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Associations of COVID-19 related experiences with maternal anxiety and depression: implications for mental health management of pregnant women in the post-pandemic era

Wei Lin a, Bo Wu a, Bin Chen a, Chuyan Zhong a, Weikang Huang a, Shixin Yuan b, Xiaoshan Zhao a, Yueyun Wang a,b, *

a Department of Healthcare, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, Shenzhen 518048, China
b Research Institute of Maternity and Child Healthcare, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, Shenzhen 518028, China

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ABSTRACT

Psychological concerns caused by the COVID-19 pandemic become a public health crisis. It is noteworthy that the associations between COVID-19 related experiences and typical mental symptoms among pregnant women remain unclear. A cross-sectional online survey among pregnant women was conducted in Shenzhen, China. Multivariable logistic regression models were applied to explore the associations of COVID-19 related experiences with anxiety and depression symptoms during pregnancy. Totally, 751 pregnant women were enrolled. Lower prevalence of anxiety and depression was observed among older individuals: 17.2%, 12.3%, and 6.7% for anxiety symptom; 40.0%, 35.3%, and 24.6% for depression symptom, respectively in age <30 years, 30 to 34 years, and ≥35 years groups. COVID-19 related experiences that associated with the anxiety and depression symptoms among pregnant women included having confirmed or suspected COVID-19 cases around, subjective moderate or high risk of being infected, subjective severe life impact, subjective moderate or severe psychological impact, and spending more than one hour in COVID-19 related news. In the post-pandemic era, the psychological strain imposed by the COVID-19 pandemic is urgently needed to be alleviated among pregnant women. The long-term impacts of COVID-19 related experiences on maternal and child health should be monitored longitudinally.

1. Introduction

As of 25 June 2021, over 179.68 million confirmed cases and nearly 3.90 million deaths of coronavirus disease 2019 (COVID-19) have been reported globally (https://covid19.who.int/). The global pandemic of COVID-19 will probably last, as effective treatment options and adequate coverage of mass vaccination are lacking. Under this stressful circumstance, psychological concerns caused by the COVID-19 pandemic become a public health crisis (Wang et al., 2020). Pregnant women are considered to be a vulnerable group with emotional instability. They may have specific health care needs and run a risk of adverse psychological effects when confronting infectious disease outbreaks (Brooks et al., 2020). During the pandemic of COVID-19, numerous studies detected prevalent mental symptoms among pregnant women, such as anxiety and depression (Hessami et al., 2020; Yan et al., 2020). Previous studies found out some associated factors of these mental symptoms, including age, parity, working status, education level, income losses, physical activity status, having a previous psychiatric diagnosis, spouse’s support, and marital life satisfaction (Berthelot et al., 2020; Effati-Daryani et al., 2020; Kahyaoglu and Kucukkaya, 2020; Li et al., 2020; Wu et al., 2020). However, known factors could not make a full explanation of the impact on mental health by the COVID-19 pandemic.

It’s revealed that the COVID-19 pandemic acted as a significant risk factor of psychological distress during pregnancy or the perinatal period (Hessami et al., 2020). The negative psychological effects of the pandemic situation may be deepened along with pregnancy (López-Morales et al., 2021). Women’s experiences of coping with the

* Corresponding author at: Department of Healthcare, Affiliated Shenzhen Maternity and Child Healthcare Hospital, Southern Medical University, No. 3012 Fuqiang Road, Futian District, Shenzhen 518048, China.
E-mail address: wangyueyun@126.com (Y. Wang).

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COVID-19 pandemic seem to play a vital role in their negative psychological response, such as suffering COVID-19 related health worries and grief (Liu et al., 2020b). In addition, other unpleasant experiences, for example, contacts with confirmed cases, self-isolation or quarantine, and subjective high risk of being infected, are likely to be psychological stressors as well. It is noteworthy that the associations between COVID-19 related experiences and typical mental symptoms among pregnant women remain unclear. Hence, we hypothesized that a pregnant woman would be predisposed to mental health problems when suffering COVID-19 related experiences as following:

1. She or her family members have close contacts related to COVID-19;
2. There are confirmed or suspected COVID-19 cases around her;
3. She rates a high risk of being infected by COVID-19;
4. She rates certain life or psychological impacts by COVID-19;
5. She spends excessive time in the news about COVID-19.

Based on the study hypotheses, we conducted a city-wide survey among pregnant women in Shenzhen city during the local epidemic of COVID-19. The goal of this study is to clarify the associations of COVID-19 related experiences with maternal anxiety and depression symptoms, which may help to guide the mental health management of pregnant women in the post-pandemic era.

2. Materials and methods

2.1. Study design and participants

Shenzhen is an economically developed city in south China and has extensive ties to Hubei Province (the first reported epicenter of COVID-19 outbreak in China). This study was based on a cross-sectional survey from February 17th to March 16th, 2020 in Shenzhen city (Lin et al., 2021). At this period, the confirmed cases of COVID-19 increased quickly. The general public was required to stay home quarantine, thus, an online survey targeted pregnant women by convenience sampling was conducted. An electronic questionnaire was spread to members of Pregnant Women schools using a unique two-dimensional code through WeChat groups. WeChat is an extremely popular messaging and social media platform, which has been used by nearly almost all smartphone users in China. This mobile phone application provides text and voice messaging, group chats, and photograph or video sharing. Furthermore, a recruitment notice of the present survey was also released officially by Shenzhen Maternity and Child Healthcare Hospital (SMCHH). People who got this notice were encouraged to transfer this questionnaire to pregnant women around through social networks. Pregnant women could read detailed information and get a full understanding of this study, such as the study objectives, questionnaire contents, associated benefits, and harms. Following the participation instructions, women who selected the option of voluntary participation then finished the whole survey with all required questions. Hence, we finally obtained a convenient sample of pregnant women in Shenzhen. The present study was approved by the Medical Ethics Committee of SMCHH.

2.2. Data collection

A structured questionnaire was used to collect socio-demographic information, COVID-19 related experiences, daily behaviors, social supports, and mental health evaluation (Lin et al., 2021). Socio-demographic characteristics included age, ethnicity, marital status, local household registration, education, employment, monthly income, health insurance, parity, and gestational weeks for the current pregnancy.

Detailed measurement of COVID-19 related experiences was reported previously (Lin et al., 2021). Women were required to answer questions about close contacts related to COVID-19, confirmed or suspected COVID-19 cases around, and taking precautions. Subjective life and psychological impacts, as well as the risk of being infected by COVID-19, were estimated using a self-rating score (range: 0–10) according to COVID-19 related contacts, infections, and precautions. In accordance with one’s rating score, life and psychological impacts were defined in mild (0–3), moderate (4–7), or severe (8–10) level. Likewise, the risk of being infected was divided into low, moderate, or high level. Besides, the time women spent per day in physical exercise, surfing on the internet or social media, sleep duration, and following news about COVID-19 were also collected. Here, the time spent in the news about COVID-19 per day was also regarded as a COVID-19 related experience. Furthermore, social supports from husbands and other family members were measured by using subjective items categorized in four levels including none, weak, moderate, and strong. The level of husband’s support was defined to be none if a woman was single or divorced.

Pregnant women were asked to evaluate their anxiety and depression symptoms with the Self-Rating Anxiety Scale (SAS) and Patient Health Questionnaire (PHQ-9) (Cronbach’s α in the current study: 0.756 for SAS, 0.871 for PHQ-9 (Lin et al., 2021). Both of these two scales have been widely used in screening mental symptoms among Chinese populations. The SAS includes 20 question items with 4-point response options (score range: 1=never, 2=sometimes, 3=often, and 4=very often), which contribute to an original sum score (range from 20 to 80) and a standard sum score (original sum score multiply by 1.25). Women with a standard score of 50 or higher were defined with anxiety symptom. The PHQ-9 is also a 4-point Likert-type scale (0=never, 1=several days, 2=more than half of the days, 3=nearly every day), consisting of 9 question items. The sum score ranges from 0 to 27, in which a cut-off value of 5 or higher was considered with depression symptom.

2.3. Statistical analysis

All statistical analyses were performed by using SPSS 21.0 (IBM SPSS Statistics, New York, United States). Chi-square tests were used to detect the different prevalence of anxiety and depression symptoms across various characteristics. For ordinal categorical characteristics, linear-by-linear association in chi-square test was adopted to detect the changes of mental symptoms with the level of the variables. Multivariable logistic regression models were applied to explore the associations of COVID-19 related experiences with anxiety and depression symptoms during pregnancy, which were represented with odds ratios (OR) and 95% confidence intervals (CI). Different potential confounders were adjusted in three models: model 1 (adjusted for age only), model 2 (based on model 1, further adjusted for socio-demographic factors with P < 0.30 in the univariate analysis), and model 3 (based on model 2, further adjusted for daily behavior and social support during the local epidemic of COVID-19). The statistical significance was set to be less than 0.05 in two-tailed tests.

3. Results

3.1. Characteristics of the participants

Overall, 751 pregnant women with a mean age of 30.51 years were enrolled. Of these mothers, 43.3% were younger than 30 years old, 38.8% were between 30 and 34 years old, and 17.8% were 35 years or older. The overall characteristics of the participants were reported previously (Lin et al., 2021).

3.2. The prevalence of anxiety and depression symptoms according to women’s characteristics

We compared the prevalence of anxiety and depression symptoms among women with distinct characteristics, which included socio-demographic characteristics, COVID-19 related experiences, daily
behaviors, and social supports during the local epidemic of COVID-19 (Table 1). Lower prevalence of anxiety and depression symptom was observed among older individuals: 17.2%, 12.3%, and 6.7% for anxiety symptom (P for trend=0.002); 40.0%, 35.3%, and 24.6% for depression symptom (P for trend=0.002), respectively in age <30 years, 30–34 years, and ≥35 years groups (Figure 1). The prevalence of anxious symptom was not differently distributed across groups of other socio-demographic characteristics (all P > 0.05), while the prevalence of depressive symptom demonstrated distributional difference across groups according to education level (P < 0.001), health insurance status (P=0.049), and parity for the current pregnancy (P=0.009). Women receiving higher education level (college or above), having health insurance, and engaged in second or more parities showed relatively higher prevalence of depression symptom.

COVID-19 related experiences did also associate with the onset of mental symptoms. The prevalence of anxious and depressive symptoms increased with the severity of COVID-19 related experiences, which included confirmed or suspected COVID-19 cases around, subjective risk of being infected by COVID-19, subjective life and psychological impacts by COVID-19, and time spent in COVID-19 related news per day (all P for trends < 0.05). However, there was no statistically different distribution of anxiety and depression symptoms among women with and without close contacts related to COVID-19 of themselves or their family members (P=0.18 and 0.53, respectively) (Table 1).

Various daily behaviors during the local epidemic of COVID-19, such as physical exercise, surfing on the internet or social media, and sleep habits, indicated different manifestations of mental symptoms. We noticed that the less time spent in physical exercise and sleep, but more time invested in the internet or social media, the higher prevalence of anxiety and depression symptoms among women (all P for trends < 0.05) (Table 1).

It was observed that 62.7% and 71.4% of the participants got strong supports from their husbands and family members, respectively. Among these women, lower prevalence of anxiety and depression symptoms was showed than those receiving weak or moderate supports (all P < 0.001) (Table 1).

3.3. Associations of COVID-19 related experiences with anxiety and depression symptoms during pregnancy

We found that COVID-19 related experiences were positively associated with anxiety and depression symptoms among pregnant women when adjusting possible confounders (Table 2 and 3). Events associated with anxiety symptom among pregnant women were: uncertainty (OR:1.88, 95%CI:1.09–3.25) or recognition (OR:3.92, 95%CI:2.05–7.50) of confirmed or suspected COVID-19 cases around, subjective moderate (OR:3.28, 95%CI:1.94–5.56) or high (OR:6.18, 95%CI:1.99–19.25) risk of being infected by COVID-19, subjective severe life impact by COVID-19 (OR:9.67, 95%CI:2.19–42.68), subjective moderate (OR:5.87, 95%CI:2.07–16.69) or severe (OR:21.43, 95%CI:6.98–65.82) psychological impact by COVID-19, and spending 1–3 hours (OR:2.55, 95%CI:1.54–4.23) or more than 3 hours (OR:2.89, 95%CI:1.45–5.79) in COVID-19 related news per day (Table 2).

Similar but weaker associations with depression symptom were also detected: uncertainty (OR:1.58, 95%CI:1.04–2.39) or recognition (OR:1.78, 95%CI:1.04–3.04) of confirmed or suspected COVID-19 cases around, subjective moderate (OR:2.02, 95%CI:1.31–3.12) or high (OR:3.75, 95%CI:1.18–11.90) risk of being infected by COVID-19, subjective severe life impact by COVID-19 (OR:2.13, 95%CI:1.05–4.32), subjective moderate (OR:2.21, 95%CI:1.42–3.45) or severe (OR:3.90, 95%CI:2.11–7.23) psychological impact by COVID-19, and spending 1–3 hours (OR:1.72, 95%CI:1.21–2.44) in COVID-19 related news per day (Table 3).

4. Discussion

Identification of psychological distress greatly facilitates the development of coping strategies against COVID-19 for pregnant women. In our study, distinct prevalence of anxiety and depression symptoms was detected across different pregnant age groups during the local epidemic of COVID-19 in Shenzhen city. Interestingly, COVID-19 related experiences did play an important role in inducing negative psychological manifestations during pregnancy, calling for further psychological healthcare concerns in the post-pandemic era.

In the current study, women under 30 years old appeared heavier burden of anxiety and depression symptoms than older counterparts. This finding was consistent with those in other population-based studies before (Koleva et al., 2011; Lee et al., 2007; McMahon et al., 2011; Qiao et al., 2009; Rich-Edwards et al., 2006) and after COVID-19 appearance (Preis et al., 2020; Wu et al., 2020), showing psychological advantages among older women. A potential explanation lies in that women with an advanced age may receive more resilience and less control from their partners (McMahon et al., 2011). Besides, other researchers also reported null differences of anxiety and depression scale scores in different age groups of Chinese pregnant women, however, the sample size was relatively small as a result of a short survey time during the COVID-19 outbreak (Dong et al., 2020). Further explorations based on qualitative studies may help to illustrate the psycho-social functioning of different age groups, as the reasons behind their behaviors and reactions should be understood (Denny and Weckesser, 2019).

There were varied assessment tools applied to detect anxiety and depression symptoms, which restricted the comparison of our findings with existing studies. Other psychiatric scales, for example, the Generalized Anxiety Disorder Scale (GAD-7), the Spielberger State-Trait Anxiety Scale questionnaire (STAI-T), the Beck Anxiety Inventory (BAI), the Edinburgh Postnatal Depression Scale (EPDS), and the Center for Epidemiologic Studies-Depression (CES-D), were also commonly used (Farrell et al., 2020; Liu et al., 2020b; Medina-Jimenez et al., 2020; Sade et al., 2020; Sinaci et al., 2020; Zhou et al., 2020). Comparing to studies using the same measurement, we found that the anxiety rate in Shenzhen (13.4%) (Lin et al., 2021) was relatively lower than that in Wuhan and Chongqing (17.2%) (Liu et al., 2020a), as well as the depression rate (35.4%) lower than that in Qatar (39.2%) during the COVID-19 pandemic (Farrell et al., 2020). When using a cut-off point of PHQ-9 scores ≥5, the prevalence of depression in our study (9.1%) (Lin et al., 2021) was higher than that in Beijing (5.3%) (Zhou et al., 2020). These disparities in the prevalence of mental symptoms among pregnant women across countries and regions are possibly derived from distinct socioeconomic, demographic, cultural, and religious backgrounds. In addition, it may be also attributed to the variation of COVID-19 related impacts in different regions to a certain extent.

The influence of the COVID-19 pandemic on pregnant women probably did not lie in their COVID-19 infected status, since a pilot comparison study in the UK revealed that the infected group by COVID-19 shared an equal level of anxious and depressive symptoms with the uninfected group (Kotabagi et al., 2020). However, a strong association with psychological manifestations was signified in our study if there were confirmed or suspected COVID-19 cases around pregnant women. Similarly, a nationwide survey in the USA found that women living in an area with a high number of COVID-19 cases had greater changes in pregnancy-related anxiety before and after COVID-19 appearance (Moyer et al., 2020). Day by day, both women and the general population also demonstrated the crash of having confirmed cases around on mental health status (Shi et al., 2020; Zhang et al., 2020). These findings remind that more psychiatric attention may be warranted to place on uninfected pregnant women, owing to more likelihood to be affected by COVID-19 infections nearby. Moreover, self-estimation of COVID-19 susceptibility possibly acts as an inducer of mental disorders. We found that the higher risk of being infected a woman estimated, the higher odds of psychological symptoms she got. It was strengthened by...
Table 1
The prevalence of anxiety and depression symptoms among pregnant women with different characteristics (N=751)

| Variables                                      | Anxiety symptom Yes (n=101), n(%) | P value | Depression symptom Yes (n=266), n(%) | P value |
|-------------------------------------------------|-----------------------------------|---------|--------------------------------------|---------|
| Socio-demographic Characteristics               |                                    |         |                                      |         |
| Age (years)                                      |                                    |         |                                      |         |
| <30                                              | 56 (17.2)                          | 0.002*  | 130 (40.0)                           | 0.002*  |
| 30~34                                            | 36 (12.3)                          |         | 103 (35.3)                           |         |
| ≥35                                              | 9 (6.7)                            |         | 33 (24.6)                            |         |
| Ethnicity                                        |                                    |         |                                      |         |
| Han ethnicity                                    | 96 (13.7)                          | 0.43    | 249 (35.6)                           | 0.75    |
| Other ethnicities                                | 5 (9.8)                            |         | 17 (33.3)                            |         |
| Marital status                                   |                                    |         |                                      |         |
| Single/divorced                                  | 5 (19.2)                           | 0.38    | 8 (30.8)                             | 0.61    |
| Married                                          | 96 (13.2)                          | 0.01    | 258 (35.6)                           | 0.41    |
| Local household registration                     |                                    |         |                                      |         |
| No                                               | 48 (13.6)                          | 0.91    | 116 (32.9)                           | 0.17    |
| Yes                                              | 53 (13.3)                          |         | 150 (37.7)                           |         |
| Education                                        |                                    |         |                                      |         |
| Senior high school or below                      | 24 (13.6)                          | 0.93    | 41 (23.3)                            | 0.002*  |
| College or above                                 | 77 (13.4)                          |         | 225 (39.1)                           |         |
| Employment status                                |                                    |         |                                      | <0.001  |
| Unemployed                                       | 34 (14.8)                          | 0.48    | 83 (36.1)                            | 0.80    |
| Employed                                         | 67 (12.9)                          |         | 183 (35.1)                           |         |
| Monthly income (RMB)                             |                                    |         |                                      |         |
| ≤5,000                                           | 40 (16.3)                          | 0.28*   | 87 (35.5)                            | 0.86*   |
| 5,001−8,000                                      | 21 (10.7)                          |         | 71 (36.2)                            |         |
| >8,000                                           | 40 (12.9)                          |         | 108 (34.8)                           |         |
| Health insurance                                 |                                    |         |                                      |         |
| No                                               | 8 (12.1)                           | 0.74    | 16 (24.2)                            | 0.047   |
| Yes                                              | 93 (13.6)                          |         | 250 (36.5)                           |         |
| Parity for the current pregnancy                 |                                    |         |                                      |         |
| First                                            | 74 (14.4)                          | 0.26    | 196 (38.5)                           | 0.009   |
| Second or more                                   | 27 (11.4)                          |         | 88 (26.7)                            |         |
| COVID-19 related experiences                     |                                    |         |                                      |         |
| Close contacts related to COVID-19 of themselves or their family members | 619 (86.9) | 0.18 | 254 (35.7) | 0.53 |
| Confirmed or suspected COVID-19 cases around      | 619 (86.9) | 0.18 | 254 (35.7) | 0.53 |
| Subjective risk of being infected by COVID-19    |                                    |         |                                      |         |
| Low                                              | 52 (9.5)                           |          | 169 (30.8)                           | <0.001* |
| Moderate                                         | 29 (22.1)                          |          | 63 (48.1)                            | 0.002*  |
| Severe                                           | 20 (28.2)                          |          | 34 (47.9)                            | 0.002*  |
| Subjective psychological impact by COVID-19      |                                    |         |                                      |         |
| Mild                                             | 59 (9.5)                           |          | 191 (30.8)                           | <0.001* |
| Moderate                                         | 35 (30.4)                          |          | 50 (43.5)                            | <0.001* |
| Severe                                           | 35 (30.4)                          |          | 50 (43.5)                            | <0.001* |
| Daily behaviors during the local epidemic of COVID-19 | 349 (91.4) | <0.001* | 115 (30.1) | 0.015* |
| Time spent in the news about COVID-19 per day (hours) | 349 (91.4) | <0.001* | 115 (30.1) | 0.015* |
| Time spent in physical exercise per day (minutes) | 349 (91.4) | <0.001* | 115 (30.1) | 0.015* |
| Time spent in the internet or social medias per day (hours) | 349 (91.4) | <0.001* | 115 (30.1) | 0.015* |
| Sleep duration at night (hours)                  |                                    |         |                                      |         |
| <7                                               | 19 (21.8)                          | 0.014*  | 44 (50.6)                            | 0.015*  |
| ≥7                                               | 20 (10.2)                          |          | 64 (32.5)                            |         |
the data from Qingdao city, which showed that risk perception to COVID-19 was positively correlated with anxiety rating scores (Yue et al., 2020). For medical staffs and the general public, having a high risk of contracting COVID-19 has been recognized as a common risk factor of psychological distress (Luo et al., 2020). Since pregnant women experienced health worries during the pandemic (Corbett et al., 2020), their psychological distress severity (Lemieux et al., 2020), indicating the negative effect of over-concentration on mass media. In step with our results, Canadian researchers noticed analogous findings that news media consumed for recommending an appropriate time limit of following COVID-19 information also facilitated psychological manifestations, which was related to being anxious and depressive (Kahyaoglu and Kurucakaya, 2020). Besides, it was noted that insufficient COVID-19 related information also facilitated psychological manifestations, which was related to being anxious and depressive (Kahyaoglu and Kurucakaya, 2020).

In our survey, women reported substantial life and psychological impacts by the coronavirus during pregnancy (Lin et al., 2021). These impacts are strongly associated with the significant changes in daily routines as the government has adopted restrictions on people’s movements and activities. Consequently, alterations in the habits of eating, exercising, and sleep come behind (Flanagan et al., 2020; Pedrosa et al., 2020). Likewise, the modes of working, transportation, and social intercourse among pregnant women are forced to make adjustments (Corbett et al., 2020). Moreover, there is a complex composition of emotional reaction, personality traits, social perception, and psychological outcomes in the fight with COVID-19 (Pedrosa et al., 2020). In the context of these big changes, we observed strong associations of life psychological outcomes in the fight with COVID-19 (Pedrosa et al., 2020). In the context of these big changes, we observed strong associations of life psychological outcomes in the fight with COVID-19 (Pedrosa et al., 2020). In the context of these big changes, we observed strong associations of life psychological outcomes in the fight with COVID-19 (Pedrosa et al., 2020).

Figure 1. Distinct prevalence of anxiety and depression symptoms among pregnant women in different age groups.

![Figure 1](image-url)

| Variables | Anxiety symptom | Depression symptom |
|-----------|----------------|-------------------|
|           | Yes (n=101), n(%) | Yes (n=266), n(%) | P value | Yes (n=485), n(%) | Yes (n=485), n(%) | P value |
| None/weak/moderate | 62 (22.1) | 129 (46.1) | <0.001 | 129 (46.1) | 151 (53.9) | <0.001 |
| Strong | 39 (8.3) | 137 (29.1) | 0.001 | 137 (29.1) | 334 (70.9) | 0.001 |
| Support from family members | None/weak/moderate | 52 (24.2) | 102 (47.4) | <0.001 | 102 (47.4) | 113 (52.6) | <0.001 |
| Strong | 49 (9.1) | 164 (30.6) | 0.001 | 164 (30.6) | 372 (69.4) | 0.001 |

* Variables of anxiety and depression symptoms among pregnant women.
* Indicates P for trend

Table 1 (continued)

Table 2

| Table 2 | Associations of COVID-19 related experiences with anxiety symptom during pregnancy (N=751) |
|---------|-----------------------------------------------------------------------------------------------|
| Variables | Model 1, OR (95%CI) | Model 2, OR (95%CI) | Model 3, OR (95%CI) |
| Close contacts related to COVID-19 of themselves or their family members | No | 1.00 (reference) | 1.00 (reference) | 1.00 (reference) |
| Yes | 1.82 (0.80, 4.12) | 1.90 (0.83, 4.34) | 1.80 (0.74, 4.37) |
| Confirmed or suspected COVID-19 cases around | No | 1.00 (reference) | 1.00 (reference) | 1.00 (reference) |
| Yes | 2.53 (1.52, 4.19) | 2.48 (1.49, 4.12) | 2.55 (1.49, 4.12) |
| Subjective risk of being infected by COVID-19 | Low | 1.00 (reference) | 1.00 (reference) | 1.00 (reference) |
| Moderate | 4.06 (2.51, 6.58) | 4.34 (2.65, 7.11) | 4.19 (2.49, 7.16) |
| High | 7.72 (2.66, 22.39) | 7.31 (2.49, 21.45) | 7.16 (2.28, 21.50) |
| Subjective life impact by COVID-19 | Mild | 1.00 (reference) | 1.00 (reference) | 1.00 (reference) |
| Moderate | 2.89 (0.68, 12.33) | 2.97 (0.69, 12.69) | 2.88 (0.65, 12.69) |
| Severe | 8.74 (2.05, 37.23) | 9.12 (2.13, 40.92) | 9.67 (2.19, 42.68) |
| Subjective psychological impact by COVID-19 | Mild | 1.00 (reference) | 1.00 (reference) | 1.00 (reference) |
| Moderate | 6.27 (2.24, 17.54) | 6.38 (2.28, 17.87) | 5.87 (2.07, 16.69) |
| Severe | 28.88 (9.70, 85.98) | 29.36 (9.84, 87.65) | 21.43 (6.98, 65.82) |
| Time spent in the news about COVID-19 per day (hours) | <1 | 1.00 (reference) | 1.00 (reference) | 1.00 (reference) |
| 1–3 | 2.45 (1.52, 3.95) | 2.48 (1.54, 4.01) | 2.85 (1.54, 4.23) |
| >3 | 3.22 (1.69, 6.13) | 3.14 (1.64, 6.01) | 2.89 (1.45, 5.79) |

Bold values indicate statistical significance.
Model 1: Adjusted for age.
Model 2: Adjusted for age, monthly income, parity for the current pregnancy (P <0.30 in the univariate analysis).
Model 3: Adjusted for age, monthly income, parity for the current pregnancy, time spent in physical exercise and using the internet or social medias per day, sleep duration at night, support from husbands and family members.

Canadian researchers noticed analogous findings that news media consulting frequency during the COVID-19 pandemic linked to psychological distress severity (Lemieux et al., 2020), indicating the negative effect of over-concentration on mass media. In step with our results, researchers found that devoting over sixty minutes to COVID-19 related information increased the severity of anxiety symptom in the general population (Hou et al., 2020). Besides, it was noted that insufficient COVID-19 related information also facilitated psychological manifestations, which was related to being anxious and depressive (Kabayoğlu and Kurucakaya, 2020). Thus, health professionals should be responsible for recommending an appropriate time limit of following COVID-19 related news, as our results illustrated, within one hour. Public warnings should be also distributed to guide people to set up screen time limits on their computers, television, and smartphones.
There were some limitations in the present study. First of all, the cross-sectional design restricted us to verify a certain causal hypothesis for existing associations. Moreover, due to the limited sample size, the confidence intervals of some odds ratios were relatively wide. Although these estimates remain statistically significant, further investigations are worthy to be conducted with longitudinal follow-up in larger samples. Second, due to online participation of this survey in one city, the present sample was non-random and could not perfectly represent all pregnant individuals (Lin et al., 2021). It may limit the generalization of our findings to those out of reach to the internet or outside the surveyed area. Third, only six question items on COVID-19 related experiences and two psychological symptoms were measured in our study, which could not reflect the direct effect of COVID-19 on mental health. Additionally, we used a one-item question rather than a validated measure tool to evaluate COVID-19 related experiences, due to no ready-to-use measure tools and no sufficient time to conduct validation and reliability tests during the survey period. Standard measurement tools are warranted of need to be developed and validated. Fourth, psychological consultation for the participants might influence the natural status of mental health. However, only a small proportion of women (1.1%) sought assistance before the survey, with negligible influence on our data.

5. Conclusion

Our study tested the substantial contribution of COVID-19 related experiences to the anxiety and depression symptoms among pregnant women in Shenzhen city, including confirmed or suspected cases around, subjective risk of being infected, subjective life and psychological impacts, and time spent in COVID-19 related news. In the post-pandemic era, public concerns should be placed on the pregnant group that has suffered COVID-19 related experiences. The psychological strain imposed by the COVID-19 pandemic is urgently needed to be alleviated with immediate health education and standard intervention among pregnant women. The long-term impacts of COVID-19 related experiences on maternal and child health should be monitored longitudinally.

Authorship contribution statement

All authors have made substantial contributions to this study in the various sections described below. Y.W. and W.L. originated the study, conceptualization, design, supervised implementation. B.W., B.C., C.Z., and W.H. acquired the data. W.L., Y.W., and S.Y. interpreted the data and performed statistical analysis. W.L. wrote the draft of the manuscript. W.L., Y.W., B.W., and X.Z. revised the manuscript. All authors gave their final approval for the manuscript to be published.

Declaration of Competing Interest

The authors declare that they have no conflict of interest.

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