



Maternal Mortality and Women's Nutritional Status in India: An Inter-State Analysis in the Context of Sustainable Development Goals

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Abstract: Maternal mortality and women's nutritional status are important indicators of population health and are closely linked to the achievement of the Sustainable Development Goals, particularly SDG 2 and SDG 3. This study examines the progress and inter-state variations in maternal mortality in India and assesses the relationship between women's nutritional status and maternal mortality across States and Union Territories. The findings indicate that the national maternal mortality indicator declined from 22.58% in 2016 to 19.17% in 2021, with a historical rate of change of 3.33, suggesting overall improvement in maternal health outcomes. However, substantial inter-state disparities remain. States such as Himachal Pradesh, Haryana, Madhya Pradesh, Manipur, Nagaland and Uttarakhand recorded notable improvements, whereas some States and Union Territories showed an increase in the maternal mortality indicator during the study period. The study further examines the association between the nutrition indicator and maternal mortality in 2021. The Pearson correlation coefficient of $r = 0.676$ ($p < 0.001$) indicates a statistically significant and moderately strong positive association between the two indicators. This finding suggests that States with higher values of the selected nutrition indicator also tend to report higher maternal mortality, depending on the construction and direction of the nutrition indicator.

Keywords: Maternal mortality, women's nutritional status, Sustainable Development Goals, India.

1. INTRODUCTION:

The pursuit of global human development reached a historic milestone on September 25, 2015, when all 193 Member States of the United Nations adopted the 2030 Agenda for Sustainable Development. This agenda introduced a comprehensive framework of 17 Sustainable Development Goals (SDGs), encompassing 169 targets and over 230 global indicators. The SDGs emerged as a necessary evolution of the preceding Millennium Development Goals (MDGs, 2000–2015). While the MDGs were highly successful in initiating global momentum toward poverty reduction, child survival, and maternal health, they were critiqued for their narrow focus—primarily targeting developing nations and focusing heavily on basic survival. The SDG framework corrected this by being fundamentally universal, applying equally to both developed and developing nations. More importantly, the SDGs recognize that sustainable development cannot be achieved in silos. They seamlessly integrate the economic, social, and environmental dimensions of human progress. At the heart of the 2030 Agenda is the guiding principle to "Leave No One Behind." This principle demands that developmental benefits reach the most vulnerable and marginalized populations—including women, children, adolescents, tribal communities, and economically disadvantaged groups—thereby addressing the deep-rooted socio-economic inequalities that the MDGs left unresolved.

Among the 17 goals, Sustainable Development Goal 3 occupies a uniquely central position, founded on the recognition that health is both an outcome of sustainable development and a fundamental prerequisite for achieving all other goals. SDG-3 boldly aims to "Ensure healthy lives and promote well-being for all at all ages". The transition to SDG-3 represents a paradigm shift in global public health. Rather than merely focusing on the absence of disease or preventing premature death, SDG-3 adopts a comprehensive life-course approach. This means healthcare interventions are designed to begin before birth and continue continuously through childhood, adolescence, adulthood, and old age.

Maternal health is universally recognized as a vital barometer of a nation's overall healthcare system, socio-economic development, and commitment to gender equity. Under the 2030 Agenda for Sustainable Development, Sustainable Development Goal 3 explicitly targets the reduction of the global Maternal Mortality Ratio (MMR) to fewer than 70 maternal deaths per 100,000 live births. MMR is defined as the death of a woman during pregnancy, childbirth, or within 42 days of termination of pregnancy, and it directly reflects the efficacy of emergency obstetric care, skilled birth attendance, and the broader healthcare infrastructure.

While improved healthcare access is crucial, biological readiness for pregnancy is heavily dictated by nutritional status. Nutrition operates on an intergenerational continuum. The nutritional health of children and adolescents directly shapes their physical development, subsequently determining their health as adult women and expecting mothers. Despite robust economic growth, India faces a persistent public health challenge concerning malnutrition.

Nutrition acts as a core catalyst. High maternal mortality in specific Indian states cannot be fully understood or mitigated without analyzing the intersecting crisis of malnutrition. A high prevalence of anemia and under nutrition almost invariably correlates with heightened maternal risks. To effectively strategize for the achievement of SDG-3 by 2030, policymakers require robust empirical evidence mapping how closely a state's nutritional deficits align with its maternal mortality burden.

This study examines maternal mortality and women's nutritional status in India, focusing on differences across states and the relationship between nutrition and maternal deaths. The following are the objectives of study:-

1. To analyze the trends in Maternal Mortality Ratio (MMR) across Indian state
2. To examine the relationship between women's nutritional status and maternal mortality across Indian states

2. RESEARCH METHODOLOGY:

The study examines India's progress towards Sustainable Development Goal 3 with special reference to maternal mortality, child and adolescent mortality, and nutrition. The study is based entirely on secondary data collected from official government reports, national surveys and recognised institutional sources. The principal sources include the National Family Health Survey , Sample Registration System , NITI Aayog, Ministry of Health and Family Welfare, Ministry of Statistics and Programme Implementation and other relevant Government of India publications.

The selected sources provide information relating to maternal mortality, child and adolescent mortality and nutritional conditions. The data for 2016, 2021 and 2024 have been compiled and organised according to the availability and comparability of the indicators. The data have subsequently been analysed to assess changes across States and Union Territories and to evaluate India's progress towards SDG-3. To achieve the objectives of the study, both descriptive statistical techniques and the Historical Rate of Change (HRC) method have been used. These techniques help assess India's progress toward Sustainable Development Goal 3 by analysing changes in Maternal Mortality Ratio (MMR), Neonatal Mortality Rate (NMR), Adolescent Birth Rate (ABR), and nutrition indicators over time.

The following tools and techniques have been applied:

1. **Estimate Historical Rate of Change**
2. **Coefficient of Correlation**

3. RESULTS AND DISCUSSION:

3.1 Maternal Mortality Rate

Maternal health is one of the most significant indicators used to measure the effectiveness of a country's healthcare system and its progress toward achieving Sustainable Development Goal 3 (Good Health and Well-being). Maternal mortality reflects the quality of healthcare services available to women during pregnancy, childbirth, and the postnatal period. A reduction in maternal mortality demonstrates improvements in antenatal care, institutional deliveries, skilled birth attendance, emergency obstetric care, nutrition, and overall healthcare infrastructure. Therefore, analysing maternal mortality provides valuable insights into the success of public health policies and maternal healthcare programmes implemented across India. The present table compares the percentage of maternal mortality across Indian States and Union Territories between 2016 and 2021 and presents the corresponding rate of change during this period. The table therefore provides an important basis for evaluating India's progress toward SDG Target 3.1, which aims to reduce maternal mortality and ensure safe motherhood by 2030.

Table 3.1. State wise maternal mortality ratio in India (2016-2021)

State / UT	2016(%)	2021(%)	Historical Rate of change
Andhra Pradesh	9.66	10.77	-2.15
Arunachal Pradesh	28.34	22.21	5.00
Assam	25.44	21.40	3.52
Bihar	45.61	37.21	4.15
Chhattisgarh	24.70	20.21	4.09
Goa	7.14	1.88	30.59
Gujrat	14.77	12.72	3.03
Haryana	23.86	16.83	7.23
Himachal Pradesh	17.42	12.51	6.85
Jharkhand	33.07	29.75	2.14
Karnataka	12.36	12.58	-0.35
Kerala	1.73	3.30	-12.12
Madhya Pradesh	29.38	21.40	6.54
Maharashtra	15.95	15.32	0.81
Manipur	17.66	12.26	7.57
Meghalaya	31.70	32.39	-0.43
Mizoram	16.11	11.32	7.31
Nagaland	33.05	22.15	8.33
Odisha	19.49	14.83	5.62
Punjab	12.70	14.24	-2.26
Rajasthan	26.33	21.17	4.46
Sikkim	5.42	6.72	-4.21
Tamil Nadu	6.70	3.31	15.15
Telangana	10.87	13.17	-3.77
Tripura	13.49	16.07	-3.44
Uttar Pradesh	35.44	30.03	3.37
Uttarakhand	28.54	20.42	6.93
West Bengal	14.38	11.43	4.70
Chandigarh	11.05	7.32	8.59
Delhi	15.20	10.07	8.58

Jammu & Kashmir	12.73	7.58	10.93
Lakshadweep	6.50	2.11	25.24
Puducherry	4.13	3.32	4.46
India	22.58	19.17	3.33

Source: Based on National Family Health Survey (NFHS-4,2015-16 and NFHS-5, 2019-21

Table 3.1 show the progress in maternal mortality in India between 2016 and 2021. At the national level, the maternal mortality indicator declined from 22.58% in 2016 to 19.17% in 2021. The HRC for India is 3.33, indicating an overall declining trend in the maternal mortality indicator during the study period. Thus, the progress graph demonstrates that India experienced an improvement in maternal health outcomes between 2016 and 2021.

The decline at the national level was accompanied by considerable variation among individual States and Union Territories. Several states recorded substantial reductions in their maternal mortality indicator. For instance, Himachal Pradesh declined from 17.42% in 2016 to 12.51% in 2021, with an HRC of 6.85. Similarly, Haryana, Madhya Pradesh, Manipur, Uttarakhand, Nagaland and Odisha also recorded relatively high positive HRC values, indicating a considerable decline over the study period. However, the improvement was not uniform across all States and Union Territories. Some states recorded increases in their maternal mortality indicator, as reflected by negative HRC values. Kerala, for example, increased from 1.73% in 2016 to 3.30% in 2021, resulting in an HRC of -12.12. Similarly, Sikkim, Telangana, Tripura, Punjab, Andhra Pradesh, Meghalaya and Karnataka recorded negative HRC values. These results indicate that the direction of change varied across regions and that national-level improvement did not translate into uniform improvement in every State and Union Territory

3.2 Correlation between Nutrition and Maternal Mortality

Maternal nutrition is one of the strongest determinants of maternal survival. The nutritional condition of a woman before conception, during pregnancy, and after childbirth directly affects both maternal health and pregnancy outcomes. Women suffering from chronic undernutrition, iron deficiency, anaemia, protein deficiency, and inadequate micronutrient intake are at a much greater risk of developing pregnancy-related complications. These complications include severe anaemia, haemorrhage, pregnancy-induced hypertension, infections, obstructed labour, premature delivery, and maternal death. The nutritional indicators included in this study, particularly anaemia among women aged 15–49 years and maternal nutritional status, demonstrate the importance of adequate nutrition in reducing maternal mortality. Anaemia reduces the oxygen-carrying capacity of blood, increases physical weakness, lowers immunity, and reduces the body's ability to withstand complications during childbirth. Consequently, anaemic mothers are more vulnerable to life-threatening complications.

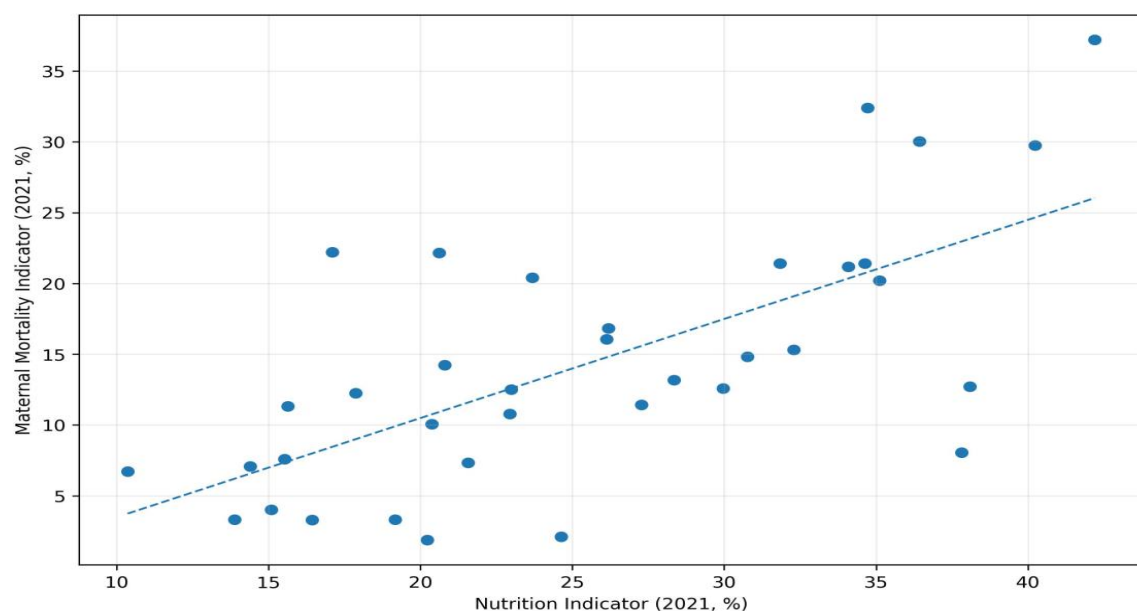
The comparative analysis indicates that states with better nutritional conditions generally report lower maternal mortality, whereas states experiencing higher levels of anaemia and poor maternal nutrition continue to experience relatively higher maternal mortality. Better nutrition improves maternal immunity, promotes healthy fetal development, reduces obstetric complications, and enhances recovery after childbirth. Therefore, nutrition exhibits a strong negative relationship with maternal mortality. As nutritional conditions improve, maternal mortality tends to decline, contributing directly to the achievement of SDG Target 3.1. Government programmes such as Poshan Abhiyaan, Pradhan Mantri Matru Vandana Yojana, Anaemia Mukh Bharat, Integrated Child Development Services, and regular antenatal nutritional supplementation have significantly contributed towards improving maternal nutritional status in India. However, regional disparities in nutrition remain an important challenge that continues to influence maternal health outcomes.

Table 3.2. State wise ratio of the nutrition indicator and maternal mortality indicator (2021)

State/UT	Nutrition Indicator (%)	Maternal Mortality Indicator (%)
Andhra Pradesh	22.94	10.77
Arunachal Pradesh	17.10	22.21
Assam	31.83	21.40
Bihar	42.20	37.21
Chhattisgarh	35.12	20.21
Goa	20.23	1.88
Gujarat	38.09	12.72
Haryana	26.19	16.83
Himachal Pradesh	22.98	12.51
Jharkhand	40.23	29.75
Karnataka	29.97	12.58
Kerala	16.44	3.30
Madhya Pradesh	34.63	21.40
Maharashtra	32.29	15.32
Manipur	17.87	12.26
Meghalaya	34.72	32.39
Mizoram	15.63	11.32
Nagaland	20.61	22.15
Odisha	30.77	14.83
Punjab	20.80	14.24
Rajasthan	34.09	21.17
Sikkim	10.36	6.72
Tamil Nadu	19.17	3.31
Telangana	28.35	13.17
Tripura	26.13	16.07
Uttar Pradesh	36.43	30.03
Uttarakhand	23.68	20.42

West Bengal	27.28	11.43
Chandigarh	21.57	7.32
Delhi	20.38	10.07
Jammu & Kashmir	15.52	7.58
Ladakh	14.40	7.07
Lakshadweep	24.63	2.11
Puducherry	13.88	3.32
India	31.52	19.17

Fig.3.1 State-wise Comparison of nutrition and maternal mortality between 2016 and 2021



The analysis of the relationship between the nutrition indicator and Maternal Mortality Ratio (MMR) across Indian States and Union Territories for 2021 shows a positive Pearson correlation coefficient of $r = 0.676$. This indicates a moderately strong positive association between the nutrition indicator used in the study and the maternal mortality indicator. The strength of the correlation suggests that variations in nutritional conditions across States and Union Territories are closely associated with differences in maternal mortality outcomes. The result therefore provides an important indication of the relationship between nutritional status and maternal health during the period under study.

In the context of the present data, higher values of the nutrition indicator are generally associated with higher maternal mortality values. The correlation is statistically significant ($p < 0.001$), which means that the observed relationship is unlikely to have occurred by chance. The statistical significance strengthens the reliability of the observed association and indicates that the relationship between the two indicators is meaningful within the dataset. However, correlation should be interpreted as an association rather than direct evidence of a causal relationship, as maternal mortality can also be influenced by several socioeconomic, demographic, and healthcare-related factors.

This finding supports the argument that nutritional conditions are closely related to maternal health outcomes. States with poorer nutritional conditions tend to report relatively higher maternal mortality, while states with better nutritional outcomes generally perform better in maternal health. For example, states such as Bihar, Uttar Pradesh, Jharkhand, and Meghalaya show comparatively high values for both the nutrition and maternal mortality indicators, whereas Kerala, Tamil Nadu, Goa,

and Sikkim record relatively lower values for both indicators. This variation across States and Union Territories demonstrates that differences in nutritional well-being may be reflected in broader maternal health outcomes. It also highlights the importance of considering nutrition as an integral component of strategies aimed at improving maternal health.

The relationship observed may be associated with the role of adequate nutrition in maintaining women's health before, during, and after pregnancy. Poor nutritional status, particularly deficiencies related to iron and other essential micronutrients, can increase vulnerability during pregnancy and may contribute to adverse maternal health outcomes. At the same time, maternal mortality is influenced by multiple factors, including the quality and accessibility of antenatal care, skilled attendance at birth, timely referral services, availability of emergency obstetric care, anaemia, poverty, education, and regional disparities in healthcare infrastructure. Therefore, improvements in nutrition need to be accompanied by wider improvements in maternal healthcare services. The result highlights the importance of improving maternal nutrition through interventions such as iron and folic acid supplementation, Anaemia Mukta Bharat, Poshan Abhiyaan, improved antenatal care, dietary diversity, and better access to healthcare services. Strengthening these measures can help address nutritional deficiencies and improve the overall health and well-being of women during pregnancy. Greater emphasis on early identification of nutritional risks, regular antenatal monitoring, and access to appropriate maternal health services can further support better outcomes. Overall, the positive and statistically significant correlation observed in 2021 indicates that nutrition and maternal mortality are closely associated across Indian States and Union Territories.

4. CONCLUSION:

The present study concludes that India has achieved measurable progress in improving health outcomes under Sustainable Development Goal 3 during the study period. The decline in maternal mortality, and improvements in nutritional status demonstrate that national health programmes and policy interventions have positively influenced public health. Expansion of institutional deliveries improved antenatal and postnatal care, better maternal and nutrition-focused programmes have significantly contributed to these improvements.

The study further establishes that nutrition is a fundamental determinant of maternal health. States with better nutritional status generally exhibit lower maternal mortality, while states experiencing higher levels of malnutrition continue to face poorer health outcomes. The comparative analysis therefore confirms that improvements in nutrition directly support the achievement of SDG Target 3 by reducing preventable deaths and promoting healthy lives. However, despite encouraging national progress, considerable disparities continue to exist among Indian States and Union Territories. Economically and socially disadvantaged regions continue to face challenges such as inadequate healthcare infrastructure, poverty, anaemia, child malnutrition, limited access to quality healthcare services, and lower female literacy. These inequalities slow overall progress toward the Sustainable Development Goals. Therefore, achieving SDG 3 by 2030 will require sustained investments in healthcare infrastructure, nutrition programmes, women's education, sanitation, universal healthcare access, and effective implementation of public health policies. A comprehensive and integrated approach involving health, nutrition, education, sanitation, and social protection will be essential for ensuring equitable health outcomes across all regions of India.

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