

Epidemiological study of maternal death in Assam

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ABSTRACT

Problem considered: Deaths due to pregnancy and child birth are potential threats to women of reproductive age. Despite the presence of proven interventions, maternal deaths in Assam have been highest among all the states of India.

Aims: To assess the distribution and determinants of maternal death in Assam.

Methods: A mixed method community based cross sectional study; where quantitative study done by community based verbal autopsy and qualitative study by in-depth interview (IDI) was conducted amongst stakeholders.

Results: Of 150 deaths investigated, hemorrhage 32(21.3%), pregnancy induced hypertension (PIH) 26 (17.3%) and sepsis 15(10%) were major direct causes, while anaemia 43(28.7%) was major indirect cause. Live birth as outcome found in 71(72.4%). Mean age of women having maternal deaths was 25 years. Early marriage was more common in High MMR Districts and 21.3% death was of adolescent pregnancy. Majority deaths 61(40.7%) occurred in postnatal period. Deaths happened mostly 90(75%) during hospital emergency hours. Tea garden community ($p = 0.000$), occupation of deceased ($p = 0.003$), husbands occupation ($p = 0.033$), gravida ($p = 0.046$), parity ($p = 0.006$) and blood pressure ($p = 0.031$) were major determinants of Maternal Deaths. In majority of the deaths 99(66%) the nearest CHC/FRU did not provide emergency obstetric services.

Conclusion: Social determinants exist as important determinant of maternal mortality. Access to quality care also found to be influencing the epidemiology of maternal death.

1. Introduction

Reduction of mortality of women, an area of concern and Governments across the Globe has set time bound targets to achieve it. Maternal death is an important indicator for effective health services to poor, and in turn acts as one of the composite measure to assess country's progress. Sadly maternal mortality is unacceptably high. Most deaths are occurring in low-resource settings, i.e., developing countries (99%) and could have been prevented.¹ One third of these deaths occur in South Asia.² Improvement in maternal health was a major goal in Millennium Declaration and India was a signatory.^{3,4} Under Millennium Development Goals (MDGs), the MDG 5 target was to reduce maternal mortality ratio (MMR) by three quarters between 1990 and 2015. SDG goal 3.1 states to reduce the global maternal mortality ratio to less than 70 per 100 000 live births by 2030⁵ In India this translates to reducing MMR from 560 in 1990 to 140 in 2015.⁶ India has missed MDG target of 108 MMR by 2015 and is committed to lower it to 100 by 2020.⁷

Assam has the highest maternal mortality. As per Annual Health

Survey (AHS 2012–13), MMR for Assam stood at 301. Highest prevalence was in Upper Assam division at 404 comprising districts of Tinsukia, Dibrugarh, Sibsagar, Jorhat and Golaghat.⁸

Maternal death review (MDR) system has been initiated since 2010 in India with involvement and giving incentives to accredited social health activist (ASHA) for reporting maternal deaths. Although each maternal death should be investigated, system is not functioning as expected. Only about 2/3rd deaths are reviewed by district committee and most analysis is confined to medical causes of death rather than finding gaps in health system and instituting corrective measures.⁹ Therefore, there is a need to comprehensively study maternal deaths and identify avoidable factors relating to maternal deaths to prioritize area specific interventions. So this study was undertaken to study epidemiology of maternal deaths to identify possible solutions so that preventable maternal deaths can be reduced.

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2. Materials and methods

2.1. Study area

Four districts were selected from Assam – 2 from upper Assam region (404) with highest mortality i.e., Dibrugarh and Tinsukia and 2 in Northern Assam with lowest mortality i.e., Dhemaji and Lakhimpur (251). Both quantitative and qualitative studies were undertaken. Quantitative study was done to describe the maternal deaths and qualitative study was to explore the issues related to maternal deaths in further detail.

2.2. Study population

All maternal deaths which were reported by health system and those that were identified during preliminary field visits by researchers occurring in selected district in last 2 years, i.e., from Apr'16- Mar'18 were included, from which the required sample is selected using random numbers generated by SPSS software while for qualitative study in-depth interview (IDU) was conducted among key stakeholders in each district.

2.3. Sample design and data collection process

For Quantitative Study list of maternal deaths in the district in the reference period was obtained from the health office. All selected maternal deaths were investigated using community-based maternal death review format (verbal autopsy). Respondent for verbal autopsy was any person who knew about the illnesses that led to death. Respondent may be husband, sister, mother, father, mother-in law, neighbor or traditional birth attendant.

For IDI, District level officials, Block level officials and Community Level persons like Community Leaders, village elder, members of mothers club, ASHA, Anganwadi workers (AWW) and Women in reproductive age group were included in the study.

A verbal autopsy for maternal deaths is a method of finding out medical causes of death and ascertaining the personal, family or community factors that may have contributed to the death in women. The verbal autopsy consists of interviewing people who are knowledgeable about the events leading to the death such as family members, neighbors' and traditional birth attendants.

Maternal death is defined as “Deaths of women while pregnant or within 42 days of the end of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes” which may be direct -Deaths resulting from obstetric complications of the pregnant state (pregnancy, labour and puerperium), from interventions, omissions, incorrect treatment, or from a chain of events resulting from any of the above or indirect -Deaths resulting from previous existing disease, or disease that developed during pregnancy and which was not due to direct obstetric causes, but which were aggravated by the physiologic effects of pregnancy.¹⁰

2.4. Sample size calculation

Taking prevalence of anemia as 72.7% (Anaemia among ever married women (15–49 years, RSOC 2013–14), with relative precision of 10% considering 95% confidence interval the required sample size is 144. Considering 10% non response rate and rounding up the sample size inflated to 160.¹¹ Two districts with highest MMR and two district with lowest MMR of Assam from same geographical region were selected.

2.5. Ethical issues

Informed written consent was obtained from respondent of verbal

autopsy. Privacy, data confidentiality and anonymity were maintained.

2.6. Statistical analysis

Socio-demographic characteristics were described. The standard chi-square test or Fisher's exact test was used to compare the distributions of factors associated with maternal death. Independent-samples *t*-test is used to compares the means between two unrelated groups on the same continuous, dependent variable. Statistical analysis was performed with IBM SPSS Statistics version 21 Software. The statistical significance level for α was set at 0.05.

3. Results

Overall 150 deaths were investigated at community level with a response rate of 94% in 4 districts based on the line list provided by Health department and 4 (2.3%) unreported cases were found during field survey.

3.1. Causes of maternal deaths

Cause of death was determined by verbal autopsy. Hemorrhage 32 (21.3%), pregnancy induced hypertension (PIH) 26 (17.3%) and sepsis 15 (10%) were the major cause of death among direct causes. Anaemia was the major indirect cause of death in 43 (28.7%) of the maternal deaths. Major reported cause of death in High MMR districts was anaemia (18.0%) and for Low MMR districts major causes were Hemorrhage (10.7%) along with anemia (10.7%) [Fig. 1] Among 150 maternal deaths, 95(63.3%) cases were from High MMR districts whereas 55(36.7%) deaths were from Low MMR districts.

3.2. Person distribution of maternal death

Mean age was 24.8 ± 4.7 years. Overall, 32(21.3%) maternal death cases were of adolescent age group, while maximum deaths were occurring in 21–25 years age group 64(42.7%) and 25.3%(38) in 26–30 years age group, 8.7%¹³ between 31 and 35 years and 2%³ above 35 years age group. Majority were Hindu by religion 88%(132), while 8%(12) Christian and 4%⁶ were Muslim. Type of family from where the

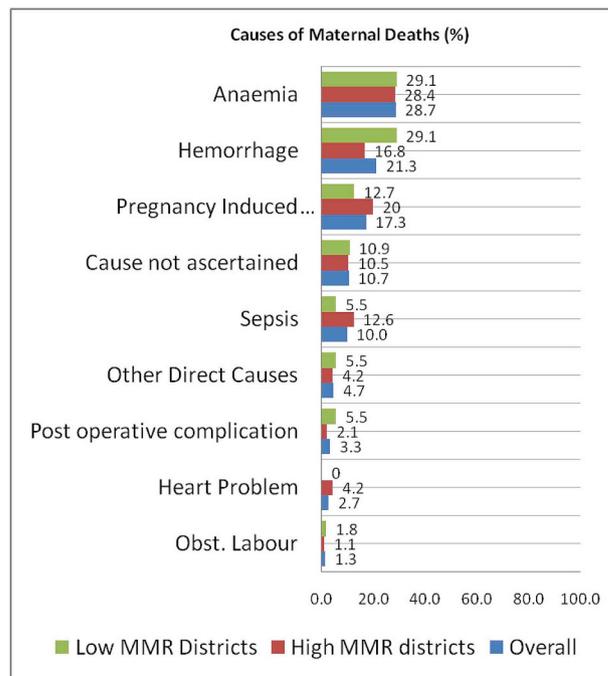


Fig. 1. Causes of maternal death in the studied population.

cases are hailing from nuclear family in 46% (69), while joint family in 54% (81). Educational status of the bereaved was: majority 37.4%(55) illiterate, while 35.4%(52) studied up to 8th standard, 21.1%(31) studied up to 12th standard, while only 6.1%⁹ were graduate or above. Tea garden community represent 69 (46%) of total maternal deaths. This proportion was more in High MMR districts which have a major percentage of people belonging to tea garden community. But in low MMR District the proportion of maternal deaths from Tea Garden Community was low around 2.7%. Among the women working in Tea gardens who died, the deaths were mainly among temporary workers 24 (86%). Overall majority of the deaths 74 (49.3%) deaths occurred in primi-gravidas and nulliparous women 56 (37.3%). Among the women who died, the deaths were mainly among women whose husbands were working as Temporary workers 18 (56.2%) in tea gardens compared to permanent workers. Marriage below 18 years among the maternal deaths was more in Dibrugarh (25%) and Tinsukia (21.3%) districts compared to Low MMR districts.

3.3. Place distribution of maternal death

Both Medical College and District hospital were the place of death in 93 (62%) of the maternal death cases signifying late referral of cases from periphery, while, 11(7.3%) deaths occurred at home signifying no medical care was sought or was unavailable [Fig. 2]. Maternal Deaths occurring in the maternal house of the women, termed as ‘Visitor death’, which is a community practice, creates problem in tracing women for ANC. Overall 4(3%) deaths were visitor deaths. Though cause of death was not significantly associated with geographical location but major cause of death was detected as anemia (28.7%) for both high and Low MMR districts. In High MMR District 18% and in Low MMR District 10.7% women died due to anemia. [Table 1].

3.4. Time distribution of maternal death

Majority 61(40.7%) deaths occurred during postnatal period. Of the 150 deaths analyzed, actual time of death was available for 120 deaths and this was analyzed in relation to hospital timings. During 8am to 2pm Hospitals were usually fully functional and at other times 2pm to 8am only emergency services were provided with few staff. Majority 90(75%) deaths occurred during the emergency hours of hospital. From June to September there is heavy rainfall in Assam and road condition worsens and floods also occur. During these months the monthly average number of deaths was higher (5.9), compared to the other two

Table 1
Association between cause of death and place of occurrence.

Cause of death	High MMR District	Low MMR District	Overall	p value
Hemorrhage	16 10.7%	16 10.7%	32 21.3%	0.072
PIH	19 12.7%	7 4.7%	26 17.3%	0.257
Anemia	27 18.0%	16 10.7%	43 28.7%	0.930
Heart Problem	4 2.7%	0 0.0%	4 2.7%	0.123
CVA	0 0.0%	1 .7%	1 .7%	0.187
Cause not ascertained	10 6.7%	6 4.0%	16 10.7%	0.942
Post operative complication	2 1.3%	3 2.0%	5 3.3%	0.271
Sepsis	12 8.0%	3 2.0%	15 10.0%	0.158
Obst. labour	1 .7%	1 .7%	2 1.3%	0.694
Diabetes	1 .7%	0 0.0%	1 .7%	0.445
Diarrhea	0 0.0%	1 .7%	1 .7%	0.187
Burn	1 .7%	0 0.0%	1 .7%	0.445
Pulmonary embolism	0 0.0%	1 .7%	1 .7%	0.187
Jaundice	2 1.3%	0 0.0%	2 1.3%	0.279

quarters i.e., 4.1 between Feb to May and 3.5 between Oct to Dec.

3.5. Determinants of maternal deaths

Amongst socio-demographic determinants belonging to tea garden community (p = 0.000), occupation of cases (p = 0.003), husbands occupation (p = 0.033) were significantly associated with high mortality. Gravida (p = 0.046), parity (p = 0.006) and blood pressure (p = 0.031) was the major obstetric determinant [Table 2].

3.6. Accessibility

A total of 89.3% respondent's had the govt. health facility within

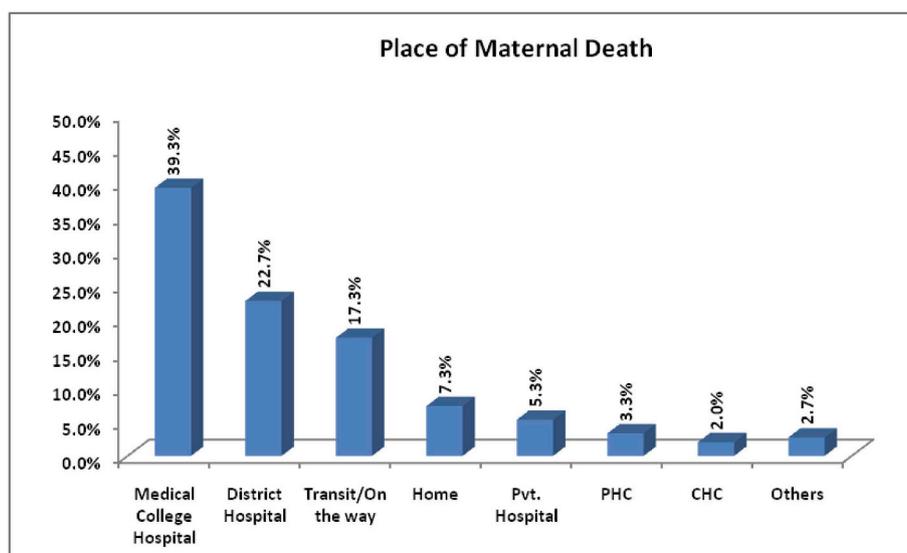


Fig. 2. Place distribution of maternal death.

Table 2
The distribution of significant factors which are associated with maternal death.

Variables			High MMR District	Low MMR District	All total	p value		
Sociodemographic characteristics	Tea Garden Community	Yes	65	4	69	0.000*		
		No	43.3	2.7	46.0			
	Occupation of cases	House Wife		30	51	81	0.003*	
				20.0	34.0	54.0		
		Agri. Labourer		66	53	119		
				44.0%	35.3%	79.3%		
		Non- daily wages Agri.		4	0	4		
				2.7%	0.0%	2.7%		
		Private employee		3	0	3		
			2.0%	0.0%	2.0%			
	Husband's occupation	Unemployed		4	1	5	0.033*	
				2.7%	.7%	3.3%		
		Agri. Labourer		18	1	19		
				12.0%	.7%	12.7%		
		Cultivator		3	0	3		
				2.0%	0.0%	2.0%		
		Non- daily wages Agri.		13	3	16		
				8.7%	2.0%	10.7%		
		Govt. Employee		10	13	23		
				6.7%	8.7%	15.3%		
Private employee			7	12	19			
			4.7%	8.0%	12.7%			
Self employed			1	1	2			
		.7%	.7%	1.3%				
Business		18	9	27				
		12.0%	6.0%	18.0%				
Others		8	4	12				
		5.3%	2.7%	8.0%				
Obstetric Characteristics	Gravida	1	6	4	10	0.046*		
		2	4.0%	2.7%	6.7%			
		3	19.3%	6.0%	25.3%			
		4	54	20	74			
		> =5	36.0%	13.3%	49.3%			
		Para	0	24	18		42	0.006*
			1	16.0%	12.0%		28.0%	
			2	11	9		20	
			3	7.3%	6.0%		13.3%	
			> =4	2	6		8	
	Blood pressure last recorded (n = 140)		Normal	4	2	6	0.031*	
			High BP	2.7%	1.3%	4.0%		
			Low BP	45	11	56		
				30.0%	7.3%	37.3%		
	Blood pressure last recorded (n = 140)		Normal	31	24	55	0.006*	
		High BP	20.7%	16.0%	36.7%			
		Low BP	11	16	27			
			7.3%	10.7%	18.0%			
	Blood pressure last recorded (n = 140)	Normal	5	2	7	0.031*		
		High BP	3.3%	1.3%	4.7%			
Low BP		3	2	5				
		2.0%	1.3%	3.3%				
Blood pressure last recorded (n = 140)	Normal	27	27	54	0.031*			
	High BP	18.0%	18.0%	36.0%				
	Low BP	59	25	84				
		39.3%	16.7%	56.0%				
Blood pressure last recorded (n = 140)	Normal	2	0	2	0.031*			
	High BP	1.3%	0.0%	1.3%				

5 km radius. Statistical significant association was seen between non govt. health facility within 5 km radius and districts. In Low MMR District this facility was available only for 4.0% of cases whereas for majority respondents (32.7%) this facility was unavailable ($p < 0.05$). Regarding mean distance from home to nearest govt. facility providing emergency obstetric services a significant mean difference was seen between High MMR District and Low MMR District. Both in High MMR District (27.3%) and Low MMR District (16.7%) maximum cases used private vehicle for transportation purpose to go to the hospital which is statistically significant ($p = 0.002$) also. Among the three delay in relation to maternal death; delay in decision making was seen in 15(15.3%) of the maternal deaths. This was highest in High MMR

District 9(9.2%) but it was not statistically significant ($p > 0.05$). [Table 3].

3.7. Utilization of services

Mode of delivery was vaginal in maximum cases 56 (57.1%), and cesarean section was done in 35 (35.7%), while 3(3.1%) deliveries were unattended by any trained person and 1% was assisted delivery. More than 4 antenatal check-up was done by 104 (70%) women. Outcome of delivery was live birth in 71(72.4%) cases. Haemoglobin testing report was not available in 92 (61.3%) cases, while in 50 (33.3%) cases testing was never done. Only eight cases had available report of which 6 (75%)

Table 3
Comparison of accessibility of health services in high and Low MMR districts of Assam.

Variables		High MMR District	Low MMR District	Overall	p value		
Govt. health facility within 5 km radius	Yes	82 54.7%	52 34.7%	134 89.3%	0.116		
	No	13 8.7%	3 2.0%	16 10.7%			
Non Govt. facility within 5 km radius	Yes	57 38.0%	6 4.0%	63 42.0%	0.000*		
	No	38 25.3%	49 32.7%	87 58.0%			
Mean distance from home to nearest govt. facility providing emergency obstetric services (in km)		24.96 ± 21.79	40.83 ± 21.78	28.32 ± 21.76	0.002**		
Type of road	No Road	1 .7%	0 0.0%	1 .7%	0.324		
	Katcha Road	29 19.3%	21 14.0%	50 33.3%			
	Gravel Road	15 10.0%	5 3.3%	20 13.3%			
	Pucca Road undamaged	26 17.3%	21 14.0%	47 31.3%			
	Pucca Road damaged	23 15.3%	8 5.3%	31 20.7%			
	water way	1 .7%	0 0.0%	1 .7%			
	Type of transport	Private Vehicle	41 27.3%	25 16.7%		66 44.0%	0.002*
		Govt Ambulance	22 14.7%	25 16.7%		47 31.3%	
Other Ambulance		25 16.7%	3 2.0%	28 18.7%			
Carts/other		7 4.7%	2 1.3%	9 6.0%			
Reasons for delay in		Decision making	9 9.2%	6 6.1%	15 15.3%	0.471	
Mobilizing funds	6 6.1%	1 1.0%	7 7.1%				
Arranging transport	5 5.1%	3 3.1%	8 8.2%				

**p-value for Student's t-test.

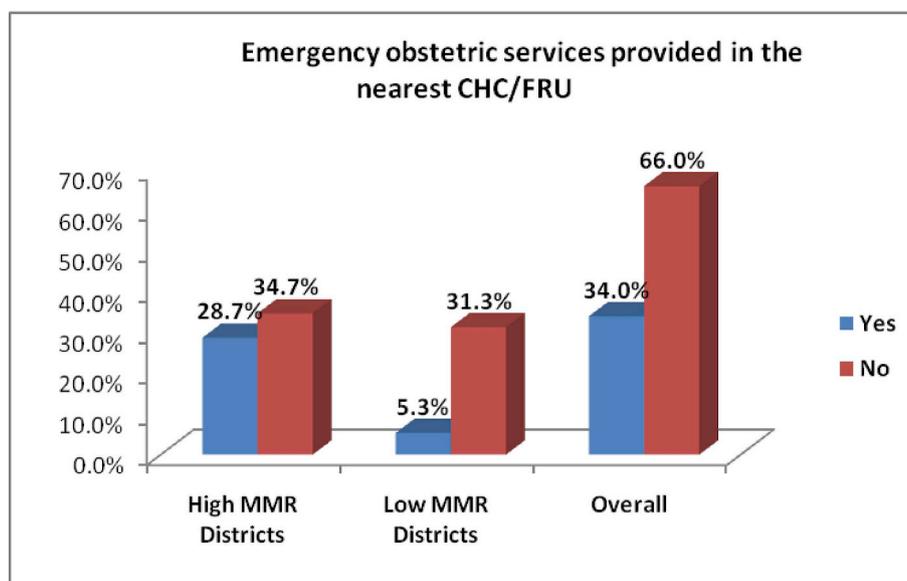


Fig. 3. Emergency obstetric services provided in the nearest CHC/FRU.

were anaemic and only two was with normal haemoglobin, which is higher in High MMR districts then in Low MMR districts (84% vs 16%). High blood pressure was recorded amongst 84 (56%) cases which also more common in high MMR district in comparison to low MMR district (70% vs 30%). Overall it was observed that in majority of the deaths 99 (66%) the nearest community health centre/first referral units (CHC/FRU) did not provide emergency obstetric services. For High MMR

districts it was 34.7% and for Low MMR districts 31.3% [Fig. 3]. Overall, majority 61(40.7%) of the maternal deaths occurred during the postnatal period. However in Low MMR districts death during delivery was higher 22(14.7%). [Fig. 4].

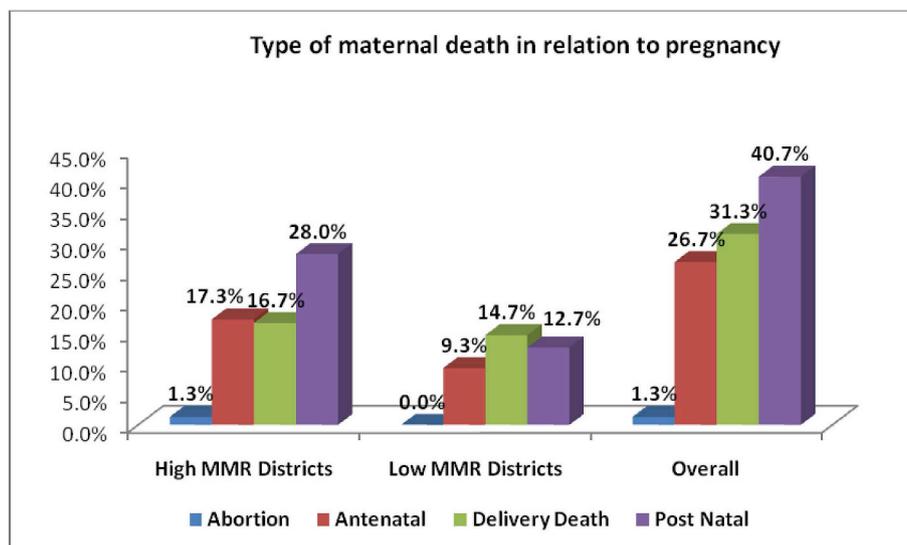


Fig. 4. Type of maternal death in relation to pregnancy.

3.8. Qualitative study

In the form of in-depth interview suggest that loss of wages for antenatal checkup, lack of facilities in tea garden hospitals, poor financial condition, lack of awareness all contribute to increased mortality and morbidity among these people.

4. Discussion

Epidemiological study in the form of time, place and person distribution showed illiteracy, lower socio-economic condition, primigravidae, tea garden community, attending hospital during emergency hours along with availing poor quality antenatal care-were more vulnerable to maternal deaths. Most of the deaths were preventable. Anaemia as a major indirect cause and haemorrhage, PIH, sepsis were similar as Global burden, indicating most of the deaths as preventable. PIH and Sepsis are also higher than South East Asian and Global estimates.¹² System strengthening is necessary to reduce high MMR. One noteworthy feature is, deaths due to abortion were only two, suggests that abortion deaths may be missed by the health system and there is a need to sensitize peripheral workers as well as the community to report such deaths. Adolescent pregnancy was also found to be higher in high MMR districts compared to low MMR District indicating early marriage and early pregnancy as a major determinant. NFHS 4 for Assam shows 32.6% women aged 20–24 years were married before age 18 years. Postnatal deaths were more, indicating need to improve quality of PNC.

Reduction in MMR in India over three periods 2001–2006, 2004–2009, and 2007–2012 was 47, 42, and 37 points, respectively showing declining trend may be the impact of different interventions and overall socioeconomic development. Overall there is a decline in maternal mortality in India, but epidemiological variation exists ranging from 300 in Assam to 61 in Kerala.¹³ Many studies documented linkage between high MMR and social inequity,^{14,15} which is evident in our study also showing more death in tea garden community which is considered as marginalized with difficult access to quality health care. Rapid decline in MMR in Bangladesh has been attributed to factor both within and outside the health system.¹⁶

PIH also found as important cause of high MMR in our study needs to be addressed properly as only 56% studied population had their blood pressure checked during antenatal period, which indicates need to improve quality ANC. Another important determinant of PIH may be high consumption of salt by tea community as evident by different studied.¹⁷ Sepsis as a cause of death indicates unhealthy delivery

practices.¹⁸

Social determinant of maternal death like illiteracy, occupation, early marriage etc were common in our study. Suggested interventions are quality ANC with risk referral, adult education, training and supervision, decentralized maternal-child health care, blood banks at delivery units, standardized obstetric care, and compulsory education of girls and later marriage.¹⁹ Therefore, functional first referral units (FRU) having blood transfusion facility and assured service delivery has potential to improve the situation and is the most cost effective intervention.²⁰ This study was subject to recall bias but all efforts were made by researchers to gather all documentary evidence available as possible. Further analytical studied can be undertaken to see the strength of association amongst different variables.

5. Conclusion

Provision of quality antenatal and post-natal services with fully functional primary care facility and easy access to emergency obstetric care along with assured referral system needs to be in place. Behavior change communication may be implemented to rise the age at marriage and to avoid early pregnancy. Focus attention needs to be given to tea garden community especially temporary workers. Overall social development like education, income generation activities, communication should be managed in an integrated manner.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cegh.2019.02.007>.

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