

Original Research Article

Estimating maternal mortality and identifying causes of maternal deaths in Jammu and Kashmir: a two-year epidemiological study

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ABSTRACT

Background: An accurate estimate of the maternal mortality ratio and its underlying causes is crucial for the effective planning of maternal health services. The aim of the study was to estimate the maternal mortality ratio (MMR) and identify causes of maternal deaths in Jammu and Kashmir. A subnational geographical area in India.

Methods: The study included maternal deaths from April 2020 to March 2022 among residents of Jammu and Kashmir. We enumerated all maternal deaths and recorded their socio-clinical parameters from interviews with family members. The cause of death was inferred from the medical records and verbal autopsy. Live births data for the corresponding period was obtained from the routine health management information system. We calculated the maternal mortality ratio using a standard formula.

Results: A total of 185 maternal deaths and 3.97 lakh live births were recorded over the two-year study period. It translated into an MMR of 47 per lakh live births, exhibiting noteworthy variability between districts. Postpartum haemorrhage (PPH) and hypertensive disorders of pregnancy accounted for a substantial proportion of maternal deaths, representing 44.3% (82/185) of cases. Sepsis and other obstetric complications were identified as the cause of death in 15.7% (29/185) and 19.5% (36/185) of maternal deaths, respectively. Furthermore, the majority of maternal deaths occurred among women between 25-30 years of age. Approximately two-thirds of maternal deaths occurred during the post-partum period.

Conclusions: In summary, our study reveals that the maternal mortality rate (MMR) in Jammu and Kashmir falls below the sustainable development goal target, albeit with marked inter-district variability pointing to disparities in healthcare delivery. We recommend expanding the coverage of evidence-based interventions aimed at reducing the incidence of postpartum haemorrhage, eclampsia, and other obstetric complications to improve maternal health outcomes.

Keywords: Maternal mortality ratio, PPH, Eclampsia, India

INTRODUCTION

Maternal mortality refers to death from any complications during pregnancy and childbirth or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, but not from accidental or incidental causes.¹ The maternal mortality ratio (MMR) represents the number of maternal deaths per 100,000 live births.^{2,3} Globally an estimated 287,000 maternal deaths occurred

worldwide in 2020.^{4,5} While there has been progress in reducing maternal deaths between 2000 and 2015, gains largely stalled or even reversed after this point.^{6,7}

Maternal deaths are primarily concentrated in the world's poorest regions and countries affected by conflict, with approximately 70% occurring in sub-Saharan Africa in 2020.^{4,8} In some of these countries, the MMR is as high as 551 maternal deaths per 100,000 live births compared to

the global rate of 223.⁹ Leading causes of maternal deaths include severe bleeding, high blood pressure, pregnancy-related infections, complications from unsafe abortions, and underlying conditions worsened by pregnancy, all of which can be prevented and treated through access to high-quality healthcare.¹⁰⁻¹²

The aim of the study was to estimate the MMR in a specific geographic area. This study aims to comprehensively analyse the factors that contribute to maternal mortality and identify targeted interventions to reduce the MMR in a specific geographic area. By shedding light on the complex interplay of factors that lead to maternal mortality, we hope to inform the development of evidence-based policies and programs to improve maternal health outcomes in the area and beyond.

METHODS

Study setting and design

The present study employed a cross sectional study design and was conducted in Jammu and Kashmir, a northern administrative region of India with a population estimated at 13.6 million, divided into 20 subdivisions, or districts. Compared to national health indicators, the study area exhibits comparatively better reproductive, maternal, and child health indicators.^{13,14} The crude birth and death rate in the study area are reported at 14.6 and 4.6 per 1000 population, respectively, as per the latest national health survey. This contrasts with the corresponding national rates of 19.5 and 6 per 1000 population, respectively. Additionally, Jammu and Kashmir's total fertility rate of 1.4 is lower than the national average of 2.¹⁵

Sample registration system which reports maternal and child mortality rates at national and subnational levels, does not provide a separate estimate of the maternal mortality ratio for this region. Currently, the maternal mortality ratio in India is estimated at 103 according to the SRS.¹⁶ While the SRS does provide child mortality rates for Jammu and Kashmir separately, the infant mortality rate of 17 in Jammu and Kashmir is lower than the national average of 28.¹⁵

Participants

The study participants included all maternal deaths between April 2020-March 2022. The study area is running a sensitive maternal death surveillance system under which all female deaths in the reproductive age group are audited to identify maternal deaths by local health care workers.¹⁷ A verbal autopsy is then conducted for all maternal deaths by trained interviewers to identify the cause, delays and factors which may have contributed to deaths. All such deaths in the two year study period were line listed and additional information related socio-clinical characteristics, time and place of death. Cause of death was ascertained from the available medical records and validated through verbal autopsy.

Variables

No of maternal deaths was obtained from review of routine surveillance data for two consecutive years. No of live births for the same period was obtained from routine health and management system (HMIS), that records routine health indicators.¹⁸ The primary variable of interest was maternal mortality ratio which was calculated using standard formula. It was calculated as $[\text{MMR} = (\text{No of maternal deaths}/\text{No of live births} \times 1,00,000)]$.³

Statistical analysis

Data was entered in Microsoft excel and analysed. We calculated mean and standard deviation for continuous variables. Confidence intervals were calculated using standard formulas. The age distribution of deaths was depicted as a scatter plot.

Ethical considerations

As data for deaths was obtained from existing data, informed consent was not taken from family members of maternal deaths. Identification details like name, detailed address and contact numbers were removed from the data before analysis.

RESULTS

During the period between April 2020 and March 2022, the study area recorded 185 maternal deaths out of 3.97 lakh live births, resulting in a maternal mortality ratio (MMR) of 46.56 (40.8-50.9). The MMR varied across districts, with the Poonch district having the highest MMR of 104, followed by Samba (87), Pulwama (83), Kulgam (73), Udhampur (67), and Baramulla (64). A district-wise breakdown of estimated deliveries, maternal deaths, and calculated MMR is presented in Table 1.

Table 2 presents the sociodemographic profile of the maternal deaths. Of the reported deaths, 137 (74.05%) were Muslim, while 46 (24.86%) belonged to the Hindu religion. Only 23 (12.43%) were illiterate, while 117 (63.24%) had at least a secondary education. As regards the caste distribution of deaths, 137 (74.05%) belonged to the general caste. Maternal deaths were most common during the post-natal period, accounting for 122 (65.95%) of all deaths. Figure 1 shows the age distribution of maternal deaths during the study period, with the age at death ranging from 19 to 44 years and a mean age of 27.8 ± 5.57 years. The most common age at death was 30 years, followed by 26 years, and almost half of the deaths (90 out of 182) were between the ages of 25-30 years. Figure 2 illustrates the underlying causes of maternal deaths, with postpartum haemorrhage (PPH) and eclampsia being the most common causes, accounting for 44.3% of all deaths. Sepsis was the cause of death in 29 (15.7%) deaths, while other obstetric complications were responsible for 36 (19.5%) deaths. Indirect causes contributed to 21 (11.4%) deaths.

Table 1: District wise MMR in Jammu and Kashmir.

S. no.	District name	No. of live births (April 2020-March 2022)	No. of maternal deaths	MMR (95% CI)
1	Anantnag	34942	10	28.6 (15.1-47.4)
2	Budgam	24416	7	28.7 (12.6-51.1)
3	Bandipore	12706	6	47.2 (19.2-74.8)
4	Baramulla	32654	21	64.3 (46.8-81.4)
5	Doda	13278	3	22.6 (5-53.8)
6	Ganderbal	9636	4	41.5 (12.1-73.7)
7	Jammu	49560	22	44.4 (30.6-59.7)
8	Kathua	19968	8	40 (20.2-66.5)
9	Kishtwar	7472	1	13.4 (0.3-57.8)
10	Kulgam	13750	10	72.7 (46.1-94.9)
11	Kupwara	28194	16	56.7 (37.1-75.5)
12	Pulwama	18154	15	82.6 (58.5-96.4)
13	Poonch	15446	16	103.6 (60.6-163.2)
14	Rajouri	20810	10	48 (27.2-72.8)
15	Ramban	9190	3	33.6 (7.4-70.1)
16	Reasi	10192	4	39.2 (12.1-73.7)
17	Samba	10330	9	87.1 (55.5-99.7)
18	Shopian	8624	4	46.4 (13.7-78.8)
19	Srinagar	40064	4	9.98 (2.6-23.1)
20	Udhampur	17978	12	66.7 (40.9-86.6)

Table 2: Socio-demographic profile of maternal deaths.

Variables	N (%)	
Total death recorded	No	185
Age (years) (age)	Mean±SD	27.8 years±5.57
Religion	Muslim	137 (74.05)
	Hindu	46 (24.86)
	Sikh	2 (1.08)
Education	Illiterate	23 (12.43)
	Up to primary	45 (24.32)
	Secondary	73 (39.46)
	Graduate and more	44 (23.78)
Caste	General	137 (74.05)
	SC/ST	48 (25.95)
	Gravida	Primigravidae
	Multigravida	99 (53.51)
Period of death	Antenatal	44 (23.78)
	Intra natal	19 (10.27)
	Post-natal	122 (65.95)

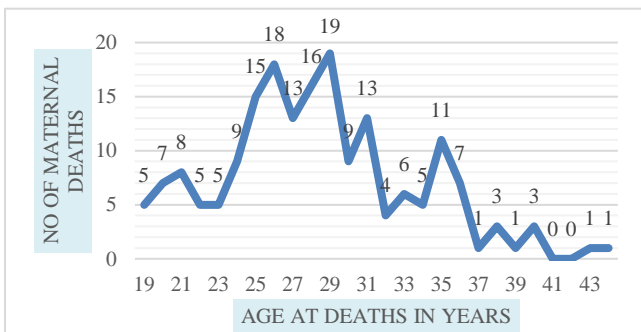


Figure 1: Number of maternal deaths as per age (in years).

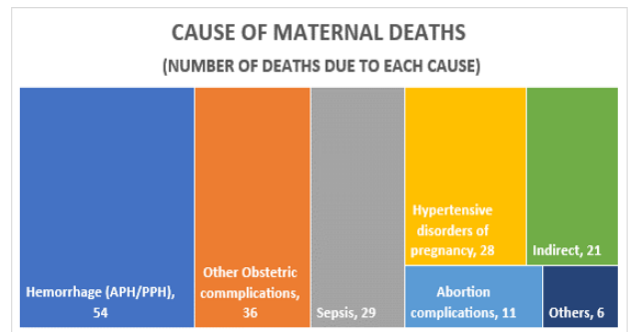


Figure 2: The relative contribution of causes for maternal deaths.

DISCUSSION

Maternal mortality rate can be taken as a proxy indicator for the overall functioning of health systems in that area in general and specifically is a good indicator to judge the quality of service provision for its disadvantaged sections. Maternal mortality remains as unfortunate event as it occurs as a consequence of a normal physiological process, causes deaths in young and productive women and severely impacts the survival of new-born. Most available evidence suggests that almost all maternal deaths are preventable and interventions already exist, which if implemented with greater scientific thought can lead to a rapid decline in maternal mortality.

We conducted this study in a unique geographical area of Jammu and Kashmir located in the north of India. Almost all the maternal and child health indicators of the area are much better than national averages of India. We listed all the maternal deaths over a two year period (April 2020 to March 2022) and calculated maternal mortality ratio using standard formulas. The cause of deaths was also identified as per ICD-10 classification and categorized into direct and indirect causes for maternal mortality.

We estimate that Jammu and Kashmir had a MMR of 47 over the two year study period. The period witnessed 185 maternal deaths and 3.97 lakh live births. The latest National level health survey estimates the national MMR to be 103. MMR estimated in the present study puts MMR of Jammu and Kashmir to be comparable to multiple southern Indian states like Telangana (MMR of 56) and Andhra Pradesh (MMR of 58) but higher than states of Kerala (MMR of 30) and Maharashtra (MMR of 38). As SRS provides both national Infant mortality rates as well as individually for Jammu and Kashmir and the IMR of Jammu and Kashmir is significantly lower than national average, we expect the same trend for MMR as most interventions for reducing MMR overlap with that for IMR.^{19,20} The lower fertility rate, higher institutional delivery rates and better coverage of other evidence based interventions can be a reason for lower MMR in Jammu and Kashmir.^{21,22}

Post partum haemorrhage was the most common cause of death with 29.2% deaths being contributed by Ante and post-partum haemorrhage. The other common causes of death were obstetric complications, sepsis and hypertensive disorders of pregnancy. Multiple other studies have also identified haemorrhage (ante and post-partum) to be the most common cause of maternal deaths.²³⁻²⁵ PPH is one of the most common complication after delivery and can rapidly lead to death. Although a common complication, PPH can be managed by the existing strategies like active management of third stage of labour and close observation after delivery to identify PPH early. The study area has one of the highest prevalence of anaemia with more than 2/3rd of women in reproductive age group having anaemia.¹³ The state needs to focus on decreasing the prevalence of anaemia using life cycle

approach to decrease the burden of post-partum haemorrhage. Hypertensive disorders of pregnancy contributed to 15.1% (28/182) of maternal deaths. This finding is in consistent with multiple other studies who also found hypertensive disorders to contribute around 1/6th of maternal deaths.^{26,27} Enhanced screening in the last trimester particularly blood pressure and urine examination is critical in preventing these deaths. The national ante-natal care guidelines do include screening for pregnancy induced hypertension in addition to management of pre-eclampsia and eclampsia.²⁸ There is a need to identify risk factors early and implementing better management of pregnancy induced hypertension. Indirect causes contributed to 11.4% (21/182) of deaths and prompt action to thoroughly understand these causes of death and develop appropriate responses is crucial to continue global progress in maternal mortality reduction.²⁹

The mean age at death was 27.8 years±5.57 with almost half of the deaths occurring between the age of 25-30 years. The age distribution is comparable to multiple previous studies which have also seen this age group contribute to most number of deaths.^{19,30} As the death is related to pregnancy and child birth, the age at death is expected to be closely correlated with the marital norms in the community. Most of the women who died were literate with more than half of women having at least secondary level education. The death of young educated women explains why maternal deaths are considered an important indicator health inequity.

Most of the deaths were contributed by general population category which was in proportion to the proportion of general category (caste) at population level. Post-natal period was the most critical period with almost 2/3rd deaths occurring in the post-partum period. Other studies have also concluded that the time around delivery and the period immediately after delivery is the most common time period for maternal deaths.^{19,30} Keeping in view that almost all deliveries happen with health facilities, there is a great opportunity to address deaths during delivery and within the early post-natal period as the patient is under the care of health systems. Strengthening of health systems and provision of essential care around birth interventions can go a long way in further decreasing maternal mortality.^{8,20}

The primary limitation of this study was that data regarding maternal deaths was taken from routine surveillance data, in which there is a chance of under reporting. The degree of under reporting could also vary among districts. In addition, there are chances of recall bias among respondents regarding the clinical history at the time of death.

CONCLUSION

Although Jammu and Kashmir's MMR is lower than the sustainable development goals target, some districts still have an MMR of more than 70, indicating a wide inter-

district variation. Moreover, there is still room for improvement in reducing the MMR at the cumulative level and preventing maternal deaths that could have been avoided. The causes of maternal deaths are similar to those at the national level and in other low and middle income countries, with PPH, eclampsia, and obstetric complications being the main culprits. Given the availability of multiple evidence-based interventions to address these causes, we recommend expanding the coverage of basic maternal and child health interventions.

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