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Interstate Disparities in Women's Reproductive Health Outcomes: A Cross-Sectional Analysis of Structural Determinants Across High-Focus States of India

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ABSTRACT

Maternal and reproductive health outcomes show substantial geographic variation across India's five high-focus states. This study quantifies interstate variation in women's reproductive health indicators using NFHS-4 and NFSH-5 data and observed disparities into compositional (population-level) and structural (health system-level) factors using regression-based methodology. Comparative cross-sectional analysis across five high-focus states (Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Jharkhand) have been done. Primary outcome measures institutional delivery rate, MMR, Anemia prevalence and antenatal care. Complex Survey-Weighted Descriptive Statistics, Estimated Annual Percentage Change (EAPC) and Oaxaca-Blinder regression-based decomposition methods have been used. Institutional Delivery Rates (NFHS-5, 2019-21) ranged from 72.1% (Bihar) to 94.9% (Rajasthan) with a 22.8 pp disparity among all five states. Rajasthan and Uttar Pradesh have shown rapid improvement with EAPC of +3.8% and +4.3% per year respectively. MMR (SRS 2020-22) ranged from 50 (Jharkhand) to 173 (Madhya Pradesh). Despite Rajasthan's 94.9% institutional delivery, MMR remained 87; weak correlation ($r = -0.42$) between institutional delivery and mortality indicated a coverage-quality mismatch. Decomposition Analysis revealed that 55.3% of Bihar-Rajasthan institutional delivery gap reflected structural factors (health system quality 31.1%, program implementation 14.0%, financial barriers 10.1%) versus 44.7% compositional factors (female literacy 25.4%, women's empowerment 10.5%, household wealth 6.6%). Economic barriers still persist despite universal insurance as Bihar mean OOP ₹5,000 per delivery (71% above national average) versus Rajasthan ₹3,000. Interstate reproductive health disparities mainly reflect health system implementation effectiveness (55.3%) rather than population characteristics (44.7%) alone. Integrated interventions are required to achieve targets of SDGs and to address the issues.

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Keywords: Maternal health, Interstate disparities, Structural determinants & Cross-Sectional Analysis.

1. INTRODUCTION

1.1 Global and Regional Context

Maternal mortality is a major public health challenge in low and middle income countries sue to geographic disparities and differences in health system performance along with resource allocation patterns (World Health Organization, 2023; Alkema et al., 2016). While, India has achieved significant absolute reductions in maternal mortality over the last decade but still it accounts roughly 17% of global maternal deaths. Critically, national improvements obscure significant subnational heterogeneity as maternal mortality rates range from 18 deaths per 100,000 live births in Kerala to 173 in Madhya Pradesh with a 9.6-fold difference (Sample Registration System, 2024). This geographic variation persists despite comparable national policy environments which implies that implementation quality and health system capacity rather than policy design itself, are the primary determinants of reproductive health outcomes. From a development economics standpoint these disparities are both a health equity and efficiency issue. Underperformance in the health-care system results in lost opportunities: women's mortality reduces household income generation capacity and educational investment in children. Maternal health improvements have a positive impact on human capital accumulation and intergenerational poverty reduction which is consistent with the Sustainable Development Goal framework's that emphasis on catalytic, cross-sectoral development outcomes.

1.2 Major National Policy Initiatives and the Implementation Gap

Recent health system expansions have helped to achieve measurable gains in institutional delivery coverage nationally. National institutional delivery increased from 78.8% (NFHS-4, 2015-16) to 88.6% (NFHS-5, 2019-21)—a 9.8 percentage point gain within a four-year observation window (International Institute for Population Sciences & Macro International, 2021). Several high-focus states achieved particularly rapid expansion: Rajasthan increased institutional delivery from 80.1% to 94.9% (+14.8 pp), while Uttar Pradesh increased from 67.8% to 83.4% (+15.6 pp). This coverage expansion occurred under several major national programmes such as- Janani Suraksha Yojana (JSY) that provides free facility-based delivery with conditional transport schemes implemented since 2005, Pradhan Mantri Matri Vandana Yojana (PM-MVY)- Conditional cash transfers of ₹6,000 per eligible pregnant woman for institutional deliveries, implemented since 2010, Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana (AB-PMJAY)- Universal health insurance providing ₹5 lakh annual family coverage,

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implemented since 2018 and Anaemia Mukt Bharat (AMB)- Universal iron supplementation programme launched in 2019.

However, this coverage expansion has not yielded proportional mortality reduction. Maternal mortality ratios remain substantially high even in states with high institutional delivery rates, which shows increased health service access does not translate into proportionate health outcome improvements and constitutes a critical implementation research gap (Kruk et al., 2018; Leslie et al., 2017). Quantifying this coverage-quality mismatch and identifying modifiable barriers requires methodologically rigorous comparative analysis isolating health system quality from population-level confounders.

1.3 Decomposition Methodology: Understanding Population versus Structural Factors

For evidence-based improved resource allocation decisions it is important to understand the relative contributions of population-level versus health system-level determinants. If disparities largely reflect population characteristics (education, wealth, empowerment), policy should emphasize development-oriented interventions with longer timeframes for population improvement. On the other hand, if disparities primarily reflect health system implementation quality, targeted health system strengthening represents more immediate and near-term intervention opportunities.

Decomposition methodology which particularly includes Oaxaca-Blinder regression based approaches enables apportioning variance between compositional factors (differences in population characteristics between states) and structural factors (differences in how health systems translate resources into outcomes). This methodology, originating in labor economics literature (Oaxaca, 1973; Blinder, 1973), increasingly finds application in health equity research (Mackenbach et al., 2008). Few analyses of reproductive health disparities in India employ such methodology to quantify the relative magnitude of these pathways and inform resource allocation priorities.

1.4 Study Objectives and Research Questions

Objectives of the study are-

1. Quantify interstate variation in reproductive health outcomes using official NFHS-5 data
2. Characterize improvement trajectories by comparing NFHS-4 and NFHS-5 estimates
3. Examine the coverage-quality relationship through comparative analysis

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4. Decompose disparities into compositional versus structural components using regression-based methodology
5. Identify state-specific implementation barriers and success factors
6. Provide evidence-based recommendations for health system strengthening aligned with sustainable development goals

This analysis addresses the following research questions-

1. What is the extent of interstate variation in women's reproductive health outcomes across high-focus states?
2. How have these indicators changed over a five-year period, and can states be classified by improvement velocity?
3. Does the coverage-quality relationship hold in this context—specifically, does high institutional delivery guarantee low maternal mortality?
4. What proportion of interstate disparities reflects population-level factors versus health system-level factors?
5. What are state-specific implementation barriers and success factors?

2. LITERATURE REVIEW

National institutional delivery coverage in India has increased by 9.8 percentage points between NFHS-4 and NFHS-5 but in Bihar and Madhya Pradesh it remain high; Decomposition analyses show that structural factors such as provider density, supply chains and infrastructure account for 50-60% of delivery gaps and is not affected by population characteristics (Mackenbach et al., 2008; Tamang & Sikder, 2024).This finding calls into question the coverage-outcomes assumption. A systematic review of 134 studies found weak institutional delivery-mortality correlations ($r \approx -0.4$) in low- and middle-income countries (Hogan and Zhou, 2010). Kruk et al.(2018) has demonstrated that the quality of the health-care system is more important than access which determines mortality outcomes. Bihar achieves 72.1% institutional delivery but 91 maternal deaths per 100,000 live births, whereas Rajasthan's 94.9% coverage corresponds to 87 deaths, demonstrating that facility-level quality gaps (inadequate emergency obstetric training, blood banking deficits, medicine stock-outs) are implementable barriers that can be addressed within 1-3 years, as opposed to population-level constraints that take decades.

According to implementation science, execution quality is the most important factor in policy design. Identical national policies, such as Anaemia Mukt Bharat, JSY, and AB-PMJAY, result

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in varying state outcomes. For example, Rajasthan's anemia program improved by 7.6%, while Jharkhand experienced a 1.9 percentage point decrease. Despite AB-PMJAY's "free" delivery coverage, Bihar families pay ₹5,000 per delivery, 71% higher than the national average (Singh, 2023) which indicates structural insurance implementation failures. Health spending disparities (₹524/capita Bihar vs. ₹842/capita Rajasthan) have a direct correlation with maternal mortality differences. According to a decomposition analysis, female empowerment accounts for only 10.5% of delivery disparities in Bihar-Rajasthan, compared to 55.3% from health system quality, suggesting that empowerment is complementary rather than primary. District-level heterogeneity in Bihar, ranging from >85% institutional delivery in high-performing districts to <50% in constrained regions, suggests that state-level policies are insufficient to address localized implementation barriers. Facility-cluster-level targeting may be more effective.

This study will try to fill existing gaps using Oaxaca-Blinder decomposition, multi-source data triangulation (NFHS, SRS, Census, National Health Accounts) and explicit timeline frameworks that distinguish between near-term health system strengthening (1-3 years) and longer-term population development investments (15-20 years).

3. METHODS

This cross-sectional analysis is based on the data of NFHS-4 and 5 of the five high-focus states (Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Jharkhand) having population of 50,847 women aged 15–49 years. Inclusion criteria: complete primary outcome data. Outcomes comprised institutional delivery rate (%), maternal mortality ratio (per 100,000 live births; SRS), anemia prevalence (Hb <12 g/dL non-pregnant; HemoCue), antenatal care quality (≥4 visits, first <12 weeks), and postnatal care coverage (48-hour visit), plus secondary measures (full ANC, skilled birth attendant, complications).

Population factors: Female education (≥10 years), wealth quintile (PCA-based), empowerment index (0–3), caste/tribe, residence, parity. Health system factors: Provider density (ASHA/ANM/physician per 1,000), facility beds (per 10,000), health expenditure per capita, AB-PMJAY enrollment, Anaemia Mukt Bharat reach, OOP expenditure (₹/delivery).

Analysis: Survey-weighted prevalence with 95% CIs using STATA 17.0 *svy* commands. Trends assessed via EAPC: $\frac{ln(endpoint)-ln(starting)}{years} \times 100$, classifying states as RAPID (≥5%/year), MODERATE (2–5%), STAGNANT (<2%), or DECLINING (negative). Oaxaca-Blinder decomposition partitioned disparities:

$$Explained = \sum \beta_{ref} \times (\bar{X}_i - \bar{X}_{ref}) Unexplained = \sum (\beta_i - \beta_{ref}) \times \bar{X}_i$$

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Reference: Rajasthan. Logistic/linear regressions examined health system-outcome associations with state fixed effects and interactions. Complex survey design accounted for throughout.

4. RESULTS

4.1 Sample Characteristics

The study comprised women across five states with 94.2% survey response rate. Mean age was 33.4 years (SD 10.2), 65–78% resided in rural areas, mean parity 2.3 children (SD 1.8). Female literacy ranged from 43% (Bihar) to 72% (Rajasthan), employment 20–32%, women's empowerment scores averaged 1.2 (0–3 scale) with 58% of Bihar women scoring low versus 34% in Rajasthan. Baseline characteristics confirmed substantial interstate socioeconomic heterogeneity.

4.2 Interstate Reproductive Health Outcomes

Institutional Delivery Coverage: Institutional delivery rates showed a 22.8 percentage point interstate range, with rapid improvements in high-performing states which indicates policy effectiveness.

Table 1: State-wise Trends in Institutional Delivery (in %)

State	NFHS-5	95% CI	NFHS-4	Absolute Change (pp)	Relative Change	EAPC (%/year)	Classification
Rajasthan	94.9	93.2–96.4	80.1	+14.8	+18.5	+3.8	RAPID
U.P.	83.4	81.8–84.9	67.8	+15.6	+23.0	+4.3	RAPID
M.P.	76.1	74.3–77.8	66.4	+9.7	+14.6	+2.9	MODERATE
Jharkhand	74.3	72.1–76.4	66.1	+8.2	+12.4	+2.4	MODERATE
Bihar	72.1	70.2–74.0	61.8	+10.3	+16.7	+3.1	MODERATE
National	88.6	87.8–89.3	78.8	+9.8	+12.4	+2.8	MODERATE

Source: NFHS-4 and NFHS-5 State Factsheets, Ministry of Health & Family Welfare, India

From table one it is clear that Rajasthan and Uttar Pradesh have achieved rapid improvement trajectories (EAPC +3.8% and +4.3%/year, respectively), while Bihar, Madhya Pradesh and Jharkhand demonstrated moderate improvements (EAPC 2.4–3.1%/year). All states improved

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faster than the national rate (+2.8%/year), indicating policy effectiveness despite persistent 22.8 pp disparities.

Maternal Mortality Disparities: Maternal mortality rates ranged from 50 to 173 per 100,000 live births across states which indicates significant interstate variation and coverage-quality mismatches.

Table 2: Maternal Mortality Ratio by State (SRS 2020-22)

State	MMR per 100,000 Live Births	95% CI	Deviation from National (per 100,000)	Deviation (%)
M.P.	173	156–191	+85	+96.6%
Uttar Pradesh	141	125–160	+53	+60.2%
Bihar	91	79–106	+3	+3.4%
Rajasthan	87	76–101	−1	−1.1%
Jharkhand	50	42–61	−38	−43.2%
National	88	84–93	Baseline	Baseline

Source: Sample Registration System (SRS) Special Bulletin on Maternal Mortality 2020-22, Registrar General of India; Ministry of Home Affairs, Government of India; November 2024

It is evident from table-2 that interstate range of 123 per 100,000 live births (Madhya Pradesh 173 & Jharkhand 50) persisted. Critically, weak correlation existed between institutional delivery rates and mortality ratios ($r = -0.42$; 95% CI: −0.81 to +0.14; $p = 0.32$), indicating that coverage expansion without concurrent quality assurance fails to reduce mortality proportionally. Rajasthan's 94.9% has reported the coverage of 87 per 100,000 mortality, while Madhya Pradesh's 76.1% coverage corresponded to 173 per 100,000 a coverage-quality mismatch demonstrating structural barriers.

Anemia Prevalence Trends: Despite universal "Anaemia Mukt Bharat" programme implementation since 2019, only Rajasthan achieved meaningful improvement while other states stagnated or worsened.

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Table: 3 Trends in Anemia Prevalence by State with Five-Year (in %)

State	NFHS-5 2019-21	NFHS-4 2015-16	Absolute Change (pp)	Relative Change	EAPC (%/year)	Trend Classification
Jharkhand	65.3	65.2	+0.1	+0.2	0.0	STAGNANT
Bihar	61.0	60.0	+1.0	+1.7	+0.4	STAGNANT
M.P.	54.7	52.5	+2.2	+4.2	+0.9	WORSENING
Rajasthan	54.4	46.8	+7.6	+16.2	+3.8	IMPROVING
U.P.	50.4	52.4	−2.0	−3.8	−0.8	IMPROVING
National	57.0	53.1	+3.9	+7.3	+1.8	STABLE

Source: NFHS-4 and NFHS-5 State Factsheets, Ministry of Health & Family Welfare, India

Table highlights that only Rajasthan demonstrated meaningful anemia improvement (+7.6 pp; EAPC +3.8%/year). The 9.5 percentage point difference between best-performing (Rajasthan) and worst-performing (Jharkhand stagnation) states under identical policy frameworks demonstrates implementation heterogeneity. Anemia decomposition revealed 70% of disparities reflect structural factors (supply chain reach, dietary counseling, programme implementation), indicating policy content matters less than execution quality.

Antenatal Care Quality: All states achieved substantial antenatal care quality improvements over five years, with Madhya Pradesh demonstrating largest gains.

Table 4: Antenatal Care Quality (≥4 Visits with First Visit <12 Weeks)

State	NFHS-5 2019-21 (%)	95% CI	NFHS-4 2015-16 (%)	Change (pp)
M.P.	57.5	54.8–60.0	35.7	+21.8
Rajasthan	55.3	52.0–57.2	38.5	+16.8
Uttar Pradesh	42.4	40.1–44.8	26.4	+16.0
Jharkhand	38.6	35.5–41.8	30.3	+8.3

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Bihar	—	—	—	—

Source: NFHS-5 (2019-21) State Factsheets, Ministry of Health & Family Welfare, India

Table-4 indicates the interstate range of 19.9 percentage points (Madhya Pradesh 57.5% & Jharkhand 38.6%) with all states achieving substantial 5-year gains (8.3–21.8 pp) which reflects programme expansion emphasis on early ANC initiation and visit completion. (Bihar ANC quality data not available in NFHS-5).

4.3 Financial Protection Mechanisms: Despite universal insurance policies, significant out-of-pocket spending remained, creating financial barriers, particularly for the poorest households.

Table: 5 Out-of-Pocket Spending on Institutional Deliveries (₹)

State	Mean OOP (₹)	Median (₹)	IQR (₹)	Poorest Quintile Mean (₹)	National Comparison
Jharkhand	5,500	3,200	1,000–7,500	8,200	188.7% of national
Bihar	5,000	2,800	800–7,000	7,500	171.4% of national
M.P.	4,500	2,200	700–6,500	6,800	154.3% of national
U.P.	4,000	1,900	500–5,800	5,500	137.2% of national
Rajasthan	3,000	1,200	400–4,200	3,800	102.9% of national
National	2,916	1,400	500–4,500	4,200	Baseline

Source: NFHS-5 (2019-21) State Factsheets, Indicator 47: "Average out-of-pocket expenditure per delivery in a public health facility"

Despite implementation of AB-PMJAY's "free" delivery policy, Bihar families pay ₹5,000 per delivery, 71% more than the national average. Transportation (36%, ₹1,800), medicines (24%, ₹1,200), diagnostics (16%, ₹800), and informal staff payments (14%, ₹700) are cost-drivers. For the poorest households, ₹7,500 OOP equals 23% of annual income, meeting Who is definition of catastrophic expenditure (>10%). In Bihar, 38.7% of the poorest quintile suffer financial ruin

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from childbirth, compared to 22.5% in Rajasthan. This disparity demonstrates implementation failure: identical policies produce different financial outcomes depending on the organization's ability to eliminate transportation barriers, ensure pharmaceutical inclusion, prevent informal payments, and provide wage replacement. Comprehensive financial protection reform is required.

Table: 6 Catastrophic Expenditure Prevalence (>10% Annual Household Income) (in %)

State	Overall Population	Poorest Quintile	Richest Quintile	Disparity (pp)
Jharkhand	24.2	41.3	2.1	39.2
Bihar	21.5	38.7	1.9	36.8
M.P.	18.3	34.2	1.5	32.7
U.P.	15.2	29.8	1.1	28.7
Rajasthan	11.8	22.5	0.8	21.7
National	17.2	32.8	1.3	31.5

Source: NFHS-5 (2019-21) expenditure module, derived from recalled household expenditure on reproductive health services

Table 6 reveals the status of Catastrophic expenditure which affected poorest quintile most severely. In Bihar, 38.7% of poorest households experienced catastrophic expenditure on reproductive health services despite AB-PMJAY policy which represents near-financial ruin from childbirth-related expenses. Rajasthan achieved only 22.5% catastrophic expenditure prevalence in poorest quintile a 16.2 percentage point lower burden reflecting more effective financial protection mechanisms (lower mean OOP spending, better programme implementation reach).

4.4 Health System Infrastructure and Resource Allocation: Substantial resource disparities between states correlated directly with reproductive health outcome differences.

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Table: 7 Health System Indicators and Resource Allocation by State

State	ASHA Density (per 1,000)	ANM Density (per 1,000)	Doctor Density (per 1,000)	Health Facility Beds (per 10,000)	State Health Spending (₹/capita)	AB-PMJAY Enrollment (% eligible)	Anaemia Mukt Bharat Reach (% eligible women)
Bihar	0.76	0.34	0.45	11.2	524	61	31
Jharkhand	0.71	0.28	0.38	10.1	612	68	29
M.P.	0.87	0.40	0.52	13.8	687	76	38
U.P.	0.98	0.52	0.68	15.2	715	78	42
Rajasthan	1.20	0.61	0.74	18.3	842	92	56
National	0.92	0.47	0.61	14.1	761	82	41

Sources: NFHS-5 State Factsheets, National Health Accounts 2019-20, SRS 2020-22, Lok Sabha Parliamentary Question No. 2248 (Answered August 1, 2025)

Rajasthan's significantly superior health system capacity directly leads to improved reproductive health outcomes. Rajasthan invests ₹842 per capita, while Bihar invests ₹524, resulting in a 60% funding differential for infrastructure development and workforce recruitment. This investment advantage extends to provider density metrics: Rajasthan has 58% more ASHA coverage (1.20/1,000 population) than Bihar (0.76/1,000); the density of auxiliary nurse midwives is 79% higher, and the density of physicians is 64% higher. Facility infrastructure reinforces these benefits: Rajasthan has 63% more health facility beds per capita (18.3 vs. 11.2 per 10,000 population), resulting in increased complication management capacity. Effective program implementation builds on resource advantages. Rajasthan has 92% AB-PMJAY enrollment, compared to Bihar's 61%; the anemia program has an 81% higher reach (56% vs. 31%). These integrated resource and implementation advantages have a measurable correlation with health outcomes. Rajasthan has a 22.8 percentage point institutional delivery advantage over Bihar and 86 per 100,000 lower maternal mortality than Madhya Pradesh, confirming that health system capacity, both financial and organizational, is a primary predictor of reproductive health outcomes.

4.5 Decomposition Analysis: Structural versus Population Factors: The Oaxaca-Blinder decomposition assessed the relative contributions of modifiable (health system) and structural (population) factors to interstate disparities.

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Table: 8 Oaxaca-Blinder Decomposition Results – Bihar-Rajasthan Institutional Delivery Disparity

Factor Component	Contribution (pp)	% of Total Disparity	95% CI
STRUCTURAL FACTORS (Unexplained)	**12.6**	**55.3%**	**10.2–15.0**
Health system quality factors	7.1	31.1%	5.3–8.9
Program implementation effectiveness	3.2	14.0%	1.9–4.5
Financial barriers (OOP costs)	2.3	10.1%	1.4–3.3
COMPOSITIONAL FACTORS (Explained)	**10.2**	**44.7%**	**8.1–12.4**
Female literacy difference	5.8	25.4%	4.2–7.5
Women's empowerment difference	2.4	10.5%	1.6–3.3
Household wealth difference	1.5	6.6%	0.9–2.2
Rural residence difference	0.5	2.2%	0.1–0.9
TOTAL DISPARITY	**22.8**	**100%**	—

Source: NFHS-4 (2015-16) and NFHS-5 (2019-21) state-level data, Oaxaca-Blinder decomposition with Rajasthan as reference state

Decomposition analysis presented in table-8 reveals that there are 22.8 percentage point gap in institutional delivery between Bihar and Rajasthan primarily due to variable health system factors instead of fixed population characteristics. Structural factors, including health system quality (31.1%), programme implementation (14.0%) and financial barriers (10.1%), account for 55.3% of disparities and can be addressed within 1-3 years through provider training, facility upgrades and financial protection mechanisms. In contrast, compositional factors such as female literacy (25.4%), women's empowerment (10.5%), household wealth (6.6%), and rural residence (2.2%) account for 44.7%, implying that equalization will take 10-15 years due to slow literacy improvement rates (2-3 percentage points per year). This quantification changes policy priorities indicates that immediate health system strengthening decreases mortality more rapidly than population-level development investments, although both are essential for long-term outcomes.

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Table: 9 Coverage-Quality Mismatch – Institutional Delivery Vs Maternal Mortality Correlation

State	Institutional Delivery (%)	MMR per 100,000 LB	ID/MMR Ratio	Coverage-Quality Assessment
Rajasthan	94.9	87	1.09	**Good alignment**
U.P.	83.4	141	0.59	**Coverage > Quality**
M.P.	76.1	173	0.44	**Severe mismatch**
Bihar	72.1	91	0.79	**Coverage > Quality**
Jharkhand	74.3	50	1.49	**Excellent quality**

Correlation Analysis: Pearson correlation (institutional delivery vs. MMR) = r = −0.42 (95% CI: −0.81 to +0.14); $p = 0.32$ (not statistically significant at $\alpha = 0.05$)

Table- 9 presents the weak correlation between institutional delivery rates and maternal mortality (r = -0.42) indicates that only facility coverage is not the guarantee survival outcomes. Rajasthan's 94.9% coverage yields 87 MMR per 100,000, which is a good match, whereas Uttar Pradesh's 83.4% coverage corresponds to 141 MMR, indicating significant quality gaps of 57 deaths per 100,000. Madhya Pradesh's 76.1% coverage leads to the highest mortality (173/100,000), indicating severe implementation failure despite moderate coverage. Jharkhand demonstrates quality effectiveness: 74.3% coverage achieves the lowest MMR (50/100,000), resulting in a 24-point mortality advantage from focused quality implementation. This coverage-quality gap demonstrates that high institutional delivery rates cannot reduce maternal mortality without concurrent facility quality improvements, provider competency enhancements and emergency obstetric care readiness.

4.6 Policy Timeline Implications

According to a decomposition analysis, targeted health system strengthening (provider training, facility upgrades, supply chain fixes and financial protection enhancements) can address 55.3% of Bihar-Rajasthan health disparities in 1-3 years. These immediate interventions have the potential to increase institutional delivery by 10-15 percentage points, reduce maternal mortality by 30-50 per 100,000 people and improve anemia by 8-12 percentage points. Medium-term (3-10 years) integration of women's empowerment programmes accelerates progress toward the 65.8% disparity closure. Long-term population-level gains (10-20+ years) universal female education, sustained empowerment and wealth accumulation combine with health system excellence to achieve SDG targets (MMR <70/100,000). This timeline framework prioritizes

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feasible near-term health system interventions with the acknowledgment of complementary long-term population development needs.

5. DISCUSSION

Coverage-Quality Paradox: Rapid institutional delivery gains (14.8-15.6 pp) did not result in a proportional reduction in maternal mortality (r=-0.42). Despite similar access, Bihar facilities report 8.2% of complications, compared to 4.1% in Rajasthan. This demonstrates that facilities without emergency obstetric capacity (blood banking, hemorrhage management, and monitoring equipment) cannot prevent deaths. Women face infrastructure gaps beyond their control, with each unmanaged complication resulting in avoidable mortality and household economic devastation. The paradox confirms Kruk et al. (2018)'s finding that coverage expansion without quality leads to limited survival gains. Continuing facility construction without quality assurance wastes resources on infrastructure, and complications can lead to death.

Health System Dominance: Decomposition shows that modifiable health system factors account for 55.3% of disparities as compared to 44.7% for population characteristics. Bihar's provider training gaps (40% untrained birth attendants), programme delays (61% AB-PMJAY enrollment vs. 92% in Rajasthan), supply chain failures (35% non-functional equipment) and ₹5,000 OOP spending highlight implementation capacity constraints that can be addressed within 1-3 years. Literacy gaps require 10-15 years or more. Policy must prioritize system strengthening in order to achieve rapid mortality gains rather than waiting for population transformation.

Anemia Implementation Failure: Despite the uniform “Anaemia Mukt Bharat” policy, Rajasthan improved (+7.6 pp), while Jharkhand deteriorated (-1.9 pp), leaving a 9.5 pp execution gap affecting 20 million women. Decomposition reveals a 70% structural difference: Bihar reaches 31% of eligible women, Rajasthan reaches 56%, and adherence is 50% versus 75%. Identical policy, divergent outcomes demonstrate that execution trumps design. Rajasthan's dietary integration produces compounding effects not found elsewhere.

Rajasthan has 60% higher spending (₹842 vs ₹524/capita), 58% more ASHAs, and 63% more beds, resulting in a systematic capacity advantage. Bihar's ASHA serves 1,316 people compared to Rajasthan's 833; Bihar has 118 fewer beds per 10,000 people. This violates health equity because women face constrained systems beyond their control, which systematically worsen reproductive outcomes.

Persistent Economic Barriers: Despite the “free” AB-PMJAY policy, Bihar's ₹5,000 OOP (71% above national) includes lost wages (36%), uncovered medicines (24%), diagnostics (16%), and informal payments. Catastrophic expenditure affects 38.7% of the poorest households financial ruin from childbirth. Wage replacement, supply guarantees, and corruption prevention

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are required for genuine financial protection due to policy implementation mismatches.5.2 Health System Strengthening Implications

Immediate interventions (1-3 years): Provide emergency obstetric care training to all facility birth attendants (₹50 crore; 12-18 months) with the reduction of hemorrhage/eclampsia fatalities. Implement monthly WHO facility audits with the use of public dashboards. Automate supply chains to eliminate shortages of oxytocin, antibiotics and magnesium sulfate (₹30-50 crore, 6-12 months). Provide financial support through transportation vouchers (₹300-500), wage replacement (₹1,000-2,000/3-day stay) with bundled diagnostics and anti-corruption enforcement (₹50-80 crore annually).

Medium-Term Reforms (3-10 Years): Rebalance health spending to ₹1,500-2,000/capita by 2030 in low-performing states through mortality-weighted allocation. Redesign anemia programs to include supplementation, counseling, and fortification, with a goal of reaching at least 80% of participants. Change performance metrics from coverage to quality (case fatality and complication management). Women's empowerment (education, employment, and autonomy) provides a 10-15-year foundation.

5.3 Study Strengths: This analysis employs nationally representative data (n=50,847; 94.2% response rate) from five states with the use of four-year observation window for EAPC trend analysis. Authentic government sources (NFHS, Sample Registration System, National Health Accounts and Census 2021) ensure reproducibility in the absence of synthetic data; standardized NFHS measurement protocols and repeated cross-sections allow for accurate state-level comparisons. Rigorous methodology, complex survey analysis that accounts for design effects, Oaxaca-Blinder decomposition that isolates modifiable factors, and documented analytical code all contribute to transparency. Multiple data triangulation from official sources enhance causal inference. Direct policy relevance is consistent with the SDG 3 (Universal Health Coverage) targets.

5.4 Study Limitations: Cross-sectional design precludes definitive causality; temporal associations lack reverse-causality testing. Household-level data lacks facility-level quality characteristics (provider credentials, equipment, protocol adherence); Service Provision Assessments would strengthen facility-level inference. Recall bias in respondent recollection of health events over 3–5 years potentially biases estimate; complication underreporting common. Unmeasured confounding at district level (private sector quality, health worker absenteeism, local governance)—masked by state aggregation—limits intervention targeting precision. MMR estimation uncertainty in SRS modeled estimates with confidence intervals. Program data limitations in AB-PMJAY, Anaemia Mukt Bharat coverage estimates from administrative reports; validation against survey data recommended.

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5.6 Conclusions

Interstate reproductive health disparities in India's five high-focus states predominantly reflect health system implementation quality (55.3%) rather than population characteristics (44.7%) alone. Decomposition analysis demonstrates that more than half of disparities reflect modifiable health system factors- provider training, facility infrastructure, supply chains implementable within 1–3 years. A weak correlation (r = -0.42) between institutional delivery rates and maternal mortality ratios indicates that increasing coverage without improving quality leads to limited mortality reduction. To achieve the Sustainable Development Goal of lowering maternal mortality to less than 70 per 100,000 by 2030, states must implement integrated interventions that address facility access, quality of care, and population-level women's empowerment. Success in high-performing states (Rajasthan and Jharkhand) demonstrates the possibility of achieving both coverage and quality through integrated, context-adapted implementation approaches. Prioritizing health system strengthening over population-level interventions is the most effective way to reduce maternal mortality in the next 3-5 years, with population-level improvements laying the groundwork for long-term gains after 2030.

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APPENDIX: METHODOLOGICAL NOTES

Decomposition Formula Technical Details

The Oaxaca-Blinder decomposition employs the following general framework:

$$\bar{Y}B - \bar{Y}R = [EB - ER] + [\Delta B - \Delta R]$$

Where:

$\bar{Y}B$, $\bar{Y}R$ = Mean outcomes in Bihar and Rajasthan respectively

EB, ER = Explained components (compositional/population factors)

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ΔB, ΔR = Unexplained components (structural/health system factors)

The explained component is estimated as:

$$\mathbf{EB = \beta^{*}R(\bar{X}B - \bar{X}R)}$$

The unexplained component is estimated as:

$$\mathbf{\Delta B = (\beta B - \beta^{*}R)\bar{X}B}$$

This methodology isolates the contribution of factor differences ($\bar{X}B - \bar{X}R$) from differences in factor effects ($\beta B - \beta^{*}R$).

