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**DATAWATCH**

# Trends In State-Level Child Mortality, Maternal Mortality, And Fertility Rates In India

*Trends in child mortality, maternal mortality, and fertility in India reveal wide variation across states. As a whole, India performs worse than many other low- and middle-income countries, although its rates of improvement have recently increased. Differences in health systems and adopted policies may account for some of the variation across Indian states.*

**T**here is growing recognition among researchers and policy makers that improvements in child mortality, maternal mortality, and reproductive health—three key United Nations Millennium Development Goals<sup>1</sup>—are tied to improvements in the quality of health care. In their efforts to improve their performance on these metrics, countries often focus on absolute levels of mortality rates and other health outcome measures.<sup>2</sup> However, factors such as geography and idiosyncrasies in a nation’s health care system can play major roles in preventing significant improvements in mortality and morbidity.

To account for these factors, and to measure progress toward the Millennium Development Goals, researchers have recently shifted their attention from absolute levels alone to the evolution of trends or rates of change in health indicators over particular time periods.<sup>3</sup>

Despite substantial economic gains over the past decade, with an impressive compound annual income growth rate of 7.7 percent from 2004 to 2014,<sup>4</sup> India still performs poorly on mortality rates for children under age five, with a national average of 48 deaths per 1,000 live births in 2015 (Exhibit 1).<sup>5</sup>

While India’s under-five mortality rate is about

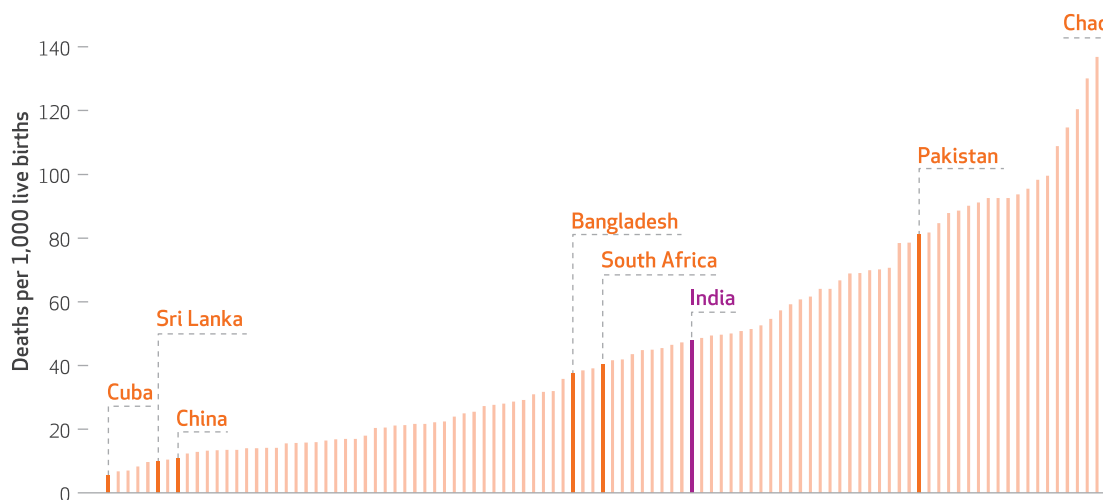
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**EXHIBIT 1**

**Mortality rates for children under age five in 102 low- and middle-income countries, 2015**

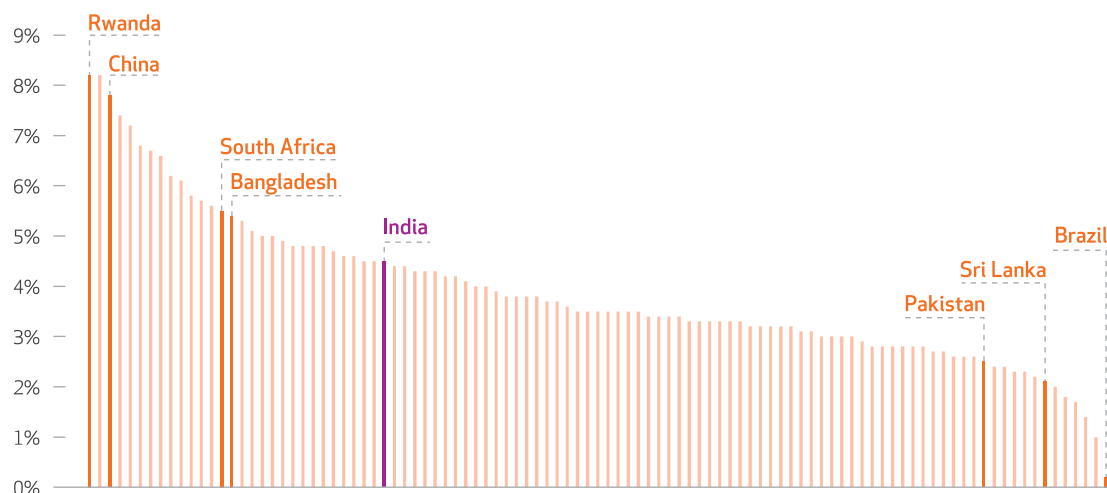


**SOURCE** Authors’ analysis of data from the following sources: United Nations Inter-Agency Group for Child Mortality Estimation; and Office of the Registrar General and Census Commissioner, India. Compendium of India’s fertility and mortality indicators, 1971–2013 (see Note 8 in text). **NOTES** The mortality rates shown are the numbers of deaths per 1,000 live births of children younger than age five in low- and middle-income countries having populations of more than one million and for which data were available in 2015. Levels ranged from 6 deaths per 1,000 in Cuba to 139 deaths per 1,000 in Chad. Other South Asian countries and countries often compared with India are highlighted.

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**EXHIBIT 2**

**Decline in mortality rates from 2010 to 2015 for children under age five in 101 low- and middle-income countries**



**SOURCE** Authors' analysis of data from the following sources: United Nations Inter-Agency Group for Child Mortality Estimation; and Office of the Registrar General and Census Commissioner, India. Compendium of India's fertility and mortality indicators, 1971–2013 (see Note 8 in text). **NOTES** The percentages shown are average annual compound rates of decline in under-five mortality rates in low- and middle-income countries having populations of more than one million and for which data were available in 2010 and 2015. The Appendix provides an explanation of the methodology (see Note 9 in text). Percentages ranged from 8.2 percent in Rwanda to 0.2 percent per year in Brazil. Other South Asian countries and countries often compared with India are highlighted.

**EXHIBIT 3**

**Average annual rates of decline in mortality rates in Indian states from 2005 to 2009 and from 2009 to 2013 for children under age five, and mortality rates in 2013**

State	Rate of decline, 2005–09	Rate of decline, 2009–13	Mortality rate (per 1,000 live births), 2013
Punjab	3.0%	9.4%	31
Tamil Nadu	1.8	8.6	23
Karnataka	2.2	8.5	35
Delhi	— <sup>a</sup>	8.4	26
Maharashtra	6.3	7.8	26
Gujarat	0.0	7.3	45
Haryana	–3.5	6.9	45
Uttar Pradesh <sup>b</sup>	3.1	6.8	64
Average for all states	3.7	6.5	49
Rajasthan	3.5	6.3	57
Bihar	4.7	6.3	54
Jharkhand	— <sup>a</sup>	6.2	48
Madhya Pradesh	1.4	6.2	69
Odisha	1.9	5.9	66
Andhra Pradesh	4.8	5.8	41
Chhattisgarh	— <sup>a</sup>	5.7	53
Jammu and Kashmir	— <sup>a</sup>	5.4	40
Himachal Pradesh	— <sup>a</sup>	5.3	41
Assam	–0.6	4.3	73
Kerala	3.7	3.8	12
West Bengal	9.5	3.3	35

**SOURCE** Authors' analysis of data from Office of the Registrar General and Census Commissioner, India (see Note 8 in text). **NOTES** States are ranked by rate of decline (percent per year) from 2009 to 2013. The Appendix presents an explanation of the methodology (see Note 9 in text). <sup>a</sup>Not available. <sup>b</sup>Undivided Uttar Pradesh (inclusive of Uttarkhand).

average for low- and middle-income countries, its rate of improvement from 2010 to 2015 is slightly above average (Exhibit 2). At the state level, however, India's mortality rates as of 2013 are highly variable.<sup>6</sup> The use of state- and province-level data is critical for impact evaluation and policy analysis, particularly in countries with large and heterogeneous populations such as India, China, and Brazil, whose states or provinces often differ in culture, policy, and the organization of the local health care system—all factors that can affect population health.<sup>7</sup>

## Study Data And Methods

We collected annual data at the state level in India based on under-five mortality rate, maternal mortality ratio (number of maternal deaths per 100,000 live births), and total fertility rate (number of births per woman). All data were obtained through the publicly available Sample Registration System of the Census of India.<sup>8</sup> For under-five mortality, we obtained data for the years 2005 and 2008–13. Maternal mortality data were available for 2004, 2008, and 2011–12. Total fertility rate data were available for 2004–13.

We compared Indian states in terms of levels for the three indicators and rates of change in those levels over the time periods for which data were available. We calculated average annual compound rates of change using a formula provided in the online Appendix<sup>9</sup> and the values at the beginning and end of each period for which data were available.

## Study Results

Exhibits 3–5 present our findings for each of the three indicators studied. Because of a lack of available data, the exhibits do not include all states. For all three metrics, levels are provided for the most recent year available, and annual rates of decline are given for approximately equal intervals during the previous ten years, depending upon data availability.

An important justification for examining current levels and rates of change separately is that they are not necessarily correlated. We compared current levels and rates of change for each metric to see whether they differed substantially. Consistent with previous literature,<sup>10</sup> we found small correlation coefficients for under-five mortality rates. Coefficients for maternal mortality ratios and total fertility rates were slightly larger, but still generally low and inconsistent across time periods (Appendix Exhibit 1).<sup>9</sup>

### EXHIBIT 4

**Average annual rates of decline in maternal mortality ratios in Indian states from 2004 to 2008 and from 2008 to 2012, and maternal mortality ratios in 2012**

State	Rate of decline, 2004–08	Rate of decline, 2008–12	Maternal mortality ratio (per 100,000 live births), 2012
Maharashtra	7.2%	10.1%	68
Andhra Pradesh	4.5	9.0	92
Karnataka	5.8	7.0	133
Kerala	5.2	6.8	61
Gujarat	2.6	6.7	112
Rajasthan	6.4	6.4	244
Assam	6.7	6.3	300
West Bengal	−0.9	6.0	113
Average for all states	5.8	5.8	167
Uttar Pradesh <sup>a</sup>	6.6	5.6	285
Bihar <sup>b</sup>	5.8	5.5	208
Tamil Nadu	4.4	5.0	79
Punjab	3.6	4.8	141
Chhattisgarh	7.1	4.8	221
Madhya Pradesh	7.1	4.8	221
Haryana	6.3	4.5	127
Odisha	5.2	3.7	222

**SOURCE** Authors' analysis of data from Office of the Registrar General and Census Commissioner, India (see Note 8 in text). **NOTES** States are ranked by rate of decline (percent per year) from 2008 to 2012. The Appendix presents an explanation of the methodology (see Note 9 in text). <sup>a</sup>Undivided Uttar Pradesh (inclusive of Uttarkhand). <sup>b</sup>Undivided Bihar (inclusive of Jharkhand).

## Discussion

Trends in child mortality, maternal mortality, and fertility in India reveal wide variations across states. As a whole, India performs worse than many low- and middle-income countries, although recent trends suggest that India's rates of improvement are increasing.

To date, most comparative studies of the factors affecting health performance across Indian states have examined differences in per capita public spending on health.<sup>7</sup> These studies have shown a gap that has increased over time between top-performing states, such as Tamil Nadu and Kerala, and bottom-performing states, such as Bihar and Madhya Pradesh. Besides variations in per capita public spending, possible determinants of differences in health outcomes between states include poor access to health facilities and a shortage of health care workers. These shortages have been attributed to, among other things, the concentration of Indian medical colleges in high-performing states.<sup>11</sup>

In the early 1980s, Kerala invested heavily in social welfare systems, which gave the state well-developed public health facilities.<sup>12</sup> In the late 1980s and early 1990s, Tamil Nadu created one of the first state-run public health organiza-

EXHIBIT 5

Average annual rates of decline in total fertility rates in Indian states from 2005 to 2009 and from 2009 to 2013, and total fertility rates in 2013

State	Rate of decline, 2005-09	Rate of decline, 2009-13	Total fertility rate (births per woman), 2013
Uttar Pradesh <sup>a</sup>	3.6%	4.0%	3.1
West Bengal	3.6	3.4	1.6
Jharkhand	2.2	3.3	2.7
Delhi	1.2	3.2	1.7
Rajasthan	2.8	3.2	2.8
Jammu and Kashmir	2.2	2.9	1.9
Chhatisgarh	2.4	2.8	2.6
Bihar	2.4	2.7	3.4
Madhya Pradesh	2.8	2.6	2.9
Odisha	2.9	2.6	2.1
Haryana	4.5	2.5	2.2
Assam	2.7	2.4	2.3
Average for all states	2.7	2.4	2.3
Himachal Pradesh	2.5	2.2	1.7
Punjab	3.6	2.2	1.7
Maharashtra	2.4	2.1	1.8
Gujarat	2.8	1.7	2.3
Karnataka	3.4	1.0	1.9
Andhra Pradesh	3.8	0.0	1.8
Tamil Nadu	1.4	0.0	1.7
Kerala	0.0	-1.1	1.8

**SOURCE** Authors' analysis of data from Office of the Registrar General and Census Commissioner, India (see Note 8 in text). **NOTES** States are ranked by rate of decline (percent per year) from 2009 to 2013. The Appendix presents an explanation of the methodology (see Note 9 in text). <sup>a</sup>Undivided Uttar Pradesh (inclusive of Uttarkhand).

tions in India, which focused on the efficient implementation of best practices and the rapid training of health care workers and their deployment to villages and rural areas.<sup>13</sup> This resulted in Tamil Nadu's having higher-quality maternal and child health services, compared to most other Indian states.<sup>14</sup>

Both current levels of performance on health indicators and rates of change in that performance are important metrics to consider in assessing a country's performance on health. Our analysis showed a wide range of performance across Indian states. Yet it also pointed to the consistently high performance of certain states (particularly Kerala, Maharashtra, and Tamil Nadu) and the consistently poor performance of other states (particularly Madhya Pradesh, Uttar Pradesh, Rajasthan, and Assam). As for rates of change, compared to other states, Maharashtra and Karnataka did relatively well, while Gujarat and West Bengal did poorly.

It is important to note that the states that performed best at the most recent point in time for which data were available did not necessarily experience the greatest improvements over time. One possible explanation is that states already performing well are likely to have difficulties improving substantially, relative to low-performing states. An alternative interpretation may be that levels tend to be less sensitive to policy changes and their impact in the short run, while rates of change tend to respond more rapidly to policy changes.

In some instances, adjacent states with similar cultural, social, and population characteristics had significantly different outcomes in performance. (For "heat" maps of India that show levels of performance and rates of change for under-five mortality, see Appendix Exhibit 2.)<sup>9</sup> For example, the neighboring states of Odisha and Andhra Pradesh on the Bay of Bengal were at opposite ends of the performance spectrum for both levels and rates of change for under-five and maternal mortality. This finding illustrates that differences in performance across Indian states might be driven by characteristics of health systems and policy differences, and it further emphasizes the need for state-level and even district-level analyses.

Kerala and Tamil Nadu have received much well-deserved attention in India for reducing mortality levels in their populations. Our analysis suggests that other states—such as Andhra Pradesh, Karnataka, and Rajasthan, which were top performers in rates of change—should be examined further. In particular, it would be valuable to understand which recent policy changes might have contributed to their successes and which factors might be key contributors to good or poor health outcomes.<sup>15</sup>

Recent innovations in Rajasthan and Andhra Pradesh include the decentralization of health facility management boards, the awarding of financial autonomy to hospitals, the centralization of drug procurement under state authority, and improvement in the monitoring of performance.<sup>16</sup> A recently lauded effort in Tamil Nadu was the launch of a unique semigovernmental organization called Tamil Nadu Medical Services Corporation. This corporation handles the purchasing, storage, and distribution of drugs and medical supplies across the state; provides other services such as the maintenance of equipment; and is responsible for the quality and accountability of the state's medical supply system.<sup>17</sup> It will be crucial for neighboring states to study these and similar examples if they are to adopt similar strategies and attain similar results.

State-level studies such as ours can also help explore and delineate a policy challenge that has

become known as the “missing middle” problem. Middle-income countries that have reached an income threshold at which they no longer qualify for health aid—known as “graduating” from aid—may not have sufficient domestic resources (for example, from tax revenues) to close the gap between available and required health care resources.<sup>18</sup> Despite having “graduated,” many middle-income countries such as India and China still have very large populations living in pockets of poverty—particularly in rural regions, where there are high rates of maternal and child mortality and avoidable mortality from infectious diseases.<sup>19</sup> Our study has helped identify which Indian states are performing poorly on mortality metrics; these states should consider implementing bold public policies.

## Conclusion

Current performance in health outcomes varies widely across states in India, and our findings suggest that state-level analyses in other countries may be worth conducting. Further research is needed at the state level in India to look at how the quality of care and public health interventions in successful states might affect child and maternal mortality metrics over different periods of time. For large countries such as India, these types of subnational analyses may provide critical insights to help low-performing regions catch up with high-performing regions. This would in turn reduce inequality and help the country as a whole achieve desired health outcomes associated with high quality of care as quickly as possible and in a fair manner. ■

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