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Trends in Diarrheal Deaths Among Under-Five Children in Karnataka in the Context of Drinking Water and Sanitation Improvements

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Abstract

Diarrhoeal diseases continue to be a significant cause of morbidity and mortality among children under five years of age in developing countries, despite being largely preventable. In India, childhood diarrhoeal mortality reflects wide regional and inter-state disparities linked to socio-economic conditions, access to healthcare, and availability of safe water and sanitation. The present study analyses trends in deaths due to diarrhoea among children aged 0–5 years in India from 2009 to 2019, with a special focus on the state of Karnataka. The study is based on secondary data collected from official sources, including the Ministry of Health and Family Welfare, Government of India, the Department of Health and Family Welfare, Government of Karnataka, India stat database, and the Indian Economic Survey. A descriptive analytical approach was adopted, using simple tables and charts to examine temporal changes, state-wise variations, and regional differences between the northern and southern zones of India. The findings reveal a substantial overall decline in diarrhoea-related child deaths at the national level, indicating the positive impact of public health interventions, improved sanitation, and enhanced child healthcare services. However, periodic spikes and persistent regional disparities, particularly in northern states, highlight ongoing vulnerabilities and uneven implementation of health and sanitation programmes. The study concludes that while India has made notable progress in reducing childhood diarrhoeal mortality, sustained, region-specific strategies focusing on sanitation, safe drinking water, maternal education, and strengthened health systems are essential to achieve equitable child health outcomes across the country.

Keywords: Childhood Diarrhoea, Under-Five Mortality, Regional Disparities, Water and Sanitation, Public Health, India, Karnataka

Introduction

Diarrhoeal diseases remain a major public health challenge and continue to be one of the leading causes of morbidity and mortality among children under five years of age, particularly in developing countries like India. Despite significant global progress in child survival, diarrhoea accounts for a substantial proportion of preventable childhood deaths due to factors such as unsafe drinking water, inadequate sanitation, poor hygiene practices, malnutrition, and limited access to timely healthcare (Black *et al*., 2010; Walker *et al*., 2013) [2, 10]. Young children are especially vulnerable because recurrent diarrhoeal episodes contribute not only to mortality but also to undernutrition, impaired physical growth, and cognitive development.

In the Indian context, diarrhoeal mortality among children aged 0–5 years has historically been high, reflecting deep-rooted socio-economic inequalities and regional disparities in health infrastructure. Studies based on national data sources, including the Million Death Study, have shown that diarrhoea remains a significant cause of under-five deaths, with a disproportionate burden concentrated in northern and central states (Million Death Study Collaborators, 2010) [6]. Although the overall trend indicates a decline in diarrhoeal deaths over the past two decades, the pace of reduction has varied considerably across states due to differences in sanitation coverage, maternal education, poverty levels, and effectiveness of public health interventions (Gupta *et al*., 2015; Rao *et al*., 2018) [4, 8]. Recognising the preventable nature of diarrhoeal deaths, the Government of India has implemented several child health and sanitation programmes, such as the National Rural Health Mission, promotion of oral rehydration salts (ORS) and zinc supplementation, and large-scale sanitation initiatives aimed at improving access to safe water and hygienic living

conditions. Evidence suggests that these interventions have contributed significantly to reducing childhood diarrhoeal mortality, particularly in states with stronger primary healthcare systems and higher social development indicators (Bhan *et al*., 2014; Prüss-Ustün *et al*., 2019) [1, 7]. Southern states like Kerala, Tamil Nadu, and Karnataka have shown more consistent improvements, while northern states continue to experience higher mortality and periodic fluctuations. Against this backdrop, the present study examines the trends and patterns of diarrhoea-related deaths among children aged 0–5 years in India from 2009 to 2019, with a special focus on Karnataka. By analysing secondary data from official sources, the study seeks to highlight temporal changes, inter-state variations, and regional disparities between northern and southern zones. Understanding these patterns is crucial for designing targeted, evidence-based policies aimed at achieving equitable child health outcomes and further reducing preventable deaths due to diarrhoeal diseases in India.

Review of Literature

Several studies have examined the trends, determinants, and policy implications of diarrhoeal mortality among children under five years of age in India. Black *et al*. (2010) [2] identified diarrhoea as one of the leading causes of under-five mortality globally and emphasized that preventable factors such as unsafe water, poor sanitation, and inadequate hygiene practices play a dominant role in developing countries, including India. Similarly, Walker *et al*. (2013) [10] highlighted that improved case management using oral rehydration salts (ORS) and zinc supplementation significantly reduces diarrhoeal deaths, stressing the importance of strengthening primary healthcare systems.

Focusing on India, Million Death Study Collaborators (2010) [6] reported a substantial burden of childhood diarrhoeal mortality, particularly in northern and central states, attributing the variation to socio-economic inequalities, maternal education, and access to healthcare services. Gupta *et al*. (2015) [4] found that states with better sanitation coverage and institutional healthcare delivery experienced sharper declines in diarrhoeal deaths, supporting the role of public health infrastructure in child survival.

Lakshminarayanan and Jayalakshmy (2015) [5] examined the epidemiology of diarrhoeal diseases in India and observed a consistent decline over time, although periodic spikes were associated with monsoon-related water contamination and poor urban sanitation. In a regional study, Bhan *et al*. (2014) [1] emphasized that behavioural interventions, including handwashing practices and safe food handling, are critical complements to medical interventions in reducing diarrhoeal morbidity and mortality.

The role of large-scale government programmes was examined by Spears (2013) [9], who demonstrated that open defecation and inadequate sanitation significantly contribute to child health outcomes in India, particularly in northern states. This finding aligns with Coffey *et al*. (2017) [3], who argued that regional disparities in child mortality persist due to uneven implementation of sanitation and nutrition programmes, despite national-level improvements.

Using secondary data analysis, Rao *et al*. (2018) [8] found that southern states such as Kerala and Tamil Nadu showed more consistent reductions in childhood diarrhoeal deaths compared to northern states, largely due to higher literacy rates, better health awareness, and effective decentralised healthcare systems. More recently, Prüss-Ustün *et al*. (2019) [7] estimated that a significant proportion of diarrhoeal deaths among children could be prevented through universal access to safely managed drinking water and sanitation, reinforcing the need for sustained investments in WASH (Water, Sanitation, and Hygiene) infrastructure. Overall, the literature suggests that while India has made substantial progress in reducing diarrhoeal mortality among children under five, regional disparities remain pronounced. The findings consistently underline the combined importance of healthcare access, sanitation, education, and effective policy implementation in achieving sustained reductions in child mortality.

Objectives of the Study

1. To Study the trends in diarrhea illness in Karnataka
2. To analyze the diarrhea illness State wise inn India

Data Methodology

The present study is based on secondary data covering a period of eleven years from 2009 to 2019 and focuses on diarrhoea-related mortality among children in the age group of 0–5 years in India, with specific reference to Karnataka. The data were collected from published and officially reported sources of the Ministry of Health and Family Welfare, Government of India, and the Department of Health and Family Welfare, Government of Karnataka. Additional supporting information was drawn from the Indiastat database and relevant issues of the Indian Economic Survey to ensure consistency and contextual understanding of national and state-level health trends.

The study adopts a descriptive and analytical research design. Secondary data were systematically compiled, classified, and tabulated to examine temporal and spatial variations in childhood diarrhoeal deaths across states and regions. Simple statistical tools such as tables, percentages, and trend-based charts were used for analysis and interpretation, enabling clear comparison between India and Karnataka as well as between different regions. This method facilitated the identification of long-term trends, inter-state disparities, and zonal differences in child mortality due to diarrhoea. As the study relies entirely on secondary data, its findings are limited to the accuracy and completeness of official records; however, the use of multiple authoritative sources enhances the reliability and validity of the analysis.

Results and Discussion

This section outlines the key results of the study and interprets the observed trends in diarrhoea-related mortality among children aged 0–5 years in India and Karnataka. It highlights temporal changes, regional variations, and state-wise differences over the study period. The discussion links these findings with public health interventions and socio-economic factors influencing child health outcomes.

Table 1: State-wise Number of Deaths of Children (Age Group 0-5 Years) Due to Diarrhoea in India (2010 to 2020) (In Number)

State	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Karnataka	550	290	33	34	26	16	21	23	124	65	61
India	19612	4953	4568	2953	1632	872	942	1004	4184	2715	1609

***Source*:** Indiastat data base

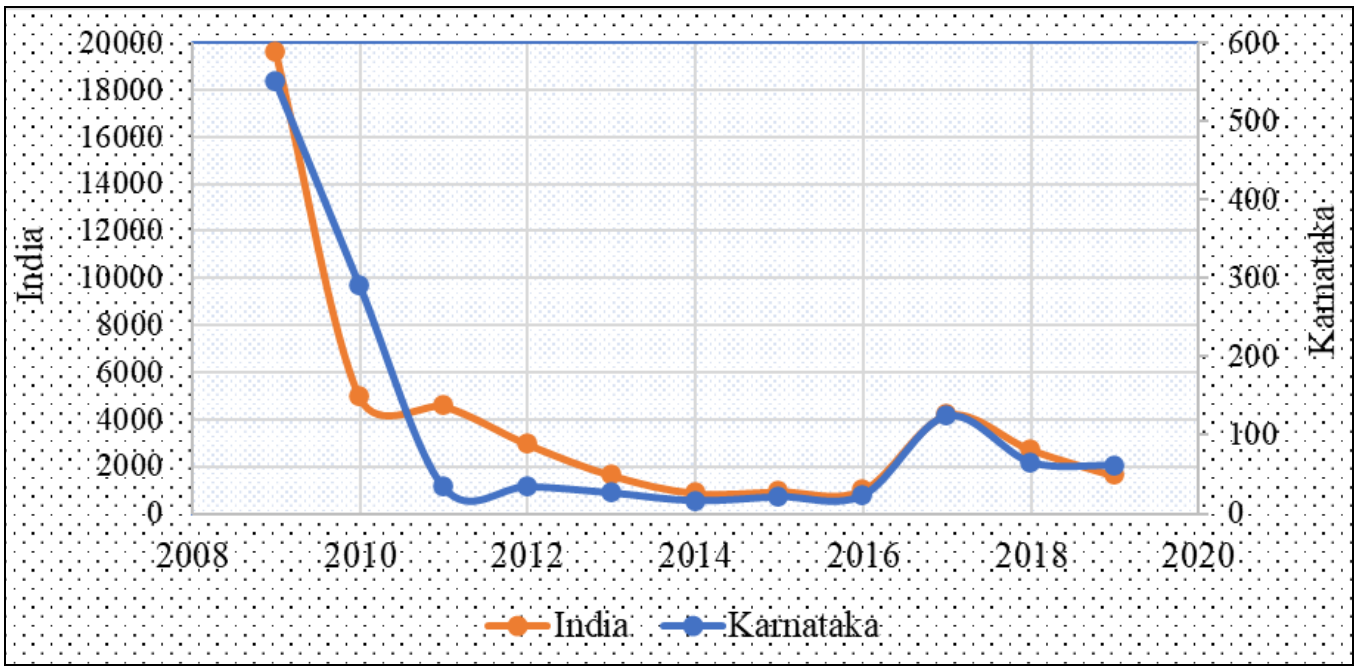

Fig 1: Trends in Deaths of Children (Age Group 0-5 Years) Due to Diarrhoea in Karnataka (2010 to 2020)

The table presents a clear declining trend in deaths of children aged 0–5 years due to diarrhoea in both Karnataka and India from 2009 to 2019, though with some fluctuations in later years. At the national level, diarrhoeal deaths decreased sharply from 19,612 in 2009 to 872 in 2014, reflecting the impact of improved public health interventions such as expanded immunization (including rotavirus vaccine), better access to oral rehydration therapy (ORS), zinc supplementation, and national programmes like the National Rural Health Mission and Swachh Bharat Abhiyan, which strengthened primary healthcare and sanitation coverage. Karnataka mirrors this overall decline, with deaths reducing drastically from 550 in 2009 to as low as 16 in 2014, indicating effective state-level implementation of child health and water–sanitation initiatives. However, the noticeable increase in reported deaths in 2017 at both the state (124) and national (4,184) levels suggests possible factors such as improved reporting mechanisms, localized disease outbreaks, climatic variations (e.g., floods affecting water quality), or temporary disruptions in health services. The subsequent decline by 2019 again points to the resilience and corrective capacity of health systems. Overall, the table underscores that sustained investments in sanitation, safe drinking water, nutrition, and child healthcare have significantly reduced diarrhoeal mortality among young children, while also highlighting the need for continuous surveillance and targeted interventions to prevent episodic reversals in progress.

Table 2: State wise Trends in Deaths of Children (Age Group 0-5 Years) Due to Diarrhoea in India (2010 to 2020) (In Number)

States/UTs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Andhra Pradesh	137	179	155	62	30	7	27	7	77	28	9
Arunachal Pradesh	3	2	8	8	-	2	2	2	10	6	0
Assam	36	38	34	79	49	34	41	39	60	53	26
Bihar	451	248	264	443	259	1	38	143	241	141	66
Chhattisgarh	233	114	52	52	48	51	41	37	138	56	29
Delhi	113	153	28	57	31	90	41	64	69	69	37
Goa	-	-	-	-	-	-	-	-	1	0	0
Gujarat	180	549	466	397	30	30	53	58	927	485	254
Haryana	36	21	1175	150	-	-	-	-	63	196	143
Himachal Pradesh	9	26	38	26	10	9	15	7	24	16	18
Jharkhand	15	12	13	20	14	25	17	32	92	77	105
Karnataka	550	290	33	34	26	16	21	23	124	65	61
Kerala	-	5	-	-	2	-	-	-	114	17	16
Madhya Pradesh	2277	445	486	204	96	111	155	147	328	314	183
Maharashtra	11737	539	814	395	285	59	16	35	81	100	98
Manipur	8	14	11	4	7	9	7	5	9	4	2

Meghalaya	93	101	61	95	114	83	122	99	153	98	40
Mizoram	24	23	11	19	19	17	11	13	11	2	6
Nagaland	16	-	7	7	3	3	5	3	8	8	2
Odisha	1212	799	85	66	36	69	59	34	83	57	37
Punjab	69	85	94	56	55	70	66	55	82	35	39
Rajasthan	937	427	370	482	365	68	90	79	128	260	170
Sikkim	-	3	-	-	-	-	-	-	2	1	0
Tamil Nadu	124	156	117	147	68	48	15	13	129	51	19
Telangana	13	1	4	4	2	3	-	5	116	166	9
Tripura	865	143	126	76	29	1	7	4	5	1	2
Uttar Pradesh	45	11	3	4	6	24	50	38	550	313	198
Uttarakhand	143	554	91	58	32	6	5	8	31	22	16
West Bengal	-	-	-	-	-	32	25	45	514	55	18
India	19612	4953	4568	2953	1632	872	942	1004	4184	2715	1609

***Source*:** Indiastat database

Table 2 reveals a substantial overall decline in diarrhoea-related deaths among children aged 0–5 years in India between 2009 and 2019, alongside pronounced inter-state disparities and intermittent reversals. At the national level, deaths fell steeply from 19,612 in 2009 to 872 by 2014, indicating the effectiveness of expanded child survival interventions such as improved access to oral rehydration salts (ORS), zinc therapy, immunisation, better nutrition, and large-scale water and sanitation initiatives. Most major states-including Maharashtra, Madhya Pradesh, Odisha, Rajasthan, Bihar, Karnataka, and Tamil Nadu-exhibited sharp reductions after 2010, suggesting strengthened primary healthcare delivery and public health outreach. However, several states recorded sudden spikes in later years, notably Gujarat (2017), Uttar Pradesh (2017), West Bengal (2017), Telangana (2017–2018), and Karnataka (2017), which may be attributed to improved death reporting systems, regional disease outbreaks, climatic shocks such as floods affecting drinking water quality, population vulnerability in poorer districts, or temporary health-system disruptions. Smaller states and Union Territories generally reported low and declining numbers, though missing data ("–") in earlier years indicate reporting gaps that limit comparability. The renewed decline at the national level by 2019 (1,609 deaths) underscores continued progress, yet the uneven trends highlight persistent regional inequalities in sanitation, safe water access, maternal education, and healthcare utilisation. Overall, the table demonstrates that while India has made significant strides in reducing childhood diarrhoeal mortality, sustained, state-specific interventions and robust surveillance systems remain essential to prevent periodic setbacks and achieve uniform child health outcomes across states.

A comparison between the southern and northern zones of India highlights marked regional differences in diarrhoea-related mortality among children aged 0–5 years during 2009–2019. The southern zone (Andhra Pradesh, Telangana, Karnataka, Tamil Nadu, and Kerala) generally exhibits lower and more rapidly declining deaths compared to the northern zone (Uttar Pradesh, Bihar, Rajasthan, Haryana, Punjab, Himachal Pradesh, Uttarakhand, and Delhi). Southern states such as Kerala and Tamil Nadu consistently report very low figures, while Karnataka and Andhra Pradesh show sharp declines after 2010, reflecting relatively better performance in public health infrastructure, higher female literacy, wider immunisation coverage, stronger primary healthcare networks, and comparatively better access to safe drinking water and sanitation. In contrast, the northern zone records higher and more volatile mortality levels, with states like Uttar Pradesh, Bihar, and Rajasthan contributing substantially to the national burden in several years, particularly during periodic spikes after 2016. These higher levels can be linked to larger child populations, higher poverty rates, uneven sanitation coverage, lower maternal education, and gaps in timely healthcare access. Although northern states also demonstrate a long-term declining trend, the persistence of fluctuations indicates greater vulnerability to environmental shocks and systemic weaknesses. Overall, the comparison suggests that the southern zone has achieved more consistent and sustainable reductions in childhood diarrhoeal deaths, whereas the northern zone, despite improvements, continues to require intensified, targeted interventions to bridge the regional health divide.

Conclusion

The analysis of state-wise and zonal trends in diarrhoea-related mortality among children aged 0–5 years in India reveals substantial progress over the last decade, alongside persistent regional disparities. At the national level, the sharp decline in deaths reflects the cumulative impact of improved child health interventions, expansion of primary healthcare services, enhanced immunisation, and increased focus on water, sanitation, and hygiene. However, the uneven patterns across states underline that these gains have not been uniformly distributed. The southern zone demonstrates more consistent and sustained reductions in childhood diarrhoeal deaths, largely attributable to stronger health systems, higher literacy levels, and better sanitation coverage. In contrast, the northern zone, while showing an overall downward trend, continues to experience higher mortality levels and periodic spikes, indicating greater vulnerability linked to socio-economic constraints, population pressure, and gaps in healthcare access. These findings emphasise that future reductions in diarrhoeal mortality require not only the continuation of national-level programmes but also targeted, region-specific strategies that address local determinants of child health. Strengthening surveillance systems, improving water and sanitation infrastructure, and prioritising maternal and child health in high-burden northern states are essential to achieving equitable and sustainable improvements in child survival across India.

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