**Title: Impact of COVID-19 pandemic on mental health during pregnancy and postpartum: A cross-sectional study**

**Running title:** Peripartum mental health during COVID-19 pandemic

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**Abstract:**

Objective- To determine the prevalence of peripartum depression (PPD) and anxiety during the COVID-19 pandemic, any differences between COVID-infected and non-infected mothers and its risk factors.

Study design- Cross-sectional study.

Setting- Tertiary care maternity hospital

Population- Pregnant and postpartum women

Methods- Questionnaire based direct interview. EPDS (Edinburgh postnatal depression scale) score, COVID-19 anxiety scale (CAS) was used.

Outcome measures- Possible PPD (EPDS≥13), Probable PPD (EPDS≥14), Peripartum anxiety (EPDS anxiety sub score≥4), COVID-19 related anxiety and risk factors of PPD.

Results- Out of 842 eligible subjects, 142 were confirmed COVID-19 positive and 670 patients were without the infection. The mean age was 25±3.9 years and

571 (67.8%) subjects were postpartum. Among the subjects, 383 (45.5%) had possible depression, 317 (37.6%) had probable depression. Peripartum anxiety was observed among 763(90.6%) subjects and the median CAS score was 15(8-28). While there was no significant difference in the prevalence of PPD, peripartum anxiety was higher among COVID non-infected subjects (91.6% vs 86.6%, p=0.04). The CAS score was higher among COVID-19 infected compared to the non-infected [17(10-28) vs 15(8-25), p=0.00]. In multivariate analysis, history of psychiatric illness [OR- 4.2(95% CI- 1.82-9.93), p=0.001], domestic violence [OR-2.4(95% CI-1.16-5.10), p=0.019] and past obstetric complications [OR-1.5(95%CI-1.01-2.27), p=0.042] were significant risk factors for PPD.

Conclusion- High prevalence of PPD was observed during COVID-19 pandemic without any significant difference between COVID-19 infected and non-infected subjects. COVID-19 infected patients had higher COVID related anxiety.

Funding- None taken

Keywords- peripartum depression; EPDS; COVID-19 anxiety scale.

Impact of COVID-19 pandemic on mental health during pregnancy and postpartum: A cross-sectional study

**Introduction:**

The first clusters of cases of pneumonia due to the novel coronavirus, SARS-COV2 (severe acute respiratory syndrome coronavirus 2), were reported from Wuhan, Hubei province in China by the end of 20191. The rapid spread of the infection became a global health problem and became a pandemic, as was declared by WHO on the 11th of March 20202. The worldwide spread of the novel coronavirus resulted in millions of deaths3. Preventive measures were taken to control the spread of the infection, mainly nationwide lockdowns, which negatively impacted the socio-economic4 and mental health status5 of a significant proportion of the population. Multiple studies have documented an increased prevalence of depression6 anxiety, stress and suicidal tendencies7, among several segments of the population. Children and adolescents8,9, elderly10, health care workers11,12, women during pregnancy and after childbirth13 are particularly vulnerable to these ailments. Patients infected with coronavirus show confusion, features of post-traumatic stress disorders during the acute illness, while some develop depression, anxiety, fatigue during the post-illness period14.

Mental health disorders during pregnancy and postpartum periods carry high morbidity and mortality among mothers and newborns15-17. Peripartum depression may affect up to one in five mothers18, with even a higher prevalence seen in low-income nations19. Prevalence of anxiety during the antenatal and postnatal period is up to 15-20% and 10%, respectively20. Multiple studies conducted after the onset of the COVID-19 pandemic show an increased prevalence of depression, anxiety, and mental health disorders during the peripartum period compared to the pre-COVID time13,21-23.

A particularly vulnerable group were pregnant and postpartum women who had to attend the healthcare facilities during the pandemic. However, whether the COVID-19 infection during the peripartum period leads to higher levels of depression and anxiety compared to the COVID non-infected subjects is largely unknown. Therefore, in the present study, our primary objective is to determine the prevalence of peripartum depression (PPD) and anxiety and any differences between COVID-infected and non-infected mothers. The secondary objective is to explore the risk factors of PPD among mothers.

**II. Methods**

**Study design and setting**

The present study is a hospital-based cross-sectional and comparative observational study conducted between 1st September 2020 to 31st December 2020 in eastern India. After the declaration of the COVID-19 pandemic and country-wide lockdown, the Medical College Hospital, Kolkata, India, was declared by the state government as a dedicated referral centre exclusively for the care of COVID-19 infected patients. The Department of Obstetrics and Gynaecology served COVID-infected pregnant and postpartum mothers, while its annexe hospital, the Lady Dufferin Victoria Hospital, was dedicated to non-COVID infected peripartum care. Data collection was done from these two busy maternity hospitals located in eastern India.

**Participants**

**Inclusion criteria:** Consecutive pregnant and postpartum women more than 18 years of age, attending the outpatients and inpatients of these two hospitals during the study period were included in our study. It included (i) COVID-19 infected mothers admitted inpatient due to obstetric indications or upper respiratory symptoms due to COVID, (ii) COVID-non infected mothers attending the routine antenatal clinic or (iii) admitted for obstetric indications.

**Exclusion criteria:** SARS COVID-19 infected patients with moderate disease with red flag signs, severe disease and patients admitted in High dependency unit or Intensive care, patients with severe obstetric complications or hemodynamic instability, patients with incomplete data or not willing to give consent, were excluded.

Subjects who satisfied the inclusion and exclusion criteria were divided into two groups-

Group 1- Pregnant and postpartum subjects admitted due to SARS-COVID-19 infection, confirmed by COVID-19 RT-PCR (reverse transcription-polymerase chain reaction) test.

Group 2- Pregnant and postpartum subjects without upper respiratory symptoms, attending the outpatients and being admitted in the ward due to obstetric indications.

Assessment of eligibility for inclusion into the study was done by one of the primary investigators. Subjects who provided written valid informed consent underwent face-to-face interviews by one of the postgraduate trainees or primary investigators in the Department of Obstetrics and Gynaecology. All the standard protective measures were taken during the collection of data from the COVID-19 infected subjects. All the information were collected in a data collection form, which included (i)the socio-demographic information of the participants, (ii) pregnancy-related information, (iii) and a set of standard questionnaires for assessment of peripartum depression, anxiety, anxiety due to the COVID19 infection and (iv) knowledge, attitude, and practices towards the COVID-19 infection.

The institutional ethical committee approved the study.

**Sample size estimation**

The target sample size of the subjects was determined using the standard formula:

N=Zα2P(1-P)/ d2 24, where N denotes the estimated sample size. We set α (significance level) = 0.05, as per recommendation, to get the statistic of the significance Zα = 1.96. The pooled prevalence of perinatal depression, as estimated from previous systematic reviews and meta-analyses18,25,26 was around 20%. Thus, we set the P (Prevalence) value for this study at 0.2. The estimated maximum marginal error for the proportion d was kept at 0.03. We further amplified the sample size by 20% to increase the statistical power and for conducting subgroup analysis. The final minimum estimated sample size for the study was determined at 819.

**Outcome variables**

**Social, demographic, and clinical information**

An information sheet was designed to collect the following data:

1. Socio-demographic factors, e.g. age, residence, monthly income, education, occupation, marital status
2. Family-related factors, e.g. family type, husband supportive or not, addiction in the husband, history of domestic abuse, financial difficulties during the COVID-19 pandemic
3. Pregnancy-related factors, e.g. planned or unplanned pregnancy, order of pregnancy, gestational age or weeks passed after delivery, gestational complications or co-morbidities, if any, past obstetric history, past history of pregnancy loss.
4. Clinical data, e.g. any upper respiratory symptoms, contact with COVID-19 infected individual, if infected with COVID-19, the severity of illness (mild/moderate)

**Edinburgh postnatal depression scale (EPDS)**

Perinatal depression was assessed using the EPDS score27. It consists of 10 questions related to the subjects' mental health. Each question has a score ranging from 0 to 3, making the maximum summative score of 30. It is an internationally recommended and validated score used to screen for depression and anxiety in the perinatal period. A recommended cut-off score of 13 or more will be used to detect depression during the application28. Subjects with a score of 14 and higher will be considered as possible depression and were used for statistical analysis.

**EPDS anxiety subscore**

Overall assessment of anxiety was done using the EPDS anxiety subscore (EPDS-3A). The summative score of questions 3,4, and 5 of the EPDS29,30 was used for screening of anxiety as per the previous studies13. A cut-off value of 4 or more was considered for screening of anxiety.

**COVID-19 related anxiety**

Anxiety towards the COVID-19 infection was assessed by the COVID-19 Anxiety Scale31, which was recently validated in a South Indian population. This is a 7-item scale, with four options in each. The maximum score is 28 and a minimum of 7. A higher score demonstrates a higher degree of anxiety due to COVID-19.

**Knowledge, attitude and practice towards COVID-19 infection**

A specific set of questions which was approved by the Department of Psychiatry, Medical College, Kolkata, and was used to assess awareness of COVID-19 infection among pregnant and postpartum women. They included questions about (i) knowledge, e.g. sources of the information, awareness about the mode of transmission and preventive measures, (ii) attitude, e.g. feels that COVID-19 infection can affect her pregnancy or baby, feels nervous about getting outside home or feels like avoiding a visit to the health care facility, feels breastfeeding can transmit the infection to the infant, (iii) practices, e.g. maintaining hand hygiene, social distancing and wearing a face mask. The answer to each question was recorded in binary response (yes or no).

**Risk factors of peripartum depression**

We analyzed several individual factors (age, education, monthly income, comorbidities, history of psychiatric illness, family history of psychiatric disease), family-related factors (domestic violence, lack of family support, addiction in the husband, overcrowding, financial difficulties) and pregnancy-related factors (gestations complications, history of child loss, previous obstetric complications) predisposing to peripartum depression.

**Statistical analysis**

The data were tabulated in Microsoft Excel and analyzed using SPSS software version 25.0. Categorical variables were presented in numbers and percentages, and the Chi-square test was used to compare them between the two study groups. The continuous variables were presented in mean± standard deviation (SD) or median (range). A comparison of COVID-19 anxiety scale scores between the COVID-19 infected and non-infected subjects were made using the Mann-Whitney U test. To determine the risk factors for probable peripartum depression (defined as EPDS score ≥14), first, univariate analysis was done, and those variables found to be significant were subjected to multivariate analysis. To find out the correlation between the EPDS score, EPDS anxiety sub-score and the COVID-19 anxiety score, the spearman correlation coefficient was calculated. A p-value less than 0.05 was used as a cut-off for defining statistical significance.

**III. Results:**

**Socio-demographic characteristics**

A total of 842 subjects were included in the analysis of the study. Among the subjects, 142 patients were confirmed COVID-19 positive (Group 1) during the conduction of the study and 670 patients were without the infection (Group 2). The patient recruitment is presented in Figure 1.

The mean age of the population was 25(±3.9) years. Post-partum (571, 67.8%) and subjects in the third trimester of pregnancy (253, 30.0%) constitute most of the study population. Most of the study population belonged to urban areas (739, 87.8%). The baseline characteristics are summarized in Table 1.

The comparison of different socio-demographic, clinical and mental health parameters between the two groups are presented in Table 2. Patients admitted with COVID-19 infection was older (25.9±4.6 vs 24.8±3.7 years, p=0.001), had higher education (59.3% vs 49.3%, p=0.02) compared to the COVID non-infected group. A higher proportion of gestational complications (27.3% vs 8.4%, p=0.000), presentation with medical co-morbidities (32% vs 4.8%, p=0.000) and high-risk pregnancy (27.3% vs 20.4%, p=0.05) was observed among COVID-19 infected patients compared to those who were not infected during the study period.

**Mental health of pregnant and postpartum**

Among the subjects, 383 (45.5%) had possible depression (EPDS score≥13), while 317 (37.6%) had probable depression (EPDS score≥14). Peripartum anxiety (EPDS 3A ≥4) was observed among 763(90.6%) subjects. Although there was no significant difference in the frequency of peripartum depression, peripartum anxiety was higher (86.6% vs 91.6%, p=0.04) among the COVID non-infected subjects than those infected (Table 2).

Anxiety related to COVID-19 was significantly higher among COVID-19 infected subjects (17(10-28) vs 15(8-25), p=0.000) compared to those who were not infected (Table 2).

**Knowledge, Attitude and Practice towards COVID-19 infection**

There were several significant differences in the parameters between COVID-19 infected and non-infected subjects, as presented in Table 3. According to the table, among the COVID infected mothers, a higher proportion of subjects was afraid of adverse pregnancy outcomes due to COVID infection (78.5% vs 57%, p=0.000), fear of transmission to the newborn with breastfeeding (64.5% vs 51.9%, p=0.003), compared to COVID non-infected mothers. In addition, while information and awareness regarding the preventive measures of COVID infection was high among both groups, overall practice of preventive measures, e.g. handwashing (10.3%), wearing a face mask (18.2%) and social distancing (33%), had been adopted by a much lower proportion.

**Risk factors of peripartum depression**

Univariate analysis of the risk factors for peripartum depression showed (Table 4) that medical co-morbidities (p=0.006), past history of psychiatric illness(p=0.000), domestic violence (p=0.000), lack of family support (p=0.009), antenatal state(p=0.015), outpatient consultation (p=0.028), past obstetric complications (p=0.001), gestational complication during present pregnancy (p=0.004) and previous history of child loss (p=0.003) were significantly associated with peripartum depression. In multivariate analysis it was found that past history of psychiatric illness [OR- 4.2(95% CI- 1.82-9.93), p=0.001], domestic violence [OR-2.4(95% CI-1.16-5.10), p=0.019] and past obstetric complications [OR-1.5(95%CI-1.01-2.27), p=0.042] were significant risk factors for peripartum depression.

**Correlation between the depression and anxiety scores**

Although there was a good correlation between the EPDS total score and the EPDS anxiety sub-score (ρ= 0.787, p=0.000) and between EPDS score and COVID-19 anxiety score (ρ= 0.138, p=0.000), there was no correlation found between the EPDS anxiety sub-score and the COVID-19 anxiety score (Table 5).

**Changes in anxiety and depression with time**

The anxiety related to the COVID-19 infection showed a declining trend during the study period (from September 2020- to December 2020) among both COVID-19 infected and non-infected subjects. On the other hand, the depression score did not show any significant change, as shown in Figure 2.

**Discussion:**

In our study, we found that (i) the prevalence of possible peripartum depression and anxiety was 45.5% and 90.6%, respectively, (ii) although there was no significant difference between the prevalence of overall depression, (iii) anxiety related to the COVID-19 disease was significantly higher among the patients infected with the virus, (iv) history of psychiatric illness, past obstetric complications and domestic abuse were significant risk factors of peripartum depression (v) awareness regarding the symptoms, mode of transmission and preventive measures was higher among COVID non-infected subjects, while (vi) fear of the adverse effect on the pregnancy, breastfeeding and off-spring was more in the COVID infected subjects,(vii) a declining trend of the COVID-related anxiety with time, with a relatively stable prevalence of peripartum depression.

This study used validated scores to identify depression and anxiety, allowing assessment of mental health disorders among peripartum women who needed hospital visits and admission during the pandemic. We further focused on comparing these parameters among COVID-infected and non-infected subjects to determine the additional contribution of COVID infection on peripartum depression and anxiety.

Peripartum depression has increased significantly during the COVID pandemic compared to the pre-COVID era 13,34. A systematic review and meta-analysis of 23 studies by Yan et al.32 have shown that the pooled prevalence of anxiety and depression in peripartum subjects during the COVID pandemic were 37% and 31%, respectively. In the present study, the prevalence of possible peripartum depression was 45.5%. A study conducted from the same institute during pre-COVID times showed a prevalence of peripartum depression of 22%33. This markedly higher prevalence of peripartum depression may be due to the adverse socio-economic effects of the pandemic.

Most of the studies conducted to determine the prevalence of peripartum anxiety during the pandemic were based on self-reported surveys. They were dependent on mobile phones and the internet, requiring a minimum level of knowledge and understanding of electronic gadgets13,32,34. As the institute where the study was conducted is a public hospital and predominantly caters for patients from mid and low socio-economic strata33, we planned to conduct a person-to-person interview method for data collection to avoid potential bias and misinterpretation of the questions. In addition, we have included a significant number of subjects in our study over three months, as ours was a tertiary care centre with a large draining area.

To the best of our knowledge, this is the first study to compare the mental health status of COVID infected and non-infected peripartum mothers. In addition, we further explored the knowledge, attitude, and practice regarding the coronavirus disease among these two groups.

Many factors contribute to peripartum depression and have been widely studied25. Past psychiatric illness is one of the most important risk factors of peripartum depression. In this study, 28 patients (3.3%) had a history of psychiatric illness, and 20(71.4%) had peripartum depression.

This pandemic has brought about job loss, drastic cuts in salaries and resulting financial destabilization. The economic insecurities had brought about immense mental stress among individuals with violent outbursts of domestic abuse. In this study, we found that 58.3% of families had a monthly income below Rs 11000, only 57.2% of the family head had full-time jobs, 49.3% husbands had some form of addiction, and 88.8% of families experienced some form of financial loss during the pandemic. Fifty-two (6.2%) subjects admitted to suffering from domestic abuse of some form and were significantly associated with peripartum depression. A study by Almeida et al.35 showed increased mental health problems in women who suffered domestic abuse. Thus, domestic violence is a long-standing issue that has significantly increased during the pandemic and needed to be addressed to keep the mothers safe and secure during the pandemic.

In this study, the median score in the COVID-19 anxiety scale was 15(8-28), with higher anxiety found in the COVID-infected subjects. Similar results were found in several studies from India36,37 which was conducted during the pandemic. In addition, we found a declining trend in the score with time, probably due to the time of conduction of this study coincided with the declining cases of COVID 19 in India from September to December 2020. On the other hand, the overall score of peripartum depression was unchanged, signifying that depression during this pandemic is multifactorial, and not only due to the COVID infection per se but also to the broader socio-economic implications of the pandemic.

**Limitations**

There are some limitations of this study. First, the tools used to detect possible peripartum depression and anxiety were screening instruments and are not diagnostic of the diseases. Secondly, the study sample we selected was peripartum mothers who had to attend the outpatient and inpatient during the pandemic and may not represent the general population. Finally, the study's cross-sectional nature has the potential to miss peripartum mental health disorders over a period and doesn’t help to detect the cause-effect relationship. Further longitudinal research focusing on the short- and long-term outcomes of peripartum depression and anxiety need to be explored.

**Conclusion**

In summary, the prevalence of peripartum depression during the COVID-19 pandemic was 45.5%, without a significant difference between COVID infected and non-infected subjects. Although the overall anxiety was 90.6%, fear due to COVID-19 was higher among the subjects infected with the virus. Past psychiatric illness, domestic violence and past obstetric complications were significant risk factors of peripartum depression. This study emphasizes the high prevalence of mental health disorders during pregnancy and childbirth during the pandemic. Furthermore, it provides the foundation of future longitudinal studies to explore and mitigate the risk factors to better care for mother and baby during the pandemic.

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**Disclosure of interests**

The authors have no conflict of interest.

**Contribution to Authorship**

RD: Conceptualization, Methodology, Formal analysis, Writing-original draft and editing; RA: Methodology, Editing; SS: Data curation; PTS: Data curation; AKS: Conceptualization, supervision; SM: Conceptualization, supervision; PM: Supervision.

**Details of ethical approval**

The study was approved by the Institutional Ethical Committee (Reg. No. ECR/287/Inst/WB/2013/RR19), Medical College Kolkata, Ref. No. MC/KOL/IEC/NON-SPON/787/09/20, dated 4 th of September, 2020.

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