Original Article

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Changing Trends of Maternal Mortality in a Rural Medical College in Eastern India: A 23-Year Retrospective Study

Obstetrics and Gynaecology Section

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ABSTRACT

Introduction: Maternal mortality in a region is a measure of reproductive health of women in that area. The direct causes of maternal deaths are largely preventable. A new era of more comprehensive, international development agenda-the Sustainable Development Goals (SDG 3.1) was launched by the United Nations General Assembly 2015, New York for ending preventable maternal deaths.

Aim: To determine the causes and changing trends of maternal mortality in at a rural centre in Eastern India.

Materials and Methods: A retrospective observational study was carried out in the Department of Obstetrics and Gynaecology of Bankura Sammilani Medical College in West Bengal in Eastern India. Individual hospital records of all the maternal deaths, from January 1998 to December 2020 were collected. Data regarding demographic profile and reproductive parameters like gravida, parity, antenatal care and cause of death were collected. The records were divided into two four yearly periods, to compare the changing trends (1998-2001) vs (2017-2020) and three five yearly (2002-2006), (2007-2011), (2012-2016) periods. The first term (1998-2001) was taken as the reference period.

Results: Comparison between first (1998-2001) and last term (2017-2020) shows significant declining trend of Maternal Mortality Ratio (MMR) (364 vs 148)/100000 live birth (p-value <0.00001). Majority of deaths occurred in primigravida (57.5% vs 60.6%). Direct obstetric causes accounted for majority of the deaths, but with a declining trend (74.7% vs 66.9%). Eclampsia remained the leading direct cause (35.5% vs 32.2%) followed by haemorrhage (20.4% vs 18.8%) and sepsis (18.8% vs 15.7%) in the first term (1998-2001) vs last term (2017-2020). Jaundice 6.45% vs 10.3%, heart disease 2.15% vs 7.1%, embolism 4.3% vs 0.8%, anaemia 6.45% vs 1.6% and other diseases 5.91% vs 13.4% in the first vs last term were the indirect causes of maternal mortality.

Conclusion: There is a declining trend of maternal mortality since 1998, which can be attributed to improvement at all levels of healthcare. Eclampsia/preeclampsia and its complications remain the leading cause of maternal mortality. Majority of these maternal deaths can be prevented by regular screening of high-risk cases, integrated antenatal and postnatal care, institutional deliveries, timely referral, and proper implementation of national health programmes.

Keywords: Eclampsia, Institutional delivery, Maternal death surveillance and response, Maternal mortality ratio, Preventable causes

INTRODUCTION

Maternal mortality is defined as "the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by pregnancy or its management, but not from accidental or incidental causes [1]. Direct causes of maternal deaths due to obstetric haemorrhage, sepsis, hypertensive disorders of pregnancy or due to complication of anaesthesia or Caesarean section are largely preventable [2]. Indirect obstetric deaths are due to pre-existing disease like anaemia, cardiac disease, liver or kidney disease [2]. One of the key indicators of maternal mortality is MMR [3], which shows marked variation due to variety of geographical and cultural regions in India [4,5]. In recent years, increasing attention is given to maternal mortality trends in developing countries, especially in context of the United Nations Millennium Declaration [6,7]. Thus, this study aimed to determine the changing trends of maternal mortality over a 23-year period in this rural centre.

MATERIALS AND METHODS

A retrospective analysis was carried out in the Department of Obstetrics and Gynaecology, B.S. Medical College and Hospital, Bankura, West Bengal, India from January 1998 to December 2020. Data collection and analysis was done from July 2021- January 2022. This institution is a rural based teaching cum referral government hospital, catering almost exclusively to the under privileged rural pregnant women of Bankura, as well as neighbouring three to four districts, with total annual delivery of 23,000 approximately. All the case records of maternal deaths from the Medical Record Section of this hospital were obtained after taking permission from the Institutional Ethical Committee (IEC) (BSMC/Aca:-2126, dated 05/07/2021).

Inclusion criteria: All maternal deaths in this institution that occurred during pregnancy or within 42 days of its termination irrespective of the site or duration of pregnancy.

Exclusion criteria: Brought dead mothers and accidental or incidental maternal deaths were excluded from the study.

Demographic data including age, parity, literacy, residential area, antenatal care, admission-death interval were recorded to review the changing trends of maternal mortality in this rural area.The records were divided into two four yearly periods, to compare the changing trends i.e.(1998-2001) vs (2017-2020) and three five yearly i.e. (2002-2006), (2007-2011), (2012-2016) periods. The first term (1998-2001) was taken as the reference period.

STATISTICAL ANALYSIS

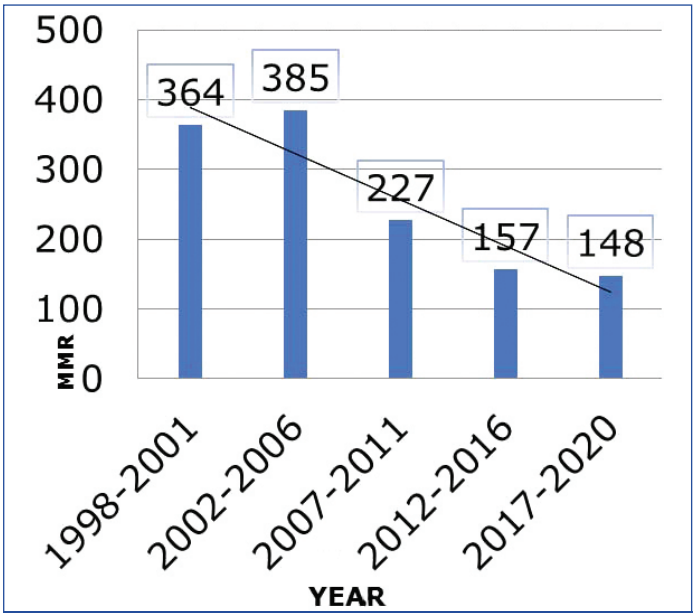
The percentages for all variables were calculated and analysed using Microsoft Excel, 2007 and Statcalc statistical software (version: 8.1). Z test for proportion was used, to calculate p-value for MMR in first term (1998-2001) vs last term (2017-2020).

RESULTS

During the study period from January 1998 to December 2020, 960 maternal deaths and 4,02,743 live births were reported in this hospital with a cumulative (Cum) MMR of 238/100000 live births over a span of 23 years. There was an increase in institutional delivery and the MMR was 364 (1998-2001), 385 (2002-2006) and 227 (2007-2011), 157(2012-2016), and 148/100000 live births during 2017-2020 [Table/Fig-1]. Comparison between first (1998-2001) and last term (2017-2020) show a statistically significant declining trend of MMR (364 vs 148)/100000 live birth (p-value <0.00001) using Z test for proportion. A significant declining trend of maternal mortality over the last two decades from 1998 to 2020 was observed [Table/Fig-2].

Term	Maternal deaths	Live births	MMR/100000 live births
1998-2001	186	51034	364
2002-2006	284	73753	385
2007-2011	200	88069	227
2012-2016	163	103818	157
2017-2020	127	86069	148
1998-2020 (Cum)	960	402743	238

[Table/Fig-1]: Term wise maternal mortality, live births and MMR in BSMCH (1998-2020).



[Table/Fig-2]: MMR at BSMCH, Bankura (1998-2020).

Majority belonged to 20-29 years primigravida. A declining death trends within 24 hours of admission (72% in the first term vs 31% in the last term) was noted, but increasing incidence in deaths after 72 hours of admission i.e.from 4% (1998-2000) to 45% in recent years [Table/Fig-3] [8].

There was a declining trend in the deaths due to eclampsia, preeclampsia (35.5% vs 32.2%), haemorrhage (20.4% vs 18.8%), sepsis (18.8% vs 15.7%) in the first term (1998-2001) vs last term (2017-2020) [Table/Fig-4].

Variables	1998-2001 n (%)	2002-2006 n (%)	2007-2011 n (%)	2012-2016 n (%)	2017-2020 n (%)
Age (years)					
<20	64 (34.4)	84 (29.6)	39 (19.5)	35 (21.5)	32 (25.2)
20-29	100 (53.8)	164 (57.7)	136 (68)	108 (66.3)	83 65.4)
>29	22 (11.8)	36 (12.7)	25 (12.5)	20 (12.2)	12 (9.4)
Parity					
Primigravida	107 (57.5)	139 (48.9)	106 (53)	99 (60.7)	77 (60.6)
Multigravida	79 (42.5)	145 (51.1)	94 (47)	64 (39.3)	50 (39.4)
Residence					
Rural	166 (89.2)	256 (90.1)	184 (92)	155 (95)	121 (95.3)
Urban	20 (10.8)	28 (9.9)	16 (08)	08 (5)	06 (4.7)
Socio-economic status with reference to (Standard of living index scale) [8]					
Lower BPL	168 (90.3)	256 (90.1)	180 (90)	145 (89)	113 (89)
Lower middle	17 (9.1)	27 (9.5)	19 (9.5)	17 (10.4)	13 (10.2)
Middle class	01 (0.6)	1 (0.4)	01 (0.5)	01 (0.6)	1 (0.8)
Educational status					
Primary	58 (31.2)	86 (30.2)	62 (31)	52 (32)	39 (30.7)
Middle	118 (63.4)	170 (59.9)	118 (59)	104 (63.8)	78 (61.4)
High school	10 (5.4)	28 (9.9)	20 (10)	07 (04.2)	10 (7.9)
Antenatal care					
Booked	12 (6.5)	68 (24)	90 (45)	133 (82)	120 (94.5)
Un booked /< 3 visits	174 (93.5)	216 (76)	110 (55)	30 (18)	07 (5.5)
Referred cases	149 (80.10)	228 (80.2)	140 (70)	105 (64.4)	77 (60.6)
Non referred cases	37 (19.9)	56 (19.8)	60 (30)	58 (35.6)	50 (39.4)
Admission-death interval (hours)					
<24	134 (72)	187 (66)	128 (64)	78 (48)	39 (31)
24-72	44 (24)	54 (19)	32 (16)	59 (36)	30 (24)
>72	8 (4)	43 (15)	40 (20)	26 (16)	58 (45)

[Table/Fig-3]: Distribution of socio-demographic factors, antenatal care and admission- death Interval [8].
BPL: Below poverty line

DISCUSSION

MMR is defined as the number of maternal deaths in a given year per 100000 live births during the same period, and measures the obstetric risk in a particular area. Comparison of the MMR in different institutions of India is shown in [Table/Fig-5] [9-15]. In India, the Sample Registration Survey (SRS) Bulletin of Register General of India of 1997-98 to 2016-2018, shows that the MMR has declined from 398/100000 live births during 1997-98 to 113/100000 live births in 2016-2018 [2,3,16]. The ratio tends to be less in urban areas which reflects easy access of city dwellers to medical services [6].

The Millennium Development Goal-5 (MDG-5) had set a desired target of reducing maternal mortality ratio by 75% between1990-2015 [6]. India's share among global deaths has declined significantly, as per

Year	Duration (years)	Direct causes				Indirect causes				
		MMR Per 100000 Live births	Eclampsia/ Preeclampsia n (%)	Hemorrhage (APH, PPH, Ectopic Pregnancy, Abortion, Rupture Uterus, n (%)	Sepsis n (%)	Anaemia n (%)	Jaundice n (%)	Embolism n (%)	Heart disease n (%)	0thers n (%)
1998-2001	4	364	66 (35.5)	38 (20.4)	35 (18.8)	12 (6.45)	12 (6.45)	8 (4.3)	4 (2.15)	11 (5.91)
2002-2006	5	385	86 (30.3)	80 (28.7)	45 (15.8)	20 (7)	12 (4.23)	15 (5.3)	10 (3.5)	16 (5.6)
2007-2011	5	227	58 (29.0)	64 (32)	24 (12)	8 (4)	11 (5.5)	10 (5)	13 (6.5)	12 (6)
2012-2016	5	157	54 (33.8)	37 (22.6)	11 (6.7)	6 (3.7)	12 (7.3)	16 (9.82)	11 (6.75)	16 (9.8)
2017-2020	4	148	41 (32.2)	24 (18.8)	20 (15.7)	2 (1.6)	13 (10.3)	1 (0.8)	9 (7.1)	17 (13.4)

[Table/Fig-4]: Causes of Maternal Mortality at BSMCH (1998-2020).
APH: Antepartum haemorrhag; PPH: Postpartum haemorrhage

Studies	Present study, Bankura, West Bengal	Yadav S and Tiwari D, [9] Indore, Madhya Pradesh	Barsode S et al., [10], Maharashtra	Singh R, et al., [11], Patna, Bihar	Boro RC et al., [12], Assam	Sreekumari U and Nair S, [13], Kerala	Mittal P, et al., [14], New-Delhi	Kachhwaha KP and Jain M, [15], Gujarat
Institute	Bankura Sammilani Medical College and Hospital, West Bengal	MGM Medical College and Hospital, Indore, Madhya Pradesh	Bharati Vidyapeeth Medical College and Hospital, Maharashtra	Patna Medical College and Hospital, Bihar	Tezpur Medical College and Hospital, Assam	SAT Hospital Govt. Medical College, Kerela	VMMC, Safdarjung, New-Delhi	BJMC and Civil Hospital, Ahmedabad, Gujarat
Year	1998-2020 (23yrs)	Jun 2000-Sept 2019 (19yrs 9 months)	Bankura 2011-2017 (6 yrs)	2003-2005 (2 yrs)	2014-2016 (2 yrs)	2011-2017 (7 years)	Jan 2013-Dec 2016 (4 yrs)	Jan 2016- Mar 2018 (18 mths)
MMR per 100000 live births	364 vs 148 Cum 238	545 vs 389 Cum 517	185	3906.5	464	152	361.71	468
Leading causes of maternal death	Eclampsia followed by Haemorrhage and Sepsis	Hypertensive disorder of pregnancy, Sepsis	Toxemia, Sepsis, Haemorrhage	Haemorrhage, Eclampsia, Sepsis	Anaemia, Haemorrhage, Toxemia	Indirect causes followed by PPH PIH,Sepsis Haemorhage	Septic abortion, PIH, Sepsis, Anaemia	Eclampsia Haemorrhage Septic abortion.

[Table/Fig-5]: Comparison of MMR in different institutions of India [9-15].
PPH: Postpartum haemorrhage; PIH: Pregnancy induced hypertension

latest MMEIG report and 71% births are assisted by Skilled Birth Attendants [7,16]. In this era of SDG, India is committed to reduce its MMR to less than 70/100000 live births by 2030 [17].

The MMR in our state, West-Bengal has substantially declined from 218/100000 live births during 1999-2001 to 98/100000 live births during 2016-2018 as per SRS [3]. In this study, the cumulative MMR was 238/100000 live births over a period of 23 years. Comparison between the first term (1998-2001) and the last term (2017-2020) showed a statistically significant declining trend of MMR (364 vs 148/100000 live births; p-value<0.00001. Being a tertiary referral centre, the number of institutional deliveries has increased significantly to 23,000 per year recently. Admission of moribund cases at BSMCH Bankura referred from the periphery have inflated the mortality ratio. Similar studies from other teaching institutions, reported MMR ranging from 185-3906/100000 livebirths [9-15]. Majority belonged to the age group of 20-29 years consistent with other studies [9-15,18-21]. There is reduction in teen-age maternal deaths over the years with 34% (1998-2001) vs 25% (2017-2020) as observed in this study, similar to that of Yadav S and Tiwari D [9] and Soni M et al., [20]. This is partly, due to liberalization of abortion, increased age at marriage and availability of the drugs-misoprostol and mifepristone. Maternal deaths of referred cases, have decreased from 80% to 65% in recent years due to upgradation and improvement of peripheral health centres. In the first period of this study, 72% deaths occurred within 24 hours of admission in unbooked primigravida mothers, similar to the other reports [18-21] probably due to lack of qualified medical attention in remote areas, poor communication and delayed referral, resulting in late intervention.

Here, it was observed that maternal deaths within 24 hours of admission have decreased by 40% due to timely referral, proper operative and High Dependency Unit (HDU) management, blood transfusion facilities and improved transportation and implementation of national maternity programmes. Studies show that eclampsia, haemorrhage and sepsis are the direct causes of maternal death whereas anaemia, embolism, jaundice and heart disease are important indirect causes in the recent days in our country [9-15]. In this institution, the direct causes were responsible for 74.7% (1998-2001) vs 66.7% (2017-2020) deaths, the leading cause being eclampsia consistent with Kachhwaha KP and Jain M [15] and Ashraf Ali M et al., [21] from Karnataka, who reported hypertensive disorders as the leading cause of death followed by haemorrhage. Singh R et al., from Bihar reported, a very high MMR (3906/100000 live births) in their study, with eclampsia as the leading cause (24%) followed by sepsis and haemorrhage [11]. Regular availability and widespread use of magnesium sulphate in eclampsia in our tertiary centre along with antihypertensive, termination of pregnancy within 24 hours of last fit, facility of Obstetrics HDU, round the clock monitoring, 24 hours on call anaesthetist team and implementation of LaQshya programme by training our faculties, postgraduates and nursing staff have resulted in the declining trend of maternal as well as perinatal mortality in this tertiary referral centre.

Although obstetric haemorrhage was vigorously tackled, the prevalence of nutritional anaemia and poor general condition failed to prevent the maternal tragedy in moribund cases. Jaundice, heart disease, anaemia are important indirect causes in rural areas [12,13]. Pre-existing anaemia worsens as pregnancy advances, leading to congestive cardiac failure, inability to resist infection or cope with haemorrhage. Most of the deaths due to septicaemia, had history of septic abortion or home delivery. The availability of misoprostol, mifepristone and antibiotics have reduced such deaths in the recent years. Periodical study and analysis of maternal mortality are therefore important to monitor progress and the trend.

Various programmes have been launched by the Government of India viz. JSY(Janani Suraksha Yojana-April 2005), with nationwide emergency referral system to promote institutional delivery, JSSK (Janani Sishu Suraksha Karyakram-June 2011) with free maternal services for delivery and free services to sick newborn, EmOC (Emergency Obstetric Care) services, menstrual hygiene scheme, peer education programme and Rashtriya Kishor Swasthya Karyakram (RKSK) for adolescents, prevention and control of anaemia with Iron and folate supplementation, monthly Village Health Nutrition Days (VHND), to provide maternal and child care, setting up of skilled labs, engagement of Accredited Social Health Activists (ASHA) to facilitate healthcare services to pregnant women, screening of high-risk cases, setting up obstetric HDU, Pradhan Mantri Surakshit Matritya Abhiyan (PMSMA), to provide fixed day assured comprehensive quality antenatal care universally to all pregnant women on the ninth of every month, LaQshya Programme, to prevent maternal death [17-22]. Maternal Death Review (MDR) was adopted in 2010 by RCH Programme, but certain gaps have prompted a paradigm shift towards Maternal Death Surveillance and Response (MDSR) in 2017 [22,23]. This focuses on surveillance and response, and identifying the gaps as per the "Three-delay model" of seeking care (Delay1), reaching care (Delay2) or receiving care (Delay3), and taking action on information obtained, from every maternal death with detailed analysis on various factors at community, facility, regional and national level, to prevent further maternal deaths [23,24].

Limitation(s)

As this was a retrospective study over last 23 years, some data like duration of gestation, mode and place of delivery could not be collected. Reliable study on the trends of maternal mortality requires large sample size, confidential community based verbal

autopsy, surveillance and response which is lacking to some extent in present study. Moreover, the effect of Coronavirus Disease-2019 (COVID-19) on maternal health outcome, in health facilities in rural areas remain poorly understood.

CONCLUSION(S)

There was a significant declining trend in MMR and increase in institutional delivery in this institution since 1998, which can be attributed to improvement at all levels of healthcare. Eclampsia/ preeclampsia, and its complications remain the leading cause of maternal mortality followed by haemorrhage and sepsis. Majority of these direct causes of maternal deaths can be prevented by regular screening of high-risk cases at the periphery centres. Implementation of effective community and facility based maternal death audits, and regular maternal death surveillance and response should be carried out to eliminate preventable maternal mortality.

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