

The Effect of the COVID-19 Pandemic on Maternal Wellbeing and Its Associated Outcomes: Article Review

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Abstract: *This is an article review about the dimensions of maternal health affected by contacting SARS-CoV2 during pregnancy, and the associated consequences taking into account the numerous ways in which the pandemic has disrupted daily life. The objective is to identify the effect of SARS-CoV2 on maternal wellbeing and its associated outcomes. The method of analysis of this article review follows PRISMA guidelines, 20 articles published between January 2020 and August 2021 have been carefully analyzed using PRISMA guidelines and consequences were identified with maternal sample size 5 to 6248 and neonatal sample size of 6 to 27. Results have shown that SARS-CoV2 affects negatively maternal physical health and mental state as well as neonatal outcomes. It has been found that many pregnant mothers who suffer from a COVID-19 infection range from asymptomatic-mild-moderate, and few suffer a severe form of SARS-CoV2. If symptomatic, the most presenting complaint is fever or cough. SARS-CoV2 can be transmitted across the placenta from COVID-19 positive mother to the unborn infant referred to as transplacental infection. Among cases of transplacental infection, it was associated with the placental microscopic changes and these are placental syncytiotrophoblast, chronic histiocytic intervillitis, and necrosis of the syncytiotrophoblast. Further, stillborn or spontaneous terminated pregnancy, underweight, neonatal asphyxia and death were also observed in transplacental infections but it was inconclusive whether it is to be associated with COVID-19. Policy or measures mandated to reduce the spread of the virus have also negative effect on maternal mental health manifested in the form of fear of contacting the illness, distress, anxiety, and depression of expectant mothers predisposing them to the risk of mental illness. In conclusion, COVID 19 infection has affected negatively maternal physical health, maternal mental health and associated outcomes are placental damage, vertical transmission of SARS-CoV2, stillbirth, intrauterine fetal death, neonatal underweight, respiratory distress syndrome and poor breastfeeding practices.*

Keywords: Maternal health, maternal mental health, SARS-CoV 19, anxiety, stress, depression, psychological distress, transplacental infection, stillborn, mental illness, intrauterine fetal death, perinatal period, post-partum period, syncytiotrophoblast, histiocytic intervillitis, necrosis

1. Introduction

Maternal health is the health care service of women during pregnancy, childbirth, up to the postpartum period. These services are provided with an intention to reduce maternal morbidity and mortality (1, 2). 'WHO indicates that maternal health should help the mother to fulfill natural experience that is emotional to the mother and reduce potential challenges where they suffer health-wise and sometimes even death'. Prior to COVID-19 pandemic, maternal health was already affected by increased maternal mortality and morbidity attributed to decreased social-economic status, cultural values and geographical remoteness. These factors increase the risk for pregnancy-related illnesses, negative consequences after birth and maternal death more in developing countries than in developed countries. Recently, the COVID-19 pandemic is feared to have negative impact on maternal health (3-5). Despite sex-disaggregated data on SARS-CoV2 mortalities suggesting more severe health outcomes for men than women, there are concerns that the disease could disproportionately burden women in a social and economic sense (4, 6). Therefore, it is a particularly significant question whether pregnant women are more susceptible to SARS-CoV-2 or might develop severe disease outcomes or

suffer SARS-CoV2 associated consequences considering the impact of the pandemic and pandemic-control policies.

2. Materials and Methods

The review includes analysis of studies by following the PRISMA guidelines. This study focuses on published quantitative studies on maternal health issues regarding COVID-19 pandemic. The inclusion and exclusion criteria are mentioned in table 1.

Table 1: Inclusion and Exclusion criteria

Inclusion criteria	Exclusion criteria
Quantitative studies about COVID 19 in pregnancy	Qualitative studies about COVID in pregnancy
Reviewed quantitative articles about COVID 19 in pregnancy	Reviewed qualitative scholar articles
Research about COVID-19 in pregnancy	Research not related to COVID-19 in pregnancy
Women of childbearing age 15-49 years	Women below or above childbearing age
Research studies done within January to 2020-August, 2021	Research studies done before January 2020 and published later than August 2021.
Articles written in the English language	Articles not written in any other language apart from English language

Search Guidelines

The primary search engines that were used to identify articles include; google scholar, Web med and hinari. One investigator was involved in the search process. The studies were chosen based on inclusion criteria such as (1) quantitative studies, (2) reviewed quantitative articles, (3) research concerned with COVID-19 in pregnancy, (4)

women of childbearing age 15-49 years, (5) research studies done between January 2020 and August 2021 and (6) articles written in English language. The search was performed by the investigator beginning 2nd to 26th September 2021, the time limit for the studies was from January, 2020-August, 2021 and the search string is mentioned in Table 2.

Table 2: Research Thread for all Databases

Search strategies	No. of Studies Available
Search terms used” maternal health”, or “maternal mental health”, or “COVID-19” or “COVID-19 and pregnancy” or “impact of COVID 19 in pregnancy” or “COVID 19 and maternal mental health”	115
Total number of studies excluded based on eligibility criteria	92
Articles remaining for screening	23
Articles remaining after screening	20

Search Strategies

Searching of studies used word (s) like ‘maternal health’, ‘maternal mental health’, ‘COVID-19’, ‘COVID 19 in pregnancy’ ‘impact of COVID 19’, ‘COVID 19 and

maternal mental health’ and there were 115 studies available, 23 were chosen based on inclusion criteria, the total number of articles excluded based on eligibility criteria 92 and 23 studies were screened for final review and 20 studies were accepted.

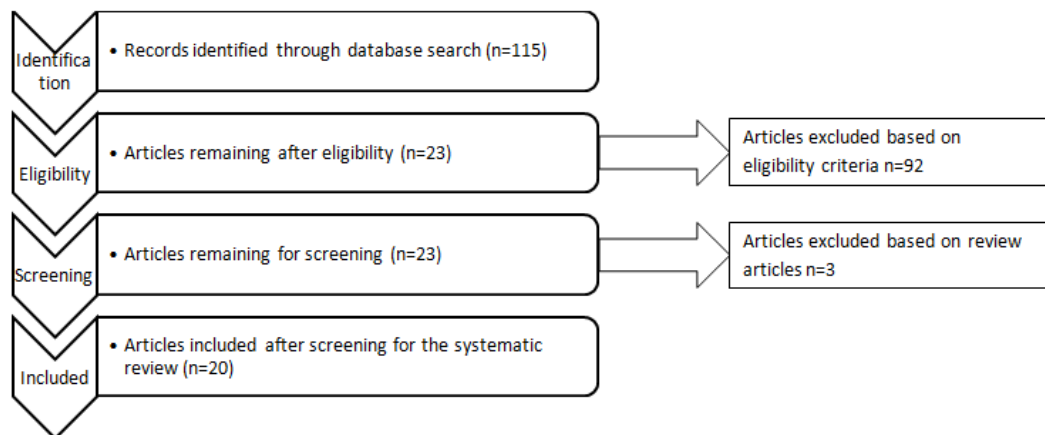


Figure 1: Prisma chart illustrating articles search and the inclusion

Quality Appraisal

Studies were appraised for quality using critical appraisal tools (CADIMA) for systematic reviews developed by the University of Adelaide, South Australia. A rating scale of 0 to 4 is used based on the following criteria;

- a) Study design=1 for “cross-section, case-control or cohort” and 0 for “otherwise”
- b) Sample size=1 for “large” and 0 for “small”

- c) Use of standardizing instruments for data collection=1 for “EPDS” and 0 for “not specific”
- d) Selection of participants=1 for “random selection or lack of bias” and 0 for “non-random sample”

The investigator rated each of the 20 studies independently based on the mentioned criteria and there is lack of inter-observer variations in the evaluation of the quality of the studies and the scores are presented in table 3.

Table 3: Impact of COVID 19 on maternal mental health

Author [Ref]	Major findings	Impact on maternal well-being and neonates	Quality of appraisal	Country of study
V. Zanardo et. Al. (2020). (7)	n=91 of COVID-19 pregnant mothers. COVID 19 is associated with significant higher mean EPDS scores for anhedonia and depression.	Negative	4	Italy
C. Mariño-Narvaez et. Al. (2020) (8)	n=162 pregnant women. COVID 19 is associated with higher levels of stress during childbirth, a worse rating of the quality of care received and higher percentage of postpartum depression in women who gave	Negative	4	Spain

	birth during the pandemic.			
An, R. et al 2021 (9)	n=209, COVID 19 is associated with postpartum depression (56.9%)	Negative	4	China
Mollard E. et al 2021 (10)	n=885, COVID 19 is associated with higher levels of depression, anxiety, stress and lower resilience among pregnant mothers	Negative	4	USA
Wang Q et al.2021 (11)	n=6248 depressed pregnant mothers.57% reported that they did not need mental health services.28.3% they needed mental health services and 19% had intentions to seek mental health services.	Negative	4	China
Layton H et al 2021 (12)	n=603, COVID 19 is associated with postpartum depression, anxiety but there were no statistical significant association with mother-infant bonding.	Negative	4	-
Durankus F & Aksu E 2020 (13)	n=92 pregnant mothers, 35.5% had higher EPDS score. A regression analysis shows a statistically significant influence of the BDI scores and the disease's psychological effects, as well as the BAI scores and the illness's social isolation effects on the EPDS scores.	Negative	4	Turkey
Di Mascio D. et al 2020 (14)	n=79pregnant mothers, 41 pregnancies were affected by COVID 19. The most common symptoms were fever (82.6%), cough (57.1%) and dyspnoea (27%).	Negative	4	-
D. Liu et. al 2020 (15)	n=15, most common symptoms is fever 13/15, cough, 9/15 had cough and no severe cases recorded.	Negative	3	China
BJF Huntley et. al.2020 (16)	n=538 pregnancies infected by SARS-CoV-2 infection, 3.0% were admitted at maternity ICU, 1.4% maternal critical disease, 0% maternal deaths were reported, 20.1% preterm birth rate, 0% vertical transmission rate, and 0.3% neonatal death rate.	Negatively	4	-
S. Valeria et. al.2020 (17)	n=77 pregnant COVID 19 positive women, 84% were symptomatic on admission.16% patients underwent urgent delivery for respiratory compromise and 8% were admitted to the ICU. No deaths occurred, preterm delivery occurred in 12% of patients, and nine newborns were admitted to the neonatal intensive care unit. greater frequency of fever or dyspnoea on admission compared with women with a non-severe disease evolution	Negative	3	-
L. Zhang et. al.2020 (18)	n=18 cases of late pregnancy infection with SARS-CoV-2.1 case was a mild type, 16 cases were moderate type, and 1 case was a severe type. All the newborns were negative for the first throat swab test of SARS-CoV-2 after birth. No maternal and neonatal deaths occurred.	Negative	3	China
J. Juan et. al.2020 (19)	n=324 pregnant women with confirmed COVID-19 infection.155 neonates had nucleic-acid testing in throat swab for SARS-CoV2, 152 neonates were negative, 3 neonates were positive. maternal deaths were 7, intrauterine fetal deaths were 4, and neonatal deaths were 2.	None	3	-
K. Diriba et. al.2020 (20)	n= 1316 COVID positive pregnant women.0 report of transmission of CoV from the mother to the fetus in utero during the study period.	None	3	-
Bäuerl C et. al.2021 (21)	n=60 COVID-19 positive breastfeeding women.0 results for SARS-CoV-2 RNA breastmilk test. Main Protease antibodies were detected in milk.82.9% of milk samples were positive for at least one of the three antibody isotypes, with 52.9% of these positive for all three Igs. Positivity rate for IgA was relatively	Negatively	3	-

	stable over time (65.2%-87.5%), whereas it raised continuously for IgG (from 47.8% for the first 10 days to 87.5% from day 41 up to day 206 post-PCR confirmation).			
C. Piankusol et. al 2021 (22)	n=903 mothers with infants ages 0-12 months after the first nationwide COVID-19 lockdown period by an online platform. There was association between the effect of lockdown and breastfeeding practices. The associated factors of changing breastfeeding practices were decreased contact with healthcare services, infant feeding support from health personnel and lacking family support and help with feeding baby.	Negative	3	Thailand
V. M. L. Tuma Calil et. al. (23)	n=20, Breastfeeding is associated with possible risks of COVID transmission during breastfeeding and possible consequences for the mother and the child.	Negative	2	-
N. Jaiswal, et. al.2021 (24)	n=27, COVID 19 is associated with placental vascular malformation and perivillous fibrin deposition was also significantly higher in the placentae of COVID-19 cases and associated with underweight of the newborn.	Negative	3	India
A. Bouachba et. al. (25)	n=5 cases of COVID-19 maternal infection. COVID 19 is associated with poor pregnancy outcomes. Immunohistochemical study and RT-PCR of SARS-Cov-2 on placenta samples.5 had cases of poor fetal outcome, 3 fetal deaths, and 2 extremely premature neonates. Placental vascular malformation was observed in all placenta.	Negative	2	-
D. A Schwartz et. al.2020 (26)	n=6 placentas from all 6 live-born neonates acquiring SARS-CoV-2 via transplacental transmission, the syncytiotrophoblast was positive for coronavirus using immunohistochemistry, RNA in situ hybridization, or both. All placentas had chronic histiocytic intervillitis and necrosis of the syncytiotrophoblast.	Negative	3	-

3.Results

A summary of the methodology, characteristics of findings, the impact of COVID-19 on maternal health, quality appraisal, and the countries of the studies are presented in Tables 3. Of the 20 studies reviewed, four were conducted in China, one in Italy, one in Spain, one in Turkey, one in USA, one in Thailand, one in India, and ten were not clearly defined. All the 20 articles utilized quantitative methodology and met inclusion criteria. Among the studies, 2 (10%) were case-control studies, 3 (15%) were cross-sectional studies, 1 (5%) web-based survey, 2 (10%) were analytical, 10 (50%) were reviewed quantitative articles and 2 (10%) were cohort studies. The total sample size of perinatal mothers varied from 5 to 6248 and neonatal sample varied from 6 to 27 populations. Only 9 articles had a sample population above 100 representing 45% and 11 articles had sample size below 100 representing 55%. 18 articles used standardized tools representing 90% and 2 articles used tools not clearly defined representing 10%. The average score of 4 means excellent, 2-3 means moderate and 0-1 means poor. 9 articles had excellent scores representing 45%, 11 articles had moderate scores representing 55% and no articles had a poor score.

3.1.1 Stress, Anxiety, Anhedonia and Depression

Of articles that addressed the impact of COVID-19 on maternal mental health, several established that COVID-19 is associated with depression. The COVID-19 study group with sample size of 91 (n=91) had significantly higher mean Edinburgh Postnatal Depression Scale (EPDS) scores (10 and above) compared with the control group (n=101) (8.5 ± 4.6 vs 6.34 ± 4.1 ; $P < 0.001$), for anhedonia (0.60 ± 0.61 vs 0.19 ± 0.36 ; $P < 0.001$) and depression (0.58 ± 0.54 vs 0.35 ± 0.45 ; $P = 0.001$) (7). A cross-sectional study utilized a sample size of 162 pregnant women, a regression analysis showed a statistical significant influence of COVID-19 on the Beck Depression Inventory scores and the disease psychological effects as well as Beck Anxiety Depression scores and social isolation effect (27).

In a case control study, women who gave birth during the pandemic had alarming levels of stress during childbirth ($U = 2652.50$; $P = 0.040$) and they received a very poor rating of the quality of care ($U = 2703.50$; $P = 0.041$). In a sample size of 212 of postpartum women, a web-based online survey was conducted aimed at assessing anxiety, depression, and knowledge level of COVID 19 in postpartum women during the COVID-19 pandemic. The depression prevalence was 34.0%, the anxiety mean was 42.69 ± 9.93 and COVID-19 knowledge level scores was

9.69 ± 1.94 ($p < 0.001$) (27). A study in Spain found a correlation of COVID-19 and depression as a result of poor quality of care, lack of support from health care workers and social isolation due to COVID preventive measures (12). Mollard et al also found that COVID 19 is associated with depression and anxiety due to stress and fear of contacting the disease (10), and 100% of women diagnosed to have depression only 19% had intentions to seek mental health services. Even though women suffer depression due to COVID 19 there is no statistical significance of association with mother-infant bonding (12).

3.1.2 Severity of COVID 19 in perinatal mothers

In Hubei Province in China, a study was conducted to evaluate SARS-CoV2 severity in pregnant women infected with COVID-19 and provide help for clinical prevention and treatment. Five ($n=5$) pregnant women with confirmed COVID-19 infection were sampled among patients who were admitted to the Maternal and Child Hospital of Hubei Province between January 20 and February 10, 2020. All sampled pregnant women did not have an antepartum fever but later developed a low-grade fever ranging 37.5°C to 38.5°C within 24 hours post delivery and no complications were observed in the newborn (18). Similar studies have added that most pregnant women diagnosed with COVID-19 infection are usually asymptomatic, or if symptomatic common manifestations are fever and cough, very few develop severe form of SARS-CoV2 and death is uncommon (14, 17). Further study results reveal that patients with severe form of COVID 19 have significantly higher pregestation body mass indexes and have a greater frequency of fever or dyspnoea on admission compared with women having lower pregestation body mass index (17).

3.1.3 Transplacental infection (vertical transmission)

In India, a case-control study was conducted aiming at assessing placental abnormalities from pregnant mothers with SARS-CoV2 infection. The study utilized a sample size of 27 for a case and 27 for the control group. The histopathological examination of the placenta was performed and the findings were recorded based on the Amsterdam consensus criteria for evidence of maternal and fetal vascular malperfusion changes. The case group had a significant placental vascular malformation microscopically than the control group. In addition, perivillous fibrin deposition was also significantly higher in the placenta of cases (17). Bouachba et al. examined placenta of 2 cohorts, 6 placenta from live neonates and 5 placenta from stillborn or terminated infants who acquired SARS-CoV2 via transplacental. The results were similar and found that syncytiotrophoblast was positive for SARS-CoV2 using immunohistochemistry and RNA in situ hybridization. Chronic histiocytic intervillitis and necrosis of the syncytiotrophoblast was noted in all placenta (25). On the contrary, Zhang et al. sampled 18 late pregnancy infection with SARS CoV2.1 case was a mild type, 16 moderate type and 1 case severe type. All newborns were negative for SARS CoV2 upon testing first throat swab (16). Multiple studies also have proved no evidence of mother to infant SARS CoV transmission

(vertical transmission) on first throat swab after birth (16, 17, 19, 20). Though some studies found no evidence of vertical transmission, few studies were able to detect SARS CoV2 infection among newborns and confirmed neonatal vertical transmission (17, 25), and results showed that vertical transmission is associated with placental vascular malperfusion and other abnormalities like histiocytic intervillitis. Also infant underweight, premature birth, neonatal respiratory distress, stillborn, intrauterine fetal death, neonatal death were found to be associated with SARS CoV2 infection in pregnancy (25, 26).

3.1.4 Breastfeeding practices

Breastfeeding practices are more likely to be affected by COVID-19. In Spain 903 breastfeeding mothers with infants ages 0-12 months were assessed using interview questionnaire survey. Multivariable logistic regression analysis was used to investigate the association between the effect of lockdown and breastfeeding practices. The study results showed that breastfeeding women changed from exclusive breastfeeding to combined breastfeeding with formula milk ($n = 22$, 2.44%) and there was reduction of the breastfeeding frequency when compared to before the pandemic ($n = 13$, 1.44%). The associated factors of changing breastfeeding practices were poor contact with healthcare services (aOR = 0.46, 95% CI 0.22 to 0.96, $p = 0.04$), infant feeding support from health personnel (aOR = 0.39, 95% CI 0.16 to 1.94, $p = 0.035$), and lack of family support and help with feeding the baby after lockdown (aOR = 7.04, 95% CI 1.92 to 25.84, $p = 0.003$) (22). In an effort to ascertain risk of SARS CoV2 transmission through breastfeeding, Bauerel et al sampled 60 COVID-19 positive breastfeeding women for SARS-CoV-2 RNA breastmilk test. Results showed no evidence of SARS-CoV2 presence except for main Protease antibodies. 82.9% of breast milk samples were positive for at least one of the three antibody isotypes and 52.9% of sampled breastmilk was positive for all three Igs. (21). And Tuma Calil et al. sampled 20 breastfeeding mothers and found associated possible risks of COVID transmission and breastfeeding practices (23).

4. Discussion

4.1 Maternal Mental Health

Pregnant mothers are unique people, with particular mental and physical health needs, and are vulnerable to issues such as domestic violence. The impact of the COVID-19 pandemic is likely to escalate the vulnerability of pregnant mothers. As a consequence of the pandemic, both maternal health and maternal mental health are usually overlooked. It is observed that the improbability surrounding COVID-19 has led to higher levels of distress, anxiety, anhedonia, and depression in pregnancy. Feeling of social isolation and greater fear of SARS-CoV2 infection among pregnant women and their infants are major triggering factors of poor mental health among expectant and postpartum mothers. Fear of contracting the COVID-19 virus has also resulted in an increasing number of home deliveries happening without trained health workers which also heightens the distress and depression in these women.

Total lockdown of cities, entire countries, and mandatory social distancing between people are presently and constantly escalating poor maternal mental health. These preventive measures have hugely impacted many aspects of human life and activities, putting pressure on economic activities resulting in vast economic losses and subsequent loss of incomes and livelihood. Consequently, the mental health of the pregnant population has become a public health concern and should be studied and carefully monitored (11, 12).

4.2 Maternal, fetal, and infant outcomes

Pregnant women, their fetuses, and newborns are likely to represent a high-risk population during the current COVID-19. Expert opinion suggests that pregnant mothers are at risk of developing a severe form of COVID-19 due to low immunity as a result of normal physiological changes in pregnancy. On the contrary, available few literature on the outcomes of COVID-19 infections during pregnancy indicates that many pregnant women who become COVID-19-positive are either asymptomatic or mild-to-moderately symptomatic and very few suffer a severe form of COVID-19 which requires hospitalization. Slow building of literature, small sample size and quality of data about SARS-CoV2 impact in pregnancy is deterring the consensus calling for further studies. However, the results obtained cannot be ignored. This review also shows a possibility of placental injury at a microscopic level which may be associated with SARS CoV2 during vertical transmission, poor pregnancy and fetal or infant outcomes. The extent of this injury in cases of COVID-19 and its outcomes needs to be further analyzed (17, 22, 24).

5. Conclusion and Recommendations

Despite the increasing number of published studies on COVID-19 in pregnancy, there are insufficient good quality data to draw unbiased conclusions concerning the severity of the disease or specific complications of COVID-19 in pregnant women, as well as vertical transmission, perinatal and neonatal complications. To answer specific questions concerning the impact of COVID-19 on pregnant women and their fetuses, through meaningful good quality research, researchers and investigators should present complete outcome data. To increase maternal health service coverage there is a need for collaborative working partnership among stakeholders, invent e-health services and utilize community health workers to reach pregnant mothers in their homes. To deal with maternal mental health, health care workers should be given depression screening tools to screen pregnant mothers for PPD and establish a proper referral pathway for mental health interventions (3, 7, 28).

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