

Neonatal Mortality in India: A District-Level Analysis Using Health Management Information System data

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Abstract: Study aims to investigate the state and district wise scenario of neonatal deaths within 24hrs and up to 4 weeks and examined the causes of neonatal deaths in India. We used Health Management Information System (HMIS) data which is the official service statistics data source of the Ministry of Health and Family Welfare (MoHFW), Government of India. The HMIS provides the neonatal deaths occurred in first 24hrs after live births in the health facility and also reported deaths up to 4 weeks. The study aims to analyse the neonatal deaths and causes of neonatal deaths at the district and state level. Altogether, more than one-fourth (26%) of neonates died in the first 24hrs considering the total neonatal deaths after live birth. Jammu & Kashmir and Arunachal Pradesh (63% each), Sikkim (41%), Uttar Pradesh (36%), Haryana (35%), Nagaland and Tripura (34% each) and Jharkhand (33%) have higher neonatal deaths within 24hrs to the total neonatal deaths in India. About 15 percent of neonatal deaths are caused due to Asphyxia and Sepsis is found to be the second major cause of neonatal deaths in India. Study concludes that districts having higher early neonatal deaths may be targeted for policy implications.

Keywords: Neonatal deaths, Causes of deaths, EAG, HMIS, India.

Introduction

Globally, about 50 percent decline has been observed in newborn deaths during 1990 to 2019 (WHO, 2019; Hug et al., 2019). Majority of deaths of under-5 mortality occurred within the first four weeks of life and around one-third neonates die on the same day of birth (WHO, 2019; IIPS and ICF, 2017; Knippenberg et al., 2005; Lawn, Cousens, and Zupan, 2005; Arokiasamy and Gautam, 2008; Singh, Kumar, and Kumar, 2013; Singh, Kumar, and Singh, 2019). Neonatal death is one of the major health issue and it share the major burden of infant and under-5 mortality in low-middle income countries including India (Knippenberg et al., 2005; WHO, 2019; Arokiasamy and Gautam, 2008).

In developing countries like India more than 50 percent infant deaths occur in the first month of life out of total infant deaths every year and 40 percent of neonatal deaths happen during labour or the first 24 hours after birth (UNICEF 2020; The Million Death Study Collaborators 2010). Mainly, the endogenous factors determined the probability of the death of the newborn in India. In fact, 37 percent of all neonatal deaths are due to the prematurity or low birth weight (The Million Death Study Collaborators, 2010). Low birth weight, preterm birth, intrapartum-related complications, infections and birth defects are major causes of

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neonatal deaths (WHO 2019). The Sustainable Development Goals (SDGs) - 3.2.1 ensure to end the preventable deaths of newborn children and all countries aim to reduce the neonatal mortality to at least as low as 12 per 1000 live births by 2030 (United Nations, 2018). Subsequently, the National Health Policy (NHP) of India target to reduce the neonatal mortality to 16 per 1000 live births by 2025 (Government of India, 2017). However, the targets of SDGs and NHP for reduction of neonatal mortality is going to be missed considering the recent updates. For instance, the fourth round of National Family Health Survey (NFHS-4) revealed that 30 newborn died per 1000 live births in India (IIPS and ICF, 2017).

The early diagnosis of medical complications and intensive medical care after live birth may improve the survival of neonates. In the larger perspective neonatal deaths are underestimated which is a great hurdle for reducing infant mortality in India. Although, the government has introduced several policies and schemes to improve the maternal and child health indicators including the neonatal health indicators but the efforts are lacking and henceforth the neonatal deaths are high across India. The present study aims to analyse the extent of neonatal deaths within 24hrs and up to 4 weeks at the state and district level in India using Health Management Information System (HMIS) data which is service statistics facility-based data. Additionally, we examine the causes of neonatal deaths at the State level in India. The findings of this study highlights the districts and states having higher neonatal deaths in India which may contribute to prepare the necessary policy implications.

Data source and methodology

The HMIS data source is the official data source of the Ministry of Health and Family Welfare (MoHFW), Government of India. HMIS provides the consolidated public and private health facility-based service statistics on mother and child health programmers, physical infrastructure, human resources at health facilities, equipment and drugs and information on implementation of various health schemes of the government. The data is consolidated and extracted from all public health facilities including Health Sub-Centre, Primary Health Centre, Community Health Centre, Sub-divisional Hospital and District Hospital in India. Along with the public health facilities the government has also instructed to all private institutions providing health services to follow the government guidelines for updating the service statistics to HMIS web portal. For the present study we have used HMIS data of the year 2019-20 and for the same year we have estimated causes of neonatal deaths. The HMIS data source is established data source for the reproductive, maternal and child health indicators which also covered four data elements associated with the neonatal deaths including: 1) Infant deaths within 24hrs 2) Infant deaths up to 4 weeks due to Sepsis 3) Infant deaths up to 4 weeks due to Asphyxia and 4) Infant deaths up to 4 weeks due to Other causes. Percent of neonatal death within 24hrs and total neonatal deaths are estimated at both state and district level for the year 2019-20. The QGIS software is used to highlight the districts having higher neonatal deaths in India. The death of a newborn before completing 4 weeks of life is defined as a neonatal death.

Results

The neonatal deaths within 24hrs and up to 4 weeks at the state level in India is presented in the Table 1. Altogether, more than one-fourth (26%) of neonates died in the first 24hrs considering the neonatal deaths after live births. The State level analysis shows that Jammu & Kashmir and Arunachal Pradesh (63% each), Sikkim (41%), Uttar Pradesh (36%), Haryana (35%), Nagaland and Tripura (34% each) and Jharkhand (33%) have higher neonatal deaths within 24hrs to the total neonatal deaths in India (Table 1). Considering the Union

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Territories, Lakshadweep (50%), Daman & Diu (36%) and Chandigarh (33%) have the highest neonatal deaths within 24hrs after live births. The estimation of neonatal deaths depicted that 853 newborns died per 100 000 live births in India. State level estimates shows that Jammu & Kashmir has the highest (2182) neonatal deaths per 100 000 live births in India. Subsequently, Madhya Pradesh (1743), Haryana (1592), Rajasthan (1564), Assam (1507), Odisha (1458) and Meghalaya (1438) have higher neonatal deaths per 100 000 live births. Chandigarh (3101) as a Union Territory has the highest neonatal deaths per 100 000 live births in India. Similarly, Dadra & Nagar Haveli have 2044 neonatal deaths per 100 000 live births (Table 1).

Table 1: Neonatal deaths and neonatal deaths (within 24hrs) at State level in India (2019-20)

States/Union Territories	Percent contribution of neonatal deaths (< 24hrs) to total neonatal deaths	Neonatal deaths to live births (per 100 000 live births)	Total Neonatal Deaths (N)	Total Live Births
Andhra Pradesh	20.5	961	7,080	7,36,774
Arunachal Pradesh	62.3	295	61	20,668
Assam	21.2	1507	9,053	6,00,797
Bihar	29.8	318	6,726	21,14,235
Chhattisgarh	19.4	1123	5,384	4,79,404
Goa	16.8	546	101	18,491
Gujarat	20.8	1226	14,081	11,48,115
Haryana	35.2	1592	8,136	5,11,004
Himachal Pradesh	30.8	1075	950	88,410
Jammu & Kashmir	62.6	2182	4,176	1,91,384
Jharkhand	32.5	519	3,794	7,31,400
Karnataka	19.9	813	7,305	8,98,459
Kerala	21.7	239	1,109	4,64,423
Madhya Pradesh	26.6	1743	24,453	14,03,115
Maharashtra	24.2	711	12,776	17,96,217
Manipur	29.7	231	91	39,462
Meghalaya	31.4	1438	1,285	89,378
Mizoram	21.2	962	198	20,577
Nagaland	34.5	535	110	20,574
Odisha	23.9	1458	9,223	6,32,591
Punjab	26.8	424	1,600	3,77,525
Rajasthan	20.8	1564	21,321	13,62,923
Sikkim	40.9	306	22	7,188
Tamil Nadu	19.8	718	6,763	9,42,471
Telangana	16.4	298	1,891	6,33,699
Tripura	33.5	1104	567	51,339
Uttar Pradesh	36.2	223	9,061	40,71,547
Uttarakhand	33.1	551	839	1,52,300
West Bengal	29.7	1298	16,301	12,56,150
Union Territories				
Andaman & Nicobar Islands	27.3	1216	44	3,618
Chandigarh	33.2	3101	867	27,957
Dadra & Nagar Haveli	11.3	2044	195	9,539
Daman & Diu	35.7	690	28	4,059
Delhi	23.5	1155	3,276	2,83,719
Lakshadweep	50.0	470	4	851
Puducherry	13.4	693	298	43,023
India	26.0	853	1,79,169	2,10,00,000

Causes of neonatal deaths

The state wise different causes of neonatal deaths in India are presented in Table 2. The HMIS data reported that about 47 percent of neonatal deaths caused due to the Other causes in India. State level results shows that more than half of the neonatal deaths in Punjab (60%), Telangana (58%), Uttarakhand (57%), Rajasthan and Chhattisgarh (56% each), Goa (55%), Kerala and Jharkhand (54% each), Madhya Pradesh (53%), Himachal Pradesh (52%) and Haryana (51%) occurred due to the Other causes (Table 2). Further, 15 percent of neonatal deaths are caused due to Asphyxia in India. The state level analysis depicts that more than two-

fourth of newborn died in Assam (27%), Andhra Pradesh, Manipur and Nagaland (26% each). Further, more or less one-fifths neonates died due to the Asphyxia in Odisha and Tamil Nadu (21% each), West Bengal and Karnataka (20% each), Mizoram (18%) and Uttar Pradesh (17%). Likewise, the Sepsis has found to be the second major cause of neonatal deaths in India followed by Asphyxia. About 12 percent of neonatal deaths are occurred due to the sepsis in India. Further, the state level analysis shows that 18 percent neonatal deaths in Nagaland and Goa happened due to the sepsis followed by Mizoram (17%), Andhra Pradesh (16%), Jammu & Kashmir, Karnataka and West Bengal (15% each). The union territory including Delhi and Puducherry (26% each) have the highest neonatal deaths due to the sepsis in India.

Table 2: Different causes of neonatal deaths at State level in India (2019-20)

States/Union Territories	Neonatal deaths due to Sepsis (%)	Neonatal deaths due to Asphyxia (%)	Neonatal deaths due to Other causes*	Total Neonatal Deaths
Andhra Pradesh	16.2	25.8	37.5	7,080
Arunachal Pradesh	9.8	16.4	11.5	61
Assam	11.6	26.8	40.5	9,053
Bihar	6.6	15.3	48.4	6,726
Chhattisgarh	8.7	15.8	56.0	5,384
Goa	17.8	9.9	55.4	101
Gujarat	13.3	16.8	49.2	14,081
Haryana	7.5	6.2	51.1	8,136
Himachal Pradesh	8.5	8.7	51.9	950
Jammu & Kashmir	15.0	5.2	17.1	4,176
Jharkhand	5.7	8.2	53.5	3,794
Karnataka	15.2	19.6	45.2	7,305
Kerala	9.8	14.5	53.9	1,109
Madhya Pradesh	9.1	11.3	53.0	24,453
Maharashtra	13.9	15.2	46.7	12,776
Manipur	4.4	26.4	39.6	91
Meghalaya	13.8	12.0.0	42.8	1,285
Mizoram	17.2	18.2	43.4	198
Nagaland	18.2	25.5	21.8	110
Odisha	13.2	21.0	41.9	9,223
Punjab	7.1	6.1	59.9	1,600
Rajasthan	12.8	10.1	56.2	21,321
Sikkim	13.6	9.1	36.4	22
Tamil Nadu	13.8	20.5	45.9	6,763
Telangana	14.7	10.6	58.3	1,891
Tripura	10.1	15.3	41.1	567
Uttar Pradesh	7.9	17.3	38.6	9,061
Uttarakhand	5.2	4.8	56.9	839
West Bengal	15.1	19.5	35.6	16,301
Union Territories				
Andaman & Nicobar Islands	11.4	20.5	40.9	44
Chandigarh	11.6	8.4	46.7	867
Dadra & Nagar Haveli	4.1	13.3	71.3	195
Daman & Diu	7.1	10.7	46.4	28
Delhi	25.8	15.5	35.2	3,276
Lakshadweep	0	25.0	25.0	4
Puducherry	25.5	15.8	45.3	298
India	12.0	15.4	46.6	1,79,169

*As per HMIS guidelines, any baby who died after first 23 hrs and on/before 28th day and the cause did not confirm with any of the above 2 causes (sepsis, asphyxia) should be indicated as death due to other causes

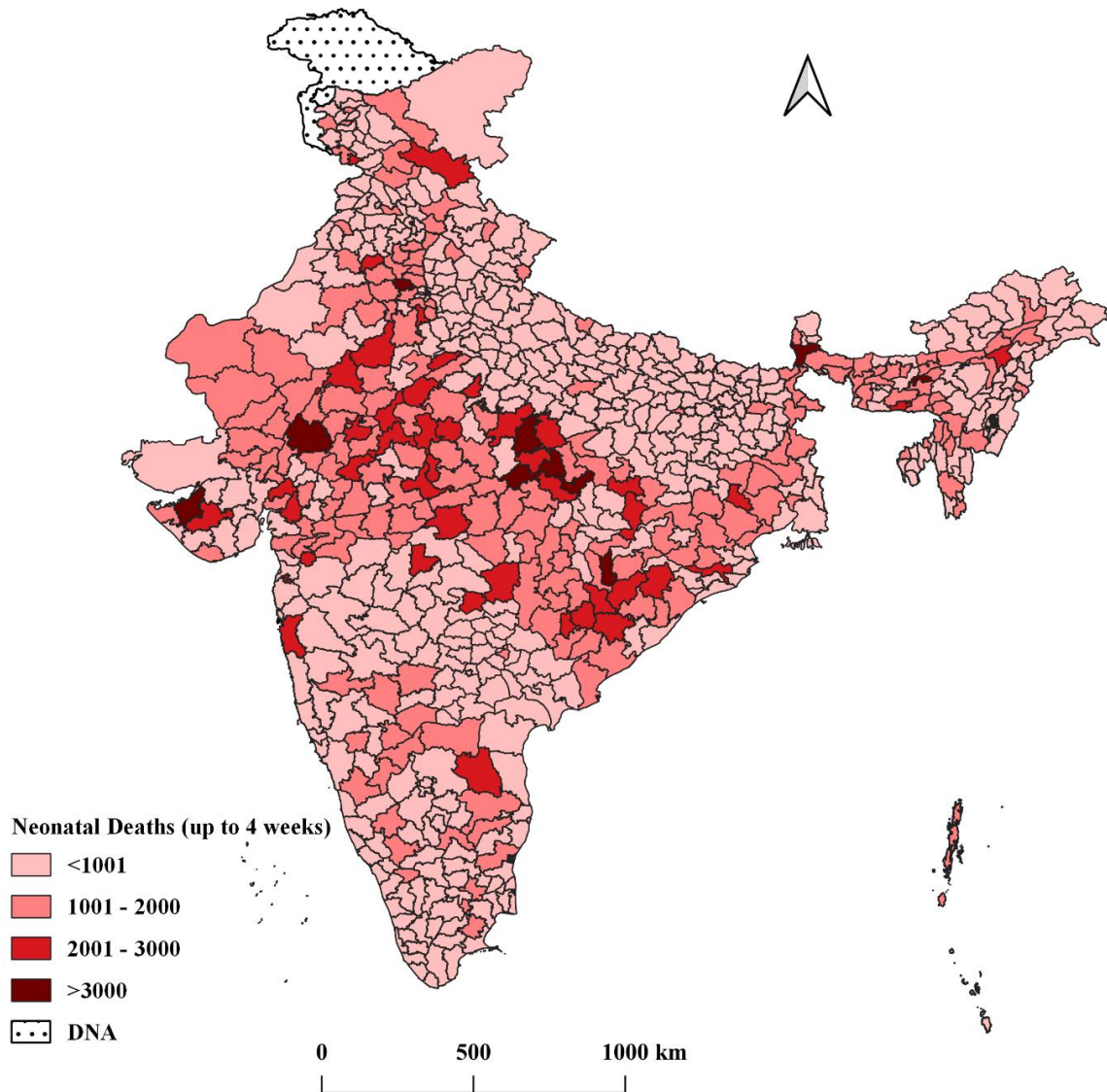
District wise neonatal deaths

The Map 1 illustrates the district wise neonatal deaths in India. Majority of the districts from EAG states including Madhya Pradesh, Chhattisgarh, Jharkhand, Odisha and Rajasthan have more than 1000 neonatal deaths per 100 000 live births (Map 1). Particularly, 13 districts of Madhya Pradesh, 6 districts of Odisha, Rajasthan (5 districts), Chhattisgarh and Gujarat (4 districts each) and Maharashtra (3 districts) have neonatal deaths more than 2000 per 100 000

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live births. Four districts of Madhya Pradesh including Jabalpur (3075), Anuppur (3086), Panna (3472) and Umariya (3479) have neonatal deaths more than 3000 per 100 000 live births. Similarly, Kamrup metropolitan (3973) of Assam, Jamnagar (4128) of Gujrat, Naupada (3073) of Odisha, Udaipur (3361) of Rajasthan and Darjeeling (3160) from West Bengal have more than 3000 neonatal deaths per 100 000 live births.

Map 1: District wise Neonatal Deaths in India

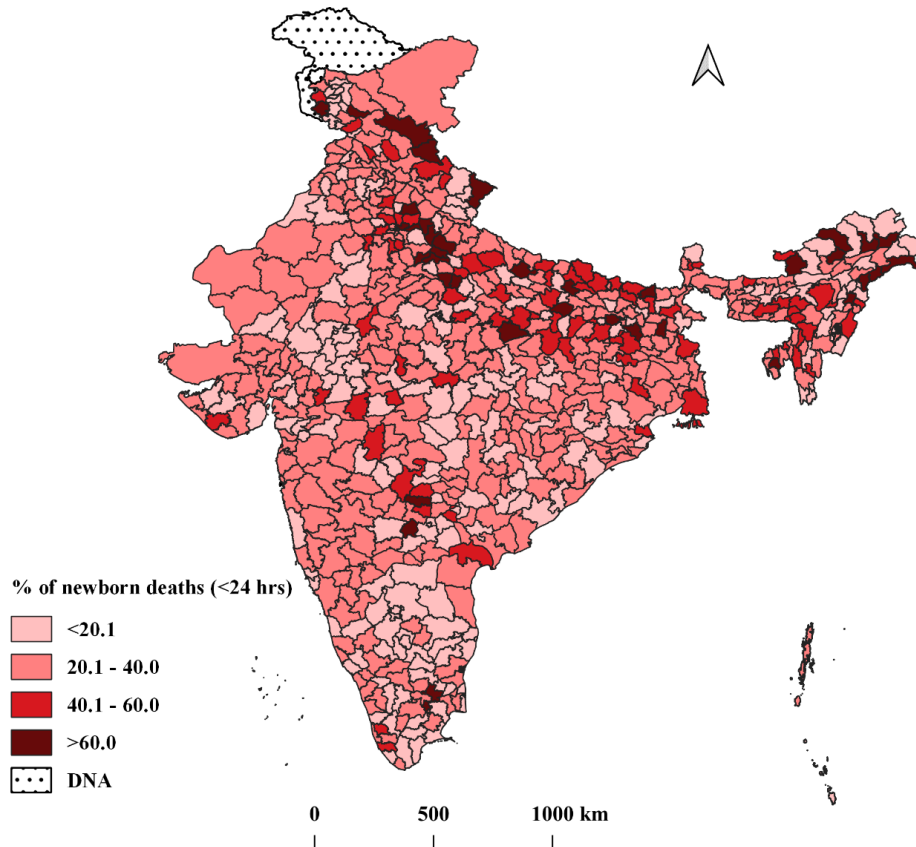


District wise percent of neonatal deaths (< 24 hours) to total neonatal deaths

The Map 2 shows the percent of deaths of neonatal less than 24 hours to total neonatal deaths in India. At the national level more than one-fourths of neonatal died within the first 24hrs of life. The study reported the state level considerable variation in reporting the neonatal deaths within 24hrs in india. Likewise, districts have similar variation while considering the neonatal deaths in India. Total 73 districts out of 704 HMIS districts in India have more than

50 percent neonatal deaths within 24hrs of their life. Further, considering the districts having highest percent (70%) deaths within 24hrs are 18 districts where seven are from Uttar Pradesh. Which includes Auraiya (85%), Deoria (81%), Gonda (88%), Hapur (100%), Mahamaya Nagar (96%), Muzaffarnagar (86%) and Sambhal (100%). Likewise, Arunachal Pradesh has six districts with more than 70 percent neonatal deaths within 24hrs of life. Districts including Changlang (100%), Lower Dibang Valley (80%), Lower Subansiri (100%), Tirap (100%) and Upper Kameng (100%).

Map 2: District wise percent of neonatal deaths (< 24 hours) to total neonatal deaths



Conclusion and policy recommendations

Child mortality has been steeply declining over the past few decades in India, government's maternal and child health-oriented policies and programs have substantial contribution in the reduction of maternal and child health indicators (Singh, Kumar, and Singh 2019; Bora and Saikia 2018). Recent studies highlighted that though there is a reduction in the child mortality over the period; however, neonatal mortality remained a major contributor and tolling higher deaths of newborns. To bring the child and infant mortality down significantly, government has to targets and focus on the regions which require additional support and identify the socio-economic determinants that may help in further reduction in child and neonatal mortality. In this context, the attempt was made to see the present situation of the neonatal mortality in India and districts which are reporting higher early neonatal deaths in India. Findings of the study highlighted that more than one-fourths (26%) of neonatal died in the first 24hrs considering the neonatal deaths after live birth. Jammu & Kashmir and

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Arunachal Pradesh (63% each), Sikkim (41%), Uttar Pradesh (36%), Haryana (35%), Nagaland and Tripura (34% each) and Jharkhand (33%) have higher neonatal deaths within 24hrs to the total neonatal deaths in India. Further, deaths depicted that 853 neonatal died per 100 000 live births in India. The Jammu & Kashmir has a highest (2182) neonatal deaths per 100 000 live births in India followed by Madhya Pradesh (1743), Haryana (1592), Rajasthan (1564), Assam (1507), Odisha (1458) and Meghalaya (1438).

The causes of deaths show that more than half of the neonatal deaths are occurred in Punjab, Telangana, Uttarakhand, Rajasthan, Chhattisgarh, Goa, Kerala, Jharkhand, Madhya Pradesh, Himachal Pradesh and Haryana due to the Other causes. Further, 15 percent of neonatal deaths occurred due to Asphyxia in India. The district wise neonatal deaths in India demonstrate that majority of the districts from EAG states including Madhya Pradesh, Chhattisgarh, Jharkhand, Odisha and Rajasthan have more than 1000 neonatal deaths per 100 000 live births. On the other hand, one-fourth of neonatal deaths occurred within the first 24hrs of life in India. Altogether, total 73 districts out of 704 HMIS districts in India have more than 50 percent neonatal deaths within 24hrs of life. Further findings show that districts such as Auraiya, Deoria, Gonda, Hapur, Mahamaya Nagar, Muzaffarnagar, and Sambhal of Uttar Pradesh followed by Changlang, Lower Dibang Valley, Lower Subansiri, Tirap and Uppar Kemeng of Arunachal Pradesh have higher burden of neonatal deaths within 24 hrs.

In the past two decades the government of India has introduced a number of policies and programs to improve the maternal and child health indicators. However, the results are not much promising but have satisfactory outcomes. The fourth round of the National Family Health Survey (NFHS-4) show that 30 neonatal are dying for per 1000 live births in India. Which is considered to be still higher as per the Sustainable Development Goals (SDGs) 3.2.1 (reduce newborn mortality to at least as low as 12 per 1000 live births). The National Rural Health Mission (NRHM) was proven to be a milestone in the Indian health system where major health issues were addressed through systematic policy implications and introducing issue based programmes. The Newborn Care Corner (NBCC) - 2011, Newborn Stabilization Unit (NBSU) - 2011, Special Newborn Care Unit (SNCU) and Navjaat Shishu Suraksha Karyakram (NSSK) - 2009, were introduced to prevent the infection, identification and prompt referral of 'at risk' and 'sick' newborn, manage the low birth weight babies and follow-up of all babies discharged from the unit & high risk newborns. Along with this, the government had few policies and programmes for pregnant and delivered women to improve the maternal and newborn health. The introduction of Janani Shishu Suraksha Karyakram (JSSK) - 2011, Janani Suraksha Yojana (JSY) – 2005, Integrated Management of Neonatal and Childhood Illness (IMNCI) - 2003, Facility Based-Integrated Management of Neonatal and Childhood Illness (F-IMNCI) - 2009, Home Based Newborn Care (HBNC) - 2011, Pradhan Mantri Matru Vandana Yojana (PMMVY) - 2017 were among those programmes which have significantly contributed into the improvement of maternal and child health indicators. In the conclusion, the study highlights that more than one-fourth of neonatal deaths are occurring within the 24hrs after the live birth in India. Districts having higher neonatal and early neonatal deaths in India may be targeted for policy implications for improving the neonatal indicators.

Limitation

The HMIS data is information of service delivered through the public health facilities in India and it does not provide the information on the socio-economic and demographic characteristics of the people accessing the services.

Availability of data and materials

The data used for the study is obtained from the web portal of Health Management Information System (<https://nrhm-mis.nic.in/SitePages/Home.aspx>). No separate ethical statement and consent for publication was required for this study as the HMIS collect the secondary data from the health facilities of India.

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References

- Arokiasamy Perianayagam, and Gautam A., 2008, “Neonatal Mortality in the Empowered Action Group States of India: Trends and Determinants.” *Journal of Biosocial Science* 40 (2): 183–201. <https://doi.org/10.1017/S0021932007002623>.
- Government of India, 2017, “National Health Policy.” New Delhi. https://www.nhp.gov.in/nhpfiles/national_health_policy_2017.pdf.
- Hug Lucia, Alexander Monica, You Danzhen, and Alkema Leontine, 2019, “National, Regional, and Global Levels and Trends in Neonatal Mortality between 1990 and 2017, with Scenario-Based Projections to 2030: A Systematic Analysis.” *The Lancet Global Health*. [https://doi.org/10.1016/S2214-109X\(19\)30163-9](https://doi.org/10.1016/S2214-109X(19)30163-9).
- IIIPS and ICF, 2017, “National Family Health Survey (NFHS-4), 2015-16.” Mumbai.
- Knippenberg Rudolf, Lawn Joy E., Darmstadt Gary L., Begkoyian Genevieve, Fogstad Helga, Walegign Netsanet, and Paul Vinod K., 2005, “Systematic Scaling up of Neonatal Care in Countries.” *Lancet* 365 (9464): 1087–98. [https://doi.org/10.1016/S0140-6736\(05\)74233-1](https://doi.org/10.1016/S0140-6736(05)74233-1).
- Lawn Joy E., Cousens Simon, and Zupan Jelka, 2005, “4 Million Neonatal Deaths: When? Where? Why?” *Lancet*. [https://doi.org/10.1016/S0140-6736\(05\)71048-5](https://doi.org/10.1016/S0140-6736(05)71048-5).
- Singh Abhishek, Kumar Kaushalendra, and Singh Ashish, 2019, “What Explains the Decline in Neonatal Mortality in India in the Last Three Decades? Evidence from Three Rounds of NFHS Surveys.” *Studies in Family Planning* 50 (4): 337–55. <https://doi.org/10.1111/sifp.12105>.
- Singh Aditya, Kumar Abhishek, and Kumar Amit, 2013, “Determinants of Neonatal Mortality in Rural India, 2007-2008.” *PeerJ* 1 (e75). <https://doi.org/10.7717/peerj.75>.
- The Million Death Study Collaborators, 2010. “Causes of Neonatal and Child Mortality in India: A Nationally Representative Mortality Survey.” *The Lancet* 376 (9755): 1853–60. [https://doi.org/10.1016/S0140-6736\(10\)61461-4](https://doi.org/10.1016/S0140-6736(10)61461-4).
- UNICEF, 2020, “Neonatal Mortality.” UNICEF Data: Monitoring the Situation of Children and Women. 2020. <https://data.unicef.org/topic/child-survival/neonatal-mortality/>.
- United Nations, 2018, “The Sustainable Development Goals Report-2018.” New York.
- WHO. 2019. “Newborns: Improving Survival and Well-Being.” World Health Organisation. 2019. <https://www.who.int/news-room/fact-sheets/detail/newborns-reducing-mortality>