

Original Research Article

A comparative analysis of health indicators in India and Madhya Pradesh using NFHS-4 and NFHS-5 data

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ABSTRACT

Background: The national family health survey (NFHS) provides important evidence for monitoring health indicators in India. This study compared changes between NFHS-4 (2015–16) and NFHS-5 (2019–21) for India and Madhya Pradesh.

Methods: Key health indicators were compared using descriptive statistics, Wilcoxon Signed Rank, Mann–Whitney U, Kruskal–Wallis, Spearman's correlation, and regression analysis. Coefficients of variation were also assessed to examine changes in variability.

Results: Mean health indicator scores increased from 38.12 to 40.81 in India and from 37.52 to 40.72 in Madhya Pradesh. Improvement was statistically significant for India ($Z=2.611$, $p=0.009$), but not for Madhya Pradesh ($Z=1.576$, $p=0.115$). The magnitude of improvement did not differ significantly between India and Madhya Pradesh ($Z=-0.133$, $p=0.894$). No significant domain-wise variation in percentage change was observed for India ($p=0.280$) or Madhya Pradesh ($p=0.212$). Strong positive correlations were observed between India and Madhya Pradesh in NFHS-4 ($r=0.936$) and NFHS-5 ($r=0.968$). Baseline NFHS-4 values did not significantly predict subsequent improvement in India ($R^2=0.011$, $p=0.455$) or Madhya Pradesh ($R^2=0.048$, $p=0.120$). Variability increased over time.

Conclusions: India showed significant improvement, while Madhya Pradesh demonstrated positive but non-significant progress. Increasing variability highlights persistent disparities, emphasizing the need for targeted and region-specific interventions to achieve equitable health improvements.

Keywords: NFHS-4, NFHS-5, Health indicators, Madhya Pradesh, India, Wilcoxon signed rank test, Mann–Whitney U test, Kruskal–Wallis test, Spearman correlation, Public health

INTRODUCTION

Health is a fundamental component of human development and an important determinant of social and economic progress. Improvements in health indicators contribute to increased productivity, reduced disease burden, and enhanced quality of life.⁷ In India, substantial efforts have been made to strengthen the healthcare system through various national health programs and

policy initiatives.⁵ Despite these efforts, considerable disparities in health outcomes continue to exist across states and regions due to differences in socio-economic conditions, educational status, healthcare infrastructure, and access to health services.⁸ Reliable and comprehensive health data are essential for monitoring progress and evaluating the effectiveness of public health interventions.⁷ The NFHS serves as one of the most important sources of population-based health information in India.^{1,2} Conducted periodically under the Ministry of

Health and Family Welfare, NFHS provides data on fertility, mortality, maternal and child health, nutrition, family planning, women's empowerment, and healthcare utilization.^{1,2} The availability of data from NFHS-4 (2015–16) and NFHS-5 (2019–21) enables researchers to assess changes in health indicators over time and identify areas requiring further improvement.^{1,2}

Madhya Pradesh is one of the largest states in India and has historically reported lower performance on several health indicators compared with national averages.^{3,4} The state is characterized by a substantial rural and tribal population, socio-economic diversity, and varying levels of healthcare accessibility.^{3,8} Therefore, a comparative assessment of health indicators between India and Madhya Pradesh provides valuable insights into regional disparities and the effectiveness of ongoing health interventions.^{3,4}

The present study focuses on selected demographic, maternal and child health, nutrition, family planning, sanitation, and women's empowerment indicators obtained from NFHS-4 and NFHS-5.¹⁻⁴ By comparing changes over time at both the national and state levels, the study aims to evaluate progress in health outcomes and identify persistent gaps. Statistical analysis was performed to assess changes in health indicators between NFHS-4 and NFHS-5 and to compare patterns of improvement between India and Madhya Pradesh.

Objective of the study

To compare and evaluate changes in selected health indicators between India and Madhya Pradesh using NFHS-4 (2015–16) and NFHS-5 (2019–21).

METHODS

Study design

This was a comparative, retrospective study based on secondary data obtained from the NFHS. The study compared selected health indicators reported in NFHS-4 (2015–16) and NFHS-5 (2019–21) at the national level for India and the state level for Madhya Pradesh. The study was designed to assess temporal changes in health indicators and compare the magnitude and pattern of improvement between India and Madhya Pradesh.

Study place and period

The study was conducted using nationally representative NFHS data for India and state-level data for Madhya Pradesh. Data were obtained from the published NFHS-4 and NFHS-5 reports prepared by the International Institute for Population Sciences (IIPS), Mumbai, under the Ministry of Health and Family Welfare, Government of India. NFHS-4 data corresponded to the survey period 2015–16, while NFHS-5 data corresponded to the survey

period 2019–21. The analysis focused on comparing the same health indicators across the two survey rounds.

Inclusion criteria

The following criteria were used for selection of indicators health and demographic indicators available in both NFHS-4 and NFHS-5. Indicators reported for both India and Madhya Pradesh. Indicators with comparable definitions and measurement criteria across the two survey rounds. Indicators relevant to demographic, reproductive, maternal and child health, nutrition, health infrastructure and living conditions, women's empowerment and gender equality, and emerging public health challenges.

A total of 52 health indicators satisfying these criteria were included in the final analysis.

Exclusion criteria

Indicators were excluded if they were not available in both NFHS-4 and NFHS-5, were reported for only one of the two geographical levels, had substantially different definitions or measurement methods between the survey rounds, or had insufficient information for meaningful comparison.

Procedure

Relevant data were extracted from the published NFHS-4 and NFHS-5 reports for India and Madhya Pradesh. The selected indicators were compiled and classified into seven broad domains: demographic and fertility indicators; family planning and reproductive health; maternal and child health; nutritional status and anaemia; health infrastructure and living conditions; women's empowerment and gender equality; and emerging public health challenges.

The corresponding indicators from NFHS-4 and NFHS-5 were matched according to their definitions and measurement units. The extracted data were systematically coded, checked for consistency and completeness, cleaned, and prepared for statistical analysis. For each indicator, the change between NFHS-4 and NFHS-5 was assessed. Percentage change was calculated to quantify the magnitude of improvement or decline.

Ethical considerations

The study used secondary data obtained from publicly available NFHS reports and did not involve direct contact with human participants or access to personally identifiable information. Therefore, individual-level informed consent was not applicable. Ethical approval or exemption/waiver was obtained from the Institutional Ethics Committee of St Johns College Agra, India.

Statistical analysis

The collected data were analyzed using appropriate descriptive and inferential statistical techniques. Descriptive statistics, including mean, standard deviation, and coefficient of variation (CV), were used to summarize the distribution, variability, and disparity of health indicators. Since the data did not satisfy the assumption of normality, non-parametric statistical methods were employed. The Wilcoxon Signed Rank Test was applied to assess significant changes in health indicators between NFHS-4 (2015–16) and NFHS-5 (2019–21) within India and Madhya Pradesh. The Mann–Whitney U Test was used to compare the percentage change in health indicators between the two regions, while the Kruskal–Wallis Test was employed to examine differences in improvements across various health domains. Spearman’s Rank Correlation Coefficient was calculated to determine the strength and direction of association between the health indicators of India and Madhya Pradesh. Furthermore, linear regression analysis was performed to evaluate the influence of baseline NFHS-4 indicator values on the observed percentage change in NFHS-5. Statistical significance was considered at a p-value of less than 0.05.

Sampling technique and sample size

As this was a secondary-data-based comparative study, no primary sampling or sample size calculation was performed. The study did not involve recruitment of individual participants. Instead, health indicators were selected using a criterion-based purposive selection approach. Indicators that were consistently available and comparable for both India and Madhya Pradesh in NFHS-4 and NFHS-5 were included. A total of 52 health indicators meeting the predefined inclusion criteria were considered for the analysis.

RESULTS

The analysis included 52 health indicators for both India and Madhya Pradesh. India’s mean health indicator score increased from 38.12 ± 24.03 in NFHS-4 to 40.81 ± 27.69 in NFHS-5. Similarly, Madhya Pradesh showed an increase from 37.52 ± 23.82 to 40.72 ± 27.77 , indicating overall improvement in both regions. The Wilcoxon signed rank test showed a statistically significant improvement in India between NFHS-4 and NFHS-5 ($Z=2.611$, $p=0.009$). In Madhya Pradesh, the improvement was not statistically significant ($Z=1.576$, $p=0.115$).

Table 1: Descriptive statistics of NFHS-4 and NFHS-5 indicators.

Region	NFHS Phase	N	Mean	Std. Deviation	Result
India	NFHS-4	52	38.12	24.0309	Baseline
India	NFHS-5	52	40.81	27.68537	Improved
M. P	NFHS-4	52	37.52	23.8168	Baseline
M. P	NFHS-5	52	40.72	27.7678	Improved

Table 2: Hypothesis test summary (Wilcoxon signed rank test).

Region	Standardized test statistic (Z)	P value (Sig.)	Decision
India	2.611	0.009	Reject null hypothesis
Madhya Pradesh	1.576	0.115	Retain null hypothesis

Table 3: Comparative test

Statistical parameters	Value for comparison (India vs MP)
Total N (sample size)	104 (52 Indicators each)
Mann-Whitney U	1331.5
Wilcoxon W	2709.5
Test statistic	1331.5
Standard error	153.817
Standardized test statistic (z)	-0.133
Asymptotic Sig. (2-sided P value)	0.894

Table 4: Results of Kruskal-Wallis test for domain-wise variation.

Region	Null hypothesis (H0)	Degree of freedom (df)	Test statistic	Sig. (P value)	Decision
India	Distribution of percent change is same across domains	6	7.464	0.28	Retain null hypothesis
MP	Distribution of Percent Change is same across Domains	6	8.37	0.212	Retain Null Hypothesis

Table 6: Regression model parameters (India and MP).

Region	Predictor	R ²	ANOVA (F)	Sig. (P value)	Beta	T-value
India	India NFHS4	0.011	0.567	0.455	-0.106	-0.753
MP	MP NFHS4	0.048	2.504	0.12	-0.218	-1.582

Table 7: Descriptive statistics and variability analysis.

Variables	N	Mean	Std. deviation (SD)	CV (%)
India (NFHS-4)	52	38.12	24.03	63.04
India (NFHS-5)	52	40.88	27.69	67.72
Madhya Pradesh (NFHS-4)	52	37.52	23.82	63.48
Madhya Pradesh (NFHS-5)	52	40.72	27.77	68.2

The Wilcoxon Signed Rank Test showed a statistically significant improvement in health indicators for India ($Z=2.611$, $p=0.009$), leading to rejection of the null hypothesis. In contrast, Madhya Pradesh showed a non-significant improvement ($Z=1.576$, $p=0.115$), and the null hypothesis was retained. The Mann–Whitney U test showed no statistically significant difference in the magnitude of improvement between India and Madhya Pradesh ($U=1331.5$, $Z=-0.133$, $p=0.894$). Therefore, the null hypothesis was retained, indicating that the magnitude of improvement was comparable between the two regions. The Kruskal–Wallis test showed no statistically significant difference in the distribution of percentage change across health domains for either India ($\chi^2=7.464$, $df=6$, $p=0.280$) or Madhya Pradesh ($\chi^2=8.370$, $df=6$, $p=0.212$). Therefore, the null hypothesis was retained for both regions, indicating that the magnitude of percentage change was comparable across the different health domains.

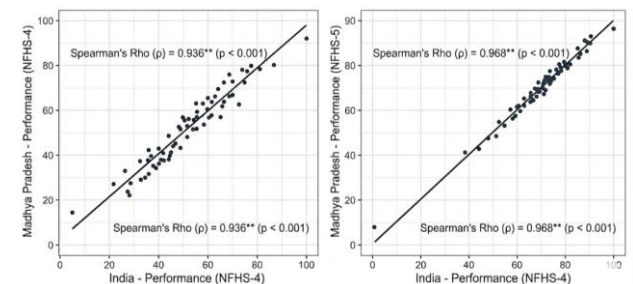
Correlation between India and Madhya Pradesh

Spearman's Rank Correlation analysis was conducted to assess the relationship between health indicators of India and Madhya Pradesh. Spearman's rank correlation analysis demonstrated a very strong positive correlation between India and Madhya Pradesh for health indicator performance. The correlation coefficient was $\rho=0.936$ ($p<0.001$) for NFHS-4 and $\rho=0.968$ ($p<0.001$) for NFHS-5. The stronger correlation observed in NFHS-5 indicates that the health indicator performance of Madhya Pradesh was closely aligned with national-level performance.

The regression analysis showed that baseline NFHS-4 values did not significantly predict the rate of improvement in health indicators. For India, the model explained 1.1% of the variance ($R^2=0.011$), with an ANOVA F value of 0.567 and $p=0.455$. The regression coefficient was negative ($\beta=-0.106$; $t=-0.753$) but not statistically significant. For Madhya Pradesh, the model explained 4.8% of the variance ($R^2=0.048$), with an ANOVA F value of 2.504 and $p=0.120$. The regression coefficient was also negative ($\beta=-0.218$; $t=-1.582$) and not statistically significant. Overall, baseline health

indicator levels did not significantly predict subsequent improvement in either India or Madhya Pradesh.

The variability analysis showed an increase in the coefficient of variation (CV) for both India and Madhya Pradesh between NFHS-4 and NFHS-5. For India, the CV increased from 63.04% in NFHS-4 to 67.72% in NFHS-5, while for Madhya Pradesh it increased from 63.48% to 68.20%. The mean health indicator scores also increased in both regions, from 38.12 to 40.88 for India and from 37.52 to 40.72 for Madhya Pradesh. The increase in CV indicates greater variability among health indicators over time.

**Figure 1: Correlation of health performance between India and Madhya Pradesh.**

DISCUSSION

The present study demonstrated an overall improvement in the selected health indicators between NFHS-4 and NFHS-5 in both India and Madhya Pradesh. The mean score increased from 38.12 ± 24.03 to 40.81 ± 27.69 in India and from 37.52 ± 23.82 to 40.72 ± 27.77 in Madhya Pradesh. These findings are consistent with the broader improvements documented between the two NFHS rounds in demographic, maternal and child health, nutrition, family planning, and other health-related indicators.^{1,2} The improvement observed in Madhya Pradesh is also reflected in the state-specific NFHS reports, although the level of performance across individual indicators remains heterogeneous.^{3,4} The Wilcoxon signed rank test showed statistically significant improvement in India ($Z=2.611$, $p=0.009$), whereas the change in Madhya Pradesh was not statistically

significant ($Z=1.576$, $p=0.115$). This difference suggests that although the overall direction of change was positive in both regions, the magnitude and consistency of changes across the 52 indicators were stronger at the national level. The national improvement is consistent with the continuing expansion of public health services and improvements in health-system-related indicators reported in national health assessments.^{5,7}

The Mann–Whitney U test showed no statistically significant difference in the magnitude of improvement between India and Madhya Pradesh ($U=1331.5$, $Z=-0.133$, $p=0.894$). This indicates that, despite differences in absolute health indicator levels, Madhya Pradesh progressed at a rate broadly comparable with the national pattern. The finding is important because comparative assessments of states emphasize that health outcomes depend not only on the level achieved but also on the pace of improvement over time.⁸

The Kruskal–Wallis analysis found no significant difference in percentage change across health domains for either India ($p=0.280$) or Madhya Pradesh ($p=0.212$). This suggests that the observed improvement was not concentrated in a particular domain but followed a relatively consistent pattern across the selected health dimensions. The multidimensional nature of the NFHS, covering reproductive health, maternal and child health, nutrition, household conditions, and women's empowerment, provides an appropriate framework for assessing such broad changes.^{1,2}

A very strong positive correlation was observed between India and Madhya Pradesh, with Spearman's ρ increasing from 0.936 in NFHS-4 to 0.968 in NFHS-5 ($p<0.001$). This indicates a close alignment between state-level and national patterns of health indicators. The stronger association in NFHS-5 suggests that the relative performance of Madhya Pradesh across the selected indicators became more closely aligned with the national pattern over time. Such comparisons are consistent with the broader approach of assessing state performance against national health benchmarks.⁸

Regression analysis showed that baseline NFHS-4 values did not significantly predict subsequent improvement in either India or Madhya Pradesh. The explanatory power was low for both India ($R^2=0.011$, $p=0.455$) and Madhya Pradesh ($R^2=0.048$, $p=0.120$). These findings indicate that the initial level of an indicator alone was insufficient to explain the extent of subsequent change. Health outcomes are influenced by multiple demographic, socioeconomic, healthcare, and policy-related factors, and therefore improvement cannot be attributed solely to baseline performance.^{5,6} Despite the overall improvement in mean scores, the coefficient of variation increased from 63.04% to 67.72% in India and from 63.48% to 68.20% in Madhya Pradesh. The simultaneous increase in mean values and relative variability suggests that progress was accompanied by greater heterogeneity among the selected

indicators. Thus, aggregate improvement should not necessarily be interpreted as uniform improvement across all health dimensions. The persistence of differences across health indicators highlights the importance of identifying weaker-performing areas and strengthening targeted interventions.^{7,8}

Overall, the findings indicate positive progress between NFHS-4 and NFHS-5 in both India and Madhya Pradesh, with statistically significant improvement at the national level. Madhya Pradesh demonstrated a comparable rate of improvement but did not achieve statistical significance in the overall paired analysis. The strong India–Madhya Pradesh correlation indicates broadly similar patterns of health development, while the increasing variability emphasizes the need for focused, equitable, and domain-specific interventions to ensure that improvements are distributed more uniformly across health indicators.¹⁻⁴

CONCLUSION

The findings of this study clearly indicate that India has made considerable progress in improving key health indicators between NFHS-4 and NFHS-5. At the national level, the observed improvement is statistically significant, reflecting the overall effectiveness of various health policies and government interventions implemented over time.

Madhya Pradesh has also demonstrated improvement across health indicators; however, the changes are not statistically significant. This suggests that while progress has been made, it is comparatively weaker and less consistent than the national level. Although the direction of change is positive, the state continues to lag behind India in overall health performance.

The analysis further shows that improvements are observed across different health domains, indicating a general pattern of advancement in areas such as maternal health, child health, nutrition, and related indicators. However, the increasing coefficient of variation highlights a significant concern regarding rising inequality in health outcomes. This suggests that the benefits of improvement are not evenly distributed, and disparities persist across indicators and population groups.

Overall, the study concludes that while India is progressing in a positive direction in terms of health development, there remains a critical need for more targeted, inclusive, and region-specific policy interventions. Special attention is required for states like Madhya Pradesh to ensure that improvements are not only sustained but also statistically significant and equitably distributed across all health domains.

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