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Utilization Patterns of Maternal Health Care: Balancing Equity and Quality between Public and Private Providers

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Abstract

Socioeconomic inequality in maternal healthcare utilization is well-established in India, but equity across public and private facilities remains underexplored. This study examines the equitable provision and utilization of maternal healthcare services across public and private sectors. The present study utilized multiple rounds of National Family Health Survey (NFHS-1 to NFHS-5) data for analysis. Multinomial logistic regression was employed to analyze the association between maternal healthcare choices and socioeconomic variables, while the concentration index quantified rank-related socioeconomic inequalities. Findings reveal a substantial shift in the utilization of public sector services for antenatal care (ANC) and institutional deliveries over the survey rounds, particularly in urban areas. The distribution of public sector utilization shifted significantly from favoring wealthier groups in NFHS-1 to benefiting economically disadvantaged populations by NFHS-5. Conversely, private sector usage remained largely stagnant for deliveries, with persistent pro-rich disparities. The concentration index values underscore evolving income-related inequalities in access to these services, highlighting gains in public sector equity alongside sustained inequality in private healthcare utilization. These findings emphasize the need for evidence-based policies targeting regional and socioeconomic discrepancies, ensuring equitable delivery of high-quality maternal healthcare services. Addressing such gaps will help optimize health outcomes for mothers and children across all segments of society.

Keywords

Maternal health care, utilization, equity, private facility, public facility

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Introduction

Maternal healthcare services play an indispensable role in monitoring and improving the health of mothers and reducing the risk of maternal mortality and complications during childbirth. Ensuring access to affordable and accessible maternal healthcare services, including antenatal care, skilled birth attendance, facility-based delivery, and postnatal care, is crucial for preventing maternal mortality and morbidity. These services are critical for women of reproductive age across diverse social, economic, and cultural backgrounds, contributing to overall maternal well-being and better health outcomes for both mothers and newborns (Benova et al., 2018; Oburota et al., 2023; Pathak et al., 2010). Despite their importance, the utilization of maternal healthcare services continues to exhibit significant inequities globally.

Numerous studies have documented disparities in maternal healthcare utilization across different socioeconomic and geographic contexts. In Ghana, for instance, wealthier individuals are more likely to access skilled attendance at birth and facility-based deliveries, even in publicly funded systems, underscoring inequitable government health spending (Zere et al., 2012). Similarly, in Vietnam, barriers such as physical distance to healthcare facilities, lack of transportation, and inadequate accommodation for women and their families contribute to the underutilization of maternal health services among ethnic minority groups (Goland et al., 2012). In Nepal, employment status emerged as a key determinant, with working women being less likely to seek maternity care due to time constraints (Shrestha et al., 2014).

In India, the National Rural Health Mission (NRHM) program was introduced to improve the availability, accessibility, and affordability of healthcare services, particularly for underserved populations. However, evidence on its long-term effectiveness and equity remains limited (Pathak et al., 2010). Across other nations, socioeconomic inequalities persist, such as the rise in disparities in antenatal care visits in Bangladesh and barriers framed within the three delays model in Namibia, which highlights delays in decision-making, reaching healthcare facilities, and receiving appropriate care (Pulok et al., 2020; Zere et al., 2010). These patterns suggest systemic challenges that exacerbate inequities in maternal health care utilization.

Despite improvements in certain regions, inequities in maternal health services continue to persist. In Turkey, unequal access to maternal and child health care stems from factors such as regional disparities, urban-rural divides, and variations in educational attainment (Santas et al., 2018). Ethiopia highlights another facet of inequity, where only highly empowered women benefit from

maternal health services, reflecting the need to address rising healthcare costs and systemic inequities (Shibre et al., 2023). In Benin, socioeconomic factors such as educational attainment, age, wealth quintile, and media exposure were identified as critical for improving maternal health service utilization (Yaya et al., 2018). Additionally, the quality of care emerged as a significant concern, with better-off individuals accessing superior services, further deepening the equity gap in Nepal (Målqvist et al., 2017).

Addressing these inequities requires an integrated approach that tackles both demand- and supply-side barriers. This involves enhancing accessibility, affordability, and quality of maternal health care services, particularly for marginalized and vulnerable populations. Methodologically, measures like the concentration index have been employed to evaluate socioeconomic rank-related inequalities in healthcare access. These insights underscore the importance of robust, data-driven strategies to ensure equitable maternal healthcare delivery worldwide.

Henceforth, the objective of this study is to examine the socioeconomic rank-related inequalities in the provision and utilization of maternal health care services across private and public facilities in India. This study specifically analyses the trends and patterns in maternal healthcare utilization among ever-married women in India over a three-decade period from 1992 to 2021.

Data and methodology

Data Source

This study draws on data from the National Family Health Survey (NFHS), India's Demographic and Health Survey (DHS), conducted between 1992-93 (NFHS-1) and 2019-2020 (NFHS-5). The NFHS is a nationally representative, cross-sectional household survey implemented by the International Institute for Population Sciences (IIPS) under the Ministry of Health and Family Welfare (MoHFW), Government of India. The survey collects data from women aged 15-49 years, providing critical insights into fertility, family planning practices, reproductive health, maternal and child healthcare, and the quality and utilization of health services across India's states and union territories.

For this study, the analysis was restricted to ever-married women aged 15-49 who had a live birth within the three years preceding each survey. This approach ensures consistency in the evaluation of maternal healthcare indicators, such as institutional delivery and antenatal care (ANC). The survey design, sampling methodology, and weighting procedures are thoroughly detailed in the NFHS round-specific reports, which ensure the

robustness and generalizability of the findings.

The number of women interviewed across NFHS rounds was 89,770 (NFHS-1), 91,000 (NFHS-2), 124,385 (NFHS-3), 699,686 (NFHS-4), and 724,115 (NFHS-5). Women meeting the inclusion criteria for institutional delivery were 32,416 (NFHS-1), 28,923 (NFHS-2), 27,038 (NFHS-3), 138,075 (NFHS-4), and 123,830 (NFHS-5). For at least four ANC visits, eligible women numbered 11,959 (NFHS-3), 64,478 (NFHS-4), and 70,703 (NFHS-5). This structured and comprehensive data serves as the foundation for analyzing maternal healthcare utilization trends and patterns over time.

Outcome Variable

In the study, two outcome variables were used to measure the utilization of maternal health care:

Facility-Based Antenatal Visits (ANC): Women who received at least four antenatal care visits during their last live births were categorized based on the location of services. The services were categorized based on the facility type:

- *Public Facility*: Women receiving four or more ANC services at public healthcare facilities, such as public hospitals, government dispensaries, urban health centers (UHC), urban health posts (UHP), urban family welfare centers (UFWC), community health centers (CHC), rural hospitals, block primary health centers (PHC), primary health centers (PHC), additional primary health centers, sub-centers, or other public sectors.
- *Private Facility:* Women receiving four or more ANC services at private hospitals, maternity homes, clinics, or other private sectors.
- *Others:* Women receiving ANC services at alternative locations (home, parents' residence, NGO/trust facilities).

Delivery Facility: This variable captured the location of childbirth, categorized as follows:

- *Public Facility:* Deliveries conducted in public healthcare institutions, such as public hospitals, government dispensaries, urban health centers (UHC), urban health posts (UHP), urban family welfare centers (UFWC), community health centers (CHC), rural hospitals, block primary health centers (PHC), primary health centers (PHC), additional primary health centers, sub-centers, or other public sectors.
- *Private Facility:* Deliveries conducted in private hospitals, maternity homes, clinics, or other private sectors.
- *Others:* Deliveries conducted at alternative locations (home, parents' residence, NGO/trust facilities).

These outcome variables were employed to evaluate the patterns of maternal

healthcare service utilization across public and private healthcare facilities, as well as non-public settings, among women who had given birth within the three years preceding the survey.

Independent variables: To explore the broader context, various independent variables corresponding demographic and socioeconomic factors were examined. These included age groups (15-24, 25-34, 35+), place of residence (rural/urban), educational attainment (illiterate, primary, secondary, higher), and economic status (wealth quintiles ranging from poorest to richest).

Statistical analysis: The analytical approach incorporated multiple statistical methods:

- ***Descriptive Statistics:*** Weighted frequencies and percentages were employed to evaluate trends in ANC utilization and institutional deliveries across the five survey rounds (NFHS-1 to NFHS-5). These trends were stratified by demographic and socioeconomic characteristics to identify shifts over time.
- ***Concentration Index:*** Socioeconomic inequalities to assess socioeconomic inequality in maternal healthcare utilization across public, private, and other sectors, were quantified using the Concentration Index (CI), which measures the extent of wealth-related disparities in maternal healthcare utilization. A CI value of 0 indicates perfect equality, while values closer to ±1 reflect greater inequality, with positive values denoting pro-rich tendencies and negative values indicating pro-poor trends. The CI is defined as:

$$\mathrm{CI} = \frac{2}{\mu} cov(yj, Rj)$$

Where Yj and Rj are the public, private, and other sectors, and fractional rank (in terms of wealth status) with the best well-off individual ranked first and least well-off ranked last of jth individual, respectively; μ is the mean of the outcome variable, and cov is the covariance. (O'Donnell et al., 2007; O'donnell et al., 2016) The study also reports the p-value and confidence interval for each survey year.

- ***Multinomial Logistic Regression:*** To analyze the changes in maternal healthcare utilization, multinomial logistic regression was used, comparing the likelihood of choosing public or private facilities against home-based care. By pooling data from all five NFHS rounds, the regression offered insights into evolving patterns over nearly three decades.

All statistical analyses were conducted using STATA Version 14, ensuring robust and reliable results. This methodological framework allows for a detailed assessment of how maternal healthcare practices have evolved across various

socioeconomic groups, providing valuable insights for healthcare policy and service delivery improvements.

Results

Trends in the utilization of institutional delivery and antenatal care from different channels

The pattern in institutional delivery and antenatal care from different channels of ever-married women in India during 1992-2021 is shown in **table 1**. Over the years, there has been a steady rise in the usage of delivery services provided by the public and private sectors. During NFHS-1, the utilization of public sector services was 14.72%, which increased to 62.51% in NFHS-5. Similarly, in NFHS-1, the utilization of private sector services was 11.43%, which rose to 27.61%. In contrast, there was a decrease in the proportion of births occurring in the other sector. The proportion of 4+ANC increased from 37% in NFHS-3 to 62% in NFHS-5. The utilization of 4+ antenatal care (ANC) services consistently increased in public and other sectors. 4+ ANC utilization increased from 9.87% in NFHS-3 to 28.25% in NFHS-5. However, in the private sector, it initially increased from 24.49% in NFHS-3 to 32.13% in NFHS-4 and subsequently decreased in NFHS-5 by 28.3%.

Table 1. Maternal health care services utilization among currently married women (15-49 years) in India, 1992–2021

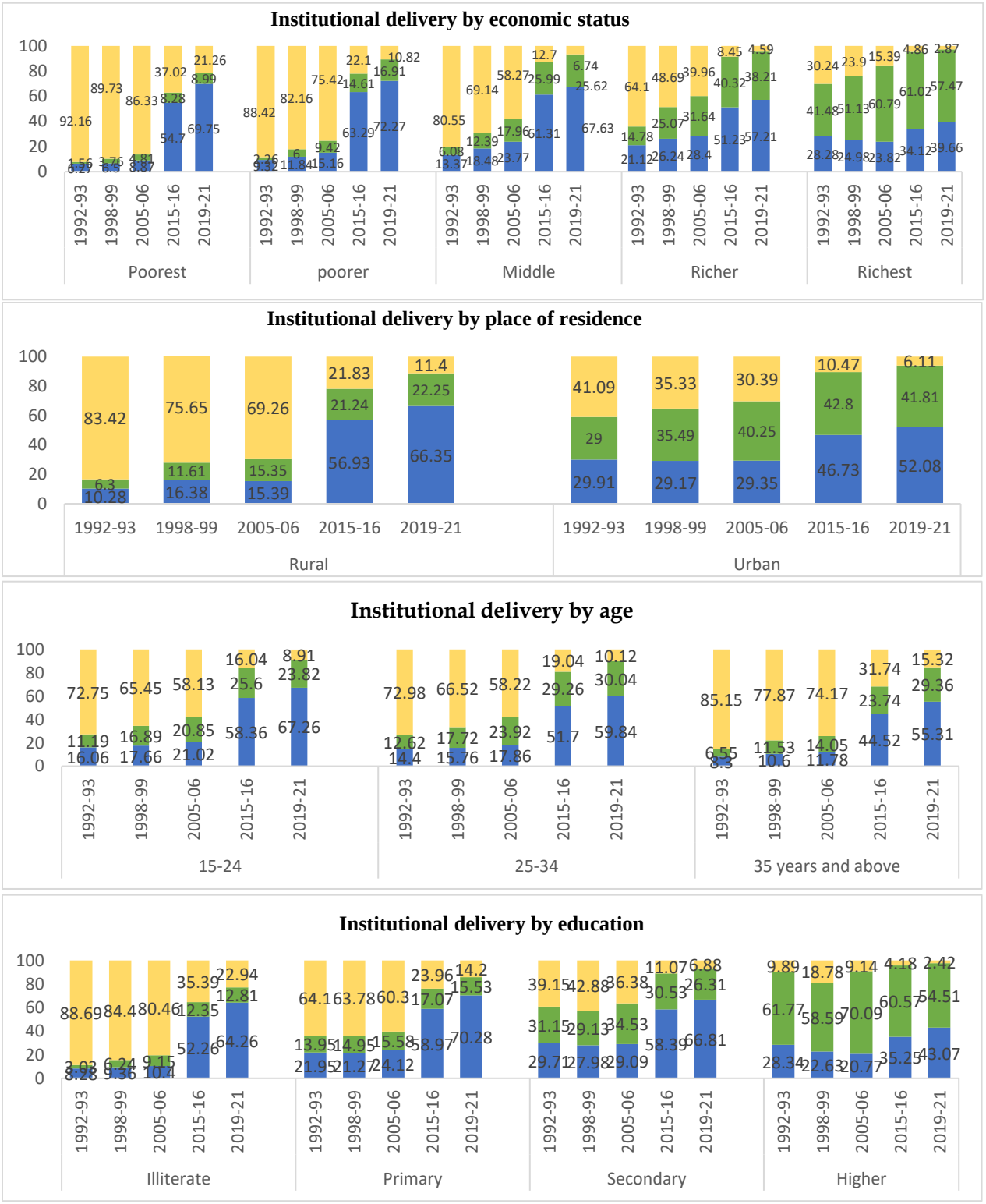
	1992-93	1998-99	2005-06	2015-16	2019-21
N (Total sample)	**32,416**	**28,923**	**27,038**	**1,38,075**	**1,23,830**
Delivery care					
Public sector	14.72	16.38	18.97	54.04	62.51
Private sector	11.43	16.89	21.74	27.35	27.51
Other	73.86	66.74	59.3	18.61	9.97
N (Total sample)			**16,619**	**89,438**	**1,01,009**
4+ ANC					
Total			36.99	61.32	62.01
Public sector			9.87	24.18	28.25
Private sector			24.49	32.13	28.3
Other			2.64	5.01	5.47

Note: Other includes –NGO or trust facilities, their own home, parents' home, others' home, and other non-public/private locations. Data on ANC care were not available in NFHS-1 (1992-93), and NFHS-2 (1998-99) by type of sector.

Trends in the utilization of institutional delivery and antenatal care from different channels according to background characteristics

The utilization of various delivery services (Public, Private, Others) by different background characteristics of ever-married women during different periods (1992-2021) is represented in **Figure 1**. Across all age groups, there has been a substantial shift from utilizing "Other" sector delivery services towards both public and private sectors. NFHS-5 revealed a noteworthy rise in public sector utilization for childbirth across age groups. In the 15-24 range, public sector utilization increased from 16.06% (NFHS-1) to 67.26%. Similarly, for the 25-34 group, it grew from 14.4% to 59.84%; for those 35 and above, it rose from 8.3% to 55.31%. Private sector use followed trends: for 15-24, it rose from 11.19% (NFHS-1) to 25.6% (NFHS-4), then dipped to 23.82% (NFHS-5). Likewise, 25-34 increased from 12.62% (NFHS-1) to 30.04% (NFHS-5), and 35+ went up from 6.55% (NFHS-1) to 29.36% (NFHS-5). "Other" services declined: 15-24 dropped to 8.91%, 25-34 to 10.12%, and 35+ to 15.32% in NFHS-5. In both rural and urban settings, there was a shift towards using formal healthcare services for childbirth over time. In rural, public-sector utilization increased significantly from 10.28% (NFHS-1) to 66.35% (NFHS-5). In urban areas, public-sector utilization remained stable and private-sector utilization showed growth, while rural private-sector utilization rose from 6.3% (NFHS-1) to 22.25% (NFHS-5). Public sector utilization grew significantly across education levels, indicating improved awareness and access to formal healthcare. Among the Illiterate, it rose from 8.28% (NFHS-1) to 64.26% (NFHS-5). For Primary education, it increased from 21.95% to 70.28%. In Secondary education, it went up from 29.71% to 66.81%. Higher education increased from 28.34% to 43.07% (NFHS-1 to NFHS-5), with a preference for private healthcare. Meanwhile, there was a decline in the utilization of "Other" delivery services over time. Public sector utilization rose significantly for the poorest, from 6.27% (NFHS-1) to 69.75% (NFHS-5), and for the poorer, from 9.32% to 72.27%. In the middle economic status, it increased from 13.37% to 67.63%. In the wealthier group, there was a partial shift from 21.12% (NFHS-1) to 57.21% (NFHS-5). Among the richest, there was a slight decrease from 28.28% to 39.66%, indicating a move towards private healthcare. The utilization of antenatal care services (Public, Private, Others) by different background characteristics of ever-married women during different periods (1992-2021) is demonstrated in **Figure 2**. The public sector saw consistent ANC utilization across age groups over time. In the 15-24 age group, utilization remained stable at 27.47% (NFHS-3) to 27.38% (NFHS-5).

Figure 1. Institutional delivery (%) trend, by type of facility, by socio-economic indicators in India, 1992–2021



A minor decrease occurred in the 25-34 range of 40.84% (NFHS-3) to 42.78% (NFHS-5). For those 35+, usage stayed consistent at 45.11% (NFHS-3) to 45.87% (NFHS-5).

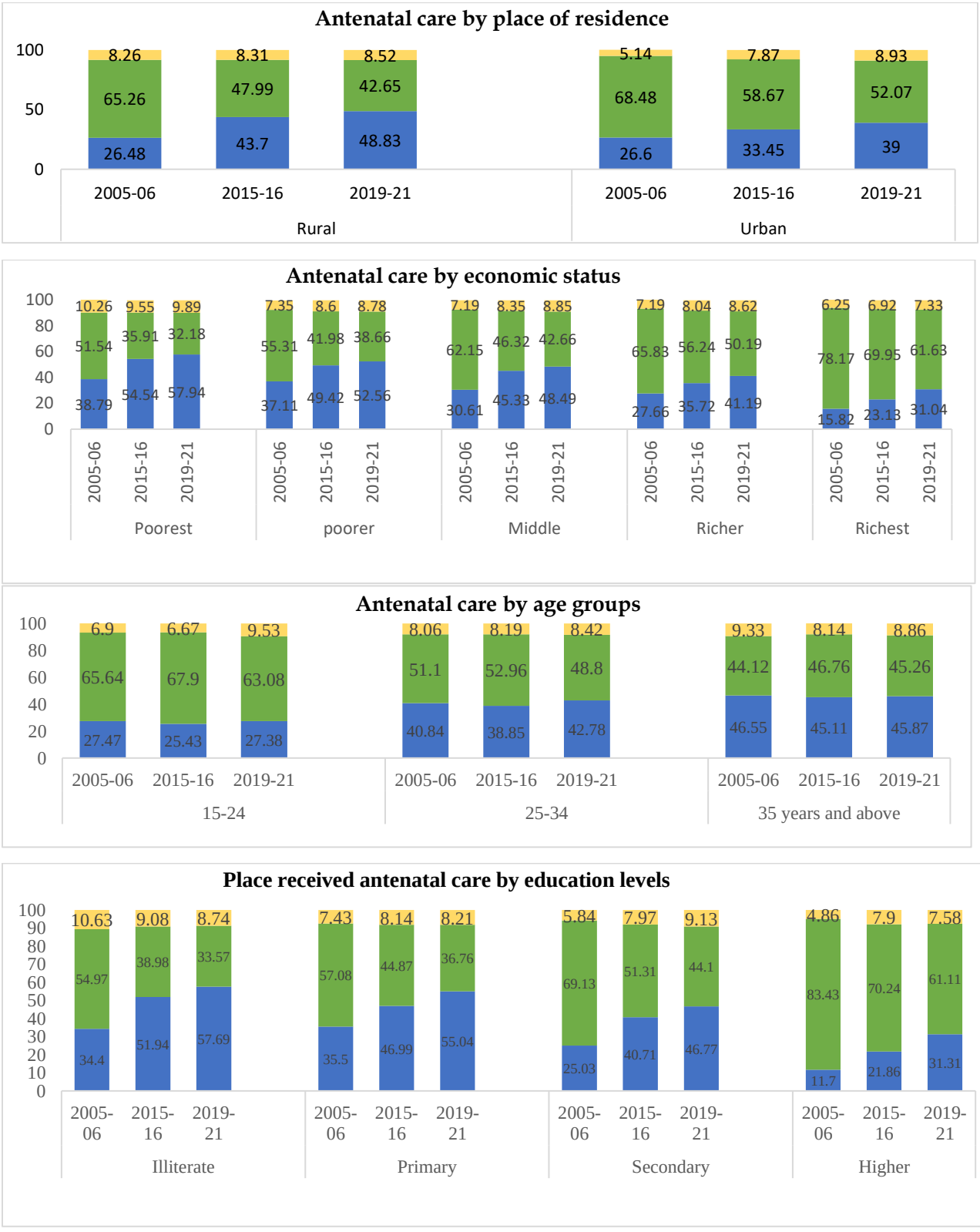
Private sector trends varied for ANC. In the 15-24 group, consistently high utilization was 65.64% (NFHS-3) to 63.08% (NFHS-5). There was a slight increase in the 25-34 group from 51.1% (NFHS-3) to 52.96% (NFHS-4), followed by a decrease of 48.8% (NFHS-5). "Other" sector utilization grew for younger age groups 15-24, 6.9% (NFHS-3) to 9.53% (NFHS-5), and a 25-34 slight increase. Consistent utilization for the 35+ groups was found. There has been a noticeable increase in the use of formal healthcare services for antenatal care (ANC) in rural and urban areas. This is evident in the rising public sector usage. Rural usage increased from 26.48% (NFHS-3) to 48.83% (NFHS-5), while urban areas showed a similar but lower trend. Private sector usage declined in both rural 65.26% (NFHS-3) to 42.65% (NFHS-5) and urban 68.48% (NFHS-3) to 52.07% (NFHS-5) areas, suggesting a reduced preference.

ANC utilization in the "Others" sector remained stable, with minor fluctuations across rural and urban regions. As private sector usage declined, ANC utilization shifted to the public sector across education levels. "Other" sector utilization remained stable. Higher-educated individuals had lower public sector use but increased from 11.7% (NFHS-3) to 31.31% (NFHS-5). Private sector use declined from 83.43% (NFHS-3) to 61.11% (NFHS-5). In the "Others" sector, ANC use was low among highly educated people (4.86% to 2.87%). Lower-educated favored the public sector; illiterate increased from 34.4% to 57.69%, mirrored by primary and secondary levels. Private sector use decreased across education levels, favoring the public sector. Public-sector ANC utilization consistently rose across all wealth quintiles over the years. In the poorest quintile, usage increased from 38.79% (NFHS-3) to 57.94% (NFHS-5), reflecting trends in other quintiles. Simultaneously, private-sector ANC utilization declined across all quintiles. In the poorest quintile, utilization dropped from 51.54% to 32.1 (NFHS-3 to NFHS-5), mirroring patterns in other wealth groups. The use of ANC in the "Others" category remained consistently stable, and there were no significant changes in the utilization rates over time.

Concentration index

The Concentration Index (CI) measures socioeconomic inequalities in public, private, and "Other" sector delivery care utilization over NFHS-1 to NFHS-5 is shown in **Table 2**. The CI ranged from 0.29 to -0.09 in the public sector. Initially, a positive CI (0.29) indicated pro-rich inequality in access, yet this inequality decreased, reaching a negative CI (-0.09) in NFHS-5.

Figure 2. Antenatal care (%) trend, by type of facility, by socio-economic indicators in India, 1992–2021



Public | Private | Other

This shift signifies improved access for lower socioeconomic backgrounds, reducing initial inequality. For private-sector delivery care, CI ranged from 0.57 to 0.33. Despite CI decrease over time, wealthier individuals maintained. higher utilization, maintaining pro-rich inequality. Within the "Other" sector, CI ranged from -0.15 to -0.36. Negative CI values indicate pro-poor inequalities, intensifying over time and favoring individuals of lower socioeconomic status. CI values for socioeconomic inequalities in 4+ ANC utilization within the public sector ranged from -0.17 (NFHS-3) to -0.11 (NFHS-5), indicating pro-poor inequalities, favoring lower socioeconomic backgrounds. In the private sector, CI values ranged from 0.07 (NFHS-3) to 0.12 (NFHS-4 and NFHS-5), indicating pro-rich inequalities favoring higher socioeconomic status. Negative CI values in the "Other" sector suggest pro-poor inequalities in 4+ ANC service utilization, benefiting lower socioeconomic backgrounds.

Pooled multinomial regression results of maternal health care service utilization in public and private facilities vs. home-based facilities in ever-married women

The outcomes of pooled logistic regression examining the utilization of specific maternal health care services among ever-married women, categorized by the Public and Private sectors compared to home-based care is displayed in **Table 3**. The findings demonstrate notable changes in birth preferences over time, as reflected by increased relative-risk ratios (RRR) for choosing private and public healthcare facilities over home-based births. In NFHS-5, selecting a public facility for childbirth over home births had a RRR of 27.72 (95% CI [26.66-28.82]), while choosing private facilities had a RRR of 19.33 (95% CI [18.41-20.29]) compared to NFHS-1. In the age groups of 23-34 and 35 years and above, the likelihood of utilizing both public and private facilities for childbirth diminished. Urban area residents displayed a 1.59-fold higher likelihood (RRR=1.59, 95% CI [1.54-1.64]) of opting for private facilities and a 1.46-fold higher likelihood (RRR=1.46, 95% CI [1.42-1.49]) of selecting public facilities compared to rural areas. Higher education and economic status significantly increased the likelihood of utilizing public and private facilities. For instance, those with higher education levels showed an 8.28-fold higher likelihood (RRR=8.28, 95% CI [7.83-8.75]) of choosing private facilities and a 3.57-fold higher likelihood (RRR=3.57, 95% CI [3.38-3.78]) of opting for public facilities. Women from the wealthiest group had a 24.80-fold higher likelihood (RRR=24.80, 95% CI [7.83-8.75]) of utilizing private facilities compared to the poorest group. Conversely, they displayed a 3.79-fold higher likelihood (RRR=3.79, 95% CI [3.62-3.96]) of utilizing public facilities.

Table 2. Concentration index values (p-value) for socioeconomic inequalities in delivery care and antenatal care by type of sector in India, 1992–2021

	1992-93		1998-99		2005-06		2015-16		2019-21	
	CI	95% CI	CI	95% CI	CI	95% CI	CI	95% CI	CI	95% CI
Delivery care										
Public sector	0.29(0.000)	[0.26—0.31]	0.26(0.000)	[0.23—0.28]	0.20(0.000)	[0.18—0.22]	-0.06(0.000)	[-0.06— (-0.05)]	-0.09(0.000)	[-0.09— (-0.08)]
Private sector	0.57(0.000)	[0.53—0.61]	0.48(0.000)	[0.45—0.51]	0.45(0.000)	[0.43—0.47]	0.36(0.000)	[0.35—0.37]	0.33(0.000)	[0.32—0.34]
Other	-0.15(0.000)	[-0.15— (-0.14)]	-0.18(0.000)	[-0.19— (-0.18)]	-0.23(0.000)	[-0.24— (-0.22)]	-0.35(0.000)	[-0.36— (0.34)]	-0.36(0.000)	[-0.38— (-0.35)]
4+ ANC										
Public sector					-0.17(0.00)	[-0.20— (-0.14)]	-0.15(0.000)	[-0.16— (-0.14)]	-0.11(0.000)	[-0.12— (-0.10)]
Private sector					0.07(0.000)	[0.06—0.09]	0.12(0.000)	[0.12—0.13]	0.12(0.000)	[0.11—0.13]
Other					-0.07(0.000)	[-0.13— (-0.01)]	-0.05(0.000)	[-0.08— (-0.03)]	-0.05(0.000)	[-0.07— (-0.02)]

Note: Other includes –NGO or trust facilities, their own home, parents' home, others' home, and other non-public/private locations; CI: Concentration index

Data on ANC care were not available in NFHS-1 (1992-93) and NFHS-2 (1998-99) by type of sector.

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Table 3. Pooled multinomial logistic regression-based relative-risk ratios for selected background characteristics of public and private sector vs home/other based births and 4+ ANC in India,1992-2021

	Institutional delivery				4+ ANC			
	Private facility		Public facility		Private facility		Public facility	
Background Characteristic	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**	**RRR**	**95% CI**
Survey round								
NFHS-1(Ref.)								
NFHS-2	1.44***	[1.36-1.52]	1.26***	[1.20-1.32]	–	–	–	–
NFHS-3	2.35***	[2.22-2.47]	1.81***	[1.74-1.89]	–	–	–	–
NFHS-4	10.61***	[10.13-11.11]	13.70***	[13.21-14.21]	0.77***	[0.72-0.84]	1.56***	[1.44-1.69]
NFHS-5	19.33***	[18.41-20.29]	27.72***	[26.66-28.82]	0.80***	[0.73-0.87]	1.87***	[1.72-2.03]
Age								
15-24 (Ref.)								
25-34	0.87***	[0.85-0.89]	0.86***	[0.84-0.87]	1.01	[0.96-1.06]	1.18***	[1.13-1.23]
35 and above	0.69***	0.66-0.72	0.63***	[0.61-0.65]	0.99	[0.91-1.09]	1.28***	[1.17-1.39]
Residence								
Rural (Ref.)								
Urban	1.59***	[1.54-1.64]	1.46***	[1.42-1.49]	1.06*	[1.01-1.12]	1	[0.95-1.06]
Education								
Illiterate (Ref.)								
Primary	1.42***	[1.37-1.48]	1.46***	[1.43-1.51]	1.13**	[1.03-1.22]	1.10***	[1.01-1.19]
Secondary	2.77***	[2.69-2.86]	2.34***	[2.29-2.39]	1.17***	[1.10-1.25]	1.02	[0.96-1.09]
Higher	8.28***	[7.83-8.75]	3.57***	[3.38-3.78]	1.46***	[1.34-1.59]	0.74***	[0.68-0.80]
Economic Status								
Poorest (Ref.)								
poorer	2.18***	[2.09-2.27]	1.45***	1.42-1.49	1.34***	[1.25-1.44]	1.06	[0.99-1.14]
Middle	4.67***	[4.48-4.87]	2.05***	1.99-2.11	1.52***	[1.41-1.63]	0.98	[0.91-1.05]
Richer	9.87***	[9.44-10.32]	2.78***	2.68-2.87	1.83***	[1.68-1.97]	0.89**	[0.82-0.96]
Richest	24.80***	[23.51-26.17]	3.79***	3.62-3.96	2.29***	[2.10-2.49]	0.70***	[0.64-0.76]

Note: Home/ other sector is taken as reference category for the regression analysis
Ref.: reference category
*p<0.05; **p<0.01; ***p<0.001 Data on ANC care were not available in NFHS-1 (1992-93), and NFHS-2 (1998-99) by type of sector.

The study reveals that various factors, including survey round, Age, education, and economic status, significantly influence the relative likelihood of choosing private and public healthcare facilities over home-based ANC care in India from NFHS-3 to NFHS-5. In NFHS-4 and NFHS-5, women were less likely to use private facilities than in NFHS-3, while they were 1.87-fold more likely to use public facilities for 4+ ANC services in NFHS-5. Women aged 23-34 and 35 years and above exhibited a slightly increased likelihood of utilizing public facilities for 4+ ANC. Private facility utilization was slightly higher, at 1.06 times for 4+ANC in women who reside in urban. Women with higher education were 1.46 -fold more likelihood (RRR= 1.46, 95% CI [1.34-1.59]) to utilize private facilities, whereas they were 36% less likely (RRR= 0.74, 95% CI [0.68-0.80]) to utilize a public facility for 4+ ANC. Among the wealthiest economic status category, there was a 2.29-fold higher likelihood (RRR= 2.29, 95% CI [2.10-2.49]) of utilizing private facilities for 4+ ANC care and a 30% lower likelihood (RRR= 0.70, 95% CI [0.64-0.76]) of utilizing public facilities.

Additionally, detailed supplementary analyses are provided in the appendices. Appendix Table 1 presents a comprehensive breakdown of four or more ANC visits utilization patterns across public, private, and other healthcare sources, stratified by socioeconomic characteristics from 2005 to 2021. This is complemented by Appendix Table 2, which provides an extended temporal analysis (1992-2021) of institutional delivery patterns across different healthcare sectors, similarly stratified by socioeconomic characteristics. These supplementary tables provide additional granularity to our main findings and support the observed trends in maternal healthcare utilization across different facility types and socioeconomic groups. (See *Appendix Tables 1 and 2* for detailed information).

Discussion

This study provides compelling evidence of the evolving landscape of maternal healthcare utilization in India over three decades (1992-2021), highlighting both achievements and persistent challenges in healthcare equity.

Transformation in Public Sector Utilization: A remarkable finding is the substantial increase in public sector facility utilization for institutional deliveries, rising from 14.72% (NFHS-1) to 62.51% (NFHS-5), and ANC services, increasing from 9.87% (NFHS-3) to 28.25% (NFHS-5). This transformation aligns with findings from similar studies in other developing nations. For instance, research in Bangladesh demonstrated that targeted public health interventions led to a 38% increase in public facility utilization over a decade (Pulok et al., 2020). This study presents promising evidence of the

beneficial effects of public sector investment in enhancing the utilization of institutional delivery care services (Joe et al., 2018).

The success in India can be largely attributed to strategic public sector investments, particularly the financial incentives via the National Rural Health Mission (NRHM) program, which has significantly enhanced healthcare infrastructure and service delivery mechanisms. Incentivization of public sector care could lead to a substitution effect, affecting both private health providers and homebirth practices. Moreover, there remains substantial potential for refining targeting strategies to further amplify the coverage of institutional delivery within the most marginalized segments of the population. Currently, home-based delivery care remains the choice of over a quarter of women hailing from the most economically challenged households. Nonetheless, the post-NRHM period has shown significant strides in reducing the disparity between affluent and disadvantaged individuals in terms of utilizing institutional delivery care services (Bowser et al., 2019; Joe et al., 2018; Lim et al., 2010; Mohanty et al., 2020; Powell-Jackson et al., 2015; Srivastava et al., 2016; Vellakkal et al., 2017)

Equity Improvements and Persistent Challenges: Our analysis reveals a noteworthy shift in public sector delivery care services from being pro-rich (NFHS-1) to pro-poor (NFHS-5), indicating successful efforts in reducing socioeconomic disparities. This finding resonates with recent research in Ethiopia (Shibre et al., 2023) that documented similar improvements in equity following targeted public health interventions. However, our study also identifies persistent pro-rich inequalities in private sector utilization, a pattern consistent with findings from other developing nations. For example, studies in Ghana (Zere et al., 2012) and Vietnam (Goland et al., 2012) reported similar socioeconomic gradients in private healthcare utilization.

It is also essential to emphasize that the use of institutional delivery services in both the public and private healthcare sectors was significantly influenced by women's education, economic level, and residence. This finding is in line with many other previous studies. (Govindasamy & Ramesh, 1997; Joe et al., 2018; Rout et al., 2021; Simkhada et al., 2008; Sohag et al., 2013) Results show that women in the women with higher education and wealth were more likely to select private-sector delivery care services. As suggested by the Concentration Index result, the most significant effect of public sector delivery care services is observed in diminishing relative socioeconomic disparities. The Concentration Index value indicates a trend where women of higher socioeconomic status tend to utilize private facilities for 4+ antenatal care services more frequently. This trend

implies an imbalance in access, revealing that women from lower socioeconomic backgrounds faced unequal opportunities to access vital services.

Although the availability of home-based delivery services has decreased over time, there are still 10% of people who rely on this method. Moreover, the economically disadvantaged group is increasingly able to access these services for birth approximately twenty-one percent. Illiteracy has been identified as a significant risk factor for noninstitutional births, and observations over time indicate a consistent association.

Regional and Socioeconomic Disparities:

Despite overall progress, significant regional disparities persist, particularly between urban and rural areas. This finding aligns with recent research in Nepal (Khatri et al., 2024) that identified substantial urban-rural differences in maternal healthcare access and utilization. Our concentration index analysis reveals that while public sector services have become more equitable, private sector services remain predominantly utilized by higher socioeconomic groups, a pattern also observed in Turkey (Santas et al., 2018) and Namibia (Zere et al., 2010).

Quality of Care Considerations:

A critical aspect emerging from our analysis is the need to consider quality of care alongside utilization patterns. Recent research in Maharashtra, India (Singh et al., 2021) found that perceived quality of care significantly influences facility choice, particularly among economically disadvantaged populations. This suggests that while utilization has improved, quality disparities may persist between public and private facilities.

Policy Implications and Future Directions: Our findings have several important policy implications. First, the success in improving public sector utilization demonstrates the effectiveness of targeted government interventions. However, as noted in recent studies in South Asia (Bhatt & Bathija, 2018), sustained investment in public healthcare infrastructure remains crucial for maintaining and extending these gains. Second, the persistent pro-rich bias in private sector utilization suggests the need for better regulation and potential public-private partnerships to enhance equity in service delivery.

It is important to take into account certain limitations when examining the results of this study. Since data is cross-sectional, it cannot determine the cause-and-effect relationship between variables. The responses for institutional delivery, antenatal care, and age were self-reported recall bias, reporting bias, and unavailability of some information in some survey rounds. One of the major limitations of the study is due to some women receiving ANC services from both public and private sources, there is possible data overlap in the case of receiving four or more antenatal care

visits. Since we have not done a study on the quality of care, we cannot say that improving the quality of care in the public sector is related to equity.

Conclusion

This study highlights significant progress in the utilization of maternal healthcare services in India, particularly through public sector interventions like the National Rural Health Mission (NRHM). The findings underscore a notable reduction in socioeconomic disparities, with increased access to institutional deliveries and antenatal care among economically disadvantaged groups. However, persistent pro-rich inequalities in private sector utilization and regional disparities remain challenges. Policymakers must prioritize equitable access to high-quality maternal healthcare services through targeted, evidence-based strategies to address these gaps and ensure comprehensive maternal health coverage for all population segments.

Declarations

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Ethical declarations

The present study utilizes a secondary dataset available in the public domain for legitimate research purposes with no identifiable information on the survey participants. Hence, there is no requirement for any additional ethical approval.

Consent for publication

Not applicable. No details, images or videos related to individual participants were obtained. In addition, data are available in the public domain.

Competing interests

The authors declare no competing interests.

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Appendix

Appendix 1. Percentage of women who received four or more ANC by public, private, and other sources by selected characteristics in India, 2005–2021

	(NFHS -3) 2005-06			(NFHS -4) 2015-16			(NFHS -5) 2019-21		
Background characteristic	**Public**	**Private**	**Others**	**Public**	**Private**	**Others**	**Public**	**Private**	**Others**
Age									
15-24	27.69	65.31	6.99	40.51	51.39	8.09	46.49	44.07	9.43
25-34	25.57	67.31	7.12	38.61	53.2	8.19	45.22	46.31	8.47
35 and above	29.4	62.35	8.24	40.51	51.11	8.38	44.33	46.73	8.94
Residence									
Rural	26.49	65.09	8.41	43.23	48.48	8.29	48.94	42.39	8.67
Urban	26.91	67.52	5.58	33.37	58.66	7.98	38.69	52.2	9.12
Education									
Illiterate	34.7	54.75	10.55	51.66	39.46	8.88	58.52	32.97	8.51
Primary	35.96	56.25	7.8	47.14	44.47	8.39	54.99	36.32	8.68
Secondary	25.3	68.58	6.12	40.08	51.84	8.08	46.24	44.33	9.43
Higher	10.95	83.79	5.26	21.13	71.17	7.7	30.69	61.83	7.47
Economic Status									
Poorest	38.96	50.78	10.26	54.32	36.12	9.56	58.73	31.13	10.15
poorer	37.69	54.96	7.35	49.38	41.89	8.73	53.1	37.84	9.06
Middle	32.13	60.68	7.19	45.03	46.78	8.2	47.98	42.91	9.11
Richer	27.76	65.05	7.19	35.71	56.44	7.85	41.41	49.88	8.71
Richest	15.92	77.83	6.25	23.14	69.49	7.38	30.59	61.99	7.41

Note: Other includes –NGO or trust facilities, their own home, parents' home, others' homes, and other non-public/private locations.

Data on ANC care was not available in NFHS-1 (1992-93), and NFHS-2 (1998-99) by type of sector.

Appendix 2. Percentage of women who received institutional delivery public, private, and other sources by selected characteristics in India, 1992–2021

	1992-93			1998-99			2005-06			2015-16			2019-21		
Background characteristic	**Public**	**Private**	**Others**	**Public**	**Private**	**Others**	**Public**	**Private**	**Others**	**Public**	**Private**	**Others**	**Public**	**Private**	**Others**
Age															
15-24	16.06	11.19	72.75	17.66	16.89	65.45	21.02	20.85	58.13	58.36	25.6	16.04	67.26	23.82	8.91
25-34	14.4	12.62	72.98	15.76	17.72	66.52	17.86	23.92	58.22	51.7	29.26	19.04	59.84	30.04	10.12
35 and above	8.3	6.55	85.15	10.6	11.53	77.87	11.78	14.05	74.17	44.52	23.74	31.74	55.31	29.36	15.32
Residence															
Rural	10.28	6.3	83.42	16.38	11.61	75.65	15.39	15.35	69.26	56.93	21.24	21.83	66.35	22.25	11.4
Urban	29.91	29	41.09	29.17	35.49	35.33	29.35	40.25	30.39	46.73	42.8	10.47	52.08	41.81	6.11
Education															
illiterate	8.28	3.03	88.69	9.36	6.24	84.4	10.4	9.15	80.46	52.26	12.35	35.39	64.26	12.81	22.94
Primary	21.95	13.95	64.1	21.27	14.95	63.78	24.12	15.58	60.3	58.97	17.07	23.96	70.28	15.53	14.2
Secondary	29.71	31.15	39.15	27.98	29.13	42.88	29.09	34.53	36.38	58.39	30.53	11.07	66.81	26.31	6.88
Higher	28.34	61.77	9.89	22.63	58.59	18.78	20.77	70.09	9.14	35.25	60.57	4.18	43.07	54.51	2.42
Economic Status															
Poorest	6.27	1.56	92.16	6.5	3.76	89.73	8.87	4.81	86.33	54.7	8.28	37.02	69.75	8.99	21.26
poorer	9.32	2.26	88.42	11.84	6	82.16	15.16	9.42	75.42	63.29	14.61	22.1	72.27	16.91	10.82
Middle	13.37	6.08	80.55	18.48	12.39	69.14	23.77	17.96	58.27	61.31	25.99	12.7	67.63	25.62	6.74
Richer	21.12	14.78	64.1	26.24	25.07	48.69	28.4	31.64	39.96	51.23	40.32	8.45	57.21	38.21	4.59
Richest	28.28	41.48	30.24	24.98	51.13	23.9	23.82	60.79	15.39	34.12	61.02	4.86	39.66	57.47	2.87

Note: Other includes –NGO or trust facilities, their own home, parents' home, others' home, and other non-public/private locations.

NFHS-5 revealed a noteworthy rise in public sector utilization for childbirth across age groups. In the 15-24 range, public sector utilization increased from 16.06% (NFHS-1) to 67.26%. Similarly, for the 25-34 group, it grew from 14.4% to 59.84%, and for those 35 and above, it rose from 8.3% to 55.31%. Private sector use followed trends: for 15-24, it rose from 11.19% (NFHS-1) to 25.6% (NFHS-4), then dipped to 23.82% (NFHS-5). Likewise, 25-34 increased from 12.62% (NFHS-1) to 30.04% (NFHS-5), and 35+ went up from 6.55% (NFHS-1) to 29.36% (NFHS-5). "Other" services declined: 15-24 dropped to 8.91%, 25-34 to 10.12% and 35+ to 15.32% in NFHS-5.

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