age younger than 35 years, a BMI of less than 18.5 kg/m², a below college education, a middle annual household income, a parity

Table 2 Correlation between prenatal anxiety and depression and postpartum depression

| item | Cases (%) | EPDS ≥ 13 | EPDS < 13 | postpartum depression (%) | r | P |
|-----------|-------------|-----------|-----------|---------------------------|-------|--------|
| SAS < 50 | 964 (72.05) | 63 | 901 | 6.54 | 0.148 | 0.113 |
| SAS ≥ 50 | 374 (27.95) | 272 | 102 | 72.73 | 0.635 | <0.001 |
| SDS < 0.5 | 883 (65.99) | 36 | 847 | 4.08 | 0.251 | 0.016 |
| SDS ≥ 0.5 | 455 (34.01) | 299 | 156 | 65.71 | 0.738 | <0.001 |

of nullipara, an assisted reproductive technology, pregnancy complications, fear of losing the job position after delivery, fear of being infected COVID-19, disrupted the scheduled pregnant inspection, poor family support, poor sleep quality. The participants' knowledge, attitudes, and practice regarding the COVID-19 pandemic seemed to easily impact the depressive symptoms during the long-term normal pandemic prevention of COVID-19. The analysis of related factors of antenatal anxiety and depression was shown in Table 3.

Univariate analysis of factors of postpartum depression

Compared with non-depressed puerperal women (EPDS < 13), postpartum depression was significantly higher in pregnant women who were younger than 35 years, fear risk of COVID-19 infection (%), shortage of knowledge on COVID-19, a lower education level, a middle annual household income, a parity of nullipara, assisted reproductive technology, disrupted the scheduled pregnant inspection, poor family support, poor sleep quality, pregnancy complications, and with a BMI < 18.5 kg/m². The detailed univariate analysis of factors of postpartum depression was shown in Table 4.

Multivariate linear regression analysis of factors of postpartum depression

Multivariate linear regression was performed to explore the factors most associated with postpartum depression. The significant variables of univariate analysis were taken as independent variables and EPDS score as dependent variables. Of the probable factors related to the development of postpartum depression that were entered into multivariate logistic regression analysis, five factors were found to be significant. The general demographic background characteristics were determined to be significant to the development of postpartum depression, which included younger than 35 years, a lower education level, a middle annual household income and a BMI < 18.5 kg/m². In addition, the pregnancy characteristics were also significant to the development of postpartum depression. The postpartum depression risk was higher among women who were with a parity of nullipara, assisted reproductive technology, disrupted the scheduled pregnant inspection, and pregnancy complications. Finally, the attitudes towards COVID-19 were associated with anxiety status. Those with relatively more knowledge

about COVID-19, a rational risk perception and enough family care were less likely to be postpartum depression.

A subgroup analysis was conducted to explore risk factors specifically associated with depressive symptoms during the long-term normal pandemic prevention of COVID-19. The occurrence of depressive symptoms was taken as the dependent variable, and logistic regression analysis was performed. The results showed that the significant risk factors for postpartum depression symptoms during the long-term normal pandemic prevention of COVID-19 included fear of being infected ([odds ratio] OR=3.924, 95% [confidence interval] CI: 1.692–8.586, P=0.001), low education level (OR=2.608, 95%CI:1.231–6.549, P=0.034), pregnancy complications (OR=2.524, 95%CI: 1.086–6.242, P=0.042), poor family care (OR=2.456, 95%CI: 1.068–5.698, P=0.032), and few knowledge of COVID-19 (OR=2.458, 95%CI:1.012–6.032, P=0.036). Multifactor regression analysis of influencing factors of postpartum depression was shown in Table 5.

Discussion

As a special population, pregnant women were more susceptible to psychological problems such as anxiety and depression due to changes in endocrine hormones, weakened psychological responses and the continuation of negative emotions. The global incidence of postpartum depression was estimated to be approximately 10–20%, depending on the different sample and methodology. The incidence of postpartum depression in China was 12.2% [31, 32]. Pregnant women during the long-term normal prevention of COVID-19 pandemic period were more likely to suffer from anxiety and depression due to receiving more information about the pandemic and difficulties in seeking medical care. The depressive symptom among the pregnant women was about 26–56.3% during COVID-19 pandemic, including 40% in US [33], 37% in Canada [34], 56.3% in Türkiye [35] and 29.6% in China [21]. In this study, the results showed that the incidence of prenatal anxiety (SAS score ≥ 50) was 27.95% (374 cases), that of prenatal depression (SDS score ≥ 0.5) was 34.01% (455 cases), and postpartum depression (EPDS score ≥ 0.5) was 25.04% (335 cases). The anxiety and depression incidences in this study were higher than those reported in Shenzhen [36]. Both the prenatal SAS score (r=0.635, P<0.001) and prenatal SDS score (r=0.738, P<0.001) were related to postpartum

Table 3 Related factors of prenatal anxiety and depression [cases (%)]

| | Prenatal anxiety | | | Prenatal depression | | |
|---|------------------|-------------|--------|---------------------|-------------|--------|
| | SAS < 50 | SAS ≥ 50 | P | SDS < 0.5 | SDS ≥ 0.5 | P |
| total | 964 (72.05) | 374 (27.95) | - | 883 (65.99) | 455 (34.01) | - |
| age: <35 | 810 (84.02) | 338 (90.37) | <0.001 | 717 (81.20) | 431 (94.73) | <0.001 |
| education: high school or below | 68 (7.05) | 120 (32.09) | <0.001 | 62 (7.02) | 126 (27.69) | <0.001 |
| income: low | 179 (18.57) | 230 (61.50) | <0.001 | 163 (18.46) | 246 (54.07) | <0.001 |
| BMI (kg/m ²): <18.5 | 67 (6.95) | 161 (43.05) | <0.001 | 55(6.23) | 173(38.02) | <0.001 |
| parity: primiparous | 609 (63.17) | 339(90.64) | <0.001 | 550 (62.29) | 398(87.47) | <0.001 |
| conception mode: assisted reproductive technology | 52(5.39) | 56 (14.97) | <0.001 | 46(5.21) | 62(13.63) | <0.001 |
| pregnancy complications | 44(4.56) | 63(16.84) | <0.001 | 41(4.64) | 66(14.51) | <0.001 |
| delivery mode: cesarean | 391 (40.56) | 331(88.50) | <0.001 | 370(41.90) | 352(77.36) | <0.001 |
| poor sleep quality | 299 (31.02) | 318 (85.03) | <0.001 | 303 (34.31) | 314 (69.01) | <0.001 |
| poor family support | 337 (34.96) | 302 (80.75) | <0.001 | 334 (37.83) | 305 (67.03) | <0.001 |
| fear of the adverse impact of chest CT examination | 560 (58.09) | 333 (89.03) | <0.001 | 488 (55.27) | 405 (89.01) | <0.001 |
| fear of adverse impact of disrupted scheduled pregnant inspection | 453 (46.99) | 247 (66.04) | 0.013 | 410 (46.43) | 290 (63.74) | 0.018 |
| worrying about difficulty in hospitalization | 280 (29.05) | 158 (42.25) | 0.070 | 292 (33.07) | 223 (49.01) | 0.028 |
| fear of being infected COVID-19 | 656(68.05) | 360 (96.26) | <0.001 | 597 (67.61) | 419 (92.09) | <0.001 |
| fear of losing job after delivery | 463 (48.03) | 247 (66.04) | 0.016 | 380 (43.04) | 330 (72.53) | 0.007 |
| lack of knowledge of COVID-19 | 434 (45.02) | 281 (75.13) | <0.001 | 364 (41.22) | 351 (77.14) | <0.001 |
| severe pain | 435 (45.12) | 228(60.96) | 0.049 | 389(44.05) | 274 (60.21) | 0.046 |

Table 4 Univariate analysis of factors of postpartum depression [cases (%)]

| item | Postpartum depression | | χ^2 | P |
|---|-----------------------|----------------|----------|--------|
| | EPDS < 13 | EPDS \geq 13 | | |
| Total | 1003 (74.96) | 335 (25.04) | - | - |
| Age:<35 | 825(82.25) | 323 (96.42) | 20.32 | <0.001 |
| Education: high school or below | 58(5.78) | 130 (38.81) | 37.06 | <0.001 |
| Income: low | 130 (12.96) | 279 (83.28) | 23.36 | <0.001 |
| BMI (kg/m ²): <18.5 | 31(3.09) | 97 (28.96) | 30.59 | <0.001 |
| Parity: primiparous | 633 (63.11) | 315 (94.03) | 17.52 | <0.001 |
| Conception mode: assisted reproductive technology | 28 (2.79) | 80 (23.88) | 35.13 | <0.001 |
| Pregnancy complications | 29 (2.89) | 78 (23.28) | 30.16 | <0.001 |
| Delivery mode: cesarean | 429 (42.77) | 293(87.46) | 32.04 | <0.001 |
| fear of being infected COVID-19 | 673 (67.10) | 309 (92.24) | 27.60 | <0.001 |
| fear of the adverse impact of chest CT | 352 (35.09) | 255 (76.12) | 29.84 | <0.001 |
| poor sleep quality | 291 (29.01) | 245 (73.13) | 33.85 | <0.001 |
| poor family support | 301 (30.01) | 242 (72.24) | 30.46 | <0.001 |
| lack of knowledge of COVID-19 | 281 (28.02) | 252 (75.22) | 35.31 | <0.001 |
| severe pain | 352 (35.09) | 168 (50.15) | 4.72 | 0.029 |
| worrying about difficulty in hospitalization | 282 (28.12) | 141 (42.09) | 3.20 | 0.074 |
| fear of losing job position after delivery | 243 (24.23) | 212 (36.01) | 3.28 | 0.076 |
| fear of adverse impact of disrupted scheduled pregnant inspection | 251(25.02) | 117(34.93) | 3.43 | 0.077 |

depression, which were a litter lower than that during COVID-19 outbreak, but still higher than that before COVID-19 outbreak.

All those strongly indicated that incidence of anxiety and depression in perinatal mothers had significantly increased during the long-term normal prevention of

COVID-19 pandemic period. Only few research showed that the pregnant women had an advantage of facing mental problems caused by COVID-19 during the COVID-19 pandemic, showing fewer anxiety and depression [37]. The attitudes towards COVID-19 were associated with anxiety status. Those with relatively more knowledge about COVID-19 and with a rational risk perception, were less likely to be anxious [38]. Additionally, positive attitudes towards online medical consultation demonstrated a protective feature from anxiety, whereas those who opted for psychological consultation showed the opposite effect.

The main risk factor included young age, low education level, low annual household income, BMI < 18.5 kg/m², primiparous, assisted reproductive technology, pregnancy complications, cesarean, poor sleep quality, poor family support, fear of being infected and few knowledge of COVID-19. Pregnant women who were younger than 35 years and primiparous seemed to be more vulnerable to develop depressive symptoms because most of them had no experience of giving birth and they were more likely get nervous. Those pregnant women with assisted reproductive technology were easily to get anxiety and depression because the pregnancy process were more difficult for them and they were more worried about their babies' health. We found that pregnant women with low annual household income and fear losing job positions were likely to report anxiety because family income pressure would make them nervous. The annual family income factor was different with previous research which reported that pregnant women from middle-level income families were about half as likely to report anxiety than were those earning an extremely high or low wage [39]. The attitudes towards COVID-19 were associated with anxiety and depression status. Those with relatively more knowledge about COVID-19 and with a rational risk perception were less likely to be anxious because they were

Table 5 Multifactor regression analysis of influencing factors of postpartum depression

| factors | β | SE | Wald χ^2 | P | OR | 95% CI |
|--|---------|-------|---------------|-------|-------|-------------|
| age below 35 | 0.904 | 0.456 | 3.945 | 0.049 | 2.469 | 1.008–6.015 |
| low education level | 1.308 | 0.418 | 6.021 | 0.034 | 2.608 | 1.231–6.549 |
| low annual household income | 0.896 | 0.428 | 4.328 | 0.039 | 2.446 | 1.055–5.683 |
| BMI < 18.5 kg/m ² | 1.106 | 0.437 | 4.980 | 0.041 | 2.538 | 1.120–6.280 |
| primiparous | 1.138 | 0.423 | 5.175 | 0.037 | 2.527 | 1.143–6.116 |
| assisted reproductive technology | 0.901 | 0.442 | 4.135 | 0.044 | 2.457 | 1.032–5.849 |
| pregnancy complications | 1.226 | 0.426 | 5.218 | 0.042 | 2.524 | 1.086–6.242 |
| cesarean | 1.064 | 0.434 | 4.676 | 0.043 | 2.491 | 1.058–6.045 |
| poor sleep quality | 1.148 | 0.425 | 7.390 | 0.016 | 3.190 | 1.380–7.140 |
| poor family support | 0.956 | 0.436 | 4.423 | 0.032 | 2.456 | 1.068–5.698 |
| fear of being infected | 1.340 | 0.415 | 10.356 | 0.001 | 3.924 | 1.692–8.586 |
| lack of knowledge of COVID-19 | 0.901 | 0.452 | 3.908 | 0.036 | 2.458 | 1.012–6.032 |
| fear of the adverse impact of chest CT | 0.448 | 0.435 | 0.959 | 0.886 | 1.380 | 0.556–3.326 |
| severe pain | 0.527 | 0.468 | 1.782 | 0.181 | 1.868 | 0.742–4.687 |

not too nervous about epidemic control. There was a significant relationship between pregnant women's concerns on the adverse effect of COVID-19 symptoms of depression. The pregnant women who were fear of adverse impact of disrupted scheduled pregnant inspection or worrying difficulty in hospitalization would develop severity of depression. Family support was also an important factor to reduce the anxiety and depression of pregnant women.

How to effectively prevent the occurrence of maternal anxiety and depression was one of the important issues for special groups of people during the long-term normal prevention of COVID-19 pandemic [40]. According to the factors influencing maternal mental health in different periods before and after delivery, appropriate psychological intervention was indispensable. It was suggested to provide pregnant women with necessary nutritional support, arrange sleep time reasonably, and avoid circadian rhythm disorders. It was also necessary to reduce exposure to COVID-19 information and reduce the negative emotions and actively respond to the psychological crisis caused by COVID-19. Online psychological counseling hotline could be widely carried out to avoid unnecessary physical and mental trauma and malignant adverse events [41, 42].

The COVID-19 situation is rapidly changing. Now, the coronavirus pandemic outbreak has almost been ended all over the world. But there are some sporadic cases who are re-infected with COVID-19 in China, only that the symptom is less severe than that during the pandemic outbreak. The findings in this study are still valid for pregnant women preventing from developing anxiety and depression. Psychological intervention and corresponding public health measures are necessary and requires multidisciplinary cooperation. These interventions include encouraging the pregnant women to get the information from authoritative sources, understanding correctly the susceptibility to disease, perceiving the risk rationally and using online counselling. Besides, preventive measures, long-term normal mental health screening, and long-term normal medical checkups are needed with the goal to reduce the risk of depression in this vulnerable population [43, 44].

One of the strengths of this study is that a multivariable logistic regression analysis method was used to examine the corresponding risk factors of anxiety and depression. In addition, the study includes a sufficient sample size to provide sufficient statistical power. However, there are several limitations in this study. First, as a majority of the women are primiparous, that itself is a cause for anxiety especially during perinatal period. Another limitation is that the participants are from only one hospital, resulting that the findings may not be representative of the entire population of pregnant women in China. Finally,

as 53.96% women have undergone caesarean section (elective or emergency), pregnant women with caesarean section history are probably easy to develop anxiety or depression.

Conclusions

In conclusion, the incidences of postpartum depression among perinatal women during the long-term normal prevention of COVID-19 pandemic period were a little lower than those during the COVID-19 outbreak period, but still twice as high as those before the COVID-19. The postpartum depression was associated with the degree of prenatal anxiety and depression. Pregnant women who were younger than 35 years, in middle household income, lower education level, underweight before pregnancy, primiparous, and fear of being infected were at increased risk for developing anxiety and depression during the long-term normal prevention of COVID-19 pandemic. Intervention should be taken to reduce the depression of pregnant women.

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Author contributions

Weiping Chen: study conception and design, manuscript preparation; Wei Peng, Yan Zhang: designed the questionnaire and did the questionnaire survey; Huansheng Zhou: data collection and analysis; Meng Zhang: study conception and manuscript revision. The authors confirm that the data supporting the findings of this study are available within the article.

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Data Availability

The authors confirm that all the data supporting the findings of this study are included in this published article.

Declarations

Ethics approval and consent to participate

The Ethics Committee of the Affiliated Hospital of Qingdao University has approved the study and waived the need for individual informed consent by formulating a declaration of no objection. All participants approved the study. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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