Anxiety and Depression Among Pregnant Women in Plain and Plateaus Areas: A Cross-sectional Study

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Abstract

**Background:** Perinatal anxiety and depression can severely damage both maternal and infant’s health and result in negative effects. In this study, we investigated the current state of anxiety and depression among pregnant women in Tibet and Guangzhou and identified its risk factors, which would provide guidance for clinical daily work.

**Methods:** From September 2018 to May 2019, 169 pregnant women in Tibet and 199 of them in Guangzhou were selected. Zung’s Self Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) were used to assess the degree of anxiety and depression, respectively. All the data were collected by the questionnaire.

**Results:** The SAS and SDS scores in Guangzhou were 42.4±8.5 and 48.0±9.5 respectively, while the same score became 46.6±8.0 and 54.7±8.9 in Tibet. Scores of pregnant women in Tibet were significantly higher than in Guangzhou (P < 0.05). Trimester, nationality, delivery times and educational experience were considered to be influence factors for anxiety and depression among pregnant women.

**Conclusions:** Pregnant women living in plateaus areas of China have higher SAS and SDS scores than in plain areas, especially for those with a low level of educational experience. More attention should be paid in future work.

**Background**

Previous research demonstrated that gestation can lead to obvious changes in the body appearance and the internal hormonal environment of pregnant women, resulting in significant alterations both physically and psychologically(1). The transformation from a woman to mother is not only the converting of social identities, but the upcoming social responsibilities. Additionally, during this special period, pregnant women are often reported as lack of self-confidence and are susceptible to the bad sides of their lives(2, 3). All those factors contribute to the prevalence of anxiety and depression during pregnancy(1, 4).

As reported by an earlier study, up to 8.5–16% of all pregnant women suffer from different degrees of depression and 4.9% of pregnant women can be diagnosed as major depression(2). At the same time, it is estimated that the prevalence of anxiety among pregnant women ranges from 4 to 39% in different regions(5, 6). These perinatal mood disorders including anxiety and depression disorders can not only increase the probability of obstetrical complications in pregnant women, such as preterm birth, low birth weight, fetal growth restriction, adverse perinatal outcome and birth defects, but also intensify the risk of postpartum depression(7–13).

Tibet is located on the Qinghai-Tibet plateau in southwest China. The economic development level of Tibet ranks relatively low in all China’s provinces and people living in Tibet plateau usually have poor medical facilities and environment(14). In addition, the unique demographic composition and religious
environment in Tibet lead to the lack of previous literature on the health status and quality of life of this population. Studies investigating perinatal mood disorders among this population are scarce as well.

In this study, we analyzed the situation of perinatal mood disorder including depression and anxiety between Tibet plateau and Guangzhou City, which represents the plain areas of China, thus contribute to improving the psychological state of pregnant women and ensure safety of maternal and offspring in Tibet plateau.

**Methods**

**Design**

The cross-sectional, observational study recruited pregnant women from September 2018 to May 2019 at the obstetric outpatient departments in two different tertiary care hospitals in Linzhi City, Tibet, China and the First Affiliated Hospital of Sun Yat-sen University in Guangzhou, China.

**Participants**

In Tibet, 169 pregnant women who met the following inclusion criteria were selected: (1) 18 years old and above, (2) a confirmed intrauterine pregnancy by ultrasound, (3) never been diagnosed with mental illness and other neurological disorders, (4) no psychotropic pharmaceuticals taken during the past three months, (5) volunteered to participate in the present survey. The excluding criteria for this study were: (1) those with serious audiovisual disorders that may affect their understanding and answers to the questionnaires, (2) with a history of severe mental and/or physical diseases, (3) long term using antipsychotics, (4) unwilling to participate in this study, and (5) those with other hereditary diseases. Simultaneously, 199 pregnant women in the First Affiliated Hospital of Sun Yat-sen University in Guangzhou were selected based on the same criteria described above.

**Measures**

The sociodemographic data were collected using a questionnaire compiled by researchers. All interviews were conducted in a private area, and the participants’ family members were not present during the interviews. The basic information collected included the name, age, level of education, ethnicity, expected date of delivery, total monthly family income, history of delivery, including artificial and natural abortion history, delivery times and complications during pregnancy.

The levels of anxiety and depression of the pregnant women were quantified by using Zung's Self Rating Anxiety Scale (SAS), and Self-Rating Depression Scale (SDS)(15). Both SAS and SDS were used for the first time in 1965. Both of them consist of 20 items, each scored on a 4-point Likert scale. The score ranged from 1 (none or a little) to 4 (most or always) and was based on the level experienced by the pregnant women in the preceding week. Participants were classified according to the SAS score as normal (0–50), mildly anxious (50–59), moderately anxious (60–69), and severely anxious (>70)(16).
Pregnant women with a SDS score of 53 to 62 were considered to be mildly depressed, meanwhile a score of 63 to 72 as moderately depressed and a score of 73 or more as severely depressed.

**Quality control**

Our investigators consisted of trained and experienced nurses who conducted face-to-face interviews with the participants in this study. This can ensure the authenticity and accuracy of this survey. Before starting with the survey, the investigators informed the participants of the purpose of and methods to be used in the present study, and the principle of confidentiality, after which the participants signed an informed consent form. After completion, all questionnaires were assessed to verify their integrity. Double proofreading and uniform coding of the results were also used to control the quality of the questionnaires and the data.

**Statistical analysis**

All statistical analyses were performed through Statistical Package for Social Sciences (SPSS) 22.0 and the level of significance was set as $p < 0.05$. Frequency distributions and rates were used to summarize and show the results. Univariate and multivariate analyses were used to analyze the data.

**Ethical Aspects**

The study has been approved by the Ethics Committee for Clinical Research and Animal Trials of the First Affiliated Hospital of Sun Yat-sen University(#178–2020, Jun-2,2020).

**Results**

**Analysis of social demographic data between two groups**

In our study, 168 pregnant women from Tibet and 199 women from Guangzhou were included. From Table 1 we can learn that in Guangzhou, the majority of the respondents were Han nationality, ranging from 23–46 years of age, of which 26.7% of them were elderly pregnant women (> 35 years old). On the other hand, the majority of interviewees in Tibet were Tibetan nationality, ranging from 18–49 years of age, and of which elderly pregnant women accounted for only 8.3% of the total. Besides, 88.9% of pregnant women in Guangzhou have received regular college education or above, while this became 46.2% in Tibet.
Table 1  
Social demographic data of pregnant women in Guangzhou and Tibet.

| Variables                  | Guangzhou (n = 199) | Tibet (n = 169) |
|----------------------------|---------------------|-----------------|
|                            | N(%)                | N(%)            |
| Age (Years)                |                     |                 |
| < 25                       | 6(3.0%)             | 31(18.3%)       |
| 25–29                      | 59(29.6%)           | 72(42.6%)       |
| 30–34                      | 81(40.7%)           | 52(30.8%)       |
| > 35                       | 53(26.7%)           | 14(8.3%)        |
| Nationality                |                     |                 |
| Han nationality            | 194(97.5%)          | 48(28.4%)       |
| Other nationality          | 5(2.5%)             | 121(71.6%)      |
| Educational experience     |                     |                 |
| Primary school or below    | 0(0%)               | 45(26.6%)       |
| High school                | 22(11.1%)           | 46(27.2%)       |
| Bachelor degree            | 141(70.8%)          | 76(45.0%)       |
| Postgraduate and above     | 36(18.1%)           | 2(1.2%)         |
| Employment situation       |                     |                 |
| Employed                   | 159(79.9%)          | 107(63.3%)      |
| Unemployed                 | 40(20.1%)           | 62(36.7%)       |
| Family monthly income      |                     |                 |
| < 10000 yuan               | 29(14.6%)           | 83(49.1%)       |
| 10000–19999 yuan           | 84(42.2%)           | 59(34.9%)       |
| 20000–29999 yuan           | 52(26.1%)           | 21(12.4%)       |
| > 30000 yuan               | 34(17.1%)           | 6(3.6%)         |
| Payment model              |                     |                 |
| Self-paying                | 55(27.6%)           | 55(32.5%)       |
| Health insurance           | 144(72.4%)          | 114(67.5%)      |

* Including but not limited to gestational diabetes mellitus, gestational hypertension, thyroid disease and so on.
Comparison of mood disorders between two groups
As shown in Table 2, the SAS and SDS scores of pregnant women from Tibet were statistically significantly higher than those from Guangzhou (both $P < 0.001$). What's more, based on the SAS and SDS evaluation system, 42.6% and 69.2 of pregnant women in Tibet experienced anxiety and depression respectively, while in Guangzhou, only 19.1% and 30.2% of pregnant women faced the same question.
### Table 2
A comparison of the SAS and SDS scores between the two areas

| Area           | SAS score (x ± s) | SDS score (x ± s) |
|----------------|-------------------|-------------------|
| Guangzhou (n = 199) | 42.4 ± 8.5       | 48.0 ± 9.5       |
| Tibet (n = 169)    | 46.6 ± 8.0        | 54.7 ± 8.9       |
| t               | 4.831             | 7.001             |
| P               | < 0.001           | < 0.001           |

**Factors influencing anxiety and depression among pregnant women in Guangzhou and Tibet**

To identify risk factors for anxiety and depression in pregnant women, univariate regression analysis was used, and those factors with a P value < 0.05 would be included in multivariate regression analysis. In Guangzhou, as shown in Tables 3, 4 and 7, we found that pregnant women in the first trimester had higher SAS score than the second trimester and those with the delivery times more than twice had higher SDS score, while pregnant women of Han nationality had high SAS and SDS score. For pregnant women in Tibet, educational experience were considered to be a risk factor for SAS and SDS scores. Women with the educational experience of primary school and below had a significantly higher SAS and SDS score than those with bachelor degrees and above (Tables 5, 6 and 8).
Table 3
Univariate analysis of anxiety for pregnant women in Guangzhou.

| Variables                        | Groups                                | SAS score ($\bar{x} \pm s$) | OR   | P   |
|----------------------------------|---------------------------------------|------------------------------|------|-----|
| Age                              | < 25 (control)                        | 48.3 ± 9.6                   | 1    |     |
|                                  | 25 ~ 29                               | 42.0 ± 8.0                   | -6.363 | 0.082 |
|                                  | 30 ~ 34                               | 42.0 ± 9.4                   | -6.343 | 0.079 |
|                                  | > 35                                  | 42.9 ± 7.6                   | -5.409 | 0.141 |
| Nationality                      | Han nationality                      | 42.6 ± 8.5                   | 8.385 | 0.029 |
|                                  | Other nationality (control)           | 34.3 ± 6.4                   | 1    | 1   |
| Educational experience           | High school and below (control)       | 41.7 ± 8.7                   | 1    |     |
|                                  | Bachelor degree and above             | 42.5 ± 8.5                   | 0.810 | 0.675 |
| Employment situation             | Employed (control)                   | 42.1 ± 8.6                   | 1    |     |
|                                  | Unemployed                            | 43.6 ± 8.1                   | 1.463 | 0.332 |
| Family monthly income            | < 10000 yuan (control)                | 40.6 ± 8.1                   | 1    |     |
|                                  | 10000–19999 yuan                      | 43.3 ± 8.2                   | 2.702 | 0.143 |
|                                  | 20000–29999 yuan                      | 41.8 ± 9.2                   | 1.132 | 0.567 |
|                                  | > 30000 yuan                          | 42.6 ± 8.7                   | 2.001 | 0.354 |
| Payment model                    | Self-paying                           | 43.7 ± 8.7                   | 1.706 | 0.207 |
|                                  | Health insurance (control)            | 42.0 ± 8.4                   | 1    |     |
| Trimester                        | First trimester                      | 43.9 ± 9.2                   | 3.041 | 0.015 |
|                                  | Second trimester (control)            | 40.9 ± 7.4                   | 1    |     |
|                                  | Third trimester                       | 41.9 ± 9.2                   | 1.016 | 0.684 |
| Pregnancy complications          | No (control)                          | 42.1 ± 8.4                   | 1    |     |
|                                  | Yes                                   | 45.2 ± 8.9                   | 3.087 | 0.109 |
| History of abnormal pregnancy   | No (control)                          | 42.4 ± 8.7                   | 1    |     |
|                                  | Yes                                   | 42.7 ± 7.8                   | 0.319 | 0.829 |
| Pregnancy times                  | 1                                     | 43.1 ± 9.1                   | 2.310 | 0.113 |
|                                  | 2 (control)                           | 40.8 ± 7.8                   | 1    |     |
|                                  | ≥ 3                                   | 43.2 ± 8.3                   | 2.388 | 0.123 |
| Variables          | Groups | SAS score($x \pm s$) | OR  | P    |
|--------------------|--------|-----------------------|-----|------|
| Delivery times     | 0      | 43.1 ± 9.4            | 1.662 | 0.180 |
|                    | 1 (control) | 41.5 ± 7.3       | 1   | -    |
|                    | ≥ 2    | 44.3 ± 9.2            | 2.836 | 0.341 |
Table 4
Univariate analysis of depression for pregnant women in Guangzhou.

| Variables                      | Groups                              | SDS score ($x \pm s$) | OR  | P    |
|-------------------------------|-------------------------------------|-----------------------|-----|------|
| Age                           | < 25 (control)                      | 55.6 ± 9.5            | 1   | -    |
|                              | 25 ~ 29                             | 46.5 ± 8.2            | -9.142 | 0.025 |
|                              | 30 ~ 34                             | 48.7 ± 9.9            | -6.890 | 0.086 |
|                              | > 35                                | 47.7 ± 10.0           | -7.960 | 0.051 |
| Nationality                   | Han nationality                     | 48.3 ± 9.3            | 11.017 | 0.010 |
|                              | Other nationality (control)         | 37.3 ± 11.9           | 1   | -    |
| Educational experience        | High school and below               | 51.6 ± 9.8            | 4.049 | 0.059 |
|                              | Bachelor degree and above (control) | 47.5 ± 9.4            | 1   | -    |
| Employment situation          | Employed (control)                 | 47.5 ± 9.5            | 1   | -    |
|                              | Unemployed                          | 50.0 ± 9.3            | 2.555 | 0.129 |
| Family monthly income         | < 10000 yuan (control)              | 47.2 ± 12.0           | 1   | -    |
|                              | 10000–19999 yuan                    | 49.0 ± 8.4            | 1.760 | 0.391 |
|                              | 20000–29999 yuan                    | 46.4 ± 9.4            | -0.78 | 0.724 |
|                              | > 30000 yuan                        | 48.7 ± 9.9            | 1.478 | 0.539 |
| Payment model                 | Self-paying                         | 49.6 ± 9.8            | 2.244 | 0.137 |
|                              | Health insurance (control)          | 47.4 ± 9.4            | 1   | -    |
| Trimester                     | First trimester                     | 48.9 ± 9.8            | 2.124 | 0.451 |
|                              | Second trimester                    | 47.3 ± 9.3            | 0.536 | 0.850 |
|                              | Third trimester (control)           | 46.7 ± 8.8            | 1   | -    |
| Pregnancy complications       | No (control)                        | 47.9 ± 9.4            | 1   | -    |
|                              | Yes                                 | 48.6 ± 10.8           | 0.727 | 0.736 |
| History of abnormal pregnancy| No (control)                        | 47.8 ± 9.1            | 1   | -    |
|                              | Yes                                 | 48.6 ± 10.8           | 0.747 | 0.649 |
| Pregnancy times               | 1                                   | 48.0 ± 8.7            | 2.316 | 0.150 |
|                              | 2 (control)                         | 45.7 ± 9.1            | 1   | -    |
|                              | ≥ 3                                 | 50.3 ± 10.5           | 4.595 | 0.008 |
| Variables        | Groups          | SDS score (x ± s) | OR  | P    |
|------------------|-----------------|-------------------|-----|------|
| Delivery times   | 0 (control)     | 47.5 ± 9.1        | 1   | -    |
|                  | 1               | 47.9 ± 9.8        | 0.424 | 0.758 |
|                  | ≥ 2             | 54.6 ± 8.3        | 7.109 | **0.032** |
### Table 5
Univariate analysis of anxiety for pregnant women in Tibet.

| Variables                          | Groups                        | SAS score($x \pm s$) | OR  | P   |
|------------------------------------|-------------------------------|-----------------------|-----|-----|
| Age                                |                               |                       |     |     |
| < 25                               | 47.3 ± 8.0                   | -0.599                | 0.818 |
| 25 ~ 29                            | 46.2 ± 9.3                   | -1.694                | 0.473 |
| 30 ~ 34                            | 46.5 ± 6.7                   | -1.343                | 0.581 |
| > 35 (control)                     | 47.9 ± 5.5                   | 1                     | -    |
| Nationality                        |                               |                       |     |     |
| Han nationality (control)          | 44.6 ± 7.0                   | 1                     | -    |
| Other nationality                  | 47.4 ± 8.3                   | 2.798                 | 0.040 |
| Educational experience             |                               |                       |     |     |
| Primary school and below           | 49.4 ± 8.5                   | 4.589                 | **0.002** |
| High school                        | 46.8 ± 6.9                   | 1.965                 | 0.179 |
| Bachelor degree and above          | 44.9 ± 7.9                   | 1                     | -    |
| (control)                          |                               |                       |     |     |
| Employment situation               |                               |                       |     |     |
| Employed (control)                 | 45.7 ± 7.9                   | 1                     | -    |
| Unemployed                         | 48.2 ± 8.1                   | 2.421                 | 0.058 |
| Family monthly income              |                               |                       |     |     |
| < 10000 yuan                       | 46.5 ± 8.1                   | 2.161                 | 0.527 |
| 10000~19999 yuan                   | 46.7 ± 8.7                   | 2.278                 | 0.511 |
| 20000~29999 yuan                   | 47.4 ± 5.6                   | 3.065                 | 0.413 |
| > 30000 yuan (control)             | 44.4 ± 8.7                   | 1                     | -    |
| Payment model                      |                               |                       |     |     |
| Self-paying (control)              | 45.3 ± 8.5                   | 1                     | -    |
| Health insurance                   | 47.3 ± 7.7                   | 2.020                 | 0.125 |
| Trimester                          |                               |                       |     |     |
| First trimester (control)          | 45.0 ± 9.3                   | 1                     | -    |
| Second trimester                   | 47.4 ± 7.7                   | 2.359                 | 0.141 |
| Third trimester                    | 46.8 ± 7.4                   | 1.780                 | 0.283 |
| Pregnancy complications            |                               |                       |     |     |
| No (control)                       | 46.6 ± 8.0                   | 1                     | -    |
| Yes                                | 47.3 ± 7.9                   | 0.750                 | 0.676 |
| History of abnormal pregnancy      |                               |                       |     |     |
| No                                 | 46.7 ± 8.0                   | 1.563                 | 0.486 |
| Yes (control)                      | 45.2 ± 8.9                   | 1                     | -    |
| Pregnancy times                    |                               |                       |     |     |
| 1                                  | 46.2 ± 7.6                   | 0.385                 | 0.773 |
| 2 (control)                        | 45.8 ± 8.4                   | 1                     | -    |
| Variables           | Groups       | SAS score (x ± s) | OR   | P    |
|---------------------|--------------|-------------------|------|------|
|                    | ≥ 3          | 50.0 ± 7.7        | 4.175| **0.022** |
| Delivery times      | 0 (control)  | 45.6 ± 8.1        | 1    | -    |
|                     | 1            | 47.1 ± 8.0        | 1.485| 0.255 |
|                     | ≥ 2          | 49.4 ± 7.3        | 3.858| 0.065 |
| Variables                      | Groups                      | SDS score (x ± s) | OR  | P     |
|-------------------------------|-----------------------------|-------------------|-----|-------|
| Age                           | < 25 (control)              | 57.0 ± 8.7        | 1   | -     |
|                              | 25 ~ 29                     | 54.1 ± 8.9        | -2.844 | 0.138 |
|                              | 30 ~ 34                     | 54.2 ± 9.2        | -2.769 | 0.172 |
|                              | > 35                        | 54.9 ± 7.6        | -2.065 | 0.472 |
| Nationality                   | Han nationality (control)   | 52.8 ± 9.6        | 1   | -     |
|                              | Other nationality           | 55.5 ± 8.5        | 2.657 | 0.079 |
| Educational experience        | Primary school and below    | 56.8 ± 8.5        | 3.925 | 0.018 |
|                              | High school                 | 56.0 ± 9.1        | 3.099 | 0.058 |
|                              | Bachelor degree and above   | 52.9 ± 8.7        | 1    | -     |
|                              | (control)                   |                   |      |       |
| Employment situation          | Employed (control)          | 54.1 ± 9.2        | 1    | -     |
|                              | Unemployed                  | 55.9 ± 8.2        | 1.810 | 0.202 |
| Family monthly income         | < 10000 yuan                | 55.1 ± 9.0        | 4.302 | 0.255 |
|                              | 10000–19999 yuan            | 54.4 ± 9.1        | 3.595 | 0.348 |
|                              | 20000–29999 yuan            | 55.2 ± 8.4        | 4.345 | 0.294 |
|                              | > 30000 yuan (control)      | 50.8 ± 8.7        | 1    | -     |
| Payment model                 | Self-paying (control)       | 53.4 ± 9.5        | 1    | -     |
|                              | Health insurance            | 55.4 ± 8.5        | 1.975 | 0.176 |
| Trimester                     | First trimester (control)   | 53.6 ± 9.9        | 1    | -     |
|                              | Second trimester            | 56.0 ± 8.5        | 2.431 | 0.170 |
|                              | Third trimester             | 54.0 ± 8.6        | 0.372 | 0.839 |
| Pregnancy complications       | No (control)                | 54.5 ± 8.9        | 1    | -     |
|                              | Yes                         | 55.4 ± 8.9        | 0.967 | 0.631 |
| History of abnormal pregnancy| No (control)                | 54.7 ± 9.0        | 1    | -     |
|                              | Yes                         | 54.7 ± 8.3        | -0.010 | 0.997 |
| Pregnancy times               | 1 (control)                 | 54.1 ± 9.4        | 1    | -     |
|                              | 2                           | 55.2 ± 8.9        | 1.072 | 0.475 |
### Table 7
Multivariate analysis of anxiety and depression for pregnant women in Guangzhou.

| Variables                        | Groups                        | SAS    | SDS       | OR     | 95% CI          | P     | OR     | 95% CI          | P     |
|----------------------------------|-------------------------------|--------|-----------|--------|-----------------|-------|--------|-----------------|-------|
| Nationality (control = Other nationality) | Han nationality               | 8.101  | 0.632 ~ 15.571 | 0.034  | 10.972 ~ 21.335 | 0.010 |
| Trimester (control = Second trimester) | First trimester               | 2.944  | 0.528 ~ 5.361  | 0.017  |                 |       |        |                 |       |
|                                | Third trimester               | 0.749  | -4.139 ~ 5.637 | 0.763  |                 |       |        |                 |       |
| Delivery times (control = 0)    | 1                             | 0.795  | -1.885 ~ 3.475 | 0.559  |                 |       |        |                 |       |
|                                | ≥ 2                           | 6.998  | 0.609 ~ 13.387 | 0.032  |                 |       |        |                 |       |

### Table 8
Multivariate analysis of anxiety and depression for pregnant women in Tibet.

| Variables                        | Groups                        | SAS    | SDS       | OR     | 95% CI          | P     | OR     | 95% CI          | P     |
|----------------------------------|-------------------------------|--------|-----------|--------|-----------------|-------|--------|-----------------|-------|
| Educational experience (control = Bachelor degree and above) | Primary school and below     | 4.589  | 1.693 ~ 7.485 | 0.002  | 3.925 ~ 7.158   | 0.018 |
|                                | High school                   | 1.965  | -0.911 ~ 4.841 | 0.179  | 3.099 ~ 6.309   | 0.058 |

**Discussion**
Compared to pregnant women from Guangzhou, those from Tibet have a higher prevalence of both anxiety and depression. Previous studies indicated that the prevalence of anxiety and depression among pregnant women in Guangzhou was the same as the average level in China. In our study, the incidence of anxiety among pregnant women from Guangzhou was 19.1%, and was consistent with previous studies in China(17). The prevalence of depression was 30.2%, while 10.1% of all was moderate depression, which was similar to the results of some studies completed in other provinces of China(17, 18). However, the incidence of anxiety and depression among Tibetan pregnant women was 42.6% and 69.2%, respectively, which was much higher than the previous studies and higher than the rest of China.

According to previous studies, the factors affecting anxiety and depression among pregnant women included age, educational experience, family income, employment situation, trimester and history of abnormal pregnancies(17, 18). We noticed that trimester was the main factor contributing to anxiety among pregnant women in Guangzhou. Women in the early stages of their pregnancy had a higher SAS score. This may be related to the changes in female hormone levels in early pregnancy, the influence of their response to an early pregnancy and the lack of knowledge on pregnancy care. What’s more, the first trimester of pregnancy is the key period of fetal development, the fear of miscarriage and fetal deformities can also make them greater anxious(19).

Consistent with the results of previous study(18), delivery times is also the main factor contributing to depression among pregnant women in Guangzhou, China. Women, especially older women, that have delivered more than twice are more prone to experiencing depression during pregnancy. In our study, 67.4% of pregnant women were older than 30 years of age, including 39.6% of them were elderly pregnant women, and 20.8% of them had pregnancy complications. Pregnancy complications can increase the incidence of anxiety and depression in pregnant women. However, with the gradual opening of the second child policy in China, there will, in the future, be more elderly pregnant women. The mental health for this group of people should be paid more attention. Besides, among those pregnant women from Guangzhou, SAS and SDS scores of Han nationality were higher than those of other nationalities. However, mainland China is mainly inhabited by Han nationality and the proportion of other nationalities is very small, so we think this result is not representative.

In our study, we found that the educational experience was the main factor affecting anxiety and depression of pregnant women in Tibet. Pregnant women with a low level of education had higher SAS and SDS scores. This result is consistent with previous studies(18). Tibet is located on the Qinghai-Tibet plateau in southwest China and it has an average altitude of over 4000 meters(14). The cold and oxygen-deficient environment makes Tibet relatively backward developed among China, both economically and educationally. In our study, 26.6% of pregnant women in Tibet have only a primary school education or less. They would usually lack awareness, and their expression, understanding and acceptance ability were often lower than those with higher educational level. Therefore, most of them have limited awareness about regular prenatal examinations and the average times of their examinations were usually only one to two times. Most of the women in Tibet were unable to provide an accurate time of their last
menstrual period, making it difficult to calculate their gestation week and proceed the subsequent scheduling prenatal examinations.

Due to the limited medical facilities and environment, the propaganda of pregnancy health care knowledge in Tibet is very inadequate. The unique language and writing in Tibet restrains pregnant women from accessing enough information from the outside world, such as the Internet and books. The whole process of pregnancy lasted about 40 weeks and all the daily diet, rest, exercise, drug use and mental health care during pregnancy need professional advice. When those pregnant women in Tibet are faced with some physiological changes or pregnancy complications, their lack of relevant knowledge and external help may end up with feeling anxious and increasing mental stress, even result in anxiety, depression and other perinatal mood disorders, which can severely damage both maternal and infant’s health.

To sum up, pregnant women in Tibet had higher SAS and SDS scores than Guangzhou, indicating the higher incidence rate of anxiety and depression. In future work, more attention should be paid to pregnant women in Tibet, especially those with low levels of education(17). To alleviate the problem of perinatal anxiety and depression, many attempts have been made in China and other countries. Based on previous studies, usage of anti-anxiety and anti-depression drugs would increase the incidence of eclampsia, even leading to neonatal toxicity, and fetal growth disorders(20, 21), which limit the use of these drugs. Other psychological interventions would be safer and more acceptable, such as hypnosis, cognitive behavioral therapy, music therapy, yoga and so on(22–26). However, compared with Guangzhou, the limitation of medical facilities and environment in Tibet restrain the generalization of the above therapies. It is very urgent to establish and strengthen the three-level maternal and child health care network in Tibet(7).

For the future, we hope to reduce perinatal anxiety and depression in Tibet by establishing an online education platform between local hospitals and other top hospitals in China(27). This platform will provide systematically training to local doctors and nurses through information sharing on health care of pregnant women. It will also provide professional psychological guidance for pregnant women by using online schools. Simultaneously, to meet the needs of pregnant women from different nationalities, our courses for physiology and mental health care will be available in both Mandarin and Tibetan languages. This will significantly reduce perinatal anxiety and depression in Tibet by improving their ability for self-caring. As the platform matures, the remote maternal health care courses would be expanded to more counties and villages and available by further more people and communities.

Conclusions

In conclusion, our study shows that pregnant women in plateaus areas of China have higher SAS and SDS scores than in plain areas. Individualized and targeted mental care should be added into clinic work to prevent negative outcomes, especially for those with a low level of educational experience.

Abbreviations
SAS: Zung's Self Rating Anxiety Scale, SDS: Zung's Self-Rating Depression Scale, CI: confidence interval, OR: odds ratio

Declarations

Ethics approval and consent to participate

The study has been approved by the Ethics Committee for Clinical Research and Animal Trials of the First Affiliated Hospital of Sun Yat-sen University(#178-2020, Jun-2, 2020).

Consent for publication

All participants have consented to the publication of this study.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to patient confidentiality reasons but are available from the corresponding author on reasonable request.

Competing interests

All authors declare no personal or commercial conflict of interest in this study.

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Authors' contributions

JC and QZ contributed to the conception and design of the research and writing of this article. CJ and JH contributed to the case collection respectively in Tibet and Guangzhou. JZ and XL contributed to quality control of all data and statistics. SD contributed to distribution of the questionnaires and follow-up with participants. GW and SY had substantial contributions to the conception and design of the research. All authors read and approved the final manuscript.

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