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Research paper

The prevalence and risk factors of depression in prenatal and postnatal women in China with the outbreak of Corona Virus Disease 2019

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ABSTRACT

Background: The prevalence of depression increase with the outbreaks of epidemic disease. The prevalence of depression during the outbreak of Corona Virus Disease 2019 (COVID-19) in prenatal and postnatal women was examined in China.

Methods: 2201 prenatal and postnatal women in mainland China were recruited in this cross-sectional study from February 28th to April 26th, 2020. The Patient Health Questionnaire (PHQ-9) was used to assess depression in prenatal and postnatal women.

Results: The prevalence rate of depression was 35.4%. The risk factors for depression included drinking ($p = 0.04$; adjusted OR = 2.81, 95%CI: 1.26~6.24), nausea and vomiting during pregnancy ($p < 0.001$; adjusted OR = 3.54, 95%CI: 1.10~11.44), pregnancy's influence on mobility ($p = 0.02$; adjusted OR = 1.42, 95%CI: 1.11~1.83), anxiety ($p < 0.001$; adjusted OR = 1.66, 95%CI: 1.57~1.75), insomnia ($p < 0.001$; adjusted OR = 1.17, 95%CI: 1.14~1.21) and daily attention to fetal movement ($p < 0.001$; adjusted OR = 0.41, 95%CI: 0.31~0.56).

Limitations: This study used a cross-sectional design, and cannot compare changes in the incidence of depression before and after the COVID-19 outbreak.

Conclusions: During the COVID-19 outbreak, the prevalence rate of depression among Chinese prenatal and postnatal women was 35.4%. Moreover, anxiety, insomnia, drinking, nausea and vomiting during pregnancy, as well as the impaired movement and less daily monitoring of fetal movement were risk factors for depression.

1. Introduction

When various infectious diseases appear, people's psychological state may change. A previous study reported that during the SARS period, about 35% of the respondents expressed "moderate to severe" or "severe" anxiety and/or depression (Cheng et al., 2004). A Canadian study showed that during SARS, 31.2% of respondents suffered from depression (Hawryluck et al., 2004). As a public health event, COVID-19 may have an impact on people's psychological results. According to a study in Milan, 31% of patients surviving COVID-19 still showed depression one month after treatment (Mazza et al., 2020). During the COVID-19 pandemic, the prevalence of depression among Emergency Department nurses in China was 43.61% (An et al., 2020). Even the general population reports about 16.5% of moderate to severe depressions (Wang et al., 2020). After a large-scale infectious disease outbreak, people may be in a state of stress.

In Western countries, depression in pregnant women has been investigated. Two studies in Spain and the United States found that the

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incidence of depression in pregnant woman is about 15% (Escriba-Aguir et al., 2013; Truijens et al., 2017). In Asia, the prevalence rate of depression among prenatal and postnatal women in Thailand is 5.7% (Kalayasiri et al., 2018). A study conducted in Kuwait showed that the incidence of postnatal depression among women was 11.7% (Pampaka et al., 2019). In China, the incidence of depression in pregnant women of normal age is 12.4% (Lu et al., 2020), while the incidence of depression in older pregnant women is 18% (Xiong and Deng, 2020) in China. Women who suffer from depression during pregnancy may have adverse effects, such as a high risk of premature birth or affecting fetal growth, as well as giving birth to underweight babies (Henrichs et al., 2010; Jarde et al., 2016). At the same time, the environment created by postpartum depression is not conducive to the personal development of the mother or the growth of the child (Slomian et al., 2019). Therefore, it is necessary to explore the degree of depression of pregnant women or a period of time after delivery. In recent studies, pregnant women and women after childbirth were discussed as a group based on previous research methods (Kalayasiri et al., 2018; Lee et al., 2020).

Physical health may affect mental health. Among the many physical diseases that may affect depression in pregnant women, the effect of morning sickness has not been determined. A study found that depression in early pregnancy is associated with the severity of nausea and vomiting (Koken et al., 2008). However, another study reached the opposite conclusion that depression is not associated with nausea and vomiting during pregnancy (Bozzo et al., 2011). The difference in experimental design may be the reason for the different results. Further research is needed to explore the relationship between nausea and vomiting during pregnancy and depression.

In addition to health issues, lifestyle and family environment can also affect the degree of depression in pregnant women. Smoking and drinking have been repeatedly shown to be important factors affecting depression in prenatal and postnatal women (Aryal et al., 2018; Jans et al., 2018; Joelsson et al., 2017; Smedberg et al., 2015). In China, although passive smoking during pregnancy has been shown to be associated with postnatal depression (Song et al., 2019), no studies have been conducted on the relationship between depression levels and smoking during pregnancy. Family income level, social support and household registration are also closely related to the depression level of prenatal and postnatal women (Karmaliani et al., 2009; Ohara et al., 2018; Peñacoba-Puente et al., 2013; Salgado et al., 2019). However, some studies have shown that regardless of social support, there is no significant difference in depression levels in pregnant women (Wang et al., 2016).

Age, education level and sleep quality of pregnant women have been identified as risk factors for depression (Ali et al., 2012; Aryal et al., 2018; Ayele et al., 2016; Gelaye et al., 2017; Peñacoba-Puente et al., 2013; Wang et al., 2016). Two previous studies have shown that lower education levels (Faisal-Cury et al., 2007) and younger maternity (Chen et al., 2004) are associated with prenatal depression. However, other studies have found that more than ten years of education (Karmaliani et al., 2009) and older age (Kazi et al., 2006) are predictors of maternal depression. The influence of age and education on depression in prenatal and postnatal women is controversial.

Insomnia and anxiety may be associated with depression in prenatal and postnatal women. Previous studies have found that insomnia is highly correlated with depression in prenatal and postnatal women (Dorheim et al., 2012; Emamian et al., 2019). Moreover, anxiety is also related to depression in prenatal (Tang et al., 2019) and postnatal women (Roman et al., 2019). After the COVID-19 outbreak, the sleep quality and anxiety levels of prenatal and postnatal women may also be affected. A study in Sri Lanka found that during the COVID-19 epidemic, the prevalence of anxiety and depression among pregnant women is higher than that before the epidemic (Patabendige et al., 2020). Other studies have also reported higher rates of perinatal and postpartum anxiety and insomnia during the COVID-19 epidemic (Ceulemans et al., 2020; Zanardo et al., 2020; Zeng et al., 2020).

To our best knowledge, after the COVID-19 outbreak, the prevalence and risk factors of depression in Chinese pregnant women have not been studied. Therefore, our research had two goals: First, what was the prevalence of depression in Chinese prenatal and postnatal women after the outbreak of COVID-19? Second, what factors might be the risk factors for their depression?

2. Methods

2.1. Study settings and participants

A cross-sectional study was conducted in Beijing, Wuhan and Lanzhou, China from February 28th to April 26th 2020. The self-assessment questionnaire was delivered by SurveyStar, an online survey platform located in Changsha, Shanghai, China. The participants were recruited using a staged sampling method. The first stage was judgmental sampling, in which three cities were selected according to their epidemic severity and economic development degree. In terms of the COVID-19 epidemic, Wuhan was the most serious, with the most confirmed cases, followed by Beijing and Lanzhou. Convenience sampling was used in the second stage. The QR code of the questionnaire was sent to investigators in three cities, who then passed it on to obstetrical medical institutions. The pregnant woman filled out a questionnaire upon arrival, which was done through the given QR code.

The ethical approval that complied with the Declaration of Helsinki was obtained from the Scientific Research Ethics Committee of the Institute of Psychology, Chinese Academy of Sciences.

A total of 2,201 participants were recruited when meeting the following criteria: (1) during pregnancy or within 8 weeks after delivery; (2) Chinese citizens over 18 years of age; (3) no more than 4 pregnancies; (4) no major somatic illnesses (Somatic disease is medically diagnosed as a disease that may cause the death of an individual, such as cancer, acute malignant tumors or serious infections). All prenatal and postnatal women were included and analyzed as the same group.

2.2. Measurements

The demographic information of the participants was collected, including a number of detailed factors: age, marital status, permanent residence, education level, family income, number of births, history of physical illness, psychiatric diagnosis, drug use, smoking, drinking, vomiting during pregnancy, daily monitoring of the fetus (Pregnant women answered this question based on the actual situation. Postnatal women answered this question by recalling their daily attention to fetal movement during pregnancy.), abdominal pain during pregnancy, pregnancy's influence on mobility (meaning that pregnancy may bring difficulty with going to different locations), worries and fears about childbirth, caregiving status and whether being infected with COVID-19 by themselves, and/or in relatives and friends.

In this study, smokers were defined as adults who had smoked 100 cigarettes in their lifetime and currently smoke cigarette every day (daily) or some days (nondaily). Alcohol users were defined as subjects with frequent or regular alcohol use (more than occasional use), more than 5 drinks each time. Occasional, light, and infrequent users were not included.

2.2.1. Depression

Depression was assessed by the Patient Health Questionnaire (PHQ-9). It contains nine items, ranging from "not at all" to "almost every day" on a four-point scale. The scale has a high internal consistency ($0.86 < \alpha < 0.88$) (Kroenke et al., 2001). Also, the Chinese version of the PHQ-9 had a high internal consistency ($\alpha = 0.86$) (Wang et al., 2014). A total score of 0 to 4 means "no depression", 5 to 9 means "mild depression", 10 to 4 means "moderate depression", 15 to 19 means "moderate to severe depression", and 20 to 27 means "severe depression". The National Institute for Health and Care Excellence (NICE) recommends the use of

PHQ-9 as a tool for measuring depression in prenatal and postnatal women (National Collaborating Centre for Mental Health, 2007). According to the American College of Obstetricians and Gynecologists (ACOG), the Edinburgh Postnatal Depression Scale (EPDS) and PHQ-9 are suitable tools for measuring prenatal and postnatal depression (American College of Obstetricians Gynecologists, 2018; Wilkes, 2015). However, PHQ-9 has fewer questions than EPDS and is easier to answer. Another study compared the consistency of EPDS and PHQ-9 in measuring depression in prenatal and postnatal women, and found that 5 points can be used as a cutoff for the PHQ-9 scale to distinguish depression (Yawn et al., 2009). Therefore, in this study, 5 point of cut-off score was used to classify participants with and without depression.

2.2.2. Sleep quality

The Insomnia Severity Index (ISI) was used to assess the severity of insomnia symptoms. The scale has a high internal consistency and has been used to measure the sleep quality of pregnant women (Mindell et al., 2015). Moreover, this scale has fewer items and is more convenient than other scales. The ISI includes seven items, all of which are scored using a five-point Likert scale (0 = no problem; 4 = very serious problem). A total score of 0 to 7 means "no insomnia symptoms", 8 to 14 means "mild insomnia symptoms", 15 to 21 means "moderate insomnia symptoms", and 22 to 28 means "severe insomnia symptoms". There is a Chinese version of ISI, which was translated and validated in previous study (Baghyahi et al., 2011).

2.2.3. Anxiety

The generalized anxiety disorder scale (GAD-7) was used to assess anxiety symptoms. It is a seven-item self-assessment tool with a 4-point Likert scale ranging from 0 (none at all) to 3 (almost every day) (Spitzer et al., 2006). GAD-7 is very effective in measuring the anxiety level of perinatal women (Sinesi et al., 2019). The Chinese version of GAD-7 was verified in outpatients of general hospitals, with a high internal consistency of 0.898 (He et al., 2010). A total score of 0 to 4 means "no anxiety symptoms", 5 to 9 means "mild anxiety symptoms", 10 to 13 means "moderate anxiety symptoms", 14 to 18 means "moderate to severe anxiety symptoms", and 19 to 21 means "severe anxiety symptoms". In this study, only the score of anxiety was used, while the anxiety level of prenatal and postnatal women was not classified.

2.3. Data analysis

The prevalence of depressions was analyzed by χ^2 test. We used one-way analysis of variance (ANOVA) for continuous variables and chi-squared for categorical variables to compare the differences in demographic and clinical variables between the depression and non-depression group. Furthermore, we conducted a binary logistic regression analysis to assess which factors were independently associated with depression. In the binary logistic regression analysis, the effects of confounding variables (including local permanent residents, caregivers, worry or fear during childbirth, stomach ache and age) were controlled in order to achieve the purpose of adjusted logistic regression analysis. The SPSS version 25.0 was used.

3. Results

3.1. Demographic characteristics

The demographic data of the participants are shown in Table 1. The average age of the participants was 30.19 ± 3.93 years. The age of the depression group was 29.93 ± 3.92 years. Participants with local household registration accounted for 91% of the sample. Marital status includes married (2149), unmarried (34), divorced (7), and remarried (11).

Table 1
Demographic and clinical characteristics with or without depression.

	Non-Depression	Depression	*p*
	(n = 1422)	(n = 778)	
Age	30.34 ± 3.93	29.93 ± 3.92	0.018
Local permanent residents			
Yes (%)	1308 (91.9)	693 (89.1)	0.023
No (%)	114 (8.1)	85 (10.9)	
Drinking			
Never drink (%)	1281 (90.1)	661 (85.0)	0.001
Already quit drinking (%)	121 (8.5)	94 (12.1)	
Still drinking (%)	20 (1.4)	23 (3.0)	
Smoking			
Never smoke (%)	1358 (95.5)	732 (94.1)	0.317
Already quit smoking (%)	61 (4.3)	43 (5.5)	
Still Smoking (%)	3 (0.4)	3 (0.4)	
Nausea and vomiting during pregnancy			
Have not (%)	425 (29.9)	175 (22.5)	<0.001
Mild (%)	932 (65.5)	502 (64.5)	
Moderate (%)	58 (4.1)	81 (10.4)	
Severe (%)	7 (0.5)	20 (2.6)	
Daily attention to fetal movement			
Yes (%)	1208 (85.0)	606 (77.9)	<0.001
No (%)	214 (15.0)	172 (22.1)	
Impact of pregnancy on action			<0.001
Have not (%)	705 (49.6)	224 (28.8)	
Mild (%)	687 (48.3)	505 (64.9)	
Moderate (%)	30 (2.1)	49 (6.3)	
Be take care of			
Never (%)	77 (5.4)	55 (7.1)	<0.001
A few times (%)	255 (17.9)	197 (25.3)	
Most of the time (%)	1090 (76.7)	526 (67.6)	
Any worries or fears during childbirth			
Yes (%)	384 (27.0)	374 (48.1)	<0.001
No (%)	1038 (73.0)	404 (51.9)	
Degree of education			
Elementary school and below (%)	10 (0.7)	7 (0.9)	0.064
junior high school (%)	42 (3.0)	32 (4.1)	
Senior middle school (%)	64 (4.5)	42 (5.4)	
Undergraduate (%)	650 (45.7)	315 (40.5)	
Master's degree (%)	151 (10.6)	65 (8.4)	
Doctor (%)	14 (1.0)	8 (1.0)	
Technical secondary school (%)	106 (7.5)	59 (7.6)	
Specialist (%)	385 (27.1)	250 (32.1)	
Stomach ache			
Have not (%)	907 (63.8)	413 (53.1)	<0.001
Mild (%)	457 (32.1)	321 (41.3)	
Moderate (%)	1 (0.1)	2 (0.3)	
Severe (%)	57 (4.0)	42 (5.4)	
Relatives or friends are infected with COVID-19			
Yes (%)	11	7	0.949
No (%)	1411	772	
Anxiety	1.06 ± 1.61	5.12 ± 4.04	<0.001
Insomnia	2.87 ± 3.22	7.31 ± 5.25	<0.001

3.2. Prevalence of depression

The prevalence of depression in prenatal and postnatal women was 35.40%. Compared with the non-depression group, the depression group had younger age (30.34 ± 3.93 years vs. 29.93 ± 3.92 years, F = 5.577, $p = 0.018$), fewer local permanent residents (1308 vs. 693, $\chi^2 = 5.171$, $p = 0.023$), more drinking (9.9% vs. 15.1%, $\chi^2 = 14.25$, $p < 0.001$), more nausea and vomiting during pregnancy (70.1% vs. 77.5%, $\chi^2 = 59.778$, $p < 0.001$), more pregnancy' s influence on mobility (50.4% vs. 71.2%, $\chi^2 = 101.59$, $p < 0.001$), less being taken care of (94.6% vs. 92.9%, $\chi^2 = 21.26$, $p < 0.001$) and more worries or fears during childbirth (27.0% vs. 48.1%, $\chi^2 = 98.83$, $p < 0.001$). Moreover, when comparing the severity of stomach pain, the two groups also showed significant difference ($\chi^2 = 24.87$, $p < 0.001$).

Interestingly, the daily attention to fetal movement was significantly

different between the two groups ($\chi^2 = 17.32$, $p < 0.001$). The anxiety score (5.12 ± 4.04, F = 1115.36, $p < 0.001$) and insomnia score (7.31 ± 5.25, F = 603.42, $p < 0.001$) of the depression group were significantly higher than those in the non-depression group.

3.3. Risk factors of depressions in prenatal and postnatal women

According to the results of ANOVA and Chi-squared test, the variables showing significant difference between the depression group and the non-depression group went into the binary logistic regression model. We set dummy variables for variables with more than or equal to three groups, and selected "first" for the reference category of the dummy variable. Some demographic and clinical variables that were controlled included local permanent residents, need for care, worry or fear during childbirth, stomach pain and age. Table 2 shows the factors related to depression that we found through the unadjusted and adjusted models of estimated crude odds ratios (OR).

Finally, the binary logistic regression method was used to identify independent risk factors for depression, showing that drinking ($p = 0.04$; adjusted OR = 2.81, 95%CI: 1.26~6.24), nausea and vomiting during pregnancy ($p < 0.001$; adjusted OR=3.54, 95%CI: 1.10~11.44), pregnancy's influence on mobility ($p = 0.02$; adjusted OR=1.42, 95%CI: 1.11~1.83), anxiety ($p < 0.001$; adjusted OR = 1.66, 95%CI: 1.57~1.75), insomnia ($p < 0.001$; adjusted OR = 1.17, 95%CI: 1.14~1.21) and daily attention to fetal movement ($p < 0.001$; adjusted OR = 0.41, 95%CI: 0.31~0.56) were associated with depression.

4. Discussion

To the best of our knowledge, this is the first report on the prevalence and risk factors of depression in Chinese prenatal and postnatal women during the epidemic of COVID-19. We found that after the COVID-19 outbreak, the prevalence rate of depression among prenatal and postnatal women in China was 35.4%. Also, it was found that many demographic and clinical variables were risk factors for depression, including anxiety, insomnia, drinking, nausea and vomiting during pregnancy, the impact of pregnancy on movement and less attention to fetal movements every day.

Table 2
Binary logistic regression analysis of factors related to depression.

	unadjusted OR (95%CI)	p	Adjusted OR (95%CI)	p
Drinking		0.001		0.04
Never drinking	1.00		1.00	
Already quit drinking	1.50 (1.13~2.00)		1.14 (0.78~1.66)	
Still drinking	2.23 (1.21~4.09)		2.81 (1.26~6.24)	
Nausea and vomiting during pregnancy		<0.001		<0.001
Have not	1.00		1.00	
Mild	1.31 (1.06~1.61)		1.29 (0.98~1.70)	
Moderate	6.94 (2.88~16.70)		3.54 (1.10~11.44)	
Severe	3.43 (2.35~5.02)		2.87 (1.72~4.78)	
Impact of pregnancy on action		<0.001		0.02
Have not	1.00		1.00	
Mild	2.30 (1.91~2.78)		1.42 (1.11~1.83)	
Moderate	5.12 (3.17~8.26)		1.34 (0.66~2.72)	
Daily attention to fetal movement	0.62 (0.50~0.78)	<0.001	0.41 (0.31~0.56)	<0.001
Anxiety	1.81 (1.72~1.90)	<0.001	1.66 (1.57~1.75)	<0.001
Insomnia	1.29 (1.26~1.33)	<0.001	1.17 (1.14~1.21)	<0.001

Note: Confounding variables include: local permanent residents (yes / no), be take care of (never / a few times / most of the time), any worries or fears during childbirth (yes / no), age and stomach ache (have not / mild / moderate / severe).

The prevalence rate of depression in prenatal and postnatal women was 35.4%, which was different from other local studies (18%) (Xiong and Deng, 2020) and previous studies in western countries (23% & 23.4%) (Ayele et al., 2016; Hobfoll et al., 1995). According to recent studies, the prevalence of depression in prenatal and postnatal women during the period of no epidemic outbreak is less than 20% in China (Lu et al., 2020), Thailand (Kalayasiri et al., 2018), Cyprus (Pampaka et al., 2019) and the Netherlands (Truijens et al., 2017). After the SARS outbreak, the incidence of depression in individuals was 6.4% higher than before the outbreak (Yu et al., 2005). During the SARS outbreak, the prevalence of depression in China and other countries exceeded 30% (Cheng et al., 2004; Hawryluck et al., 2004). Similarly, after the outbreak of Ebola virus, the incidence of depressions rose to 50% (Kamara et al., 2017). These results are consistent with the findings of this study. Previous studies have demonstrated that perception of life threat was predictor of anxiety and depression (Wu et al., 2005). After the outbreak of COVID-19, people may feel that their lives are being threatened, which results in an increase in the prevalence of depression in prenatal and postnatal women. In the future, when infectious diseases break out, medical institutions should pay more attention to the psychological state of prenatal and postnatal women and provide them with psychological assistance in time.

The scores of anxiety and insomnia were significantly associated with depression among prenatal and postnatal women. Previous studies have found that both insomnia and anxiety are associated with depression (Jansson-Frojmark and Lindblom, 2008), and that insomnia is a stable marker for both anxiety and depression (Neckelmann et al., 2007). Insomnia in pregnant women is associated with depression and anxiety (Ferri et al., 2017). Anxiety and depression are highly comorbid, and sleep disturbance is one of the common symptoms of these two diseases (Zbozinek et al., 2012). This study coincides with their findings and proves that anxiety and insomnia are risk factors for depression. Therefore, in clinical practice, medical staff should also pay attention to the anxiety and sleep quality of pregnant women.

This study found that nausea and vomiting during pregnancy were risk factors for depression. The findings of this study support previous studies showing that nausea and vomiting during pregnancy may affect depression levels. A recent study of people with health problems has found that after admission to the hospital, pregnant women become more confident as their health problems are resolved (Ucar and Pinar, 2020). Other studies found that depression was strongly associated with nausea and vomiting that persists into pregnancy (Bray et al., 2019; Koken et al., 2008). In the course of clinical treatment, doctors can try to alleviate the symptoms of morning sickness in pregnant women to relieve their pain, thereby alleviating the possible depression.

As the fetus grows, the pregnant woman's activity capacity gradually declines, which may become a risk factor for depression. Our findings are in line with previous studies showing that depression is exacerbated when individuals are engaged in low physical activity (Ferri et al., 2017; Stubbs et al., 2016), which can contribute to the impairment of an individual's mental health. Moreover, a study of pregnant women in the United States found that physical activity was negatively associated with depression (Loprinzi et al., 2012). Those Chinese pregnant women who are kept at home during the COVID-19 may be under dual-pressure due to restricted movement. Some previous studies have noted that proper exercise may regulate people's emotions. For example, previous studies emphasized that even regular physical exercise indoors (such as laughter yoga, walking) significantly reduced depression in pregnant women (Battle et al., 2015). Therefore, it will be interesting for future studies to explore more potential mechanisms underlying activity and depression

among pregnant women.

This finding suggests that daily monitoring of fetal movement is recognized as a protective factor for depression. In other words, reducing the daily detection of fetal movement may be a risk factor for depression in pregnant women. At present, there is no direct research showing that there is a strong correlation between daily monitoring of fetal movement and depression. However, it has been found that counting fetal movements enhances the recognition of fetal growth restriction (Saastad et al., 2011) and enhances pregnant women's sense of control. The changing sense of control has a positive effect on the prediction of depression (Kim and Fusco, 2015), and it can improve pregnant women's sense of control by monitoring fetal movement every day. On the contrary, it may have a negative effect on depression. Medical staff can encourage pregnant women to record their fetal movements, so that pregnant women can enhance their sense of control over their physical state and stabilize their emotion.

After controlling for confounding variables, drinking became a risk factor for female depression. A recent study showed that as an unhealthy lifestyle behavior, alcohol consumption was associated with depressive symptoms and anxiety in pregnant women (Salih Joelsson et al., 2017), which is consistent with our finding in this study. Compared with pregnant women without depression, pregnant women with depression were more likely to consume alcohol during pregnancy (Hyer et al., 2019). Moreover, compared to non-depressed participants, participants with depression were more likely to engage in heavy drinking during follow-up (An and Xiang, 2015), suggesting that depression may be a predictor of drinking behavior. Therefore, in future family health care, attention should be paid to pregnant women's alcoholism and timely screening for potential depression.

Several limitations of this study should be mentioned here. First, this study adopted a cross-sectional design, which did not show the causal relationship between variables. Second, the participants came from three cities, without prenatal and postnatal women in other cities. Third, we cannot rule out the disturbing effect of unexpected life events on the emotions of the participants. The sample size is relatively large, so it is difficult for us to control everyone's living environment, and it is difficult to rule out random factors. Fourthly, it is known that pregnant women experience many changes in hormone levels, heart rate, blood pressure, and endocrine system during pregnancy. Unfortunately, due to design limitations, these data were not collected, which merit further investigation. Fifth, many studies have shown that pregnant women may have different levels of depression during different stages of pregnancy. Sixth, it is worth noting that the relationship of prenatal and postnatal depression as well as anxiety to the outbreak of COVID-19 is still not demonstrated. Most of the factors examined in this study are the general factors in pregnant women, but not the pregnant women in pandemic area. More specific factors associated with the outbreak, such as the proximity of living area relative to the outbreak area, the infected family members and risked behaviors should have been collected, which should be remedied in future studies.

In summary, the results show a higher prevalence of depression among prenatal and postnatal women in China during the COVID-19 epidemic. The existence of depressions is closely associated with higher scores of anxiety, insomnia. Risk factors also included drinking, nausea and vomiting, and impaired movement during pregnancy. Also, less daily monitoring to fetal movement is a risk factor for depression. However, due to the cross-sectional study design, we cannot attribute causal relationship to depression. Furthermore, due to the limitations of this study, such as no control group, cross-sectional design, unbalanced sample selection, and lack of medical information, our findings should be considered preliminary and require further exploration. Since the occurrence of depression is related to certain unhealthy lifestyles, mental and physical conditions, some interventions can be considered to reduce the risk. In addition, since it has been discovered that daily monitoring of fetal movement may help reduce the occurrence of depression, pregnant women can increase the frequency of monitoring fetal movement.

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CRediT authorship contribution statement

Chuanxiao Li: Data curation, Formal analysis, Writing - original draft, Writing - review & editing. **Lijuan Huo:** Conceptualization, Methodology, Software, Validation. **Ruoxi Wang:** Conceptualization, Writing - review & editing. **Ling Qi:** Data curation, Formal analysis, Validation. **Wenjia Wang:** Data curation, Formal analysis, Validation. **Xin Zhou:** Validation, Visualization. **Yongjie Zhou:** Data curation, Methodology, Project administration, Resources, Supervision, Writing - review & editing. **Xiangyang Zhang:** Conceptualization, Supervision, Writing - review & editing.

Declaration of Competing Interest

None.

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