BMJ Global Health

Public health insurance coverage in India before and after PM-JAY: repeated cross-sectional analysis of nationally representative survey data

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To cite: Mohanty SK, Upadhyay AK, Maiti S, *et al*. Public health insurance coverage in India before and after PM-JAY: repeated cross-sectional analysis of nationally representative survey data. *BMJ Glob Health* 2023;**8**:e012725. doi:10.1136/bmjgh-2023-012725

Handling editor Seye Abimbola

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjgh-2023-012725).

Received 29 April 2023
Accepted 8 August 2023

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ABSTRACT

Introduction The provision of non-contributory public health insurance (NPHI) to marginalised populations is a critical step along the path to universal health coverage. We aimed to assess the extent to which Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana (PM-JAY)—potentially, the world's largest NPHI programme—has succeeded in raising health insurance coverage of the poorest two-fifths of the population of India.

Methods We used nationally representative data from the National Family Health Survey on 633 699 and 601 509 households in 2015–2016 (pre-PM-JAY) and 2019–2021 (mostly, post PM-JAY), respectively. We stratified by urban/rural and estimated NPHI coverage nationally, and by state, district and socioeconomic categories. We decomposed coverage variance between states, districts, and households and measured socioeconomic inequality in coverage. For Uttar Pradesh, we tested whether coverage increased most in districts where PM-JAY had been implemented before the second survey and whether coverage increased most for targeted poorer households in these districts.

Results We estimated that NPHI coverage increased by 11.7 percentage points (pp) (95% CI 11.0% to 12.4%) and 8.0 pp (95% CI 7.3% to 8.7%) in rural and urban India, respectively. In rural areas, coverage increased most for targeted households and pro-rich inequality decreased. Geographical inequalities in coverage narrowed. Coverage did not increase more in states that implemented PM-JAY. In Uttar Pradesh, the coverage increase was larger by 3.4 pp (95% CI 0.9% to 6.0%) and 4.2 pp (95% CI 1.2% to 7.1%) in rural and urban areas, respectively, in districts exposed to PM-JAY and the increase was 3.5 pp (95% CI 0.9% to 6.1%) larger for targeted households in these districts.

Conclusion The introduction of PM-JAY coincided with increased public health insurance coverage and decreased inequality in coverage. But the gains cannot all be plausibly attributed to PM-JAY, and they are insufficient to reach the goal of universal coverage of the poor.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Health insurance coverage in India has been low and highly unequal. It increased with income, educational attainment and higher occupational status and varied widely across states and communities.

⇒ Rashtriya Swasthya Bima Yojana (RSBY)—a centrally funded non-contributory public health insurance (NPHI) scheme—had limited success in covering households below the poverty line and providing financial protection.

⇒ Small scale studies found PM-JAY—an ambitious replacement of RSBY that aims to cover the poorest 40% of the population—to be ineffective in increasing coverage during early implementation.

WHAT THIS STUDY ADDS

⇒ This is the first study to use data that were representative at national, state and district levels to estimate NPHI coverage in India by state, district and socioeconomic characteristics before and after Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana (PM-JAY).

⇒ Over the study period, NPHI accounted for most of the increase in health insurance coverage.

⇒ Geographical and socioeconomic inequalities in NPHI coverage narrowed.

⇒ In Uttar Pradesh, we estimated that PM-JAY could plausibly account for one-third to two-fifths of the increase in NPHI coverage.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ PM-JAY is an important first step towards universal coverage in India.

⇒ This study suggests that while PM-JAY has raised health insurance coverage and reduced geographical and socioeconomic inequalities, there is still a lack of universal coverage of the poor.

INTRODUCTION

Progress towards universal health coverage has been uneven.[1] Only one-fifth of the non-elderly adult (16–59 years) population in 56 low-and middle-income countries has

health insurance.[2] Insurance coverage is often lower among those who are poorer, less educated, informally employed, older, female and rural residents.[2–4] Non-contributory public health insurance (NPHI) financed from general government revenues has been used, with varying degrees of success, to extend coverage to poorer households.[4–10] The most ambitious example is India's Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana (PM-JAY), which aims to become the world's largest NPHI programme.

Prior to PM-JAY, the publicly funded Rashtriya Swasthya Bima Yojana (RSBY) programme in India had limited success in extending coverage to the poor.[11–14] Health insurance increased with income, educational attainment and higher occupational status.[11 12 14] Coverage varied markedly between states and across communities.[15]

Recognising the limitations of RSBY and state NPHI schemes,[11 16–19] the Government of India launched PM-JAY in September 2018, aiming to provide publicly financed health insurance to 500 million individuals comprising the poorest 40% of the population.[20] Unlike RSBY, eligibility is based on the Socioeconomic and Caste Census (SECC) 2011 database of poor households.[21 22] In rural and urban areas, these households were identified from deprivation and occupational characteristics, respectively (online supplemental text S1). Households previously covered by RSBY, which was subsumed into PM-JAY, were made eligible and states could include households previously covered by their own NPHI schemes. Eligibility can be checked against the SECC/RSBY lists on presentation at an empanelled hospital.[23]

PM-JAY covers annual household medical expenses up to a ceiling of Rs500 000 (~US$6130) without limit on the number of household members incurring expenses—compared with only Rs30 000 accumulated over no more than five household members under RSBY. The benefit package, which includes 1393 treatments in 24 specialties with no exclusion of pre-existing conditions, is wider, as well as deeper, than that of RSBY.[20] PM-JAY aimed to further improve access by extending cover to treatment at empanelled private hospitals that, like public hospitals, are reimbursed for all direct treatment costs. Like RSBY, PM-JAY pays hospitals directly, avoiding any need for patients to make up-front cash payments. The effort to expand public health insurance coverage through PM-JAY followed a National Health Mission that increased investment in public health facilities and coincided with reduced inequality in utilisation of inpatient and maternal care.[24]

The central government finances PM-JAY jointly with the state governments that decided whether to adopt the programme, are responsible for its implementation and can choose to bear the financial consequences of extending its generosity. Between September 2018 and May 2021, PM-JAY was implemented in all but three states and union territories (UTs) (online supplemental text S2).

By July 2021, around 171 million PM-JAY cards had been issued that differ between rural and urban areas. This is not the net increase in coverage achieved by the programme since many would have been covered previously through RSBY and state schemes. Further, since cards can be issued on contact with health facilities, their number does not indicate the level of awareness of PM-JAY cover that may be critical to improving healthcare access. PM-JAY reimbursed Rs283 billion of medical expenses arising from 24 million admissions to over 24 000 empanelled hospitals up to July 2021 (online supplemental table S1).[25] However, the volume and value of claims varied markedly between states and specialties.[26] Empanelled hospitals are mostly (56%) public and are disproportionately located in states that had NPHI prior to PM-JAY.[27] There have been reports of delays in claim reimbursement, lack of front-line worker capacity and variable access to treatment and satisfaction.[28 29] A study covering the first year of PM-JAY implementation in one state (Chhattisgarh) found that enrolment in the programme was not associated with improved access to healthcare or financial protection.[30]

There is a lack of evidence on trends in health insurance coverage nationwide and in the poorer population targeted by PM-JAY since its launch. There is no estimate of the net impact of the programme on NPHI coverage, nor of how awareness of having this cover has changed. It is not yet established whether large socioeconomic and geographical inequalities in coverage narrowed after the introduction of PM-JAY. This paper aims to fill these gaps by comparing changes in coverage in the PM-JAY implementation period between socioeconomic groups and geographical locations with different exposures to the programme.

METHODS

Data

We used data from the fourth and fifth rounds of the National Family and Health Survey (NFHS) conducted from January 2015 to December 2016 and from June 2019 to May 2021, respectively.[31] Each survey covered all states/UTs and districts in India and was representative at national, state/UT and district levels. The surveys used the same stratified, two-stage random sampling design[32 33] (online supplemental text S2). The number of households interviewed was 601 509 and 636 699 in NFHS-4 (2015–2016) and NFHS-5 (2019–2021), respectively. We included all households in the analysis in order to estimate changes in health insurance coverage and inequality over the period in which PM-JAY was introduced, and to assess the extent to which coverage increased disproportionately among the poorest households identified from contemporary data, and not from the SECC 2011 database that PM-JAY principally uses to target the poorest 40% (online supplemental text S1).

Measurement of health insurance

Respondents were asked if anyone in their household was covered by a health scheme or health insurance. Those

responding positively were asked to indicate the type of health insurance from a list of nine categories that was the same in both NFHS-4 and NFHS-5. We created a binary indicator of anyone in the household having health insurance that was not acquired through employment and was not purchased from a private company (NPHI: no=0, yes=1) (online supplemental table S2). This NPHI indicator was positive if it was reported that anyone in the household obtained health insurance from a state health insurance scheme, RSBY, a community health insurance programme, or any other health insurance. The residual category could be selected by those covered by PM-JAY, which the questionnaire did not list separately.

Covariates

We estimated NPHI coverage separately for rural and urban areas and by sociodemographic characteristics that included wealth, education of the head of the household (no education, primary, secondary and tertiary) and religion (Hindu, Muslim, Christian, Sikh and others). Wealth was proxied by rural-specific and urban-specific indices derived from principal components analyses (PCA) of 33 indicators of household ownership of durable assets, housing conditions, land holdings and indicators of drinking water, toilet facility, cooking fuel and electricity (online supplemental table S3).[34] To facilitate pooling and comparison across states, the PCA were not state specific. The wealth index was used to rank households from the poorest to the richest. For some analyses, we used the index to categorise each household into one of five equally sized (after weighting) quintile groups (poorest, poorer, middle, richer, richest). We also estimated insurance coverage by five of the six SECC 2011 deprivation characteristics that determine eligibility for PM-JAY in rural areas: scheduled caste/tribe (SC/ST), no adult aged 16–59 years, female head of household with no male aged 16–59, single room dwelling without solid walls/roof, and landless with income mainly from causal manual labour (online supplemental text S1).[21 22] We created a binary indicator of a household having any of these characteristics (eligible: no=0, yes=1), each of which is sufficient to qualify for PM-JAY. We could not identify households with a disabled person and no able-bodied adult member nor the destitute, who are also eligible for PM-JAY in rural areas. In urban areas, PM-JAY eligibility, through SECC 2011, is determined by 11 occupational categories (online supplemental text S1), which were not measured in the survey.

We used information on the timing of PM-JAY implementation in relation to the NFHS-5 fieldwork to create a binary indicator of whether the programme was operating in a household's location at the interview date (PM-JAY: no=0, yes=1) (online supplemental table S4). This indicator mainly varied across states/UTs. Uttar Pradesh was an exception. In that state, PM-JAY was implemented in March 2020. NFHS-5 fieldwork started in December 2019 and ended in April 2021. Consequently, 27 districts (25 464 households) in Uttar Pradesh were surveyed before PM-JAY implementation, and 48 districts (45 072 households) were surveyed after implementation (online supplemental table S5).

Statistical analysis

We stratified all analyses by urban/rural. We estimated the NPHI coverage in 2015/2016 and 2019/2021 at the national level, and by state/UT, district and covariates. We used the coefficient of variation to summarise between-state/UT inequality in NPHI coverage in each period. At the district level, we plotted the change in coverage between 2015/2016 and 2019/2021 against baseline coverage. To estimate proportions of the total variation in NPHI that were attributable to differences between state/UTs, between districts within states/UTs, and between households within districts, we estimated a multilevel logistic regression of the binary NPHI indicator with random effects for states/UTs and districts (online supplemental text S4, Eq. S1). We used the estimates to decompose the total variance into three levels—state/UT, district and household—and so establish at which level there was most inequality in NPHI and whether inequality was increasing or decreasing at each level. We used a concentration index[35] to measure socioeconomic inequality in insurance coverage, with socioeconomic status proxied by the wealth index. We used a z-test of the significance of an interaction in the regression used to estimate the concentration index to test the null hypothesis that it did not change between periods.[36]

Using data from Uttar Pradesh, we estimated a linear probability model (LPM) of the NPHI coverage indicator on district fixed effects (FEs), a survey round FE, and an indicator of PM-JAY having been implemented when the NFHS-5 interviews were conducted in a district (online supplemental text S4, Eq. S2). The coefficient on the latter indicator gave a non-parametric estimate of the average effect of PM-JAY on coverage in the Uttar Pradesh districts exposed to the programme at the time of NFHS-5 under the assumption that those districts would have had the same trend in coverage as that observed in districts not exposed to PM-JAY by NFHS-5 if the programme had not been implemented. We tested whether PM-JAY succeeded in raising coverage in the targeted households by using the Uttar Pradesh rural sample to estimate an extended LPM of NPHI that also included the indicator of PM-JAY eligible, its interaction with each of the survey round and PM-JAY implemented indicators (online supplemental text 4, Eq. S3). The coefficient on the latter interaction provided an estimate of the difference between (A) the change in coverage among households that were eligible for PM-JAY in districts where the programme was implemented and (B) the change in coverage for households less likely to be eligible in the same districts. The latter households were not necessarily ineligible since not all eligibility criteria were measured and actual eligibility is determined by characteristics recorded at the time of the SECC 2011. The method, therefore, gave a lower-bound estimate of the effect of PM-JAY in the targeted

population. We used both the rural and urban Uttar Pradesh samples to conduct analogous triple difference analyses with the PM-JAY eligibility indicator replaced by an indicator of a household being among the poorest 40% according to the wealth index (online supplemental text 4, Eq. S4).

We applied sample weights in all analyses. In the regression analyses, we adjusted 95% CIs and SEs for clustering at the district level. Analyses were done by using STATA V.16.0 and R V.4.1.0.

Patient and public involvement

Patients and the public were not directly involved in the design of this study or the formulation of research questions and outcome measures.

Role of funding source

The research funder had no role in the study design, data collection, analysis and interpretation, decision to publish or writing of the manuscript.

RESULTS

Table 1 shows sample characteristics in each survey round. In 2015–2016, the head of household had received no schooling in around 38% of rural households and 18% of urban households. In 2019–2021, the respective illiteracy rates had fallen to around 34% and 17%. In rural areas, about 62% of households were in states/UTs/districts where PM-JAY had been implemented before the NFHS-5 interviews were conducted in 2019–2021. In urban areas, the respective percentage was around 67%. In rural areas in 2019–2021, more than two-thirds of households satisfied at least one of the criteria that were sufficient for PM-JAY eligibility and were measured in the survey.

Table 2 shows, separately by rural and urban location and period, estimated NPHI coverage overall and by household characteristics. In rural areas, we estimated that coverage was 26.9% (95% CI 26.5% to 27.4%) in 2015–2016 and increased by 11.7 percentage points (pp) (95% CI 11.0% to 12.4%) to reach 38.6% (95% CI 38.2% to 39.0%) in 2019–2021. In these areas, almost all health insurance was obtained through NPHI and this type of insurance accounted for most of the increase in coverage (online supplemental table S6). In urban areas, NPHI coverage increased by 8.0 pp (95% CI 7.3% to 8.7%) from 19.6% (95% CI 19.0% to 20.1%) in 2015–2016 to 27.6% (95% CI 27.1% to 28.1%) in 2019–2021. In these areas, there was more reliance on employment-based and private health insurance, although NPHI schemes were still the most prevalent and accounted for most of the increase in coverage (online supplemental table S6) . In both rural and urban areas, the increase in NPHI coverage was mainly due to more households in 2019–2021 reporting the residual category of other insurance, which would include PM-JAY (online supplemental table S6).

The estimated increase in coverage was lower (p<0.001) in the states/UTs where PM-JAY was implemented between the survey rounds: 9.6 pp (95% CI 8.4% to 10.6%) vs 10.8 pp (95% CI 9.5% to 12.2%) in rural areas, and 7.0 pp (95% CI 6.1% to 8.0%) vs 10.0 pp (95% CI 8.7% to 11.2%) in urban areas.

In rural areas in 2015–2016, NPHI coverage was lowest among the poorest fifth of households (19.8%, 95% CI 19.2% to 20.3%) but the increase in coverage was largest in this group (13.6 pp, 95% CI 12.7% to 14.5%) and in the next poorest fifth (13.4 pp, 95% CI 12.5% to 14.2%). In urban areas, NPHI coverage was lowest in the richest fifth of households in 2015–2016 (13.2%, 95% CI 12.3% to 14.0%), and the change in coverage was not associated with wealth quintile. In both rural and urban areas, coverage was initially lowest in the most educated households and this group had the smallest increase in coverage. In rural areas, NPHI coverage was initially higher among households belonging to SC/STs (30.5%; 95% CI 29.8% to 31.1%). But the point estimate of the increase in coverage was only slightly higher for this group, and there was no significant difference (p=0.746). In rural areas, the increase in NPHI coverage was smaller for households who were eligible for PM-JAY because they were headed by a female, lived in a single room without solid walls/roof, or did not have land. NPHI coverage in 2015–2016 was higher among rural households that would have met any of the PM-JAY eligibility criteria if the programme had been operating at that time: 29.1% (95% CI 28.6% to 29.6%) vs 22.6% (95% CI 22.1% to 23.2%). The increase in coverage was smaller for the group that, due to household characteristics, would have become eligible for PM-JAY if they were located where the programme was introduced: 11.1 pp (95% CI 10.3% to 11.8%) vs 12.8 pp (95% 12.0% to 13.7%).

Figure 1 shows geographical variation in NPHI coverage rates in 2019–2021. Less than 1% of the population of Andaman and Nicobar Islands were covered. In Rajasthan, almost three-quarters of the urban population and 90% of the rural population were covered. Between 2015–2016 and 2019–2021, NPHI coverage increased most in Rajasthan—72.2 pp (95% CI 70.8% to 73.6%) and 61.7 pp (95% CI 58.7% to 64.8%) in rural and urban areas, respectively (online supplemental table S7). Point estimates indicate a fall in coverage in some states. Over the period, the between state/UT coefficient of variation in NPHI coverage decreased by 31.5 pp and 30.7 pp in rural and urban areas, respectively (online supplemental table S7).

Figure 2 plots the percentage point change between 2015–2016 and 2019–2021 in district NPHI coverage against the baseline 2015–2016 coverage. In general, the increase was largest in districts that started with low coverage, which are predominantly in the North. Conversely, districts that had the highest initial coverage rates experienced either the smallest increases—particularly in the South—or the largest decreases—particularly in the Northeast. Differences in NPHI coverage between states/UTs and between districts within states/UTs decreased slightly over the period from 2015–2016

Table 1 Sample characteristics

	Rural				Urban			
	2015–2016		2019–2021		2015–2016		2019–2021	
	N=423 257	%	N=44 380	%	N=174 637	%	N=159 114	%
PM-JAY in state/UT by NFHS-5								
No	139 144	38.1	155 986	38.3	52 965	32.9	50 529	33.1
Yes	284 113	61.9	318 394	61.7	121 672	67.1	108 585	67.0
Wealth quintile group								
Poorest	84 256	20.0	95 718	20.0	39 725	20.1	34 850	20.1
Poor	86 181	20.0	99 154	20.0	35 807	20.1	33 195	20.1
Middle	86 478	20.0	95 328	20.0	33 968	20.0	31 376	20.0
Rich	82 655	20.0	91 577	20.0	32 137	20.0	30 093	20.0
Richest	83 687	20.0	92 603	20.0	33 000	19.9	29 600	19.9
Education of household head								
None	155 130	37.8	160 945	34.3	23 064	18.2	27 809	17.0
Primary	84 810	20.2	93 903	20.4	26 494	14.7	23 411	15.0
Secondary	161 224	36.9	191 293	39.2	82 171	47.5	76 527	47.4
Tertiary	22 093	5.2	28 239	6.0	32 908	19.6	31 367	20.6
Scheduled caste/tribes								
No	273 589	65.4	273 589	64.6	127 374	79.2	114 705	77.5
Yes	200 791	34.6	200 791	35.5	47 263	20.8	44 409	22.5
Religion								
Hindu	322 168	83.7	363 192	83.7	123 335	77.2	116 354	78.2
Muslim	43 724	10.6	48 071	10.9	29 073	16.2	24 319	15.4
Christian	34 710	2.5	38 053	2.6	14 100	3.1	11 461	3.3
Sikh	9185	1.7	10 557	1.6	3743	1.5	3307	1.4
Others	13 470	1.5	14 507	1.2	4386	2.0	3673	1.7
No adult aged 16–59 years in household								
No	403 161	94.8	447 400	93.9	168 728	96.4	151 522	94.7
Yes	20 096	5.2	26 980	6.1	5909	3.6	7592	5.3
Female headed household with no male aged 16–59 years								
No	416 647	98.2	465 445	97.9	172 766	98.8	156 710	98.3
Yes	6610	1.8	8935	2.1	1871	1.2	2404	1.7
Living in single room without solid walls and roof								
No	382 118	91.0	437 383	93.0	168 599	98.0	155 068	98.2
Yes	41 139	9.0	36 997	7.0	6038	2.0	4046	1.8
Has agricultural land								
Yes	237 774	52.6	267 247	52.1	28 984	13.4	24 841	13.1
No	185 483	47.4	207 133	47.9	145 653	86.6	134 273	87.0
Eligible for PM-JAY								
No	133 144	33.1	145 635	32.2	N/A		N/A	
Yes	290 113	66.9	328 745	67.8	N/A		N/A	

2015–2016 data from NFHS-4. 2019–2021 data from NFHS-5. PM-JAY in state/UT by NFHS-5—yes if resident of state/UT that had implemented PM-JAY by time of NFHS-5 interviews. Eligible for PM-JAY=yes if yes for scheduled caste/tribes, or yes for no adult aged 16–59 years in household, or yes for female headed household …, or yes for living in single room …, or no for has agricultural land. The eligibility indicator is not applicable (N/A) for 2015–2016 because PM-JAY had not been introduced and for urban because the respective eligibility criteria used in urban locations are not measured in the survey.
N/A, not available; NFHS, National Family and Health Survey; PM-JAY, Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana; UT, union territory.

Table 2 Non-contributory public health insurance coverage by rural/urban, period and sociodemographic characteristics, India

	Rural			Urban		
	2015–2016	2019–2021	Change	2015–2016	2019–2021	Change
	N=423 257	N=474 380	N=897 637	N=174 637	N=159 114	N=333 751
	% (95% CI)	% (95% CI)	pp (95% CI)	% (95% CI)	% (95% CI)	pp (95% CI)
Overall	26.9 (26.5 to 27.4)	38.6 (38.2 to 39.0)	11.7 (11.0 to 12.4)	19.6 (19.0 to 20.1)	27.6 (27.1 to 28.1)	8.0 (7.3 to 8.7)
PM-JAY in state/UT by NFHS-5						
No	24.2 (23.6 to 24.8)	38.0 (37.4 to 38.7)	10.8 (9.5 to 12.2)	13.9 (13.0 to 14.8)	23.9 (23.0 to 24.8)	10.0 (8.7 to 11.2)
Yes	28.6 (28.0 to 29.2)	39.0 (38.5 to 39.5)	9.6 (8.4 to 10.6)	22.4 (21.7 to 23.0)	29.4 (28.8 to 30.0)	7.0 (6.1 to 8.0)
Wealth quintile group						
Poorest	19.8 (19.2 to 20.3)	33.4 (32.8 to 34.0)	13.6 (12.7 to 14.5)	22.4 (21.3 to 23.5)	30.0 (28.9 to 31.0)	7.5 (6.0 to 9.1)
Poor	24.8 (24.2 to 25.4)	38.2 (37.6 to 38.8)	13.4 (12.5 to 14.2)	23.1 (22.0 to 24.1)	31.3 (30.3 to 32.3)	8.2 (6.8 to 9.7)
Middle	30.2 (29.5 to 30.9)	41.5 (40.9 to 42.1)	11.3 (10.3 to 12.3)	21.9 (20.9 to 22.8)	30.1 (29.2 to 31.0)	8.2 (6.9 to 9.6)
Rich	33.5 (32.7 to 34.3)	43.0 (42.4 to 43.7)	9.6 (8.4 to 10.7)	17.3 (16.4 to 18.2)	25.6 (24.8 to 26.5)	8.3 (7.1 to 9.6)
Richest	26.4 (25.7 to 27.1)	37.0 (36.2 to 37.7)	10.5 (9.4 to 11.7)	13.2 (12.3 to 14.0)	20.8 (20.0 to 21.6)	7.7 (6.5 to 8.9)
Education of household head						
None	28.4 (27.8 to 29.0)	39.8 (39.3 to 40.3)	11.4 (10.5 to 12.3)	23.4 (22.3 to 24.4)	31.8 (30.8 to 32.8)	8.4 (7.0 to 9.9)
Primary	29.8 (29.2 to 30.4)	41.7 (41.1 to 42.3)	12.0 (10.9 to 12.8)	23.6 (22.5 to 24.6)	32.5 (31.5 to 33.5)	9.0 (7.5 to 10.4)
Secondary	24.8 (24.3 to 25.3)	37.2 (36.8 to 37.7)	12.4 (11.7 to 13.2)	19.1 (18.4 to 19.8)	27.7 (27.1 to 28.3)	8.6 (7.7 to 9.5)
Tertiary	20.0 (19.1 to 20.8)	30.5 (29.1 to 31.2)	10.5 (8.9 to 12.1)	14.2 (13.4 to 15.0)	20.3 (19.5 to 21.1)	6.1 (5.0 to 7.2)
Scheduled caste/tribes						
No	25.1 (24.6 to 25.6)	36.7 (36.2 to 37.1)	11.6 (10.8 to 12.4)	18.9 (18.4 to 19.5)	27.0 (26.4 to 27.5)	8.0 (7.2 to 8.8)
Yes	30.5 (29.8 to 31.1)	42.2 (41.7 to 42.8)	11.8 (10.8 to 12.7)	22.0 (20.7 to 23.3)	29.8 (28.7 to 30.9)	7.9 (6.2 to 9.6)
Religion						
Hindu	27.9 (27.4 to 28.3)	39.6 (39.1 to 40.0)	11.8 (11.0 to 12.5)	20.3 (19.7 to 20.9)	28.5 (27.9 to 29.0)	8.2 (7.3 to 9.0)
Muslim	18.9 (17.9 to 20.0)	31.0 (29.9 to 32.0)	12.0 (10.5 to 13.5)	16.7 (15.4 to 17.8)	24.0 (22.6 to 25.4)	7.4 (5.5 to 9.2)
Christian	43.8 (41.6 to 46.0)	54.8 (53.1 to 56.4)	10.9 (8.0 to 13.9)	28.9 (26.4 to 31.4)	35.3 (32.5 to 38.1)	6.4 (2.6 to 10.1)
Sikh	15.7 (14.1 to 17.3)	17.7 (16.2 to 19.1)	2.0 (-0.2 to 4.1)	10.6 (8.7 to 12.5)	14.6 (12.6 to 16.7)	4.0 (1.3 to 6.8)
Others	16.5 (14.9 to 18.0)	33.3 (31.3 to 35.4)	16.8 (14.3 to 19.4)	8.6 (6.7 to 10.6)	15.7 (13.2 to 18.1)	7.0 (3.9 to 10.2)
No adult aged 16–59 years in household						
No	26.9 (26.5 to 27.4)	38.7 (38.2 to 39.1)	11.7 (11.0 to 12.4)	19.6 (19.0 to 20.1)	27.6 (27.0 to 28.1)	8.0 (7.2 to 8.7)
Yes	26.7 (25.7 to 27.7)	38.1 (37.2 to 39.0)	11.4 (10.0 to 12.8)	19.4 (17.6 to 21.1)	27.9 (26.4 to 29.4)	8.5 (6.2 to 10.8)
Female headed household with no male 16–59 years						
No	26.9 (26.5 to 27.4)	38.6 (38.2 to 39.1)	11.7 (11.0 to 12.4)	19.6 (19.0 to 20.1)	27.6 (27.1 to 28.1)	7.9 (7.2 to 8.7)

Continued

Table 2 Continued

	Rural			Urban		
	2015–2016	2019–2021	Change	2015–2016	2019–2021	Change
	N=423 257	N=474 380	N=897 637	N=174 637	N=159 114	N=333 751
	% (95% CI)	% (95% CI)	pp (95% CI)	% (95% CI)	% (95% CI)	pp (95% CI)
Yes	27.1 (25.5 to 28.9)	37.4 (35.8 to 39.0)	10.2 (7.9 to 12.6)	20.9 (18.2 to 23.8)	29.8 (27.3 to 32.2)	8.8 (5.1 to 12.6)
Living in single room without solid wall/roof						
No	27.2 (26.7 to 27.6)	39.1 (38.7 to 39.6)	12.0 (11.2 to 12.6)	19.5 (19.0 to 20.1)	27.6 (27.1 to 28.1)	8.1 (7.3 to 8.8)
Yes	24.7 (23.8 to 25.6)	32.3 (31.5 to 33.1)	7.6 (6.4 to 8.9)	22.5 (20.2 to 24.7)	27.6 (25.2 to 30.0)	5.1 (1.9 to 8.4)
Has agricultural land						
Yes	24.5 (24.0 to 24.9)	38.4 (38.0 to 38.9)	13.9 (13.2 to 14.7)	16.4 (15.4 to 17.3)	27.9 (26.9 to 28.9)	11.5 (10.1 to 13.0)
No	29.7 (29.1 to 30.2)	38.8 (38.3 to 39.4)	9.2 (8.2 to 10.1)	20.1 (19.5 to 20.6)	27.5 (27.0 to 28.1)	7.5 (6.7 to 8.3)
Eligible for PM-JAY						
No	22.6 (22.1 to 23.2)	35.4 (34.9 to 36.0)	12.8 (12.0 to 13.7)	N/A		
Yes	29.1 (28.6 to 29.6)	40.1 (39.7 to 40.6)	11.1 (10.3 to 11.8)	N/A		

Change is the 2019–2021 value minus the 2015–2016 value.
N/A, not available; NFHS, National Family and Health Survey; PM-JAY, Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana; pp, percentage points; UT, union territory.

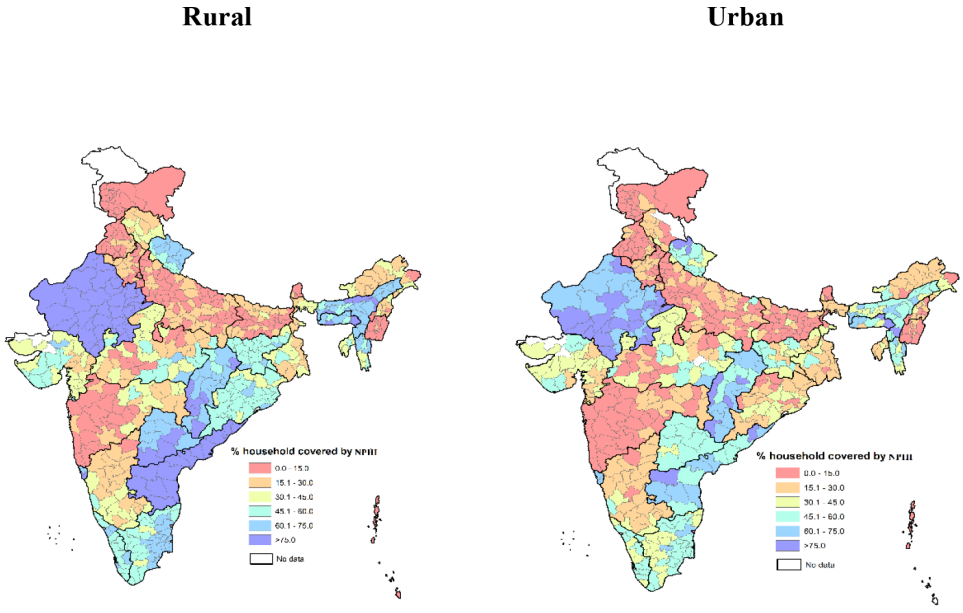

Figure 1 Non-contributory public health insurance coverage by district in 2019–2021, India. See online supplemental figure S1 for map of any health insurance coverage across districts.

to 2019–2021 relative to the total variation in coverage (online supplemental table S9). At least two-thirds of this variation was between households within districts, and this proportion increased over time.

Table 3 shows concentration index measures of wealth-related inequality in NPHI coverage. Inequality differed between rural and urban areas. In the latter, the index is significantly negative for both periods, indicating that, consistent with the intended targeting, poorer urban households were more likely to have NPHI. This pro-poor inequality decreased over time (p=0.025). In rural areas, positive indices imply pro-rich inequality in NPHI that decreased over the period. In both rural and urban areas, more wealthy households were more likely to have any health insurance in both periods (online supplemental table S10)

Table 4 shows estimates of changes in NPHI coverage between 2015–2016 and 2019–2021 in Uttar Pradesh. In Panel A, the estimate in the third column of the row headed 2019–2021 indicates that NPHI increased by 7.5 pp (95% CI 6.0% to 9.1) in districts where the NFHS-5 data were collected before PM-JAY was implemented. The coefficients on the interactions in the first row of this panel are all significantly positive, indicating greater increases in coverage in districts that had been exposed to PM-JAY. We estimated that coverage in rural (urban) parts of these districts increased by 3.4 pp (95% CI 0.9% to 6.0%) (4.2 pp; 95% CI 1.2% to 7.1%) more than it did in districts that had not yet been exposed to PM-JAY when the NFHS-5 data were collected. These estimates were robust to adjusting for covariates (online supplemental table S12) and estimation by probit (online supplemental table S13).

Panel B gives triple difference estimates of changes in NPHI coverage in rural Uttar Pradesh. The estimate of 0.046 (95% CI 0.032 to 0.059) in the bottom row (2019–2021) indicates that coverage increased by 4.6 pp in districts where PM-JAY was not implemented between survey rounds. The middle row (PM-JAY×2019–2021) estimate of 0.014 (95% CI −0.007 to 0.035) implies an

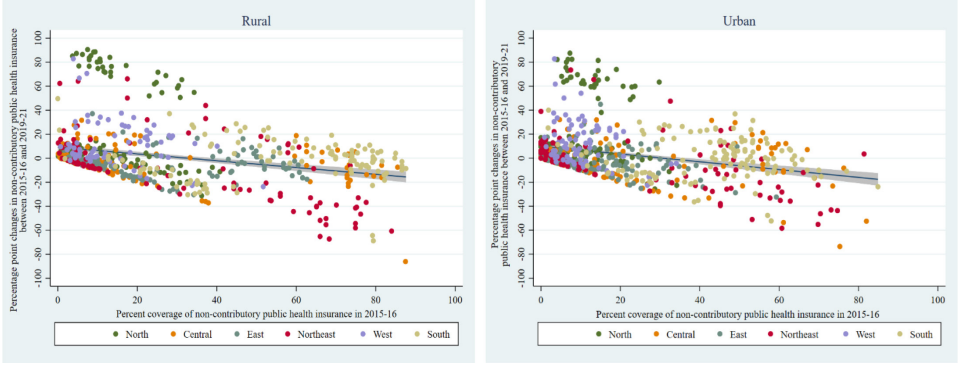

Figure 2 Change in non-contributory public health insurance coverage between 2015–2016 and 2019–2021 against coverage in 2015–2016 by district. See online supplemental figure S2 for analogous figure for any health insurance and online supplemental figure S3 for analogous figure at state/UT level. UT, union territory.

Table 3 Wealth-related inequality in non-contributory public health insurance coverage, India

	Concentration index (95% CI)		H_0: no change
	2015–2016	2019–2021	P value
Rural	0.089 (0.081 to 0.096)	0.039 (0.032 to 0.047)	<0.001
Urban	0.125 (–0.144 to –0.107)	0.099 (–0.113 to –0.085)	0.025

The concentration index is a scaled covariance between a binary indicator of NPHI coverage and wealth rank.[35] Positive (negative) value indicates pro-rich (pro-poor) inequality. See online supplemental figure S4 for graphical presentations of inequality in concentration curves. See online supplemental table S10 and figure S5 for inequality in any health insurance coverage.
NPHI, non-contributory public health insurance.

additional 1.4 pp increase in districts where PM-JAY was implemented averaged across households that did not meet any of the eligibility criteria measured in the survey. The top row (Eligible×PM JAY×2019–2021) estimate of 0.035 (95% CI 0.009 to 0.061) indicates an additional increase in coverage of 3.5 pp across households that were exposed to the programme and were eligible. Panel C shows the analogous triple difference estimates obtained with an indicator of being among the poorest 40% of households replacing the PM-JAY eligibility indicator. The top row estimate suggests that the increase in NPHI coverage associated with location in a district that implemented PM-JAY was 2.8 pp (95% CI –0.1% to 5.6%) larger for the poorest rural households that the programme aimed to target. In urban areas, the increase in coverage was greater in districts that were exposed to PM-JAY, but coverage did not increase (differentially) by even more among the urban poor in these districts.

DISCUSSION

To assess the success of PM-JAY—the most ambitious publicly funded health insurance programme in the developing world—in raising coverage of the poor population of India, we analysed two rounds of the largest ever population-based health survey. We compared trends in NPHI coverage between households that did and did not have characteristics the programme uses for targeting and between states and districts where the programme was and was not implemented between the survey rounds. To the best of our knowledge, this is the

Table 4 Change in non-contributory public health insurance coverage between 2015–2016 and 2019–2021 by exposure to PM-JAY and eligibility/poverty status, Uttar Pradesh

		Rural	Urban	Overall
		Coeff. (95% CI)	Coeff. (95% CI)	Coeff. (95% CI)
A	PM-JAY exposure			
	PM-JAY×2019–2021	0.034 (0.009 to 0.060)	0.042 (0.012 to 0.071)	0.036 (0.015 to 0.058)
	2019–2021	0.079 (0.062 to 0.095)	0.069 (0.046 to 0.091)	0.075 (0.060 to 0.091)
B	PM-JAY exposure and eligibility			
	Eligible×PM JAY×2019–2021	0.035 (0.009 to 0.061)	N/A	N/A
	PM-JAY×2019–2021	0.014 (–0.007 to 0.035)	N/A	N/A
	2019–2021	0.046 (0.032 to 0.059)	N/A	N/A
C	PM-JAY exposure and poverty status			
	Poorest 40%×PM JAY×2019–2021	0.028 (–0.001 to 0.056)	0.007 (–0.041 to 0.026)	0.018 (–0.007 to 0.043)
	PM-JAY×2019–2021	0.028 (0.003 to 0.052)	0.045 (0.018 to 0.073)	0.032 (0.012 to 0.053)
	2019–2021	0.061 (0.042 to 0.080)	0.059 (0.041 to 0.077)	0.060 (0.044 to 0.077)
	District fixed effects	Yes	Yes	Yes
	N	112 273	34 308	146 581

Linear probability models of household non-contributory public health insurance indicator estimated using pooled NFHS-4 (2015–2016) and NFHS-5 (2019–2021) data for from Uttar Pradesh. All models include district fixed effects (FE), the 2019–2021 indicator and its interaction with an indicator (PM-JAY) of location in a district where PM-JAY was implemented when NFHS-5 was fielded. Panel B additionally includes an indicator of household eligibility for PM-JAY and its interactions with each and both of PM-JAY and 2019–2021. Panel C is from an analogous model with an indicator of the household being among the poorest 40% replacing the indicator of PM-JAY eligibility. 95% CIs adjusted for clustering at the district level. Online supplemental table S11 gives full estimates of the models from which the Panels B and C estimates are extracted. Online supplemental table S12 gives estimates for an extended version of the Panel A model that also include the covariates listed table 1. Online supplemental table S13 gives estimates of marginal effects from analogous probit models of NPHI.
NFHS, National Family and Health Survey; PM-JAY, Ayushman Bharat-Pradhan Mantri Jan Arogya Yojana.

first study to conduct such an assessment of changes in NPHI coverage in India.

We estimated that the fraction of the population with NPHI increased by almost 12 pp in rural areas and 8 pp in urban areas between 2015–2016 and 2019–2021. These increases accounted for most of the respective increases any health insurance coverage over a period that spans the introduction of PM-JAY. Across the country, the increase in NPHI coverage was not greater among households who met criteria used to determine PM-JAY eligibility in rural areas. Further, NPHI coverage did not increase more in the states/UTs where PM-JAY was implemented between the survey rounds.

This may have been due to low take-up in the early stages of implementation or because the effect of the programme spilled over to states that did not implement it. The latter states may have responded to PM-JAY by increasing efforts to raise coverage of their own health insurance schemes (online supplemental text S2). Coverage of state government schemes increased by 5.8 pp (95% CI 5.0% to 6.5%) in rural areas and by 3.2 pp (95% CI 2.6% to 3.8%) in urban areas (online supplemental table S6). Rajasthan recorded the largest increase in coverage despite not implementing PM-JAY until after NFHS-5 was completed in the state. The large increase in coverage was due to expansion of the state scheme from covering 15.8% (95% CI 14.9% to 16.6%) of the Rajasthan population in 2015–2016 to 85.4% (95% CI 84.5% to 86.3%) in 2019–2021.

Our analysis between districts of Uttar Pradesh avoided any potential bias arising from spillover effects by exploiting variation in exposure to PM-JAY that was entirely driven by the timing of survey interviews. We estimated that PM-JAY increased NPHI coverage by 3.4 pp in rural areas and 4.2 pp in urban areas of the state. Between 2015–2016 and 2019–2021, the increase in NPHI coverage was 9.9 pp and 9.7 pp in rural and urban areas, respectively. Hence, around one-third to two-fifths of the total increase may be plausibly attributed to PM-JAY. The remainder of the coverage increase presumably resulted from improved supply of other schemes labelled NPHI, which include community health insurance, or demand-side changes that caused more people to acquire insurance through those schemes without PM-JAY becoming available. If the relative effect of PM-JAY on NPHI we estimated in Uttar Pradesh were to extrapolate to the national level, it would be a substantial proportionate increase in coverage. But it would still leave the country a long way short of universal coverage, even of the poor population. We estimated that NPHI coverage of the poorest two-fifths of the national population increased by only 8–13 pp to reach around 30–35 % in 2019–2021. Even if PM-JAY had been responsible for all of this increase, which our estimates from Uttar Pradesh suggest is not the case, then the programme would only have made modest progress in propelling India's poor along the path to universal coverage.

In rural areas of Uttar Pradesh, we estimated that PM-JAY increased NPHI coverage of targeted households by around 3.5 pp using programme eligibility characteristics and by 2.8 pp using the poorest 40% identified by our own wealth index. These triple difference estimates are not only specific to the targeted population, they also avoid a potential bias in the estimates obtained from comparison between districts that were exposed to PM-JAY at the time of the 2019–2021 survey and those that were not yet exposed because the survey was fielded earlier. The former districts were also more likely to have been exposed to COVID-19 by the time that interviews were conducted. If this second exposure motivated enrolment in NPHI, then it would confound the effect of PM-JAY. The triple differences analysis used variation between households within a district and so removed this potential bias. With this analysis, we estimated a 2.8–3.5 pp increase in coverage for rural households targeted by PM-JAY. In urban areas of Uttar Pradesh, we did not find evidence of a greater increase in NPHI coverage among the poorest two-fifths of households, which could indicate failure to target PM-JAY effectively on the urban poor in this state.

In India, the COVID-19 lockdown started in March 2020. By that time, NFHS-5 fieldwork had been completed in 21 states/UTs, and it was yet to be completed in 15 states/UTs. Changes in NPHI coverage did not differ between these two groups of states/UTs (online supplemental table S14). This suggests that our finding of increased coverage throughout the country is not merely a consequence of the pandemic.

In rural areas, there has been a substantial decrease in pro-rich inequality in NPHI that has moved closer to the goal of covering poorer households. Belonging to a scheduled tribe or caste was the PM-JAY eligibility criterion most closely associated with NPHI coverage. Poor quality housing was actually associated with markedly lower NPHI coverage. In urban areas, poorer households had higher NPHI coverage prior to PM-JAY but this targeting subsequently weakened. Generally, there is scope for substantial improvement in the targeting of NPHI schemes, including PM-JAY.

There was extensive geographical inequality in NPHI coverage across states and districts that has narrowed somewhat over time. Coverage increased most in northern districts that started with low coverage and fell by most in northeastern districts that started with high coverage. Despite this convergence and the introduction of PM-JAY close to nationwide, geographical inequality remained substantial in 2019–2021.

One limitation of this study is that the survey did not include PM-JAY as an insurance category and so we were not able to estimate coverage through this programme. However, the health insurance questions were the same in both surveys, which made it possible to construct consistent measures of NPHI coverage and use them to assess the change in this coverage associated with the introduction of PM-JAY. The increase in NPHI coverage was mainly

due to increased reporting of a residual category of any other insurance, which respondents could use to report PM-JAY cover. The absence of any explicit mention of this programme in the second survey questionnaire may have biased our estimates of the change in NPHI coverage, but only if it raised the likelihood that those with NPHI incorrectly reported having employment-based insurance, private insurance or no insurance compared with the magnitudes of such reporting errors in the first survey. While any self-reported data are potentially prone to measurement error, self-reported insurance status has the advantage of informing of coverage awareness, which is critical to securing improvements in healthcare access and financial protection from insurance. In principle, PM-JAY would cover medical expenses at empanelled hospitals of all members of households on the SECC 2011 list of the poor. However, if such a household is unaware of this cover, then its members may not go for treatment and they will not enjoy the peace of mind that comes from being financially protected against treatment costs.

A second limitation is that the survey did not include information on occupation, which is the main characteristic used to determine eligibility for PM-JAY in urban areas. This limited the analysis of programme targeting in urban areas, although we did this with a wealth index. The survey measured five of the six characteristics used in rural areas to determine eligibility. And it measured these characteristics some years after the SECC 2011 measurements that determine eligibility. Some of those we coded as 0 on the eligibility indicator would, therefore, have been eligible. Some of those we coded as 0 on the eligibility indicator would, therefore, have been eligible. While the likely positive correlation between eligibility characteristics will have reduced the magnitude of this problem, it does mean that our triple difference analysis probably gave a lower bound estimate of the effect of PM-JAY.

A third limitation is that we did not estimate effects of insurance coverage on outcomes related to health, healthcare utilisation and healthcare payments. It is these potential effects of health insurance that determine its value. A dated systematic review concluded that NPHI increased service coverage in 9 of 15 countries and reduced out-of-pocket payments in only 4 countries.[37] More recent and rigorous studies obtained more positive results from major NPHI reforms in Karnataka (India),[9] Peru,[7] Thailand[6 38] and Turkey.[5 10] Systematic reviews of evidence from India found that NPHI schemes increased healthcare utilisation but had no clear impact on financial risk protection.[14 18] In one state (Chhattisgarh), enrolment in PM-JAY in its first year of operation was not found to be associated with greater use of healthcare or with reduced out-of-pocket payments.[30] For the Uttar Pradesh analysis, we did not examine pretrends to assess the plausibility of an assumption of common trends between districts where PM-JAY had and had not been implemented by the time of the NFHS-5 interviews. However, such assessment would be irrelevant to our triple differences analysis that used within district variation and so did not assume common trends between districts.

This study documented a substantial increase in public health insurance coverage in India over a period in which PM-JAY was introduced. We showed marked reductions in socioeconomic and geographical inequalities in coverage. However, these inequalities were far from eliminated and NPHI coverage remained some distance from the goal of universality among the poor. Our best estimates suggest that PM-JAY raised that coverage by no more than two-fifths of the baseline, which leaves substantial gaps.

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Funding Swiss National Science Foundation and the Swiss Agency for Development and Cooperation grant 400640_160374.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. The datasets are publicly available and can be accessed by registering at https://dhsprogram.com/data/new-user-registration.cfm.

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