Analysis of the Factors leading to Severe Acute Maternal Morbidity and Maternal Mortality during COVID 19 Pandemic

Junu Shrestha, Sudiksha Thapa, Nidhish Sharma
Manipal College of Medical Sciences, Pokhara, Nepal

ABSTRACT

Aims: To determine prevalence, causes and factors leading to severe acute maternal morbidity and mortality during COVID 19 pandemic.

Methods: The was a cross sectional observational study conducted in the department of Obstetrics and Gynaecology of Manipal teaching hospital from March 2020 to February 2022 amid COVID 19 pandemic. Women who sustained severe acute maternal morbidity (according to World health organization organ system criteria) and maternal deaths during pregnancy, labour and six weeks postpartum were included. Maternal characteristics, total live births, pregnancy outcome, causes and factors leading to morbidity and mortality were noted. The acquisitioned data was analyzed using Statistical Package for Social Sciences version 21.

Results: There were 37 cases of severe acute maternal morbidity and 2 cases of maternal deaths. The severe acute maternal morbidity ratio was 9.4 per 1000 live births and maternal mortality ratio was 51 per 100,000 live births. Therefore, severe acute maternal morbidity mortality ratio was 18.5:1 and mortality index 5.1%. Haematological and coagulation system (45.9%) and neurological system (29.7%) were the common organ systems involved. Hypertensive disorders (40.5%) and haemorrhage (32.4%) were the main causes of severe acute morbidity. Both maternal deaths occurred due to eclampsia. There was no severe acute maternal morbidity or mortality due to COVID infection in pregnancy. Delay in seeking and reaching to the health centre (65%) was major delay leading to severe morbidity and mortality.

Conclusions: Indices and causes of severe acute maternal morbidity and mortality during COVID 19 pandemic was not worse compared to those prior to COVID 19 pandemic. Primary delay in seeking and reaching health care was the main factor leading to severe morbidity and mortality.

 Keywords: COVID 19; Maternal mortality; Morbidity; time factors

Correspondence
Dr Junu Shrestha, Department of Obstetrics and Gynecology, Manipal College of Medical Sciences, Pokhara, Nepal

Email:
junu152001@yahoo.com
Phone: +977-9856033826

INTRODUCTION

There had been many challenges and obstacles in the delivery of the essential health care services during Corona Virus Disease 19 (COVID 19) pandemic. As the major focus had been on preparation of the health care system for the mitigation and management of COVID 19, other health care services including reproductive health, maternity services and new born care were among the ones to suffer. The travel restrictions imposed by government had also prevented pregnant women from getting health services leading to

delay in seeking and reaching health care facilities. Likewise, infection amongst health care personnel leading to temporary shutting down of the health centres had interrupted the delivery of reproductive health services to the population in need. This had also propagated fear in the women leading to their unwillingness to visit the health services even at times of dire need. These issues resulted in increasing deterioration in maternal and perinatal health alike.

There had already been reports of underutilization of antenatal care services, intrapartum services, family planning and abortion services resulting in the increasing number of maternal deaths compared to past.[1] One study in Nepal has reported reduction in the institutional deliveries by more than half during lockdown with increasing stillbirths and neonatal deaths.[1] A sharp rise in the number of maternal deaths was reported in the lockdown period.[2] These indirect effects of COVID 19 in the maternal health could be disastrous. It is therefore important to find out about severe morbidity and mortality of pregnant women during COVID 19 pandemic. Moreover, it is more important to determine the different delays that would have led to these serious maternal morbidity and mortality. Determining these factors could help in addressing these factors in order to take measures to prevent such events in future.

Therefore, this study was conducted with the aims of finding out prevalence and causes of severe acute maternal morbidity (SAMM) and maternal mortality (MM) and the factors leading to these during COVID 19 pandemic.

METHODS

This was a cross sectional observational study, conducted in the department of Obstetrics and Gynaecology of Manipal Teaching Hospital. It was conducted from March 2020 to February 2022 for a period of two years during the time of COVID 19 pandemic. Women who had sustained severe acute maternal morbidity as per the WHO criteria[3] based on clinical, laboratory and management parameters [Table-1] during pregnancy, labor and 6 weeks postpartum were included. Of the various criteria used for identifying SAMM, WHO organ system based criteria seemed to be a more useful approach with less bias and was hence used in this study.[4,5] Maternal deaths during pregnancy, labour or six weeks postpartum during the study period were also included.

The study was conducted after obtaining ethical clearance (MEMG/IRC/389/GA). Consent was obtained from the patient's visitor or even from the patient herself once condition had been stabilized.

Maternal near miss cases were identified during the morning meetings, ward round and discussions in the department. Cases were identified from the labour ward, high risk pregnancy room, postnatal ward and various intensive care units. All those cases who met the WHO criteria for SAMM were included. All cases of maternal deaths during the period were analyzed. Information was taken from the patients or their kin, from the case chart and from the team of medical personnel involved in management of the patient whenever required. Preformed performa was filled up which included the details of the patients, criteria based on which they are classified as SAMM and factors that had led to this condition. The causes of maternal mortality and SAMM were also noted. Finally, the maternal and perinatal outcome was also noted.

Age of the women, gestational age at delivery, parity, the type of SAMM accordi-

Table-1: WHO Severe Acute Maternal Morbidity Identification Criteria[3]

Dysfunctional Organ System	Clinical Criteria	Laboratory Criteria	Management Criteria
Cardiovascular system	Shock Cardiac arrest	Severe hypoperfusion (lactate >5mmol/l or >45mg/dl) Severe acidosis (pH < 7.1)	Use of continuous vasoactive drugs Cardiopulmonary resuscitation
Respiratory system	Acute cyanosis Gasping Severe tachypnea (respiratory rate>40 bpm) Severe bradypnea (respiratory rate <6 bpm)	Severe hypoxemia (O2 saturation <90% for >60 minutes or PaO2/FiO2 <200)	Intubation and ventilation not related to anaesthesia
Renal	Oliguria not responsive to fluids or diuretics	Severe azotemia 9 keratinize>3.5 mg/dl)	Dialysis for acute renal failure
Haematological/ Coagulation	Failure to form clots	Severe acute thrombocytopenia (<50,000 platelets /ml)	Massive transfusion of blood / red cells (>5 units)
Hepatic	Jaundice in presence of preeclampsia	Severe acute hyperbilurubinemia (Bilirubin>6 mg/dl)	
Neurological	Prolonged unconsciousness (lasting >12hrs) Uncontrollable fits/status epilepticus Global paralysis		
Others			Hysterectomy following infection or haemorrhage

ng to organ system criteria, mode of delivery, factors leading to delay like delay in seeking care, delay in reaching care, and delay in receiving care were studied. In case of maternal mortality, cause of maternal deaths and the factors leading to death were studied. Data was entered in the Microsoft Excel sheet. Statistical Package for Social Sciences (SPSS) version 21 was used for data analysis. Frequency and percentage was used to calculate the socio-demographic and obstetric variables. Total deliveries and live births during the period were noted. Various indices like Maternal mortality ratio (MMR), SAMM Ratio (SAMM /Live birth), Severe Acute Maternal morbidity mortality Index (MI - MD/ SAMM+MD) were calculated. Simple percentage was used in analyzing the various causes of SAMM and MD and different factors leading to maternal morbidity and death.

RESULTS

There were 37 cases of SAMM and 2 maternal deaths during the study period. There were a total of 4003 total deliveries and 3922 live births during the study period. [Table-2]

The maternal characteristics of SAMM are presented [Table-3]

Most of the severe acute morbidities and both mortalities occurred in the third trimester of pregnancy during the antenatal period. Majority of the women had been booked (81.1%) but on analyzing the number and quality of the antenatal care only 51.4% of women had been supervised well during pregnancy. Nearly two-thirds of the women presented with severe SAMM at time of admission.

The different organ systems involved in women with sever acute morbidity and mortality are presented. Two deaths occurred due to neurological cause. [Table-4]

Table-2: Severe Acute Maternal Morbidity and Mortality Indices during COVID 19 Pandemic

Severe Acute Maternal Morbidity and Mortality (SAMMR) Indicators		Indices
Number of Maternal Near Miss (MNM)		37
Number of Maternal deaths (MD)		2
Total Live Births (LB)		3922
Mortality Index (MI)	MD/SAMM +MD	5.1%
SAMM ratio	SAMM per 100,000 livebirths	9.4 per 1000 live births
SAMMR	SAMM:MD	18.5:1
Maternal Mortality Ratio (MMR)	MD per 100,000 Live births	51 per 100,000 live births

Haematological and coagulation system was the commonest (45.9%) organ system involved followed by neurological system (29.7%), cardiovascular system (27%) and

Table-4: Maternal Organ System Involvement in Severe Acute Maternal Morbidity and Mortality during COVID 19

Organ System Involvement	SAMM (n=37)
Cardiovascular system	10 (27.0)
Respiratory system	10 (27.0)
Renal system	3 (8.1)
Haematological/Coagulation system	17 (45.9)
Hepatic system	2 (5.4)
Neurological system	11 (29.7)
Uterine dysfunction	2 (5.4)
Multiple organ system	13 (35.1)
More than one organ system involvement in few cases	

respiratory system (27%). Nine women (24.3%) had at least 2 organ system involved and 4 women (10.8%) had more than 2 organ systems involved. Both maternal deaths were due to eclampsia during the study period. One woman was brought dead in the hospital after number of recurrent seizures at home and on the way to hospital.

Causes of SAMM and maternal mortality are presented. Two deaths occurred due to eclampsia. [Table-5]

Table-3: Maternal Characteristic of the Severe Acute Maternal Morbidity and Mortality during COVID 19 Pandemic

Maternal characteristics		SAMM during COVID (n=37)	Mortality during COVID (n=2)
Age	≤ 19	6 (16.2)	-
	20 – 35	27 (73.0)	1 (50.0)
	>35	4 (10.8)	1 (50.0)
Parity	1	22 (59.5)	1 (50.0)
	2-4	15 (40.5)	1 (50.0)
	>4	-	-
Gestational Age	< 13 weeks	8 (21.6)	-
	13- 28 weeks	2 (5.4)	-
	>28 weeks	27 (73.0)	2 (100.0)
Booking status	Unbooked	7 (18.9)	-
	At MTH	3 (8.1)	-
	At primary centres	17 (45.9)	2 (100.0)
	At tertiary centres	10 (27.1)	-
Adequacy of antenatal supervision	Yes	19 (51.4)	-
	No	18 (48.6)	2 (100.0)
Stage of pregnancy during SAMM	Antenatal	22 (59.5)	2 (100.0)
	Intrapartum	5 (13.5)	-
	Postnatal	10 (27.0)	-
Timing of SAMM	On admission	27 (73.0)	2 (100.0)
	At hospital	10 (27.0)	-

Most of the SAMM (78.4%) and both maternal deaths occurred due to direct causes: mostly due to hypertensive disorders (40.5%) and haemorrhage (32.4%).

Table-6: Pregnancy Outcome of Severe Acute Maternal Morbidity and Mortality during COVID 19 Pandemic

Pregnancy Outcome		SAMM (n=37)
Mode of pregnancy termination	Vaginal delivery	7 (18.9)
	Cesarean section	22 (59.5)
	Manual Vacuum aspiration	3 (8.1)
	Laparotomy	5 (13.5)
Neonatal Outcome	First trimester pregnancy termination	8 (21.6)
	Live birth	18 (48.6)
	Still births	9 (24.3)
	Neonatal deaths	2 (5.4)

There was one case of SAMM each due to amniotic fluid embolism and pulmonary embolism. All 3 cases of SAMM due to acute

thrombocytopenia were first identified only at time of delivery. Both maternal deaths were due to eclampsia.

Pregnancy outcome of the women with SAMM and maternal mortality are presented. [Table-6]

Table-5: Causes of Severe Acute Maternal Morbidity and Mortality during COVID 19 Pandemic		
Causes of SAMM and MM		SAMM (n=37)
Direct cause		
Haemorrhage	Incomplete abortion	3 (8.1)
	Ruptured ectopic	5 (13.5)
	Abruptio placenta	2 (5.4)
	PPH	2 (5.4)
Hypertensive disorders	Eclampsia	12 (32.4)
	Severe Hypertension	3 (8.1)
Dystocia		2 (5.4)
Indirect cause		
Cardio-respiratory causes	Embolism	2 (5.4)
	Postpartum cardiomyopathy	2 (5.4)
Acute thrombocytopenia		3 (8.1)
Acute pancreatitis		1 (2.7)

Majority of women had cesarean section (59.5%) and there were 8 cases (21.6%) of first trimester pregnancy termination managed by manual vacuum aspiration or emergency laparotomy. In both maternal deaths, post mortem cesarean section was done to deliver the baby. One woman was brought dead to the hospital while the other who was brought in moribund state died within an hour of hospitalization. Both the babies were stillborn.

In both cases of maternal deaths, there was delay in seeking and reaching the health centres. Both had reached the hospital in moribund state – one was already dead and the other died within an hour of reaching hospital. In most of the cases of SAMM (70%), there had been delay at some level. Delay in seeking was noted in 35% cases and delay in seeking and reaching care in 21% of

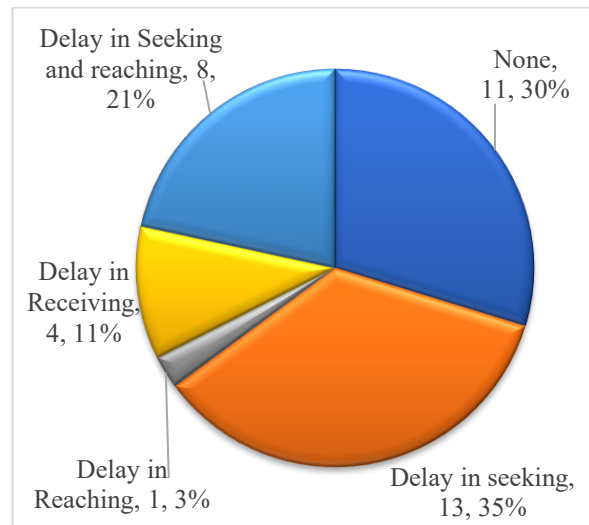women. The delaying to SAMM are analyzed and presented. [Figure-1]

Figure-1: Factors leading to Severe Acute Maternal Morbidity during COVID 19 Pandemic

DISCUSSION

The COVID 19 pandemic affected the health care delivery system due to travel restrictions imposed and also due to propagation of fear resulting in reluctance to seek health care services even at times of need. The underutilization of the health care thus had a secondary impact on the maternal and perinatal health. This study was conducted with the aim to find out the women with SAMM and mortality at the time of pandemic and to find out delays that could have lead to these conditions.

There were many studies focusing on the severe acute maternal morbidity following COVID infection in pregnancy. Studies to find out the prevalence of SAMM not related to COVID infection during pandemic were scarce. Studies to find out the maternal and perinatal outcome as a collateral effect of COVID pandemic on maternal health showed that worldwide, there was increased maternal deaths, stillbirths, poorer fetal outcome, increased chances of ruptured ectopic pregnancies and increase in the prevalence of maternal depression.[6]

Likewise, excess of maternal deaths was observed during COVID period compared to pre-COVID period in Nepal in a study conducted by Ministry of Health and Population.[7]

Studies on severe acute maternal morbidity/ maternal near miss during pandemic in our country could not be found which has made comparisons with different studies difficult. However, study conducted in our institute on maternal near miss cases using WHO organ system criteria in the year 2013/14 to 2014/2015 (pre-COVID period) was used to see if there were any deviations in the prevalence and causes during COVID.[8]

In this study, there were 37 cases of SAMM and 2 maternal mortalities giving SAMM ratio of 9.4 per 1000 live births and maternal mortality ratio (MMR) of 51 per 100,000 live births. Compared to the previous study in our institute, SAMM ratio was found to be slightly more during COVID.[8]

The ratio of SAMM to MM (severe acute maternal morbidity mortality ratio) is the ratio of number of cases of near miss to number of maternal deaths, higher ratio indicating better care. During COVID, it was 18.5:1 indicating that for every 18.5 life threatening conditions, there was one maternal death. This was better compared to ratio of 10:1 in the pre- COVID period in our institute as well as in others.[8,9] It showed that despite pandemic, services had been optimal in managing life threatening conditions.

Mortality index (MI) is defined as the number of maternal deaths divided by the number of severe acute morbidities. Higher the index, poorer is the quality of care as more women with life threatening condition are likely to die and lower index suggest better care. During COVID, the MI was 5.1% better than MI of 9.1% prior to COVID.[8] This also suggests provision of better care and services during COVID pandemic. The MI

was also better compared to that many other studies conducted before the pandemic (7.5 to 8.9%).[9,10] Despite the shutting down of many primary health care centres like birthing centres and basic emergency obstetric and neonatal care centres during pandemic,[7] referral institutes like ours were functioning at its best; which could be the reason for better morbidity indicators during pandemic.

The SAMM occurred mostly in age group 20 to 35 years, multiparous women and in the third trimester of pregnancy. These were consistent with the findings of study done before COVID.[8] However, there was increase in the proportion of SAMM in first trimester (21.6%) during COVID compared to cases before COVID (5%).[8] Increase in the number of first trimester complication was noted during COVID. Guidelines during the early period of pandemic to delay booking visit during pregnancy, curtail the number of antenatal visits, travel restrictions imposed by government and shutdown of many health facilities could have prevented early diagnosis of the first trimester complications. The SAMM mostly occurred in the antenatal period (59.5%). Nearly, three-fourths of the SAMM were present at the time of admission indicating delay in the presentation during COVID. Prior to COVID, 60% of cases had SAMM at the time of admission.[8]

In our study, hypertensive disorders (40.5%) followed by haemorrhage (32.4%) were the common causes of SAMM during COVID same as in period before COVID.[8] Both the cases of maternal deaths were due to hypertensive disorders in pregnancy same. Many other studies before COVID also reported haemorrhage and hypertension as the top causes of severe acute maternal morbidity.[9-13] Hypertension, haemorrhage and infection are the three most important causes of maternal mortality in low income

country like ours. The same pattern was noted for SAMM in our study pre and during COVID. This indicates that implementing programmes and practices to reduce hypertension and haemorrhage would be valuable in decreasing the maternal deaths and improving maternal health.

Haematological and coagulation systems (45.9%) were the most common organ system involved followed by neurological system (29.7%) in this study. Similar pattern of organ system involvement was observed in study done before COVID at our institute.[8] This relates to haemorrhage and hypertensive disorders being the common causes of SAMM during and before COVID pandemic.

On analyzing the delays, in 70% of the cases, some kind of delay was noted. Majority of the women had delay in seeking for care (35%). Further 21% women also had delay in seeking as well as reaching care. One patient had delay in reaching care. The delay in seeking for care could be due to fear of attending the health centres during pandemic. In addition, focus of the health care delivery system in management of mitigation of COVID, also lead the public to change their health care seeking behavior. The travel restriction and lockdown imposed by government also caused delay in reaching the health care centres. Moreover, even at times of dire need, unavailability of the ambulance services for transfer of sick patients could have lead to delay in reaching the health institutes on time.

However, similar delays were noted even prior to COVID pandemic.[10,11] Delay in seeking and reaching care prior to COVID could be due to lack of knowledge, financial constrains, difficult terrain etc. During pandemic, additional factors related to COVID also added on to these factors.

This was a single-centered institute based study. Community based and multi-centric studies would give a more candid picture of SAMM during COVID.

CONCLUSIONS

The severe acute maternal morbidity and mortality were 18 times more common than maternal deaths during COVID 19 pandemic. The SAMM ratio was 9.4 per 1000 live births and mortality index was 5.1%. These indices were better compared to pre- COVID times. Hypertensive disorders and haemorrhage were the common causes of SAMM as in the pre- COVID times. Most of the women with SAMM presented late due to delay in seeking and reaching the health care centre.

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