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# Trends over a decade in geographical inequality for opportunity in access to maternal care services from the National Family Health Surveys in India

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3	22	ABSTRACT
4 5	23	<b>Objectives</b> : To examine the trends in geographical inequality of opportunity in maternal health
6 7 9	24	services in India considering the ENAP 2025 coverage targets.
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10 11	25	Setting: India
12 13	26	Participants: Women in the National Family Health Survey (NFHS) - NFHS-4 (2014-15) and NFHS-5
14 15	27	(2019-21).
16 17	28	Primary and secondary measures: District-level coverages of 4+ antenatal care (ANC) visits,
19 20	29	institutional delivery with skilled birth attendant (SBA), postnatal care (PNC) services within 48 hours
21 22	30	of delivery, Continuum of care (CoC) services for women with most recent livebirths. Human
23 24	31	Opportunity Index (HOI) documented the opportunities for equitable access of these
25 26 27	32	services, ranging from 0 (high inequality) to 100 (universal access). HOI was compared between the
28 29	33	survey rounds and wealth index quintiles (WI) that the women belonged to.
30 31	34	Results: Coverages of 4+ ANC visits, institutional delivery, PNC, and CoC in India increased by 22.8%
32 33	35	(95% CI 22.1-23.5), 12.6% (12.2-12.9), 28.5% (28.0-29.0), and 38.6% (37.6-39.6) between NFHS-4 and
34 35 26	36	NFHS-5, respectively. The HOI for 4+ ANC visits was 48.4 in NFHS-5, ranging from 11.3 to 92.4 in
30 37 38	37	states and from 31.1 to 70.5 for WI I to V. The HOI for institutional delivery was 80.4 in NFHS-5,
39 40	38	ranging from 37.4 to 99.7 in the states and from 21.0 to 100 for WII to V. The HOI for PNC services
41 42	39	was 73.5 in NFHS-5, ranging from 37.5 to 95.6 in the states and from 61.2 to 88.3 for WI I to V. The
43 44	40	HOI for CoC was 37.1, ranging from 6.5 to 88.8 in the states and from 19.8 to 62.7 for WI I to V for
45 46 47	41	CoC in NFHS-5.
48 49	42	Conclusion: Though significant improvements in the geographic inequity of maternal health services
50 51	43	have been made, the geographic inequity for 4+ANC visits coverage lags significantly behind
52 53	44	resulting in CoC coverage inequity to achieve the ENAP targets for these services.
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3 4	46	Keywords: Antenatal care services, continuum of care, human opportunity index, India, inequity,
5 6	47	institutional delivery, NFHS, postnatal care, wealth index.
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0	STRENGTHS AND LIMITATIONS OF THE STUDY
1	• District-level inequity estimated in the coverages of maternal health services for India using
2	large-scale demographic surveys
3	• Human opportunity index used to indicate the extent of inequity in the coverages by
4	geography and by wealth index
5	Quality of services not captured in the assessment
6	

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#### 57 INTRODUCTION

With the Sustainable Development Goal (SDG) 10, the governments worldwide have committed to act on inequality through multiple, interconnected goals, requiring combined policy action in order to meet an overall commitment to 'leave no-one behind'.(1) Access to health care for all also intersects with the inequalities related to gender, socio-economic status, education levels, employment status and geographical location, with the most marginalized being the least able to access quality healthcare.(2) Inequality in access to essential health-care services has implications on achieving universal health coverage, including maternal health services among both the general and the most disadvantaged populations.(3) Significant literature on the extent of inequities in maternal health services is available from developing countries including from India, predominately based on the Demographic and Health Surveys (DHS) and focusing on socio-economic inequalities in the use of maternal health services.(4-16) In the context of Countdown to 2030, SDGs 3.1 and 3.2 which aim to reduce maternal and

neonatal mortality by 2030,(3) we examine the trends in geographical inequality of opportunity in access for the coverage of antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), and postnatal care (PNC) visits within 48 hours in India using the National Family Health Survey (NFHS), which is the equivalent of DHS in India.(17) In addition, we also measure geographical inequality in the coverage of continuum of care (CoC), which is recommended as one of the global strategies for maternal health to improve maternal and neonatal outcomes in the developing country setting.(18-20) The maternal health program in India is implemented at the district level, (21) and the Every Newborn Action Plan (ENAP) 2025 provides for maternal care services coverage target indicators based on the district-level coverage of these services in a state.(22) Therefore, we examine district-level inequality in India and its states as these have implications on planning to achieve the ENAP 2025 coverage targets.

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2 3	82	METHODS
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6	83	Study design
/ 8 9	84	We utilized the publicly available data from the two most recent rounds of NFHS conducted post
10 11	85	year 2010, NFHS-4 (2014-15) and NFHS-5 (2019-21).(17, 23) These nationally representative
12 13	86	population-based surveys are conducted by the International Institute of Population Sciences,
14 15	87	Mumbai, India, with the primary aim to provide estimates of maternal and child health and
16 17 18	88	reproductive health indicators at the district-level for India.(17, 23) No ethics approval was required
19 20	89	for this analysis as we utilised the de-identified data available in public domain.
21 22	90	The NFHS-4 provided data for livebirths between 2011 and 2015-2016 and NFHS-5 on
23 24	91	livebirths between 2016 and 2020-2021. We defined the CoC for this analysis as a woman having
25 26 27	92	reported four or more ANC visits and institutional delivery with SBA and PNC within 48 hours of
27 28 29	93	delivery for her most recent livebirth in the last 5 years. We calculated the coverage of 4 or more
30 31	94	ANC visits (4+ ANC visits), institutional delivery with SBA, PNC within 48 hours of delivery, and CoC
32 33	95	for the most recent livebirth for NFHS-4 and NFHS-5 for India, and its states and districts.
34 35	96	Data analysis
30 37 38	97	The primary objective of this analysis was to measure the trends in geographical inequality for the
39 40	98	opportunity to access maternal care services in India and its states, for which we utilised the Human
41 42	99	Opportunity Index (HOI). The HOI is a measure of the coverage rate of an opportunity discounted by
43 44	100	inequality in the distribution across the circumstance groups, and is estimated as:(24, 25)
45 46 47	101	$HOI = (1 - D) \times C$
47 48 49	102	Where D measures the dissimilarity between access of services for groups defined by circumstance
50 51	103	characteristics (such as wealth index, education, distance, etc) and the average access coverage for
52 53	104	the same service for the population as a whole; C is average access coverage of services the
54 55	105	population as a whole. The HOI ranges from 0 (high inequality) to 100 (universal access). In this
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57 58	106	analysis, D is the index of geographical inequality at the district-level within each state compared

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3 4	108	each of the three maternal care services and CoC for India and its states was estimated using the
5 6	109	district level coverage of these services in NFHS-4 and NFHS-5, and the change in HOI between
7 8	110	NFHS-4 and NFHS-5 was assessed. The number of districts in each state in NFHS-4 and NFHS-5 are
9 10 11	111	shown in supplemental table 1.
12 13	112	In addition, we explored inequality by wealth index (WI) quintile in NFHS-5. The WI quintile is
14 15	113	provided in the NFHS dataset at the household level which is based on the number and kinds of
16 17	114	consumer goods each household owns calculated using principal component analysis.(17, 26) We
18 19 20	115	calculated HOI for India and states for each WI quintile for each maternal health service and CoC. We
20 21 22	116	report the ratio of state average HOI with WI I and WI V, and the ratio of HOI WI Ito WI V for each
23 24	117	maternal health service and CoC.
25 26	118	The states of India were grouped based on its development status for this analysis. The
27 28	119	Empowered Action Group of states as categorized by the government of India (Bihar, Chhattisgarh,
29 30 31	120	Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh, Uttarakhand, and the north-eastern
32 33	121	states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura) were
34 35	122	grouped as 'less developed' and the remaining states were categorised as "more developed." (27, 28)
36 37 38	123	Delhi, Jammu and Kashmir including Ladakh were considered as a state for this analysis, and all the
38 39 40	124	other Union Territories were excluded. We have reported 95% confidence interval for all estimates as
41 42	125	relevant and all the analyses were carried out using STATA version 13.1 and Microsoft Excel 2016.
43 44	126	
45 46	127	Patient and Public Involvement statement: Patients were not involved in planning of this analysis.
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45 46 47	1
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# **BMJ** Open Page 9 of 38 1 .30 RESULTS A total of 188,506 and 174,796 ever-married women aged 15-49 years provided data on their most .31 .32 recent livebirth in NFHS-4 and NFHS-5, respectively. The coverages for 4+ ANC visits, institutional .33 delivery with SBA, and PNC in 48 hours, and CoC for NFHS-4 and NFHS-5 for India, grouping of states, .34 and individual states are shown in supplemental table 2. 4+ ANC visits .35 .36 The coverage of 4+ ANC visits for India was 57.0% (95% CI 56.8 to 57.3) in NFHS-5. The percent change in coverage of 4+ ANC visits from NFHS-4 to NFHS-5 was estimated at 22.8% (95% CI 22.1 to .37 23.5), 33.3% (95% CI 32.3 to 34.3), and 3.4% (95% CI 2.6 to 4.1) for India, less developed and more .38 .39 developed states, respectively (supplemental table 2). This coverage ranged from 15.6% in Nagaland 40 to 80.0% in Odisha in the less developed states, and 58.3% in Punjab to 93.2% in Goa in the more developed states in NFHS-5 (supplemental table 2). The HOI for geographic inequality in 4+ ANC .41 42 visits for India was 48.4 in NFHS-5, an improvement of 35.2% (95% CI 34.5 to 35.9) between NFHS-4 .43 to NFHS-5 (supplemental table 2), and was substantially higher for the more developed states at 44 68.2 than the less developed states at 40.7 in NFHS-5 (table 1 and supplemental table 3). HOI 45 ranged from 8.3 to 88.9 in the states in NFHS-4, and 11.3 to 92.4 in the states in NFHS-5 (Figure and supplemental table 3). Three and 6 states from the less and more developed states showed a 46 47 reduction in HOI between NFHS-4 to NFHS-5, respectively (supplemental table 3). The highest gains

in HOI were made in the state of Uttarakhand (115.1; 95% CI 109.0 to 121.1) between NFHS-4 to 48 .49 NFHS-5, with the HOI for the state at 55.7 in NHFS-5.

.50 Considering WI (table 1), HOI ranged from 33.8 for WI I to 64.4 for WI V for India, and the corresponding range was 31.1 to 57.0 and 58.6 to 70.5 for less and more developed states in NFHS-.51 5, respectively. The HOI ratio of WI V to average was 1 or more in all states except Sikkim, Tamil .52 .53 Nadu and Kerala. Substantial variations were seen in HOI ratio of WI I to V, ranging from 0.16 to .54 1.41, with this ratio being <1 in 27 (90.0%) states in NFHS-5, and the lowest HOI ratio between WI I

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3	155	and V was seen in Mizoram at 0.16. Among the 20 states with WI I to state HOI ratio at >0.70, 15
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159	Table 1: Average Human opportunity index (HOI) and by wealth index quintile (WI) and ratio between will and average HOI, WI V and
160	average HOI and between WI I and V for four or more antenatal care visits for India and its states, Nagon Wi Family Health Survey-5.
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				Four o	r more AN	C visits		
				HOI by WI				HOI Ratio
	Average						WII:	WIV:
	HOI		II	III	IV	V	average	average
India	48.4	33.8	44.0	53.1	59.3	64.4	0.70	1.33
Less developed states	40.7	31.1	38.9	45.4	50.1	57.0	0.76	1.40
Arunachal Pradesh	34.3	20.2	31.6	37.0	44.2	47.3	0.59	1.38
Assam	45.6	38.9	46.4	53.3	60.1	61.5	0.85	1.35
Bihar	22.9	15.6	22.9	30.2	37.4	49.2	0.68	2.15
Chhattisgarh	57.2	54.3	53.4	60.9	60.5	61.0	0.95	1.07
Jharkhand	36.0	28.6	38.5	41.9	51.8	56.0	0.79	1.56
Madhya Pradesh	52.2	44.6	49.3	56.1	59.1	62.3	0.85	1.19
Manipur	61.2	36.7	64.6	78.7	84.9	91.3	0.60	1.49
Meghalaya	45.4	36.8	45.8	50.0	61.5	55.5	0.81	1.22
Mizoram	46.6	11.0	37.8	49.9	61.5	69.9	0.24	1.50
Nagaland	11.3	5.4	10.1	20.8	26.9	20.0	0.48	1.77
Odisha	76.2	69.3	78.6	79.1	81.6	82.4	0.91	1.08
Rajasthan	51.2	45.7	45.9	49.6	52.2	59.0	0.89	1.15
Sikkim	60.1	66.9	61.1	59.1	61.3	47.6	1.11	0.79
Tripura	50.4	41.7	52.8	56.6	64.6	51.2	0.83	1.02
Uttar Pradesh	38.1	30.4	35.0	38.9	41.4	50.9	0.80	1.34
Uttarakhand	55.7	35.2	44.2	51.8	62.6	69.1	0.63	1.24
More developed states	68.2	58.6	65.1	67.1	70.1	70.5	0.86	1.03
Andhra Pradesh	68.3	45.5	64.2	64.8	66.5	69.2	0.67	1.01
Goa	92.4	100.0	81.2	89.8	92.5	93.5	1.08	1.01
Gujarat	73.1	63.2	69.1	72.4	75.9	80.5	0.86	1.10
Haryana	56.6	33.5	44.8	49.7	53.3	64.5	0.59	1.14
Himachal Pradesh	67.1	52.1	53.4	62.3	74.2	74.8	0.78	1.11
Jammu and Kashmir	76.3	60.2	75.8	76.7	80.6	79.5	0.79	1.04

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				Four o	or more AN	C visits	1		<u>ud 391</u>
				HOI by WI				HOI Ratio	ling
	Average						WII:	WIV:	fo W∄
	HOI	I	II		IV	V	average	average	, ₩
Karnataka	65.1	51.8	60.3	65.4	71.2	69.5	0.80	1.07	ies Ov
Kerala	77.3	71.3	87.6	76.0	78.6	74.8	0.92	0.97	e në
Maharashtra	66.7	49.9	63.3	65.1	71.2	73.8	0.75	1.11	a ago
Delhi	75.3	26.6	45.1	62.2	68.6	78.8	0.35	1.05	<u> 7</u> 202
Punjab	54.7	31.2	41.6	47.1	50.7	57.6	0.57	1.05	te SO:
Tamil Nadu	89.6	88.3	89.1	89.1	90.3	87.0	0.99	0.97	
Telangana	68.2	53.5	63.9	64.8	70.0	68.5	0.78	1.00	
West Bengal	72.2	66.5	72.1	75.0	78.7	78.0	0.92	1.08	dat 80
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2 3	4.65	
4	165	Institutional delivery with SBA
5 6	166	The coverage of institutional delivery with SBA for India was 85.0% (95% CI 84.9 to 85.2) in NFHS-5.
/ 8 0	167	The percent change from NFHS-4 to NFHS-5 was estimated at 12.6% (95% CI 12.2 to 12.9), 14.6%
9 10 11	168	(95% CI 14.1 to 15.1) and 6.2% (95% CI 5.8 to 6.6) for India, less developed and more developed
12 13	169	states, respectively (supplemental table 2). This coverage ranged from 58.6% in Meghalaya to 96.3%
14 15	170	in Sikkim in less developed states and 84.3% in Himachal Pradesh to 99.8% in Kerala in more
16 17	171	developed states in NFHS-5 (supplemental table 2). The HOI for geographic inequality for
18 19 20	172	institutional delivery with SBA for India was 80.4, 90.1 and 76.2 for India, more developed and less
21 22	173	developed states in NFHS-5, respectively (table 2 and supplemental table 3). HOI ranged from 26.2
23 24	174	to 99.8 in the states in NFHS-4, and 37.4 to 99.7in the states in NFHS-5 (Figure and supplemental
25 26 27	175	table 3). The highest gains in HOI between NHFS-4 and NFHS-5 were made in Arunachal Pradesh
27 28 29	176	state (64.9%; 95% CI 61.3 to 68.5), with the HOI for the state at 77.5 in NHFS-5 (supplemental table
30 31	177	3).
32 33	178	Considering WI (table 2), HOI ranged from 65.1 for WI I to 93.7 for WI V for India, and the
34 35 36	179	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS-
37 38	180	5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI
39 40	181	ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5.
41 42	182	Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had the W1 I to WI V HOI
43 44 45	183	ratio at <0.70.
46 47	184	
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BMJ Open Table 2: Human opportunity index (HOI) by wealth index quartile (WI) and ratio between WI I and average HOI, WI V and average HOI and between WI I and V for institutional delivery with skilled birth attendant (SBA) for India and its states National Family Health Survey-5. 

		Institutional delivery with SBA						ŝ	
			HOI b	y WI				HOI Ratio	es -
	Average						WII:	WIV:	Tel:
	HOI		II	III	IV	V	average	average	Tee
India	80.4	65.1	78.8	86.0	90.2	93.7	0.81	1.17	đ
Less developed									9
states	76.2	63.6	76.6	83.5	87.8	92.0	0.83	1.21	a
Arunachal Pradesh	77.5	56.0	77.6	86.7	92.0	96.0	0.72	1.24	
Assam	82.3	72.1	87.0	91.7	94.8	95.5	0.88	1.16	Jata
Bihar	72.1	63.9	76.6	81.2	82.9	88.7	0.89	1.23	Ī
Chhattisgarh	78.5	68.0	80.1	85.9	90.3	94.3	0.87	1.20	
Jharkhand	70.4	60.7	77.1	83.8	91.3	94.7	0.86	1.35	0
Madhya Pradesh	84.1	75.4	84.8	90.0	91.7	90.3	0.90	1.07	
Manipur	62.0	37.7	65.1	78.7	88.2	93.7	0.61	1.51	all
Meghalaya	52.5	38.8	57.6	72.6	82.5	82.2	0.74	1.57	<b>J</b>
Mizoram	72.4	26.4	59.1	80.5	92.8	95.8	0.36	1.32	, a
Nagaland	37.4	26.2	37.9	57.1	64.7	74.9	0.70	2.00	10
Odisha	87.3	77.6	91.6	93.9	95.5	95.6	0.89	1.10	
Rajasthan	93.9	89.2	91.8	94.1	94.8	97.1	0.95	1.03	lar
Sikkim	95.2	88.5	94.5	94.8	97.3	94.2	0.93	0.99	Tec
Tripura	83.5	71.8	88.8	91.9	94.0	90.6	0.86	1.09	
Uttar Pradesh	78.0	68.3	76.4	79.4	82.8	90.1	0.88	1.16	000
Uttarakhand	78.5	62.1	62.7	75.0	85.7	91.9	0.79	1.17	10S
More developed									•
states	90.1	76.5	85.8	90.1	92.6	95.1	0.85	1.06	
Andhra Pradesh	95.4	73.9	93.0	94.2	95.9	98.7	0.77	1.03	
Goa	98.5	100.0	90.6	100.0	98.5	98.7	1.02	1.00	
Gujarat	87.5	75.3	85.9	88.8	92.1	91.1	0.86	1.04	
Haryana	90.5	64.7	77.0	86.8	91.1	96.0	0.71	1.06	

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Average						WII:	WI V:	ing for	2 /PI: V 21,
82.5	5/1	<b>II</b> 68.1	80.8	86.5	<b>V</b>	average	average	4 Se	
87.9	71.5	82.7	88.6	94.7	96.6	0.81	1.10	is re	<b>6</b> 74
90.3	83.8	85.6	90.6	93.8	93.2	0.93	1.03	Era	<b>6</b> .90
99.7	100.0	100.0	99.5	99.8	99.6	1.00	1.00		800
88.2	69.5	85.4	89.0	92.3	95.0	0.79	1.08	o te	<b>6</b> .73
90.2	21.9	68.7	82.7	83.0	91.6	0.24	1.02	<b>X</b> OC	6.24
92.9	79.4	80.7	96.5	90.5	94.6	0.85	1.02	nd	<b>2</b> 84
99.2	95.6	97.9	99.2	99.5	100.0	0.96	1.01	dat	<b>8</b> .96
90.4	75.5	88.9	90.0	90.4	91.4	0.84	1.01	a m	<b>6</b> 83
89.2	83.7	90.6	93.8	94.6	93.1	0.94	1.04	Т.	<b>6</b> .90
						), 💻	Ratio o	g,Altrai∰in⊛;a	http://bmjope
	Average HOI           82.5           87.9           90.3           99.7           88.2           90.2           92.9           99.2           90.4           89.2	Average HOI         I           82.5         54.1           87.9         71.5           90.3         83.8           99.7         100.0           88.2         69.5           90.2         21.9           92.9         79.4           99.2         95.6           90.4         75.5           89.2         83.7	Average HOI         I         II           82.5         54.1         68.1           87.9         71.5         82.7           90.3         83.8         85.6           99.7         100.0         100.0           88.2         69.5         85.4           90.2         21.9         68.7           99.2         95.6         97.9           90.4         75.5         88.9           89.2         83.7         90.6	Inst           Average         HOI by WI           Average         II         III           82.5         54.1         68.1         80.8           87.9         71.5         82.7         88.6           90.3         83.8         85.6         90.6           99.7         100.0         100.0         99.5           88.2         69.5         85.4         89.0           90.2         21.9         68.7         82.7           92.9         79.4         80.7         96.5           99.2         95.6         97.9         99.2           90.4         75.5         88.9         90.0           89.2         83.7         90.6         93.8	BMJ O         Image       Image	BMJ Open         Institutional delivery with         Hol by WI         Average       II       III       IV       V         Average       I       II       III       IV       V         82.5       54.1       68.1       80.8       86.5       90.6         90.3       83.8       85.6       90.6       93.8       93.2         99.7       100.0       100.0       99.5       99.8       99.6         88.2       69.5       85.4       89.0       92.3       95.0         90.2       21.9       68.7       82.7       83.0       91.6         99.2       95.6       97.9       99.2       95.5       100.0         90.4       75.5       88.9       90.0       90.4       91.4         89.2       83.7       90.6       93.8       94.6       93.1	BBJ Open         Institutional delivery with SBA         HOI by WI       WI I:         Average       II       III       IV       V       average         B2.5       54.1       68.1       80.8       86.5       90.6       0.66         87.9       71.5       82.7       88.6       94.7       96.6       0.81         90.3       83.8       85.6       90.6       93.8       93.2       0.93         99.7       100.0       100.0       99.5       99.8       99.6       1.00         88.2       69.5       85.4       89.0       92.3       95.0       0.79         90.2       21.9       68.7       82.7       83.0       91.6       0.24         92.9       79.4       80.7       96.5       90.5       94.6       0.85         99.2       95.6       97.9       99.2       95.5       100.0       0.96         90.4       75.5       88.9       90.0       90.4       91.4       0.84         89.2       83.7       90.6       93.8       94.6       93.1       0.94         91.4       88.9       90.0       90.	BM Open         Institutional delivery with SBA         Average       HOI by WI       HOI Ratio         Average       II       III       IV       V       average       average         82.5       54.1       68.1       80.8       86.5       90.6       0.66       1.10         90.3       83.8       85.6       90.6       93.8       93.2       0.93       1.03         99.7       100.0       100.0       99.5       99.8       99.6       1.00       1.01         90.2       21.9       68.7       82.7       83.0       91.6       0.24       1.02         99.2       95.4       89.0       92.3       95.0       0.79       1.08         90.2       21.9       68.7       82.7       83.0       91.6       0.24       1.02         99.2       95.5       90.0       99.5       100.0       0.96       1.01         90.4       75.5       88.9       90.0       90.4       91.4       0.84       1.01         89.2       83.7       90.6       93.8       94.6       93.1       0.94       1.04         89.2       83.7       90.6       <	BMJ Open         BMJ Open         Institutional delivery with SBA         HOI by WI       HOI Ratio         Average       HOI       I       II       IV       V       average       average       average       average         HOI       I       II       III       IV       V       average       average <tht< td=""></tht<>

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# 191 **PNC within 48 hours of delivery**

192	The coverage of PNC within 48 hours of delivery was 78.9% (95% CI 78.7-79.1), 75.1% (95% CI 74.8-
193	75.3), and 86.0% (95% CI 85.7-86.3) in India, more developed and less developed states in NFHS-5,
194	respectively, (supplemental table 2). This coverage ranged from 43.2% in Nagaland to 92.1% in
195	Odisha in the less developed states and 68.2% in West Bengal to 96.3% in Goa in the more
196	developed states in NFHS-5 (supplemental table 2). The HOI for geographic inequality in PNC within
197	48 hours of delivery for India was 73.5 in NFHS-5, which improved by 34.6% (95% CI 34.2 to 35.1)
198	between NFHS-4 to NFHS-5. The HOI was substantially higher for the more developed states 82.6
199	than the less developed states 69.4 in NFHS-5 (table 3 and supplemental table 3). HOI ranged from
200	17.2 to 90.5 in the states in NFHS-4, and 37.5 to 95.6 in the states in NFHS-5 (Figure and
201	supplemental table 3). The highest gains in HOI were made in Arunachal Pradesh (128.6%; 95% CI
202	122.1 to 135.2) and Nagaland (118.0%; 95% CI 108.5 to 127.5), with the HOI for the states at 51.9
203	and 37.5 in NHFS-5, respectively (supplemental table 3).
204	Considering WI (Table 3), HOI ranged from 62.0 for WI I to 85.0 for WI V in India, and the
205	corresponding range was from 61.2 to 83.0 and 67.4 to 88.3 for less and more developed states in
206	NFHS-5, respectively. The HOI ratio of WI V to state was 1 or more in all the states, except for Sikkim
207	and Tamil Nadu. The HOI ratio of WI I to WI V was <1 in 28 (93.3%) states and was <0.60 in 4 (13.3%)
208	states in NFHS-5. Among the 27 states with WI I to state HOI ratio at >0.70, 2 states had the WI I to
209	WI V HOI ratio at <0.70.
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211	Table 3: Human opportunity index (HOI) by wealth index quartile (WI) and ratio between WI I and average HOI, WI V and average HOI and
212	between WI I and V for post-natal care in 48 hours of delivery for India and its states, National Family Health Survey-5

		PNC with 48 hours of delivery							
		HOI by WI					HOI Ratio		
	Average						WII:	WIV: 👾 👖	
	HOI		II	III	IV	V	average	averag	
India	73.5	62.0	70.7	77.1	81.3	85.0	0.84	1.16 <b>5</b> 2	
Less developed states	69.4	61.2	68.7	73.6	77.4	83.0	0.88	1.20 g j	
Arunachal Pradesh	51.9	41.5	52.6	53.2	53.6	59.6	0.80	1.15 🛓	
Assam	64.7	56.8	67.4	72.7	74.4	72.0	0.88	1.11 0	
Bihar	59.6	54.0	61.8	65.8	69.0	75.8	0.91	1.27 a	
Chhattisgarh	85.3	81.8	85.5	85.2	89.4	87.8	0.96	1.03 <u>=</u> .	
Jharkhand	70.9	65.8	74.6	74.5	81.4	81.4	0.93	1.15 <b>];</b>	
Madhya Pradesh	82.8	78.7	81.5	84.4	85.7	86.7	0.95	1.05 <sup><b>9</b></sup>	
Manipur	57.7	38.1	59.2	72.7	78.1	79.0	0.66	1.37 🛓	
Meghalaya	53.4	49.3	55.6	59.3	54.9	56.3	0.92	1.05 <b>a</b> i	
Mizoram	63.9	28.2	55.0	72.2	72.1	77.3	0.44	1.21 <b>j</b>	
Nagaland	37.5	27.2	38.8	55.2	59.8	57.5	0.73	1.53 a	
Odisha	90.7	87.6	90.7	92.9	92.9	92.9 🗸	0.97	1.02 💁	
Rajasthan	82.6	78.2	80.8	82.3	83.4	85.2	0.95	1.03 <u>3</u>	
Sikkim	70.4	66.9	69.3	71.4	70.6	57.4	0.95	0.82 <b>a</b>	
Tripura	64.2	56.4	63.0	72.9	79.1	82.8	0.88	1.29 <mark>ຕ</mark> ິ	
Uttar Pradesh	73.2	66.0	72.6	73.6	77.3	82.8	0.90	1.13 <b>D</b>	
Uttarakhand	81.5	71.1	73.6	80.9	85.4	87.3	0.87	1.07 <b>ල</b>	
More developed states	82.6	67.4	77.2	83.0	85.3	88.3	0.82	1.07 😴	
Andhra Pradesh	90.4	67.6	87.2	91.1	90.3	92.1	0.75	1.02	
Goa	95.6	100.0	90.6	89.8	96.6	98.7	1.05	1.03	
Gujarat	87.1	85.7	85.4	85.8	86.3	89.3	0.98	1.03	
Haryana	88.7	64.2	76.7	88.7	88.7	92.2	0.72	1.04	
Himachal Pradesh	87.3	71.3	78.7	88.3	88.3	92.1	0.82	1.05	
Jammu and Kashmir	77.2	64.7	72.9	78.1	80.3	82.5	0.84	1.07	

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				PNC with	48 hours	of delivery	1	¥	39
				HOI by WI				HOI Rat	22
	Average						WII:	WI V: 🕁	¥VI
	HOI	1	II	111	IV	V	average	average	- <u>-</u>
Karnataka	83.6	76.3	80.7	84.7	85.5	83.8	0.91	1.00 🥳	<b>0</b>
Kerala	91.5	81.6	83.9	88.3	92.1	91.7	0.89	1.00 <u>ē</u>	<b>. 3</b> 0
Maharashtra	80.8	66.9	78.3	80.7	83.3	86.0	0.83	1.06 <b>a</b>	<b>ě</b> (
Delhi	85.1	31.2	59.7	76.4	80.3	87.2	0.37	1.02	20
Punjab	85.4	69.4	75.0	96.6	83.1	86.6	0.81	1.01 ត្	<b>4</b> 0
Tamil Nadu	90.4	84.0	90.4	90.3	90.1	89.4	0.93	0.99	<b>0</b>
Telangana	85.4	78.1	83.1	83.5	84.4	88.2	0.91	1.03	
West Bengal	63.8	56.2	62.0	67.6	76.4	80.4	0.88	1.26 🖬	
								ess than <b>G</b> .5	0
								ess than 🛱 5	05
							0	.51-0.89 🧮	bm
							0	.90-1.09 <b>Ģ</b>	op
							1	.10-1.49 <b>a</b>	en.k
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217 <b>Cor</b>	ntinuum c	of care (	(CoC)
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218	The coverage of CoC was 45.6% (95% CI 45.4-45.9), 36.5% (95% CI 36.3-36.8), and 62.5% (95% CI
219	62.2-62.9) in India, less developed and more developed states in NFHS-5, respectively (supplemental
220	table 2). The coverage ranged from 9.4% in Nagaland to 69.4% in Odisha in the less developed
221	states, and 50.2% in Punjab to 90.1% in Goa in the more developed states in NFHS-5 (supplemental
222	table 2). The HOI for geographic inequality in CoC for India was 37.1, which improved by 52.2% (95%
223	CI 51.1 to 53.0) between NFHS-4 to NFHS-5. The HOI was substantially higher for the more
224	developed states at 56.3 than the less developed states at 29.7 in NFHS-5 (table 4 and supplemental
225	table 3). HOI ranged from 4.4 to 79.0 in the states in NFHS-4, and 6.5 to 88.8 in the states in NFHS-5
226	(Figure and supplemental table 3). The highest gains in HOI were made in Arunachal Pradesh
227	(167.1%; 95% Cl 154.4 to 179.8) and Uttarakhand (147.4%; 95% Cl 139.3 to 155.5), with the HOI for
228	the states at 21.9 and 43.3 in NFHS-5, respectively (supplemental table 3).
229	Considering WI (Table 4), HOI ranged from 21.7 for WI I to 56.5 for WI V for India, and the
230	corresponding range was 19.8 to 48.8 and 39.3 to 62.7 for less and more developed states in NFHS-
231	5, respectively. The HOI ratio of WI V to state was 1 or more in 27 states. The HOI ratio of WI I to WI
232	V was <1 in 28 (93.3%) states and was <0.60 in 18 (60.0%) states in NFHS-5. Among the 12 states
233	with WI I to state HOI ratio at >0.70, 3 states the WI I to WI V HOI ratio at <0.70.

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BMJ Open Table 4: Human opportunity index (HOI) by wealth index quartile (WI) and ratio between WI I and average HOI, WI V and average HOI and between WI I and V for continuum of care based on the maternal services for India and its states, Nater Family Health Survey-5. 

				HOI by WI				HOI Ratio
	Average						WII:	WI V: 🖁
	HOI	I	II	111	IV	ν	average	average 🗟
India	37.1	21.7	32.3	41.9	49.2	56.5	0.58	1.52 <b>e</b>
Less developed states	29.7	19.8	27.9	34.5	40.2	48.8	0.67	1.64 <b>t</b>
Arunachal Pradesh	21.9	12.4	20.9	22.8	26.0	32.8	0.57	1.50 🙀
Assam	31.0	22.9	32.1	40.3	49.0	44.3	0.74	1.43 a
Bihar	15.3	9.5	15.1	21.0	28.4	38.6	0.62	2.52 d
Chhattisgarh	43.3	37.3	39.2	47.9	50.7	53.4	0.86	1.23 at
Jharkhand	24.1	16.7	27.8	31.6	41.5	45.9	0.69	1.90 <b>E</b>
Madhya Pradesh	41.2	31.7	39.0	46.5	50.7	53.2	0.77	1.29 <b>n</b>
Manipur	41.5	19.8	41.3	60.2 🧹	68.0	67.1	0.48	1.62 <sup>9</sup>
Meghalaya	20.5	14.1	21.7	27.6	34.7	28.1	0.69	1.37
Mizoram	36.6	6.7	27.6	40.4	49.5	57.3	0.18	1.57 an
Nagaland	6.5	2.2	5.9	12.2	17.4	35.6	0.34	5.48 <b>j</b>
Odisha	64.8	53.2	68.2	71.9	75.1	77.3	0.82	1.19 ິຍ
Rajasthan	44.2	38.0	39.8	42.3	45.2	52.0	0.86	1.18 🦕
Sikkim	48.3	47.6	49.0	45.6	50.3	37.6	0.99	0.78
Tripura	35.3	19.5	37.4	39.8	56.2	51.2	0.55	1.45 <sup>a</sup>
Uttar Pradesh	27.9	19.2	24.9	28.5	31.7	43.7	0.69	1.57 <mark>8</mark>
Uttarakhand	43.3	24.5	28.2	38.5	51.2	59.2	0.57	1.37 <b>n</b>
More developed states	56.3	39.3	50.0	55.5	59.8	62.7	0.70	1.11 🧕
Andhra Pradesh	59.3	32.4	53.6	59.6	60.5	64.9	0.55	1.09
Goa	88.8	100.0	71.9	86.4	87.2	91.6	1.13	1.03
Gujarat	61.2	49.8	56.9	60.0	64.0	69.9	0.81	1.14
Haryana	51.2	23.3	35.5	45.0	47.2	60.3	0.46	1.18
Himachal Pradesh	54.3	31.8	39.5	51.0	59.7	65.1	0.59	1.20
Jammu and Kashmir	59.5	40.2	53.9	62.3	66.1	66.0	0.68	1.11
Karnataka	52.6	36.3	47.1	53.9	59.9	56.4	0.69	1.07

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3					HOI by WI				HOI Ratio	0833
4		Average						WII:	WIV:	🖥 🕅 I: WI
5		ної	I	П	Ш	IV	v	average	average 🚽	on V
7	Kerala	72.9	68.0	69.1	70.1	74.5	71.6	0.93	0.98	0.95
8	Maharashtra	54.5	33.5	49.9	51.8	60.3	65.9	0.61	1.21	<b>0</b> .51
9	Delhi	65.3	1.6	28.0	47.9	55.4	68.8	0.02	1.05	
10	Punjab	46.9	28.7	31.5	95.8	41.8	50.1	0.61	1.07	ager 0.57
 12	Tamil Nadu	82.0	75.6	81.9	81.7	82.6	79.1	0.92	0.96	20.96
13	Telangana	54.9	35.9	51.0	52.2	56.2	57.0	0.65	1.04	<b><u>\$</u>.63</b>
14	West Bengal	47.3	37.7	45.6	52.3	61.3	65.6	0.80	1.39	<b>0.57</b>
15       237         16       238         17       18         19       20         21       22         23       24         25       26         27       28         29       30         31       32         33       34         35       36         37       38         39       40         41       42         43       44			For pee	er review o	only - http://	bmjopen.b	mj.com/site	e/about/guic	Ra Les 0.5 1.1 1.5 Constructions 1.5 Constructions Constru	HOI HOI HOI HOI HOI HOI HOI HOI HOI HOI

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This analysis of coverage of maternal health services for livebirths over a decade between NFHS-4 and NFHS-5 has highlighted significant improvements in the geographic inequity for coverage of these services at the state-level in India, and has identified the inequities that remain to be addressed to achieve the ENAP 2025 coverage targets for these services. The geographic inequity for the coverage of 4+ANC visits lags significantly behind that of institutional delivery with SBA and PNC within 48 hours of delivery, contributing to the CoC inequity in NFHS-5. The HOI ratio for CoC at 0.38 highlights the extent of inequity between the women belonging to the lowest and the highest wealth index guintiles in India.

A policy aiming at equitable access would require progress towards two objectives: first, expanding the coverage by ensuring that as many women as possible get the opportunity; and second, by allocating new opportunities first to the vulnerable population who are at a disadvantage due to their circumstances.(29) We utilised HOI,(25) as a tool to measure the distribution of opportunities and equitable access to maternal health services. The HOI not only carries information about the coverage rate of the service but also how fairly the available services are distributed among women of different backgrounds, in this case of different wealth index quintiles.(30) In terms of expanding coverage to ensure that as many women as possible get the opportunity, the coverage of 4+ ANC visits was for 4 of 7 women, and that for institutional delivery with SBA was 6 out of 7 women, and for PNC within 48 hours of delivery was 4 out of 5 women in NFHS-5. The differential increase over the decade between the coverages of these three maternal health services can possibly be explained by how the national programs to reduce maternal and neonatal mortality were implemented during this period. The program to address ANC services was launched in 2016 after NFHS-4, and is aimed to guarantee a minimum package of ANC services to women in their 2nd/3rd trimesters of pregnancy at designated government health facilities.(31) There is no monetary incentive either to the health worker or to the pregnant women under this program. The likely impact of this program on HOI for 4+ ANC visits coverage will be documented in the next round 

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	265	of NFHS (round 6). However, given the extent of low coverage of 4+ ANC visits in most of the less
	266	developed states and some of the more developed states, major inputs are needed to address the
	267	barriers for improved ANC utilisation to achieve the ENAP 2025 target for 4+ ANC visits.(32-34) The
0	268	increased coverage for institutional deliveries with SBA between the two surveys resulted in nearly
2 3	269	doubling of HOI over this period, and near universality of this service in the more developed states.
4 5	270	Two programs – the Janani Suraksha Yojana (JSY) and the Janani Shishu Suraksha Karyakaram (JSSK)
6 7	271	- initiated to increase the coverage of institutional deliveries in India have contributed to the
8 9	272	exponential increase in access to institutional delivery. (35, 36) The JSY was initiated in 2005 and was
0 1 2	273	a large-scale national program that offered conditional cash transfer and support services to poor
2 3 4	274	pregnant women to use institutional delivery care facilities, especially in the states with lower
5 6	275	coverage.(35) The JSSK, initiated in 2011, provided free and cashless delivery along with some other
7 8	276	benefits to pregnant women to eliminate out-of-pocket expenses in order to increase the
9 0 1	277	institutional deliveries.(37) The PNC coverage was estimated at 61% HOI at 73.5 for India in NFHS-5
2 3	278	with a wide variation at the state-level. The increased PNC coverage also resulted in 34.6% increase
4 5	279	in HOI for PNC coverage between NFHS-4 and NFHS-5. According to the Indian PNC guidelines,(38)
6 7	280	the health workers are paid INR 250 (USD 3.5) for PNC visits, and are expected to undertake 6-7 PNC
8 9 0	281	visits at home from 1 <sup>st</sup> to 42 <sup>nd</sup> day of delivery for counselling the mother on various issues and
0 1 2	282	enabling referral if needed. Considering all the three maternal health services together, the CoC
- 3 4	283	coverage remained at 62.5% in NFHS-5 with only 19.5% change between the two surveys even in the
5 6	284	more developed states. Only 45% CoC coverage in NFHS-5 for India translates into 5 out of every 11
7 8 0	285	woman and newborn not having received all the three MNCH services, which is the basic premise of
9 0 1	286	the ENAP and INAP to address neonatal and maternal mortality.(19, 21)
2 3	287	With regards to the policy objective of allocating new opportunities to the vulnerable
4 5	288	population who are at a disadvantage due to their circumstances, socio-economic inequities in
6 7 0	289	maternal health services in India have been reported previously(16, 39-45) but the use of HOI to
9	290	measure inequity has not been attempted. For all the maternal health services, the women

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belonging to the lowest WI quintile had low HOI compared to those in the highest WI quintile, and the difference was starker for ANC services and in the less developed states. Though the within-district inequalities in intervention coverages are reducing in most states, the pace of reduction has not been the same for every woman. The state of Delhi with the national capital had the one of the least HOI ratio for the women belonging to the lowest WI quintile. The extent of HOI ratio for the lowest to the highest WI quintile and that to average HOI between the maternal health services within states highlights the specificity needed in targeting women with the respective interventions to achieve 2025 coverage targets. One of the challenges in achieving equity in maternal health services in India is the dependence on NFHS for retrospective situational analysis rather than for monitoring and evaluation, because the routine health information management system (HMIS) does not allow for tracking of CoC for maternal health services per woman. (46) Real time tracking of women for utilisation of these services at the district-level is needed to reduce inequity in the coverage of these services. India has a Mother and Child Tracking System (MCTS) in place since 2009 to follow a mother-child dyad through the CoC, but it is known to be fraught with several issues.(47-49) Clearly, it is important that strategies to improve the MCTS, within digital health, are looked into urgently if India were to reach every woman and newborn to achieve the SDG targets of reduced maternal and neonatal mortality at the district-level.(50-52) High quality timely data for evidence-informed decision making to reduce inequity at the district level can also be obtained through continuous surveys.(53) Furthermore, incentivisation of services is currently only for institutional delivery and for PNC services. With poor coverage of ANC services resulting in poor coverage of CoC, it may be worth considering incentivising the CoC rather than individual maternal health services to address inequity. It is important to note that we considered only the inequity in coverage and not in the quality of contact with the health system during service utilisation in this analysis. There is a

9 316 including from India from pregnancy to delivery,(4, 49, 54-64) and also of poor quality of health care

growing literature documenting increased coverage but poor quality of contact for these services,(4)

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317	being a major driver of excess mortality across conditions, including neonatal mortality.(65-68)
318	Health system redesign has been suggested for equity in maternal and new born health, by moving
319	all childbirth care services to hospitals in all countries, combined with improvements in the quality of
320	care provided in these facilities, transportation from home to hospital, and continuity of care
321	through hub-and-spoke arrangements.(69) While commenting on the scope of health system re-
322	design is beyond the scope of the analysis undertaken for this paper, more discussion is needed and
323	more options need to be rigorously tried and tested to develop sustainable district health systems
324	which are fit for purpose and respond to continuity of care needs of women and their babies.(70)
325	
326	CONCLUSION
327	In conclusion, the findings of this assessment are encouraging but also emphasise the need for
328	improved targeting of women to reduce the remaining inequity gap. It will be important for the
329	national program to monitor the CoC coverage in real time in addition to the three maternal health
330	services individually to monitor and track inequity at the level of every woman.
331	

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3 4	332	Ethics approval
5 6	333	No ethics approval was required for this analysis as we utilised the de-identified data available in
7 8	334	public domain.
9 10 11	335	
12 13	336	Authors' contributions
14 15	337	RD and GAK conceptualized the study; GAK and MM had full access to data in the study and
16 17	338	performed data analysis; RD and GAK take full responsibility for the integrity of data and accuracy of
18 19 20	339	the data analysis, and had final responsibility for the decision to submit for publication; RD drafted
21 22	340	the manuscript; all authors contributed to the interpretation and approved of the final version of the
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52 53	354	India maps.
54 55 56 57	355	
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2 3 4	554	FIGURE LEGEND
5 6	555	Figure. Human Opportunity Index (HOI) for 4+ antenatal care visits, institutional delivery with skilled
7 8	556	birth attendant, post-natal care within 48 hours of delivery, and continuum of care in NFHS-4 in
9 10 11	557	2015-16 and NFHS-5 in 2019-2021 for each state of India.
$\begin{array}{c} 10\\ 11\\ 12\\ 13\\ 14\\ 15\\ 16\\ 17\\ 18\\ 19\\ 20\\ 21\\ 22\\ 23\\ 24\\ 25\\ 26\\ 27\\ 28\\ 29\\ 30\\ 31\\ 32\\ 33\\ 34\\ 35\\ 36\\ 37\\ 38\\ 39\\ 40\\ 41\\ 42\\ 43\\ 44\\ 45\\ 46\\ 47\\ 48\\ 49\\ 50\\ 51\\ 52\\ 53\\ 54\\ 55\\ 56\\ 57\\ 58\\ 59\\ 60\\ \end{array}$	557	2015-16 and NFHS-5 in 2019-2021 for each state of India.



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Trends over a decade in geographical inequality of opportunity in access to maternal care services from the National Family Health Surveys in India

Supplementary file

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## Supplementary Table 1. Number of districts by state in the National Family Health Survey (NFHS) rounds 4 and 5.

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Supplementary Table 2. Coverage of four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), and post-natal care within 48 hours of delivery, and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) 4 and NFHS 5 for India and its states. CI der tes confidence interval.

State	State Four of more ANC visits			Institutional delivery with SBA* 7			Post-natal care within 48 hours of delivery				ivery Continuum of care			
	NFHS-4	NFHS-5	Percent change from	NFHS-4	NFHS-5	Perce	Ent change	NFHS-4	NFHS-5	Percent change	NFHS-4	NFHS-5	Percent change from	
	N=188,506	N=174,796	NFHS-4 to NFHS-5	N=188,506	N=174,796	from	=NFHS-4 to	N=188,506	N=174,796	from NFHS-4 to	N=188,506	N=174,796	NFHS-4 to NFHS-5	
	(95% CI)	(95% CI)	(95% CI)	(95% CI)	% OT N (95% CI)	NFHS	E5 (95% CI)	% OT N (95% CI)	(95% CI)	NFH3-5 (95% CI)	% Of N	(95% CI)	(95% CI)	
India	46.4 (46.2-46.7)	57.0 (56.8-57.3)	22.8 (22.1-23.5)	75.5 (75.3-75.7)	85.0 (84.9-85.2)	12.6	ក្នុ ភ្នា2.2-12.9)	61.4 (61.2 - 61.6)	78.9 (78.7-79.1)	28.5 (28.0-29.0)	32.9 (32.7-33.1)	45.6 (45.4-45.9)	38.6 (37.6-39.6)	
Less developed	36.0 (35.7-36.3)	48.0 (47.7-48.3)	33.3 (32.3-34.3)	70.6 (70.3-70.8)	80.9 (80.7-81.2)	14.6	14.1-15.1)	57.0 (56.7-57.2)	75.1 (74.8-75.3)	31.8 (31.1-32.4)	24.8 (24.6- 25.1)	36.5 (36.3-36.8)	47.2 (45.7-48.6)	
Arunachal Pradesh	24.6 (23.3- 26.0)	37.2 (35.8-38.6)	51.2 (45.1-57.4)	52.7 (51.1-54.2)	80.6 (79.4-81.7)	52.9	<b>g</b> 49.8-56.1)	27.5 (26.1-28.9)	55.4 (53.9-56.8)	101.5 (95.7-107.2)	11.8 (10.8- 12.8)	25.3 (24.1-26.6)	114.7(104.4-124.4)	
Assam	45.4 (44.3- 46.4)	50.9 (49.8-51.9)	12.1 (9.5-14.7)	72.5 (71.5-73.4)	84.8 (84.1-85.5)	\$7.0	<del>(1</del> 5.6-18.4)	56.9 (55.8-57.9)	67.8 (66.8-68.7)	19.1 (17.1-21.2)	29.9 (20.9-30.9)	35.5 (34.5-36.5)	18.7 (15.1-22.4)	
Bihar	14.6 (14.1 -15.2)	25.5 (24.7-26.2)	74.7 (70.0-79.3)	66.0 (65.3-66.7)	75.1 (74.4-75.8)	<b>§</b> 3.8	<u>(1</u> 2.5-15.0)	47.8 (47.1-48.6)	65.4 (64.6-66.2)	36.8 (35.0-38.7)	9.0 (8.6- 9.4)	17.8 (17.2-18.4)	97.8 (91.5-104.1)	
Chhattisgarh	56.9 (55.7 - 58.0)	61.2 (60.0-62.4)	7.6 (5.3-9.9)	71.8 (70.7-72.8)	82.1 (81.2-83.0)	<b>9</b> 4.3	<b>2</b> 12.7-16.0)	67.2 (66.0-68.3)	87.2 (86.3-87.9)	29.8 (28.0-31.5)	37.6 (36.4-38.7)	47.3 (46.1-48.5)	25.8 (22.4-29.2)	
Jharkhand	29.9 (29.0 - 30.9)	38.6 (37.5-39.7)	29.1 (25.4-32.8)	63.8 (62.8-64.8)	74.5 (73.5-75.5)	<b>£</b> 6.8	<b>1</b> 5.0-18.5)	46.8 (45.8-47.8)	74.0 (73.0-75.0)	58.1 (55.6-60.6)	17.0 (16.2-17.8)	27.0 (26.0-28.0)	58.8 (53.3-64.4)	
Madhya Pradesh	34.9 (34.1-35.6)	57.0 (56.1-57.9)	63.3 (60.9-65.7)	75.9 (75.2-76.5)	86.6 (86.0-87.2)	<u>8</u> 4.1	<b>0</b> 13.2-15.0)	55.9 (55.1-56.6)	85.1 (84.4-85.7)	52.2 (50.8-53.7)	23.1 (22.4 -23.7)	46.1 (45.2-47.0)	99.6 (96.2-102.9)	
Manipur	65.1 (63.7-66.5)	68.7 (66.8-70.4)	5.5 (2.9-8.2)	67.9 (66.5-69.3)	70.9 (69.1-72.6)	9 4	<b>9</b> 4 (1.9-6.9)	62.8 (61.4-64.2)	64.9 (62.9-66.7)	3.3 (0.5-6.2)	49.2 (47.7 -50.7)	50.9 (48.9-52.8)	3.5 (-0.3-7.2)	
Meghalaya	50.1 (48.4-51.9)	50.3 (48.8-51.7)	0.4 (-3.5-4.3)	56.0 (54.3-57.8)	58.6 (57.2-60.0)		(1.2-8.1)	58.0 (56.3-59.8)	58.3 (56.8-59.7)	0.5 (-2.8-3.8)	32.1 (30.4 - 33.7)	23.9 (22.7-25.1)	-25.5 (-31.1 to -20.0)	
Mizoram	56.4 (54.8-58.0)	52.4 (50.2-54.7)	-7.1 (-10.6 to -3.6)	78.1 (76.7-79.4)	79.3 (77.4-81.0)	57 1.5	<b>a</b> (-0.5-3.6)	62.8 (61.2-64.3)	68.1 (65.9-70.1)	8.4 (5.4-11.5)	41.5 (39.9 -43.1)	42.1 (39.9-44.4)	1.4 (-3.3-6.2)	
Nagaland	$\frac{13.5(12.3-14.7)}{(22.3-14.7)}$	15.6 (14.1-17.2)	15.6 (5.2-25.9)	33.8 (32.2-35.5)	42.5 (40.5-44.6)		$\frac{620.0-31.4}{(7.1.0.2)}$	22.6 (21.2-24.1)	43.2 (41.2-45.3)	91.2 (83.3-99.0)	7.6 (6.7-8.6)	9.4 (8.3-10.7)	23.7 (9.3-38.1)	
Daissthan		80.0 (79.1-80.9)		83.3 (82.5-84.0)	90.1 (89.4-90.7)		(7.1-9.2)	//.4 (/6.5-/8.3)	92.1 (91.5-92.7)	19.0 (17.8-20.2)	47.8 (46.8 - 48.8)	69.4 (68.4-70.5)	45.2 (42.8-47.6)	
Sikkim	38.3 (37.3-39.2)	50.5(55.0-57.5)	47.5 (44.9-50.1)		95.0 (94.5-95.4)		$\frac{11.0-12.0}{3}$		85.2 (84.5-85.9)	30.7 (28.3-32.1)	29.1 (28.2 - 29.9)	49.4 (48.5-50.4)		
	74.9(71.9-77.0)	53.4(51.4-59.2)	-12.7(-17.0(0-0.3))	95.2 (95.0-90.4)	90.5 (94.4-97.5)	<u><u><u>q</u></u></u>	$\mathbf{K}$ (-0.5-2.6)	<u>(72.0-77.7)</u>	73.5(09.7-70.9)	-2.1 (-0.3-2.3)	45 0 (42 0 48 7)	32.0 (47.9-30.1)	-7.1(-15.7(0-0.0))	
Illttar Pradech	27.4(26.9-27.9)	34.0(51.7-50.2)	-15.0 (-19.7 (0 -10.3)	68 1 (67 5-68 6)	81 1 (80 6-81 5)	<b>9</b> 0.1	$2^{(5,1-11,1)}$	50.1(58.6-50.7)	76.9(76.4-70.7)	12.1(7.2-17.0)	45.9 (45.0 -46.7) 20.0 (19.5 -20.4)	39.7(37.3-42.0) 31.1(30.5-31.7)	-13.5 (-20.2 (0 -0.8)	
Uttarakhand	29.7 (28.3-31.1)	41.3 (40.3-42.1) 60 6 (58 8-62 3)	104.0 (98.7-109.4)	67.9 (66.5-69.2)	80.1 (78.6-81.5)	60 <sup>9.1</sup>	$\frac{10.2}{20.0}$	56.9 (55.4-58.4)	84.2 (82.8-85.4)	48.0 (45.2-50.8)	20.0 (19.3 -20.4)	47 7 (45 9-49 5)	132 7 (125 5-139 9)	
More developed	71.3 (70.9-71.7)	73 7 (73 4-74 1)	3 4 (2 6-4 1)	87.2 (86.9-87.5)	92.6 (92.4-92.8)		$\frac{1}{6}$ (5.8-6.6)	71 9 (71 5-72 3)	86.0 (85.7-86.3)	19.6 (19.0-20.3)	52.3 (51.9- 52.7)	62.5 (62.2-62.9)	19.5 (18.4-20.6)	
Andhra Pradesh	75.7 (73.9 - 77.4)	69.3 (67.2-71.2)	-8.5 (-11.0 to -5.9)	89.5 (88.2-90.7)	95.7 (94.8-96.5)		<b>₩</b> (5.5-8.4)	79.3 (77.6 – 80.9)	90.8 (89.5-91.9)	14.5 (12.3-16.7)	57.8 (55.7-59.8)	62.2 (60.1-64.3)	7.6 (3.8-11.5)	
Delhi	71.4 (68.8 - 73.8)	79.9 (78.2-81.4)	11.9 (8.3-15.6)	88.0 (86.1-89.7)	91.7 (90.5-92.7)		2 (2.1-6.3)	63.3 (60.6 - 66.0)	87.2 (85.8-88.5)	37.8 (33.3-42.1)	46.6 (43.9 - 49.4)	69.6 (67.7-71.4)	49.4 (43.2-55.5)	
Goa	87.6 (83.7 - 90.7)	93.2 (89.8-95.4)	6.4 (2.2-10.5)	96.8 (94.4-98.2)	98.8 (96.7-99.5)	× @2	<b>Q</b> (0.1-4.0)	91.4 (87.9 - 93.9)	96.3 (93.5-97.9)	5.4 (2.0-8.7)	80.7 (76.2 - 84.5)	90.1 (86.3-92.9)	11.6 (6.3-17.0)	
Gujarat	66.4 (65.2 - 67.6)	77.7 (76.7-78.6)	17.0 (15.1-19.0)	83.9 (82.9-84.8)	90.3 (89.6-90.9)	angles	<b>≤</b> 6 (6.4-8.8)	62.9 (61.7 - 64.2)	89.4 (88.6-90.0)	42.1 (40.1-44.2)	42.3 (41.0- 43.5)	66.3 (65.3-67.4)	56.7 (53.5-60.0)	
Haryana	45.4 (44.1 - 46.7)	60.8 (59.4-62.1)	33.9 (30.7-37.1)	82.1 (81.1-83.1)	93.4 (92.6-94.0)	<b>a</b> 378	<b>0</b> 12.5-15.0)	68.3 (67.0 - 69.5)	91.3 (90.5-92.0)	33.7 (31.8-35.5)	34.3 (33.1 - 35.6)	55.6 (54.3-57.0)	62.1 (58.0-66.2)	
Himachal Pradesh	66.2 (64.3 - 68.1)	71.8 (69.8-73.6)	8.5 (5.3-11.7)	75.9 (74.1-77.6)	84.3 (82.7-85.8)	a19.	<b>6</b> (8.6-13.6)	73.6 (71.8 - 75.4)	88.9 (87.5-90.2)	20.8 (18.2-23.4)	49.5 (47.4 - 51.5)	59.3 (57.261.3)	19.8 (15.2-24.4)	
Jammu & Kashmir <sup>§</sup>	79.5 (78.5 - 80.5)	80.7 (79.6-81.7)	1.5 (0.1-2.9)	83.2 (82.2-84.1)	91.0 (90.2-91.7)	<b>B</b> 9.2	(8.2-10.6)	73.0 (71.9 - 74.1)	80.3 (79.2-81.3)	10.0 (8.4-11.6)	61.8 (60.6 - 63.0)	65.1 (63.8-66.4)	5.3 (3.2-7.5)	
Karnataka	73.5 (72.3 - 74.6)	70.8 (69.6-71.9)	-3.7 (-5.4 to -2.0)	90.7 (90.0-91.5)	92.5 (91.8-93.1)	lin 2	<b>9</b> 0 (1.1-2.9)	60.5 (59.2 - 61.7)	86.4 (85.5-87.2)	42.8 (40.6-45.0)	44.6 (43.3 - 45.9)	59.1 (57.9-60.3)	32.5 (29.4-35.6)	
Kerala	90.3 (89.0 - 91.5)	82.2 (80.6-83.7)	-9.0 (-10.6 to -7.4)	99.9 (99.6-100.0)	99.8 (99.5-99.9)	.0- في ح	<b>1</b> (-0.3-0.1)	86.3 (84.7 - 87.7)	92.8 (91.7-93.8)	7.5 (5.7-9.3)	78.4 (76.6 - 80.1)	77.9 (76.2-79.5)	-0.6 (-3.1-1.8)	
Maharashtra	72.3 (71.3 - 73.3)	71.3 (70.3-72.3)	-1.4 (-3.0- 0.2)	86.7 (85.9-87.5)	91.0 (90.3-91.6)	<u></u>	0 (4.0-5.9)	76.9 (75.9 - 77.9)	84.1 (83.3-84.9)	9.4 (8.0-10.7)	54.4 (53.2 - 55.5)	60.2 (59.1-61.3)	10.7 (8.3-13.0)	
Punjab	68.2 (66.7 - 69.6)	58.3 (56.8-59.7)	-14.5 (-16.8 to -12.2)	92.0 (91.2-92.8)	94.1 (93.4-94.7)	ain 2	3 (1.3-3.2)	88.4 (87.4 - 89.3)	87.1 (86.1-88.0)	-1.5 (-2.7 to -0.3)	59.1 (57.6 - 60.6)	50.2 (48.7-51.6)	-15.1 (-17.8 to -12.3)	
Tamil Nadu	80.7 (79.7 - 81.7)	91.6 (90.8-92.3)	13.5 (12.2-14.8)	98.8 (98.5-99.1)	99.5 (99.3-99.7)	in g	7 (0.4-1.0)	72.4 (71.3 - 73.5)	92.2 (91.4-92.9)	27.3 (25.7-29.0)	60.8 (59.6 - 62.0)	84.9 (84.0-85.9)	39.6 (37.5-41.8)	
Telangana	73.1 (71.0 - 75.1)	69.7 (68.5-70.9)	-4.7 (-7.6 to -1.7)	87.2 (85.6-88.7)	91.4 (90.6-92.1)	<u>ຼັ</u> 4	8 (3.0-6.6)	81.7 (79.8 - 83.4)	86.6 (85.7-87.5)	6.0 (3.7-8.2)	57.6 (55.3–59.9)	56.9 (55.6-58.2)	-1.2 (-5.3-2.9)	
West Bengal	74.2 (72.9 - 75.5)	75.7 (74.4-76.9)	2.0 (0.1-3.9)	77.0 (75.8-78.2)	91.2 (90.4-91.9)	<u><u></u>8.4</u>	(16.8-20.1)	63.1 (61.7 - 64.5)	68.2 (66.9-69.5)	8.1 (5.6-10.5)	47.4 (46.0 - 48.9)	52.0 (50.6-53.4)	9.7 (6.3-13.1)	
*Includes doctor, auxiliary nurse midwife, nurse, midwife, and lady health visitor <sup>1</sup> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery, and continuum of care in NBPS <sup>1</sup> Ladakh is combined with Jammu & Kashmir in NFHS-5; NFHS 4 did not provide separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery, and continuum of care in NBPS <sup>1</sup> Ladakh is combined with Jammu & Kashmir in NFHS-5; NFHS 4 did not provide separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery, and continuum of care in NBPS <i>1</i> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery, and continuum of care in NBPS <i>1</i> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery, and continuum of care in NBPS <i>1</i> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery, and continuum of care in NBPS <i>1</i> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery, and continuum of care in NBPS <i>1</i> Data missing on 101 women for institutional delivery with SBA, PNC within 48 hours of delivery and continuum of care in NBPS <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 101 women for institutional delivery with separate data for Ladakh <i>1</i> Data missing on 10														
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	Four of more ANC visits				nstitutiona	l delivery with SBA	Post-natal care within 48 hours of delivery				Contin	uum of care
	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)
India	35.8	48.4	35.2 (34.5 to 35.9)	68.9	80.4	16.7 (16.5 to 17.0)	54.6	73.5	34.6 (34.2 to 35.1)	24.4	37.1	52.2 (51.1 to 53.0
Less developed states	27.9	40.7	45.9 (44.9 to 46.9)	64.5	76.2	18.1 (17.3 to 18.6)	50.6	69.4	37.2 (36.6 to 37.8)	18.5	29.7	60.5 (59.2 to 61.9
Arunachal Pradesh	20.2	34.3	69.8 (62.7 to 76.9)	47.0	77.5	64.9 <b>5</b> 1. <del>2</del> to 68.5)	22.7	51.9	128.6 (122.1 to 135.2)	8.2	21.9	167.1 (154.4 to 179.8
Assam	40.7	45.6	12.0 (9.2 to 14.9)	66.5	82.3	23.8 22.± to 25.4)	51.1	64.7	26.6 (24.3 to 28.9)	24.9	31.0	24.5 (20.3 to 28.7
Bihar	12.8	22.9	78.9 (73.9 to 83.9)	61.0	72.1	18.2 <b>£</b> 16. <b>&amp;</b> to 19.6)	43.1	59.6	38.3 (36.2 to 40.3)	7.7	15.3	98.7 (91.8 to 105.6
Chhattisgarh	52.0	57.2	10.0 (7.5 to 12.5)	68.6	78.5	14.4 <b>2</b> 12. <b>3</b> to 16.2)	63.0	85.3	35.4 (33.5 to 37.3)	33.1	43.3	30.8 (27.0 to 34.6
Iharkhand	25.0	36.0	44.0 (39.7 to 48.3)	59.5	70.4	18.3 <b>6</b> 16. <b>8</b> to 20.3)	43.2	70.9	64.1 (61.4 to 66.8)	13.8	24.1	74.6 (68.3 to 81.0
Madhya Pradesh	29.4	52.2	77.6 (74.8 to 80.3)	70.8	84.1	18.8 <b>1</b> 7.7 to 19.8)	51.3	82.8	61.4 (59.8 to 63.0)	19.1	41.2	115.7 (111.9 to 119.5
Manipur	54.9	61.2	11.5 (8.2 to 14.8)	58.0	62.0	6.9 (3.8 to 10.0)	54.4	57.7	6.1 (2.7 to 9.4)	39.2	41.5	5.9 (1.3 to 10.4
Meghalaya	44.3	45.4	2.5 (-1.9 to 6.9)	49.6	52.5	5 <del>3</del> 8 (19 to 9.8)	52.0	53.4	2.7 (-1.1 to 6.4)	26.4	20.5	-22.3 (-28.8 to -15.9
Mizoram	52.4	46.6	-11.1 (-14.8 to -7.3)	72.1	72.4	0.4 (-20 to 2.9)	59.0	63.9	8.3 (5.0 to 11.6)	37.9	36.6	-3.4 (-8.5 to 1.6
Nagaland	8.3	11.3	36.1 (22.3 to 50.0)	26.2	37.4	42.7 \$5.8 to 49.7)	17.2	37.5	118.0 (108.5 to 127.5)	4.4	6.5	47.7 (28.0 to 67.5
Odisha	59.2	76.2	28.7 (26.8 to 30.6)	79.2	87.3	10.2 (9.1 to 11.4)	74.4	90.7	21.9 (20.6 to 23.2)	42.6	64.8	52.1 (49.4 to 54.8
Rajasthan	33.0	51.2	55.2 (52.2 to 58.1)	81.8	93.9	14.8 (13.9) to 15.7)	61.2	82.6	35.0 (33.4 to 36.5)	24.6	44.2	79.7 (76.0 to 83.3
Sikkim	71.3	60.1	-15.7 (-20.5 to -10.9)	94.4	95.2	0.8 (-029 to 2.6)	71.9	70.4	-2.1 (-6.7 to 2.5)	52.1	48.3	-7.3 (-14.4 to -0.2
Tripura	60.4	50.4	-16.6 (-21.6 to -11.5)	76.4	83.5	9.3 (5.9 to 12.7)	58.2	64.2	10.3 (5.1 to 15.5)	42.9	35.3	-17.7 (-24.8 to -10.6
Uttar Pradesh	21.9	38.1	74.0 (71.4 to 76.6)	64.0	78.0	21.9 22 .9 to 22.8)	53.5	73.2	36.8 (35.6 to 38.0)	15.6	27.9	78.8 (75.6 to 82.1
Uttarakhand	25.9	55.7	115.1 (109.0 to 121.1)	65.2	78.5	20.4 <b>£12.8</b> to 22.8)	54.3	81.5	50.1 (47.1 to 53.1)	17.5	43.3	147.4 (139.3 to 155.5
More developed states	65.2	68.2	4.6 (3.9 to 5.3)	82.8	90.1	883 8.4 to 9.2)	66.2	82.6	24.8 (24.1 to 25.4)	45.7	56.3	23.2 (22.2 to 24.2)
Andhra Pradesh	74.3	68.3	-8.1 (-10.8 to -5.4)	88.0	95.4	8.4 (8.9 to 10.0)	77.6	90.4	16.5 (14.2 to 18.8)	56.1	59.3	5.7 (1.7 to 9.7)
Goa	86.0	92.4	7.4 (3.0 to 11.9)	96.7	98.5	1.9 G 2 to 3.9)	90.5	95.6	5.6 (2.1 to 9.2)	79.0	88.8	12.4 (6.7 to 18.1)
Gujarat	59.7	73.1	22.4 (20.2 to 24.7)	80.1	87.5	9.2 ( <b>9</b> . <b>1</b> to 10.6)	59.9	87.1	45.4 (43.2 to 47.6)	36.7	61.2	66.8 (63.1 to 70.4
Haryana	37.3	56.6	51.7 (47.9 to 55.5)	75.6	90.5	19.7 <b>±</b> 18. <b>±</b> to 21.3)	61.3	88.7	44.7 (42.5 to 46.9)	27.2	51.2	88.2 (83.3 to 93.1
Himachal Pradesh	61.7	67.1	8.8 (5.2 to 12.3)	72.7	82.5	13.5 <b>₽</b> 10. <b>2</b> to 16.2)	69.8	87.3	25.1 (22.2 to 27.9)	45.4	54.3	19.6 (14.6 to 24.6
Jammu & Kashmir*	71.9	76.3	6.1 (4.4 to 7.8)	77.8	87.9	13.0 <sup>°</sup> (11. <sup>6</sup> to 14.4)	67.1	77.2	/ 15.1 (13.2 to 16.9)	53.3	59.5	11.6 (9.1 to 14.2
Karnataka	69.3	65.1	-6.1(-7.9 to -4.2)	88.4	90.3	2 1 (1 to 3.1)	55.3	83.6	51.2 (48.8 to 53.6)	39.6	52.6	32.8 (29.4 to 36.3
Kerala	88.9	77.3	-13.0 (-14.8 to -11.3)	99.8	99.7	-0.¥ (-03 to 0.1)	84.2	91.5	8.7 (6.7 to 10.6)	75.7	72.9	-3.7 (-6.3 to -1.1
Maharashtra	69.3	66.7	-3.8(-5.5 to -2.0)	83.9	88.2	521 (40 to 6.2)	74.2	80.8	8.9 (7.4 to 10.4)	50.0	54.5	9.0 (6.4 to 11.6
Delhi	68.8	75.3	9.4 (5.5 to 13.3)	86.0	90.2	49 (26 to 7.2)	59.1	85.1	44.0 (39.3 to 48.7)	42.7	65.3	52.9 (46.2 to 59.7
Punjab	64.6	54.7	-15.3 (-17.8 to -12.8)	91.1	92.9	2 <b>0</b> (10 to 3.0)	86.9	85.4	-1.7 (-3.0 to -0.4)	55.5	46.9	-15.5 (-18.5 to -12.5
Tamil Nadu	77.5	89.6	15.6 (14.2 to 17.0)	98.4	99.2	08 (05 to 1.1)	68.4	90.4	32.2 (30.4 to 33.9)	56.4	82.0	45.4 (43.0 to 47.7
Telangana	71.8	68.2	-5.0 (-8.0 to -2.0)	85.6	90.4	5 <del>%</del> 6 ( <b>3</b> 7 to 7.6)	79.9	85.4	6.9 (4.5 to 9.3)	55.7	54.9	-1.4 (-5.7 to 2.8
Most Bongal	69.4	72.2	4.0 (1.9 to 6.2)	71.3	89.2	25.1 <b>2</b> 3. <b>2</b> to 27.1)	58.0	63.8	10.7 (7.3 to 12.7)	42.0	47.3	12.6 (8.8 to 16.4

Supplementary Table 3. Human Opportunity Index for geographic inequality for four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), post-natal care within 48 hours of delivery and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) rourids 4 and 5 for India and its states. CI denotes confidence interval.

## **BMJ Open**

#### Population-level trends over a decade in geographical inequality for opportunity in access to maternal care services: findings from the National Family Health Surveys in India

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Secondary Subject Heading:	Health policy, Public health
Keywords:	Pregnant Women, Primary Health Care, PUBLIC HEALTH, Surveys and Questionnaires, Health Equity, Health Services





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21	10	Family Health Surveys in India
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28	13	Rakhi Dandona, <sup>1,2</sup> Moutushi Majumder, <sup>1</sup> G Anil Kumar <sup>1</sup>
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3 4	24	ABSTRACT
5 6	25	Objectives: To examine the trends in geographical inequality of opportunity in maternal health
/ 8 0	26	services in India considering the Every Newborn Action Plan (ENAP) 2025 coverage targets.
9 10 11	27	Setting: India
12 13	28	Participants: Women in the National Family Health Survey (NFHS) - NFHS-4 (2014-15) and NFHS-5
14 15	29	(2019-21).
16 17	30	Primary and secondary measures: District-level coverages of 4+ antenatal care (ANC) visits,
18 19 20	31	institutional delivery with skilled birth attendant (SBA), postnatal care (PNC) services within 48 hours
21 22	32	of delivery, Continuum of care (CoC) services for women with most recent livebirths were
23 24	33	considered. Human Opportunity Index (HOI) documented the opportunities for equitable access of
25 26 27	34	these services, ranging from 0 (high inequality) to 100 (universal access). HOI was compared
27 28 29	35	between the survey rounds and wealth index quintiles (WI) that the women belonged to.
30 31	36	<b>Results</b> : Coverages of 4+ ANC visits, institutional delivery, PNC, and CoC in India increased by 22.8%
32 33	37	(95% CI 22.1-23.5), 12.6% (12.2-12.9), 28.5% (28.0-29.0), and 38.6% (37.6-39.6) between NFHS-4 and
34 35 36	38	NFHS-5, respectively. The HOI for 4+ ANC visits was 48.4 in NFHS-5, ranging from 11.3 to 92.4 in
37 38	39	states and from 31.1 to 70.5 for WI I to V. The HOI for institutional delivery was 80.4 in NFHS-5,
39 40	40	ranging from 37.4 to 99.7 in the states and from 21.0 to 100 for WII to V. The HOI for PNC services
41 42	41	was 73.5 in NFHS-5, ranging from 37.5 to 95.6 in the states and from 61.2 to 88.3 for WI I to V. The
43 44 45	42	HOI for CoC was 37.1, ranging from 6.5 to 88.8 in the states and from 19.8 to 62.7 for WI I to V for
46 47	43	CoC in NFHS-5.
48 49	44	Conclusion: Though significant improvements in the geographic inequity of maternal health services
50 51	45	have been made in India, the geographic inequity for 4+ANC visits coverage lags significantly behind
52 53 54	46	resulting in CoC coverage inequity to achieve the ENAP targets for these services.
55 56	47	
57 58	48	Keywords: Antenatal care services, continuum of care, human opportunity index, India, inequity,
59 60	49	institutional delivery, NFHS, postnatal care, wealth index.

#### STRENGTHS AND LIMITATIONS OF THE STUDY

- District-level inequity estimated in the coverages of maternal health services for India using • large-scale demographic surveys.
- Human opportunity index is used to measure not only the distribution of coverage of maternal health services but also how fairly the available services are distributed among
- women by geography and by wealth index.
- Socio-economic inequities in maternal health services in India have been reported previously • but the use of Human Opportunity Index to measure inequity has not been attempted.
- Quality of services not captured in the assessment.

INTRODUCTION

1

With the Sustainable Development Goal (SDG) 10, the governments worldwide have committed to

act on inequality through multiple, interconnected goals, requiring combined policy action in order

to meet an overall commitment to 'leave no-one behind'.(1) Access to health care for all also

employment status and geographical location, with the most marginalized being the least able to

access quality healthcare.(2) Inequality in access to essential health-care services has implications

on achieving universal health coverage, including maternal health services among both the general

maternal health services is available from developing countries including from India, predominately

based on the Demographic and Health Surveys (DHS) and focusing on socio-economic inequalities in

neonatal mortality by 2030,(3) we examine the trends in geographical inequality of opportunity in

attendant (SBA), and postnatal care (PNC) visits within 48 hours in India using the National Family

Health Survey (NFHS), which is the equivalent of DHS in India.(17) In addition, we also measure

the global strategies for maternal health to improve maternal and neonatal outcomes in the

developing country setting.(18-20) The maternal health program in India is implemented at the

district level, (21) and the Every Newborn Action Plan (ENAP) 2025 provides for maternal care

services coverage target indicators based on the district-level coverage of these services in a

states as these have implications on planning to achieve the ENAP 2025 coverage targets.

state.(22) Therefore, we examine define geographic inequality at the district-level in India and its

geographical inequality in the coverage of continuum of care (CoC), which is recommended as one of

access for the coverage of antenatal care (ANC) visits, institutional delivery with skilled birth

In the context of Countdown to 2030, SDGs 3.1 and 3.2 which aim to reduce maternal and

and the most disadvantaged populations.(3) Significant literature on the extent of inequities in

intersects with the inequalities related to gender, socio-economic status, education levels,

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the use of maternal health services.(4-16)

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#### 85 METHODS

1 2

We utilized the publicly available data from the two most recent rounds of NFHS conducted post
year 2010, NFHS-4 (2014-15) and NFHS-5 (2019-21).(17, 23) These nationally representative
population-based surveys are conducted by the International Institute of Population Sciences,
Mumbai, India, with the primary aim to provide estimates of maternal and child health and
reproductive health indicators at the district-level for India.(17, 23) No ethics approval was required
for this analysis as we utilised the de-identified data available in public domain.

The NFHS documents data on the most recent livebirth for ever-married women in the last 5 92 93 years from the time of data collection. The NFHS-4 documented data for livebirths born between 94 2011 and early 2016 whereas the NFHS-5 documented data on livebirths born between 2016 and 95 early 2021. We defined the CoC for this analysis as a woman having reported four or more ANC 96 visits and institutional delivery with SBA and PNC within 48 hours of delivery for her most recent 97 livebirth in the last 5 years. We calculated the coverage of 4 or more ANC visits (4+ ANC visits), 98 institutional delivery with SBA, PNC within 48 hours of delivery, and CoC for the most recent livebirth 99 for NFHS-4 and NFHS-5 for India, and its states and districts.

7 100 Data analysis

108

We utilised the Human Opportunity Index (HOI) to measure the trends in geographical inequality for
the opportunity to access maternal care services in India and its states. The HOI is a measure of the
coverage rate of an opportunity discounted by inequality in the distribution across the circumstance
groups, where D measures the dissimilarity between access of services for groups defined by
circumstance characteristics (such as wealth index, education, distance, etc) and the average access
coverage for the same service for the population as a whole; C is average access coverage of services the
population as a whole and is estimated as :(24, 25)

109 . The HOI value ranges from 0 (high inequality) to 100 (universal access). In this analysis, D is the
 110 index of geographical inequality at the district-level within each state compared with the average

 $HOI = (1 - D) \times C$ 

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3 4	111	coverage of a particular maternal service for a given state. The HOI for coverage of each of the three
5 6	112	maternal care services and CoC for India and its states was estimated using the district level
/ 8	113	coverage of these services in NFHS-4 and NFHS-5, and the change in HOI between NFHS-4 and NFHS-
9 10 11	114	5 was assessed. The number of districts in each state in NFHS-4 and NFHS-5 are shown in
12 13	115	supplemental table 1.
14 15	116	In addition, we explored the geographical inequality within each of the wealth index (WI)
16 17	117	quintile in NFHS-5. The WI quintile is provided in the NFHS dataset at the household level which is
18 19 20	118	based on the number and kinds of consumer goods each household owns calculated using principal
20 21 22	119	component analysis.(17, 26) We calculated HOI for India and states for each WI quintile for each
23 24	120	maternal health service and CoC. We report the ratio of state average HOI with WI I and WI V, and the
25 26	121	ratio of HOI WI Ito WI V for each maternal health service and CoC.
27 28 29	122	The states of India were grouped based on its development status for this analysis. The
30 31	123	Empowered Action Group of states as categorized by the government of India (Bihar, Chhattisgarh,
32 33	124	Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh, Uttarakhand, and the north-eastern
34 35	125	states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura) were
36 37 38	126	grouped as 'less developed' and the remaining states were categorised as "more developed." (27, 28)
39 40	127	Delhi, Jammu and Kashmir including Ladakh were considered as a state for this analysis. The other
41 42	128	Union Territories were excluded as there are no districts in these Union Territories to undertake this
43 44	129	analysis. We have reported 95% confidence interval for all estimates as relevant and all the analyses
45 46 47	130	were carried out using STATA version 13.1 and Microsoft Excel 2016.
48 49	131	
50 51	132	Patient and Public Involvement statement: Patients were not involved in planning of this analysis.
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#### 

#### 135 RESULTS

A total of 188,506 ever-married women provided data on 249,020livebirths in NFHS-4 and 174,796
ever-married women provided data on 195,277livebirths in NFHS-5. The coverages for 4+ ANC visits,
institutional delivery with SBA, and PNC in 48 hours, and CoC for NFHS-4 and NFHS-5 for India,

139 grouping of states, and individual states are shown in supplemental table 2.

**4+ ANC visits** 

The coverage of 4+ ANC visits for India was 57.0% (95% CI 56.8 to 57.3) in NFHS-5. The percent change in coverage of 4+ ANC visits from NFHS-4 to NFHS-5 was estimated at 22.8% (95% CI 22.1 to 23.5) for India, 33.3% (95% CI 32.3 to 34.3) for less developed, and 3.4% (95% CI 2.6 to 4.1) for more developed states(supplemental table 2). This coverage ranged from 15.6% in Nagaland to 80.0% in Odisha in the less developed states, and 58.3% in Punjab to 93.2% in Goa in the more developed states in NFHS-5 (supplemental table 2). The HOI for geographic inequality in 4+ ANC visits for India was 48.4 in NFHS-5, an improvement of 35.2% (95% CI 34.5 to 35.9) between NFHS-4 to NFHS-5 (supplemental table 2), and was substantially higher for the more developed states at 68.2 than the less developed states at 40.7 in NFHS-5 (table 1 and supplemental table 3). HOI ranged from 8.3 to 88.9 in the states in NFHS-4, and 11.3 to 92.4 in the states in NFHS-5 (Figure 1 and supplemental table 3). Three and 6 states from the less and more developed states showed a reduction in HOI between NFHS-4 to NFHS-5, respectively (supplemental table 3). The highest gains in HOI were made in the state of Uttarakhand (115.1%; 95% CI 109.0 to 121.1) between NFHS-4 to NFHS-5, with the HOI for the state at 55.7 in NHFS-5.

Considering WI (table 1), HOI ranged from 33.8 for WI I to 64.4 for WI V for India, and the
 corresponding range was 31.1 to 57.0 and 58.6 to 70.5 for less and more developed states in NFHS 5, respectively. The HOI ratio of WI V to average was 1 or more in all states except Sikkim, Tamil
 Nadu and Kerala. Substantial variations were seen in HOI ratio of WI I to V, ranging from 0.16 to
 1.41, with this ratio being <1 in 27 (90.0%) states in NFHS-5, and the lowest HOI ratio between WI I</li>

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2 3	160	and V was seen in Mizoram at 0.16 (supplemental table 4) Among the 20 states with WI I to state
4 5	100	
6 7	161	HOI ratio at >0.70, 15 states had the W1 I to WI V HOI ratio at <0.70 (supplemental table 4).
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164	Table 1: Overall Human opportunity index (HOI) and by wealth index quintile (WI) for four or more antenattal care visits and the ratio
165 166	between WI I and overall HOI, WI V and overall HOI for India and its states, National Family Health Suger 5.

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				Four	or more ANC VISI			<b></b>
				HOI by WI	1	s re	HOII	Ratio
	Overall		2	2		nber Hate	WI 1:	V
India			2	5	4 50.2			Over
	40.4	55.0	44.0	55.1	59.5	64.40 1.2 te h.4	0.70	-
states	40.7	31.1	38.9	45.4	50.1	¥,60 ₽ 57.02 € \$	0.76	1
Arunachal Pradesh	34.3	20.2	31.6	37.0	44.2	47.3 cho	0.59	1
Assam	45.6	38.9	46.4	53.3	60.1	61.5a 0 0	0.85	1
Bihar	22.9	15.6	22.9	30.2	37.4	49.2 <b>2</b> . 5	0.68	2
Chhattisgarh	57.2	54.3	53.4	60.9	60.5	61.0	0.95	1
Jharkhand	36.0	28.6	38.5	41.9	51.8	56.0 🛓 🧧	0.79	1
Madhya Pradesh	52.2	44.6	49.3	56.1	59.1	62.3	0.85	1
Manipur	61.2	36.7	64.6	78.7	84.9	91.3	0.60	1
Meghalaya	45.4	36.8	45.8	50.0	61.5	55.5	0.81	1
Mizoram	46.6	11.0	37.8	49.9	61.5	69.9	0.24	1
Nagaland	11.3	5.4	10.1	20.8	26.9	20.0 <b>%</b> ; 🛃	0.48	1
Odisha	76.2	69.3	78.6	79.1	81.6	82.4ar	0.91	1
Rajasthan	51.2	45.7	45.9	49.6	52.2	59.0 <b>6 o</b>	0.89	1
Sikkim	60.1	66.9	61.1	59.1	61.3	47.63	1.11	(
Tripura	50.4	41.7	52.8	56.6	64.6	51.20 ne	0.83	1
Uttar Pradesh	38.1	30.4	35.0	38.9	41.4	50.9 jg	0.80	1
Uttarakhand	55.7	35.2	44.2	51.8	62.6	69.1 8	0.63	1
More developed states	68.2	58.6	65.1	67.1	70.1	ਰ ਬ 70.5 ਯੂ	0.86	1
Andhra Pradesh	68.3	45.5	64.2	64.8	66.5	69.2 <b>b</b> a	0.67	1
Goa	92.4	100.0	81.2	89.8	92.5	93.5	1.08	1
Guiarat	73.1	63.2	69.1	72.4	75.9	80.5 <b>n</b>	0.86	1

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ge 11 of 46					BMJ Open		/bmjopen-2024 1 by copyright,		
					Four	or more ANC vi	sits L 39		
					HOI by WI		22 o ding	HOI F	<b>Ratio</b>
		Overall HOI	1	2	3	4	on 21 N J for us 5	WI 1: Overall HOI	WI 5: Overall HOI
	Haryana	56.6	33.5	44.8	49.7	53.3	64.5 <b>% </b>	0.59	1.14
	Himachal Pradesh	67.1	52.1	53.4	62.3	74.2	74.8 m	0.78	1.11
	Jammu and Kashmir	76.3	60.2	75.8	76.7	80.6	79.5 ed	0.79	1.04
	Karnataka	65.1	51.8	60.3	65.4	71.2	69.5 <b>5 ng 2</b> 2	0.80	1.07
	Kerala	77.3	71.3	87.6	76.0	78.6	74.8 2 0 T	0.92	0.97
	Maharashtra	66.7	49.9	63.3	65.1	71.2	73.8	0.75	1.11
	Delhi	75.3	26.6	45.1	62.2	68.6	78.8	0.35	1.05
	Punjab	54.7	31.2	41.6	47.1	50.7	57.6 5	0.57	1.05
	Tamil Nadu	89.6	88.3	89.1	89.1	90.3	87 mini	0.99	0.97
	Telangana	68.2	53.5	63.9	64.8	70	68.5 <b>2</b> 3	0.78	1.00
	West Bengal	72.2	66.5	72.1	75.0	78.7	78 ≥ 🚦	0.92	1.08
167 168						ey	Ratio of HO           Less than 0500           0.51-0.89           0.90-1.69	)	

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169	Institutional	delivery	with .	SBA
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170	The coverage of institutional delivery with SBA for India was 85.0% (95% CI 84.9 to 85.2) in NFHS-5.
171	The percent change from NFHS-4 to NFHS-5 was estimated at 12.6% (95% CI 12.2 to 12.9) for India,
172	14.6% (95% CI 14.1 to 15.1) for less developed and 6.2% (95% CI 5.8 to 6.6) for more developed
173	states (supplemental table 2). This coverage ranged from 58.6% in Meghalaya to 96.3% in Sikkim in
174	less developed states and 84.3% in Himachal Pradesh to 99.8% in Kerala in more developed states in
175	NFHS-5 (supplemental table 2). The HOI for geographic inequality for institutional delivery with SBA
176	for India was 80.4, 90.1 and 76.2 for India, more developed and less developed states in NFHS-5,
177	respectively (table 2 and supplemental table 3). HOI ranged from 26.2 to 99.8 in the states in NFHS-
178	4, and 37.4 to 99.7in the states in NFHS-5 (Figure 2 and supplemental table 3). The highest gains in
179	HOI between NHFS-4 and NFHS-5 were made in Arunachal Pradesh state (64.9%; 95% CI 61.3 to
180	68.5), with the HOI for the state at 77.5 in NHFS-5 (supplemental table 3).
181	Considering WI (table 2), HOI ranged from 65.1 for WI I to 93.7 for WI V for India, and the
182	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS-
182 183	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI
182 183 184	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5
182 183 184 185	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5 (supplemental table 4). Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had
182 183 184 185 186	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5 (supplemental table 4). Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had the W1 I to WI V HOI ratio at <0.70 (supplemental table 4).
182 183 184 185 186 187	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5 (supplemental table 4). Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had the W1 I to WI V HOI ratio at <0.70 (supplemental table 4).
182 183 184 185 186 187	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5 (supplemental table 4). Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had the W1 I to WI V HOI ratio at <0.70 (supplemental table 4).
182 183 184 185 186 187	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5 (supplemental table 4). Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had the W1 I to WI V HOI ratio at <0.70 (supplemental table 4).
182 183 184 185 186 187	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS- 5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5 (supplemental table 4). Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had the W1 I to WI V HOI ratio at <0.70 (supplemental table 4).

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188	Table 2: Overall Human opportunity index (HOI) by wealth index quartile (WI) for institutional delivery with skilled birth attendant (SBA)
189 100	and the ratio between WI I and overall HOI, WI V and overall HOI for India and its states, National Fagily Health Survey-5.

				Institution	nal delivery w	vith SBA			
	HOI by WI						🖉 🦉 HOI Rati		
	Overall HOI	1	2	3	4	5	စ္ခ်က္အခဲ/၊ 1: စာမ္ရက္ရေall HOI	W Over	
India	80.4	65.1	78.8	86.0	90.2	93.7	<b>ö</b> – <b>B</b> .81	1	
Less developed states	76.2	63.6	76.6	83.5	87.8	92.0	4. Dog hoges text an	1	
Arunachal Pradesh	77.5	56.0	77.6	86.7	92.0	96.0	d cho	1	
Assam	82.3	72.1	87.0	91.7	94.8	95.5	ata	1	
Bihar	72.1	63.9	76.6	81.2	82.9	88.7	m, 4.89	1	
Chhattisgarh	78.5	68.0	80.1	85.9	90.3	94.3	0.87	1	
Jharkhand	70.4	60.7	77.1	83.8	91.3	94.7	× 2.86	1	
Madhya Pradesh	84.1	75.4	84.8	90.0	91.7	90.3	tra 😫 90	1	
Manipur	62.0	37.7	65.1	78.7	88.2	93.7	<b>b</b> .61	1	
Meghalaya	52.5	38.8	57.6	72.6	82.5	82.2	<b>9</b> .74	1	
Mizoram	72.4	26.4	59.1	80.5	92.8	95.8	<b>d e</b> .36	1	
Nagaland	37.4	26.2	37.9	57.1	64.7	74.9	<b>S 9</b> .70	2	
Odisha	87.3	77.6	91.6	93.9	95.5	95.6	<b>a 9</b> .89	1	
Rajasthan	93.9	89.2	91.8	94.1	94.8	97.1	<b>6 0</b> .95	1	
Sikkim	95.2	88.5	94.5	94.8	97.3	94.2	<b>1 0</b> .93	0	
Tripura	83.5	71.8	88.8	91.9	94.0	90.6	<b>b</b> .86	1	
Uttar Pradesh	78.0	68.3	76.4	79.4	82.8	90.1	<b>Jie 19</b> .88	1	
Uttarakhand	78.5	62.1	62.7	75.0	85.7	91.9	<b>8</b> .79	1	
More developed							5 at		
states	90.1	76.5	85.8	90.1	92.6	95.1	<b>0</b> .85	1	
Andhra Pradesh	95.4	73.9	93.0	94.2	95.9	98.7	<b>8</b> .77	1	
Goa	98.5	100.0	90.6	100.0	98.5	98.7	<b>1</b> .02	1	
Gujarat	87.5	75.3	85.9	88.8	92.1	91.1	<b>Ä</b> .86	1	

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	1	1					, in 08	
				Institutio	nal delivery w	ith SBA	cludi 2392	
	Overall			HOI by WI				Ratio
	HOI	1	2	3	4	5		
Harvana	90.5	64.7	77.0	86.8	91.1	96.0		
Himachal Pradesh	82.5	54.1	68.1	80.8	86.5	90.6		-
Jammu and Kashmir	87.9	71.5	82.7	88.6	94.7	96.6	atec 80.81	1
Karnataka	90.3	83.8	85.6	90.6	93.8	93.2		1
Kerala	99.7	100.0	100.0	99.5	99.8	99.6		1
Maharashtra	88.2	69.5	85.4	89.0	92.3	95.0	a g g g.79	1
Delhi	90.2	21.9	68.7	82.7	83.0	91.6	<b>0 0 0</b> .24	1
Punjab	92.9	79.4	80.7	96.5	90.5	94.6	ata 0,85	1
Tamil Nadu	99.2	95.6	97.9	99.2	99.5	100.0	ni <del>0</del> .96	1
Telangana	90.4	75.5	88.9	90.0	90.4	91.4	<b>Đ</b> .84	1
West Bengal	89.2	83.7	90.6	93.8	94.6	93.1	≥ 0.94	1
						R 60 00 11 1	atig         of         IOI           .51         0.89	
							I2, 2025 at Department C lies.	

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3 4	193	PNC within 48 hours of delivery
5 6	194	The coverage of PNC within 48 hours of delivery was 78.9% (95% CI 78.7-79.1) in NFHS-5. The
7 8	195	percent change from NFHS-4 to NFHS-5 was estimated at 28.5% (95% CI 28.0-29.0) for India, 31.8%
9 10 11	196	(95 % CI 31.1-32.4) for less developed and 19.6% (95% CI 19.0-20.3) for more developed states
12 13	197	(supplemental table 2). This coverage ranged from 43.2% in Nagaland to 92.1% in Odisha in the less
14 15	198	developed states and 68.2% in West Bengal to 96.3% in Goa in the more developed states in NFHS-5
16 17	199	(supplemental table 2). The HOI for geographic inequality in PNC within 48 hours of delivery for India
18 19 20	200	was 73.5 in NFHS-5, which improved by 34.6% (95% CI 34.2 to 35.1) between NFHS-4 to NFHS-5. The
20 21 22	201	HOI was substantially higher for the more developed states 82.6 than the less developed states 69.4
23 24	202	in NFHS-5 (table 3 and supplemental table 3). HOI ranged from 17.2 to 90.5 in the states in NFHS-4,
25 26	203	and 37.5 to 95.6 in the states in NFHS-5 (Figure 3 and supplemental table 3). The highest gains in HOI
27 28 20	204	were made in Arunachal Pradesh (128.6%; 95% CI 122.1 to 135.2) and Nagaland (118.0%; 95% CI
29 30 31	205	108.5 to 127.5), with the HOI for the states at 51.9 and 37.5 in NHFS-5, respectively (supplemental
32 33	206	table 3).
34 35	207	Considering WI (Table 3), HOI ranged from 62.0 for WI I to 85.0 for WI V in India, and the
36 37	208	corresponding range was from 61.2 to 83.0 and 67.4 to 88.3 for less and more developed states in
38 39 40	209	NFHS-5, respectively. The HOI ratio of WI V to state was 1 or more in all the states, except for Sikkim
41 42	210	and Tamil Nadu. The HOI ratio of WI I to WI V was <1 in 28 (93.3%) states and was <0.60 in 4 (13.3%)
43 44	211	states in NFHS-5 (supplemental table 4). Among the 27 states with WI I to state HOI ratio at >0.70, 2
45 46	212	states had the WI I to WI V HOI ratio at <0.70 (supplemental table 4).
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				PNC with	in 48 hours of de	elivery <u>o</u> N		
				HOI by WI		N L	HOLI	Ratio
	Overall HOI	1	2	3	4	ovemb Er es reta	WI 1: Overall HOI	WI 5: Overall HC
India	73.5	62.0	70.7	77.1	81.3	85 0 e	0.84	1.16
Less developed states	69.4	61.2	68.7	73.6	77.4	2024. E musbo I to tax x	0.88	1.20
Arunachal Pradesh	51.9	41.5	52.6	53.2	53.6	5947 5947	0.80	1.15
Assam	64.7	56.8	67.4	72.7	74.4	7265	0.88	1.11
Bihar	59.6	54.0	61.8	65.8	69.0	7538 ade	0.91	1.27
Chhattisgarh	85.3	81.8	85.5	85.2	89.4	8728 đ	0.96	1.03
Jharkhand	70.9	65.8	74.6	74.5	81.4	81134 Om	0.93	1.15
Madhya Pradesh	82.8	78.7	81.5	84.4	85.7	867 🚆	0.95	1.05
Manipur	57.7	38.1	59.2	72.7	78.1	7940	0.66	1.37
Meghalaya	53.4	49.3	55.6	59.3	54.9	563	0.92	1.05
Mizoram	63.9	28.2	55.0	72.2	72.1	79.3 8	0.44	1.21
Nagaland	37.5	27.2	38.8	55.2	59.8	5725	0.73	1.53
Odisha	90.7	87.6	90.7	92.9	92.9	9 <b>2</b> 9 🧵	0.97	1.02
Rajasthan	82.6	78.2	80.8	82.3	83.4	8512 og	0.95	1.03
Sikkim	70.4	66.9	69.3	71.4	70.6	574	0.95	0.82
Tripura	64.2	56.4	63.0	72.9	79.1	8218 n	0.88	1.29
Uttar Pradesh	73.2	66.0	72.6	73.6	77.3	8288 Ine	0.90	1.13
Uttarakhand	81.5	71.1	73.6	80.9	85.4	8 <b>9</b> 8 <b>12</b>	0.87	1.07
More developed states	82.6	67.4	77.2	83.0	85.3	s. 2025 88.3	0.82	1.07
Andhra Pradesh	90.4	67.6	87.2	91.1	90.3	92.1	0.75	1.02
Goa	95.6	100.0	90.6	89.8	96.6	98.7 <b>5</b>	1.05	1.03
Gujarat	87.1	85.7	85.4	85.8	86.3	89.3 <b>T</b>	0.98	1.03
Haryana	88.7	64.2	76.7	88.7	88.7	92.2 <b>e</b>	0.72	1.04

## BMJ Open Table 3: Overall Human opportunity index (HOI) by wealth index quartile (WI) for post-natal care in 42 hours of delivery and the ratio between WI I and overall HOI, WI V and overall HOI for India and its states, National Family Health Sugver 5.

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[					PNC with	in 48 hours of de	elivery E &		
·					HOI by WI		ding	HOL	Ratio
		Overall					g fo	WI 1:	WI 5:
		HOI	1	2	3	4	Р1 N	Overall HOI	Overall HOI
	Himachal Pradesh	87.3	71.3	78.7	88.3	88.3	9 <b>2</b> 81 🔽	0.82	1.05
	Jammu and Kashmir	77.2	64.7	72.9	78.1	80.3	8255	0.84	1.07
	Karnataka	83.6	76.3	80.7	84.7	85.5	8.900 r. 1	0.91	1.00
	Kerala	91.5	81.6	83.9	88.3	92.1	915 7 22	0.89	1.00
	Maharashtra	80.8	66.9	78.3	80.7	83.3	800 1. D	0.83	1.06
	Delhi	85.1	31.2	59.7	76.4	80.3	8 24 S	0.37	1.02
	Punjab	85.4	69.4	75.0	96.6	83.1	860 nlo	0.81	1.01
	Tamil Nadu	90.4	84.0	90.4	90.3	90.1	8934 ade	0.93	0.99
	Telangana	85.4	78.1	83.1	83.5	84.4	8847.2 fr	0.91	1.03
	West Bengal	63.8	56.2	62.0	67.6	76.4	8 <b>9</b>	0.88	1.26

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8 <b>@</b> :4	ĭ	0.88
), Al training, a	http://bmjope	Ratio of HOI
Ind	n.b	Less than 0.50
sin	<u>.</u>	0.51-0.89
nita	ön	0.90-1.09
rte	<b>1</b> 0	1.10-1.49
chr	n ح	1.50 or more
ologies.	ne 12, 2025 at Department GEZ-LTA	

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(supplemental table 4).

217 <b>C</b>	ontinuum	of care	(CoC)
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The coverage of CoC was 45.6% (95% CI 45.4-45.9) in NFHS-5. The percent change from NFHS-4 to NFHS-5 was estimated at 38.6% (95% CI 37.6-39.6) for India, 47.2% (95% CI 45.7-48.6.) for less developed and 19.5% (95% CI 18.4-20.6) for more developed states (supplemental table 2). The coverage ranged from 9.4% in Nagaland to 69.4% in Odisha in the less developed states, and 50.2% in Punjab to 90.1% in Goa in the more developed states in NFHS-5 (supplemental table 2). The HOI for geographic inequality in CoC for India was 37.1, which improved by 52.2% (95% CI 51.1 to 53.0) between NFHS-4 to NFHS-5. The HOI was substantially higher for the more developed states at 56.3 than the less developed states at 29.7 in NFHS-5 (table 4 and supplemental table 3). HOI ranged from 4.4 to 79.0 in the states in NFHS-4, and 6.5 to 88.8 in the states in NFHS-5 (Figure 4 and supplemental table 3). The highest gains in HOI were made in Arunachal Pradesh (167.1%; 95% CI 154.4 to 179.8) and Uttarakhand (147.4%; 95% CI 139.3 to 155.5), with the HOI for the states at 21.9 and 43.3 in NFHS-5, respectively (supplemental table 3). Considering WI (Table 4), HOI ranged from 21.7 for WI I to 56.5 for WI V for India, and the corresponding range was 19.8 to 48.8 and 39.3 to 62.7 for less and more developed states in NFHS-5, respectively. The HOI ratio of WI V to state was 1 or more in 27 states. The HOI ratio of WI I to WI V was <1 in 28 (93.3%) states and was <0.60 in 18 (60.0%) states in NFHS-5 (supplemental table 4). Among the 12 states with WI I to state HOI ratio at >0.70, 3 states the WI I to WI V HOI ratio at <0.70 Page 19 of 46

				HOI by WI			HOI	Ratio
	Overall	1	2	3	4	lovem Jes rel	WI 1: Overall	WI 5: C
India	37.1	21.7	32.3	41.9	49.2		0.58	1 5
Less developed	0,11		52.0	11.0		to 102	0.50	1.5
states	29.7	19.8	27.9	34.5	40.2		0.67	1.6
Arunachal Pradesh	21.9	12.4	20.9	22.8	26.0	332788	0.57	1.5
Assam	31.0	22.9	32.1	40.3	49.0	a c ⊐ 44830	0.74	1.4
Bihar	15.3	9.5	15.1	21.0	28.4	88.6p	0.62	2.5
Chhattisgarh	43.3	37.3	39.2	47.9	50.7	<b>nu</b> 3.4 <b>f</b>	0.86	1.2
Jharkhand	24.1	16.7	27.8	31.6	41.5		0.69	1.9
Madhya Pradesh	41.2	31.7	39.0	46.5	50.7	₽3.2 <del>4</del>	0.77	1.2
Manipur	41.5	19.8	41.3	60.2	68.0	<b>ឆ្</b> 7.1	0.48	1.6
Meghalaya	20.5	14.1	21.7	27.6	34.7		0.69	1.3
Mizoram	36.6	6.7	27.6	40.4	49.5	ິຍິສ7.3 <mark>ອ</mark>	0.18	1.5
Nagaland	6.5	2.2	5.9	12.2	17.4	<b>a</b> 5.6	0.34	5.4
Odisha	64.8	53.2	68.2	71.9	75.1	<b>8</b> 7.3	0.82	1.1
Rajasthan	44.2	38.0	39.8	42.3	45.2		0.86	1.1
Sikkim	48.3	47.6	49.0	45.6	50.3	<b>ទុ</b> 7.69	0.99	0.7
Tripura	35.3	19.5	37.4	39.8	56.2		0.55	1.4
Uttar Pradesh	27.9	19.2	24.9	28.5	31.7	<b>@</b> 3.7 <sup>e</sup>	0.69	1.5
Uttarakhand	43.3	24.5	28.2	38.5	51.2	<b>6</b> 9.2	0.57	1.3
More developed states	56.3	39.3	50.0	55.5	59.8	025 62.7නූ	0.70	1.1
Andhra Pradesh	59.3	32.4	53.6	59.6	60.5	64.9 <b>2</b>	0.55	1.0
Goa	88.8	100.0	71.9	86.4	87.2	91.6 <b>2</b>	1.13	1.0
Gujarat	61.2	49.8	56.9	60.0	64.0	69.9 <b>0</b>	0.81	1.1

# BMJ Open Table 4: Overall Human opportunity index (HOI) by wealth index quartile (WI) for continuum of care and the ratio between WI I and overall HOL WI V and overall HOL based on the maternal services for India and its states. National Family Heatth Survey-5

				С	ontinuum of care	392;	1	
				HOI by WI	1	ing or	HOI	Ratio
	Overall HOI	1	2	3	4	1 21 N for us	WI 1: Overall HOI	WI 5:
Haryana	51.2	23.3	35.5	45.0	47.2	<b>8</b> 0.3	0.46	1
Himachal Pradesh	54.3	31.8	39.5	51.0	59.7		0.59	1.
Jammu and Kashmir	59.5	40.2	53.9	62.3	66.1	BE GROT	0.68	1.
Karnataka	52.6	36.3	47.1	53.9	59.9	19 6 6 4 2 2	0.69	1.
Kerala	72.9	68.0	69.1	70.1	74.5	<u>8</u> <u>8</u> <u>8</u> <u>8</u> <u>8</u> <u>8</u>	0.93	0.
Maharashtra	54.5	33.5	49.9	51.8	60.3		0.61	1.
Delhi	65.3	1.6	28.0	47.9	55.4	68688 68688	0.02	1.
Punjab	46.9	28.7	31.5	95.8	41.8	20.1g	0.61	1.
Tamil Nadu	82.0	75.6	81.9	81.7	82.6	19.15	0.92	0.
Telangana	54.9	35.9	51.0	52.2	56.2	<b>Ģ</b> 7.0 <sup>2</sup>	0.65	1.
West Bengal	47.3	37.7	45.6	52.3	61.3	<b>&amp;</b> 5.6	0.80	1.
						ven.bmj.com/ on Jun , and similar technol	Ratio o           Less that           0.51-0.           0.90-1.           1.10-1.           1.50 or	f HOI an 0.50 89 09 49 more
						9 12, 2025 a )gies.		

Ratio of HOI
Less than 0.50
0.51-0.89
0.90-1.09
1.10-1.49
1.50 or more

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3 4	239	DISCUSSION
5 6	240	This analysis of coverage of maternal health services for livebirths over a decade between NFHS-4
7 8	241	and NFHS-5 has highlighted significant improvements in the geographic inequity for coverage of
9 10 11	242	these services at the state-level in India, and has identified the inequities that remain to be
12 13	243	addressed to achieve the ENAP 2025 coverage targets for these services. The geographic inequity
14 15	244	for the coverage of 4+ANC visits lags significantly behind that of institutional delivery with SBA and
16 17	245	PNC within 48 hours of delivery, contributing to the CoC inequity in NFHS-5. The HOI ratio for CoC at
18 19	246	0.38 highlights the extent of inequity between the women belonging to the lowest and the highest
20 21 22	247	wealth index quintiles in India.
23 24	248	A policy aiming at equitable access would require progress towards two objectives: first,
25 26	249	expanding the coverage by ensuring that as many women as possible get the opportunity; and
27 28	250	second, by allocating new opportunities first to the vulnerable population who are at a disadvantage
29 30 21	251	due to their circumstances.(29) We utilised HOI,(25) as a tool to measure the distribution of
32 33	252	opportunities and equitable access to maternal health services. The HOI not only carries information
34 35	253	about the coverage rate of the service but also how fairly the available services are distributed
36 37	254	among women of different backgrounds, in this case of different wealth index quintiles.(30) In
38 39	255	terms of expanding coverage to ensure that as many women as possible get the opportunity, the
40 41 42	256	coverage of 4+ ANC visits was for 4 of 7 women, and that for institutional delivery with SBA was 6
43 44	257	out of 7 women, and for PNC within 48 hours of delivery was 4 out of 5 women in NFHS-5. The
45 46	258	differential increase over the decade between the coverages of these three maternal health services
47 48	259	can possibly be explained by how the national programs to reduce maternal and neonatal mortality
49 50 51	260	were implemented during this period. The program to address ANC services was launched in 2016
52 53	261	after NFHS-4, and is aimed to guarantee a minimum package of ANC services to women in their
54 55	262	2nd/3rd trimesters of pregnancy at designated government health facilities.(31) There is no
56 57	263	monetary incentive either to the health worker or to the pregnant women under this program. The
58 59 60	264	likely impact of this program on HOI for 4+ ANC visits coverage will be documented in the next round

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265	of NFHS (round 6). However, given the extent of low coverage of 4+ ANC visits in most of the less
266	developed states and some of the more developed states, major inputs are needed to address the
267	barriers for improved ANC utilisation to achieve the ENAP 2025 target for 4+ ANC visits.(32-34) The
268	increased coverage for institutional deliveries with SBA between the two surveys resulted in nearly
269	doubling of HOI over this period, and near universality of this service in the more developed states.
270	Two programs – the Janani Suraksha Yojana (JSY) and the Janani Shishu Suraksha Karyakaram (JSSK)
271	- initiated to increase the coverage of institutional deliveries in India have contributed to the
272	exponential increase in access to institutional delivery.(35, 36) The JSY was initiated in 2005 and was
273	a large-scale national program that offered conditional cash transfer and support services to poor
274	pregnant women to use institutional delivery care facilities, especially in the states with lower
275	coverage.(35) The JSSK, initiated in 2011, provided free and cashless delivery along with some other
276	benefits to pregnant women to eliminate out-of-pocket expenses in order to increase the
277	institutional deliveries.(37) The PNC coverage was estimated at 61% HOI at 73.5 for India in NFHS-5
278	with a wide variation at the state-level. The increased PNC coverage also resulted in 34.6% increase
279	in HOI for PNC coverage between NFHS-4 and NFHS-5. According to the Indian PNC guidelines,(38)
280	the health workers are paid INR 250 (USD 3.5) for PNC visits, and are expected to undertake 6-7 PNC
281	visits at home from 1 <sup>st</sup> to 42 <sup>nd</sup> day of delivery for counselling the mother on various issues and
282	enabling referral if needed. Considering all the three maternal health services together, the CoC
283	coverage remained at 62.5% in NFHS-5 with only 19.5% change between the two surveys even in the
284	more developed states. Only 45% CoC coverage in NFHS-5 for India translates into 5 out of every 11
285	woman and newborn not having received all the three MNCH services, which is the basic premise of
286	the ENAP and INAP to address neonatal and maternal mortality.(19, 21)
287	With regards to the policy objective of allocating new opportunities to the vulnerable
288	population who are at a disadvantage due to their circumstances, socio-economic inequities in
289	maternal health services in India have been reported previously, (16, 39-45) but the use of HOI to

290 measure inequity has not been attempted. For all the maternal health services, the women

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belonging to the lowest WI quintile had low HOI compared to those in the highest WI quintile, and the difference was starker for ANC services and in the less developed states. Though the within-district inequalities in intervention coverages are reducing in most states, the pace of reduction has not been the same for every woman. The state of Delhi with the national capital had the one of the least HOI ratio for the women belonging to the lowest WI quintile. The extent of HOI ratio for the lowest to the highest WI quintile and that to average HOI between the maternal health services within states highlights the specificity needed in targeting women with the respective interventions to achieve 2025 coverage targets. One of the challenges in achieving equity in maternal health services in India is the dependence on NFHS for retrospective situational analysis rather than for monitoring and evaluation, because the routine health information management system (HMIS) does not allow for tracking of CoC for maternal health services per woman. (46) Real time tracking of women for utilisation of these services at the district-level is needed to reduce inequity in the coverage of these services. India has a Mother and Child Tracking System (MCTS) in place since 2009 to follow a mother-child dyad through the CoC, but it is known to be fraught with several issues.(47-49) Clearly, it is important that strategies to improve the MCTS, within digital health, are looked into urgently if India were to reach every woman and newborn to achieve the SDG targets of reduced maternal and neonatal mortality at the district-level.(50-52) High quality timely data for evidence-informed decision making to reduce inequity at the district level can also be obtained through continuous surveys.(53) Furthermore, incentivisation of services is currently only for institutional delivery and for PNC services. With poor coverage of ANC services resulting in poor coverage of CoC, it may be worth considering incentivising the CoC rather than individual maternal health services to address inequity.

The major strength of this analysis is the utilisation of HOI to indicate not only inequity in the coverage rate of the services but also how fairly the available services are distributed among women by geography and wealth index quintiles. This, we believe, allows for understanding the women who need to be targeted to reduce the inequity in the maternal health care in India. The inclusion of 

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CoC is another strength as it brings the woman to the centre stage as against the individual maternal health care services. Some limitations of the analysis presented should be taken into account. The data on service utilisation is documented in the NFHS are self-reported by women, which may be subject to recall bias. We believe this bias to be of less concern as women self-report accurately indicators related to concrete and observable actions performed on them as opposed to information or advice they were offered.(54, 55) We only considered the inequity in coverage and not in the quality of contact with the health system during service utilisation in this analysis as such data are not available in the NFHS. There is a growing literature documenting increased coverage but poor quality of contact for these services, (4) including from India from pregnancy to delivery, (4, 49, 56-66) and also of poor quality of health care being a major driver of excess mortality across conditions, including neonatal mortality.(67-70) Health system redesign has been suggested for equity in maternal and new born health, by moving all childbirth care services to hospitals in all countries, combined with improvements in the quality of care provided in these facilities, transportation from home to hospital, and continuity of care through hub-and-spoke arrangements.(71) While commenting on the scope of health system re-design is beyond the scope of the analysis undertaken for this paper, more discussion is needed and more options need to be rigorously tried and tested to develop sustainable district health systems which are fit for purpose and respond to continuity of care needs of women and their babies.(72) CONCLUSION In conclusion, the findings of this assessment of coverage of maternal health services for livebirths over a decade are encouraging as significant reductions in geographic inequity are documented. However, the findings also emphasise the need for improved targeting of women to reduce the remaining inequity gap to achieve the ENAP targets, in particular for the coverage of 4+ANC visits. It

- 7 341 will be important for the national program to monitor the CoC coverage in real time in addition to

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3 4	342	the three maternal health services individually to monitor and track inequity at the district level for
5 6	343	every pregnant woman to ensure that inequity by wealth index is also addressed in India.
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3 4	346	Ethics approval
5 6	347	No ethics approval was required for this analysis as we utilised the de-identified data available in
7 8	348	public domain.
9 10 11	349	
12 13	350	Authors' contributions
14 15	351	RD and GAK conceptualized the study; GAK and MM had full access to data in the study and
16 17	352	performed data analysis; RD and GAK take full responsibility for the integrity of data and accuracy of
18 19 20	353	the data analysis, and had final responsibility for the decision to submit for publication; RD drafted
21 22	354	the manuscript; all authors contributed to the interpretation and approved of the final version of the
23 24	355	manuscript. RD is the guarantor.
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39 40	362	The authors have no conflict of interest.
41 42 42	363	
43 44 45	364	Data availability statement sharing
46 47	365	All data generated or analysed during this study are included in this published article and its
48 49	366	supplementary information files.
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57 58 59 60	370	

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## **FIGURE LEGENDS**

Figure 1. Human Opportunity Index for 4+ antenatal care visits in NFHS-4 in 2015-16 and NFHS-5 in

2019-2021 for each state of India. 

- Figure 2. Human Opportunity Index for institutional delivery with skilled birth attendant in NFHS-4
- in 2015-16 and NFHS-5 in 2019-2021 for each state of India.
- Figure 3. Human Opportunity Index for post-natal care within 48 hours of delivery in NFHS-4 in
- 2015-16 and NFHS-5 in 2019-2021 for each state of India.
- Jac. Figure 4. Human Opportunity Index for continuum of care in NFHS-4 in 2015-16 and NFHS-5 in 2019-
- 2021 for each state of India.

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Figure 1. Human Opportunity Index for 4+ antenatal care visits in NFHS-4 in 2015-16 and NFHS-5 in 2019-2021 for each state of India.

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Aramachal Pradesh Sikkim agaland Manipur Jharkhano Tripura Mizoram



Population level trends over a decade in geographical inequality for opportunity in access to maternal care services: findings from the National Family Health Surveys in India

Supplementary file

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# Supplementary Table 1. Number of districts by state in the National Family Health Survey (NFHS) rounds 4 and 5.

India Less developed Arunachal Pradesh	NFHS-4	
I <b>ndia</b> L <b>ess developed</b> Arunachal Pradesh		NFHS-5
<b>.ess developed</b> Arunachal Pradesh	628	695
Arunachal Pradesh	363	395
	16	20
Assam	27	33
Bihar	38	38
Chhattisgarh	18	27
Jharkhand	24	24
Madhya Pradesh	50	51
Manipur	9	9
Meghalaya	7	11
Mizoram	8	8
Nagaland	11	11
Odisha	30	30
Rajasthan	33	33
Sikkim	4	4
Tripura	4	8
Uttar Pradesh	71	75
Uttarakhand	13	13
More developed	265	300
Andhra Pradesh	13	13
Delhi	9	11
60a	2	2
Guiarat	26	2
Harvana	20	33
Himachal Bradesh	12	12
lammu & Kashmir <sup>§</sup>	22	22
	22	22
Karala	30	30
	14	
WidfidfaSfilfa	35	36
Punjab Tamil Nadu	20	22
	32	32
reiangana	10	31
west Bengal	19	20

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Supplementary Table 2. Coverage of four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), and post-natal care within 48 hours of delivery, and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) 4 and NFHS 5 for India and its states. CI der tes confidence interval.

State	Sampl	e size	Four	of more ANC vi	sits	Institut	ional delivery wit	h SBA* 🖁	Post-natal care	within 48 hours	of delivery		Continuum of o	are
	NFHS-4	NFHS-5	NFHS-4	NFHS-5	Percent change	NFHS-4	NFHS-5	Percent change	NFHS-4	NFHS-5	Percent change	NFHS-4 % of N	NFHS-5	Percent change from NFHS-4 to
	(N)	(N)	% of N (95% CI)	% of N (95% CI)	from NFHS-4 to NFHS-5 (95% CI)	% of N (95% CI)	% of N (95% CI)	from NFHS- 4 to NFHS-5 (95% द्वी)	% of N (95% CI)	% of N (95% CI)	4 to NFHS- 4 to NFHS-5 (95% CI)	(95% CI)	% of N (95% CI)	NFHS-5 (95% CI)
India	188,506 <sup>+</sup>	174,796	46.4 (46.2-46.7)	57.0 (56.8-57.3)	22.8 (22.1-23.5)	75.5 (75.3-75.7)	85.0 (84.9-85.2)	12.6 (12-12.9)	61.4 (61.2 - 61.6)	78.9 (78.7-79.1)	28.5 (28.0-29.0)	32.9 (32.7-33.1)	45.6 (45.4-45.9)	38.6 (37.6-39.6)
Less developed	132,809	113,519	36.0 (35.7-36.3)	48.0 (47.7-48.3)	33.3 (32.3-34.3)	70.6 (70.3-70.8)	80.9 (80.7-81.2)	ลี่14.6 (161-19.1)	57.0 (56.7-57.2)	75.1 (74.8-75.3)	31.8 (31.1-32.4)	24.8 (24.6- 25.1)	36.5 (36.3-36.8)	47.2 (45.7-48.6)
Arunachal Pradesh	3,858	4,570	24.6 (23.3- 26.0)	37.2 (35.8-38.6)	51.2 (45.1-57.4)	52.7 (51.1-54.2)	80.6 (79.4-81.7)	<b>1</b> 52.€ (40€8-556.1)	27.5 (26.1-28.9)	55.4 (53.9-56.8)	101.5 (95.7-107.2)	11.8 (10.8- 12.8)	25.3 (24.1-26.6)	114.7 (104.4-124.4)
Assam	8,534	9,247	45.4 (44.3- 46.4)	50.9 (49.8-51.9)	12.1 (9.5-14.7)	72.5 (71.5-73.4)	84.8 (84.1-85.5)	op17.00 (15,6-18,4)	56.9 (55.8-57.9)	67.8 (66.8-68.7)	19.1 (17.1-21.2)	29.9 (20.9-30.9)	35.5 (34.5-36.5)	18.7 (15.1-22.4)
Bihar	16,822	13,874	14.6 (14.1 -15.2)	25.5 (24.7-26.2)	74.7 (70.0-79.3)	66.0 (65.3-66.7)	75.1 (74.4-75.8)	, <b>13.</b> (1 <b>2</b> 5-1 <b>5</b> .0)	47.8 (47.1-48.6)	65.4 (64.6-66.2)	36.8 (35.0-38.7)	9.0 (8.6- 9.4)	17.8 (17.2-18.4)	97.8 (91.5-104.1)
Chhattisgarh	6,805	6,526	56.9 (55.7 - 58.0)	61.2 (60.0-62.4)	7.6 (5.3-9.9)	71.8 (70.7-72.8)	82.1 (81.2-83.0)	(1 <b>2</b> ;7-1 <b>6</b> .0)	67.2 (66.0-68.3)	87.2 (86.3-87.9)	29.8 (28.0-31.5)	37.6 (36.4-38.7)	47.3 (46.1-48.5)	25.8 (22.4-29.2)
Jharkhand	8,947	7,465	29.9 (29.0 - 30.9)	38.6 (37.5-39.7)	29.1 (25.4-32.8)	63.8 (62.8-64.8)	74.5 (73.5-75.5)	(15:0-1 <b>2</b> .5)	46.8 (45.8-47.8)	74.0 (73.0-75.0)	58.1 (55.6-60.6)	17.0 (16.2-17.8)	27.0 (26.0-28.0)	58.8 (53.3-64.4)
Madhya Pradesh	17,406	11,700	34.9 (34.1-35.6)	57.0 (56.1-57.9)	63.3 (60.9-65.7)	75.9 (75.2-76.5)	86.6 (86.0-87.2)	(13,2-15,0)	55.9 (55.1-56.6)	85.1 (84.4-85.7)	52.2 (50.8-53.7)	23.1 (22.4 -23.7)	46.1 (45.2-47.0)	99.6 (96.2-102.9)
Manipur	4,429	2,511	65.1 (63.7-66.5)	68.7 (66.8-70.4)	5.5 (2.9-8.2)	67.9 (66.5-69.3)	70.9 (69.1-72.6)	mbe tras elategy (tep	62.8 (61.4-64.2)	64.9 (62.9-66.7)	3.3 (0.5-6.2)	49.2 (47.7 -50.7)	50.9 (48.9-52.8)	3.5 (-0.3-7.2)
Meghalaya	3,119	4,602	50.1 (48.4-51.9)	50.3 (48.8-51.7)	0.4 (-3.5-4.3)	56.0 (54.3-57.8)	58.6 (57.2-60.0)	10 (19) (19) (19) (19) (19) (19) (19) (19)	58.0 (56.3-59.8)	58.3 (56.8-59.7)	0.5 (-2.8-3.8)	32.1 (30.4 -33.7)	23.9 (22.7-25.1)	-25.5 (-31.1 to -20.0)
Mizoram	3,681	1,896	56.4 (54.8-58.0)	52.4 (50.2-54.7)	-7.1 (-10.6 to - 3.6)	78.1 (76.7-79.4)	79.3 (77.4-81.0)	00%#iloa 00#filoa 00#schoo (t and da	62.8 (61.2-64.3)	68.1 (65.9-70.1)	8.4 (5.4-11.5)	41.5 (39.9 -43.1)	42.1 (39.9-44.4)	1.4 (-3.3-6.2)
Nagaland	3,136	2,205	13.5 (12.3-14.7)	15.6 (14.1-17.2)	15.6 (5.2-25.9)	33.8 (32.2-35.5)	42.5 (40.5-44.6)	(200-341.4)	22.6 (21.2-24.1)	43.2 (41.2-45.3)	91.2 (83.3-99.0)	7.6 (6.7- 8.6)	9.4 (8.3-10.7)	23.7 (9.3-38.1)
Odisha	9,015	7,141	64.7 (63.7-65.7)	80.0 (79.1-80.9)	23.6 (22.0-25.3)	83.3 (82.5-84.0)	90.1 (89.4-90.7)		77.4 (76.5-78.3)	92.1 (91.5-92.7)	19.0 (17.8-20.2)	47.8 (46.8 -48.8)	69.4 (68.4-70.5)	45.2 (42.8-47.6)
Rajasthan	11,950	10,831	38.3 (37.5-39.2)	56.5 (55.6-57.5)	47.5 (44.9-50.1)	85.0 (84.4-85.6)	95.0 (94.5-95.4)	(1 <b>2</b> -11.8) (1 <b>2</b> -1 <b>2</b> .6)	65.2 (64.3-66.0)	85.2 (84.5-85.9)	30.7 (28.3-32.1)	29.1 (28.2 -29.9)	49.4 (48.5-50.4)	69.8 (66.5-73.0)
Sikkim	899	569	74.9 (71.9-77.6)	65.4 (61.4-69.2)	-12.7 (-17.0 to - 8.3)	95.2 (93.6-96.4)	96.3 (94.4-97.5)	in1.2008) (-20.5-208) (-20.5-208)	75.0 (72.0-77.7)	73.5 (69.7-76.9)	-2.1 (-6.3-2.3)	56.0 (52.7-59.2)	52.0 (47.9-56.1)	-7.1 (-13.7 to -0.6)
Tripura	1,169	1,860	63.5 (60.7-66.2)	54.0 (51.7-56.2)	-15.0 (-19.7 to - 10.3)	80.3 (77.9-82.5)	86.8 (85.2-88.3)	sim <u>II</u> -101) (5ar to	61.2 (58.4-64.0)	68.6 (66.4-70.7)	12.1 (7.2-17.0)	45.9 (43.0 -48.7)	39.7 (37.5-42.0)	-13.5 (-20.2 to -6.8)
Uttar Pradesh	28,741	25,556	27.4 (26.9-27.9)	41.5 (40.9-42.1)	51.5 (49.3-53.7)	68.1 (67.5-68.6)	81.1 (80.6-81.5)	<u>دیا</u> 9.1 (122-29.0)	59.1 (58.6 - 59.7)	76.9 (76.4-77.4)	30.1 (29.1-31.2)	20.0 (19.5 -20.4)	31.1 (30.5-31.7)	55.5 (52.8-58.2)
Uttarakhand	4,298	2,966	29.7 (28.3-31.1)	60.6 (58.8-62.3)	104.0 (98.7- 109.4)	67.9 (66.5-69.2)	80.1 (78.6-81.5)	Q18.0 (1977-20.3)	56.9 (55.4-58.4)	84.2 (82.8-85.4)	48.0 (45.2-50.8)	20.5 (19.3 -21.7)	47.7 (45.9-49.5)	132.7 (125.5-139.9)
More developed	55,697	61,277	71.3 (70.9-71.7)	73.7 (73.4-74.1)	3.4 (2.6-4.1)	87.2 (86.9-87.5)	92.6 (92.4-92.8)	6.2 <sup>27</sup> (5.8-6.6)	71.9 (71.5-72.3)	86.0 (85.7-86.3)	19.6 (19.0-20.3)	52.3 (51.9- 52.7)	62.5 (62.2-62.9)	19.5 (18.4-20.6)
Andhra Pradesh	4,055	2,092	75.7 (73.9 - 77.4)	69.3 (67.2-71.2)	-8.5 (-11.0 to -	89.5 (88.2-90.7)	95.7 (94.8-96.5)	6.9 <b>90</b> (5.5-8 <b>1</b> 4)	79.3 (77.6 – 80.9)	90.8 (89.5-91.9)	14.5 (12.3-16.7)	57.8 (55.7– 59.8)	62.2 (60.1-64.3)	7.6 (3.8-11.5)
Delhi	1,258	2,379	71.4	79.9	5.9) 11.9	88.0	91.7	4.2 <b>t</b>	63.3	87.2	37.8	46.6	69.6	49.4

## BMJ Open

State	State Sample size Four of more ANC visits				Institut	ional delivery wi	th SBA*	Post-natal care	within 48 hours	of delivery	Continuum of care			
	NFHS-4	NFHS-5	NFHS-4	NFHS-5	Percent change	NFHS-4	NFHS-5	Percest chanse	NFHS-4	NFHS-5	Percent change	NFHS-4 % of N	NFHS-5	Percent change from NFHS-4 to
	(N)	(N)	% of N	% of N	from	% of N	% of N	from NEHS-	% of N	% of N	from NFHS-	(95% CI)	% of N	NFHS-5 (95% CI)
			(95% CI)	(95% CI)	NFHS-4 to NFHS-5	(95% CI)	(95% CI)	4 to NF벍S-5 (95% 로)	(95% CI)	(95% CI)	4 to NFHS-5 (95% CI)		(95% CI)	
					(95% CI)			, rst p			(			
			(68.8 - 73.8)	(78.2-81.4)	(8.3-15.6)	(86.1-89.7)	(90.5-92.7)	(2.1-653)	(60.6 - 66.0)	(85.8-88.5)	(33.3-42.1)	(43.9 - 49.4)	(67.7-71.4)	(43.2-55.5)
Goa	347	322	87.6 (82 7 00 7)	93.2	6.4 (2.2.10.5)	96.8 (04.4.08.2)	98.8 (06.7.00.5)	2.1 <u>5</u>	91.4 (87.002.0)	96.3 (02 5 07 0)	5.4	80.7 (76.2 84.5)	90.1	11.6
Guiarat	5.827	7.575	66.4	77.7	17.0	83.9	90.3	(0.1-400) 7.600	62.9	89.4	42.1	42.3	66.3	56.7
	- / -	<i>,</i>	(65.2 - 67.6)	(76.7-78.6)	(15.1-19.0)	(82.9-84.8)	(89.6-90.9)	( <b>64</b> -8 <b>8</b> )	(61.7 - 64.2)	(88.6-90.0)	(40.1-44.2)	(41.0- 43.5)	(65.3-67.4)	(53.5-60.0)
Haryana	5,719	5,162	45.4	60.8	33.9	82.1	93.4		68.3	91.3	33.7	34.3	55.6	62.1
Llineeshel	2 202	2.145	(44.1 - 46.7)	(59.4-62.1)	(30.7-37.1)	(81.1-83.1)	(92.6-94.0)	(1265-198.0)	(67.0 - 69.5)	(90.5-92.0)	(31.8-35.5)	(33.1 - 35.6)	(54.3-57.0)	(58.0-66.2)
Himachai Pradesh	2,292	2,145	66.2 (64 3 - 68 1)	/1.8 (69 8-73 6)	8.5 (5 3-11 7)	75.9 (74 1-77 6)	84.3 (82 7-85 8)	(8-6-1 <b>%</b> -6)	73.6 (71 8 - 75 4)	88.9 (87 5-90 2)	20.8 (18 2-23 4)	49.5 (47 4 - 51 5)	59.3 (57 2- 61 3)	19.8 (15.2-24.4)
Jammu &	6,280	5,367	79.5	80.7	1.5	83.2	91.0	09.40	73.0	80.3	10.0	61.8	65.1	5.3
Kashmir <sup>§</sup>			(78.5 - 80.5)	(79.6-81.7)	(0.1-2.9)	(82.2-84.1)	(90.2-91.7)	(82-106)	(71.9 - 74.1)	(79.2-81.3)	(8.4-11.6)	(60.6 - 63.0)	(63.8-66.4)	(3.2-7.5)
Karnataka	5,876	6,389	73.5	70.8	-3.7	90.7	92.5		60.5	86.4	42.8	44.6	59.1	32.5
			(72.3 - 74.6)	(69.6-71.9)	(-5.4 to -	(90.0-91.5)	(91.8-93.1)	(표1-2년) 도 83	(59.2 - 61.7)	(85.5-87.2)	(40.6-45.0)	(43.3 - 45.9)	(57.9-60.3)	(29.4-35.6)
Kerala	2,128	2.360	90.3	82.2	-9.0	99.9	99.8	<u>u</u> <u>9</u> 22	86.3	92.8	7.5	78.4	77.9	-0.6
	_,	_,	(89.0 - 91.5)	(80.6-83.7)	(-10.6 to -	(99.6-100.0)	(99.5-99.9)	(-4,3-6)	(84.7 - 87.7)	(91.7-93.8)	(5.7-9.3)	(76.6 - 80.1)	(76.2-79.5)	(-3.1-1.8)
					7.4)		22	21   or u						
Maharashtra	7,143	7,415	72.3	71.3	-1.4	86.7	91.0		76.9	84.1	9.4	54.4 (52.2 55.5)	60.2	10.7
Puniah	4 1 3 2	4 520	68.2	58.3	-14 5	92.0	94.1		88.4	87 1	-1 5	(55.2 - 55.5)	50.2	-15.0)
i anjao	1)202	1,520	(66.7 - 69.6)	(56.8-59.7)	(-16.8 to -	(91.2-92.8)	(93.4-94.7)	(1933372)	(87.4 - 89.3)	(86.1-88.0)	(-2.7 to -0.3)	(57.6 - 60.6)	(48.7-51.6)	(-17.8 to -12.3)
					12.2)			1 to						
Tamil Nadu	6,181	5,228	80.7	91.6	13.5	98.8	99.5		72.4	92.2	27.3	60.8	84.9	39.6
Tolongono	ΝΔ	5 420	(79.7 - 81.7)	(90.8-92.3)	(12.2-14.8)	(98.5-99.1)	(99.3-99.7)	(0;42;100) ⊐,⁄2°≤	(71.3 - 73.5)	(91.4-92.9)	(25.7-29.0)	(59.6 - 62.0)	(84.0-85.9)	(37.5-41.8)
reidrigaria	NA	5,429	(71.0 - 75.1)	(68.5-70.9)	-4.7 (-7.6 to -	87.2 (85.6-88.7)	91.4 (90.6-92.1)	( <u>\$</u> 0666)	(79.8 - 83.4)	(85.7-87.5)	(3.7-8.2)	57.6 (55.3–59.9)	(55.6-58.2)	(-5.3-2.9)
			( ,	(,	1.7)	(,		videc			(,	(,	( ,	
West Bengal	4,459	4,894	74.2	75.7	2.0	77.0	91.2	n <u>1</u> 8. <b>4</b> ro	63.1	68.2	8.1	47.4	52.0	9.7
ıl			(72.9 - 75.5)	(74.4-76.9)	(0.1-3.9)	(75.8-78.2)	(90.4-91.9)	(168-29.1)	(61.7 - 64.5)	(66.9-69.5)	(5.6-10.5)	(46.0 - 48.9)	(50.6-53.4)	(6.3-13.1)
Data missing or	n 101 wome	en for instit	ashmir in NFHS-5	with SBA, PNC v	within 48 hour. ot provide sepa	s of delivery, and rate data for Lad	continuum of car akh	://smjopen.bmj.com/ on June 12, 2025 at Department G IS tranning, and similar technologies. re						
						For peer re	view only - http:,	YEZ- LT A //bmjopen.bmj.c	om/site/about/guid	elines.xhtml				

N						l <mark>i</mark> uman Opp	portunity In	dex				
N		Four of r	nore ANC visits	I	nstitutiona	l delivery with SBA	Post-na	atal care wit	hin 48 hours of delivery		Contin	uum of care
	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (955 CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)
ndia	35.8	48.4	35.2 (34.5 to 35.9)	68.9	80.4	16.7 (16. 🖁 to 17.0)	54.6	73.5	34.6 (34.2 to 35.1)	24.4	37.1	52.2 (51.1 to 53.0)
ess developed states	27.9	40.7	45.9 (44.9 to 46.9)	64.5	76.2	18.1 (17.a to 18.6)	50.6	69.4	37.2 (36.6 to 37.8)	18.5	29.7	60.5 (59.2 to 61.9)
Arunachal Pradesh	20.2	34.3	69.8 (62.7 to 76.9)	47.0	77.5	64.9 <b>5</b> 1. <del>3</del> to 68.5)	22.7	51.9	128.6 (122.1 to 135.2)	8.2	21.9	167.1 (154.4 to 179.8)
Assam	40.7	45.6	12.0 (9.2 to 14.9)	66.5	82.3	23.8 22.± to 25.4)	51.1	64.7	26.6 (24.3 to 28.9)	24.9	31.0	24.5 (20.3 to 28.7)
Jihar	12.8	22.9	78.9 (73.9 to 83.9)	61.0	72.1	18.2 <b>£</b> 16. <b>&amp;</b> to 19.6)	43.1	59.6	38.3 (36.2 to 40.3)	7.7	15.3	98.7 (91.8 to 105.6)
Chhattisgarh	52.0	57.2	10.0 (7.5 to 12.5)	68.6	78.5	14.4 <b>2</b> 12. <b>3</b> to 16.2)	63.0	85.3	35.4 (33.5 to 37.3)	33.1	43.3	30.8 (27.0 to 34.6)
harkhand	25.0	36.0	44.0 (39.7 to 48.3)	59.5	70.4	18.3 <b>£</b> 16. <b>£</b> to 20.3)	43.2	70.9	64.1 (61.4 to 66.8)	13.8	24.1	74.6 (68.3 to 81.0)
√adhya Pradesh	29.4	52.2	77.6 (74.8 to 80.3)	70.8	84.1	18.8 <b>1</b> 7. <b>7</b> to 19.8)	51.3	82.8	61.4 (59.8 to 63.0)	19.1	41.2	115.7 (111.9 to 119.5)
√anipur	54.9	61.2	11.5 (8.2 to 14.8)	58.0	62.0	6. <b>§</b> (3. <b>§</b> to 10.0)	54.4	57.7	6.1 (2.7 to 9.4)	39.2	41.5	5.9 (1.3 to 10.4)
√leghalaya	44.3	45.4	2.5 (-1.9 to 6.9)	49.6	52.5	5 <del>3</del> 8 (129 to 9.8)	52.0	53.4	2.7 (-1.1 to 6.4)	26.4	20.5	-22.3 (-28.8 to -15.9)
∕lizoram	52.4	46.6	-11.1 (-14.8 to -7.3)	72.1	72.4	0.4 (-200 to 2.9)	59.0	63.9	8.3 (5.0 to 11.6)	37.9	36.6	-3.4 (-8.5 to 1.6)
Vagaland	8.3	11.3	36.1 (22.3 to 50.0)	26.2	37.4	42.7 35.8 to 49.7)	17.2	37.5	118.0 (108.5 to 127.5)	4.4	6.5	47.7 (28.0 to 67.5)
Jdisha	59.2	76.2	28.7 (26.8 to 30.6)	79.2	87.3	10.͡ᢅફ (9.₱ to 11.4)	74.4	90.7	21.9 (20.6 to 23.2)	42.6	64.8	52.1 (49.4 to 54.8)
≀ajasthan	33.0	51.2	55.2 (52.2 to 58.1)	81.8	93.9	14.8 13.9 to 15.7)	61.2	82.6	35.0 (33.4 to 36.5)	24.6	44.2	79.7 (76.0 to 83.3)
ikkim	71.3	60.1	-15.7 (-20.5 to -10.9)	94.4	95.2	0. <b>\$</b> (-0.9 to 2.6)	71.9	70.4	-2.1 (-6.7 to 2.5)	52.1	48.3	-7.3 (-14.4 to -0.2)
Tripura	60.4	50.4	-16.6 (-21.6 to -11.5)	76.4	83.5	9. 💐 (5. 💆 to 12.7)	58.2	64.2	10.3 (5.1 to 15.5)	42.9	35.3	-17.7 (-24.8 to -10.6)
Jttar Pradesh	21.9	38.1	74.0 (71.4 to 76.6)	64.0	78.0	21.9 <b>529.9</b> to 22.8)	53.5	73.2	36.8 (35.6 to 38.0)	15.6	27.9	78.8 (75.6 to 82.1)
Jttarakhand	25.9	55.7	115.1 (109.0 to 121.1)	65.2	78.5	20.4 12.8 to 22.8)	54.3	81.5	50.1 (47.1 to 53.1)	17.5	43.3	147.4 (139.3 to 155.5)
Nore developed states	65.2	68.2	4.6 (3.9 to 5.3)	82.8	90.1	8ॡ <del>7</del> 8 <u>.</u> 4 to 9.2)	66.2	82.6	24.8 (24.1 to 25.4)	45.7	56.3	23.2 (22.2 to 24.2)
Andhra Pradesh	74.3	68.3	-8.1 (-10.8 to -5.4)	88.0	95.4	8.4 (8.9 to 10.0)	77.6	90.4	16.5 (14.2 to 18.8)	56.1	59.3	5.7 (1.7 to 9.7)
Зоа	86.0	92.4	7.4 (3.0 to 11.9)	96.7	98.5	1.5 É 2 to 3.9)	90.5	95.6	5.6 (2.1 to 9.2)	79.0	88.8	12.4 (6.7 to 18.1)
Jujarat	59.7	73.1	22.4 (20.2 to 24.7)	80.1	87.5	9.菜( <b>2</b> .蓖 to 10.6)	59.9	87.1	45.4 (43.2 to 47.6)	36.7	61.2	66.8 (63.1 to 70.4)
laryana	37.3	56.6	51.7 (47.9 to 55.5)	75.6	90.5	19.7 ±18.4 to 21.3)	61.3	88.7	44.7 (42.5 to 46.9)	27.2	51.2	88.2 (83.3 to 93.1)
limachal Pradesh	61.7	67.1	8.8 (5.2 to 12.3)	72.7	82.5	13.5 <b>≩</b> 10. <b>g</b> to 16.2)	69.8	87.3	25.1 (22.2 to 27.9)	45.4	54.3	19.6 (14.6 to 24.6)
ammu & Kashmir*	71.9	76.3	6.1 (4.4 to 7.8)	77.8	87.9	13.0 <b>°(</b> 11. <mark>6</mark> to 14.4)	67.1	77.2	15.1 (13.2 to 16.9)	53.3	59.5	11.6 (9.1 to 14.2)
(arnataka	69.3	65.1	-6.1(-7.9 to -4.2)	88.4	90.3	2 1 (1 to 3.1)	55.3	83.6	51.2 (48.8 to 53.6)	39.6	52.6	32.8 (29.4 to 36.3)
(erala	88.9	77.3	-13.0 (-14.8 to -11.3)	99.8	99.7	-0.¥ (-🛂 to 0.1)	84.2	91.5	8.7 (6.7 to 10.6)	75.7	72.9	-3.7 (-6.3 to -1.1)
√aharashtra 🛛 👘 🖉	69.3	66.7	-3.8(-5.5 to -2.0)	83.9	88.2	521 (40 to 6.2)	74.2	80.8	8.9 (7.4 to 10.4)	50.0	54.5	9.0 (6.4 to 11.6)
Jelhi	68.8	75.3	9.4 (5.5 to 13.3)	86.0	90.2	49 (26 to 7.2)	59.1	85.1	44.0 (39.3 to 48.7)	42.7	65.3	52.9 (46.2 to 59.7)
<sup>v</sup> unjab	64.6	54.7	-15.3 (-17.8 to -12.8)	91.1	92.9	2 2 0 (1 0 to 3.0)	86.9	85.4	-1.7 (-3.0 to -0.4)	55.5	46.9	-15.5 (-18.5 to -12.5)
amil Nadu	77.5	89.6	15.6 (14.2 to 17.0)	98.4	99.2	038 (055 to 1.1)	68.4	90.4	32.2 (30.4 to 33.9)	56.4	82.0	45.4 (43.0 to 47.7)
elangana	71.8	68.2	-5.0 (-8.0 to -2.0)	85.6	90.4	5 <b>%</b> 6 ( <b>3</b> 7 to 7.6)	79.9	85.4	6.9 (4.5 to 9.3)	55.7	54.9	-1.4 (-5.7 to 2.8)
Nest Bengal	69.4	72.2	4.0 (1.9 to 6.2)	71.3	89.2	25.1 \$23.2 to 27.1)	58.0	63.8	10.7 (7.3 to 12.7)	42.0	47.3	12.6 (8.8 to 16.4)

Supplementary Table 3. Human Opportunity Index for geographic inequality for four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), post-natal care within 48 hours of delivery and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) rourds 4 and 5 for India and its states. CI denotes confidence interval.

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Supplementary Table 4. Ratio of Human opportunity index (HOI) between wealth index quintiles I and V for the maternal services for India and its states, National Family Health Survey-5.

				BMJ
	R	atio of HOI between weal	th index quintiles I and V	Open:
	Four of more antenatal care visits	Institutional delivery with skilled birth attendant	Post-natal care within 48 hours of delivery	Continuum of care
India	0.52	0.69	0.73	0.38 <mark>9</mark>
Less developed states	0.55	0.69	0.74	0.41
Arunachal Pradesh	0.43	0.58	0.70	<b>⊕</b> .38 <sup>8</sup>
Assam	0.63	0.75	0.79	<b>8</b> .52 <b>2</b>
Bihar	0.32	0.72	0.71	<b>8</b> .25
Chhattisgarh	0.89	0.72	0.93	<u>.</u> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del> <del>.</del>
Jharkhand	0.51	0.64	0.81	<b>8</b> .36
Madhya Pradesh	0.72	0.83	0.91	<b>4</b> .60
Manipur	0.40	0.40	0.48	<u>نې</u> 30
Meghalaya	0.66	0.47	0.88	<del>.</del> .50 <b>E</b>
Mizoram	0.16	0.28	0.36	g.12
Nagaland	0.27	0.35	0.47	90. <b>đ</b>
Odisha	0.84	0.81	0.94	<b>8</b> .69
Rajasthan	0.77	0.92	0.92	<b>9</b> .73
Sikkim	1.41	0.94	1.17	<b>ä</b> .27
Tripura	0.81	0.79	0.68	R. HE
Uttar Pradesh	0.60	0.76	0.80	<b>6</b> .84
Uttarakhand	0.51	0.68	0.81	10.4%
More developed states	0.83	0.80	0.76	
Andhra Pradesh	0.66	0.75	0.73	80.80×
Goa	1.07	1.01	1.01	
Gujarat	0.79	0.83	0.96	Q.71g
Haryana	0.52	0.67	0.70	<b>9</b> .39 <del>.</del>
Himachal Pradesh	0.70	0.60	0.77	<b>ā</b> .49 <sup>3</sup>
Jammu and Kashmir	0.76	0.74	0.78	<b>2</b> .61
Karnataka	0.75	0.90	0.91	<b>ឆ្</b> .64
Kerala	0.95	1.00	0.89	<b>1</b> .95
Maharashtra	0.68	0.73	0.78	ິນ.5 <mark>1</mark> 6
Delhi	0.34	0.24	0.36	<b>0</b> .02
Punjab	0.54	0.84	0.80	<b>9</b> .57
Tamil Nadu	1.01	0.96	0.94	<b>9</b> .96
Telangana	0.78	0.83	0.89	<b>@</b> .63 <b>2</b>
West Bengal	0.85	0.90	0.70	9.57E

|--|

Less than 0.50
0.51-0.89
0.90-1.09
1.10-1.49
1.50 or more

<u>Population level</u> Ttrends over a decade in geographical inequality forof opportunity in access to maternal care services: findings from the National Family Health Surveys in India

Supplementary file

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## Supplementary Table 1. Number of districts by state in the National Family Health Survey (NFHS) rounds 4 and 5.

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Supplementary Table 2. Coverage of four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), and post-natal care within 48 hours of delivery, and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) 4 and NFHS 5 for India and its states. CI derestes confidence interval.

State	Sampl	e size	Four	of more ANC vi	sits	Institut	ional delivery with	SBA* 🖁	Post-natal care	within 48 hours	of delivery		Continuum of a	are
			NFHS-4	NFHS-5	Percent	NFHS-4	NFHS-5	Percent	NFHS-4	NFHS-5	Percent	NFHS-4	NFHS-5	Percent change
	NFHS-4	NFHS-5	<del>N=188,506</del>	<del>N=174,796</del>	change	<del>N=188,506</del> <sup>‡</sup>	<del>N=174,796</del>	change	<del>N=188,506</del> ‡	<del>N=174,796</del>	change	<del>N=188,506</del> ‡	<del>N=174,796</del>	from NFHS-4 to
	(N)	(N)	% of N	% of N	from	% of N	% of N	from N <u>#</u> HS-	% of N	% of N	from NFHS-	% of N	% of N	NFHS-5 (95% CI)
			(95% CI)	(95% CI)	NFHS-4 to	(95% CI)	(95% CI)	4 to NF	(95% CI)	(95% CI)	4 to NFHS-5	<u>(95% CI)</u>	(95% CI)	
					NFHS-5			(95% हूँन)			(95% CI)			
					(95% CI)			hed						
India	<u>188,506<sup>+</sup></u>	<u>174,796</u>	46.4	57.0	22.8	75.5	85.0	12.6 (17)	61.4	78.9	28.5	32.9	45.6	38.6
	400.000	442 540	(46.2-46.7)	(56.8-57.3)	(22.1-23.5)	(75.3-75.7)	(84.9-85.2)	(12-12.9)	(61.2 - 61.6)	(78.7-79.1)	(28.0-29.0)	(32.7-33.1)	(45.4-45.9)	(37.6-39.6)
Less	<u>132,809</u>	<u>113,519</u>	36.0		33.3	/0.6 (70.2.70.9)	80.9		57.0	(74 9 75 2)	31.8	24.8 (24.6.25.1)	36.5	4/.2
Arupachal	2 95 9	4 5 7 0	24.6	(47.7-40.5)	[32.3-34.3]	[70.3-70.8]	(00.7-01.2)	(1491-159'1)	27 5	( <b>74.6-75.5</b> )	101 5	11 0	(30.3-30.0)	(45.7-46.0)
Pradesh	<u>3,030</u>	4,370	(23 3- 26 0)	(35 8-38 6)	(15 1-57 A)	52.7 (51 1-54 2)	00.0 (79 /1-81 7)		(26.1-28.9)	(53 9-56 8)	(95 7-107 2)	(10.8-12.8)	(24 1-26 6)	$(104 A_{-}124 A)$
Assam	8 52/	0 2/17	(23.3-20.0)	50.0	12.1	72 5	(79.4-81.7) 84.8	$(430^{-3}6^{-1})$	56.0	67.8	10 1	20.0	25 5	19.7
Assain	<u>0,334</u>	<u> 3,247</u>	45.4 (11 3- 16 1)	(10.9)	(95-147)	(71 5-73 A)	04.0 (8/1 1-85 5)		(55 8-57 0)	(66.8-68.7)	(17 1-21 2)	(20.0-20.0)	(24 5-26 5)	$(15 1_2 22 A)$
Pibar	16 922	12 97/	14 6	25 5	(9.3-14.7)	(71.3-73.4)	75 1		(55.8-57.5)	65 /	26.9	(20.9-30.9)	17 0	(13.1-22.4)
Dillai	10,022	<u>13,074</u>	14.0 (1/1 1 -15 2)	(24.7-26.2)	(70,0-79,3)	(65 3-66 7)	(74 4-75 8)	(12=5-160)	47.8 (47.1-48.6)	(64 6-66 2)	(35 0-38 7)	9.0 (8 6- 9 4)	(17.2-18.4)	(91 5-10/ 1)
Chhattisgarh	6 805	6 5 2 6	56 9	61 2	76	71 8	87 1		67.2	87.2	29.8	37.6	47 3	25.8
Sinattisgan	0,000	0,320	(55.7 - 58.0)	(60.0-62.4)	(5.3-9.9)	(70.7-72.8)	(81.2-83.0)	(1 <b>≟</b> 7-1 <b>16</b> .0)	(66.0-68.3)	(86.3-87.9)	(28.0-31.5)	(36.4-38.7)	(46.1-48.5)	(22.4-29.2)
Jharkhand	8.947	7,465	29.9	38.6	29.1	63.8	74.5	<u> </u>	46.8	74.0	58.1	17.0	27.0	58.8
	<u>0,5 17</u>	<u>7,100</u>	(29.0 - 30.9)	(37.5-39.7)	(25.4-32.8)	(62.8-64.8)	(73.5-75.5)	(15:0-12.5)	(45.8-47.8)	(73.0-75.0)	(55.6-60.6)	(16.2-17.8)	(26.0-28.0)	(53.3-64.4)
Madhya	17,406	11,700	34.9	57.0	63.3	75.9	86.6	<u>5</u> 14.2	55.9	85.1	52.2	23.1	46.1	99.6
Pradesh	<u></u>	<u>,</u>	(34.1-35.6)	(56.1-57.9)	(60.9-65.7)	(75.2-76.5)	(86.0-87.2)	(13.2-15.0)	(55.1-56.6)	(84.4-85.7)	(50.8-53.7)	(22.4 -23.7)	(45.2-47.0)	(96.2-102.9)
Manipur	4.429	2.511	65.1	68.7	5.5	67.9	70.9		62.8	64.9	3.3	49.2	50.9	3.5
	<u>.,</u>		(63.7-66.5)	(66.8-70.4)	(2.9-8.2)	(66.5-69.3)	(69.1-72.6)		(61.4-64.2)	(62.9-66.7)	(0.5-6.2)	(47.7 - 50.7)	(48.9-52.8)	(-0.3-7.2)
Meghalava	3.119	4.602	50.1	50.3	0.4	56.0	58.6	54E62	58.0	58.3	0.5	32.1	23.9	-25.5
			(48.4-51.9)	(48.8-51.7)	(-3.5-4.3)	(54.3-57.8)	(57.2-60.0)	$(f_{1}2, g_{2}, g_{1})$	(56.3-59.8)	(56.8-59.7)	(-2.8-3.8)	(30.4 - 33.7)	(22.7-25.1)	(-31.1 to -20.0)
Mizoram	3,681	1,896	56.4	52.4	-7.1	78.1	79.3		62.8	68.1	8.4	41.5	42.1	1.4
			(54.8-58.0)	(50.2-54.7)	(-10.6 to -	(76.7-79.4)	(77.4-81.0)	(- <b>6</b> , <b>5</b> , <b>5</b> , <b>6</b> )	(61.2-64.3)	(65.9-70.1)	(5.4-11.5)	(39.9 -43.1)	(39.9-44.4)	(-3.3-6.2)
					3.6)	. ,		loa						
Nagaland	<u>3,136</u>	<u>2,205</u>	13.5	15.6	15.6	33.8	42.5	a25.8	22.6	43.2	91.2	7.6	9.4	23.7
			(12.3-14.7)	(14.1-17.2)	(5.2-25.9)	(32.2-35.5)	(40.5-44.6)	(200-34.4)	(21.2-24.1)	(41.2-45.3)	(83.3-99.0)	(6.7- 8.6)	(8.3-10.7)	(9.3-38.1)
Odisha	<u>9,015</u>	<u>7,141</u>	64.7	80.0	23.6	83.3	90.1	ing8.1m	77.4	92.1	19.0	47.8	69.4	45.2
			(63.7-65.7)	(79.1-80.9)	(22.0-25.3)	(82.5-84.0)	(89.4-90.7)	(7,1-92)	(76.5-78.3)	(91.5-92.7)	(17.8-20.2)	(46.8 -48.8)	(68.4-70.5)	(42.8-47.6)
Rajasthan	<u>11,950</u>	<u>10,831</u>	38.3	56.5	47.5	85.0	95.0	<b>4</b> 1.	65.2	85.2	30.7	29.1	49.4	69.8
			(37.5-39.2)	(55.6-57.5)	(44.9-50.1)	(84.4-85.6)	(94.5-95.4)	(1 <b>ဋ</b> 0-1 <b>ဋ</b> .6)	(64.3-66.0)	(84.5-85.9)	(28.3-32.1)	(28.2 - 29.9)	(48.5-50.4)	(66.5-73.0)
Sikkim	<u>899</u>	<u>569</u>	74.9	65.4	-12.7	95.2	96.3	<b>i</b> ng1.20	75.0	73.5	-2.1	56.0	52.0	-7.1
			(71.9-77.6)	(61.4-69.2)	(-17.0 to -	(93.6-96.4)	(94.4-97.5)	(-2.5-28)	(72.0-77.7)	(69.7-76.9)	(-6.3-2.3)	(52.7-59.2)	(47.9-56.1)	(-13.7 to -0.6)
					8.3)			h br						
Tripura	<u>1,169</u>	<u>1,860</u>	63.5	54.0	-15.0	80.3	86.8	sin8.12	61.2	68.6	12.1	45.9	39.7	-13.5
			(60.7-66.2)	(51.7-56.2)	(-19.7 to -	(77.9-82.5)	(85.2-88.3)	(5 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	(58.4-64.0)	(66.4-70.7)	(7.2-17.0)	(43.0 -48.7)	(37.5-42.0)	(-20.2 to -6.8)
					10.3)			te o						
Uttar	<u>28,741</u>	<u>25,556</u>	27.4	41.5	51.5	68.1	81.1		59.1	76.9	30.1	20.0	31.1	55.5
Pradesh			(26.9-27.9)	(40.9-42.1)	(49.3-53.7)	(67.5-68.6)	(80.6-81.5)	(182-29.0)	(58.6 - 59.7)	(76.4-77.4)	(29.1-31.2)	(19.5 - 20.4)	(30.5-31.7)	(52.8-58.2)
Uttarakhand	<u>4,298</u>	<u>2,966</u>	29.7	60.6	104.0	67.9	80.1	<b>3</b> 18.0°	56.9	84.2	48.0	20.5	47.7	
			(28.3-31.1)	(58.8-62.3)	(98.7-	(66.5-69.2)	(78.6-81.5)	(1927-270.3) N	(55.4-58.4)	(82.8-85.4)	(45.2-50.8)	(19.3 -21.7)	(45.9-49.5)	(125.5-139.9)
Moro	EE 607	61 377	71.0	72.7	109.4)	07.3	02.0	025	71.0	86.0	10.0	E2 2	63.5	10 г
developed	55,697	01,277	/1.3 (70 9-71 7)	(73 4-74 1)	5.4 (2.6-4.1)	87.2 (86 9-87 5)	92.6	(5.8-676)	/1.9 (71 5-72 3)	85.0	(19.0-20.3)	52.3 (51 9- 52 7)	(62.5	(18 4-20 6)
Andhra	4.055	2 092	75 7	69.2	-2 5	29 5	95.7	600	79.2	90 x	14 5	57.8	62.2	7.6
Pradesh	<u>,055</u>	2,032	(73 9 <u>-</u> 77 <i>1</i> )	(67 2-71 2)	(-11 0 to -	(88 2-90 7)	(94 8-96 5)	(5 5-2 <b>5</b> )	(77 6 – 20 Q)	(89 5-01 0)	(12 3-16 7)	(55 7- 59 R)	(60 1-64 3)	(3 8-11 5)
Tuucsii			(73.5 - 77.4)	(0,.2-,1.2)	5.9)	(00.2-50.7)	(57.0-50.5)		(77.0 00.5)	(05.5-51.5)	(12.3-10.7)	(33.7 33.0)	(00.1-04.5)	(5.0 11.5)
Delhi	1.258	2.379	71.4	79.9	11.9	88.0	91.7	4.2	63.3	87.2	37.8	46.6	69.6	49.4
	<u>-,00</u>	<u> -,,,,,</u>	/ ±.T		11.5	00.0	52.7			07.2	57.0	10.0	00.0	13.4

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State Sample size Four of more ANC visits						Institut	ional delivery wit	h SBA*	Post-natal care	s of delivery	Continuum of care			
			NFHS-4	NFHS-5	Percent	NFHS-4	NFHS-5	Percett	NFHS-4	NFHS-5	Percent	NFHS-4	NFHS-5	Percent change
	NFHS-4	NFHS-5	<del>N=188,506</del>	<del>N=174,796</del>	change	<del>N=188,506</del> ‡	<del>N=174,796</del>	change	<del>N=188,506</del> <sup>±</sup>	<del>N=174,796</del>	change	<del>N=188,506</del> ‡	<del>N=174,796</del>	from NFHS-4 to
	(N)	(N)	% of N	% of N	from	% of N	% of N	from NEHS-	% of N	% of N	from NFHS-	% of N	% of N	NFHS-5 (95% CI)
			(95% CI)	(95% CI)	NFHS-4 to	(95% CI)	(95% CI)	4 to NFES-5	(95% CI)	(95% CI)	4 to NFHS-5	<u>(95% CI)</u>	(95% CI)	
					NFHS-5			(95% <u>당</u> ) 것			(95% CI)			
			(68.8 - 73.8)	(78.2-81.4)	(95% CI) (8.3-15.6)	(86.1-89.7)	(90.5-92.7)	(2.1-653)	(60.6 - 66.0)	(85.8-88.5)	(33.3-42.1)	(43.9 - 49.4)	(67.7-71.4)	(43.2-55.5)
Goa	347	322	87.6	93.2	6.4	96.8	98.8	2.15	91.4	96.3	5.4	80.7	90.1	11.6
			(83.7 - 90.7)	(89.8-95.4)	(2.2-10.5)	(94.4-98.2)	(96.7-99.5)	(0.1-4 <b>c</b> )	(87.9 - 93.9)	(93.5-97.9)	(2.0-8.7)	(76.2 - 84.5)	(86.3-92.9)	(6.3-17.0)
Gujarat	<u>5,827</u>	<u>7,575</u>	66.4	77.7	17.0	83.9	90.3	_7.6a	62.9	89.4	42.1	42.3	66.3	56.7
			(65.2 - 67.6)	(76.7-78.6)	(15.1-19.0)	(82.9-84.8)	(89.6-90.9)	(64-8-8)	(61.7 - 64.2)	(88.6-90.0)	(40.1-44.2)	(41.0- 43.5)	(65.3-67.4)	(53.5-60.0)
Haryana	<u>5,719</u>	<u>5,162</u>	45.4	60.8	33.9	82.1	93.4		68.3	91.3	33.7	34.3	55.6	62.1
Llimachal	2 202	2.145	(44.1 - 46.7)	(59.4-62.1)		(81.1-83.1)	(92.6-94.0)	(1265-100.0)	(67.0 - 69.5)	(90.5-92.0)	(31.8-35.5)	(33.1 - 35.6)	(54.3-57.0)	(58.0-66.2)
Pradesh	<u>2,292</u>	<u>2,145</u>	(64.3 - 68.1)	(69 8-73 6)	0.5 (5 3-11 7)	75.9 (74 1-77 6)	84.3 (82 7-85 8)		73.0 (71 8 - 75 4)	(87 5-90 2)	20.8 (18.2-23.4)	49.5 (47.4 - 51.5)	59.3 (57 2- 61 3)	(15 2-24 4)
lammu &	6 280	5 367	79.5	80.7	15	83.2	91.0		73.0	80.3	10.0	61.8	65.1	5 3
Kashmir <sup>§</sup>	0,200	<u>3,307</u>	(78.5 - 80.5)	(79.6-81.7)	(0.1-2.9)	(82.2-84.1)	(90.2-91.7)	(872-10.6)	(71.9 - 74.1)	(79.2-81.3)	(8.4-11.6)	(60.6 - 63.0)	(63.8-66.4)	(3.2-7.5)
Karnataka	5,876	6,389	73.5	70.8	-3.7	90.7	92.5		60.5	86.4	42.8	44.6	59.1	32.5
			(72.3 - 74.6)	(69.6-71.9)	(-5.4 to -	(90.0-91.5)	(91.8-93.1)	( <u>5</u> 1-20)	(59.2 - 61.7)	(85.5-87.2)	(40.6-45.0)	(43.3 - 45.9)	(57.9-60.3)	(29.4-35.6)
					2.0)			339 clu						
Kerala	<u>2,128</u>	<u>2,360</u>	90.3	82.2	-9.0	99.9	99.8		86.3	92.8	7.5	78.4	77.9	-0.6
			(89.0 - 91.5)	(80.6-83.7)	(-10.6 to -	(99.6-100.0)	(99.5-99.9)	(-1,3-6,1)	(84.7 - 87.7)	(91.7-93.8)	(5.7-9.3)	(76.6 - 80.1)	(76.2-79.5)	(-3.1-1.8)
			70.0	74.0	7.4)				76.0					10.7
Maharashtra	<u>7,143</u>	<u>7,415</u>	(71.2, 72.2)	(70.2, 72.2)	-1.4	86.7 (95.0.97.5)	91.0		/6.9 (75.0	84.1	9.4	54.4	60.2	
Puniah	/ 132	4 5 2 0	(71.5 - 75.5)	58.3	(-5.0-0.2)	92 0	(90.3-91.0) 9/ 1		88 /	87 1	(8.0-10.7)	(55.2 - 55.5) 50 1	50.2	(0.5-15.0)
Fulljab	4,132	4,520	(66 7 - 69 6)	(56 8-59 7)	(-16.8 to -	(91 2-92 8)	(93 4-94 7)		(87 4 - 89 3)	(86 1-88 0)	(-2 7 to -0 3)	(57.6 - 60.6)	(48 7-51 6)	(-17.8 to -12.3)
				(30.0 35.7)	12.2)	(31.2 32.0)	(33.4 54.7)			(00.1 00.0)	(2.7 to 0.5)	(37.0 00.0)	(40.7 51.0)	(17.010 12.3)
Tamil Nadu	6,181	5,228	80.7	91.6	13.5	98.8	99.5	16 B	72.4	92.2	27.3	60.8	84.9	39.6
			(79.7 - 81.7)	(90.8-92.3)	(12.2-14.8)	(98.5-99.1)	(99.3-99.7)	(0 4 8 10)	(71.3 - 73.5)	(91.4-92.9)	(25.7-29.0)	(59.6 - 62.0)	(84.0-85.9)	(37.5-41.8)
Telangana	<u>NA</u>	<u>5,429</u>	73.1	69.7	-4.7	87.2	91.4	nd Ker	81.7	86.6	6.0	57.6	56.9	-1.2
			(71.0 - 75.1)	(68.5-70.9)	(-7.6 to -	(85.6-88.7)	(90.6-92.1)	(କ୍ଷୁତ୍ର୍ଷ୍ଟ୍ରେ)	(79.8 - 83.4)	(85.7-87.5)	(3.7-8.2)	(55.3– 59.9)	(55.6-58.2)	(-5.3-2.9)
					1.7)			a led						
West Bengal	<u>4,459</u>	<u>4,894</u>	74.2	75.7	2.0	77.0	91.2		63.1	68.2	8.1	47.4	52.0	9.7
			(72.9 - 75.5)	(74.4-76.9)	(0.1-3.9)	(75.8-78.2)	(90.4-91.9)	(188-29.1)	(61.7 - 64.5)	(66.9-69.5)	(5.6-10.5)	(46.0 - 48.9)	(50.6-53.4)	(6.3-13.1)
Data missing or Ladakh is comb	n 101 wom	en for instit ammu & K	tutional delivery v ashmir in NFHS-5	with SBA, PNC v ; NFHS 4 did no	within 48 hour. It provide sepa	s of delivery, and rate data for Lad	continuum of care	//smjopen.bmj.com/ on June 12, 2025 at Departmen S ranning, and similar technologies. in						
						For peer re	view only - http://	<b>rt GEZ-LTA</b> /bmjopen.bmj.c	om/site/about/guid	delines.xhtml				

						Hauman Opp	portunity Inc	dex				
		Four of r	nore ANC visits	I	nstitutiona	l delivery with SBA ភ្នំ	Post-na	atal care with	hin 48 hours of delivery		Contin	uum of care
	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95ﷺ CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)
India	35.8	48.4	35.2 (34.5 to 35.9)	68.9	80.4	16.7 (16. <del>द्व</del> to 17.0)	54.6	73.5	34.6 (34.2 to 35.1)	24.4	37.1	52.2 (51.1 to 53.0)
Less developed states	27.9	40.7	45.9 (44.9 to 46.9)	64.5	76.2	18.1 (17.a to 18.6)	50.6	69.4	37.2 (36.6 to 37.8)	18.5	29.7	60.5 (59.2 to 61.9)
Arunachal Pradesh	20.2	34.3	69.8 (62.7 to 76.9)	47.0	77.5	64.9 <b>5</b> 61. <b>3</b> to 68.5)	22.7	51.9	128.6 (122.1 to 135.2)	8.2	21.9	167.1 (154.4 to 179.8)
Assam	40.7	45.6	12.0 (9.2 to 14.9)	66.5	82.3	23.8 🛱 2. 🗄 to 25.4)	51.1	64.7	26.6 (24.3 to 28.9)	24.9	31.0	24.5 (20.3 to 28.7)
Bihar	12.8	22.9	78.9 (73.9 to 83.9)	61.0	72.1	18.2 <b>£</b> 16. <b>§</b> to 19.6)	43.1	59.6	38.3 (36.2 to 40.3)	7.7	15.3	98.7 (91.8 to 105.6)
Chhattisgarh	52.0	57.2	10.0 (7.5 to 12.5)	68.6	78.5	14.4 <b>2</b> 12. <b>3</b> to 16.2)	63.0	85.3	35.4 (33.5 to 37.3)	33.1	43.3	30.8 (27.0 to 34.6)
Jharkhand	25.0	36.0	44.0 (39.7 to 48.3)	59.5	70.4	18.3 <b>£</b> 16. <b>£</b> to 20.3)	43.2	70.9	64.1 (61.4 to 66.8)	13.8	24.1	74.6 (68.3 to 81.0)
Madhya Pradesh	29.4	52.2	77.6 (74.8 to 80.3)	70.8	84.1	18.8 <b>1</b> 7. <b>7</b> to 19.8)	51.3	82.8	61.4 (59.8 to 63.0)	19.1	41.2	115.7 (111.9 to 119.5)
Manipur	54.9	61.2	11.5 (8.2 to 14.8)	58.0	62.0	6.9 (3.8 to 10.0)	54.4	57.7	6.1 (2.7 to 9.4)	39.2	41.5	5.9 (1.3 to 10.4)
Meghalaya	44.3	45.4	2.5 (-1.9 to 6.9)	49.6	52.5	5=38 (1=9 to 9.8)	52.0	53.4	2.7 (-1.1 to 6.4)	26.4	20.5	-22.3 (-28.8 to -15.9)
Mizoram	52.4	46.6	-11.1 (-14.8 to -7.3)	72.1	72.4	0. ž (-2 20 to 2.9)	59.0	63.9	8.3 (5.0 to 11.6)	37.9	36.6	-3.4 (-8.5 to 1.6)
Nagaland	8.3	11.3	36.1 (22.3 to 50.0)	26.2	37.4	42.7 \$5.8 to 49.7)	17.2	37.5	118.0 (108.5 to 127.5)	4.4	6.5	47.7 (28.0 to 67.5)
Odisha	59.2	76.2	28.7 (26.8 to 30.6)	79.2	87.3	10.ᡒᢆ(9.ᢋᢩto 11.4)	74.4	90.7	21.9 (20.6 to 23.2)	42.6	64.8	52.1 (49.4 to 54.8)
Rajasthan	33.0	51.2	55.2 (52.2 to 58.1)	81.8	93.9	14.8 13.9 to 15.7)	61.2	82.6	35.0 (33.4 to 36.5)	24.6	44.2	79.7 (76.0 to 83.3)
Sikkim	71.3	60.1	-15.7 (-20.5 to -10.9)	94.4	95.2	0.8 (-Q 9 to 2.6)	71.9	70.4	-2.1 (-6.7 to 2.5)	52.1	48.3	-7.3 (-14.4 to -0.2)
Tripura	60.4	50.4	-16.6 (-21.6 to -11.5)	76.4	83.5	9.3 (5.5 to 12.7)	58.2	64.2	10.3 (5.1 to 15.5)	42.9	35.3	-17.7 (-24.8 to -10.6)
Uttar Pradesh	21.9	38.1	74.0 (71.4 to 76.6)	64.0	78.0	21.9 529.9 to 22.8)	53.5	73.2	36.8 (35.6 to 38.0)	15.6	27.9	78.8 (75.6 to 82.1)
Uttarakhand	25.9	55.7	115.1 (109.0 to 121.1)	65.2	78.5	20.4 212 to 22.8)	54.3	81.5	50.1 (47.1 to 53.1)	17.5	43.3	147.4 (139.3 to 155.5)
More developed states	65.2	68.2	4.6 (3.9 to 5.3)	82.8	90.1	8 \$ \$ 8 \$ 4 to 9.2)	66.2	82.6	24.8 (24.1 to 25.4)	45.7	56.3	23.2 (22.2 to 24.2)
Andhra Pradesh	74.3	68.3	-8.1 (-10.8 to -5.4)	88.0	95.4	8.4 (8.8 to 10.0)	77.6	90.4	16.5 (14.2 to 18.8)	56.1	59.3	5.7 (1.7 to 9.7)
Goa	86.0	92.4	7.4 (3.0 to 11.9)	96.7	98.5	1. <del>9</del> 🖧 2 to 3.9)	90.5	95.6	5.6 (2.1 to 9.2)	79.0	88.8	12.4 (6.7 to 18.1)
Gujarat	59.7	73.1	22.4 (20.2 to 24.7)	80.1	87.5	9.2 (9.8 to 10.6)	59.9	87.1	45.4 (43.2 to 47.6)	36.7	61.2	66.8 (63.1 to 70.4)
Haryana	37.3	56.6	51.7 (47.9 to 55.5)	75.6	90.5	19.7 <b>1</b> 8. <b>4</b> to 21.3)	61.3	88.7	44.7 (42.5 to 46.9)	27.2	51.2	88.2 (83.3 to 93.1)
Himachal Pradesh	61.7	67.1	8.8 (5.2 to 12.3)	72.7	82.5	13.5 <b>ਵ</b> 10. <b>ਭ</b> to 16.2)	69.8	87.3	25.1 (22.2 to 27.9)	45.4	54.3	19.6 (14.6 to 24.6)
Jammu & Kashmir*	71.9	76.3	6.1 (4.4 to 7.8)	77.8	87.9	13.0 <b>1</b> 1.5 to 14.4)	67.1	77.2	15.1 (13.2 to 16.9)	53.3	59.5	11.6 (9.1 to 14.2)
Karnataka	69.3	65.1	-6.1(-7.9 to -4.2)	88.4	90.3	2 🔁 ( <mark>ছ</mark> 1 to 3.1)	55.3	83.6	51.2 (48.8 to 53.6)	39.6	52.6	32.8 (29.4 to 36.3)
Kerala	88.9	77.3	-13.0 (-14.8 to -11.3)	99.8	99.7	-0.¥ (-3 to 0.1)	84.2	91.5	8.7 (6.7 to 10.6)	75.7	72.9	-3.7 (-6.3 to -1.1)
Maharashtra	69.3	66.7	-3.8(-5.5 to -2.0)	83.9	88.2	521 (40 to 6.2)	74.2	80.8	8.9 (7.4 to 10.4)	50.0	54.5	9.0 (6.4 to 11.6)
Delhi	68.8	75.3	9.4 (5.5 to 13.3)	86.0	90.2	4 4 (2 6 to 7.2)	59.1	85.1	44.0 (39.3 to 48.7)	42.7	65.3	52.9 (46.2 to 59.7)
Punjab	64.6	54.7	-15.3 (-17.8 to -12.8)	91.1	92.9	2 <b>9</b> 0 ( <b>1</b> 0 to 3.0)	86.9	85.4	-1.7 (-3.0 to -0.4)	55.5	46.9	-15.5 (-18.5 to -12.5)
Tamil Nadu	77.5	89.6	15.6 (14.2 to 17.0)	98.4	99.2	038 (05 to 1.1)	68.4	90.4	32.2 (30.4 to 33.9)	56.4	82.0	45.4 (43.0 to 47.7)
Telangana	71.8	68.2	-5.0 (-8.0 to -2.0)	85.6	90.4	5 <sup>3</sup> 6 (37 to 7.6)	79.9	85.4	6.9 (4.5 to 9.3)	55.7	54.9	-1.4 (-5.7 to 2.8)
West Bengal	69.4	72.2	4.0 (1.9 to 6.2)	71.3	89.2	25.1 🖗 3. <b>3</b> to 27.1)	58.0	63.8	10.7 (7.3 to 12.7)	42.0	47.3	12.6 (8.8 to 16.4)
West Bengal *Ladakh is combined with Ja	69.4 ammu & Kasl	72.2	4.0 (1.9 to 6.2) S-5; NFHS 4 did not provide sepa	71.3 arate data fo	89.2 )	25.1 (\$23.93 to 27.1) nologies. 2025 at Department GE	58.0	63.8	10.7 (7.3 to 12.7)	42.0	47.3	12.6 (8.8 to 16.4
				For pe	eer review or	hly - http://bmjopen.bmj.com/si	te/about/gui	delines.xhtml				

Supplementary Table 3. Human Opportunity Index for geographic inequality for four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), post-natal care within 48 hours of delivery and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) rourids 4 and 5 for India and its states. CI denotes confidence interval.

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	Ra	atio of HOI between weal	th index quintiles I and V	Opei
	Four of more antenatal care visits	Institutional delivery with skilled birth attendant	Post-natal care within 48 hours of delivery	근 Continuum录f care
- India	<u>0.52</u>	0.69	<u>0.73</u>	0.3 <b>:</b>
ss developed states	<u>0.55</u>	<u>0.69</u>	<u>0.74</u>	0.41 <b>6</b>
runachal Pradesh	0.43	0.58	0.70	<del>9</del> 38 <mark>8</mark>
ssam	<u>0.63</u>	<u>0.75</u>	<u>0.79</u>	<b>8</b> .52
har	0.32	<u>0.72</u>	<u>0.71</u>	cte
hhattisgarh	<u>0.89</u>	<u>0.72</u>	<u>0.93</u>	<u>8.70</u>
narkhand	<u>0.51</u>	<u>0.64</u>	<u>0.81</u>	y og So
1adhya Pradesh	<u>0.72</u>	<u>0.83</u>	<u>0.91</u>	<u>9.60</u>
lanipur	<u>0.40</u>	<u>0.40</u>	0.48	-202 ligh
1eghalaya	0.66	0.47	<u>0.88</u>	<b>.</b> 5( <b>4-</b> 0
/lizoram	0.16	0.28	0.36	839 I.Clu
agaland	0.27	0.35	0.47	din.0(22
disha	0.84	<u>0.81</u>	0.94	<del>g</del> .69
ajasthan	0.77	0.92	0.92	<b>9</b> .73
ikkim	1.41	0.94	1.17	8.27K
ipura	0.81	0.79	0.68	emt E
Ittar Pradesh	0.60	0.76	0.80	ras ted
ttarakhand	0.51	0.68	0.81	202 I to
Nore developed states	0.83	0.80	0.76	
ndhra Pradesh	0.66	0.75	0.73	ges an
60	1.07	1.01	1.01	
ujarat	0.79	0.83	0.96	a.71e
aryana	0.52	0.67	0.70	<b>1</b> .39 <b>1</b>
machal Pradesh	0.70	0.60	0.77	om ing
mmu and Kashmir	0.76	0.74	0.78	<b>B</b> .61
rnataka	0.75	0.90	0.91	ធ.64
erala	0.95	1.00	0.89	ntr.95
aharashtra	0.68	0.73	0.78	<b>9</b> ,51
lhi	0.34	0.24	0.36	nd.0.b
 njab	0.54	0.84	0.80	<b>9</b> .57
mil Nadu	1.01	0.96	0.94	<b>a</b> .96
langana	0.78	0.83	0.89	<b>ģ</b> .63 <b>2</b>
Vest Bengal	0.85	0.90	0.70	9.57c

ary Table 4. Ratio of Human opportunity index (HOI) between wealth index quintiles I and V for the maternal services for India and its states, National Family Health Survey-5. Supplement

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## Population-level trends over a decade in geographical inequality for opportunity in access to maternal care services: a cross-sectional analysis from the National Family Health Surveys in India

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Secondary Subject Heading:	Health policy, Public health
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3 4	24	ABSTRACT
5 6	25	Objectives: To examine the trends in geographical inequality of opportunity in maternal health
/ 8 0	26	services in India considering the Every Newborn Action Plan (ENAP) 2025 coverage targets.
9 10 11	27	Setting: India
12 13	28	Participants: Women in the National Family Health Survey (NFHS) - NFHS-4 (2014-15) and NFHS-5
14 15	29	(2019-21).
16 17 19	30	Primary and secondary measures: District-level coverages of 4+ antenatal care (ANC) visits,
18 19 20	31	institutional delivery with skilled birth attendant (SBA), postnatal care (PNC) services within 48 hours
21 22	32	of delivery, Continuum of care (CoC) services for women with most recent livebirths were
23 24	33	considered. Human Opportunity Index (HOI) documented the opportunities for equitable access of
25 26 27	34	these services, ranging from 0 (high inequality) to 100 (universal access). HOI was compared
28 29	35	between the survey rounds and wealth index quintiles (WI) that the women belonged to.
30 31	36	<b>Results</b> : Coverages of 4+ ANC visits, institutional delivery, PNC, and CoC in India increased by 22.8%
32 33	37	(95% CI 22.1-23.5), 12.6% (12.2-12.9), 28.5% (28.0-29.0), and 38.6% (37.6-39.6) between NFHS-4 and
34 35 36	38	NFHS-5, respectively. The HOI for 4+ ANC visits was 48.4 in NFHS-5, ranging from 11.3 to 92.4 in
37 38	39	states and from 31.1 to 70.5 for WI I to V. The HOI for institutional delivery was 80.4 in NFHS-5,
39 40	40	ranging from 37.4 to 99.7 in the states and from 21.0 to 100 for WII to V. The HOI for PNC services
41 42	41	was 73.5 in NFHS-5, ranging from 37.5 to 95.6 in the states and from 61.2 to 88.3 for WI I to V. The
43 44 45	42	HOI for CoC was 37.1, ranging from 6.5 to 88.8 in the states and from 19.8 to 62.7 for WI I to V for
46 47	43	CoC in NFHS-5.
48 49	44	Conclusion: Though significant improvements in the geographic inequity of maternal health services
50 51	45	have been made in India, the geographic inequity for 4+ANC visits coverage lags significantly behind
52 53	46	resulting in CoC coverage inequity to achieve the ENAP targets for these services.
55 56	47	
57 58	48	Keywords: Antenatal care services, continuum of care, human opportunity index, India, inequity,
59 60	49	institutional delivery, NFHS, postnatal care, wealth index.

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## STRENGTHS AND LIMITATIONS OF THE STUDY

- District-level inequity estimated in the coverages of maternal health services for India using • large-scale demographic surveys.
  - Human opportunity index is used to measure not only the distribution of coverage of maternal health services but also how fairly the available services are distributed among
- women by geography and by wealth index.
- Socio-economic inequities in maternal health services in India have been reported previously • but the use of Human Opportunity Index to measure inequity has not been attempted.
- Quality of services not captured in the assessment.

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# 60 INTRODUCTION

61 With the Sustainable Development Goal (SDG) 10, the governments worldwide have committed to 62 act on inequality through multiple, interconnected goals, requiring combined policy action in order to meet an overall commitment to 'leave no-one behind'.[1] Access to health care for all also 63 64 intersects with the inequalities related to gender, socio-economic status, education levels, 65 employment status and geographical location, with the most marginalized being the least able to access quality healthcare.[2] Inequality in access to essential health-care services has implications 66 67 on achieving universal health coverage, including maternal health services among both the general 68 and the most disadvantaged populations.[3] Significant literature on the extent of inequities in 69 maternal health services is available from developing countries including from India, predominately 70 based on the Demographic and Health Surveys (DHS) and focusing on socio-economic inequalities in 71 the use of maternal health services.[4-16] 72 In the context of Countdown to 2030, SDGs 3.1 and 3.2 which aim to reduce maternal and 73 neonatal mortality by 2030,[3] we examine the trends in geographical inequality of opportunity in 74 access for the coverage of antenatal care (ANC) visits, institutional delivery with skilled birth

75 attendant (SBA), and postnatal care (PNC) visits within 48 hours in India using the National Family 76 Health Survey (NFHS), which is the equivalent of DHS in India.[17] In addition, we also measure 77 geographical inequality in the coverage of continuum of care (CoC), which is recommended as one of 78 the global strategies for maternal health to improve maternal and neonatal outcomes in the 79 developing country setting.[18-20] The maternal health program in India is implemented at the 80 district level, [21] and the Every Newborn Action Plan (ENAP) 2025 provides for maternal care services coverage target indicators based on the district-level coverage of these services in a 81 82 state.[22] Therefore, we examine define geographic inequality at the district-level in India and its 83 states as these have implications on planning to achieve the ENAP 2025 coverage targets.

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## 85 METHODS

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We utilized the publicly available data from the two most recent rounds of NFHS conducted post
year 2010, NFHS-4 (2014-15) and NFHS-5 (2019-21).[23 24] These nationally representative
population-based surveys are conducted by the International Institute of Population Sciences,
Mumbai, India, with the primary aim to provide estimates of maternal and child health and
reproductive health indicators at the district-level for India.[23 24] No ethics approval was required
for this analysis as we utilised the de-identified data available in public domain.

92 The NFHS documents data on the most recent livebirth for ever-married women in the last 5 93 years from the time of data collection. The NFHS-4 documented data for livebirths born between 94 2011 and early 2016 whereas the NFHS-5 documented data on livebirths born between 2016 and 95 early 2021. We defined the CoC for this analysis as a woman having reported four or more ANC 96 visits and institutional delivery with SBA and PNC within 48 hours of delivery for her most recent 97 livebirth in the last 5 years. We calculated the coverage of 4 or more ANC visits (4+ ANC visits), 98 institutional delivery with SBA, PNC within 48 hours of delivery, and CoC for the most recent livebirth 99 for NFHS-4 and NFHS-5 for India, and its states and districts. 100 **Data analysis** 

We utilised the Human Opportunity Index (HOI) to measure the trends in geographical inequality for 101 102 the opportunity to access maternal care services in India and its states. The HOI is a measure of the 103 coverage rate of an opportunity discounted by inequality in the distribution across the circumstance 104 groups, where D measures the dissimilarity between access of services for groups defined by 105 circumstance characteristics (such as wealth index, education, distance, etc) and the average access 106 coverage for the same service for the population as a whole; C is average access coverage of services the 107 population as a whole and is estimated as :[25 26]  $HOI = (1 - D) \times C$ 108

The HOI value ranges from 0 (high inequality) to 100 (universal access). In this analysis, D is the
 index of geographical inequality at the district-level within each state compared with the average

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2 3	111	coverage of a particular maternal convice for a given state. The UOI for coverage of each of the three
4	111	coverage of a particular maternal service for a given state. The HOLIOF coverage of each of the three
6 7	112	maternal care services and CoC for India and its states was estimated using the district level
7 8 9	113	coverage of these services in NFHS-4 and NFHS-5, and the change in HOI between NFHS-4 and NFHS-
10 11	114	5 was assessed. The number of districts in each state in NFHS-4 and NFHS-5 are shown in
12 13	115	supplemental table 1.
14 15	116	In addition, we explored the geographical inequality within each of the wealth index (WI)
16 17 18	117	quintile in NFHS-5. The WI quintile is provided in the NFHS dataset at the household level which is
19 20	118	based on the number and kinds of consumer goods each household owns calculated using principal
21 22	119	component analysis.[24 27] We calculated HOI for India and states for each WI quintile for each
23 24	120	maternal health service and CoC. We report the ratio of state average HOI with WI I and WI V, and the
25 26 27	121	ratio of HOI WI Ito WI V for each maternal health service and CoC.
28 29	122	The states of India were grouped based on its development status for this analysis. The
30 31	123	Empowered Action Group of states as categorized by the government of India (Bihar, Chhattisgarh,
32 33	124	Jharkhand, Madhya Pradesh, Odisha, Rajasthan, Uttar Pradesh, Uttarakhand, and the north-eastern
34 35 36	125	states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura) were
37 38	126	grouped as 'less developed' and the remaining states were categorised as "more developed." [28 29]
39 40	127	Delhi, Jammu and Kashmir including Ladakh were considered as a state for this analysis. The other
41 42	128	Union Territories were excluded as there are no districts in these Union Territories to undertake this
43 44 45	129	analysis. We have reported 95% confidence interval for all estimates as relevant and all the analyses
45 46 47	130	were carried out using STATA version 13.1 and Microsoft Excel 2016.
48 49	131	
50 51	132	Patient and Public Involvement statement: Patients were not involved in planning of this analysis.
52 53 54 55 56 57 58 59 60	133	

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## 

## 135 RESULTS

A total of 188,506 ever-married women provided data on 249,020 livebirths in NFHS-4 and 174,796
ever-married women provided data on 195,277 livebirths in NFHS-5. The coverages for 4+ ANC visits,
institutional delivery with SBA, and PNC in 48 hours, and CoC for NFHS-4 and NFHS-5 for India,

139 grouping of states, and individual states are shown in supplemental table 2.

**4+ ANC visits** 

The coverage of 4+ ANC visits for India was 57.0% (95% CI 56.8 to 57.3) in NFHS-5. The percent change in coverage of 4+ ANC visits from NFHS-4 to NFHS-5 was estimated at 22.8% (95% CI 22.1 to 23.5) for India, 33.3% (95% CI 32.3 to 34.3) for less developed, and 3.4% (95% CI 2.6 to 4.1) for more developed states (supplemental table 2). This coverage ranged from 15.6% in Nagaland to 80.0% in Odisha in the less developed states, and 58.3% in Punjab to 93.2% in Goa in the more developed states in NFHS-5 (supplemental table 2). The HOI for geographic inequality in 4+ ANC visits for India was 48.4 in NFHS-5, an improvement of 35.2% (95% CI 34.5 to 35.9) between NFHS-4 to NFHS-5 (supplemental table 2), and was substantially higher for the more developed states at 68.2 than the less developed states at 40.7 in NFHS-5 (table 1 and supplemental table 3). HOI ranged from 8.3 to 88.9 in the states in NFHS-4, and 11.3 to 92.4 in the states in NFHS-5 (Figure 1 and supplemental table 3). Three and 6 states from the less and more developed states showed a reduction in HOI between NFHS-4 to NFHS-5, respectively (supplemental table 3). The highest gains in HOI were made in the state of Uttarakhand (115.1%; 95% CI 109.0 to 121.1) between NFHS-4 to NFHS-5, with the HOI for the state at 55.7 in NHFS-5.

Considering WI (table 1), HOI ranged from 33.8 for WI I to 64.4 for WI V for India, and the
 corresponding range was 31.1 to 57.0 and 58.6 to 70.5 for less and more developed states in NFHS 5, respectively. The HOI ratio of WI V to average was 1 or more in all states except Sikkim, Tamil
 Nadu and Kerala. Substantial variations were seen in HOI ratio of WI I to V, ranging from 0.16 to
 1.41, with this ratio being <1 in 27 (90.0%) states in NFHS-5, and the lowest HOI ratio between WI I</li>

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2 3	160	and V was seen in Mizoram at 0.16 (supplemental table 4). Among the 20 states with WI I to state
4 5	161	HOI ratio at $>0.70$ , 15 states had the W(1) to W(1)/ HOI ratio at <0.70 (supplemental table 4)
6 7	101	norratio at 20.70, 15 states had the W11 to W1V norratio at <0.70 (supplemental table 4).
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				Four	or more ANC vis	sits <u>5</u> z	1			
				HOI by WI			HOI Ratio			
	Overall HOI	1	2	3	4	mber ( Erası elated 5	WI 1: Overall HOI	V Ove		
India	48.4	33.8	44.0	53.1	59.3	64.45 ng N	0.70	:		
Less developed states	40.7	31.1	38.9	45.4	50.1	text and 57.0an	0.76			
Arunachal Pradesh	34.3	20.2	31.6	37.0	44.2	47.3 d cho	0.59	<u>_</u>		
Assam	45.6	38.9	46.4	53.3	60.1	61.5 <b>a o a</b>	0.85	:		
Bihar	22.9	15.6	22.9	30.2	37.4	49.2 <b>2</b> fr	0.68	2		
Chhattisgarh	57.2	54.3	53.4	60.9	60.5	61.0 <b>g</b> 🖁	0.95	:		
Jharkhand	36.0	28.6	38.5	41.9	51.8	56.0 🛓 📑	0.79	:		
Madhya Pradesh	52.2	44.6	49.3	56.1	59.1	62.35	0.85	1		
Manipur	61.2	36.7	64.6	78.7	84.9	91.3	0.60	-		
Meghalaya	45.4	36.8	45.8	50.0 🧹	61.5	55.5 <b>e</b>	0.81	í í		
Mizoram	46.6	11.0	37.8	49.9	61.5	69.9 <b>0</b>	0.24	-		
Nagaland	11.3	5.4	10.1	20.8	26.9	20.0 <b>5</b>	0.48	-		
Odisha	76.2	69.3	78.6	79.1	81.6	82.4a	0.91	1		
Rajasthan	51.2	45.7	45.9	49.6	52.2	59.0 <b>6 o</b>	0.89	-		
Sikkim	60.1	66.9	61.1	59.1	61.3	47.63	1.11	(		
Tripura	50.4	41.7	52.8	56.6	64.6	51.20 ne	0.83	1		
Uttar Pradesh	38.1	30.4	35.0	38.9	41.4	50.9 gg	0.80	1		
Uttarakhand	55.7	35.2	44.2	51.8	62.6	69.1 <b>8</b>	0.63	:		
More developed states	68.2	58.6	65.1	67.1	70.1	ਰ at 70.5 ਯੂ	0.86			
Andhra Pradesh	68.3	45.5	64.2	64.8	66.5	69.2 <b>b</b> a	0.67	<u> </u>		
Goa	92.4	100.0	81.2	89.8	92.5	93.5	1.08			
Gujarat	73.1	63.2	69.1	72.4	75.9	80.5 <b>ដ</b>	0.86	:		

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				HOI by WI	or more ANC VI	sits iu 39 din 22	НОЦ	Ratio
	Overall					n gr	WI 1:	WI 5:
	HOI	1	2	3	4	5 u 7	Overall HOI	Overall HO
Haryana	56.6	33.5	44.8	49.7	53.3	64.5 <b>% </b>	0.59	1.14
Himachal Pradesh	67.1	52.1	53.4	62.3	74.2	74.8 m m	0.78	1.11
Jammu and Kashmir	76.3	60.2	75.8	76.7	80.6	79.56 s	0.79	1.04
Karnataka	65.1	51.8	60.3	65.4	71.2	69.50 u	0.80	1.07
Kerala	77.3	71.3	87.6	76.0	78.6	74.8	0.92	0.97
Maharashtra	66.7	49.9	63.3	65.1	71.2	73.89 S X	0.75	1.11
Delhi	75.3	26.6	45.1	62.2	68.6	78.80 0	0.35	1.05
Punjab	54.7	31.2	41.6	47.1	50.7	57.6a •	0.57	1.05
Tamil Nadu	89.6	88.3	89.1	89.1	90.3		0.99	0.97
Telangana	68.2	53.5	63.9	64.8	70	68.5 <b>2</b> B	0.78	1.00
West Bengal	72.2	66.5	72.1	75.0	78.7	78 2	0.92	1.08
						Ratio of Homoren Component GEZ- 1.10-1.20 1.50 or genes. 1.50 or genes.		

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169	Institutional	delivery	with	SBA
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170	The coverage of institutional delivery with SBA for India was 85.0% (95% CI 84.9 to 85.2) in NFHS-5.
171	The percent change from NFHS-4 to NFHS-5 was estimated at 12.6% (95% CI 12.2 to 12.9) for India,
172	14.6% (95% CI 14.1 to 15.1) for less developed and 6.2% (95% CI 5.8 to 6.6) for more developed
173	states (supplemental table 2). This coverage ranged from 58.6% in Meghalaya to 96.3% in Sikkim in
174	less developed states and 84.3% in Himachal Pradesh to 99.8% in Kerala in more developed states in
175	NFHS-5 (supplemental table 2). The HOI for geographic inequality for institutional delivery with SBA
176	for India was 80.4, 90.1 and 76.2 for India, more developed and less developed states in NFHS-5,
177	respectively (table 2 and supplemental table 3). HOI ranged from 26.2 to 99.8 in the states in NFHS-
178	4, and 37.4 to 99.7in the states in NFHS-5 (Figure 2 and supplemental table 3). The highest gains in
179	HOI between NHFS-4 and NFHS-5 were made in Arunachal Pradesh state (64.9%; 95% CI 61.3 to
180	68.5), with the HOI for the state at 77.5 in NHFS-5 (supplemental table 3).
181	Considering WI (table 2), HOI ranged from 65.1 for WI I to 93.7 for WI V for India, and the
182	corresponding range was 63.6 to 92.0 and 76.5 to 95.1 for less and more developed states in NFHS-
183	5, respectively. The WI V to average HOI ratio was 1 or more in all the states except Sikkim. The HOI
184	ratio of WI I to WI V was <1 in 28 (93.3 %) states and was <0.60 in 6 (20.0 %) states in NFHS-5
185	(supplemental table 4). Among the 26 states with W1 1 to state HOI ratio being >0.70, 6 states had
186	the W1 I to WI V HOI ratio at <0.70 (supplemental table 4).
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188	Table 2: Overall Human opportunity index (HOI) by wealth index quartile (WI) for institutional delivery with skilled birth attendant (SBA)
189 100	and the ratio between WI I and overall HOI, WI V and overall HOI for India and its states, National Fagily Health Survey-5.

				Institution	nal delivery w	vith SBA		
				HOI by WI				Ratio
	Overall HOI	1	2	3	4	5	စ္ခ်က္ခဲဟုပါ 1: စြာမွာကိုျ HOI	W Over
India	80.4	65.1	78.8	86.0	90.2	93.7	<b>ö g 8</b> .81	1
Less developed states	76.2	63.6	76.6	83.5	87.8	92.0	4. Dog hoges text an	1
Arunachal Pradesh	77.5	56.0	77.6	86.7	92.0	96.0	d cho	1
Assam	82.3	72.1	87.0	91.7	94.8	95.5	ata	1
Bihar	72.1	63.9	76.6	81.2	82.9	88.7	n <u>4</u> .89	1
Chhattisgarh	78.5	68.0	80.1	85.9	90.3	94.3	0.87	1
Jharkhand	70.4	60.7	77.1	83.8	91.3	94.7	× 2.86	1
Madhya Pradesh	84.1	75.4	84.8	90.0	91.7	90.3	tra 😫 90	1
Manipur	62.0	37.7	65.1	78.7	88.2	93.7	<b>b</b> .61	1
Meghalaya	52.5	38.8	57.6	72.6	82.5	82.2	<b>9</b> .74	1
Mizoram	72.4	26.4	59.1	80.5	92.8	95.8	<b>d e</b> .36	1
Nagaland	37.4	26.2	37.9	57.1	64.7	74.9	<b>S 9</b> .70	2
Odisha	87.3	77.6	91.6	93.9	95.5	95.6	<b>a 9</b> .89	1
Rajasthan	93.9	89.2	91.8	94.1	94.8	97.1	<b>6 0</b> .95	1
Sikkim	95.2	88.5	94.5	94.8	97.3	94.2	<b>1 0</b> .93	0
Tripura	83.5	71.8	88.8	91.9	94.0	90.6	<b>b</b> .86	1
Uttar Pradesh	78.0	68.3	76.4	79.4	82.8	90.1	<b>Jie 19</b> .88	1
Uttarakhand	78.5	62.1	62.7	75.0	85.7	91.9	<b>8</b> .79	1
More developed							5 at	
states	90.1	76.5	85.8	90.1	92.6	95.1	<b>0</b> .85	1
Andhra Pradesh	95.4	73.9	93.0	94.2	95.9	98.7	<b>8</b> .77	1
Goa	98.5	100.0	90.6	100.0	98.5	98.7	<b>1</b> .02	1
Gujarat	87.5	75.3	85.9	88.8	92.1	91.1	<b>Ä</b> .86	1

Page	14	of	41
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				Institutio	nal delivery w	vith SBA	08392	
	0			HOI by WI				Ratio
	HOI	1	2	3	4	5	oʻ (VII) Qvejcall HOI	Ovei
Haryana	90.5	64.7	77.0	86.8	91.1	96.0	<b>8 8</b> .71	1
Himachal Pradesh	82.5	54.1	68.1	80.8	86.5	90.6	е п .66	1
Jammu and Kashmir	87.9	71.5	82.7	88.6	94.7	96.6	ted 80.81	1
Karnataka	90.3	83.8	85.6	90.6	93.8	93.2	<b>to nu 2</b> .93	1
Kerala	99.7	100.0	100.0	99.5	99.8	99.6		1
Maharashtra	88.2	69.5	85.4	89.0	92.3	95.0	an 6 4.79	1
Delhi	90.2	21.9	68.7	82.7	83.0	91.6		1
Punjab	92.9	79.4	80.7	96.5	90.5	94.6	a 6.85	1
Tamil Nadu	99.2	95.6	97.9	99.2	99.5	100.0	ni <del>0</del> .96	1
Telangana	90.4	75.5	88.9	90.0	90.4	91.4	ing <b>B</b> .84	1
West Bengal	89.2	83.7	90.6	93.8	94.6	93.1	<b>Þ 9</b> .94	1

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3 4	193	PNC within 48 hours of delivery
5 6	194	The coverage of PNC within 48 hours of delivery was 78.9% (95% CI 78.7-79.1) in NFHS-5. The
/ 8	195	percent change from NFHS-4 to NFHS-5 was estimated at 28.5% (95% CI 28.0-29.0) for India, 31.8%
9 10 11	196	(95 % CI 31.1-32.4) for less developed and 19.6% (95% CI 19.0-20.3) for more developed states
12 13	197	(supplemental table 2). This coverage ranged from 43.2% in Nagaland to 92.1% in Odisha in the less
14 15	198	developed states and 68.2% in West Bengal to 96.3% in Goa in the more developed states in NFHS-5
16 17	199	(supplemental table 2). The HOI for geographic inequality in PNC within 48 hours of delivery for India
18 19 20	200	was 73.5 in NFHS-5, which improved by 34.6% (95% CI 34.2 to 35.1) between NFHS-4 to NFHS-5. The
20 21 22	201	HOI was substantially higher for the more developed states 82.6 than the less developed states 69.4
23 24	202	in NFHS-5 (table 3 and supplemental table 3). HOI ranged from 17.2 to 90.5 in the states in NFHS-4,
25 26	203	and 37.5 to 95.6 in the states in NFHS-5 (Figure 3 and supplemental table 3). The highest gains in HOI
27 28	204	were made in Arunachal Pradesh (128.6%; 95% CI 122.1 to 135.2) and Nagaland (118.0%; 95% CI
29 30 31	205	108.5 to 127.5), with the HOI for the states at 51.9 and 37.5 in NHFS-5, respectively (supplemental
32 33	206	table 3).
34 35	207	Considering WI (Table 3), HOI ranged from 62.0 for WI I to 85.0 for WI V in India, and the
36 37	208	corresponding range was from 61.2 to 83.0 and 67.4 to 88.3 for less and more developed states in
38 39 40	209	NFHS-5, respectively. The HOI ratio of WI V to state was 1 or more in all the states, except for Sikkim
40 41 42	210	and Tamil Nadu. The HOI ratio of WI I to WI V was <1 in 28 (93.3%) states and was <0.60 in 4 (13.3%)
43 44	211	states in NFHS-5 (supplemental table 4). Among the 27 states with WI I to state HOI ratio at >0.70, 2
45 46	212	states had the WI I to WI V HOI ratio at <0.70 (supplemental table 4).
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				PNC with	in 48 hours of de	elivery 🔂 🤉			
								HOI Ratio	
	Overall					es I	WI 1:	WI 5:	
	HOI	1	2	3	4	e E E	Overall HOI	Overall HC	
India	73.5	62.0	70.7	77.1	81.3	85 <u>6</u> 08 e	0.84	1.16	
Less developed states	69.4	61.2	68.7	73.6	77.4	2024. E	0.88	1.20	
Arunachal Pradesh	51.9	41.5	52.6	53.2	53.6	59n	0.80	1.15	
Assam	64.7	56.8	67.4	72.7	74.4	7춘63 등	0.88	1.11	
Bihar	59.6	54.0	61.8	65.8	69.0	7538 ade	0.91	1.27	
Chhattisgarh	85.3	81.8	85.5	85.2	89.4	8 <b>2</b> 8 <b>d</b>	0.96	1.03	
Jharkhand	70.9	65.8	74.6	74.5	81.4	8154 om	0.93	1.15	
Madhya Pradesh	82.8	78.7	81.5	84.4	85.7	8677	0.95	1.05	
Manipur	57.7	38.1	59.2	72.7	78.1	7950	0.66	1.37	
Meghalaya	53.4	49.3	55.6	59.3	54.9	5623	0.92	1.05	
Mizoram	63.9	28.2	55.0	72.2	72.1	79.3 💂	0.44	1.21	
Nagaland	37.5	27.2	38.8	55.2	59.8	525	0.73	1.53	
Odisha	90.7	87.6	90.7	92.9	92.9	9 <b>2</b> 9.9	0.97	1.02	
Rajasthan	82.6	78.2	80.8	82.3	83.4	8512 9	0.95	1.03	
Sikkim	70.4	66.9	69.3	71.4	70.6	5764 0	0.95	0.82	
Tripura	64.2	56.4	63.0	72.9	79.1	8278 T	0.88	1.29	
Uttar Pradesh	73.2	66.0	72.6	73.6	77.3	8208 Ine	0.90	1.13	
Uttarakhand	81.5	71.1	73.6	80.9	85.4	8 <b>6</b> 3 12	0.87	1.07	
More developed						s. 20)			
states	82.6	67.4	77.2	83.0	85.3	88.3 5	0.82	1.07	
Andhra Pradesh	90.4	67.6	87.2	91.1	90.3	92.1 👼	0.75	1.02	
Goa	95.6	100.0	90.6	89.8	96.6	98.7 <b>ਦ੍ਹ</b>	1.05	1.03	
Gujarat	87.1	85.7	85.4	85.8	86.3	89.3 <b>f</b>	0.98	1.03	
Haryana	88.7	64.2	76.7	88.7	88.7	92.2 <b>9</b>	0.72	1.04	

# BMJ Open Table 3: Overall Human opportunity index (HOI) by wealth index quartile (WI) for post-natal care in 42 hours of delivery and the ratio between WI I and overall HOI, WI V and overall HOI for India and its states, National Family Health Sugrev 5.

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				PNC with	nin 48 hours of de	livery L 33		
				HOI by WI		., idin	HOI	Ratio
	Overall HOI	1	2	3	4	on 21 N g foruns	WI 1: Overall HOI	Ov
Himachal Pradesh	87.3	71.3	78.7	88.3	88.3	9 <b>2</b> 1 2	0.82	
Jammu and Kashmir	77.2	64.7	72.9	78.1	80.3	825 <u>5</u> 5	0.84	
Karnataka	83.6	76.3	80.7	84.7	85.5		0.91	
Kerala	91.5	81.6	83.9	88.3	92.1	91572	0.89	
Maharashtra	80.8	66.9	78.3	80.7	83.3	80.00	0.83	
Delhi	85.1	31.2	59.7	76.4	80.3	8 <b>2</b> 3 2 5 8	0.37	
Punjab	85.4	69.4	75.0	96.6	83.1	8660 nl	0.81	
Tamil Nadu	90.4	84.0	90.4	90.3	90.1	8 <b>9 2</b>	0.93	
Telangana	85.4	78.1	83.1	83.5	84.4	8882.2 fr	0.91	
West Bengal	63.8	56.2	62.0	67.6	76.4	8 <b>05</b> 4 m	0.88	
						ttp://bmjope <mark>n.bm</mark> Al training, and s	Ratio of HOI Less than 0.50	
							0.51-0.89	
							0.90-1.09	
							1.10-1.49	
							1.50 01 11016	

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), Al training, a	http://bmjope	Ratio of HOI
and	2	Less than 0.50
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nita	ğ	0.90-1.09
rte	<b>1</b> 0	1.10-1.49
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217	Continuum	of care (	'CoC)
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The coverage of CoC was 45.6% (95% CI 45.4-45.9) in NFHS-5. The percent change from NFHS-4 to NFHS-5 was estimated at 38.6% (95% CI 37.6-39.6) for India, 47.2% (95% CI 45.7-48.6.) for less developed and 19.5% (95% CI 18.4-20.6) for more developed states (supplemental table 2). The coverage ranged from 9.4% in Nagaland to 69.4% in Odisha in the less developed states, and 50.2% in Punjab to 90.1% in Goa in the more developed states in NFHS-5 (supplemental table 2). The HOI for geographic inequality in CoC for India was 37.1, which improved by 52.2% (95% CI 51.1 to 53.0) between NFHS-4 to NFHS-5. The HOI was substantially higher for the more developed states at 56.3 than the less developed states at 29.7 in NFHS-5 (table 4 and supplemental table 3). HOI ranged from 4.4 to 79.0 in the states in NFHS-4, and 6.5 to 88.8 in the states in NFHS-5 (Figure 4 and supplemental table 3). The highest gains in HOI were made in Arunachal Pradesh (167.1%; 95% CI 154.4 to 179.8) and Uttarakhand (147.4%; 95% CI 139.3 to 155.5), with the HOI for the states at 21.9 and 43.3 in NFHS-5, respectively (supplemental table 3). Considering WI (Table 4), HOI ranged from 21.7 for WI I to 56.5 for WI V for India, and the corresponding range was 19.8 to 48.8 and 39.3 to 62.7 for less and more developed states in NFHS-5, respectively. The HOI ratio of WI V to state was 1 or more in 27 states. The HOI ratio of WI I to WI V was <1 in 28 (93.3%) states and was <0.60 in 18 (60.0%) states in NFHS-5 (supplemental table 4). Among the 12 states with WI I to state HOI ratio at >0.70, 3 states the WI I to WI V HOI ratio at <0.70

 $^{43}_{44}$  235 (supplemental table 4).
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						Q 	ног	Ratio
	Querell							
	HOI	1	2	3	4	emb ه rela	HOI	H
India	37.1	21.7	32.3	41.9	49.2	<b>ૻૢ</b> ૡૻઙૺઽૼ	0.58	1.
Less developed						2024 nush to te		
states	29.7	19.8	27.9	34.5	40.2	<u>*8</u> 865	0.67	1.
Arunachal Pradesh	21.9	12.4	20.9	22.8	26.0	<u> 3</u> 27,8 <u>×</u>	0.57	1.
Assam	31.0	22.9	32.1	40.3	49.0	<u><u></u></u>	0.74	1.
Bihar	15.3	9.5	15.1	21.0	28.4	<u><u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u><u></u></u></u>	0.62	2.
Chhattisgarh	43.3	37.3	39.2	47.9	50.7	<b>n</b> 3.4 <b>f</b>	0.86	1.
Jharkhand	24.1	16.7	27.8	31.6	41.5		0.69	1.
Madhya Pradesh	41.2	31.7	39.0	46.5	50.7	<u>8</u> 3.2	0.77	1.
Manipur	41.5	19.8	41.3	60.2	68.0	<b>6</b> 7.1	0.48	1.
Meghalaya	20.5	14.1	21.7	27.6	34.7		0.69	1.
Mizoram	36.6	6.7	27.6	40.4	49.5	រត្ន7.3 <mark>ខ</mark>	0.18	1.
Nagaland	6.5	2.2	5.9	12.2	17.4	<b>8</b> 5.6	0.34	5.
Odisha	64.8	53.2	68.2	71.9	75.1	5.3	0.82	1.
Rajasthan	44.2	38.0	39.8	42.3	45.2		0.86	1.
Sikkim	48.3	47.6	49.0	45.6	50.3	<b>ģ</b> 7.6 <b>9</b>	0.99	0.
Tripura	35.3	19.5	37.4	39.8	56.2		0.55	1.
Uttar Pradesh	27.9	19.2	24.9	28.5	31.7	<b>g</b> 3.7°	0.69	1.
Uttarakhand	43.3	24.5	28.2	38.5	51.2	<b>8</b> 9.2	0.57	1.
More developed	56.2	20.2	50.0		50.0	025	0.70	1
states	50.3	39.3	50.0	55.5	59.8	<u> </u>	0.70	1.
Andhra Pradesh	59.3	32.4	53.6	59.6	60.5	64.96	0.55	1.
GOa	88.8	100.0	/1.9	86.4	87.2	91.6	1.13	1.
Gujarat	61.2	49.8	56.9	60.0	64.0	69.9 <b>e</b>	0.81	1.
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# BMJ Open Table 4: Overall Human opportunity index (HOI) by wealth index quartile (WI) for continuum of care and the ratio between WI I and overall

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				C	ontinuum of care			
				HOI by WI		22 c ding	HOI	Ratio
	Overall HOI	1	2	3	4	n 21 N 1 for us	WI 1: Overall HOI	WI 5: ( H
Haryana	51.2	23.3	35.5	45.0	47.2	<b>6</b> 0.3	0.46	1.
Himachal Pradesh	54.3	31.8	39.5	51.0	59.7	<u></u>	0.59	1.
Jammu and Kashmir	59.5	40.2	53.9	62.3	66.1	Beron	0.68	1.
Karnataka	52.6	36.3	47.1	53.9	59.9	9 <u>6</u> 42	0.69	1.
Kerala	72.9	68.0	69.1	70.1	74.5		0.93	0.
Maharashtra	54.5	33.5	49.9	51.8	60.3		0.61	1.
Delhi	65.3	1.6	28.0	47.9	55.4	68680 68680	0.02	1.
Punjab	46.9	28.7	31.5	95.8	41.8	<u>50.1</u> g	0.61	1.
Tamil Nadu	82.0	75.6	81.9	81.7	82.6	<b>1</b> 9.15	0.92	0.
Telangana	54.9	35.9	51.0	52.2	56.2	<b>Ģ</b> 7.0 <mark>2</mark>	0.65	1.
West Bengal	47.3	37.7	45.6	52.3	61.3	<b>\$</b> 5.6	0.80	1.
						omj.com/ on June 12, 20 d similar technologies.	0.51-0. 0.90-1. 1.10-1. 1.50 or	49 09 49 more
						25 at Department GEZ		

Ratio of HOI
Less than 0.50
0.51-0.89
0.90-1.09
1.10-1.49
1.50 or more

2		
3 4	239	DISCUSSION
5 6	240	This analysis of coverage of maternal health services for livebirths over a decade between NFHS-4
7 8	241	and NFHS-5 has highlighted significant improvements in the geographic inequity for coverage of
9 10 11	242	these services at the state-level in India, and has identified the inequities that remain to be
12 13	243	addressed to achieve the ENAP 2025 coverage targets for these services. The geographic inequity
14 15	244	for the coverage of 4+ANC visits lags significantly behind that of institutional delivery with SBA and
16 17	245	PNC within 48 hours of delivery, contributing to the CoC inequity in NFHS-5. The HOI ratio for CoC at
18 19 20	246	0.38 highlights the extent of inequity between the women belonging to the lowest and the highest
20 21 22	247	wealth index quintiles in India.
23 24	248	A policy aiming at equitable access would require progress towards two objectives: first,
25 26	249	expanding the coverage by ensuring that as many women as possible get the opportunity; and
27 28 20	250	second, by allocating new opportunities first to the vulnerable population who are at a disadvantage
29 30 31	251	due to their circumstances.[30] We utilised HOI,[26] as a tool to measure the distribution of
32 33	252	opportunities and equitable access to maternal health services. The HOI not only carries information
34 35	253	about the coverage rate of the service but also how fairly the available services are distributed
36 37 29	254	among women of different backgrounds, in this case of different wealth index quintiles.[31] In
38 39 40	255	terms of expanding coverage to ensure that as many women as possible get the opportunity, the
41 42	256	coverage of 4+ ANC visits was for 4 of 7 women, and that for institutional delivery with SBA was 6
43 44	257	out of 7 women, and for PNC within 48 hours of delivery was 4 out of 5 women in NFHS-5. The
45 46	258	differential increase over the decade between the coverages of these three maternal health services
47 48 49	259	can possibly be explained by how the national programs to reduce maternal and neonatal mortality
50 51	260	were implemented during this period. The program to address ANC services was launched in 2016
52 53	261	after NFHS-4, and is aimed to guarantee a minimum package of ANC services to women in their
54 55	262	2nd/3rd trimesters of pregnancy at designated government health facilities.[32] There is no
56 57 58	263	monetary incentive either to the health worker or to the pregnant women under this program. The
59 60	264	likely impact of this program on HOI for 4+ ANC visits coverage will be documented in the next round

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265	of NFHS (round 6). However, given the extent of low coverage of 4+ ANC visits in most of the less
266	developed states and some of the more developed states, major inputs are needed to address the
267	barriers for improved ANC utilisation to achieve the ENAP 2025 target for 4+ ANC visits.[33-35] The
268	increased coverage for institutional deliveries with SBA between the two surveys resulted in nearly
269	doubling of HOI over this period, and near universality of this service in the more developed states.
270	Two programs – the Janani Suraksha Yojana (JSY) and the Janani Shishu Suraksha Karyakaram (JSSK)
271	- initiated to increase the coverage of institutional deliveries in India have contributed to the
272	exponential increase in access to institutional delivery.[36 37] The JSY was initiated in 2005 and was
273	a large-scale national program that offered conditional cash transfer and support services to poor
274	pregnant women to use institutional delivery care facilities, especially in the states with lower
275	coverage.[36] The JSSK, initiated in 2011, provided free and cashless delivery along with some other
276	benefits to pregnant women to eliminate out-of-pocket expenses in order to increase the
277	institutional deliveries.[38] The PNC coverage was estimated at 61% HOI at 73.5 for India in NFHS-5
278	with a wide variation at the state-level. The increased PNC coverage also resulted in 34.6% increase
279	in HOI for PNC coverage between NFHS-4 and NFHS-5. According to the Indian PNC guidelines,[39]
280	the health workers are paid INR 250 (USD 3.5) for PNC visits, and are expected to undertake 6-7 PNC
281	visits at home from 1 <sup>st</sup> to 42 <sup>nd</sup> day of delivery for counselling the mother on various issues and
282	enabling referral if needed. Considering all the three maternal health services together, the CoC
283	coverage remained at 62.5% in NFHS-5 with only 19.5% change between the two surveys even in the
284	more developed states. Only 45% CoC coverage in NFHS-5 for India translates into 5 out of every 11
285	woman and newborn not having received all the three MNCH services, which is the basic premise of
286	the ENAP and INAP to address neonatal and maternal mortality.[19 21]
287	With regards to the policy objective of allocating new opportunities to the vulnerable
288	population who are at a disadvantage due to their circumstances, socio-economic inequities in
289	maternal health services in India have been reported previously, [16 40-46] but the use of HOI to

measure inequity has not been attempted. For all the maternal health services, the women

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belonging to the lowest WI quintile had low HOI compared to those in the highest WI quintile, and the difference was starker for ANC services and in the less developed states. Though the within-district inequalities in intervention coverages are reducing in most states, the pace of reduction has not been the same for every woman. The state of Delhi with the national capital had the one of the least HOI ratio for the women belonging to the lowest WI quintile. The extent of HOI ratio for the lowest to the highest WI quintile and that to average HOI between the maternal health services within states highlights the specificity needed in targeting women with the respective interventions to achieve 2025 coverage targets. One of the challenges in achieving equity in maternal health services in India is the dependence on NFHS for retrospective situational analysis rather than for monitoring and evaluation, because the routine health information management system (HMIS) does not allow for tracking of CoC for maternal health services per woman.[47] Real time tracking of women for utilisation of these services at the district-level is needed to reduce inequity in the coverage of these services. India has a Mother and Child Tracking System (MCTS) in place since 2009 to follow a mother-child dyad through the CoC, but it is known to be fraught with several issues.[48-50] Clearly, it is important that strategies to improve the MCTS, within digital health, are looked into urgently if India were to reach every woman and newborn to achieve the SDG targets of reduced maternal and neonatal mortality at the district-level.[51-53] High quality timely data for evidence-informed decision making to reduce inequity at the district level can also be obtained through continuous surveys.[54] Furthermore, incentivisation of services is currently only for institutional delivery and for PNC services. With poor coverage of ANC services resulting in poor coverage of CoC, it may be worth considering incentivising the CoC rather than individual maternal health services to address inequity.

The major strength of this analysis is the utilisation of HOI to indicate not only inequity in the coverage rate of the services but also how fairly the available services are distributed among women by geography and wealth index quintiles. This, we believe, allows for understanding the women who need to be targeted to reduce the inequity in the maternal health care in India. The inclusion of 

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> CoC is another strength as it brings the woman to the centre stage as against the individual maternal health care services. The results from this analysis are generalisable as the sample for the NFHS are nationally representative of ever-married women who reported a livebirth in the last 5 years from the time of data collection. Hence, owing to the large sample size and broad geographic coverage strengthens the external validity of these findings ensuring applicability across different population in India.

Some limitations of the analysis presented should be taken into account. The data on service utilisation is documented in the NFHS are self-reported by women, which may be subject to recall bias. We believe this bias to be of less concern as women self-report accurately indicators related to concrete and observable actions performed on them as opposed to information or advice they were offered. [55 56] We only considered the inequity in coverage and not in the quality of contact with the health system during service utilisation in this analysis as such data are not available in the NFHS. There is a growing literature documenting increased coverage but poor quality of contact for these services,[4] including from India from pregnancy to delivery,[4 50 57-67] and also of poor quality of health care being a major driver of excess mortality across conditions, including neonatal mortality.[68-71] Health system redesign has been suggested for equity in maternal and new born health, by moving all childbirth care services to hospitals in all countries, combined with improvements in the quality of care provided in these facilities, transportation from home to hospital, and continuity of care through hub-and-spoke arrangements.[72] While commenting on the scope of health system re-design is beyond the scope of the analysis undertaken for this paper, more discussion is needed and more options need to be rigorously tried and tested to develop sustainable district health systems which are fit for purpose and respond to continuity of care needs of women and their babies.[73] CONCLUSION

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In conclusion, the findings of this assessment of coverage of maternal health services for livebirths over a decade are encouraging as significant reductions in geographic inequity are documented. However, the findings also emphasise the need for improved targeting of women to reduce the remaining inequity gap to achieve the ENAP targets, in particular for the coverage of 4+ANC visits. It will be important for the national program to monitor the CoC coverage in real time in addition to μ. use indiv. usure that inequa the three maternal health services individually to monitor and track inequity at the district level for every pregnant woman to ensure that inequity by wealth index is also addressed in India. 

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2		
3 4	351	Ethics approval
5 6	352	No ethics approval was required for this analysis as we utilised the de-identified data available in
/ 8	353	public domain.
9 10 11	354	
12 13	355	Authors' contributions
14 15	356	RD and GAK conceptualized the study; GAK and MM had full access to data in the study and
16 17 18	357	performed data analysis; RD and GAK take full responsibility for the integrity of data and accuracy of
18 19 20	358	the data analysis, and had final responsibility for the decission to submit for publication; RD drafted
21 22	359	the manuscript; all authors contributed to the interpretation and approved of the final version of the
23 24	360	manuscript. RD is the guarantor.
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32 33	364	decision to publish this paper.
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39 40	367	The authors have no conflict of interest.
41 42	368	
43 44 45	369	Data availability statement sharing
43 46 47	370	All data generated or analysed during this study are included in this published article and its
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54 55 56	374	India maps.
57 58 59 60	375	

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#### **FIGURE LEGENDS**

Figure 1. Human Opportunity Index for 4+ antenatal care visits in NFHS-4 in 2015-16 and NFHS-5 in

2019-2021 for each state of India.

- Figure 2. Human Opportunity Index for institutional delivery with skilled birth attendant in NFHS-4
- in 2015-16 and NFHS-5 in 2019-2021 for each state of India.
- Figure 3. Human Opportunity Index for post-natal care within 48 hours of delivery in NFHS-4 in
- 2015-16 and NFHS-5 in 2019-2021 for each state of India.
- Jaci Figure 4. Human Opportunity Index for continuum of care in NFHS-4 in 2015-16 and NFHS-5 in 2019-

#### 2021 for each state of India.



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Figure 4. Human Opportunity Index for continuum of care in NFHS-4 in 2015-16 and NFHS-5 in 2019-2021 for each state of India. NFHS-4



GEZ-LT

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Uttarakhand

Uttar Prade

Delhi

Chhattisgarh

Andhra Pradesh

Odisha

Bihi

narkhand

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Population level trends over a decade in geographical inequality for opportunity in access to maternal care services: findings from the National Family Health Surveys in India

Supplementary file

rice to: Prof. Rakhi Dandona; rakhi.c. propro24083922 on 21 Norm r BMJ Open: first published as 10.1136/bmjopen-2024-083922 on 21 November 2024. Downloaded from http://bmjopen.bmj.com/ on June 12, 2025 at Department GEZ-LTA Erasmushogeschool . Protected by copyright, including for uses related to text and data mining, Al training, and similar technologies.

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## Supplementary Table 1. Number of districts by state in the National Family Health Survey (NFHS) rounds 4 and 5.

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ujarat   26   33     aryana   21   22     machal Pradesh   12   12     mmu & Kashmir <sup>§</sup> 22   22     rnataka   30   30     rala   14   14     aharashtra   35   36     njab   20   22     mil Nadu   32   32     langana   10   31     est Bengal   19   20
10   10   10     aryana   21   22     machal Pradesh   12   12     mmu & Kashmir <sup>§</sup> 22   22     rnataka   30   30     rala   14   14     aharashtra   35   36     njab   20   22     mil Nadu   32   32     langana   10   31     est Bengal   19   20
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State	Sampl	le size	Four	of more ANC vi	isits	Institut	ional delivery witl	h SBA* 🖁	Post-natal care	within 48 hours	s of delivery		Continuum of c	are
	NFHS-4 (N)	NFHS-5 (N)	NFHS-4 % of N (95% Cl)	NFHS-5 % of N (95% Cl)	Percent change from NFHS-4 to NFHS-5 (95% CI)	NFHS-4 % of N (95% CI)	NFHS-5 % of N (95% CI)	Percent change from NHHS- 4 to NFHS- (95% 중1)	NFHS-4 % of N (95% CI)	NFHS-5 % of N (95% CI)	Percent change from NFHS- 4 to NFHS-5 (95% CI)	NFHS-4 % of N (95% CI)	NFHS-5 % of N (95% Cl)	Percent change from NFHS-4 to NFHS-5 (95% CI)
India	188,506 <sup>+</sup>	174,796	46.4 (46.2-46.7)	57.0 (56.8-57.3)	22.8 (22.1-23.5)	75.5 (75.3-75.7)	85.0 (84.9-85.2)	12.6 (12-12-12.9)	61.4 (61.2 - 61.6)	78.9 (78.7-79.1)	28.5 (28.0-29.0)	32.9 (32.7-33.1)	45.6 (45.4-45.9)	38.6 (37.6-39.6)
Less developed	132,809	113,519	36.0 (35.7-36.3)	48.0 (47.7-48.3)	33.3 (32.3-34.3)	70.6 (70.3-70.8)	80.9 (80.7-81.2)	ສາ4.6 (1461-199.1)	57.0 (56.7-57.2)	75.1 (74.8-75.3)	31.8 (31.1-32.4)	24.8 (24.6- 25.1)	36.5 (36.3-36.8)	47.2 (45.7-48.6)
Arunachal	3,858	4,570	24.6	37.2	51.2	52.7	80.6	52.9	27.5	55.4	101.5	11.8	25.3	114.7
Pradesh	,	,	(23.3- 26.0)	(35.8-38.6)	(45.1-57.4)	(51.1-54.2)	(79.4-81.7)	(4 <b>5</b> 8-5 <b>5</b> .1)	(26.1-28.9)	(53.9-56.8)	(95.7-107.2)	(10.8- 12.8)	(24.1-26.6)	(104.4-124.4)
Assam	8,534	9,247	45.4	50.9	12.1	72.5	84.8	<b>0</b> 17.6	56.9	67.8	19.1	29.9	35.5	18.7
			(44.3- 46.4)	(49.8-51.9)	(9.5-14.7)	(71.5-73.4)	(84.1-85.5)	(156-18.4)	(55.8-57.9)	(66.8-68.7)	(17.1-21.2)	(20.9-30.9)	(34.5-36.5)	(15.1-22.4)
Bihar	16,822	13,874	14.6	25.5	74.7	66.0	75.1	<b>,71</b> 3.82	47.8	65.4	36.8	9.0	17.8	97.8
			(14.1 -15.2)	(24.7-26.2)	(70.0-79.3)	(65.3-66.7)	(74.4-75.8)	(1 <b>2</b> 5-1 <b>6</b> .0)	(47.1-48.6)	(64.6-66.2)	(35.0-38.7)	(8.6- 9.4)	(17.2-18.4)	(91.5-104.1)
Chhattisgarh	6,805	6,526	56.9	61.2	7.6	71.8	82.1	сц4.39 сц4.39	67.2	87.2	29.8	37.6	47.3	25.8
			(55.7 - 58.0)	(60.0-62.4)	(5.3-9.9)	(70.7-72.8)	(81.2-83.0)	(1 <b>2</b> 7-1 <b>8</b> .0)	(66.0-68.3)	(86.3-87.9)	(28.0-31.5)	(36.4-38.7)	(46.1-48.5)	(22.4-29.2)
Jharkhand	8,947	7,465	29.9	38.6	29.1	63.8	74.5	<b>g</b> 16. <b>0</b>	46.8	74.0	58.1	17.0	27.0	58.8
			(29.0 - 30.9)	(37.5-39.7)	(25.4-32.8)	(62.8-64.8)	(73.5-75.5)	(15:0-1 <b>\$</b> .5)	(45.8-47.8)	(73.0-75.0)	(55.6-60.6)	(16.2-17.8)	(26.0-28.0)	(53.3-64.4)
Madhya	17,406	11,700	34.9	57.0	63.3	75.9	86.6	<u>ມ</u> ຊ. <b>ຊຸ</b>	55.9	85.1	52.2	23.1	46.1	99.6
Pradesh			(34.1-35.6)	(56.1-57.9)	(60.9-65.7)	(75.2-76.5)	(86.0-87.2)	(1322-15.0)	(55.1-56.6)	(84.4-85.7)	(50.8-53.7)	(22.4 -23.7)	(45.2-47.0)	(96.2-102.9)
Manipur	4,429	2,511	65.1	68.7	5.5	67.9	70.9	ela.	62.8	64.9	3.3	49.2	50.9	3.5
			(63.7-66.5)	(66.8-70.4)	(2.9-8.2)	(66.5-69.3)	(69.1-72.6)	( <b>Ē</b> 986 <sup>9</sup> 9)	(61.4-64.2)	(62.9-66.7)	(0.5-6.2)	(47.7 -50.7)	(48.9-52.8)	(-0.3-7.2)
Meghalaya	3,119	4,602	50.1	50.3	0.4	56.0	58.6	ਰ4 <u>ਵ</u> 68	58.0	58.3	0.5	32.1	23.9	-25.5
			(48.4-51.9)	(48.8-51.7)	(-3.5-4.3)	(54.3-57.8)	(57.2-60.0)	( <b>b</b> 288 <u>1</u> )	(56.3-59.8)	(56.8-59.7)	(-2.8-3.8)	(30.4 -33.7)	(22.7-25.1)	(-31.1 to -20.0)
Mizoram	3,681	1,896	56.4	52.4	-7.1	78.1	79.3	t a	62.8	68.1	8.4	41.5	42.1	1.4
			(54.8-58.0)	(50.2-54.7)	(-10.6 to - 3.6)	(76.7-79.4)	(77.4-81.0)	(-64 da	(61.2-64.3)	(65.9-70.1)	(5.4-11.5)	(39.9 -43.1)	(39.9-44.4)	(-3.3-6.2)
Nagaland	3,136	2,205	13.5	15.6	15.6	33.8	42.5	a25.80	22.6	43.2	91.2	7.6	9.4	23.7
			(12.3-14.7)	(14.1-17.2)	(5.2-25.9)	(32.2-35.5)	(40.5-44.6)	(2 <b>₫</b> 0-3 <b>‡</b> .4)	(21.2-24.1)	(41.2-45.3)	(83.3-99.0)	(6.7- 8.6)	(8.3-10.7)	(9.3-38.1)
Odisha	9,015	7,141	64.7	80.0	23.6	83.3	90.1	ing.1m	77.4	92.1	19.0	47.8	69.4	45.2
			(63.7-65.7)	(79.1-80.9)	(22.0-25.3)	(82.5-84.0)	(89.4-90.7)	(7,1-9,2)	(76.5-78.3)	(91.5-92.7)	(17.8-20.2)	(46.8 -48.8)	(68.4-70.5)	(42.8-47.6)
Rajasthan	11,950	10,831	38.3	56.5	47.5	85.0	95.0		65.2	85.2	30.7	29.1	49.4	69.8
			(37.5-39.2)	(55.6-57.5)	(44.9-50.1)	(84.4-85.6)	(94.5-95.4)	(1 <b>ဋ</b> 0-1 <mark>2</mark> .6)	(64.3-66.0)	(84.5-85.9)	(28.3-32.1)	(28.2 -29.9)	(48.5-50.4)	(66.5-73.0)
Sikkim	899	569	74.9	65.4	-12.7	95.2	96.3	<u>j</u> 1.25	75.0	73.5	-2.1	56.0	52.0	-7.1
			(71.9-77.6)	(61.4-69.2)	(-17.0 to - 8.3)	(93.6-96.4)	(94.4-97.5)	(-a.5-28) d <b>.</b> 5-28)	(72.0-77.7)	(69.7-76.9)	(-6.3-2.3)	(52.7-59.2)	(47.9-56.1)	(-13.7 to -0.6)
Tripura	1,169	1,860	63.5	54.0	-15.0	80.3	86.8	Sin 8.1	61.2	68.6	12.1	45.9	39.7	-13.5
			(60.7-66.2)	(51.7-56.2)	(-19.7 to - 10.3)	(77.9-82.5)	(85.2-88.3)	(5) - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	(58.4-64.0)	(66.4-70.7)	(7.2-17.0)	(43.0 -48.7)	(37.5-42.0)	(-20.2 to -6.8)
Uttar	28,741	25,556	27.4	41.5	51.5	68.1	81.1	<u>č1</u> 9. <b>P</b>	59.1	76.9	30.1	20.0	31.1	55.5
Pradesh			(26.9-27.9)	(40.9-42.1)	(49.3-53.7)	(67.5-68.6)	(80.6-81.5)	(1 <b>&amp;</b> 2-2 <b>Q</b> .0)	(58.6 - 59.7)	(76.4-77.4)	(29.1-31.2)	(19.5 -20.4)	(30.5-31.7)	(52.8-58.2)
Uttarakhand	4,298	2,966	29.7	60.6	104.0	67.9	80.1	<b>8</b> 18.0	56.9	84.2	48.0	20.5	47.7	132.7
			(28.3-31.1)	(58.8-62.3)	(98.7- 109.4)	(66.5-69.2)	(78.6-81.5)	(1 <b>9</b> 7-29.3) 20	(55.4-58.4)	(82.8-85.4)	(45.2-50.8)	(19.3 -21.7)	(45.9-49.5)	(125.5-139.9)
More	55,697	61,277	71.3	73.7	3.4	87.2	92.6	6.2 <sup>05</sup>	71.9	86.0	19.6	52.3	62.5	19.5
developed			(70.9-71.7)	(73.4-74.1)	(2.6-4.1)	(86.9-87.5)	(92.4-92.8)	(5.8-64)	(71.5-72.3)	(85.7-86.3)	(19.0-20.3)	(51.9- 52.7)	(62.2-62.9)	(18.4-20.6)
Andhra	4,055	2,092	75.7	69.3	-8.5	89.5	95.7	6.9 <b>0</b>	79.3	90.8	14.5	57.8	62.2	7.6
Pradesh			(73.9 - 77.4)	(67.2-71.2)	(-11.0 to - 5.9)	(88.2-90.7)	(94.8-96.5)	(5.5-854) ne	(77.6 – 80.9)	(89.5-91.9)	(12.3-16.7)	(55.7–59.8)	(60.1-64.3)	(3.8-11.5)
Delhi	1.258	2,379	71.4	79.9	11.9	88.0	91.7	4.2	63.3	87.2	37.8	46.6	69.6	49.4

Supplementary Table 2. Coverage of four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), and post-natal care within 48 hours of delivery, and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) 4 and NFHS 5 for India and its states. CI der tes confidence interval.

State	te Sample size		Four of more ANC visits		Institutional delivery with SBA*			Post-natal care	within 48 hours	s of delivery	Continuum of care			
			NFHS-4	NFHS-5	Percent	NFHS-4	NFHS-5	Percegit	NFHS-4	NFHS-5	Percent	NFHS-4	NFHS-5	Percent change
	NFHS-4	NFHS-5			change			change			change	% of N		from NFHS-4 to
	(N)	(N)	% of N	% of N	from	% of N	% of N	from NBHS-	% of N	% of N	from NFHS-	(95% CI)	% of N	NFHS-5 (95% CI)
			(95% CI)	(95% CI)	NFHS-4 to	(95% CI)	(95% CI)	4 to NF貰S-5	(95% CI)	(95% CI)	4 to NFHS-5		(95% CI)	
					NFHS-5			(95% 줮)			(95% CI)			
			(60.0.70.0)		(95% CI)		(00 5 00 7)	st p						
<u></u>	247	222	(68.8 - 73.8)	(78.2-81.4)	(8.3-15.6)	(86.1-89.7)	(90.5-92.7)	(2.1-653)	(60.6 - 66.0)	(85.8-88.5)	(33.3-42.1)	(43.9 - 49.4)	(67.7-71.4)	(43.2-55.5)
Goa	347	322	87.6 (92 7 00 7)	93.2 (80.8.05.4)	6.4 (2.2.10.5)	96.8	98.8 (06.7.00.5)		91.4	96.3 (02 E 07 0)	5.4	80.7 (76.2 94.5)	90.1	11.b (6.2.17.0)
Guiarat	5 827	7 5 7 5	66.4	(89.8-95.4)	17.0	83.9	90.3	7.60	62 9	89.4	(2.0-8.7)	42.3	66.3	56.7
Gujarut	5,027	1,575	(65.2 - 67.6)	(76.7-78.6)	(15.1-19.0)	(82.9-84.8)	(89.6-90.9)	( <b>G</b> 4-8-8)	(61.7 - 64.2)	(88.6-90.0)	(40.1-44.2)	(41.0-43.5)	(65.3-67.4)	(53.5-60.0)
Haryana	5,719	5,162	45.4	60.8	33.9	82.1	93.4	<u>ຼີຄ</u> 13.8	68.3	91.3	33.7	34.3	55.6	62.1
			(44.1 - 46.7)	(59.4-62.1)	(30.7-37.1)	(81.1-83.1)	(92.6-94.0)	(1265-198.0)	(67.0 - 69.5)	(90.5-92.0)	(31.8-35.5)	(33.1 - 35.6)	(54.3-57.0)	(58.0-66.2)
Himachal	2,292	2,145	66.2	71.8	8.5	75.9	84.3	<b>b</b> 11.00	73.6	88.9	20.8	49.5	59.3	19.8
Pradesh			(64.3 - 68.1)	(69.8-73.6)	(5.3-11.7)	(74.1-77.6)	(82.7-85.8)	(8-6-1 <b>3</b> -6)	(71.8 - 75.4)	(87.5-90.2)	(18.2-23.4)	(47.4 - 51.5)	(57.261.3)	(15.2-24.4)
Jammu &	6,280	5,367	79.5	80.7	1.5	83.2	91.0	opy9.4en	73.0	80.3	10.0	61.8	65.1	5.3
Kashmir <sup>§</sup>			(78.5 - 80.5)	(79.6-81.7)	(0.1-2.9)	(82.2-84.1)	(90.2-91.7)	(82-166)	(71.9 - 74.1)	(79.2-81.3)	(8.4-11.6)	(60.6 - 63.0)	(63.8-66.4)	(3.2-7.5)
Karnataka	5,876	6,389	73.5	70.8	-3.7	90.7	92.5	<b>,∓</b> 2.0 <b>2</b>	60.5	86.4	42.8	44.6	59.1	32.5
			(72.3 - 74.6)	(69.6-71.9)	(-5.4 to -	(90.0-91.5)	(91.8-93.1)	(15:1-20)	(59.2 - 61.7)	(85.5-87.2)	(40.6-45.0)	(43.3 - 45.9)	(57.9-60.3)	(29.4-35.6)
	0.400				2.0)			392 Iud	0.5.0			70.4	77.0	
Kerala	2,128	2,360	90.3	82.2	-9.0	99.9	99.8		86.3	92.8	7.5	78.4	77.9	-0.6
			(89.0 - 91.5)	(80.6-83.7)	(-10.6 to -	(99.6-100.0)	(99.5-99.9)	(-04,3-051) <u> </u>	(84.7 - 87.7)	(91.7-93.8)	(5.7-9.3)	(76.6 - 80.1)	(76.2-79.5)	(-3.1-1.8)
Maharashtra	7 1 / 2	7 / 15	77.2	71.2	7.4)	96.7	01.0		76.0	0/1	0.4	F <i>1 1</i>	60.2	10.7
ivialia asilu a	7,145	7,415	(71 3 - 73 3)	(70 3-72 3)	(-3.0-0.2)	(85 9-87 5)	(90 3-91 6)	(4°0-5 <del>~</del> 9)	(75 9 - 77 9)	(83 3-84 9)	9.4 (8.0-10.7)	54.4 (53 2 - 55 5)	(59 1-61 3)	(8 3-13 0)
Puniab	4 1 3 2	4 520	68.2	58.3	-14 5	92.0	94 1		88.4	87.1	-1 5	59 1	50.2	-15.1
i unjub	4,132	4,520	(66.7 - 69.6)	(56.8-59.7)	(-16.8 to -	(91.2-92.8)	(93.4-94.7)		(87.4 - 89.3)	(86.1-88.0)	(-2.7 to -0.3)	(57.6 - 60.6)	(48.7-51.6)	(-17.8 to -12.3)
			(,	(,	12.2)	(	(,	to 202		(,	(,	(,	(	(
Tamil Nadu	6,181	5,228	80.7	91.6	13.5	98.8	99.5	24. tey	72.4	92.2	27.3	60.8	84.9	39.6
			(79.7 - 81.7)	(90.8-92.3)	(12.2-14.8)	(98.5-99.1)	(99.3-99.7)	(0.4610)	(71.3 - 73.5)	(91.4-92.9)	(25.7-29.0)	(59.6 - 62.0)	(84.0-85.9)	(37.5-41.8)
Telangana	NA	5,429	73.1	69.7	-4.7	87.2	91.4	nd SEP nd	81.7	86.6	6.0	57.6	56.9	-1.2
			(71.0 - 75.1)	(68.5-70.9)	(-7.6 to -	(85.6-88.7)	(90.6-92.1)	(କ୍ଷ୍ମିପ୍ରେର୍ଦ୍ଧେର୍ଚ୍ଚ)	(79.8 - 83.4)	(85.7-87.5)	(3.7-8.2)	(55.3– 59.9)	(55.6-58.2)	(-5.3-2.9)
					1.7)			a nr						
West Bengal	4,459	4,894	74.2	75.7	2.0	77.0	91.2		63.1	68.2	8.1	47.4	52.0	9.7
			(72.9 - 75.5)	(74.4-76.9)	(0.1-3.9)	(75.8-78.2)	(90.4-91.9)	(168-259.1)	(61.7 - 64.5)	(66.9-69.5)	(5.6-10.5)	(46.0 - 48.9)	(50.6-53.4)	(6.3-13.1)
Data missing or Ladakh is comb	n 101 wom	en for instil ammu & Ka	tutional delivery v ashmir in NFHS-5	with SBA, PNC v	within 48 hours	s of delivery, and rate data for Lad	continuum of care	// <mark>smjopen.bmj.com/</mark> on June 12, 2025 at Department S rathing, and similar technologies. N in						
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ndia 3	Four of more ANC visits				nstitutiona	l delivery with SBA	first	Post-na	atal care with	in 48 hours of delivery	Continuum of care		
ndia	HS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change fro to NFHS-5 (95	m NFHS 4	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)	NFHS-4	NFHS-5	Percent change from NFHS 4 to NFHS-5 (95% CI)
	35.8	48.4	35.2 (34.5 to 35.9)	68.9	80.4	16.7 (16.	to 17.0)	54.6	73.5	34.6 (34.2 to 35.1)	24.4	37.1	52.2 (51.1 to 53.0
ess developed states	27.9	40.7	45.9 (44.9 to 46.9)	64.5	76.2	18.1 (17.	to 18.6)	50.6	69.4	37.2 (36.6 to 37.8)	18.5	29.7	60.5 (59.2 to 61.9
Arunachal Pradesh	20.2	34.3	69.8 (62.7 to 76.9)	47.0	77.5	64.9 61.	to 68.5)	22.7	51.9	128.6 (122.1 to 135.2)	8.2	21.9	167.1 (154.4 to 179.8
Assam	40.7	45.6	12.0 (9.2 to 14.9)	66.5	82.3	23.8	to 25.4)	51.1	64.7	26.6 (24.3 to 28.9)	24.9	31.0	24.5 (20.3 to 28.7
3ihar 🤅	12.8	22.9	78.9 (73.9 to 83.9)	61.0	72.1	18.2 816.	to 19.6)	43.1	59.6	38.3 (36.2 to 40.3)	7.7	15.3	98.7 (91.8 to 105.6
Chhattisgarh !	52.0	57.2	10.0 (7.5 to 12.5)	68.6	78.5	14.4€12.	to 16.2)	63.0	85.3	35.4 (33.5 to 37.3)	33.1	43.3	30.8 (27.0 to 34.6
harkhand	25.0	36.0	44.0 (39.7 to 48.3)	59.5	70.4	18.3 <b>6</b> 16.	to 20.3)	43.2	70.9	64.1 (61.4 to 66.8)	13.8	24.1	74.6 (68.3 to 81.0
Vadhya Pradesh 7	29.4	52.2	77.6 (74.8 to 80.3)	70.8	84.1	18.8 17.	to 19.8)	51.3	82.8	61.4 (59.8 to 63.0)	19.1	41.2	115.7 (111.9 to 119.5
Vanipur !	54.9	61.2	11.5 (8.2 to 14.8)	58.0	62.0	6. <b>9</b> (3.	<b>S</b> to 10.0)	54.4	57.7	6.1 (2.7 to 9.4)	39.2	41.5	5.9 (1.3 to 10.4
Veghalaya 4	44.3	45.4	2.5 (-1.9 to 6.9)	49.6	52.5	5=8 (1	9 to 9.8)	52.0	53.4	2.7 (-1.1 to 6.4)	26.4	20.5	-22.3 (-28.8 to -15.9
Vizoram !	52.4	46.6	-11.1 (-14.8 to -7.3)	72.1	72.4	0.聋(-2	<b>a</b> 0 to 2.9)	59.0	63.9	8.3 (5.0 to 11.6)	37.9	36.6	-3.4 (-8.5 to 1.6
Vagaland	8.3	11.3	36.1 (22.3 to 50.0)	26.2	37.4	42.7 35.	to 49.7)	17.2	37.5	118.0 (108.5 to 127.5)	4.4	6.5	47.7 (28.0 to 67.5
Jdisha !	59.2	76.2	28.7 (26.8 to 30.6)	79.2	87.3	10.2 (9.	to 11.4)	74.4	90.7	21.9 (20.6 to 23.2)	42.6	64.8	52.1 (49.4 to 54.8
Rajasthan	33.0	51.2	55.2 (52.2 to 58.1)	81.8	93.9	14.8 413.	to 15.7)	61.2	82.6	35.0 (33.4 to 36.5)	24.6	44.2	79.7 (76.0 to 83.3
sikkim -	71.3	60.1	-15.7 (-20.5 to -10.9)	94.4	95.2	0.8 (-0	9 to 2.6)	71.9	70.4	-2.1 (-6.7 to 2.5)	52.1	48.3	-7.3 (-14.4 to -0.2
Гripura (	60.4	50.4	-16.6 (-21.6 to -11.5)	76.4	83.5	9. 3. (5.	to 12.7)	58.2	64.2	10.3 (5.1 to 15.5)	42.9	35.3	-17.7 (-24.8 to -10.6
Jttar Pradesh	21.9	38.1	74.0 (71.4 to 76.6)	64.0	78.0	21.9 22.	to 22.8)	53.5	73.2	36.8 (35.6 to 38.0)	15.6	27.9	78.8 (75.6 to 82.1
Jttarakhand 7	25.9	55.7	115.1 (109.0 to 121.1)	65.2	78.5	20.4 512.	to 22.8)	54.3	81.5	50.1 (47.1 to 53.1)	17.5	43.3	147.4 (139.3 to 155.5
More developed states	65.2	68.2	4.6 (3.9 to 5.3)	82.8	90.1	86878	.4 to 9.2)	66.2	82.6	24.8 (24.1 to 25.4)	45.7	56.3	23.2 (22.2 to 24.2
Andhra Pradesh	74.3	68.3	-8.1 (-10.8 to -5.4)	88.0	95.4	8.4	to 10.0)	77.6	90.4	16.5 (14.2 to 18.8)	56.1	59.3	5.7 (1.7 to 9.7
Goa f	86.0	92.4	7.4 (3.0 to 11.9)	96.7	98.5	1. <b>9</b> 60	2 to 3.9)	90.5	95.6	5.6 (2.1 to 9.2)	79.0	88.8	12.4 (6.7 to 18.1
Gujarat !	59.7	73.1	22.4 (20.2 to 24.7)	80.1	87.5	9.2.00.	to 10.6)	59.9	87.1	45.4 (43.2 to 47.6)	36.7	61.2	66.8 (63.1 to 70.4
Haryana 🤅	37.3	56.6	51.7 (47.9 to 55.5)	75.6	90.5	19.7 18.	to 21.3)	61.3	88.7	44.7 (42.5 to 46.9)	27.2	51.2	88.2 (83.3 to 93.1
Himachal Pradesh	61.7	67.1	8.8 (5.2 to 12.3)	72.7	82.5	13.5 10.	to 16.2)	69.8	87.3	25.1 (22.2 to 27.9)	45.4	54.3	19.6 (14.6 to 24.6
ammu & Kashmir* -	71.9	76.3	6.1 (4.4 to 7.8)	77.8	87.9	13.0 <mark>9</mark> 11.	to 14.4)	67.1	77.2	15.1 (13.2 to 16.9)	53.3	59.5	11.6 (9.1 to 14.2
Karnataka é	69.3	65.1	-6.1(-7.9 to -4.2)	88.4	90.3	21 (1	1 to 3.1)	55.3	83.6	51.2 (48.8 to 53.6)	39.6	52.6	32.8 (29.4 to 36.3
دerala ۶	88.9	77.3	-13.0 (-14.8 to -11.3)	99.8	99.7	-0. <b>ヨ</b> .(-0	3 to 0.1)	84.2	91.5	8.7 (6.7 to 10.6)	75.7	72.9	-3.7 (-6.3 to -1.1
Vaharashtra f	69.3	66.7	-3.8(-5.5 to -2.0)	83.9	88.2	521 (4	0 to 6.2)	74.2	80.8	8.9 (7.4 to 10.4)	50.0	54.5	9.0 (6.4 to 11.6
Jelhi (	68.8	75.3	9.4 (5.5 to 13.3)	86.0	90.2	4 <u>9</u> 9 (2	6 to 7.2)	59.1	85.1	44.0 (39.3 to 48.7)	42.7	65.3	52.9 (46.2 to 59.7
Punjab é	64.6	54.7	-15.3 (-17.8 to -12.8)	91.1	92.9	2 0 (1	0 to 3.0)	86.9	85.4	-1.7 (-3.0 to -0.4)	55.5	46.9	-15.5 (-18.5 to -12.5
ramil Nadu	77.5	89.6	15.6 (14.2 to 17.0)	98.4	99.2	0.58 (0.58)	5 to 1.1)	68.4	90.4	32.2 (30.4 to 33.9)	56.4	82.0	45.4 (43.0 to 47.7
relangana -	71.8	68.2	-5.0 (-8.0 to -2.0)	85.6	90.4	5,46 (3	7 to 7.6)	79.9	85.4	6.9 (4.5 to 9.3)	55.7	54.9	-1.4 (-5.7 to 2.8
Nest Bengal	69.4	72.2	4.0 (1.9 to 6.2)	71.3	89.2	25.1 823.	to 27.1)	58.0	63.8	10.7 (7.3 to 12.7)	42.0	47.3	12.6 (8.8 to 16.4

Supplementary Table 3. Human Opportunity Index for geographic inequality for four of more antenatal care (ANC) visits, institutional delivery with skilled birth attendant (SBA), post-natal care within 48 hours of delivery and continuum of care for the most recent livebirth in the last 5 years in the National Family Health Survey (NFHS) round s 4 and 5 for India and its states. CI denotes confidence interval.

	Ra	Open:			
	Four of more antenatal care visits	Institutional delivery with skilled birth attendant	Post-natal care within 48 hours of delivery	Continuum of care	
India	0.52	0.69	0.73	0.3 <b>&amp;</b>	
Less developed states	0.55	0.69	0.74	0.41	
Arunachal Pradesh	0.43	0.58	0.70	<b>⊕</b> .38 <sup>8</sup>	
Assam	0.63	0.75	0.79	<b>8</b> .52 <b>2</b>	
Bihar	0.32	0.72	0.71	<mark>ھ</mark> .25 ھ	
Chhattisgarh	0.89	0.72	0.93	<u>.</u> 70g	
Jharkhand	0.51	0.64	0.81	<b>8</b> .3@	
Madhya Pradesh	0.72	0.83	0.91	¥.60 <sup>4</sup>	
Manipur	0.40	0.40	0.48	ig.302	
Meghalaya	0.66	0.47	0.88	<u>4</u> .50	
Mizoram	0.16	0.28	0.36	0.123	
Nagaland	0.27	0.35	0.47	<b>din</b> .06	
Odisha	0.84	0.81	0.94	<b>8</b> .69	
Rajasthan	0.77	0.92	0.92	<b>9</b> .73	
Sikkim	1.41	0.94	1.17	ä.27€	
Tripura	0.81	0.79	0.68	ater diti	
Uttar Pradesh	0.60	0.76	0.80		
Uttarakhand	0.51	0.68	0.81		
More developed states	0.83	0.80	0.76		
Andhra Pradesh	0.66	0.75	0.73		
Goa	1.07	1.01	1.01		
Gujarat	0.79	0.83	0.96		
Haryana	0.52	0.67	0.70	19.39t	
Himachal Pradesh	0.70	0.60	0.77	<b>a</b> .49 <b>B</b>	
Jammu and Kashmir	0.76	0.74	0.78	<b>2</b> .61	
Karnataka	0.75	0.90	0.91	<b>រ</b> .64	
Kerala	0.95	1.00	0.89	<b>1</b> .95	
Maharashtra	0.68	0.73	0.78	<b>D</b> .5 <b>1</b>	
Delhi	0.34	0.24	0.36	<b>6</b> .02	
Punjab	0.54	0.84	0.80	<b>9</b> .5 <b>%</b>	
Tamil Nadu	1.01	0.96	0.94	<b>ឆ្</b> .96	0.01-1.00
Telangana	0.78	0.83	0.89	<b>ģ</b> .63 <b>2</b>	1 10-1 40
West Bengal	0.85	0.90	0.70	₹.5Æ	1.10-1.49

Supplementary Table 4. Ratio of Human opportunity index (HOI) between wealth index quintiles I and V for the maternal services for India and its states, National Family Health Survey-5.

Ratio of HOI	
Less than 0.50	
0.51-0.89	

0.90-1.09
1.10-1.49
1.50 or more

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