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**Original Research Article**

# Direct and indirect impact of COVID-19 pandemic on maternal mortality at tertiary care institute of north India

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## ABSTRACT

**Background:** During COVID-19 pandemic, healthcare services and infrastructures have been utilized primarily in screening and management of COVID-19 infected patients that might have compromised routine antenatal health care services especially in low- and middle-income countries. This study was planned to know impact of COVID-19 pandemic on antenatal care and maternal mortality at our institute.
**Methods:** This retrospective cohort study compared labour room and maternal mortality statistics before (group 'A') and after declaration of COVID-19 pandemic in our country (group 'B'). One year data (from 1st April, 2019 to 31st March, 2020) before declaration of lockdown in India on 24th March, 2020 was compared with (group 'B') data of 1 year after first nation wise lockdown (from 1st April, 2020 to 31st March 2021). Outcomes which were studied included impact on Institutional delivery, cesarean section and still birth rate along with maternal mortality ratio and its causes in both the groups. Modifiable factors such as level-I, level-II, and level-III delay were also considered.
**Results:** There was 66% decline (fall from 5867 before to 1985 during pandemic) observed in institutional delivery, statistically significant rise observed in still birth (p=0.0030) and cesarean section rate (p=0.0007) during pandemic. Maternal mortality ratio (MMR) increased from 649 to 1786 per one lac live birth (64% rise, p=0.0001) during COVID-19 pandemic. Demographic profiles of deceased women were comparable between both the groups. Hypertensive disorder of pregnancy remained the leading direct cause of maternal mortality. COVID-19 associated maternal mortality observed during second wave of pandemic. Delay in seeking care remains the leading indirect cause of maternal mortality like before (23/38,61% versus 21/35,60%, p=1 before and during pandemic).
**Conclusions:** COVID-19 pandemic resulted in fall in institutional delivery and rise still birth rate and maternal mortality ratio. Gestational hypertension remained the leading cause of maternal mortality during COVID-19 pandemic. Type 1 delay was the leading modifiable factor of maternal mortality before and during pandemic. Hence, it is recommended to strengthen health care services at primary health centers and redeployment of staff involved in obstetrical care should be strictly abandoned for timely care and referrals of complicated cases from peripheral health center.

**Keywords:** COVID-19 pandemic, Hypertensive disorders pregnancy, Obstetric transition, Maternal mortality ratio, World Health Organization

## INTRODUCTION

Worldwide, maternal mortality ratio (MMR) and near miss mortality have been considered as the most sensitive markers of quality of health care services in a country. World Health Organization (WHO) and partners released a consensus statement to end preventable maternal mortality and to bring down global maternal mortality ratio (MMR) to less than 70 maternal deaths per 100 000 live births by 2030.[1] There is fall in overall proportion of maternal deaths in women of reproductive age (15-49 years) at 9.8% in 2020- down from 12.6% in 2000 and 10.3% in 2016. India's maternal mortality ratio also fallen to 145 in year 2017.[2] Therefore, India was on a right track

to achieve sustainable development goal by providing comprehensive and easily accessible free of cost health care services to the remotest areas.[2] However, efforts to sustain the ongoing achievement in declining MMR might be inadvertently affected by COVID-19 pandemic which was also reported during Ebola virus outbreak at Sierra Leone due to limited health infrastructure of these countries.[3]

Diversion of manpower and infrastructures in the management of SARS COVID-19 pandemic led to disruptions in regular and essential health care service in India too. Widespread rise in morbidity and mortality was anticipated and reported due to SARS COVID-19 virus especially in patients with untreated and uncontrolled underlying co-morbidity. The impact on maternal mortality is not apparent as yet. Hence, the present study was planned to study the various direct or indirect impact of COVID-19 pandemic on maternal mortality at our tertiary care institute.

## METHODS

This retrospective cohort study was conducted in the department of obstetrics and gynecology at GMCH-32, Chandigarh in a north Indian population after approval from research and ethical committee of the Institute (No. GMCH/IEC/2020/401/197, dated 11th November 2020). It was also registered at CTRI/2020/12/030127, Clinical Trials Registry - India (ICMR-NIMS). According to study period, data was divided into 2 groups: (group 'A'), 1 year data (from 1st April, 2019 to 31st March, 2020) before declaration of lockdown in India on 24th March, 2020 was compared with (group 'B') data of 1 year after first nation wise lockdown (from 1st April, 2020 to 31st March 2021). Labour room's data and maternal mortality data was analyzed in this study.

Labour room's data was collected from delivery room's data entry register. A total of 5867 and 1985 pregnancies who have visited in our emergency labour room were analyzed from pre-and post-COVID-19 pandemic period respectively. Changes in institutional delivery, total number of babies born, live birth and still birth rate, caesarean section rate were analyzed.

Data of maternal mortality was collected from the facility based maternal mortality review proformas and details of them were analyzed from the case file of individual patients. All cases of maternal mortality that occurred within 42 days of after termination of pregnancy due to pregnancy related complications, irrespective of the duration and the site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, childbirth, and the puerperium at our institute or that happened during way to our Institute were also included in this study.

All accidental deaths due to suicide, poisoning, snake bite, hanging, burns and road side accident were excluded. Three delays being which includes type level I-delay in decision to seek care, level II-delay in identifying and reaching medical facility and level III -delay in providing adequate and appropriate treatment at facility were also analyzed.

Institutional stillbirth rate was defined as the number of babies born in the institution with no signs of life, with a gestational age of ≥26 weeks or more per 1000 births.

### *Statistical analysis*

Discrete categorical data is presented as n (%). Continuous data written as mean and standard deviation. For categorical data, comparisons are made by Pearson Chi-square test or Fisher exact test as appropriate. All statistical tests were performed at a significance level of $\alpha \leq 0.05$. The analysis was conducted using IBM SPSS (version 25).

## RESULTS

There was statistically significant decline (-66%) observed in institutional delivery with significant rise in caesarean section and still birth rate during pandemic (Table 1).

**Table 1: Obstetrical and neonatal outcome.**

| | Pre-COVID (group 'A') | Post-COVID (group 'B') | Changes | P value |
|---|---|---|---|---|
| **Total no. of pregnancies** | 5867 | 1985 | -66% decline | |
| **Total no. of babies born** | 6087 | 2069 | -66.01% decline | |
| **Live born babies** | 5858 (96.23%) | 1960 (94.73%) | 1.5% decline | 0.0030** |
| **Still born babies** | 229/6087, 3.8% | 109/2069, 5.3% | 1.5% increase | 0.0030** |
| **Caesarean section rate** | 2694/5858, 46% | 988/1960, 50% | 4% increase | 0.0007** |
| **No. of maternal mortality** | 38 (0.65%) | 35 (1.78%) | 1.13% increase | <0.001** |
| **Maternal mortality ratio** | 649/lac live birth | 1786/lac live birth | +64%, rise | <0.0001** |

P value marked with * show statistically significant difference.

There were 38 maternal mortalities after excluding four accidental deaths which occurred before pandemic (group 'A') and 35 maternal mortalities in group 'B' during pandemic. Mean age of patients was 27.17±5.7 and 28.4±5.0 0.372 years in group 'A' and 'B' respectively. Primigravida's were 14/38,37% and 14/35,40%, p=0.777,

in group 'A' and 'B' respectively and rest of them were multigravidas. More number of maternal mortalities occurred in antenatal period before pandemic (25/38), 66% whereas significant rise in maternal mortalities occurred in postpartum period during pandemic (21/35), 60% (Table 2).

**Table 2: Demographic parameter of deceased in both the groups.**

| Maternal parameter | Pre-COVID (group 'A') N=38 | Post-COVID (group 'B') N=35 | P value |
|---|---|---|---|
| **Age** | 27.17±5.7 | 28.4±5.0 | 0.372 |
| **Illiterate** | 7/38, 18% | 12/35, 34% | 0.122 |
| **Below poverty line** | 8/38, 21% | 10/35, 29% | 0.458 |
| **Primigravida** | 14/38, 37% | 14/35, 40% | 0.777 |
| **Demise during antenatal period** | 25/38, 66% | 14/35, 40% | 0.027* |
| **Condition on arrival** | | | |
| Stable | 11/38, 29% | 06/35, 17% | 0.233 |
| Unconscious | 06/38, 16% | 10/35, 29% | 0.187 |
| Semiconscious | 21/38 | 19/35 | |
| **Undelivered** | 10/38, 26% | 08/35, 23% | 0.729 |
| **Delivered** | 26/38, 68% | 23/35, 66% | 0.806 |
| Vaginal delivery | 19 | 13 | 0.269 |
| Caesarean section | 07 | 10 | 0.305 |
| **Abortion** | 02/38, 5.3% | 02/35, 5.7% | 1 |
| **Ectopic pregnancy** | 00 | 02/35, 5.7% | 0.226 |
| **Live birth** | 12/38, 32% | 16/35, 46% | 0.214 |
| **Still birth** | 14/38, 37% | 07/35, 20% | 0.112 |
| **No delay** | 13/38, 34% | 11/35, 31% | 0.806 |
| **Type 1 delay** | 23/38, 61% | 21/35,60% | 1 |
| **Type 2 delay** | 02/38 | 03/35 | 1 |
| **Died within 24 hours** | 21/38, 55% | 18/35, 51% | 0.740 |

P value marked with * show statistically significant difference.

**Table 3: Causes of maternal mortality in both the groups.**

| Causes of maternal mortality | Pre-COVID (group 'A') N=38 | Post-COVID (group 'B') N=35 | P value |
|---|---|---|---|
| **Direct causes of mortality** | 17/38 (45%) | 20/35 (57%) | 0.289 |
| **Hypertensive disorders of pregnancy** | 9/38 (24%) | 9/35 (26%) | 0.841 |
| **Sepsis** | 5 | 7 | 0.431 |
| **Postpartum hemorrhage** | 3 | 3 | 1 |
| **Amniotic fluid embolism** | | 1 | 0.479 |
| **Indirect cause of maternal mortality** | 21/38, (55%) | 15/35, (43%) | 0.289 |
| **Severe anaemia in failure** | 2 | 5 | 0.249 |
| **Community acquired pneumonia including swine flu** | 7 | 1 | 0.057* |
| **Dengue hemorrhagic fever** | 1 | | 1 |
| **Gastroenteritis** | 2 | 1 | 1 |
| **Hepatic failure with coagulopathy** | 3 | 2 | 1 |
| **Heart disease** | 2 | 1 | 1 |
| **Ovarian malignancy** | 1 | | 1 |
| **Breast abscess with septic shock, DIC** | 1 | | 1 |
| **Scrub typhus** | 2 | | 0.493 |
| **Varicella induced ARDS with renal failure and sepsis** | | 1 | 0.479 |
| **TB meningitis with multi organ failure, refractory shock** | | 1 | 0.479 |
| **Severe SARS COVID-19 infection** | | 3 | 0.105 |

Abbreviation: Disseminated intravascular coagulation (DIC), acute respiratory distress syndrome (ARDS). P value marked with * show statistically significant difference.

There was no statistically significant difference observed in direct cause of maternal mortality between both the groups where as significant number of mortalities occurred due to community acquired pneumonia including swine flu before pandemic and severe COVID-19 related death occurred during second wave of pandemic (Table 3).

## DISCUSSION

Emergence of COVID-19 pandemic led to nation wise lockdown before widespread transmission of virus in our country only to initiate COVID-19 preparedness; policy making, testing, patient care, procurement of personal protective equipment and establishment of COVID care centers. Diversion of limited manpower (including ASHA workers, ANM, AWW and MPW) and infrastructures have been done for testing and tracing of contacts of COVID-19 positive patients which led to further compromise in basic antenatal care at grassroot level which cater a large population of pregnant women at community level. The impact of limited essential health care services on maternal and neonatal mortality have been estimated very early at onset of COVID-19 pandemic.[4,5]

There was 66% decline observed in institutional delivery in present study much higher than reported from another Indian study (45.1%) conducted over 5 months from April to August 2020 and 52.4% in Nepal (over 9.5 weeks during pandemic) which was due to delay in seeking health as a result of lockdown and fear of contracting COVID-19 viral infection.[6,7] The decline in institutional delivery is also reflected by significant rise in number of maternal mortalities in delivered women during pandemic in present study. Another reason of fall in institutional delivery could be our attempt of reducing load of absolutely uncomplicated antenatal patients from peripheral center to curtail problems related to social distancing due to covid-crisis that did not allow sharing of beds between pairs of patients and their neonates which was often to the extent of 225% bed occupancy in pre-era at our institute. Anxiety of getting infection while visiting to hospital might be the reason of delay in seeking care as large numbers of patients received in altered sensorium during pandemic although it was not found to be statistically significant. Redeployment of limited health care workers (including ASHA workers, ANM), lack of PPE kits and apprehension among the health care workers might have affected quality of antenatal care particularly at Peripheral health care center that led to delay in diagnosis of complications and further delay in referral of patients at higher institute.

There was statistically significant rise noted in stillbirth rate (from 3.8% to 5.3%, p.003) after lockdown in present study similar to other studies.[7-9] Ashish et al reported significant rise in institutional stillbirth rate from 14 per 1000 total births (1.4%) before lockdown to 21 per 1000 total births (2.1%), (p=0·0002) during lockdown in Nepal in 12·5 weeks duration before the national lockdown and 9·5 weeks' time period during the lockdown in this study.[7]

Another study conducted over a period of 10 weeks post lockdown (March 25-June 2, 2020) by Kumar et al also noticed significant rise in stillbirth rate from 2.25% to 3.15% (p<0.001) from pre-lockdown to post lockdown period.[8] Similarly, another study conducted in north Indian population revealed significant difference in the rate of stillbirths from 2.99% (29.9/1000) to 3.74% (37.4/1000) (p=0.045) when compared between before COVID-19 pandemic and during lockdown period.[9]

Whereas a study conducted over a lockdown period of 3 month in England from 1st April, 2020, and June 30, 2020, was compared for same period in previous years data.[10] There were 543 stillbirths [0.41% (95% CI, 0.38-0.45%)], and 565 stillbirths [0.40% (95% CI, 0.37-0.44%)] during pandemic and before lockdown respectively, this study did not reveal any statistically significant difference in rate of still birth during pandemic which suggest that pandemic compromise health services more in low- and middle-income countries.

Finally, a systematic review and meta-analysis that was done to know the effects of pandemic on maternal, fetal, and neonatal outcomes included 40 studies which revealed significant increases in stillbirth [pooled OR 1·28 (95% CI 1·07-1·54); $I^2$=63%; 12 studies, 168 295 pregnancies during and 198993 before the pandemic] during pandemic.[11]

Present study also revealed significant rise in caesarean section rate from 46% to 50 % during COVID-19 pandemic. Ashish et al also reported significant rise in caesarean section rate from 33% to 37.03%, p, 0·04 in lockdown period.[7] Kumar et al also reported rise in lower segment caesarean section in 7 month duration from March to September, 2020 after declaration of COVID-19 pandemic when compared with same duration of pervious year in 2019, (14/134, 10.4% versus 5/183, 2.7%).[9] The rise in caesarean section rate is explained by relative decline in admission of uncomplicated antenatal patients at our institute whereas increase in still birth rate is explained by decrease in quality of antenatal care during pandemic. Overall, no significant effects were identified in modes of delivery (spontaneous vaginal delivery, caesarean section, or instrumental delivery) in a systemic review and metanalysis conducted to know impact of pandemic on maternal and fetal outcome.

Maternal mortality ratio increased to 64% after lockdown in present study whereas 20% rise was reported in another study from a medical college of western India that was done only over a 10-week period during pandemic.[8] A systematic review and meta-analysis also confirmed rise in maternal death in 2 studies both from low-income and middle-income countries [1·37 (1·22–1·53; $I^2$=0%) 1 237 018 and 2 224 859 pregnancies] during versus before the pandemic.[11]

Hypertension induced mortality was remained the leading cause of preventable and direct cause of maternal mortality

during COVID -19 pandemic too. Though, severe COVID -19 infection has been reported to be a risk factor of hypertensive disorder of pregnancy and severe enough to develop renal failure and Acute fatty liver of pregnancy (AFLP syndrome).[12,13] However, none of the hypertensive patient had signs and symptoms of COVID-19 infections and all tested negative by real time reverse transcriptase polymerase chain reaction (RT PCR) assay for COVID-19 virus.

Werner et al reported rise in operatively managed ectopic pregnancy during COVID-19 pandemic.[19] Similarly, in present study 2 maternal mortality occurred as a result of ruptured ectopic pregnancy with sepsis. More number of ectopic pregnancies treated by surgery during the pandemic [OR 5·81 (2·16-15·6); I 2=26%; three studies, 37 and 272 pregnancies] were observed in a systematic review and metaanalysis.[11]

Anaemia during COVID-19 pandemic is explained by lack of accessibility to even freely available hospital supply of iron tablets that could be due to decrease in number of hospital visit owing to fear of getting infection while going to hospital, unchecked compliance because of sketchy and limited physical examinations. Unemployment might have adversely affected the buying capacity also.

Among the indirect cause, pneumonia has been the most common cause of maternal mortality including Influenza 'A' H1N1 like illness before pandemic. H1N1 like illness has been reported to cause more serious respiratory illness and mortality during pregnancy as compared to nonpregnant women.[15,16] Therefore, influenza vaccine and early antiviral treatment has been recommended to prevent and treat influenza like respiratory syndrome during pregnancy.[17,18] Whereas, COVID-19 infection fortunately did not seem to be as serious as H1N1 pneumonia as significantly smaller number of Hospital and ICU admission reported in infected COVID-19 pregnant women during first wave of pandemic.[19,20] None of the mortality occurred due to COVID-19 infection during first wave in present study too. However, 3 deaths were reported during beginning of second wave suggestive of more virulent COVID-19 virus strain (Delta variant) during second wave of pandemic.

Type 1 delay or delay in seeking care was the most common reason of maternal mortality in (23/38,61% and 21/35, 60%, p-0.806) pre and post covid period without any statistically significant difference. Similarly, another study also did not find any significant difference in type 1 delay in pre and post lockdown period (43/134, 32.1% of the cases and 53/183, 29.1% of the controls).[9] That study reported type 2 delay only during pandemic (12.7%, p<0.006, RR 47.7) whereas type 2 delay was observed in 02/38 versus 03/35 cases in pre and post lockdown period in present study. We did not observe any rise in type 3 delay after lockdown in present study whereas significant rise in maternal mortality was noticed in another study due to inadequate care at hospital (31.3%vs 11.5%, p<0.001, RR 2.7) during COVID-19 pandemic.[9] Present study revealed no delay in 13/38,34% versus 11/35,31%, p=0.806 cases when data compared between pre and post COVID-19 pandemic.

These results suggest that there are certain strata of population where there is deficiency of care at home and who also have lack of awareness of warning symptoms leading to delay in seeking care. As low education and poverty prevails in both the groups and no significant difference observed in their education and socioeconomic status between both the groups. Hence, there is an urgent need to improve antenatal care at peripheral health care centre by avoiding redeployment of staff involved in care of obstetric patients, importance of home blood pressure measurement, distribution of free of cost iron tablets in remotest areas can be a solution to cut short antenatal visits as multiple visits to hospital always carry a risk of exposure to the virus. Out of 8 antenatal visits, 4 can be done through telemedicine and rest can be fulfilled in direct contact with the health care provider.[21] Intravenous iron sucrose and ferric carboxy-maltose may be considered in women found to be noncompliant to oral iron therapy in iron deficiency anemia.

Main limitation of this study was its of retrospective nature and other was inclusion of data from one institute only. Hence, the present study needs authentication from other large institutes or multicentric data to help frame recommendations to maintain quality of obstetrical care during COVID-19 pandemic as pregnancy and childbirth requires regular and essential health care services irrespective of pandemic. This is first ever study that compared labour room statistics and data of maternal mortality over a period of 1 year during COVID-19 pandemic which was the major strength of this study.

## CONCLUSION

COVID-19 pandemic resulted in fall in institutional delivery and rise in maternal mortality ratio. Gestational hypertension remained the leading cause of maternal mortality during COVID-19 pandemic. As type 1 delay was the main reason behind them, redeployment of staff involved in obstetrical care should be strictly abandoned to sustain quality of antenatal care and timely referrals from community level. Hence, minimum 8 antenatal contact with the health care provider must be ensured at grass root level.

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