

Maternal Mortality in the Remote Islands of India— Unraveling the Conundrum

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ABSTRACT

Introduction: Reduction in maternal mortality has been a top priority in low- and lower middle-income countries of Asia-Pacific region. India, being one of them, has a major responsibility of reducing maternal mortality especially in light of the commitment on the part of the Sustainable Development Goals. Despite massive efforts and availability of technology needed to avert maternal deaths, the maternal mortality ratio (MMR) in India continues to be high especially in remote areas. This study aims at collecting the MMR data and analyzing in the context of island infrastructure. **Material and Methods:** This was a hospital-based cross-sectional study. The records of maternal deaths from January 2010 to December 2019 were collected from the medical record section and analyzed. **Results:** The MMR was estimated to be 95.63 per 100,000 live births. Majority of the patients were multigravida (82%) in the age group of 21 to 30 years (75%). Around 64% of them were referred cases. Majority (86%) of the deaths occurred in the postpartum period. Hemorrhage was the leading direct cause of maternal deaths (35.7%) followed by hypertensive disorders of pregnancy (HDP) (21.4%). **Conclusion:** Most maternal deaths are preventable. Early detection of high-risk pregnancies and early referral of such patients to a well-equipped center is the key to curb the catastrophe of mortality. Adopting methods like qSOFA (quick sequential organ failure assessment) for identifying patients requiring intensive care and miniPIERS (Preeclampsia Integrated Estimate of RiSk) model for predicting adverse outcome in HDP is the need of hour. More efforts should be made to retain the specialists in the islands.

Keywords: Eclampsia, intensive care unit, maternal mortality, PIERS, qSOFA: quick Sequential (Sepsis-related) Organ Failure Assessment, three delays

Introduction

Maternal mortality is an important index to assess social progress, cultural, and economic development in a nation. It is also a major indicator to reflect the quality of work on maternal and child health care.^[1] Reducing maternal mortality has been a crucial global and national priority since the Safe Motherhood

Conference held in Nairobi in 1987.^[2,3] Despite the recognition of maternal mortality and morbidity as a grave public health issue, a total of 2,95,000 maternal deaths worldwide were reported by World Health Organization (WHO) in 2017. Most of these deaths (94%) occurred in resource-poor countries, and a large number could have been prevented.^[4] India adopted the Millennium Development Goals (MDGs) and had made far reaching progress in recent years in bringing down the maternal mortality ratio (MMR) by 77%, from 556 per 100,000 live births in 1990 to 130 per 100,000 live births in 2016.^[3] At present, India's MMR is below the MDG target and thereby it becomes important to achieve the Sustainable Development Goal (SDG) of an MMR

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Received: 10-07-2021

Revised: 01-12-2021

Accepted: 16-12-2021

Published: 16-02-2022

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_1365_21

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How to cite this article: Yadav A, Prakash A, Sharma C, Saha MK, Yadav S, Baghel J, *et al.* Maternal mortality in the remote Islands of India—Unraveling the conundrum. J Family Med Prim Care 2022;11:733-8.

below 70 by 2030.^[5] The National Institution for Transforming India (NITI Aayog) with its “Team India hub” and “Knowledge and Innovation Hub” has shown intense commitment in planning ways to reduce the MMR below the target.^[6]

According to WHO, maternal death is defined as “the death of a woman while pregnant or within forty-two days of termination of pregnancy, irrespective of the duration and site of pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.” MMR is defined as the number of maternal deaths during a given time period per 100,000 live births during the same time period.^[7] Causes of maternal deaths are varied and are highly dependent on the factors like infrastructure, manpower present in the area, and also on the relief and connectivity of that area. The common causes are obstetric hemorrhage, pregnancy-related infection, hypertensive disorders of pregnancy (HDP), unsafe abortion, and obstructed labor. Around 80% of maternal deaths are due to direct causes occurring during pregnancy, labor, and puerperium, and 20% are due to indirect causes.^[4] Most of the maternal deaths can be averted if expectant mothers receive care from skilled professionals in facilities with adequate equipment and supplies and if they have access to emergency obstetric care.^[8]

In low resource and developing countries, maternal mortality has been attributed to the “three delays”: delay in deciding to seek care, delay in reaching care in time, and delay in receiving adequate treatment. The first delay occurs due to inability of the mother, family, or community in recognizing a life-threatening condition. The second delay is in reaching a health-care facility and may be due to poor connectivity, lack of transportation, or unfavorable location. The third delay occurs at the health care facility when upon arrival, women receive inadequate care, or inefficient treatment.^[9,10] Hence, the primary care physicians have a great role here to timely identify those cases who require specialized care and refer them timely.

The Andaman and Nicobar Islands, a Union Territory, is located approximately 1200 km away from the mainland. The islands have a dense network of health infrastructure, spread all over in the form of one referral hospital, two district hospitals, five urban health centers, four community health centers (CHC), 22 primary health centers (PHC), and 122 subcenters.^[11] There is only one tertiary referral center in the whole island catering the entire population.

National health policy 2017 proposed the target of achieving antenatal care (ANC) coverage and skilled attendance at birth above 90% by 2025.^[12] As per District Level Household and Facility Survey-4 (DLHS 4), Andaman and Nicobar Islands have the ANC registration rate of 90.6% and the institutional delivery rate of 93.9%.^[13] But against the backdrop of such glorifying statistics, there are matters of serious concerns. The island's health care system is riddled with a perpetual manpower and network crisis. The specialists from mainland India are not too keen to come and serve in such remote places. At the same time,

referral of high-risk cases requires their transportation through helicopters or ship from far off islands. However, despite all the adversities, the medical college located in the capital has efficiently catered to all eventualities.

This study determined the trends and demographic changes in maternal deaths over the past 10 years from January 2010 to December 2019 so that valuable measures can be taken to improve the statistics. It also highlights the importance of primary care physicians who are the first checkpoints for the pregnant women. It is they who first screen the high-risk cases from among the cohort of pregnant women and guide them for specialized care.

Materials and Methods

Study design

Retrospective Cross-sectional Observational Study.

Study duration

Ten years (2010–2019)

Study setting

This study was conducted at a tertiary care center catering to the health needs of the whole island. The research was conducted in accord with prevailing ethical principles and reviewed by the hospital administration and the institutional ethics committee.

Data collection

The study included collecting and analyzing the details of maternal deaths that occurred at the hospital during the study period of 10 years (2010–2019). The medical records of women from the maternity ward, labor room, medical, and surgical Intensive care Units (ICU) were reviewed and operative notes and death records were summarized. Demographic variables like age, parity, booking status, education, and pregnancy details like gestational age, delivery details, complications, any interventions done, causes of death, and admission to death interval were studied.

We excluded maternal deaths that occurred 42 days after the termination of pregnancy and due to accident, homicide, or suicide. Data were collected retrospectively from 2010 to 2019 from the Medical records department of the hospital. Since it was a retrospective observational study, there was no interference in the management of the patients. Statistical analysis was done using Statistical Package for Social Sciences software version 22. Descriptive statistics are presented as numbers and percentages. The data are expressed as mean and standard deviation.

Results

There were 28 maternal deaths, 32,431 deliveries, and 29,278 live births reported during the study period. The estimated MMR in

each year varied with a range between 37 and 211 per 100,000 live births. Table 1 shows the annual distribution of the MMR. The overall, 10-year MMR was found to be 95.63 per 100,000 live births.

A fluctuating trend with two peak periods in 2015 and 2019 was observed as shown in Figure 1. Table 2 shows the baseline demographic details of the study population. The maximum number (21/28; 75%) of maternal deaths occurred in the age group of 21 to 30 years. The majority were multipara (23/28; 82.1%). Approximately, 64.3% (18/28) of the women were referred for the first time from the other far off islands with 3 being from Car Nicobar. Around 50% of women who died had undergone lower segment caesarean section. The majority (85.8%) of the deaths were occurred in the postpartum period.

Figure 2 depicts the various causes of maternal deaths. Among direct causes, death due to hemorrhage was the leading cause being 35.7% (10/28), followed by HDP 21.4% (6/28). Among indirect causes, 7.1% of women died because of anemia and underlying cardiovascular pathology.

Admission to death interval analysis showed that 32.1% of women died in less than 24 h of admission to the hospital as shown in Table 2. All of them received ICU care and supportive treatment. Eighteen patients received multiple blood products and 4 patients required dialysis. Surgical interventions in the form of relaparotomy and hysterectomy were done in total of 9 patients.

Discussion

There is a paucity of published studies on maternal mortality (hospital or community based) in the Andaman and Nicobar Islands. This study utilized the hospital information in understanding and analyzing the pattern and causes of maternal mortality. Although situated far away from the mainland, these islands are far ahead of many of the Indian states in terms of reproductive health.

The 10-year MMR for the island was found to be 95.63 per 100,000 live births which is significantly lower than the national value of 130/100,000 live births and far better as compared

with the MMR of 383/100 000 live births in 9 empowered action group states in India.^[14] Various Indian studies in the past 15 years have demonstrated a wide variation in MMR ranging from 47/100,000 to 625/100,000 births.^[15-17]

In this study, the maximum number (21/28, 75%) of maternal deaths occurred in the age group of 21 to 30 years. Similar findings have also been reported by other Indian studies.^[7,18,19] This can be explained as the highest number of births are reported in this age group. Moreover, in many communities and regions, early marriage and early child birth still prevails.^[20] In contrast, a study by Khumanthem *et al.*^[21] shows the highest number of maternal deaths in the age group of 30 to 40 years. It is important, therefore, to involve the primary care physicians in educating the women importance of small family and promoting family planning services and pre- and post-natal care services to reduce maternal mortality among women of reproductive age group.

Our study highlights the fact that the majority of deaths (23/28, 82.1%) occurred in multigravida women. Similar results of 74%, 75%, 71%, and 60% were observed in other studies also.^[18,21-23] However, in one study,^[7] primiparas were accounted for 74% of deaths. This variation in studies suggests that every pregnancy, irrespective of the order, carries the risk of maternal mortality.

Although illiteracy is closely related to maternal mortality, none of the women in this study were illiterate. This was a major difference from many other Indian studies where the majority of

Table 1: Year-wise distribution of live births, maternal deaths, and maternal mortality ratio

Year	Live births	Number of maternal deaths	MMR
2010	3220	3	93.16
2011	3225	3	93.02
2012	3115	2	64.20
2013	3192	0	0
2014	3028	3	99.07
2015	2842	6	211.11
2016	2700	2	74.07
2017	2659	3	112.82
2018	2638	1	37.90
2019	2659	5	188.04
Total	29278	28	95.63

MMR- Maternal mortality ratio per 100,000 live births

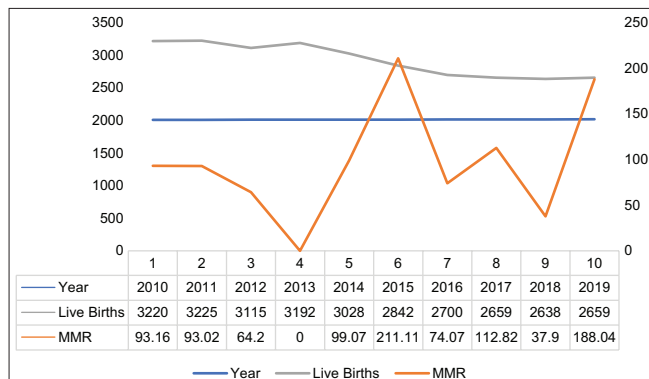


Figure 1: The fluctuating trend of maternal mortality

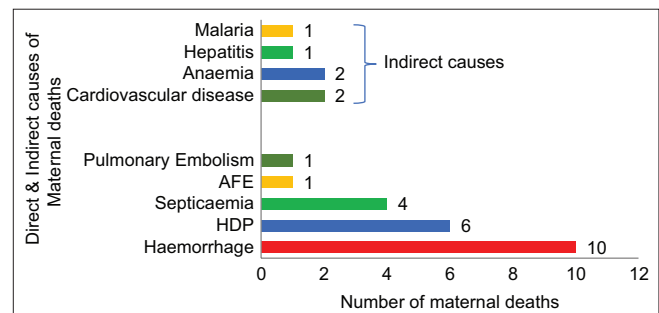


Figure 2: Distribution of direct and indirect causes of maternal deaths

Table 2: Baseline demographic details of the study population

Characteristics	Groups	Maternal death n=28 (%)
Age (Years)	<20	0 (0)
	21-30	21 (75)
	31-40	07 (25)
	>40	0 (0)
Parity	Primigravida	5 (17.9)
	Multigravida	23 (82.1)
Antenatal care coverage	Booked	10 (35.7)
	Unbooked	0 (0)
	Referred	18 (64.3)
Residence	Rural	23 (82.1)
	Urban	05 (17.9)
Education	Literate	28 (100)
	Illiterate	0 (0)
Gestation age (weeks)	<20	0 (0)
	20-37	9 (32.1)
	>37	19 (67.9)
Delivery Status	Delivered at index institution	19 (67.9)
	Delivered outside	7 (25)
	Undelivered	2 (7.1)
Mode of Delivery (n=26)	Vaginal	11 (42.3)
	Instrumental	2 (7.7)
	LSCS	13 (50)
Health Facility admission	Routine	0 (0)
	Emergency	28 (100)
Admission-death interval (hours)	<24	9 (32.14)
	24-48	2 (7.14)
	48-72	3 (10.71)
	>72	14 (50)

maternal deaths were among illiterate women.^[15,21] Possibly, this factor could have contributed to the lower MMR in this study as compared with national statistics.

There were many Indian studies where the majority of maternal deaths were among the unbooked patients.^[15,18,21–23] However, this was not the case in this study where none of the patients were unbooked. Sreekumari *et al.*^[24] also reported the similar observation. This emphasizes that not just booking but early detection of risk factors and timely referrals are very important to decrease morbidity and mortality. Antenatal care should not just be a visit, but an opportunity for women to know the risks associated with pregnancy and the need to discuss as well as plan their options for further professional care.

Our hospital, being the only tertiary referral center of the island, caters all referral cases from far off peripheral islands. Interestingly, the referral procedure is not that smooth and easy, as it is in mainland owing to its geographical location. The administration needs to facilitate air referral or sea referral through ships where road transport facility is not available. This aspect definitely matters, as most (18/28, 64.3%) of the women in our study who unfortunately could not survive were referred from the peripheral islands suggesting a lag in the time

taken to reach the tertiary center. It is similar to other studies where the percentage of referred cases was 85% and 63.8%, respectively.^[7,25] This further indicates the importance of prompt and timely referrals. Moreover, the 24 h caesarean section facility and blood bank facility are not available in peripheral islands which lead to delay in treatment. Most women referred from far-off places were in poor general condition at the time of admission.

India being a developing country is struggling to provide health care services for a large dispersed, mainly rural, and inaccessible population with a high fertility rate. With the efforts of NITI Aayog, as many as five islands of Andaman and Nicobar group of islands have been identified for sustainable development. For improving air connectivity, necessary actions have been taken to make Diglipur Airport operational for civilian aircraft, which is now ready to use.^[6]

In this study, 86% of deaths occurred in the postpartum period. This is consistent with the findings documented by other studies.^[7,22,23,25] Some complications may appear during labor or postpartum period, hence intense monitoring is needed in the fourth stage of labor and the postpartum period.

Admission to death interval analysis showed that 32% of women expired within the first 24 h of admission, whereas 50% of women died after a week of admission to the hospital. The findings are in accordance with the study done by Shobha G *et al.*,^[7] where 41% of women expired within a week. In contrast, another study revealed 60% of deaths occurring within the first 20 h.^[21]

As far as the causes are concerned, 78.57% of maternal deaths in our study were due to direct obstetrical causes and 21.43% due to indirect causes. Among the direct causes of death, the majority were due to hemorrhage (45.45%) followed by HDP (27.27%). Hemorrhage was also the leading cause of maternal death in other Indian studies.^[21,26,27] However, there are few exceptions where equal contribution by hemorrhage and eclampsia has been reported,^[14] while HDP was found to be the major cause of maternal mortality in some studies.^[28,29] A recent study also assessed the national and regional trends and causes-specific distribution of maternal mortality in India. The authors concluded that the leading causes of maternal death were obstetric hemorrhage (47%; higher in poorer states), pregnancy-related infection (12%), and HDP (7%).^[30]

On analyzing our dataset, we observed that early detection of preeclampsia, optimum monitoring, use of antihypertensives and magnesium sulphate, as well as timely referral and delivery could have helped reduce the incidence. The newer risk prediction models for adverse outcomes of preeclampsia have recently come up which could decrease the frequency of deaths due to HDP. The miniPIERS (Preeclampsia Integrated Estimate of RiSk) model is a simple tool to identify women at risk of death or major complications of preeclampsia who need immediate intervention.^[31] It is based only on maternal clinical symptoms

and signs and does not rely on laboratory parameters, hence can be implemented in use at PHCs also. The primary care physicians can be trained to apply these models practically and implement in their day to day practice.

On the other hand, it was also noticed that the women who died of hemorrhage related cause had reached our institution very late or in the stage of irreversible shock. For such patients, shock index (Heart rate/systolic blood pressure) can be a useful guide. A score of <0.9 indicates that the risk of massive resuscitation is low and >1.4 indicates urgent intervention or stabilization or transfer to tertiary facility if the patient is at PHC.^[29] In addition, use of Non-Pneumatic anti shock garments while transferring the patients from distant places can also prove beneficial. Basic procedures like active management of the third stage of labor, early detection of postpartum hemorrhage, appropriate use of oxytocins, intravenous fluids, blood and blood products, and timely surgical intervention has been enforced in use time and again as a crucial step to prevent hemorrhage related maternal deaths. Such training programmes need to be continued. In this study, the major indirect causes were attributed to anemia and cardiovascular disorders followed by hepatitis and malaria.

Another pearl in the ICU care is obstetrically modified quick Sequential (sepsis related) organ failure assessment (qSOFA) scores, which need only clinical data to assess for need of ICU care and therefore delay due to biochemical reports can be avoided.

This study has some limitations. Being retrospective in nature, the information collected from medical records could be prone to misclassification or misreporting of the causes of death depending on who certified the death. Moreover, since only hospital data were analyzed, it might not give a true imagery of the situation in the community. For a more comprehensive overview of maternal deaths in the region, a larger study including the district and rural hospitals would be required. Considering the paucity of data from the islands, the information provided by this study may be utilized for planning, implementing, and evaluating current and future safe-motherhood interventions and research.

Conclusions

Improving and upgrading the referral centers, better internet and communication facilities, and proper transport system in the islands is the need of the hour. Empowerment of nurses, medical officers, and primary care physicians through quality education, clinical exposure, and skill development is the most urgent necessity at places where availability of specialists is an issue. In the remote islands, where distance becomes a major issue for referral, there is a need for retention of doctors in the islands and motivation of specialists to work in a team so that unnecessary referrals can be curtailed. Telemedicine will be a boon for such remote and poorly connected areas.

Further strengthening of peripheral hospitals with more blood and blood component storage facilities, use of risk prediction

models like “miniPIERS” and “qSOFA,” better ICU care, provision of round the clock specialists in anesthesia, critical care, and cardiology is mandatory to achieve the level targeted by SDG.

Key messages

- Early detection of high-risk pregnancies and early referral of such patients to a tertiary center is the key to curb the catastrophe of mortality.
- This study highlights that risk prediction models like miniPIERS and qSOFA should be routinely followed in clinical practice for deciding immediate interventions.
- In the remote islands, where distance becomes a major issue for referral, there is a need for retention of doctors in the islands and motivation of specialists to work in a team so that unnecessary referrals can be curtailed.

Individual Author’s Contribution: AY and CS designed the project proposal. AY, CS, AP, SY and MKS dealt with the cases directly and collected the clinical data. AY, AP, JB and AK wrote the manuscript. CS revised the manuscript and introduced graphical representations. AY and MKS did final proof reading and approved the final manuscript. All of the authors read and approved the final manuscript.

Acknowledgments

We acknowledge all the staff of maternity unit, ICU and Operation theatre of Andaman and Nicobar Islands Institute of Medical Sciences, Port Blair, who directly or indirectly supported in patient care. We also Acknowledge the Medical Records section staff who helped in data retrieval.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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