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Original Research Article

Audit on maternal mortality in a tertiary care centre in India of 6 years, a retrospective analysis

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ABSTRACT

Background: This study is carried out on 382 cases of maternal deaths from July 2010 to June 2016 at the department of obstetrics and gynaecology of tertiary centre to evaluate causes and risk factor associated with maternal deaths.

Methods: Retrospective analysis of all maternal deaths occurred in department of obstetrics and gynaecology of tertiary care hospital from July 2010 to June 2016.

Results: The MMR in the study period was 915/100000 live births. Maximum no. of maternal death 42.7% were in age group of 21-25 years, majority of them residing in urban area. 117 patients referred from sub-district/district hospital. 76.4% patients were registered. 60% maternal deaths were seen in postnatal period. In present study majority of maternal deaths 60% were due to indirect cause while 40% patients died due to direct cause. Major causes of maternal deaths were hypertensive disorder 12%, obstetric haemorrhage 11% tuberculosis 11%, hepatitis E 8% and pregnancy related infections 5.6%.

Conclusions: High maternal mortality can be due to the fact that the study was conducted in tertiary care referral centre. Referral of moribund cases from rural, sub-district, district and peripheral hospital to our institute have inflated this mortality ratio. All of these being preventable causes of death can be avoided by improving standard of obstetric care, increasing number of health professionals, upgradation of healthcare facilities at first referral units and by making better health policies.

Keywords: Direct cause, Health facilities, Indirect cause, Intervention, Maternal deaths, Referral

INTRODUCTION

Parturition is a natural process, which can take a turn making it 'lethal' for any patient. Pregnancy and childbirth is a Universally celebrated event. Yet for many women, it is a tortuous journey that may end in death.¹ A woman dies as a result of complication arising during pregnancy and childbirth every 90 seconds in the world, and every 7 minutes in India.² The majority of these deaths are avoidable. Maternal health is a very sensitive issue which has not only affected on the social and economic development of a country but also on the rights

of the highest attainable standard of health of an individual.

Maternal mortality - According to WHO "The death of a woman during pregnancy or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes".³

Everyday approximately 830 women die from preventable cause of maternal mortality. 99% of all

maternal deaths occur in developing countries.⁴ Globally, there were an estimated 303,000 maternal deaths in 2015, a decline of 44% from 1990.⁵ Maternal death audit - it is an in-depth systematic review of maternal deaths to describe their underlying health social and other contributory factors, and the lessons learned from such an audit are used in making recommendations to prevent similar future deaths. Although this audit process empowers local authorities to understand and helps to take steps to improve maternal health.⁶ Each year in India, roughly 28 million women experience pregnancy and 26 million have a live birth. Of these, an estimated 67,000 maternal deaths and one million new-born deaths occur each year.⁷ Hence, it is important to evaluate the spectrum of causes behind this large number of maternal deaths in our country. Hence the present study has been undertaken to evaluate the causes, risk factors associated with maternal mortality and to find out the measures which can be taken to reduce maternal mortality.

METHODS

This study will include retrospective analysis of all maternal deaths occurred in department of obstetrics and gynaecology of tertiary care hospital from July 2010 to June 2016.

The study commenced after the approval of institutional ethics committee.

Data regarding maternal mortality will be documented from maternal mortality register after obtaining permission.

Inclusion criteria

- All pregnant women irrespective of gestational age and postpartum within 42 days of delivery registered or unregistered who died due to direct or indirect causes in tertiary care hospital will be included in the study
- Death due to ectopic pregnancy.

Exclusion criteria

- Coincidental maternal deaths like suicide and accidental deaths.

All cases of maternal mortality between July 2010 to June 2016 will be included in the study. Thorough analysis of the individual case record of all the cases of maternal mortality will be undertaken and data will be analysed.

Statistical analysis

Being a retrospective observational study, frequency and percentage calculations were used in the statistical analysis.

Maternal mortality ratio will be calculated by using the formula:

$$MMR = \frac{\text{Total no of maternal deaths} \times 100000}{\text{Total no of livebirths}}$$

RESULTS

Table 1: Age distribution.

Age (years)	No. of patients (n = 382)	% of patients
< or = 20	31	8.1
21-25	163	42.7
26-30	138	36.1
31-35	37	9.7
> 35	13	3.5

Table 2: Residence.

Residence	No. of patients (n = 382)	% of patients
Urban	313	82
Rural	69	18

Table 3: Type of admission.

Type of admission	No. of patients (n = 382)	% of patients
Referred	289	75.6
Direct admission	93	24.3

Table 4: Transportation.

Free transport available	No. of patients (n = 380)	% of patients
Yes	100	26.32
No	182	64.54
Direct admission	93	24.47
Undelivered/abortion/ectopic	152	39.7

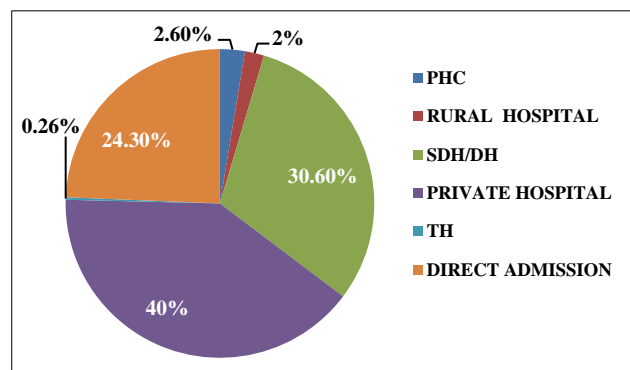


Figure 1: Type of referral facility.

Figure 1 shows when type of facility from where these patients were referred was evaluated, it was found that most of the patients 289 (75.6%) were referred to tertiary

health centre majority from SDH/DH 117 (30.6%) and Private hospital 153 (40%).

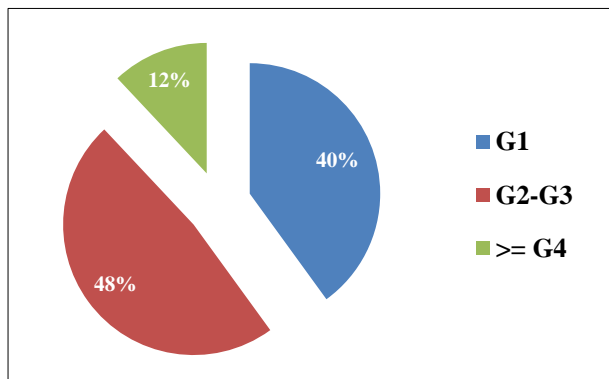


Figure 2: Gravidity.

Figure 2 shows almost half of the women (183) 48% were multigravida, 40% (155) women were primigravida and only 12% (44) women were grandmultipara.

Table 5: Gestational period of death.

Death during	No. of patients (n = 382)	% of patients
Ectopic	6	1.6
Antenatal	109	28.5
Postnatal	230	60
Postabortal	37	9.6

Table 6: Mode of delivery.

Mode of delivery	No. of patients (n = 382)	% of patients
Vaginal delivery	137	36
Operative vaginal delivery	18	5
LSCS	71	18.5
Classical caesarean section	2	0.5

Table 7: Intervention.

Operative procedure done	No. of patients (n=382)	% of patients
Exploratory laparotomy for perforative peritonitis, uterinerupture, hemoperitoneum	10	2.6
Exploratory laparotomy with unilateral salpingectomy	6	1.57
Exploratory laparotomy with obstetric hysterectomy	6	1.57
Classical caesarean section with obstetric hysterectomy	1	0.26
Classical caesarean section	1	0.26
Lower segment caesarean section	71	18.5
BMV	5	1.31
Not required	283	74.0

Table 8: Direct causes of maternal mortality.

Direct causes of maternal mortality	No. of patients (n = 382)	% of patients	
Group name/number			
Pregnancies with abortive outcome/ectopic/miscarriage	Ectopic	6	1.57
	Abortion	11	2.87
Hypertensive disorders in pregnancy, childbirth, and the puerperium	Preclampsia	9	2.3
	Eclampsia	28	7.3
	HELLLP	9	2.3
Obstetric haemorrhage		42	11
Pregnancy-related infection		20	5.6
Other obstetric complications	Acute fatty liver of pregnancy	13	3.4
	Pulmonary embolism	1	.26
	Corticovenous sinus thrombosis	8	2
	Peripartum cardiomyopathy	3	0.78
	Hepatorenalsyndrome	3	0.78
Unanticipated complications of management	Anaesthesia related	0	0
Indirect cause		229	60

Figure 3 and 4 show that majority of women were registered i.e. 292 (76.4%) and 90 (23.6%) were

unregistered patients. Out of 292 registered patients 194 (51%) women had more than 3 ANC visits and 75 (20%)

women had less than 3 ANC visits. Number of ANC visits of about 2/3 (6%) women were not known.

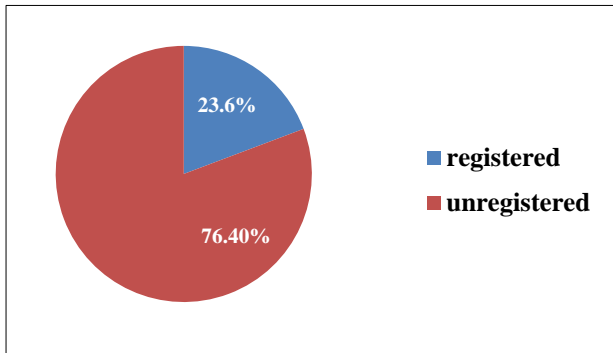


Figure 3: ANC registration.

comprehensive prevention strategies be formulated to prevent these unanticipated deaths among women.

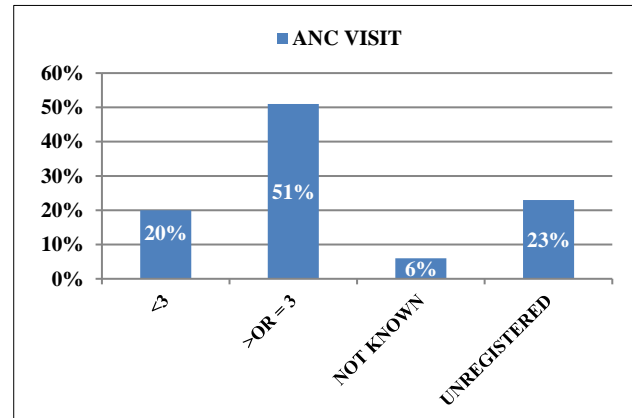


Figure 4: ANC visit.

Table 9: Indirect cause.

Indirect cause	No. of patients (n = 382)	% of patients
Anaemia	8	2
Respiratory conditions (except TB and HINI)	22	5.75
Acute febrile illness with ARDS	5	
Cardiac disease	25	6.5
Gastro intestinal disease (except hepatitis E)	11	2.8
Endocrine disease	2	0.52
Central nervous system conditions (viral encephalitis + subchorionic bleed)	15	4
Autoimmune disorders	9	2.3
Malignancy	9	2.3
Septicaemia with DIC	6	1.57
Infections		
Tuberculosis	42	11
Hepatitis E	32	8.37
Malaria	12	3.1
Dengue	7	1.8
HIV	3	0.78
Leptospirosis	3	0.78
H1N1	7	1.8
Other	11	2.8

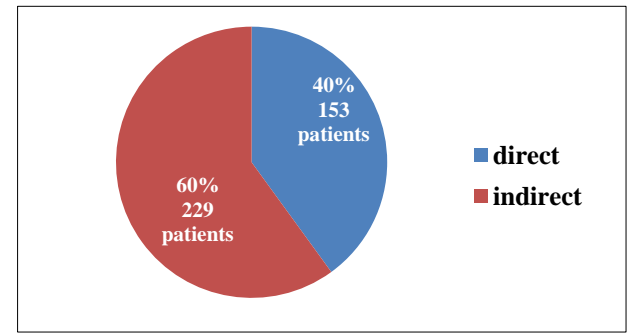


Figure 5: Causes of maternal mortality.

Age distribution

In present retrospective study of six year duration between July 2010 to June 2016 maximum no. of maternal death (42.7%) were in age group of 21-25 years followed by 36.1% in age group of 26-30 years, 8.1% maternal deaths were seen in age less than 20 years and 3.1% maternal deaths were seen in age group more than 35 years as shown in Table 1.

Retrospective study by Mukherjee S, et al observed that maximum deaths (68%) occurred in age group of 20-30years followed by 22% in more than 30 years while 10% in age group of less than 20 years.¹¹ Shannon Fernandes, et al showed that 64% maternal deaths were seen in age group of 21-30 years followed by 31% in age more than 31years and 5% in age less than 20 years.¹²

DISCUSSION

Maternal mortality refers to deaths due to complications from pregnancy or childbirth. Complete and accurate identification of all deaths associated with pregnancy is a critical first step in the prevention of such deaths. Reducing the maternal morbidity and mortality is the prime healthcare goal in developing countries. Only by having a clear understanding of the changing trends and the magnitude of pregnancy-related mortality can be

Maximum number of maternal deaths can be attributed to the Indian tradition of early marriages which results in early pregnancy. The reduction in number of deaths in women age < 20 years of age is partly due to liberalization of abortion law (MTP Act), as a result of which many young women seek help from specialist doctor for legal abortion, thus reducing number of death associated with criminal abortions and its complication.

Residence

In present study maximum no of maternal deaths 82% were of women residing in urban area and rest 18% came from rural areas as shown in Table 2.

As this study was carried out in tertiary care centre attached to teaching institute of a metropolitan city hence maximum cases belonged to urban area.

Type of admission

Maximum patients in present study were referred from other hospital to our tertiary care centre in view of higher and specialised treatment with facilities of emergency obstetric care. In present study majority of patients referred from sub-district hospital/district hospital and private hospital. Rest of the patients referred from rural hospital and PHC as shown in Table 3 and Figure1.

Badrinath M et al observed that 97.4% patients were referred and 2.6% patients directly admitted.¹³ Paul et al also observed that 88% of the patients referred from other health facilities.¹⁴ Purandare N et al, observed that out of 30 patient 23 patients were referred from other health care facilities.¹⁵ Tertiary care centre has the maximum burden of complicated referred cases with potential maternal mortality.

ANC registration

In present study 292 (76.4%) patients were registered as shown in Figure 3. Out of 292 registered patients 228 patients were referred from other health facilities. Out of 292 registered patients (51%) women had more than 3 ANC visits and 20% women had less than 3 ANC visits. Number of ANC visits of about 23 (6%) women were not known (Figure 4). Similar result were seen in retrospective study conducted by Purandare et al where out of 30 patients 27 women were registered and 3 patients were unregistered. This is in contradiction with other study which observed that maximum number of maternal deaths in unregistered cases. Vidyadhar et al had 71% unregistered cases.¹⁶ Zaman observed that out of 58 patients 32 were unregistered, 6 patients had 1 ANC visit, 3 patients had 2 ANC visit and 10 patients had 3 ANC visit and 5 patients had more than 4 ANC visit.¹⁷ As the present study was carried out in tertiary centre in metropolitan city the number of registered patients were more as compared to other studies. In present study free transportation was provided to only 100 (26.3%) referred patients. While 189 (49%) referred patients had come with private ambulance/vehicle, free transportation was not available for them (Table 4). Facility of prompt and free transportation for early referral is required.

Gestational period of death

In present study maximum number of maternal deaths 60% were seen in postnatal period, followed by

28.5% maternal deaths seen in antenatal period. In post-abortion period 9.6% maternal deaths were seen while 6 patients died due to ectopic pregnancy (Table 5). Shobha Mukherjee, et al observed that 47% maternal deaths were seen in antenatal period, 43% were seen in postnatal period, 6% maternal deaths were seen in post-abortion period and 4% patients died due to ectopic pregnancy.¹² Zaman S et al observed that maximum deaths 46% were during postnatal period, followed by 36% during antenatal period and 16% during intranatal period.¹⁷ Anupamma N et al observed that 66% of maternal death were seen in postnatal period and 33% of maternal deaths were seen in antenatal period. Above study finding is consistent with present study findings while Badrinath M et al observed that maternal deaths in 1st, 2nd, 3rd trimester, intranatal and postnatal period were 4.5%, 13%, 40%, 4.6% and 35.5% respectively.¹⁸

Gravidity

In present study almost half of the women 48% were multigravida, 40% women were primigravida and only 12% women were grand-multipara as shown in figure 2. Retrospective study by Fernandes S observed that 47% deaths were among primigravida, 50% deaths among multigravida and 2.5% deaths were seen in grandmultipara.¹²

Too many and too close pregnancy adversely affect maternal health.

Mode of delivery

Present study also shows that most of the women 36% delivered vaginally, 5% patients underwent operative vaginal delivery, 18.5% patients had LSCS, 0.5% patients underwent classical caesarean section. Rest of patients (152) were either undelivered or died due to ectopic or died during post-abortion period (Table 6). Similar result found in retro-prospective study done by Arpita et al study who observed that 47% patients delivered vaginally, 18% patients underwent LSCS, 6.7% patients underwent exploratory laparotomy, 23% patients undelivered and 10% were early pregnancy death.¹⁹ Mundkar and Rai et al observed that out of 66 patients 22% (15) patients were delivered vaginally, 30.3% (20) patients underwent LSCS, 4.5% (3) patients had abortion and 3% (2) patients died due to ectopic pregnancy and rest 22 patients were undelivered.²⁰ Purandare N et al observed that 7 of the 30 patients died ante partum and 22 postpartum. There was one intrapartum death. Of those that had delivered, 14 had delivered normally, one by forceps extraction, and 7 by cesarean section. 18 of the 22 had live births while 4 had stillbirths.¹⁵

Operative procedure

In present study out of 382 maternal deaths 71 patients underwent lower segment caesarean section, 10 patients underwent exploratory laparotomy for perforative

peritonitis, uterine rupture, hemoperitoneum, 6 patients underwent exploratory laparotomy with unilateral salpingectomy for ruptured ectopic pregnancy, 6 patients underwent exploratory laparotomy with obstetric hysterectomy, one patient underwent classical caesarean section with obstetric hysterectomy, while one patient underwent only classical caesarean section, and 5 patients underwent balloon mitral valvotomy for heart disease (Table 7).

Arpita N et al, observed that out of 194 patients 35 patients underwent lower segment caesarean section and 13 patients underwent exploratory laparotomy for ruptured ectopic pregnancy.¹⁹ Mundkur and Rai observed that 20 out of 62 patients underwent lower segment caesarean section and 2 patients underwent exploratory laparotomy for ruptured ectopic.²⁰ An increasing number of operative procedures were performed in the recent years with the intention to save more.

Table 10: Retrospective study of various causes.

Retrospective studies	Haemorrhage	Hypertensive disorder	Sepsis
Mundkar and Rai	20 %	3.2%	17.7%
Badrinath M et al	26.66%	26.66%	18.33%
Vidyadhar et al	21%	10.8%	7.8%
Fernandes S et al	26.6%	21.43%	14.3%
Present study	11%	12%	5.6%

Causes of maternal mortality

In present study majority of maternal deaths 60% (229) were due to indirect cause while 40% (153) patients died due to direct cause. Cause of death are divided according to the WHO Application of ICD-10 to deaths during pregnancy, childbirth and the puerperium: ICD-MM.

In present study deaths due to direct causes were 40% as shown in figure 5 which is divided in 6 groups, Group 1 included deaths due to abortion 2.8% and deaths due to ruptured ectopic 1.57%. Group 2 included deaths due to preeclampsia 9%, due to eclampsia 28% and deaths due to HELLP syndrome 9%. Group 3 included deaths due to obstetric hemorrhage were 11%. Group 4 included deaths due to pregnancy related infection were 5.6%. Group 5 contain deaths due to other obstetric complication like deaths due to acute fatty liver of pregnancy 3.4%, pulmonary embolism 0.26%, cortico venous sinus thrombosis 2%, peripartum cardiomyopathy 3%, and due to hepatorenal syndrome 3%. Group 6 include anaesthesia related death, no such death found in this study. In present study maximum deaths were due to hypertensive disorder followed by obstetric hemorrhage (Table 8). Group 7 include indirect causes. Most common indirect cause of death was tuberculosis 42 cases (11%) which is equivalent to death due to obstetric hemorrhage Disseminated tuberculosis, multidrug resistant TB, pulmonary tuberculosis, CNS tuberculoma, tubercular meningitis were the major causes of maternal deaths. Deaths due to hepatitis E were 8.37% (32). 25 (6%) deaths were due to heart disease which included rheumatic heart disease with pulmonary hypertension and congenital heart disease, 5.75% deaths were due to respiratory disease which included deaths due to ARDS, respiratory failure with pneumonia. 4% deaths were due to CNS disorder which included deaths due to viral encephalitis and subarchnoid hemorrhage. 12 deaths were

due to malaria both falciparum and vivax, 8 deaths were due to anaemia it also included sickle cell crisis. 9 deaths were due to autoimmune disorder which included deaths due to SLE, scleroderma. 9 deaths were due to malignancy.⁷ deaths were due to dengue, 7 deaths were due to HINI, 3 deaths were due to HIV and 3 deaths were due to leptospirosis. 12 deaths were due to other causes (Table 9).

According to SRS the leading causes of maternal death in India have been, haemorrhage (38%), sepsis (11%), and abortion (8%).

According to WHO Between 2003 and 2009, haemorrhage (27.1%), hypertensive disorders (14%), and sepsis (10%) were responsible for more than half of maternal deaths worldwide. More than a quarter of deaths were attributable to indirect.

Various retrospective study conducted in tertiary centre observed that major cause of maternal mortality haemorrhage, hypertensive disorder and sepsis as shown in Table 10.^{12,13,16,19,20} Madhuribadrinath et al, observed that 72.5% of maternal deaths were due to direct causes. Like hemorrhage (26.66%), eclampsia (26.66%), and sepsis (18.33%).¹³

Vidyadhar et al observed that 50% maternal deaths were due to direct and 50% maternal deaths were due to indirect causes. 21% deaths due to hemorrhage, 10.5% were due to eclampsia, 10.5% were due to embolism, 7.8% were due to sepsis, 21% were due to hepatitis, 13% were due to heart disease, 7.8% were due to cerebral malaria, 5.25% were due to viral encephalitis and 2.6% were due to anemia.¹⁶

Maternal deaths in Mumbai have increased 40% over the past five years. According to recent news report one of

the most common cause of maternal deaths in Mumbai is tuberculosis, an infectious disease that is curable. The finding assumes significance given the resurgence of drug-resistant tuberculosis in the city and other parts of the country. Deaths as a result of anaemia, have reduced drastically, but tuberculosis has emerged as the top cause for maternal mortality. After tuberculosis, hepatitis A and hepatitis E (foodborne infections) have killed most pregnant women admitted at hospitals in Mumbai. Earlier, the most common causes for maternal deaths were antepartum and post-partum haemorrhage, pre-eclampsia, sepsis as a result of infection. This report of Hindustan Times is consistent with our study as our study was also conducted in tertiary hospital of Mumbai.²¹

Maternal mortality ratio

In the present study of 6-year duration from July 2010 to June 2016 there were 41749 live births and total no. of maternal deaths were 382. The MMR in the study period was 915/100000 live births which is higher than state and national average.

An estimated 303,000 maternal deaths occurred globally in 2015, yielding an overall MMR of 216 maternal deaths per 100,000 live births from 1990 to 2015, the global maternal mortality ratio declined by 44 per cent - from 385 deaths to 216 deaths per 100,000 live births.⁵

The overall MMR in developing regions is 239, which is 20 times higher than that of developed regions, where it is just 12.⁵

Almost 99% maternal deaths occur in developing regions. Two regions, sub-Saharan Africa and South Asia, account for 88 per cent of maternal deaths worldwide. Sub-Saharan Africans suffer from the highest maternal mortality ratio - 546 maternal deaths per 100,000 live births, or 201,000 maternal deaths a year. This is two thirds of all maternal deaths per year worldwide. South Asia follows, with a maternal mortality ratio of 182, or 66,000 maternal deaths a year, accounting for 22 per cent of the global total.⁵ The national MMR level has come down from 327 per 100,000 live births in 1999-2001 to 167 per 100,000 live births in 2011-13.⁸

Maternal Mortality Ratio (MMR) of India has declined by 16 percent from 212 during 2007-09 to 178 during 2010-12. India's rate of decline of MMR between 2007-09 and 2011-13 is 5.7 per cent. MMR of Maharashtra had fall from 104 in 2007-09 to 87 in 2010-2012, achieved target of MDG.⁹ In present study high maternal mortality can be due to the fact that the study was conducted in tertiary care referral centre. Admissions of moribund cases referred from rural, sub-district, district and peripheral hospital have inflated this mortality ratio, like other teaching institutions of India. Other similar studies from tertiary care institutions reported MMR range from 270 to 1180 as shown in Table 11.

As this study conducted in tertiary health centre of Mumbai and according to Brihanmumbai Municipal Corporation's (BMC's) health department the total number of deaths in Mumbai has jumped over the last few years with 222 maternal deaths reported during 2010-2011, 259 in 2011-2012, 278 in 2012-2013 and 260 deaths reported in the first 11 months of the financial year (April 2013 till February 2014). The high incidence of maternal deaths in the city is due to a large number of patients the civic hospitals receive from outside the city (Kalyan, Thane, Navi Mumbai, etc). "If we take maternal deaths of only Mumbai residents, then the MMR reduces to 71, which meets the millennium development goals".¹⁰

Table 11: Retrospective studies for MMR.

Retrospective studies conducted in tertiary centre	MMR PER 100000 live birth
Mukharji S et al	1180
Suratzaman et al	709
Arpita N et al	555.5
Vidhydhar et al	302
Nishupriya et al	270
Present study	915

Many women were referred in moribund state and in irreversible shock and could not be saved even at our tertiary care hospital. Strengthening of the referral units with blood bank, equipment and adequately competent staff for early detection of high risk and timely referral should be of prime importance.

CONCLUSION

A systematic audit of each and every maternal death should be conducted for the analysis of root cause. The corrective action to prevent the recurrence of such deaths should be taken. In the present study, majority of the maternal deaths were preventable. Hemorrhage, sepsis, PIH, TB, hepatitis E and DIC were found to be the commonest causes for maternal mortality. It important to note that, in the present study, many mothers had received antenatal care, had no teenage pregnancy, had very few obstructed labour or rupture uterus, and yet they died. There is a change in the trend of causes of maternal mortality. Strengthening of the first referral units with equipment, blood bank, and adequately competent staff should be of prime importance. Continued medical education of the medical personnel at the periphery is required. Taking appropriate remedial measures for preventing lapses noted in the management of these cases will be of immense value in reducing the maternal mortality.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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