Review Article

Maternal death due to COVID-19, truth or a myth: A narrative review and experience from a teaching hospital in India

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Abstract

The course of coronavirus disease-2019 (COVID-19) in pregnancy is unpredictable with outcome trends ranging from milder disease with zero mortality to severe forms and deaths in different parts of the world. We did a comprehensive review of the literature to understand maternal deaths due to COVID-19 in detail. The search was conducted in the PubMed, Embase, and Google Scholar databases, using the keywords "maternal mortality", "maternal death", "COVID-19", "septic shock" and "DIC". The search included original articles, review articles, case reports published till date. We found varying case fatality rates ranging from 0.1% to 12.9%. There are various predictors of maternal death, notably the presence of symptoms, comorbidities, severe disease with cytokine storm and multi-organ dysfunction. We also report higher maternal deaths from low-resource regions owing to gaps in expected and delivered maternal care. While reviewing our institutional data, we found 3 maternal deaths related to COVID-19 in pregnancy. We discussed our experience at our institute of three COVID-19 related maternal mortalities to add evidence to the present data. Most maternal deaths occurred in postpartum period. Late referral, loss to follow-up and inadequate care were important determinants of maternal mortality. We concluded that pregnancy cases with or without complications must be considered high risk and addressed judiciously beginning from infection prevention, early diagnosis, disease categorization, and multidisciplinary approach of management to prevent morbidity and mortality. We strongly suggest strengthening the health care delivery system to save pregnant women from dying, particularly in low-resource countries.

Keywords: ARDS, COVID-19, cytokine storm, DIC, maternal deaths, maternal mortality, septic shock, venous thromboembolism

Introduction

The World Health Organization (WHO) notified 2.1% global case fatality rate for COVID-19 with significant geographical variation (13 July 2021).[1] Pregnancy is associated with cardio-pulmonary and immunological changes predisposing women to severe respiratory illnesses as was seen in epidemics of two beta coronaviruses, Severe acute respiratory syndrome (SARS- CoV) and the Middle East respiratory syndrome (MERS-CoV) with maternal mortality of 15% and 27% respectively.[2] Literature regarding novel COVID-19 virus impact on pregnant women is varied - initial reports suggesting comparatively a benign course in pregnancy with zero mortality; recent sporadic case reports and series along with surveillance databases warning about the potential risks associated with

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COVID-19 in pregnancy.[3] We reviewed our institutional data from 1 April to 31 December 2020, where a total of 140 RTPCR confirmed antenatal cases got admitted. There were three maternal mortalities. Institutional COVID-19 related maternal case fatality rate was 2.14% (3/140); in nonpregnant women it was 3.39% (44/1295) and in the overall infected population it was 4.02% (136/3375). The maternal mortalities are often under-reported with lack of mention of exact factors responsible for them. Metz *et al.*[4] highlighted the importance of maternal mortality review committee to investigate maternal deaths due to COVID-19. So, the present study was undertaken to probe into the factors responsible for maternal mortalities due to COVID-19 along with the description of our institutional experience of the same. This would enhance the available data and predict determinants of maternal mortality due to COVID-19.

Methods

We did a comprehensive review of the literature with reference to our institutional experience to understand maternal deaths due to COVID-19 in detail (GIMS/IEC/HR/2020/13). The search was conducted in the PubMed, Embase, and Google Scholar databases, using the keywords "maternal mortality", "maternal death", "COVID-19", "septic shock" and "DIC". The search included original articles, review articles, case reports published till date in English that included maternal mortality due to COVID-19 in the antepartum period or until 6 weeks after delivery. Total 83 studies were screened. Studies with data duplication, unreported and incomplete data reporting, and preprint studies were excluded. Total 42 studies were included in this narrative review.

Experience of our tertiary care center of 3 maternal deaths

Case 1, Mrs. X, a 25-year-old pregnant woman, known asthmatic, unbooked primigravida, with 26 weeks gestation, got admitted with a positive RT PCR report for SARS CoV-2. She has complaint of fever and cough for 4 days and shortness of breath (SOB) for 2 days. She was dyspneic with respiratory rate 38/min, SpO2 (oxygen saturation) 82% on room air, pulse rate 134/min, blood pressure 116/76 mmHg with Quick Sequential Organ Failure Assessment (q-SOFA) score of 1 on admission. Obstetrical examination revealed a relaxed uterus of 26 weeks fundal height. Patient was admitted in COVID intensive care unit (ICU) and oxygen supplementation was given via non-rebreathing mask with the reservoir at 12 liters/min raising saturation to 98%. Bronchodilators- both systemic and inhalational injectable steroids, 3rd generation antibiotics, and leukotriene inhibitors were started. All relevant investigations were done. X-ray revealed patchy alveolar opacities in the bilateral mid and lower lung zones suggesting viral pneumonia. d-dimer and lactate dehydrogenase (LDH) were markedly raised. Low molecular weight heparin (LMWH) 40 mg subcutaneously and aspirin 75 mg orally daily were initiated. Repeat X-ray on day 3 of admission showed bilateral confluent opacities suggesting acute respiratory distress syndrome (ARDS). In view of persistent dyspnea and rising leukocyte count, antibiotics were stepped up and the option of convalescent plasma therapy was given which was transfused on days 4 and 5 of admission. Exogenous oxygen support continued until day 6 when she acutely decompensated, intubated, and kept on ventilatory support but expired **a**fter a total stay of 5 days 6 h. Probable cause of death was acute respiratory failure secondary to COVID-19 pneumonia with ARDS with bronchial asthma at 26 weeks gestation.

Case 2, Mrs Y, a 32-year-old elderly primigravida, in-vitro fertilization (IVF) conceived, a diamniotic dichorionic twin gestation of 36 weeks 4 days period of gestation, with COVID-19 positive RTPCR reported with a complaint of leaking per vaginum for 6 h. She was asymptomatic with no history of contact or travel and was lost to follow up for the last 2 months due to lockdown. She was an average-built woman having pulse rate 102/min, blood pressure 126/92 mm Hg, respiratory rate 22/min, and SpO2 97% on room air with presence of pallor, icterus, and pedal edema. Abdomen was overdistended with the first fetus in breech presentation. On internal examination, leaking was present and liquor was meconium tinged, the internal os was closed, and the calculated Bishop's score was 3. Cardiotocography showed late deceleration in the first twin. She underwent an emergency caesarean section under regional anesthesia delivering two male babies of 2.4 kg and 2.2 kg with two separate placentas. Patient had atonic postpartum hemorrhage (PPH) at the operation table which was managed timely by the uterotonic agents; carboprost, oxytocin, and tranexamic acid. She was shifted to the COVID-ICU. Her investigations, collected postoperatively, showed deranged liver and kidney functions; leukocytosis; raised CRP (C- Reactive protein), LDH, and d-dimer suggestive of probable COVID related dysfunction while pre-eclampsia with HELLP syndrome was also considered in the differential diagnosis (although there was no proteinuria and blood pressure was never ≥140/90 mm Hg). Chest X-ray was normal. In view of sepsis with organ dysfunction, she was switched to fourth generation antibiotics, vitamin K and injection frusemide 20 mg 8 hourly. Being postoperative case with atonic PPH during surgery, it was planned to initiate LMWH 24 h post-operatively. She remained stable until 18 h post operatively when she suddenly complained dyspnea and perspiration; SpO2 dropped to 48%, blood pressure 80/50 mm Hg and pulse rate 132/min suggesting acute hemodynamic instability. She was immediately intubated and noradrenaline infusion started. Sonography revealed rectus sheath hematoma. She was reexplored, the rectus sheath hematoma was drained removing 800cc of blood clots. Two units of blood and four fresh frozen plasma were transfused with continuation of ionotropic support. Her vitals were maintained while urine output started decreasing. On day 2, she again went into shock with SpO2 falling to 70%, ionotropic support was escalated, cardiopulmonary resuscitation was done but despite the measures taken, she expired on postpartum day 2 after 1 day and 17 h of stay. The probable cause of death was thromboembolism with multiple organ dysfunction syndrome (MODS) with sepsis secondary to COVID-19.

Case 3, Mrs. Z, a 30-year-old gravida 2 with previous caesarean delivery with 34 weeks 5 days gestation with hypothyroidism and preeclampsia got admitted with complaints of fever for 5 days and shortness of breath for 2 days. She had been admitted at a private hospital for the last 5 days with complaints of fever, headache, and gastrointestinal symptoms. She was diagnosed as a case of lower respiratory tract infection with preeclampsia and was managed for the same. Later, she was referred to the higher center in view of persistent fever with shortness of breath having strong clinical suspicion of COVID-19. At the time of referral, her SPO2 was 94% at ambient air, respiratory rate 22/min, blood pressure 140/70 mmHg, and pulse 98/min. Before coming to our institute, she visited various hospitals where admission was denied owing to either unavailability of beds or the facility not being a dedicated COVID-19 center. When she came to our institute, she was gasping with altered sensorium, SpO2 40%, pulse feeble, blood pressure not recordable. She was immediately intubated and put on mechanical ventilation with 100% FiO2 and ionotropic support started. Cardiopulmonary resuscitation initiated. Despite maximum resuscitative efforts, she expired within half an hour of her arrival with a probable diagnosis of COVID-19 suspect with ARDS with severe hypoxemic shock. Later, her RTPCR came out to be positive for SARS-CoV2. We don't have any other investigations available to us. However, we discussed this case to highlight the importance of clinical diagnosis and a robust referral health system to manage such cases. Clinical outcomes, biochemical and radiological parameters of the first two cases have been compiled in Tables 1 and 2.

Prognostic factors in relation to critical disease in pregnancy

Review of the literature regarding fatality and prognostic factors revealed that the commonest fatal complications in COVID-19 infection include acute hypoxic respiratory failure, venous thromboembolism (VTE), disseminated intravascular coagulation (DIC), cytokine storm, septic shock, acute liver, kidney, and cardiac injury.[5,6]

Acute respiratory failure

Acute respiratory failure is the leading cause of mortality in COVID-19, especially in comorbid conditions like chronic obstructive pulmonary disease, advanced age, obesity, smoking, etc.[7] Case 1 was a known asthmatic with COVID pneumonia with severe unresponsive hypoxia.

Cytokine storm

Cytokine storm in COVID-19 may cause ARDS or MODS and even death.[8] Elevated proinflammatory cytokines (interleukin-2, 6, 8, 10, tumor necrosis factor-alpha) and inflammatory markers (C-reactive protein (CRP), serum ferritin, LDH, d-dimer, Procalcitonin) have been reported.[9] A case reported from US highlighted about cytokine storm, elevated d-dimer (24 fold higher), and MODS resulting in maternal death post caesarean after 36 h of admission.[10] The findings of this case could be readily correlated to case 2 with elevated D-dimer, CRP, and LDH rapidly progressing to MODS post caesarean and resulting in death after 41 h of admission. Case 1 with elevated D-dimer (four times) and LDH progressed to ARDS.

Thrombo-embolism

Thrombo-embolism has been reported in 20-80% of severe COVID-19 cases and is attributed to cytokine storm, hypoxic injury, endothelial dysfunction, hypercoagulability, etc., Risks are widened in pregnancy due to hypercoagulability, multiple gestations and post caesarean immobility.[11-13] In COVID-19, the local inflammatory process in the lung itself, rather than dislodged emboli, is responsible for the formation of pulmonary micro-thrombi.[14] Elevated D-dimer levels are directly related to the risk of VTE. Case 2, having no documented co-morbidity, underwent emergency caesarean; further, she was an elderly

Table 1: Clinical profile of two cases

Parameters	Case 1	Case 2
Age	25 yr	32 yr
Parity	G1P0	G1P0
Gestation	singleton gestations at 26 weeks	Diamniotic Dichorionic IVF conceived twin gestation at 36 weeks 4 days
Symptoms	Shortness of breath, fever	Asymptomatic
q-SOFA score on admission	1	0
Co morbidities	Bronchial Asthma	None
Poor prognostic factors	Raised TLC, Lymphopenia, Neutrophilia Raised D Dimer and LDH Chest X ray suggestive of ARDS	Raised TLC, CRP, Neutrophilia, Raised D-Dimer and LDH, Deranged LFT & KFT. Hypoproteinemia
Delivered	No	Yes - Caesarean Section
Operated	No	Yes (twice- caesarean and laparotomy)
O2 support	Yes	No
Ventilator support	Yes, antepartum on Day 6	Yes, post-partum day 1
Low molecular weight heparin	Yes	No
Plasma therapy	Yes	No
Probable cause of death	Acute respiratory failure secondary to COVID pneumonia with ARDS	Venous thromboembolism with Multi organ dysfunction syndrome and Sepsis
Hospital stay	5 days 6 h	1 day 17 h

Table 2: Biochemical and radiological profile of two cases

Investigations with reference values	Day 1	Day 6	Day 1	Day 2
Hemoglobin (11.5-15 gm/dl)	11.3	10.7	13.2	10
Total Leucocyte Count (4000-10,000 cell/mm^3)	12300	15300	20200	22000
Differential Leucocyte Count				
Polymorphs (P 40-80%)	82	85	71	84
Lymphocytes (L 20-40%)	11	9	20	18
Eosinophils (E 1-6%)	5	4	7	6
Monocytes (M 2-10%)	2	2	2	2
Platelet (1.5-4.5 lac/mm^3)	2.77	3.28	1.4L	1.4L
Blood Sugar (70-140 mg/dl)	109.6	-	90	49.4
Urine routine microscopy	No albumin, sugar or ketone	Glucose +	No albumin, sugar or ketone	No albumin, sugar or ketone
Urea (13-43 mg/dl)	16.0	24.7	74	80
Creatinine (0.6-1.2 mg/dl)	0.77	0.7	3.08	3.5
Uric acid (2.6-6.0 mg/dl)	4.6	2.3	9.6	9
Bilirubin Total (0.3-1.2 mg/dl)	0.6	0.65	9.7	9.5
Direct (<0.2 mg/dl)			6.8	6.7
Indirect (0.2-0.7 mg/dl)			2.94	2.8
Aspartate aminotransferase (<40 IU/L)	76	144	250	258
Alanine aminotransferase (<40 IU/L)	62	133.5	201	220
Alkaline phosphatise (60-240 IU/L)	241.7	243.5	900	978
Proteins (3.8-5.5 mg/dl)	4	4.1	3.3	3.2
Prothrombin Time	14.9	14.2	14.8	15.3
Activated Partial Thromboplastin time (28.69-41.89)	32.5	31.2	39.3	42.5
International normalized ratio INR	1.10	1.05	1.09	1.13
D-Dimer (<500 ng/ml)	2847	3500	10,000	>10,000
CRP (<3 mg/L)	1	2	37.6	40
Lactate Dehydrogenase LDH (125-220 U/L)	772	792	597	655
Ferritin (15-150 ng/ml)	72.8	65	66.54	74
Arterial blood gas analysis (ABG)	Mild respiratory alkalosis	Severe metabolic acidosis	Not done	Severe metabolic acidosis with hypoxia with hyperkalemia
Chest X ray	Patchy alveolar opacities bilateral mid and lower lung zones ? viral pneumonia RALE score: 30	Day 4 Patchy confluent opacities bilateral lungs ?ARDS RALE Score: 42	Apparently normal RALE score: 0	

primigravida with twin gestation, had elevated D-dimers, CRP, and LDH levels – all increasing risk of VTE. Demelo-Rodríguez and Wichmann reaffirmed it by reporting high incidence of asymptomatic venous thrombosis in COVID-19 cases (14.7% and 58% respectively).[15,16] Ahmed *et al.*[17] reports the first maternal death in the UK due to venous thromboembolism and basilar artery thrombosis.

Disseminated intravascular coagulation (DIC)

DIC related to severity is reported in 71% of non-survivors and manifests clinically with bleeding and biochemically as elevated fibrinogen, high D-dimer with minimal change in prothrombin time, activated partial thromboplastin time and platelet count.[18] Similar findings were observed in case-2 with abdominal wall bleeding. LMWH prophylaxis is recommended against VTE and DIC till 36 weeks and in the postpartum period while unfractionated heparin after 36 weeks because of short half-life.[19] We could not start LMWH in Case-2 as she was an immediate post caesarean case with per operative atonic PPH followed by rectus sheath hematoma.

Acute Liver and Kidney injury

Acute Liver and kidney injuries can occur due to cytokine storm or micro-thrombi mediated damage and are directly related to the severity of infection. Deranged Liver enzymes, elevated bilirubin, and reduced albumin are reported in one-third patients,[20,21] and acute kidney injury in 5-10% of patients.[22] In Case-2, both liver and renal functions were grossly deranged with hypoalbuminemia, which may explain the rapid progression to the critical stage.

Septic shock

Septic shock has been reported in 4% to 8% of COVID-19 patients with noradrenaline being the preferred first-line agent for management.[23] Case-2 developed septic shock after caesarean section and progressed to MODS.

Presence of comorbidities

Takemoto *et al.*[24] reported 20 COVID-19 related maternal deaths in Brazil. Among 20, 9 women had ≥ 1 comorbidities and 5 out of 9 were asthmatic. Case-1 was also known asthmatic.

Given the similarity between the climate and geography of India and Brazil, this finding has important implications. Pregnant women with COPD, asthma, and other respiratory ailments should be given priority-based care. Other studies also reported presence of the comorbidities: obesity, diabetes, asthma, hypothyroidism, and advanced maternal age among maternal deaths.[25,26] On the contrary, out of the 7 maternal deaths reported by Hantoushzadeh *et al.*,[6] 5 had no underlying health issues suggesting that pregnancy itself could put women at higher risk of more severe consequences from SARS-CoV-2 infection.

Gaps in maternity care

Case 2 was lost to follow-up while case 3 was a victim of poor referral system similar to a case of maternal mortality reported by Zamaniyan *et al.*[27] Kumari *et al.*[28] reported 43.2% reduced hospital admissions, 66.4% reduction in referred obstetric emergencies and observed a significant increase in maternal mortality (0·20 vs 0·13%; $P = 0·01$) due to lockdown. Establishment of social distancing norms and COVID-related psychological stress could have possibly led to avoidance of hospitals by pregnant women A study from Brazil has also attributed inadequate health care access and presence of risk factors to maternal mortality in COVID-19.[24] This highlights the gap between expected and tendered quality of maternity health services received by pregnant women even after the introduction of "Point-of-care Quality Improvement" by WHO.[29]

Burden of Disease and Case fatality rate

As far as the burden of COVID-19-related maternal morbidity and mortality is concerned, Centres for Disease Control and Prevention on 12 July 2021 reported 113 maternal deaths out of 100,472 cases, 13.7% ICU admissions with 9.4% receiving invasive ventilation.[30] An earlier report by CDC stated that symptomatic pregnant women were at significantly increased risk for severe outcomes compared with nonpregnant women. After adjusting for all contributing factors, CDC reports that compared to nonpregnant women, pregnant women had more ICU admissions (3.9 vs 10.5 per 1000 cases), more cases receiving invasive ventilation (1.1 versus 2.9 per 1000 cases), and more case fatality rate (1.2 per 1,000 cases vs 1.5 per 1,000 cases) suggesting 70% increased relative risk for mortality in them. CDC also reports more afflictions by COVID-19 in Hispanic black and Asian women compared to non-Hispanic white women, suggesting racial and ethnic disparities. In the subgroup analysis, it was found that pregnant women of age group 35–44 years with COVID-19 had four times more risk of invasive ventilation and two times more risk of dying than nonpregnant women of the same age.[31] Lumbreras-Marquez *et al.*[25] reported the difference between anticipated and actual maternal mortality ratio (29.5 vs 42.4, respectively) in Mexico till August 2020, with 32% higher deaths owing to respiratory ailments. COVID-19 is among the leading causes for the same.

Various studies have reported varying case fatality rates (CFR) of 0.1% to 12.9% for pregnant women infected with COVID-19 [Table 3].[6,24,25,30-41] In the largest living systematic review and meta-analysis till date, Allotey *et al.*[36] highlighted some key findings: 10% pregnant women attending the hospital for any reason is diagnosed with suspected/confirmed COVID-19, the pregnant women are less likely to be symptomatic and are more prone for ICU admission and invasive ventilation with case fatality rate of 1%. Juan J *et al.*[41] in a review including 324 pregnant patients with COVID-19 infection reported the rate of severe pneumonia from 0–14% and there were 9 (2.7%) maternal deaths. Institutional maternal CFR (case fatality rate) for COVID-19 at our institute was 2.14%.

Time Frame of the Event (Maternal Mortality)

In a systematic review by Hessami *et al.*,[26] they reported that out of the total 37 maternal deaths, 31 of the deaths occurred in the postpartum period. High mortality in postpartum period is also supported by other studies emphasizing the need to optimize postpartum care.[6,24,39]

Case 2 died in the postpartum period. However, Toro *et al.*[35] in a systematic review and meta-analysis concluded that there is significantly more disease progression in antenatal women as compared to post-natal women.

Role of Primary Care Physicians

Primary care physicians are the physicians of first contact forming the crucial link in the referral chain. Timely decisions and interventions by them could generate a significant difference in the maternal outcome. This study will help them in identifying the Covid-19 pregnant women with high-risk factors. This article will sensitize them towards rampant issue of maternal mortality and help them in timely referral to a designated tertiary COVID-19 hospital which was not done in case 3. Being the physicians of first contact with the knowledge of increased severity of Covid-19 in pregnant patients, they could also motivate pregnant and lactating mother to voluntarily opt for COVID-19 vaccination as per Government of India guidelines.[42]

Key Learning Points

- Prognostic factors associated with Covid-19 pregnancy cases include the presence of COVID-19 symptoms, increased age, comorbidities, lymphopenia, elevated D- dimer, elevated inflammatory markers, liver, kidney, and cardiac injury markers, cesarean delivery, and gaps in maternity care.
- Patients without symptoms and having normal imaging should not be taken lightly, instead the full biochemical profile should be done and used for disease categorization. It is difficult to ascertain the actual contribution of COVID-19 to maternal mortality at times because changes in biochemical parameters may mimic pregnancy-associated complications.
- As routine follow-up of patients is reduced in the pandemic, pregnancy-related complications are often missed and

Table 3: COVID-19 related maternal morbidity and mortality among various studies

Authors	Study type	Total no. of COVID-19 Pregnant women	Percentage of pregnant patients with severe/ critical COVID-19	Total no. of maternal COVID-19 deaths; Case fatality rate	Comments
Papapanou *et al.* (Jan 2021)[32]	Systematic review and meta-analysis	-	3-10%	<2%	This study attributed contradictory maternal rates across the world to differing healthcare infrastructure in various countries.
Chi *et al.* (Dec 2020)[33]	Systematic review and meta-analysis	230	17.5%	1; 0.43%	15 out of 20 studies included in this review were from China. So, the findings of this study can't be generalised.
Kim *et al.* (Nov 2020)[34]	Systematic review and meta-analysis)	85 (all ICU cases)	100%	11; 12.9%	1. The unusually high case fatality rate is because of including only patients admitted to ICU. 2. This study emphasizes the importance of recognizing maternal disease severity and associated intervention timely to decrease the risk of death in critically ill pregnant patients.
Taro *et al.* (Nov 2020)[35]	Systematic review and meta-analysis	1100	8%	5; 0.45%	This study demonstrated case fatality rate in pregnant and non-pregnant females to be the same. However, the studies included exhibited significant heterogeneities.
Allotey *et al.* (Sept 2020)[36]	Living Systematic review and meta-analysis	11,432	13%	73; 0.1%	They observed increased incidence of asymptomatic disease, ICU admission and invasive ventilation in pregnant patients as compared to non-pregnant women.
Khalil *et al.* (July 2020)[37]	Systematic review and meta-analysis	2567	7%	43; 0.9%	Only studies with sample size >15 included. Small case series/case reports were excluded
Di Mascio *et al.* (Sep 2020)[38] (22 different countries)	Multinational retrospective cohort study from WAPM*	388	11%	3; 0.8%	1. There was no statistically significant difference in the maternal mortality and morbidity observed between different regions. 2. The presence of COVID-19 symptoms was only predictor of primary outcome (composite measure of maternal mortality and morbidity). 3. Non-inclusion of low-income countries limits the generalization of findings.
Marquez *et al.* (Aug2020)[25] (Mexico)	Research Article	308	-	7; 2.3%	1. They highlighted the gap between expected and delivered level of maternity care. 2. The role of COVID-19 as a direct or indirect cause of mortality was not clear.
Takemoto *et al.* (Aug2020)[39] (Brazilian ARDS surveillance system)	Research Article	978 (all ARDS cases)	100%	124; 12.4%	1. The disturbing high case fatality rate is due to inclusion of only COVID-19 pregnant women with ARDS. 2. Authors have missed the opportunity to compare this result to the non-pregnant women affected with COVID-19 induced ARDS. 3. This case fatality rate may not be true as 30% cases were not included due to incomplete data.
Hantoushzadeh *et al.*[6] July 2020 (Iran)	Case Series	9	100%	7; 77%	Mortality rate for severe cases cannot be generalized from this study as it is not a surveillance cohort. However, it is one of the first case series to show that maternal mortality due to COVID-19 is not zero.
Antoun *et al.* July 2020[40] (UK)	Prospective cohort study	23	34.8%	1; 4.3%	This study presents data from early phase of the pandemic from UK with 70% of the infected patients from Asian background.

* (World Association of Perinatal Medicine) working group

treatment is delayed. Therefore, there is an urgent need to introduce telemedicine facilities and strengthen the health referral systems in developing countries.

- Comprehensive review of all maternal deaths should be done critically so that steps to reduce these tragic events in the future can be taken.

Strengths and Limitations

Strengths

- This is a comprehensive narrative review of maternal mortality complemented by data from our institute.
- All possible direct and indirect COVID-19 related maternal mortality have been discussed with supportive evidence from the literature.

Limitations

- Quality of the studies was not assessed.
- Under-reporting of maternal deaths by various countries might have led to underestimation of the issues (determinants of maternal mortality) discussed.

Conclusions

The potential risk of maternal mortality in COVID-19 pregnancies cannot be underestimated. Although the number of maternal mortality appears small, obstetricians need to be well versed with the factors predictive of poor outcome. Decoding maternal mortality and strengthening the health care delivery systems is vital to save pregnant women from dying, particularly in low-resource countries.

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Conflicts of interest

There are no conflicts of interest.

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