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The prevalence of and factors associated with antenatal depression among all pregnant women attending the obstetrics clinic for the first time in a comprehensive teaching hospital

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Abstract

Background: Antenatal depression is one of the most common complications among women. However, few policy-related studies have examined this problem. This study aimed to determine the prevalence of and risk factors for antenatal depression among all pregnant women first attending the obstetrics clinic in a comprehensive teaching hospital.

Methods: From June to December 2019, 5780 pregnant women completed online mental health questionnaires, and data from 5728 of the women were analyzed. The women were categorized into two groups according to the presence or absence of depression. Depression was assessed by the PHQ-9, and the cutoff point for depression was 10. Anxiety and somatic symptoms were measured by the GAD-7 and PHQ-15, respectively. Univariate analysis and binary logistic regression analysis were used to determine the association among antenatal depression, anxiety, somatic symptoms and participants' characteristics.

Results: The prevalence of antenatal depression was 16.3%. Having a low level of education ($P=0.012$), being a rural resident ($P=0.008$), having an early pregnancy ($P<0.0001$), having a higher GAD-7 score ($P<0.0001$) and having a higher PHQ-15 score ($P<0.0001$) were risk factors for antenatal depression among women.

Conclusions: One in six women was depressed throughout the pregnancy. Online mental health assessment is an effective and convenient screening method that should be widely used for pregnant women in obstetric clinics, and special attention should be paid to some risk factors (i.e., early pregnancy, anxiety symptoms, somatic symptoms, low levels of education, rural residence).

Key words: Antenatal depression; prevalence; associated factors; online questionnaires;

Introduction

Depression has become a common public mental health problem, characterized by low mood, decreased interest and anhedonia. The World Health Organization (WHO) predicted that depression would rank first in the world disease burden by 2030 [1]. In china, national mental health survey 2019 reported the lifetime prevalence of depression had reached up to 3.4% [2]. Numerous epidemiological studies have shown that women are more susceptible to depression than men, with an approximately 2-fold greater risk. The increasing prevalence of depression correlates with hormonal variations in women, particularly during puberty, prior to menstruation, following pregnancy and at perimenopause [3]. Childbearing age is the highest-risk period for the development of depression among females due to a mixture of hormonal changes and a series of psychosocial factors [4]. Moreover, depression is more common in pregnant than non-pregnant women. A recently published meta-analysis reported that 16.3% of pregnant women were found to have depressive symptoms during pregnancy [5]. In low- and middle-income countries, such as Africa, the prevalence of antepartum depression was even higher, up to 26.3% [6]. Risk factors of antepartum depression are multifactorial including age of mother during pregnancy, marital status, income, education, occupation, unplanned pregnancy, history of the previous mental disorder, complication during pregnancy, conflict, social support,

number of gestations, history of fetal loss, relationship with husband.

Furthermore, there is strong evidence that antenatal depression is associated with a series of adverse effects on mothers, infants and families, including postpartum depression [7], pregnancy complications [8], preterm birth [9], low birth weight [10], infant mental development [11], and a higher risk of developing mental disorders in adolescent offspring [12]. Unfortunately, until now, less attention has been paid to antepartum depression than to postpartum depression. Hence, the US Preventive Services Task Force (USPSTF) proposed the recommendation of screening for perinatal depression and anxiety and providing counselling interventions in time for public health [13]. However, there has still been little policy attention directed towards this mental health problem, and correspondingly, a limited number of screening strategies and interventions have been applied to alleviate the problem. Therefore, antepartum depression was often overlooked by clinical doctors and it is necessary to carry out research on the status of, screening for and intervention in prenatal depression.

Although there have been some studies on the prevalence and risk factors for antenatal depression in China [14-16], little is known about antenatal depression of all pregnant women in obstetrics clinics in China, despite a high prevalence of depression in this area. Furthermore, Edinburgh Postnatal Depression Scale (EPDS), a postnatal depression screening tool, was used to assess antenatal depression in prior published papers and different cut-off points were selected for depression. And pregnant women with serious physical and mental disease were excluded in most studies. These factors gave rise to great variations in prevalence of antenatal depression. In addition, antenatal depression remains under-recognized and under-treated in China. To better understand the current state of antenatal depression in China, a maternal MDT (multidisciplinary team) composed of psychiatrists, obstetricians and psychological counsellors was set up in May 2019 in our hospital, and an online screening questionnaire was developed to assess the mental health of all pregnant women after the first appointment was set up in obstetric clinics. The depression screening tool

used was the Chinese-language version of the Patient Health Questionnaire-9 (PHQ-9) which contains all of the nine symptoms required for DSM-5 diagnosis of major depression and is the most commonly used tool for screening for depression in primary care ^[17]. In addition, PHQ-9 has good reliability and validity among pregnant populations. We also use the Generalized Anxiety Disorder-7(GAD-7) and the Patient Health Questionnaire-15(PHQ-15) to assess participants' anxiety and somatic symptoms. Furthermore, pregnant women who screened positive for depression or suicidal ideation were recommended to visit the maternal MDT to complete further professional psychiatric interviews, general psychological counselling and other interventions. To our knowledge, this was the first study to estimate the burden of antenatal depression among all pregnant women attending the obstetrics outpatient department after their first appointment. And, we also investigated some potential factors associated with prenatal depression. Results of our study might contribute to provide valuable information for policy making and a reference for antenatal depression screening and interventions in comprehensive hospitals to improve maternal and neonatal outcomes.

Methods

Study population

After their first appointment was set up at the Department of Obstetrics and Gynecology, the First Affiliated Hospital of Chongqing Medical University, China or after they were referred to our hospital, all pregnant women attending antenatal care were required to complete mental health assessments for free, except for those who were illiterate or who could not read and understand the Chinese questionnaire. A total of 5780 participants finished the assessments. Fifty-two women were excluded due to being postpartum or missing information on any of the three scales (PHQ-9, GAD-7, PHQ-15). A total of 5728 women remained for the analysis. Written informed consent was obtained from all study participants before evaluation. Study protocols were approved by the ethics committee of Chongqing Medical University, China.

Depression assessment

The PHQ-9 is a 9-item scale to assess depression in the 14 days prior to assessment, assigning scores of 0~3 according to the response categories (0="none at all", 1="several days", 2="more than half the days", and 3="nearly every day"). The results categories were as follows: 0~4 were classified as normal, 5~9 as mild depression, 10~14 as moderate depression, 15~19 as moderate and severe depression, and 20~27 as severe depression. Depression was defined as score of 10 or higher, and for this cut-off point, the sensitivity and specificity were 88% and 86%, respectively [18]. The Chinese version of the PHQ-9 has good reliability and validity among pregnant populations.

Anxiety assessment

A Chinese-language version of the Generalized Anxiety Disorder-7 scale (GAD-7) was used to assess anxiety in the 14 days prior to evaluation [19]. The GAD-7 score was calculated with scores of 0~3, corresponding to the following response options: 0="not at all", 1="several days", 2="more than half the days" and 3="nearly every day". The results categories were as follows: 0~5 were classified as normal, 6~9 as mild anxiety, 10~14 as moderate anxiety, and 15~21 as severe anxiety. Anxiety was defined as a cut-off score of 10 or higher, with a sensitivity of 86.2% and specificity of 95.5% [20].

Somatic symptoms assessment

The Patient Health Questionnaire-15 (PHQ-15) was used to assess the number and severity of somatic symptoms in the past four weeks prior to the evaluation. There were a total of 15 somatic symptom items, scored from 0~2 to the following response: 0="no disturbance", 1="little disturbance" and 2="little disturbance". The results criteria: 0~4 were classified as normal, 5~9 as mild somatic symptoms, 10~14 as moderate somatic symptoms, and 15~30 as severe somatic symptoms. The Chinese version of the PHQ-15 has good reliability and validity in the general population [21]. A cut-off point of 10 or higher was used to assess the presence of somatic symptoms,

with a sensitivity of 80.2% and a specificity of 58.5% [22].

Other variables

General individual information was collected from all the participants by the structured questionnaires, which included demographic data such as age, occupation, nationality, level of education, marital status, residence, date of last menstrual period, and history of pregnancy and giving birth. Participants' age was categorized as follows: ≤ 24 , 25-29, 30-34, 35-39, or ≥ 40 years old. Other sociodemographic variables were nationality (Han vs other), residence (rural vs urban), marital status (married, unmarried or divorced, and remarried), level of education (middle school or lower, high school, college, master's degree or higher), parity (nulliparous vs multiparous), occupation (fixed employed, self-employed, unemployed) and gestational weeks at interview.

Statistical analysis

Data were analysed in IBM SPSS Statistics 22.0. Categorical variables were expressed as numbers and percentages. Continuous variables were expressed as the mean \pm standard deviation ($M \pm SD$). We compared demographic variables between pregnant women with and without depression by using the chi-square test for categorical variables and the Mann-Whitney nonparametric test or ANOVA for nonnormally or normally distributed continuous variables, respectively. Furthermore, we applied binary logistic regression analysis to examine the factors related to antenatal depression. Odds ratios (ORs) with their 95% confidence intervals (CIs) were calculated to measure the strength of association. P (two-tailed) < 0.05 was considered statistically significant.

Results

Table 1 shows the general sociodemographic characteristics and associated factors of the participants enrolled in our study. A total of 5728 valid questionnaires remained in the analysis. Most participants were aged between 25 and 34 years

(n=4190; 73.1%), were urban residents (n=3108; 54.3%), were of Han nationality (n=5407; 94.4%), were married (n=4984; 87%), were employed (n=4629; 80.8%), and had at least a high school education (n=90%). A total of 3283 (57.3%) participants were multigravida. The proportions of pregnant women in the first, second and third trimesters were 60%, 28.1%, and 11.9%, respectively. A total of 16.6% (n=933) of pregnant women had antenatal depression (PHQ-9 \geq 10), which was higher than the proportion of the healthy Chinese population with depression [2]. In addition, 25.6% (n=1471) of pregnant women had significant somatic symptoms (PHQ-15 \geq 10), and 4.4% (n=252) of pregnant women had significant anxiety (GAD \geq 10). Compared to anxiety and depression, somatic symptoms were more common for women during pregnancy.

Compared to pregnant women without depression, pregnant women with depression tended to have the following characteristics: being younger or older (p=0.014); living in a rural area (p<0.001); being unmarried, remarried or divorced (p=0.003); having a lower educational level; and being in early pregnancy (p< 0.001). Additionally, pregnant women with depression had higher PHQ-15 scores and GAD-7 scores (p < 0.001) than did pregnant women without depression (see Table 1).

Table 1 Demographic characteristics and bivariate analysis showing factors related with antenatal depression.

Characteristic	Total sample (n=5728)	PHQ-9 \geq 10 (n=933)	PHQ-9<10 (n=4795)	<i>P</i>
Age, No. (%)				0.014*
\leq 24	654 (11.4)	134 (14.4)	520 (10.8)	
25–29	2322 (40.5)	366 (39.2)	1956 (40.8)	
30–34	1868 (32.6)	288 (30.9)	1580 (33.0)	
35–39	575 (10.0)	86 (9.2)	489 (10.2)	
\geq 40	309 (5.4)	59 (6.3)	250 (5.2)	
Residence, No. (%)				< 0.001*
Rural	2620 (45.7)	503 (53.9)	2117 (44.2)	
Urban	3108 (54.3)	430 (46.1)	2678 (55.8)	
Race, No. (%)				0.46
Han nationality	5407 (94.4)	876 (93.9)	4531(94.5)	
Others	321 (5.6)	57 (6.1)	264 (5.5)	

Marital status, No. (%)				0.003*
Married	4984 (87.0)	781 (83.7)	4203 (87.7)	
Unmarried/divorce)	674 (11.8)	135 (14.5)	539 (11.2)	
Remarried	70 (1.2)	17 (1.8)	53 (1.1)	
Education , No. (%)				< 0.001*
Middle school or less	570 (10.0)	114 (12.2)	456 (9.5)	
High school	818 (14.3)	156 (16.7)	662 (13.8)	
Technical secondary school	1770 (30.9)	314 (33.7)	1456 (30.4)	
College	2171 (37.9)	306 (32.8)	1865 (38.9)	
Master or higher	399 (7.0)	43 (4.6)	356 (7.4)	
Gravidity, No. (%)				0.068
Primigravida	2445 (42.7)	373 (40.0)	2072 (43.2)	
Multigravida	3283 (57.3)	560 (60.0)	2723 (56.8)	
Occupation, No. (%)				0.424
Fixed employed	3782 (66.0)	612 (16.29)	3170 (83.8)	
Self-employed	847 (14.8)	150 (16.1)	697 (14.5)	
Not employed	1099 (19.2)	171 (15.6)	928 (84.4)	
Gestational weeks, No. (%)				< 0.001*
First trimester (<13)	3434 (60.0)	621 (66.6)	2813 (58.7)	
Second trimester (13–24)	1610 (28.1)	254 (27.2)	1356 (28.3)	
Third trimester (24–40)	684 (11.9)	58 (6.2)	626 (13.1)	
PHQ-15 score, Mean (SD)	6.85 ± 4.34	11.04 ± 4.42	6.03 ± 3.82	< 0.001*
GAD-7 score, Mean (SD)	2.96 ± 3.23	6.44 ± 4.53	2.28 ± 2.38	< 0.001*

For continuous variables, *P*-value was calculated using the ANOVA for normally distributed or the Mann-Whitney nonparametric test for nonnormally distributed; For categorical variables, *P*-value was calculated using the chi-square test.

Abbreviation: PHQ-9 and PHQ-15, patient health questionnaire; GAD-7, Generalized anxiety disorder;

*Statistically significant: *P* < 0.05.

To further clarify the relationship among antenatal depression, anxiety and somatic symptoms, the risk of antenatal depression among pregnant women with different levels of anxiety or somatic symptoms was compared. Table 2 shows that the severity of anxiety or somatic symptoms was positively parallel to the risk of antenatal depression among pregnant women. The more severe the anxiety or somatic symptoms were, the higher the risk of antenatal depression among pregnant women.

Furthermore, binary multivariate logistic regression was used to determine the

relationship between antenatal depression and its associated factors. All the factors with significant differences ($P < 0.05$) by univariate analysis (see Table 1) were included in binary regression analysis. Education level [OR 0.898 (95% CI 0.826–0.977)], residence [OR 0.78 (95% CI 0.649–0.936)], PHQ-15 score [OR 2.687 (95% CI 2.419–2.984)], GAD-7 score [OR 3.105 (95% CI 2.731–3.529)] and trimester of pregnancy [OR 0.682 (95% CI 0.598–0.778)] were associated with antenatal depression and remained statistically significant ($P < 0.05$) (see Table 3). Pregnant women who had a higher education level, were from an urban area or a city and were at a later point in gestation were less likely to have antenatal depression than those who did not. Pregnant women with higher PHQ-15 scores had more than twice the risk of antenatal depression than did those with lower scores. Women who were pregnant and had higher GAD-7 scores were more than three times more likely to have antenatal depression than were those with lower scores.

Table 2 Relation among GAD level, PHQ-15 level and antenatal depression.

Characteristics	Total sample (n = 5728)	PHQ-9 ≥ 10 (n = 933)	PHQ-9 < 10 (n = 4795)	<i>P</i>
GAD level, No. (%)				$< 0.001^*$
No anxiety symptoms	4396 (76.7)	368 (39.4)	4028 (84.0)	
Mild anxiety	1080 (18.9)	367 (39.3)	713 (14.9)	
Moderate anxiety	154 (2.7)	114 (12.2)	40 (0.8)	
Moderate-severe anxiety	77 (1.3)	65 (7.0)	12 (0.3)	
Severe anxiety	21 (0.4)	19 (2.0)	2 (0.0)	
PHQ-15 level, No. (%)				$< 0.001^*$
No somatic symptoms	1905 (33.3)	52 (5.6)	1853 (33.3)	
Mild somatic symptoms	2352 (41.1)	300 (32.2)	2052 (41.1)	
Moderate somatic symptoms	1165 (20.3)	387 (41.5)	778 (16.2)	
Severe somatic symptoms	306 (5.3)	194 (20.8)	121 (2.3)	

For categorical variables, P-value was calculated using chi-square test.

Abbreviation: PHQ-9 and PHQ-15, patient health questionnaire; GAD-7, Generalized anxiety disorder;

*Statistically significant: $P < 0.05$.

Table 3 Multivariate logistic analysis significant factors associated with antenatal depression

	B	SE	wald	Exp(B)	P	95% CI
Education level	-0.107	0.043	6.24	0.898	0.012	(0.826, 0.977)
Urban Residents	-0.249	0.094	7.01	0.780	0.008	(0.649, 0.936)
PHQ-15 level	0.988	0.053	341.33	2.687	< 0.0001	(2.419, 2.984)
GAD-7 level	1.133	0.065	300.09	3.105	< 0.0001	(2.731, 3.529)
Late pregnancy	-0.382	0.067	32.47	0.682	< 0.0001	(0.598, 0.778)

Only the above five factors remained statistically significant ($P < 0.05$) after adjusting for age, residence, marital status, race, gravidity.

Abbreviation: PHQ-15, patient health questionnaire-15; GAD-7, Generalized anxiety disorder; CI: confidence interval.

Discussion

The aim of our study was to evaluate the prevalence of and factors related to antenatal depression among all pregnant women at their first attending antenatal care in the obstetrics clinic. To the best of our knowledge, this is the first study in China to examine the prevalence of and risk factors for antenatal depression in all pregnant women regardless of whether they had severe physical or mental disease. The prevalence of antenatal depression in our study was 16.3%, and almost one in six pregnant women had depressive symptoms. We also found that significant risk factors for antenatal depression among pregnant women were low educational level, rural residence, higher anxiety scores, higher somatic symptom scores and early pregnancy.

The prevalence of this study was equivalent to that reported in a recent meta-analysis [5], but relatively lower than estimates reported in most previous studies in China. For example, Li used the Edinburgh Postpartum Depression Scale (EPDS) to evaluate the depressive symptoms of 1377 pregnant women in the second trimester of pregnancy and set 12 as the cut-off point for depression, finding that the prevalence of antenatal depression was 19.1% [10]. Another study published by Chen showed that the incidence of antenatal depression is 29.6% [14], but in this study, the cut-off point for depression on the EPDS was 9. Therefore, the incidence of antenatal depression reported in China varies greatly. Several reasons accounted for this difference. For example, the tools used to assess depression [23] and the inconsistent cut-off point for

the EDPS used in previous studies can explain antenatal depression disparities. Nine [14], 10 [16], 12 [10], or 13 [24] have been chosen as cut-off points for depression on the EDPS, which led to different prevalence estimates for antenatal depression. Second, the study population might cause these differences. In our study, all pregnant women were enrolled after the first appointment was set up in our obstetric clinics, regardless of whether the pregnant woman had a serious physical or mental illness. It was shown that pregnant women with serious physical and mental disease had a higher incidence of antenatal depression. For example, several studies have shown that the prevalence of antenatal depression in HIV-positive pregnant women is higher [25-26] and that a history of mental health problems increases the risk of developing antenatal depression [27]. Third, gestational weeks might affect the prevalence of antenatal depression, and a study reported that the incidence of depression varied in the three trimesters during pregnancy [5]. This study was a real-world study among all pregnant women at their first attending antenatal care in the obstetrics clinic. Therefore, the results of our study were more likely to reflect the status of prenatal depression in the obstetric clinics in the comprehensive teaching hospital setting.

The incidence of antenatal depression in our study was significantly lower than that reported in low- and middle-income areas, such as Africa, where the incidence was 26.3% [6], but the prevalence reported in our study might be slightly higher than that reported in high-income countries, such as Ireland [28]. This discrepancy in prevalence between countries might be due to the differences in depression screening tool, culture, study methodology, study population, socio-economic and socio-demographic variations. In a word, depression in pregnant women has become a public health problem, and more attention should be given to its prevention and intervention.

Furthermore, this study showed that antenatal depression was closely related to the severity of somatic symptoms and anxiety symptoms during pregnancy. Higher scores for anxiety or somatic symptoms were risk factors for maternal antenatal depression. A large number of studies on depression have confirmed that depression is

closely related to anxiety and somatic symptoms ^[29]. For example, depression is more common in patients with physical discomfort disorder ^[30-31] or anxiety disorder ^[32-33], and patients with depression usually also experience anxiety and somatic symptoms. Consistent with our research, Barthel also found that anxiety was a risk factor for perinatal depression ^[34]. It was also reported that the total score for somatic complaints, as evaluated by a checklist of 18 somatic complaints, moved from 3 to 7, and the risk of antenatal depression increased 1.91 times ^[35]. Another study reported that changes in energy levels were responsible for the increased incidence of minor depression evaluated by the PHQ-8 in pregnant women ^[36]. As a whole, there have been few studies on the association between antenatal depression and somatic symptoms or anxiety.

Previous studies have shown that somatic symptoms (nausea and vomiting or morning sickness) are very common complaints during early pregnancy, affecting almost 60~80% of pregnant women ^[37-38]. Severe or long durations of somatic symptoms can bring distress or stress to pregnant women and increase the risk of depression. In addition, inflammation and oxidative stress might also lead to the higher prevalence of depression in women with somatic symptoms during pregnancy. Previous abundant evidence indicates that inflammation is one of the main pathophysiological processes of depression, and inflammation is closely related to depression ^[39-42]. Eutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR) and CRP are clinical common indicators used to reflect the inflammatory response. Studies shows that NLR and PLR of hyperemesis gravidarum patients were significantly higher than the healthy pregnant women ^[43-44]. Consistent findings were also found in other inflammatory markers, such as white blood cell count, total oxidative status (TOS) ^[45], CRP ^[46-47]. So, we speculate somatic symptoms during pregnancy might induce higher inflammation and oxidative stress level, which in turn lead to higher prevalence of depression.

Our study also found that gestational age was associated with the incidence of antenatal depression, with a higher incidence in early pregnancy than in the second or

third trimester. Combined with the correlation between antenatal depression and somatic symptoms found in this study, it was reasonable to speculate that somatic symptoms associated with early pregnancy, such as nausea, vomiting, frequent urination, fatigue and constipation, might be responsible for the higher incidence of depression in early pregnancy. In addition, another important factor is spontaneous abortion, the most common complication in the first trimester of pregnancy. And its incidence decreases with the increase of gestational age. Study showed that women facing threatened miscarriage had a higher risk for major depressive and anxiety symptomatology than those with stable pregnancies ^[48]. And, there was study showing that first-trimester vaginal bleeding is an independent risk factor for adverse obstetric outcomes ^[49]. It was also reported that obstetric complications might increase the risk of antenatal depression ^[50] and were significant predictors of antenatal depression (adjusted OR 3.14) ^[51]. However, further studies are needed to determine the causes of the differences in the incidence of depression during pregnancy and the interaction among antenatal depression, anxiety and somatic symptoms. Therefore, in the outpatient department of obstetrics, more attention should be given to the pregnant women with morning sickness, such as vomiting, nausea, and fatigue and women vaginal bleeding in the first trimester. Timely explanation, mental health evaluation, counselling and psychological support should be given to pregnant women suffering from somatic symptoms during pregnancy, which might be helpful in reducing the incidence of perinatal depression.

Moreover, this study also found that low education level and rural residence are risk factors for antenatal depression, which might be caused by the associations among low income, low education level and rural residence. According to China's National Bureau of Statistics, the per capita disposable income of urban residents in 2019 was 42,359 yuan, while that of rural residents was only 16,021 yuan. Therefore, the income of rural residents was much lower than that of urban residents. Duan found that education level contributed the most to the income gap between urban and rural residents ^[52]. Becker also reported that education levels were the strongest

predictor of both later adult income and later adult occupational status. A series of studies have reported that low income and financial stress are risk factors for antenatal depression [6]. Therefore, in clinical work, pregnant women with low education levels and low income, especially from rural areas, should be given more attention with respect to mental health evaluations.

There are still some limitations in this study. It was a cross-sectional study, so the relationship between variables could not be proven. Few psychosocial factors that might affect depression in pregnant women were evaluated, such as marital relationship, financial income, relationship between mother-in-law and daughter-in-law and history of childhood trauma and partner violence. Therefore, this study failed to comprehensively evaluate the relationship between multiple psychosocial factors and antenatal depression. However, the main purpose of this project was to comprehensively evaluate the mental health level of all pregnant women after the first appointment was set up in obstetric clinics through network evaluation questionnaires. Due to the large sample size and the effects of testing time and the number of items on the test results, only some common personal information was collected in this study. Again, this study was a cross-sectional study, and a longitudinal study may be more helpful in clarifying the status of antenatal depression. In light of the above limitations, we would conduct further studies to investigate more psychosocial factors and even dynamically assess depression in women during different pregnancy stages.

Conclusion

Antenatal depression in women has become a very common complication throughout pregnancy, especially in early pregnancy. Anxiety symptoms, somatic symptoms, low levels of education, rural residence and early pregnancy were risk factors for antenatal depression. Therefore, strengthening the screening and early intervention of antenatal depression during pregnancy is critical for public mental health. Online mental health assessment is an effective and convenient screening

method for antenatal depression and should be widely used for pregnant women in obstetric clinics, especially for women with certain risk factors.

Abbreviations

PHQ-9: Patient Health Questionnaire-9; GAD-7: Generalized Anxiety Disorder-7; PHQ-15: Patient Health Questionnaire-15; EPDS: Edinburgh Postnatal Depression Scale; MDT: Multidisciplinary team; WHO: World Health Organization; TOS: Total oxidative status; NLR: Neutrophil-to-lymphocyte ratio; PLR: Platelet-to-lymphocyte ratio; CRP: C-reactive protein; DSM: Diagnostic and Statistical Manual of Mental Disorders;

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Author contributions

Jiamei Guo: analyzing the data and writing the paper; Anhai Zheng: helping modifying the paper; Jinglan He and Yao Gan: helping designing the questionnaire and collecting the data; Ming Ai and Qi Zhang: developing the online assessing systems; Lulu Chen, Sisi Liang, and Xiaoyu Yu: helping patient finishing the questionnaires. Li Kuang: conceived and designed the experiments; Fund provider; Writing - review.

Statement

We confirm that we have complied with our institution's intellectual property regulations and there are no impediments to publication, including the timing of publication, with respect to intellectual property.

We further confirm that all methods were carried out in accordance with relevant guidelines and regulations.

Ethics approval and consent to participate

The study was approved by the ethics committee of the First Affiliated Hospital of Chongqing Medical University and written informed consent was signed by the pregnant women who agreed to participate.

Consent for publication

Not Applicable.

Availability of data and materials

All data included in this study are available during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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