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Population at Stabilisation in Districts of India

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David Burg

Abstract

A district in India is the lowest administrative unit for governance and for planning and programming development and welfare activities. Estimating district population at stabilisation, therefore, has implication for planning for a sustainable future society. This paper presents, for the first time, estimate of the population at stabilisation in 640 districts of the country as they existed at the 2011 population census, following the population growth modelling approach. The sum of the population at stabilisation in 640 districts of the country closely approximates the most likely upper limit of population growth in India projected by the United Nations. The time when the population of the district stabilises is, however, different in different districts as districts are at distinct stages of population transition. The paper also highlights the inter-district variation in the density of population and male-female balance in the population at stabilisation in each of the 640 districts.

Background

A district, in India, is the third tier of the population and development administration system. Population and development policies India are conceptualised and programmed at the national level, customised at state/Union Territory level but implemented at the district level. The progress of population and development programmes and interventions at state/Union Territory level and national level is simply an aggregation of the progress at the district level. The Constitution of India mandates formation of District Planning Committee in each district to prepare district development plan in recognition of the inter-district diversity in all aspects of population and development with emphasis on the integration of population factors in the development planning process.

The only source of data about population and other demographic characteristics in India is the population census. India had the unbroken series of decennial population since 1881 through 2011. This unbroken series is now broken as the 2021 decennial population census could not be carried out because of the COVID-19 pandemic. In the absence of the 2021 population census, demographers, planners, and other stakeholders face the challenge of estimating the growth of district population. The usual approach to project district population beyond 2011, the last population census, is to apply the

population growth rate during 2001-2011 in each district to estimate population beyond 2011. This approach, however, does not reflect the complex empirical reality as the population growth rate may have changed with time. Estimating and projecting the population size and ascertaining the growth of population at the district level, however, is important for district level population and development planning and for monitoring the progress of the implementation of development and welfare activities.

In the absence of the 2021 decennial population census, attempts have been made in recent years to forecast or project district population beyond 2011 (Chaurasia, 2023; Dhar, 2022; ESRI India, 2023). These attempts have followed different approaches. Chaurasia (2023) has followed the modelling approach in which the population growth pattern in the district during 1951-2011 is modelled using the logistic growth curve and the resulting model has been used to forecast the population of the district for different years of the period 2011-2041. Dhar (2022), on the other hand, has used the ratio method (Smith et al, 2013) which expresses the population of a district as a proportion of the population of the country or the state/Union Territory to which each district belongs. The method used by Dhar (2022) apportions the population of the country projected by the Government of India after the 2011 decennial population census (Government of India, 2020) to estimate the population of districts for the period 2011-2036. The ESRI India (2023), on the other hand, has used the ratio of population change method to estimate district population with the population of the population projected by the Government of India as the reference. Verma (2023) has reviewed these three approaches of forecasting or projecting district population in India and has recommended the approach adopted by Chaurasia (2023) for forecasting or projecting district population as the approach is based on historical data on district population growth.

An advantage of the approach followed by Chaurasia (2023) is that it permits to obtain an estimate of the population of the district at stabilisation. Estimating the population at stabilisation is important for understanding the implications of long-term population growth for the economic and social well-being as well as safeguarding the environment at the district level. It is well-known that the environment that sustains the life on the planet Earth is being endangered primarily by human-driven processes and their synergistic interactions (Brooks et al, 2008). It is, therefore, imperative that the population at stabilisation in the districts is estimated to plan for a sustainable future society. Population stabilises when it stops growing. The upper limit of population size, therefore, is the population size at stabilisation. There has yet to be an attempt to estimate population at stabilisation in districts of India. The National Population Policy 2000 of India envisions stabilising population growth by the year 2045 at a level consistent with the requirements of sustainable economic growth, social development, and environmental protection by achieving the replacement fertility by the year 2010 (Government of India, 2000). The Policy is, however, silent about the size of the population at stabilisation. The population projections carried out by the Government of India, after the 2011 population census, project population of the country and its states and Union Territories up to the year 2036. Yet, the Policy is silent about the forecasted size of the population at stabilisation. This paper, makes, for the first time, an attempt to estimate the population at stabilisation in 640 districts of India as they existed at the 2011 population following the modelling approach adopted by Chaurasia (2023).

The present paper is divided into five sections including this background. The next section of the paper describes the data source used in the analysis. We have used male and female population enumerated at different decennial population censuses since 1951 in 640 districts of India as they existed at 2011 population census made available by the Registrar General and Census Commissioner of India. The third section of the paper outlines the approach adopted for estimating the population of the district at stabilisation. The approach is based on modelling population growth during the 70 years between 1951 and 2011 in each district. Estimates of the population at stabilisation in 640 districts are presented in section four of the paper. Section five presents the variation in the density of population at stabilisation across the 640 districts while section seven analyses the variation across districts in the sex ratio of the population of the district at stabilisation. The last section of the paper summarises the main findings and discusses their policy and programme imperatives.

The Data

A major problem in modelling population growth in the districts of India is the increase in the number of districts at different decennial population censuses due to administrative reasons. At the 1951 population census, there were 316 districts in the country. This number increased to 640 at the 2011 population census and, today, there are 785 districts in the country (Government of India, 2024). The Registrar General and Census Commissioner of India has recently provided enumerated population of 640 districts, as they existed at the 2011 population census, at different population censuses beginning 1901. This district population dataset, spanning over a period of more 110 years, provides, for the first time, an opportunity to model district population growth and use the model to estimate the population at stabilisation in the districts of the country.

The present paper is based on the modelling of population growth in the 640 districts of the country during the period 1951-2011. We have not used the population of districts enumerated before 1951 for the purpose of modelling population growth for two reasons. First, enumerated population in many districts prior to 1951 has not been made available by the Registrar General and Census Commissioner of India. Second, the population growth pattern during 1901-1951 is found to be different from the population growth pattern during 1951-2011 in majority of the districts possibly because of the demographic discontinuity before and after 1951. Since the objective of the present paper is to estimate the size of the population of the district at stabilisation, we have modelled the district population growth based on the population enumerated at decennial population censuses beginning 1951 through 2011.

The population enumerated at decennial population censuses in India is known to be associated with several errors, including the error of omission and duplication at the time of enumeration. The Registrar General and Census Commissioner of India undertakes a post-enumeration survey after every decennial population census to estimate the error of omission and duplication at the time of the enumeration of the population. The post enumeration survey conducted after the 2011 population census has revealed that there was a net omission of around 23 persons for every 1000 persons enumerated at the 2011

population census (Government of India, 2014). There was an estimated undercount of 23.08 persons for every 1000 persons enumerated which was offset by an estimated duplication of 0.10 persons for every 1000 persons enumerated. The post enumeration survey, however, revealed that there was no statistically significant difference in the net omission rate by sex, although the net omission rate was comparatively higher in females than the net omission rate in males. The post enumeration survey has also revealed that the net omission rate was markedly higher in urban (29 persons per 1000 persons enumerated) as compared to the rural (20 persons per 1000 persons enumerated) areas of the country. A comparison of the net omission rate in the 2011 population census with that in the 2001 population census also reveals that there has been little change in the net omission rate in the enumeration of the population at the two decennial population censuses.

The Registrar General and Census Commissioner of India has not provided estimates of the net omission rate in the enumeration of the population for the states/Union Territories and districts of the country but provides estimates of the net omission rate for the five zones of the country – north zone, west zone, south zone, east zone, and central zone. These estimates suggest that the net omission rate in the 2011 population census was the lowest in the eastern zone but the highest in the central zone of the country (Government of India, 2014) and it is likely that the net omission rate varies widely from the zonal average across districts of each zone. The Registrar General and Census Commissioner of India has also not made any attempt to adjust the enumerated population for the estimated net omission error derived from the post enumeration survey. Since, district level estimates of the net omission rate are not available for different population censuses in the country beginning 1951, it is not possible to make any adjustment in the population of districts at different population census. We have, therefore, used the data made available by the Registrar General and Census Commissioner of India to model population growth in the districts of the country without any adjustment about the error of omission and duplication in population enumeration in different population censuses since 1951.

There are also some gaps in the population of districts enumerated at the 1951 and 1961 population censuses made available by the Registrar General and Census Commissioner of India. The enumerated population at the 1951 population is not available for 42 of the 640 districts as they existed at the 2011 population census, whereas in 10 districts, the population enumerated at both 1951 and 1961 population censuses is not available. The population growth modelling exercise in 32 districts of the country has been based on the population enumerated at the 1961 through 2011 population censuses, whereas, in 10 districts, the modelling exercise is based on the population enumerated at the 1971 through 2011 population censuses. Since 1971, the enumerated population is available for all the 640 districts as they existed at the time of 2011 population census except for 27 districts in Assam where the 1981 population census could not be carried out. We have, therefore, estimated the population of the 27 districts of Assam in 1981 as the average of the population enumerated at the 1971 population census and the population enumerated at the 1991 population census. to estimate the population of the 27 districts of Assam for the purpose of modelling population growth.

The Method

The method that we have followed assumes that population growth in a district follows an *S*-shaped growth trajectory which has three phases – an initial phase in which population increases exponentially; a middle phase in which population increases linearly; and a final phase in which population growth slows down and approaches an upper limit. The upper limit of population growth is the size of the population at stabilisation. There are different mathematical models that can characterise the *S*-shaped trajectory of population growth. These include, among others, the logistic growth model, the Gompertz growth model and the generalised logistic growth model. The logistic growth model is the simplest description of an *S*-shaped trajectory of population growth. It was first developed by Verhulst (1838) and later re-discovered independently by Pearl and Reed (1920). The model assumes that population grows exponentially under the constraint of an upper limit (Lotka, 1956). Application of the logistic growth model to describe population growth has a long history. It was a popular method of population forecasting in the past. Several studies have shown that the application of the logistic growth curve may often provide reasonably accurate forecast of the growth of the population (Dorn, 1950; Leach, 1981). In recent years, there has been a renewed interest in the logistic growth model to describe and forecast population growth (Hrytsiuk et al, 2023; Marchetti et al, 1996; Burg and Ausubel, 2023; Mondol et al, 2018; Shariff Ullah et al, 2019). Bhat (1999) had used the logistic growth model to forecast population of Delhi, the capital city of India. If the population growth in a district empirically follows the initial stages of the logistic growth curve, then the upper asymptote of the logistic growth model may provide a good estimate of the upper limit for district population growth which may be taken as the size of the population of the district at stabilisation.

The logistic growth model is defined as:

$$P_t = \frac{U-L}{1+e^{-r(t-t_m)}} + L \qquad (1)$$

where

P_t = the population at time t
L = lower asymptote of the model
U = upper asymptote of the model
r = intrinsic population growth rate
t_m = the time of inflexion or the time when the population reaches half of the upper asymptote.

The intrinsic population growth rate r representing the "steepness" of the growth trajectory can be calculated from the time required for the population to grow from 10 per cent to 90 per cent of the upper asymptote, U, of the logistic growth model and is termed as the "characteristic time", or Δt (Meyer et al, 1999). If P_1 is 10 per cent of the upper asymptote, U, of the model, then

$$0.1 = \frac{P_1}{U} = \frac{1}{1+e^{-r(t_1-t_m)}} \; or \; 9 = \frac{1}{e^{-r(t_1-t_m)}} \qquad (2)$$

Similarly, if P_2 is 90 per cent of U, then,

$$0.9 = \frac{P_2}{U} = \frac{1}{1+e^{-r(t_2-t_m)}} \; or \; 9 = e^{-r(t_2-t_m)} \quad (3)$$

Equation (2) and (3) suggest that.

$$9 \times 9 = 81 = \frac{e^{-r(t_2-t_m)}}{e^{-r(t_1-t_m)}} = e^{r(t_2-t_1)} = e^{r\times\Delta t} \quad (4)$$

so that

$$r = \frac{\ln(81)}{\Delta t} \quad (5)$$

The upper asymptote, *U*, of the logistic growth model can be estimated using the three critical phases of logistic growth. There are several methods available to determine the critical points of the logistic growth curve (Passos et al, 2012). These include accelerating growth function method, tangent at the inflexion point method, segmented regression method; modified segmented regression method; non-significant difference method; and non-significant difference by simulation method (Passos et al, 2012). We have used the tangent at the point of inflexion method, as found by the first derivative, to estimate the parameters of the logistic growth model (1). If *s* is the slope of the population growth trajectory when the population growth is maximal, then the size of the population at the point of interaction of the tangent at the inflexion point with the upper asymptote, *K*, can be approximated by

$$K = \frac{4\times s}{r} \quad (6)$$

K is, however, an underestimate of the upper asymptote *U* of the model (1) or the upper limit of population growth. Forecasting population growth using *K* as the upper asymptote of the model (1) has, therefore, substantial impact on the population forecast based on the logistic growth model (Smith et al, 2013). It can, however, be shown for the logistic curve that (Passos et al, 2012)

$$U = K \times (1 + \exp(-2)) \quad (7)$$

We have used the open source Loglet software package to fit the logistic growth model (1) to the population growth data (Burg et al, 2023). The fits were performed for each of the 640 districts for the period 1951-2011. The software provides estimate of *K* for each district from which the upper asymptote of the model (1) or the population at stabilisation in each of the 640 districts in conjunction with equation (7). The software also provides estimates of mean absolute percentage error (MPAE), goodness-of-fit statistics (RSS and RMS) and the coefficient of determination, R^2, to test the appropriateness of the logistic growth model (1) in describing the pattern of population growth in each of the 640 districts of the country. Although, R^2 is not regarded as an appropriate measure for ascertaining the appropriateness of the fit in nonlinear models such as the logistic growth model (Spiess and Neumeyer, 2010), yet it can be used to test the appropriateness of fit in the present case because the logistic growth model can be transformed into a linear model through the Fisher-Pry transformation (Fisher and Pry, 1971). We found that the model has provided good fit to population growth during 1951-2011 in all but a few districts of the country so that the upper asymptote of the model represents an estimate of the upper limit of district population growth or population of the district at stabilisation.

Modelling District Population Growth

We have applied the logistic growth model (1) to model population growth during 1951-2011 in each of 640 districts of India. Detailed results of the modelling exercise are given elsewhere (Chaurasia, 2023). In each district, male and female population growth was modelled separately. The parameters of the model (1) as well as the mean absolute per cent error (MAPE) and the coefficient of determination R^2 is found to varied across districts. Table 1 summarises variation in R^2 and in MAPE across districts which suggests that the model has provided very good fit to population growth during 1951-2011 in all but a few districts. The MAPE is less than 0.05 in the male population in 578 districts and in 575 districts in the female population. Similarly, the linear R^2, is 0.90 and more in the male population in 620 districts and in 611 districts in the female population. There are only 3 districts where linear R^2 is less than 0.80 in the male population and in 4 districts in the female population. Out of these 7 districts, 4 are in the north-eastern part of the country while 3 are in Nagaland alone. Similarly, the MAPE is found to be 10 per cent and higher in 10 districts in case of male population and in 8 districts in case of female population. One reason of relatively poor goodness of fit statistics of the logistic growth model (1) to population growth during 1951-2011 in these districts is either very rapid increase or very rapid decrease in the population enumerated at successive decennial population censuses. For example, in district Kiphire in Nagaland, the enumerated population more than doubled between the 1991 and the 2001 decennial population censuses but the increase in population slowed down considerably between the 2001 and 2011 decennial population censuses, On the other hand, in two districts in the National Capital Territory of Delhi – Central district and New Delhi district – the enumerated population has either remained virtually unchanged or even decreased during the 60 years between the 1951 and the 2011 population censuses. It appears that the imperfect fit of model (1) to population growth in these districts is due to very large fluctuation in the population enumerated at different population censuses since 1951. We have, however, assumed in the present analysis that population growth during 1951-2011 in these districts has also followed the logistic growth model and used the upper asymptote of the logistic growth model to obtain the size of the population at stabilisation in these districts.

Table 1: Results of fitting of the logistic growth model to population growth in districts, 1951-2011. Variation in MAPE and R^2 across districts.

MAPE			R^2		
Range	Males	Females	Range	Males	Females
<0.02	206	202	>=0.95	558	520
0.02-0.04	315	305	0.90-0.95	62	91
0.04-0.06	80	94	0.85-0.90	10	19
0.06-0.08	21	22	0.80-0.85	5	4
0.08-0.10	8	7	<0.80	3	4
>= 0.10	10	8			
No data	2	2	No data	2	2
Total	640	640	Total	640	640

Source: Authors

Population of Districts at Stabilisation

Estimates of the size of the population at stabilisation in 640 districts of the country are presented in the appendix table. The population of district Thane in Maharashtra is expected to stabilise at around 18 million which will be the largest population at stabilisation among the 640 districts of the country. On the other hand, the population of district Dibang Valley in Arunachal Pradesh is expected to stabilise at less than 9 thousand, which will be the smallest at stabilisation among the 640 districts. In 8 districts of the country, the size of population at stabilisation is likely to be more than 10 million whereas in 15 districts, the size of the population at stabilisation will be less than 100 thousand. The proportionate increase in population between the population enumerated at the last 2011 population census and the population estimated at stabilisation will be the highest in district Kurung Kumey of Arunachal Pradesh but the lowest in district Mamit of Mizoram. In majority of districts, however, the proportionate increase in population between the population enumerated at the 2011 population census and the population at stabilisation is expected to range between 20-40 per cent. There are only 24 districts in the country where the proportionate increase in population between the population enumerated at the 2011 population census and the population at stabilisation will be more than 60 per cent. There are only 7 districts, where the population at stabilisation will be more than two times the population enumerated at 2011 population census. These districts are Gurgaon in Haryana, Gautam Budh Nagar in Uttar Pradesh, Kurung Kumey in Arunachal Pradesh, Senapati in Manipur, Daman in Daman and Diu, Dadra and Nagar Haveli, and Yanam in Puducherry.

Aggregating the estimated population at stabilisation of the 640 districts, the population at stabilisation of the country India is estimated to be around 1620 million – around 828 million males and 792 million females (Table 2). This estimate of the population at stabilisation of the country is very close to the estimate of the population the country when it stops increasing according to the medium variant of the population projection for India prepared by the United Nations (2022) and the population of the country projected by Kulkarni (2021). According to the most likely medium variant of the population projection for India prepared by the United Nations, the population of the country is projected to peak to around 1697 million (United Nations, 2022). On the other hand, Kulkarni (2021) has projected that the population of the country will peak at around 1660 million. The closeness of our estimate of the upper limit of population growth or the population at stabilisation in the country based on through the bottom-up approach of adding population at stabilisation in the districts of the country with the likely upper limit of population growth in India projected by the United Nations (2022) and by Kulkarni (2021) provides the credence to the modelling approach adopted in this paper for estimating the size of the population at stabilisation in the districts of the country. Our estimates suggest that at stabilisation, the population of the country is expected to be around 409 million more than the population of the country enumerated at the 2011 population census, or the population of the country is likely to increase by more than 37 per cent from the population enumerated at the 2011 population census before it will stop increasing or will stabilise. This increase in population will be more than the population of the country enumerated at the 1951 population census.

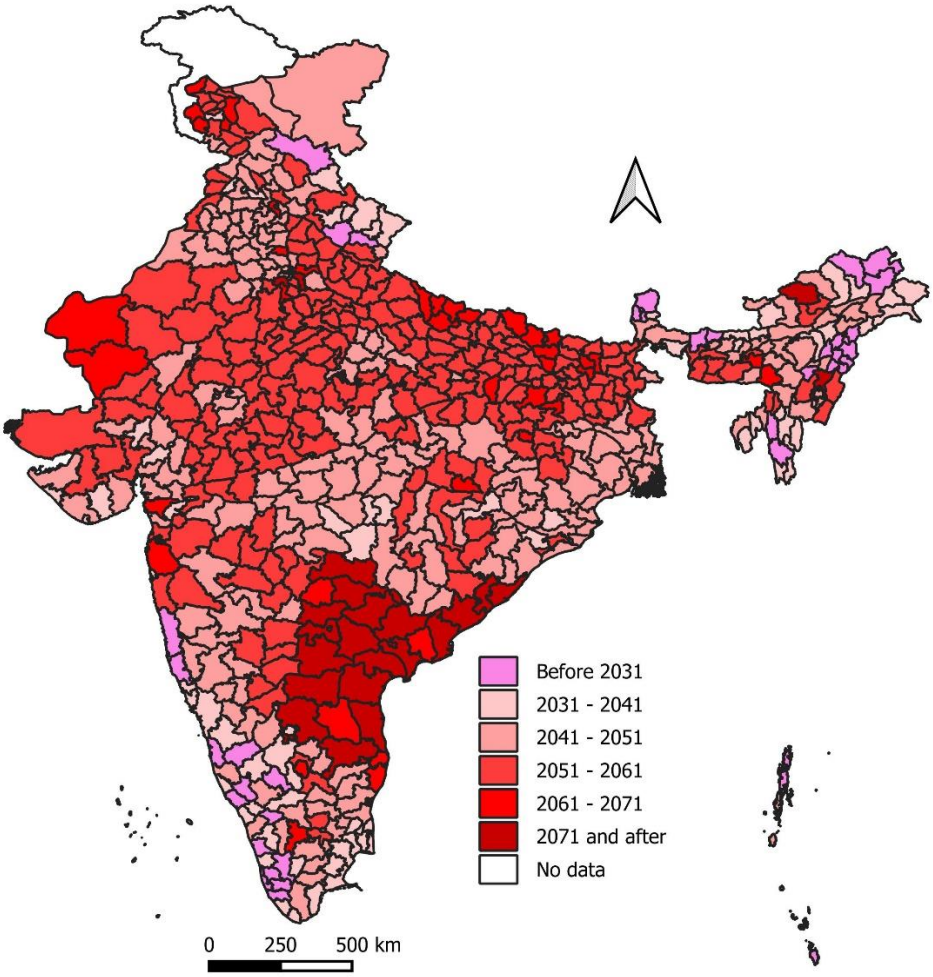

Figure 1: The year when 99 per cent of the upper limit of population growth will be achieved in districts of India.
Source: Author

Table 2 gives the population at stabilisation in states and Union Territories of the country. The population at stabilisation in Uttar Pradesh, the most populous state of the country, is estimated to be around 280 million whereas population at stabilisation in Bihar will be around 150 million. On the other hand, population at stabilisation in the Union Territory of Lakshadweep is likely to be around 78 thousand. In Dadra and Nagar Haveli, Arunachal Pradesh, Daman, and Diu, the population at stabilisation is expected to around 150 per cent higher from the population enumerated at the 2011 population census. In 6 states/Union Territories, the population at stabilisation is expected to be more than 40 per cent higher than the population enumerated at the 2011 population census. It is also estimated that more than 40 per cent of the increase in population of the country before it

stops increasing would be confined to only three states – Uttar Pradesh (20 per cent), Bihar (11 per cent), and Maharashtra (9 per cent). By comparison, the increase in population by the time it stabilises or stops increasing in Kerala and Jammu and Kashmir is estimated to account for less than 1.5 per cent of the increase in the population at stabilisation of the country or before the population stops increasing. The differential contribution of the increase in the population of different states and Union Territories to the increase in the population of the country before it stops increasing will be different in different states as states/Union Territories are at distinct stages of population transition.

Table 2: Population at stabilisation (million) in the states and Union Territories of India and increase in population (million) since 2011.

Country/State/Union Territory	Male	Female	Person	Increase since 2011	
				Number	%
Jammu and Kashmir	9.731	8.568	18.298	5.757	45.9
Himachal Pradesh	4.372	4.231	8.603	1.738	25.3
Punjab	18.642	16.677	35.319	7.576	27.3
Chandigarh	0.768	0.637	1.406	0.350	33.2
Uttarakhand	6.761	6.780	13.541	3.455	34.2
Haryana	19.458	17.126	36.585	11.233	44.3
National Capital Territory of Delhi	11.849	10.603	22.453	5.665	33.7
Rajasthan	48.831	45.809	94.640	26.092	38.1
Uttar Pradesh	143.462	136.91	280.373	80.560	40.3
Bihar	77.872	72.306	150.178	46.078	44.3
Sikkim	0.388	0.349	0.737	0.127	20.7
Arunachal Pradesh	1.825	1.718	3.543	2.159	156.1
Nagaland	1.333	1.241	2.574	0.595	30.1
Manipur	2.067	2.068	4.135	1.279	44.8
Mizoram	0.669	0.676	1.345	0.248	22.6
Tripura	2.304	2.210	4.514	0.840	22.9
Meghalaya	2.143	2.180	4.323	1.356	45.7
Assam	19.634	19.151	38.785	7.579	24.3
West Bengal	58.455	55.814	114.269	22.993	25.2
Jharkhand	23.123	22.094	45.217	12.229	37.1
Odisha	26.202	25.741	51.942	9.968	23.7
Chhattisgarh	16.778	16.715	33.492	7.947	31.1
Madhya Pradesh	50.124	47.396	97.52	24.893	34.3
Gujarat	42.875	38.164	81.039	20.600	34.1
Daman and Diu	0.415	0.187	0.602	0.359	147.6
Dadra and Nagar Haveli	0.597	0.286	0.884	0.540	157.1
Maharashtra	77.684	72.676	150.36	37.986	33.8
Andhra Pradesh	53.758	53.574	107.332	22.751	26.9
Karnataka	40.524	39.600	80.124	19.029	31.1
Goa	0.887	0.874	1.761	0.303	20.7
Lakshadweep	0.040	0.038	0.078	0.014	21.5
Kerala	18.898	20.612	39.51	6.104	18.3
Tamil Nadu	44.423	47.155	91.578	19.431	26.9
Puducherry	0.894	1.084	1.977	0.729	58.4
Andaman and Nicobar Islands	0.257	0.225	0.482	0.101	26.7
India	828.043	791.476	1619.519	408.664	33.7

Source: Authors

Population Density at Stabilisation

The Northeast district in the National Capital Territory of Delhi will be having the highest density of population at stabilisation – more than 46 thousand persons per square Kilometre compared to 36 thousand persons per square Kilometre in 2011 (Figure 2). In 14 districts, density of population at stabilisation will be more than 10 thousand persons per square Kilometre. In districts Yanam, Chandigarh, Hyderabad, Mumbai, Mumbai Suburban, Kolkata, and Chennai, the density of population at stabilisation will be exceptionally high which will have implications for the demand of resources, development of necessary infrastructure and facilities, and the environment. By contrast, density of population at stabilisation will be less than 100 persons per square Kilometre in 47 districts and will be just around 1 person per square Kilometre in district Dibang Valley of Arunachal Pradesh.

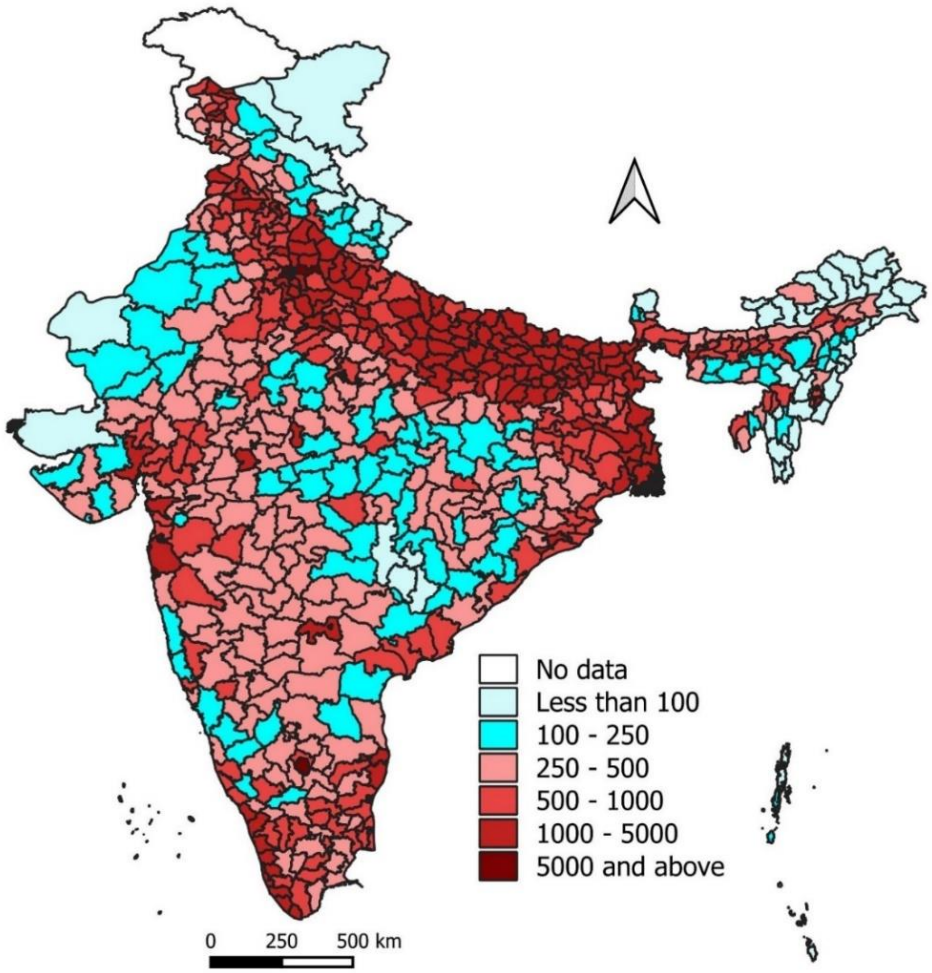

Figure 2: Population density at stabilisation in districts of India.
Source: Authors

Population Sex Ratio at Stabilisation

In 118 districts, there will be very high male advantage in the population at stabilisation but in 18 districts, there will be very high female advantage. In most of the districts, however, the sex ratio of population at stabilisation will vary between 95-105 males for every 100 females so that sex ratio of population at stabilisation of the country will be around 105 males for every 100 females but there will be variation across states/Union Territories. The population at stabilisation of Union Territories of Daman and Diu and Dadra and Nagar Haveli is likely to have very high male advantage whereas the population at stabilisation of the Union Territory of Puducherry is likely to have very high female advantage. There will be female advantage in the population at stabilisation in the southern region but male advantage in the northern region of the country.

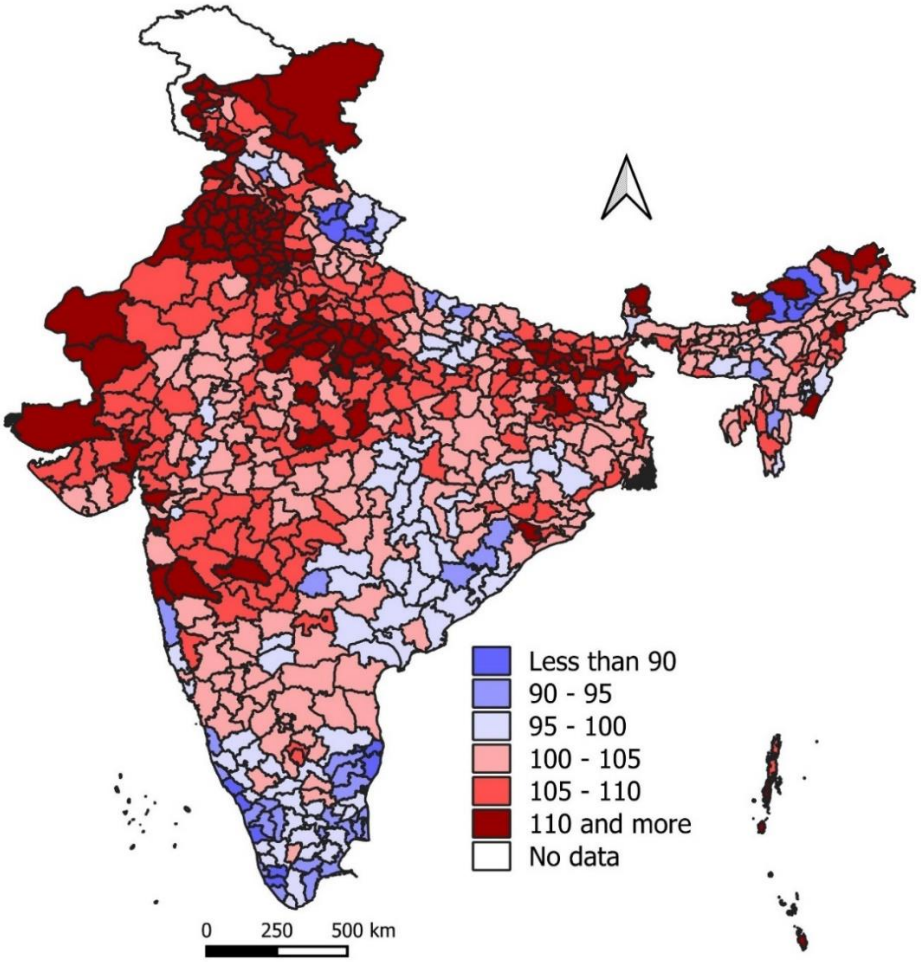

Figure 3: Population sex ratio at stabilisation in districts of India.
Source: Authors

Table 3: Distribution of sex ratio of population at stabilisation (number of males per 100 females) in the districts of India, and in the districts of states/Union Territories of the country.

Country/State/Union Territory	Sex ratio	Number of districts having						Total
		Female advantage at stabilisation			Male advantage at stabilisation			
		High <90	Moderate 90-95	Average 95-100	Average 100-105	Moderate 105-110	High ≥110	
Andaman & Nicobar Islands	114	0	0	0	0	1	2	3
Andhra Pradesh	100	0	1	11	9	2	0	23
Arunachal Pradesh	106	4	0	1	4	2	5	16
Assam	103	0	0	2	23	2	0	27
Bihar	108	0	1	0	10	18	9	38
Chandigarh	121	0	0	0	0	0	1	1
Chhattisgarh	100	0	0	9	8	1	0	18
Dadra & Nagar Haveli	209	0	0	0	0	0	1	1
Daman & Diu	222	0	0	1	0	0	1	2
Delhi	112	0	0	0	0	2	7	9
Goa	102	0	0	1	1	0	0	2
Gujarat	112	0	0	1	7	14	4	26
Haryana	114	0	0	0	0	4	17	21
Himachal Pradesh	103	0	1	2	3	3	3	12
Jammu and Kashmir	114	0	0	1	1	6	14	22
Jharkhand	105	0	0	3	12	7	2	24
Karnataka	102	0	1	8	18	3	0	30
Kerala	92	5	5	4	0	0	0	14
Lakshadweep	106	0	0	0	0	1	0	1
Madhya Pradesh	106	0	0	6	18	19	7	50
Maharashtra	107	0	1	1	11	17	5	35
Manipur	100	0	0	5	3	0	1	9
Meghalaya	98	0	1	2	3	1	0	7
Mizoram	99	0	1	1	4	2	0	8
Nagaland	107	0	0	0	3	6	2	11
Odisha	102	0	3	6	15	5	1	30
Puducherry	82	2	2	0	0	0	0	4
Punjab	112	0	0	0	2	4	14	20
Rajasthan	107	0	0	1	10	16	6	33
Sikkim	111	0	0	0	1	1	2	4
Tamil Nadu	94	2	12	15	3	0	0	32
Tripura	104	0	0	0	3	1	0	4
Uttar Pradesh	105	0	2	9	19	29	12	71
Uttarakhand	100	5	0	3	5	0	0	13
West Bengal	105	0	0	1	12	4	2	19
India	105	18	31	94	208	171	118	640

Source: Authors

The regional pattern in the sex ratio of population at stabilisation will remain quite marked. There will be high male advantage in the population at stabilisation. In 45 of the 63 districts of Jammu and Kashmir, Punjab, and Haryana, whereas in 14 districts, there will be moderate male advantage. There is no district in these states where there will be either moderate or high female advantage in the population at stabilisation. All these states are located in the north-west corner of the country. On the other hand, in 13 states/Union Territories, there is no district where there will be high male advantage in the population at stabilisation. There are 18 districts where there will be high female advantage in the population at stabilisation and these districts are in only 5 states/Union Territories, four of which are in the southern part of the country. There will be either high or moderate female advantage in the population at stabilisation in 10 of the 14 districts of Kerala and in 14 of the 32 districts of Tamil Nadu. In 12 districts of Uttar Pradesh, 7 districts of Madhya Pradesh and 6 districts of Rajasthan which constitute a geographic cluster, there will be high male advantage in the population at stabilisation. In 9 geographically contiguous districts of Bihar also there will be high male advantage in the population at stabilisation.

Conclusions

In this paper, we have followed the population growth modelling approach to estimate the population at stabilisation in 640 districts of India as they existed at the 2011 decennial population census. This is the first time any attempt has been made to estimate the population at stabilisation in the districts of the country. We have found that population growth during the period 1951-2011 can be modelled through the logistic growth model in all but a few districts of the country. This means that the upper asymptote of the logistic growth model provides an estimate of the upper limit of population growth or the size of population at stabilisation in each of the 640 districts of India. Interestingly, we have also found that the aggregate of the population at stabilisation in the 640 districts is a close approximation of the medium variant of the most recent population projection for India by the United Nations based on the cohort-component method (United Nations, 2022). The closeness our results to the industry standard validates the approach presented here. Population stabilisation has been a key agenda in the development discourse of country right since independence. The present paper provides, for the first time, estimate of population at stabilisation in the districts of the country. A district in India is the lowest administrative unit for development planning and programming directed towards improving the quality of life of the people and for controlling population growth. In view of the social, cultural, economic, and environmental diversity of the country India, there has always been emphasis on the decentralised district-based development planning and programming. Estimating the population at stabilisation of a district is expected to significantly contribute to estimating the long-term development and welfare needs of the people and to analysing the long-term impact of population growth on development and environment at the local level.

The present analysis suggests that the long-term implications of population growth to social and economic development and the environment will be different in different districts of the country. For example, the population density, the single most important

indicator of the population pressure on the environment at the local level, is likely to increase to more than 46 thousand persons per square kilometre in district Northeast in the National Capital Territory of Delhi, the highest in the country. Similarly, even in the long run, the present male-female imbalance is likely to remain highly advantageous to males in many districts of the country even when the population stabilises. This seems to be the case despite all efforts of social and economic development including efforts to reduce the male-female ratio inequality. At the national level, however, the male-female imbalance is likely to normalise to around 105 males for every 100 females at stabilisation.

Attempts to forecast district population in India are rare and there has yet been any attempt to estimate population at stabilisation in the districts or even in the states and Union Territories of the country. This is critical since the size and the composition of population is an essential input to development planning and programming in India at national and local (district) levels. Population stabilisation has repeatedly been and continues to be stressed as necessary in the development discourse of the country for the accelerated social and economic progress, but this is the first attempt to provide a methodology to derive insight on this issue. Estimating the limit to population growth or population at stabilisation is a necessary input for estimating long-term development and welfare needs of the people of the district including the demand for water, energy, and housing, and for assessing the long-term impact of population on natural resources at the local level. One reason, of course, has been the paucity of district level data necessary for forecasting or projecting population growth. This research makes first attempt in this direction and shows that the long-term implications of population growth will be different in different districts of the country.

The estimate of district population at stabilisation is derived following the data driven approach which makes no explicit assumption about future trends in fertility, mortality, and migration. It is based on the characterisation of the population growth pattern in the district observed during the period 1951-2011 as revealed through the population enumerated in the district in different decennial population census since 1951. This pattern of population growth may change with the arrival of new data which will then lead to new model describing the pattern of district population growth and hence new estimate of the upper limit of population growth or population at stabilisation. The arrival of new data may also lead to more than one population growth patterns in the same district, one confined to one sub-period and the other to another sub-period. There is also a possibility that one model depicts the increase in population while the other depicts the decrease in population as population starts decreasing when the upper limit of the population is achieved. Eventually, district population growth may be more complex than the one which can be described by single wave logistic growth model. However, the extant data appear to support the hypothesis of a logistic growth trend alluding to the macro-scale population inertia and the resulting trajectories may conserve the *S*-curve pattern.

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Appendix Table: Size of the population at stabilisation (000), increase in population before population stops increasing, population sex ratio (males for every 100 females) and population density (number of persons per square Kilometre) at stabilisation in 640 districts of India as they existed at the 2011 population census.

Country/State/Union	Population at stabilisation			Increase since 2011		Population	
Territory/District	Male	Female	Person	Number	%	Sex ratio	Density
Jammu and Kashmir							
Kupwara	859	609	1468	598	68.7	141	617
Badgam	581	514	1094	341	45.2	113	804
Leh (Ladakh)	113	67	179	46	34.2	169	4
Kargil	105	83	188	47	33.5	126	13
Punch	400	352	751	275	57.6	114	449
Rajouri	539	446	986	343	53.5	121	375
Kathua	431	381	811	195	31.6	113	324
Baramula	761	671	1432	424	42.0	113	337
Bandipore	313	280	593	201	51.2	112	1718
Srinagar	914	838	1752	515	41.6	109	885
Ganderbal	268	221	490	192	64.6	121	1890
Pulwama	418	375	793	232	41.4	111	730
Shupiyan	197	198	394	128	48.1	99	1264
Anantnag	942	935	1876	798	73.9	101	525
Kulgam	274	260	534	110	25.9	105	1303
Doda	308	288	595	185	45.2	107	67
Ramban	219	205	424	140	49.3	107	319
Kishtwar	165	153	318	87	37.8	107	193
Udhampur	418	356	774	219	39.4	118	293
Reasi	225	207	431	117	37.1	109	251
Jammu	1064	942	2006	476	31.1	113	856
Samba	221	188	409	90	28.3	117	452
Himachal Pradesh							
Chamba	329	327	656	137	26.4	101	101
Kangra	921	929	1850	340	22.5	99	322
Lahul & Spiti	20	17	37	5	17.1	118	3
Kullu	304	290	594	156	35.7	105	108
Mandi	599	606	1205	206	20.6	99	305
Hamirpur	266	281	547	93	20.4	95	490
Una	345	325	669	148	28.4	106	435
Bilaspur	235	229	464	82	21.6	103	398
Solan	415	364	779	199	34.2	114	402
Sirmaur	354	329	683	153	29.0	108	242
Shimla	529	488	1017	203	24.9	108	198
Kinnaur	55	45	100	16	18.7	122	16
Punjab							
Gurdaspur	1503	1324	2827	529	23.0	113	796
Kapurthala	525	469	994	179	22.0	112	609
Jalandhar	1441	1319	2760	566	25.8	109	1052
Hoshiarpur	985	958	1943	356	22.5	103	574
Shahid	365	358	723	111	18.1	102	564
Fatehgarh Sahib	394	342	736	136	22.6	115	624
Ludhiana	2445	2108	4553	1054	30.1	116	1273
Moga	649	572	1221	225	22.6	113	545
Firozpur	1393	1210	2604	575	28.3	115	491
Muktsar	594	533	1127	225	25.0	112	435
Faridkot	410	363	773	155	25.2	113	530
Bathinda	934	808	1741	353	25.4	116	519
Mansa	498	446	944	174	22.6	112	429

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Patiala	1252	1110	2362	466	24.6	113	710
Amritsar	1766	1581	3347	857	34.4	112	1248
Tarn Taran	744	693	1437	317	28.3	107	595
Rupnagar	448	409	857	172	25.2	110	632
Sahibzada Ajit Singh Nagar	809	757	1565	571	57.4	107	1431
Sangrur	1097	969	2066	411	24.8	113	570
Barnala	390	348	738	143	24.0	112	498
Chandigarh							
Chandigarh	768	637	1406	350	33.2	121	12330
Uttarakhand							
Uttarkashi	215	207	422	92	27.8	104	53
Chamoli	232	242	474	82	21.0	96	59
Rudraprayag	135	158	294	51	21.2	85	148
Tehri Garhwal	348	391	739	120	19.4	89	203
Dehradun	1253	1210	2462	766	45.1	104	797
Garhwal	376	420	796	109	15.8	90	149
Pithoragarh	285	290	576	92	19.1	98	81
Bageshwar	145	161	306	46	17.8	90	137
Almora	335	387	722	100	16.0	87	230
Champawat	158	161	318	59	22.7	98	180
Nainital	686	672	1358	403	42.3	102	319
Udham Singh Nagar	1184	1134	2318	669	40.6	104	912
Hardwar	1410	1345	2756	865	45.8	105	1168
Haryana							
Panchkula	397	365	761	200	35.6	109	848
Ambala	791	675	1466	337	29.9	117	931
Yamunanagar	855	750	1605	391	32.2	114	908
Kurukshetra	637	562	1199	234	24.3	113	784
Kaithal	706	622	1328	254	23.6	113	573
Karnal	1019	917	1935	430	28.6	111	768
Panipat	963	844	1807	602	49.9	114	1425
Sonipat	984	848	1832	382	26.3	116	863
Jind	888	769	1657	322	24.2	115	613
Fatehabad	607	548	1155	213	22.6	111	455
Sirsa	851	767	1618	323	24.9	111	378
Hisar	1195	1048	2243	499	28.6	114	563
Bhiwani	1100	977	2078	443	27.1	113	435
Rohtak	709	605	1314	253	23.8	117	753
Jhajjar	654	552	1207	248	25.9	118	658
Mahendragarh	625	551	1177	255	27.6	113	620
Rewari	644	554	1197	297	33.0	116	751
Gurgaon	2526	2085	4611	3096	204.4	121	3665
Mewat	1017	958	1975	886	81.3	106	1310
Faridabad	1508	1406	2915	1105	61.0	107	3933
Palwal	782	724	1507	464	44.5	108	1109
National Capital Territory of Delhi							
Northwest	2650	2319	4970	1313	35.9	114	11218
North	635	586	1221	333	37.5	108	20020
Northeast	1507	1364	2871	629	28.1	110	46302
East	1159	1055	2215	505	29.6	110	35151
New Delhi	78	64	142	0	0.0	122	4057
Central	308	274	582	0	0.0	112	27730
West	1750	1590	3340	797	31.3	110	25693
Southwest	1822	1610	3432	1139	49.7	113	8152
South	1940	1741	3680	949	34.7	111	14901

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Rajasthan							
Ganganagar	1344	1204	2548	579	29.4	112	232
Hanumangarh	1179	1067	2246	471	26.5	110	233
Bikaner	1831	1682	3513	1149	48.6	109	116
Churu	1399	1305	2704	664	32.6	107	195
Jhunjhunun	1387	1338	2724	587	27.5	104	460
Alwar	2737	2489	5226	1551	42.2	110	624
Bharatpur	1804	1642	3446	898	35.2	110	680
Dhaulpur	914	809	1723	516	42.8	113	568
Karauli	1099	967	2066	608	41.7	114	374
Sawai Madhopur	939	865	1804	469	35.1	109	401
Dausa	1243	1148	2391	757	46.3	108	697
Jaipur	5054	4662	9717	3090	46.6	108	872
Sikar	1843	1747	3591	913	34.1	106	464
Nagaur	2311	2172	4483	1176	35.5	106	253
Jodhpur	2717	2563	5281	1593	43.2	106	231
Jaisalmer	596	540	1137	467	69.7	110	30
Barmer	2128	1914	4042	1438	55.2	111	142
Jalor	1316	1251	2567	738	40.4	105	241
Sirohi	750	709	1460	423	40.8	106	284
Pali	1280	1266	2546	509	25.0	101	206
Ajmer	1776	1719	3495	912	35.3	103	412
Tonk	954	929	1883	462	32.5	103	262
Bundi	741	708	1449	338	30.4	105	251
Bhilwara	1633	1625	3258	849	35.3	101	312
Rajsamand	748	736	1484	327	28.3	102	319
Dungarpur	955	945	1900	512	36.9	101	504
Banswara	1266	1198	2464	667	37.1	106	545
Chittaurgarh	991	975	1966	422	27.3	102	251
Kota	1380	1302	2683	732	37.5	106	514
Baran	834	807	1641	418	34.2	103	235
Jhalawar	945	895	1839	428	30.4	106	296
Udaipur	2153	2038	4191	1123	36.6	106	357
Pratapgarh	584	589	1172	304	35.1	99	263
Uttar Pradesh							
Saharanpur	2436	2255	4691	1224	35.3	108	1272
Muzaffarnagar	2842	2641	5483	1340	32.3	108	1368
Bijnor	2549	2452	5001	1318	35.8	104	1096
Moradabad	3531	3387	6919	2147	45.0	104	1861
Rampur	1646	1572	3218	882	37.8	105	1359
Jyotiba Phule Nagar	1348	1299	2647	807	43.8	104	1177
Meerut	2366	2148	4514	1071	31.1	110	1764
Baghpat	855	756	1611	308	23.6	113	1220
Ghaziabad	4553	4297	8851	4169	89.0	106	7507
Gautam Buddha Nagar	1932	1764	3696	2048	124.3	110	2883
Bulandshahr	2309	2145	4454	955	27.3	108	987
Aligarh	2678	2477	5155	1481	40.3	108	1412
Mahamaya Nagar	1057	956	2012	448	28.6	111	1094
Mathura	1868	1733	3601	1054	41.4	108	1078
Agra	3295	2991	6286	1867	42.3	110	1556
Firozabad	1839	1674	3513	1015	40.6	110	1459
Mainpuri	1277	1169	2446	577	30.9	109	886
Budaun	2673	2533	5206	1524	41.4	106	1007
Bareilly	3233	3122	6356	1907	42.9	104	1543
Pilibhit	1443	1331	2775	744	36.6	108	753

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Shahjahanpur	2241	2080	4321	1314	43.7	108	985
Kheri	3126	2914	6040	2018	50.2	107	786
Sitapur	3348	3079	6427	1943	43.3	109	1119
Hardoi	2923	2709	5632	1539	37.6	108	941
Unnao	2088	1930	4018	910	29.3	108	882
Lucknow	3489	3433	6921	2332	50.8	102	2738
Rae Bareli	2400	2295	4695	1289	37.9	105	1019
Farrukhabad	1317	1230	2546	661	35.1	107	1168
Kannauj	1135	1038	2173	517	31.2	109	1038
Etawah	1057	946	2003	421	26.6	112	867
Auraiya	916	815	1732	352	25.5	112	859
Kanpur Dehat	1208	1058	2266	470	26.2	114	750
Kanpur Nagar	3151	2748	5899	1318	28.8	115	1870
Jalaun	1153	1034	2187	497	29.4	111	479
Jhansi	1351	1220	2570	572	28.6	111	512
Lalitpur	908	892	1800	578	47.3	102	357
Hamirpur	734	636	1370	266	24.1	115	341
Mahoba	587	543	1130	254	29.0	108	359
Banda	1230	1098	2327	528	29.3	112	528
Chitrakoot	723	665	1388	397	40.0	109	432
Fatehpur	1752	1625	3376	744	28.2	108	813
Pratapgarh	2167	2193	4360	1151	35.9	99	1173
Kaushambi	1179	1087	2265	666	41.6	108	1273
Allahabad	4253	4013	8265	2311	38.8	106	1508
Bara Banki	2378	2277	4655	1394	42.8	104	1057
Faizabad	1680	1649	3329	858	34.7	102	1422
Ambedkar Nagar	1614	1655	3269	871	36.3	98	1391
Sultanpur	2570	2688	5257	1460	38.5	96	1185
Bahraich	2759	2641	5400	1913	54.8	104	1031
Shrawasti	905	955	1860	743	66.5	95	1134
Balrampur	1611	1673	3284	1135	52.8	96	981
Gonda	2592	2561	5153	1719	50.1	101	1287
Siddharthnagar	1928	2093	4021	1462	57.1	92	1389
Basti	1652	1705	3358	893	36.2	97	1249
Sant Kabir Nagar	1198	1185	2382	667	38.9	101	1447
Mahrajganj	1982	1967	3950	1265	47.1	101	1338
Gorakhpur	3040	2961	6001	1560	35.1	103	1807
Kushinagar	2646	2570	5215	1651	46.3	103	1795
Deoria	2056	2093	4149	1048	33.8	98	1633
Azamgarh	3142	3219	6361	1747	37.9	98	1569
Mau	1571	1527	3098	892	40.4	103	1809
Ballia	2220	2094	4314	1074	33.2	106	1447
Jaunpur	2908	3043	5951	1457	32.4	96	1474
Ghazipur	2461	2433	4895	1274	35.2	101	1449
Chandauli	1407	1319	2727	774	39.6	107	1073
Varanasi	2564	2434	4998	1321	35.9	105	3256
Sant Ravidas Nagar	1008	1055	2064	486	30.8	96	2033
Mirzapur	1799	1698	3497	1000	40.0	106	794
Sonbhadra	1379	1352	2731	868	46.6	102	395
Etah	1236	1143	2379	605	34.1	108	979
Kanshiram Nagar	992	936	1928	491	34.2	106	986
Bihar							
Pashchim Champaran	2962	2835	5797	1862	47.3	104	1109
Purba Champaran	4106	3777	7883	2784	54.6	109	1987
Sheohar	563	545	1108	452	68.8	103	3174

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Sitamarhi	2753	2629	5383	1959	57.2	105	2346
Madhubani	3354	3157	6510	2023	45.1	106	1860
Supaul	1560	1466	3027	798	35.8	106	1248
Araria	2082	1909	3991	1179	41.9	109	1410
Kishanganj	1221	1173	2394	703	41.6	104	1270
Purnia	2385	2265	4650	1386	42.5	105	1440
Katihar	2331	2097	4428	1357	44.2	111	1449
Madhepura	1548	1421	2970	968	48.4	109	1661
Saharsa	1488	1345	2833	932	49.0	111	1679
Darbhanga	2940	2709	5649	1712	43.5	109	2479
Muzaffarpur	3786	3280	7066	2265	47.2	115	2227
Gopalganj	1715	1855	3571	1009	39.4	92	1756
Siwan	2400	2272	4672	1341	40.3	106	2105
Saran	2804	2715	5520	1568	39.7	103	2090
Vaishali	2802	2392	5194	1699	48.6	117	2551
Samastipur	3183	2876	6059	1797	42.2	111	2086
Begusarai	2276	2065	4341	1370	46.1	110	2263
Khagaria	1324	1210	2534	867	52.0	109	1705
Bhagalpur	2230	1984	4213	1176	38.7	112	1640
Banka	1517	1395	2912	877	43.1	109	964
Munger	941	847	1788	420	30.7	111	1260
Lakhisarai	717	659	1376	375	37.5	109	1121
Sheikhpura	449	431	879	243	38.2	104	1276
Nalanda	1961	1804	3765	888	30.8	109	1599
Patna	4330	4021	8351	2513	43.0	108	2608
Bhojpur	1987	1768	3755	1026	37.6	112	1568
Buxar	1212	1175	2387	681	39.9	103	1402
Kaimur (Bhabua)	1253	1213	2466	839	51.6	103	740
Rohtas	2074	1951	4025	1065	36.0	106	1037
Aurangabad	1972	1844	3817	1277	50.3	107	1155
Gaya	3250	3141	6391	2000	45.5	103	1284
Nawada	1698	1553	3251	1032	46.5	109	1304
Jamui	1345	1289	2634	873	49.6	104	850
Jehanabad	849	774	1623	498	44.3	110	1744
Arwal	503	463	966	265	37.8	109	1514
Sikkim							
North District	29	22	51	7	16.1	133	12
West District	83	80	163	26	19.2	104	139
South District	92	85	178	31	21.0	108	237
East District	184	162	346	63	22.0	114	363
Arunachal Pradesh							
Tawang	46	29	75	25	49.6	160	34
West Kameng	56	48	103	19	22.8	117	14
East Kameng	48	58	106	27	34.4	83	26
Papum Pare	135	153	288	111	62.9	88	83
Upper Subansiri	54	65	120	36	43.4	83	17
West Siang	68	66	134	22	19.5	104	16
East Siang	59	60	119	20	19.7	97	33
Upper Siang	22	19	41	5	15.4	115	6
Changlang	95	91	187	39	26.0	105	40
Tirap	69	67	136	24	21.2	104	57
Lower Subansiri	63	75	138	55	66.1	85	39
Kurung Kumey	962	850	1813	1721	1868.6	113	300
Dibang Valley	5	4	9	1	9.6	129	1
Lower Dibang Valley	33	32	65	11	20.2	106	17

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Lohit	96	91	187	41	28.2	105	36
Anjaw	13	12	25	4	18.9	106	4
Nagaland							
Mon	160	142	302	52	20.8	112	169
Mokokchung	129	117	246	52	26.5	110	152
Zunheboto	89	86	175	34	24.3	104	139
Wokha	103	101	204	37	22.5	102	125
Dimapur	270	254	525	146	38.5	106	566
Phek	103	100	203	39	23.9	104	100
Tuensang	128	118	246	49	25.0	108	97
Longleng	51	46	96	46	91.1	112	172
Kiphire	53	49	103	29	38.5	108	91
Kohima	187	173	360	92	34.3	108	246
Peren	60	55	115	20	20.7	108	70
Manipur							
Senapati	518	512	1030	551	115.0	101	315
Tamenglong	105	102	207	67	47.4	102	47
Churachandpur	182	181	362	88	32.2	101	79
Bishnupur	145	146	291	53	22.5	99	586
Thoubal	265	271	537	115	27.2	98	1044
Imphal West	313	326	639	121	23.4	96	1232
Imphal East	281	287	568	112	24.5	98	801
Ukhrul	137	143	280	96	52.1	96	62
Chandel	121	99	220	76	52.5	122	66
Mizoram							
Mamit	47	44	91	5	5.4	106	30
Kolasib	54	54	109	25	29.6	100	79
Aizawl	240	255	495	94	23.6	94	138
Champhai	78	77	155	29	23.2	100	49
Serchhip	40	40	80	15	23.2	101	56
Lunglei	98	93	191	30	18.3	105	42
Lawngtlai	78	77	155	37	31.4	101	61
Saiha	35	35	70	13	23.3	99	50
Tripura							
West Tripura	1091	1041	2132	406	23.5	105	712
South Tripura	534	516	1049	173	19.8	104	343
Dhalai	234	220	454	76	20.1	106	189
North Tripura	445	433	878	185	26.6	103	431
Meghalaya							
West Garo Hills	467	466	932	289	45.0	100	254
East Garo Hills	234	230	464	146	45.9	102	178
South Garo Hills	106	97	203	61	42.6	109	108
West Khasi Hills	286	290	576	193	50.3	98	110
Ribhoi	208	206	414	155	59.9	101	169
East Khasi Hills	546	575	1121	295	35.7	95	408
Jaintia Hills	297	316	613	218	55.2	94	161
Assam							
Kokrajhar	538	518	1056	168	19.0	104	320
Dhubri	1316	1251	2567	618	31.7	105	1180
Goalpara	642	628	1271	262	26.0	102	697
Barpeta	1072	1026	2098	405	23.9	104	919
Morigaon	612	603	1215	258	26.9	102	783
Nagaon	1753	1768	3521	697	24.7	99	886
Sonitpur	1201	1176	2377	453	23.5	102	457
Lakhimpur	633	630	1263	221	21.2	100	555

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Dhemaji	431	410	841	155	22.6	105	260
Tinsukia	812	805	1617	289	21.7	101	427
Dibrugarh	796	782	1579	252	19.0	102	467
Sivasagar	712	686	1398	247	21.4	104	524
Jorhat	656	643	1299	207	18.9	102	456
Golaghat	662	646	1308	241	22.6	103	373
Karbi Anglong	597	580	1178	221	23.2	103	113
Dima Hasao	141	137	278	64	29.8	103	57
Cachar	1129	1097	2226	489	28.2	103	588
Karimganj	816	780	1596	367	29.9	105	882
Hailakandi	434	409	843	184	27.9	106	635
Bongaigaon	474	462	936	197	26.6	103	856
Chirang	281	272	553	71	14.7	103	288
Kamrup	952	916	1868	350	23.1	104	602
Kamrup Metropolitan	848	866	1713	459	36.6	98	1794
Nalbari	462	441	903	131	17.0	105	858
Baksa	564	557	1121	171	18.0	101	456
Darrang	607	581	1188	259	27.9	104	749
Udalguri	494	480	974	143	17.2	103	484
West Bengal							
Darjiling	1194	1200	2393	546	29.6	99	760
Jalpaiguri	2487	2372	4859	986	25.5	105	780
Koch Bihar	1727	1625	3352	533	18.9	106	990
Uttar Dinajpur	2098	1994	4092	1085	36.1	105	1303
Dakshin Dinajpur	1078	1033	2111	435	25.9	104	951
Maldah	2739	2480	5219	1230	30.8	110	1398
Murshidabad	4778	4669	9447	2343	33.0	102	1774
Birbhum	2217	2115	4332	830	23.7	105	953
Barddhaman	4751	4584	9335	1617	21.0	104	1329
Nadia	3325	3141	6466	1298	25.1	106	1646
North Twenty	6473	6231	12703	2693	26.9	104	3103
Hugli	3389	3271	6660	1141	20.7	104	2115
Bankura	2209	2122	4331	734	20.4	104	629
Puruliya	1865	1790	3655	724	24.7	104	584
Haora	3103	2962	6065	1215	25.0	105	4134
Kolkata	2767	2472	5239	743	16.5	112	28320
South 24 Parganas	5391	5187	10578	2416	29.6	104	1062
Paschim Medinipur	3652	3522	7174	1260	21.3	104	766
Purba Medinipur	3214	3046	6260	1164	22.8	106	1328
Jharkhand							
Garhwa	980	937	1917	594	44.9	105	468
Chatra	782	758	1541	498	47.7	103	414
Kodarma	583	525	1107	391	54.6	111	436
Giridih	1905	1649	3554	1109	45.3	116	716
Deoghar	1152	1068	2220	727	48.8	108	896
Godda	949	906	1855	542	41.2	105	819
Sahibganj	812	784	1596	446	38.7	104	774
Pakur	654	653	1307	406	45.1	100	722
Dhanbad	1752	1667	3419	734	27.3	105	1676
Bokaro	1371	1305	2676	614	29.8	105	928
Lohardaga	359	350	709	247	53.4	103	472
Purbi Singhbhum	1462	1425	2886	592	25.8	103	810
Palamu	1436	1343	2779	839	43.2	107	632
Latehar	531	512	1044	317	43.6	104	243
Hazaribagh	1225	1148	2373	638	36.8	107	667

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Ramgarh	605	588	1193	243	25.6	103	890
Dumka	869	885	1754	432	32.7	98	466
Jamtara	566	538	1104	313	39.6	105	610
Ranchi	2019	1938	3957	1043	35.8	104	776
Khunti	351	351	702	171	32.1	100	277
Gumla	703	661	1364	339	33.0	106	254
Simdega	372	366	738	138	23.1	102	195
Pashchimi Singhbhum	956	998	1953	451	30.0	96	270
Saraikela-Kharsawan	730	741	1471	406	38.1	99	554
Odisha							
Bargarh	898	884	1781	300	20.3	102	305
Jharsuguda	369	359	728	148	25.6	103	344
Sambalpur	637	629	1266	225	21.6	101	191
Debagarh	191	189	380	67	21.5	101	129
Sundargarh	1246	1256	2502	408	19.5	99	258
Kendujhar	1109	1096	2205	403	22.4	101	266
Mayurbhanj	1588	1601	3189	669	26.6	99	306
Baleshwar	1493	1399	2891	571	24.6	107	760
Bhadrak	953	937	1890	384	25.5	102	755
Kendrapara	852	850	1702	262	18.2	100	644
Jagatsinghapur	694	666	1359	222	19.6	104	815
Cuttack	1612	1543	3155	531	20.2	104	802
Jajapur	1150	1115	2265	438	24.0	103	781
Dhenkanal	735	698	1433	240	20.1	105	322
Anugul	821	777	1597	323	25.4	106	251
Nayagarh	597	538	1135	172	17.9	111	292
Khordha	1558	1425	2984	732	32.5	109	1061
Puri	1063	1020	2083	385	22.6	104	599
Ganjam	2217	2171	4388	859	24.3	102	535
Gajapati	340	357	698	120	20.8	95	161
Kandhamal	454	488	942	209	28.4	93	117
Baudh	287	283	570	129	29.3	101	184
Subarnapur	388	369	757	147	24.1	105	324
Balangir	1000	994	1995	346	21.0	101	303
Nuapada	364	368	732	122	20.0	99	190
Kalahandi	1015	1013	2028	452	28.6	100	256
Rayagada	576	617	1193	226	23.3	93	169
Nabarangapur	774	804	1578	357	29.2	96	298
Koraput	858	908	1766	386	28.0	95	201
Malkangiri	364	383	747	134	21.9	95	129
Chhattisgarh							
Koriya	414	408	822	163	24.8	102	124
Surguja	1600	1570	3170	811	34.3	102	202
Jashpur	510	500	1010	158	18.6	102	173
Raigarh	959	958	1917	423	28.3	100	271
Korba	811	803	1614	407	33.7	101	245
Janjgir-Champa	1195	1173	2367	748	46.2	102	614
Bilaspur	1886	1787	3674	1010	37.9	106	444
Kabeerdham	571	584	1155	333	40.4	98	273
Rajnandgaon	959	1000	1959	422	27.4	96	243
Durg	2056	2102	4158	814	24.4	98	487
Raipur	2793	2740	5533	1469	36.2	102	447
Mahasamund	616	624	1240	208	20.1	99	259
Dhamtari	508	521	1029	229	28.6	97	252
Uttar Bastar Kanker	455	461	915	166	22.2	99	128

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Bastar	881	911	1792	379	26.8	97	171
Narayanpur	93	93	186	46	33.1	100	40
Dakshin Bastar Dantewada	310	322	632	98	18.4	96	76
Bijapur	159	159	318	63	24.6	100	37
Madhya Pradesh							
Sheopur	512	457	969	281	40.9	112	147
Morena	1442	1232	2674	708	36.0	117	536
Bhind	1175	995	2170	467	27.4	118	487
Gwalior	1483	1329	2813	781	38.4	112	617
Datia	540	493	1033	246	31.3	110	356
Shivpuri	1286	1172	2458	732	42.4	110	244
Tikamgarh	1032	949	1980	535	37.0	109	392
Chhatarpur	1264	1166	2430	667	37.9	108	280
Panna	695	643	1338	322	31.7	108	188
Sagar	1603	1463	3066	687	28.9	110	299
Damoh	849	772	1621	357	28.2	110	222
Satna	1548	1452	3000	772	34.6	107	400
Rewa	1691	1570	3261	896	37.9	108	516
Umaria	454	429	883	238	37.0	106	217
Neemuch	535	513	1048	222	26.9	104	246
Mandsaur	871	852	1723	383	28.6	102	311
Ratlam	960	950	1910	455	31.3	101	393
Ujjain	1310	1272	2582	595	29.9	103	424
Shajapur	1025	973	1998	486	32.1	105	323
Dewas	1057	1021	2078	514	32.9	103	296
Dhar	1557	1510	3067	881	40.3	103	376
Indore	2579	2420	4999	1722	52.6	107	1282
Khargone (West Nimar)	1255	1253	2508	635	33.9	100	313
Barwani	1011	1005	2016	630	45.5	101	371
Rajgarh	1084	1062	2146	600	38.8	102	349
Vidisha	993	923	1916	457	31.3	108	260
Bhopal	1753	1699	3452	1081	45.6	103	1245
Sehore	922	851	1773	462	35.2	108	270
Raisen	927	839	1766	435	32.6	110	209
Betul	999	977	1976	401	25.4	102	197
Harda	396	374	770	200	35.0	106	231
Hoshangabad	822	769	1591	350	28.2	107	237
Katni	863	827	1690	398	30.8	104	341
Jabalpur	1589	1488	3077	613	24.9	107	590
Narsimhapur	723	667	1390	298	27.3	109	271
Dindori	431	436	868	163	23.2	99	116
Mandla	655	669	1324	269	25.5	98	228
Chhindwara	1355	1303	2658	567	27.1	104	225
Seoni	869	848	1717	338	24.5	102	196
Balaghat	1012	1027	2039	337	19.8	99	221
Guna	926	887	1814	572	46.1	104	284
Ashoknagar	590	535	1124	279	33.1	110	241
Shahdol	681	671	1352	286	26.8	101	218
Anuppur	471	475	946	197	26.2	99	252
Sidhi	812	787	1599	472	41.9	103	330
Singrauli	944	870	1813	635	53.9	108	320
Jhabua	728	734	1462	437	42.6	99	406
Alirajpur	499	508	1007	278	38.1	98	316
Khandwa (East Nimar)	856	816	1672	362	27.6	105	227
Burhanpur	490	464	954	197	25.9	106	279

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Gujarat							
Kachchh	1624	1386	3010	917	43.8	117	66
Banas Kantha	2231	2084	4316	1195	38.3	107	402
Patan	819	764	1583	239	17.8	107	273
Mahesana	1275	1165	2439	404	19.9	109	554
Sabar Kantha	1530	1440	2971	542	22.3	106	402
Gandhinagar	910	836	1746	354	25.4	109	816
Ahmadabad	5034	4562	9596	2382	33.0	110	1184
Surendranagar	1159	1084	2243	486	27.7	107	215
Rajkot	2585	2387	4972	1168	30.7	108	444
Jamnagar	1336	1250	2586	426	19.7	107	182
Porbandar	350	333	683	98	16.7	105	295
Junagadh	1684	1606	3290	547	19.9	105	373
Amreli	895	863	1758	244	16.1	104	238
Bhavnagar	1899	1734	3633	753	26.1	109	362
Anand	1297	1195	2492	399	19.1	109	778
Kheda	1415	1313	2728	428	18.6	108	690
Panch Mahals	1538	1493	3031	640	26.8	103	579
Dohad	1578	1551	3129	1002	47.1	102	859
Vadodara	2679	2522	5200	1035	24.8	106	689
Narmada	362	349	711	121	20.5	104	252
Bharuch	1011	930	1941	390	25.1	109	298
The Dangs	151	155	306	78	34.1	98	173
Navsari	824	792	1617	287	21.6	104	720
Valsad	1266	1124	2390	684	40.1	113	794
Surat	6952	4774	11726	5644	92.8	146	2578
Tapi	473	471	944	137	17.0	100	301
Daman and Diu							
Diu	32	33	65	13	25.0	99	1668
Daman	383	155	537	346	181.1	248	7462
Dadra and Nagar Haveli							
Dadra & Nagar Haveli	597	286	884	540	157.1	209	1799
Maharashtra							
Nandurbar	1137	1099	2236	587	35.6	103	375
Dhule	1322	1245	2567	516	25.2	106	357
Jalgaon	2745	2504	5249	1019	24.1	110	446
Buldana	1713	1599	3312	726	28.1	107	343
Akola	1150	1102	2252	438	24.2	104	397
Washim	787	726	1514	317	26.4	108	309
Amravati	1811	1747	3558	669	23.2	104	291
Wardha	807	755	1562	261	20.1	107	248
Nagpur	3085	2996	6081	1427	30.7	103	615
Bhandara	725	715	1440	240	20.0	102	352
Gondiya	760	758	1518	195	14.8	100	290
Gadchiroli	684	675	1359	286	26.7	101	94
Chandrapur	1368	1327	2695	491	22.3	103	236
Yavatmal	1772	1673	3446	673	24.3	106	254
Nanded	2310	2167	4477	1115	33.2	107	425
Hingoli	798	737	1535	358	30.4	108	318
Parbhani	1244	1171	2414	578	31.5	106	389
Jalna	1352	1254	2606	647	33.0	108	339
Aurangabad	2816	2622	5438	1737	46.9	107	537
Nashik	4394	4081	8475	2368	38.8	108	546
Thane	9534	9431	18965	7905	71.5	101	1984
Mumbai Suburban	6190	5331	11521	2164	23.1	116	25832

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Mumbai	2064	1625	3689	604	19.6	127	23498
Raigarh	1880	1696	3575	941	35.7	111	500
Pune	7477	6727	14204	4775	50.6	111	908
Ahmadnagar	2929	2776	5704	1161	25.6	106	335
Bid	1765	1590	3355	770	29.8	111	314
Latur	1715	1569	3284	830	33.8	109	459
Osmanabad	1071	978	2049	391	23.6	109	271
Solapur	2830	2648	5478	1161	26.9	107	368
Satara	1835	1802	3637	633	21.1	102	347
Ratnagiri	908	1004	1912	297	18.4	90	233
Sindhudurg	494	503	997	147	17.3	98	191
Kolhapur	2449	2330	4778	902	23.3	105	622
Sangli	1764	1713	3477	655	23.2	103	406
Andhra Pradesh							
Adilabad	1730	1747	3477	736	26.8	99	216
Nizamabad	1515	1596	3111	560	21.9	95	391
Karimnagar	2287	2336	4623	847	22.4	98	391
Medak	1951	1925	3875	842	27.8	101	400
Hyderabad	2423	2283	4705	762	19.3	106	21684
Rangareddy	5319	5056	10374	5077	95.9	105	1385
Mahbubnagar	2607	2532	5140	1086	26.8	103	279
Nalgonda	2113	2135	4248	759	21.8	99	298
Warangal	2159	2138	4297	784	22.3	101	335
Khammam	1696	1730	3426	628	22.5	98	214
Srikakulam	1605	1650	3254	551	20.4	97	558
Vizianagaram	1361	1380	2742	397	16.9	99	419
Visakhapatnam	2656	2728	5384	1093	25.5	97	482
East Godavari	3013	3033	6046	892	17.3	99	559
West Godavari	2308	2305	4613	676	17.2	100	596
Krishna	2743	2749	5492	975	21.6	100	629
Guntur	2902	2924	5826	938	19.2	99	511
Prakasam	2085	2055	4140	743	21.9	101	235
Sri Potti Sriramulu Nellore	1814	1792	3606	643	21.7	101	276
Y. S. R.	1775	1771	3546	663	23.0	100	231
Kurnool	2580	2556	5136	1082	26.7	101	291
Anantapur	2569	2529	5098	1017	24.9	102	267
Chittoor	2548	2624	5173	999	23.9	97	341
Karnataka							
Belgaum	3006	2955	5961	1181	24.7	102	444
Bagalkot	1213	1193	2406	516	27.3	102	367
Bijapur	1437	1402	2839	662	30.4	103	270
Bidar	1128	1061	2189	486	28.5	106	402
Raichur	1261	1278	2539	610	31.6	99	301
Koppal	941	916	1857	467	33.6	103	333
Gadag	646	632	1277	213	20.0	102	274
Dharwad	1142	1131	2272	425	23.0	101	533
Uttara Kannada	854	836	1690	253	17.6	102	164
Haveri	986	960	1946	348	21.8	103	403
Bellary	1640	1617	3256	803	32.8	101	385
Chitradurga	1017	1007	2025	365	22.0	101	240
Davanagere	1190	1169	2360	414	21.3	102	398
Shimoga	1020	1008	2028	275	15.7	101	239
Udupi	649	707	1357	179	15.2	92	379
Chikmagalur	667	678	1345	207	18.2	98	187
Tumkur	1614	1605	3219	540	20.2	101	304

Country/State/Union Territory/District	Population at stabilisation			Increase since 2011		Population	
	Male	Female	Person	Number	%	Sex ratio	Density
Bangalore	8473	7878	16351	6730	69.9	108	7446
Mandya	1053	1060	2113	307	17.0	99	426
Hassan	1046	1061	2107	331	18.6	99	309
Dakshina Kannada	1238	1260	2498	408	19.5	98	514
Kodagu	317	326	644	89	16.1	97	157
Mysore	1878	1856	3734	733	24.4	101	592
Chamarajanagar	600	606	1206	186	18.2	99	214
Gulbarga	1684	1656	3340	774	30.2	102	305
Yadgir	801	805	1606	432	36.8	100	305
Kolar	961	944	1905	368	24.0	102	479
Chikkaballapura	771	747	1518	263	21.0	103	358
Bangalore Rural	652	613	1264	273	27.6	106	550
Ramanagara	638	634	1272	189	17.5	101	362
Goa							
North Goa	502	484	986	168	20.5	104	568
South Goa	385	390	775	135	21.0	99	394
Lakshadweep							
Lakshadweep	40	38	78	14	21.5	106	2610
Kerala							
Kasaragod	758	825	1584	276	21.1	92	796
Kannur	1365	1588	2953	430	17.0	86	997
Wayanad	483	494	977	160	19.5	98	459
Kozhikode	1726	1920	3645	559	18.1	90	1555
Malappuram	2454	2713	5167	1054	25.6	90	1454
Palakkad	1614	1734	3348	538	19.1	93	747
Thrissur	1721	1915	3636	515	16.5	90	1201
Ernakulam	1881	1947	3827	545	16.6	97	1250
Idukki	649	655	1304	195	17.6	99	299
Kottayam	1119	1161	2279	305	15.4	96	1033
Alappuzha	1167	1280	2447	319	15.0	91	1729
Pathanamthitta	657	736	1394	196	16.4	89	525
Kollam	1451	1614	3066	430	16.3	90	1235
Thiruvananthapuram	1852	2031	3883	582	17.6	91	1774
Tamil Nadu							
Thiruvallur	2759	3205	5965	2237	60.0	86	1757
Chennai	2748	2844	5593	946	20.4	97	31958
Kancheepuram	2891	3565	6456	2458	61.5	81	1440
Vellore	2398	2534	4932	995	25.3	95	812
Tiruvannamalai	1448	1535	2983	518	21.0	94	482
Viluppuram	2103	2227	4330	871	25.2	94	602
Salem	2179	2151	4329	847	24.3	101	827
Namakkal	1071	1096	2168	441	25.6	98	634
Erode	1341	1399	2741	489	21.7	96	476
The Nilgiris	425	453	878	143	19.4	94	342
Dindigul	1276	1326	2602	442	20.5	96	431
Karur	633	664	1297	233	21.9	95	447
Tiruchirappalli	1574	1694	3268	546	20.1	93	725
Perambalur	345	360	705	140	24.7	96	401
Ariyalur	438	456	894	139	18.5	96	461
Cuddalore	1535	1587	3121	515	19.8	97	843
Nagapattinam	934	986	1920	304	18.8	95	747
Thiruvarur	722	761	1483	219	17.3	95	652
Thanjavur	1369	1489	2858	452	18.8	92	838
Pudukkottai	959	996	1955	337	20.8	96	421
Sivaganga	767	788	1555	216	16.1	97	367

Country/State/Union	Population at stabilisation			Increase since 2011		Population	
Territory/District	Male	Female	Person	Number	%	Sex ratio	Density
Madurai	1785	1849	3633	595	19.6	97	979
Theni	721	704	1425	179	14.4	103	497
Virudhunagar	1165	1230	2395	453	23.3	95	565
Ramanathapuram	766	809	1575	222	16.4	95	384
Thoothukkudi	984	1038	2022	272	15.5	95	426
Tirunelveli	1833	1912	3745	668	21.7	96	560
Kanniyakumari	1055	1100	2155	285	15.2	96	1280
Dharmapuri	948	928	1876	369	24.5	102	417
Krishnagiri	1265	1281	2546	666	35.4	99	496
Coimbatore	2091	2212	4304	846	24.5	95	910
Tiruppur	1893	1975	3868	1389	56.0	96	746
Puducherry							
Yanam	104	214	318	262	471.7	48	10601
Puducherry	643	708	1351	400	42.1	91	4594
Mahe	23	28	51	9	22.6	84	5696
Karaikal	124	134	257	57	28.5	92	1639
Andaman and Nicobar Islands							
Nicobars	25	20	46	9	23.6	123	25
North & Middle Andaman	67	62	129	23	22.0	109	34
South Andaman	165	143	308	69	29.2	115	115

Source: Authors

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Anaemia Prevalence in Children and Women Across India: Levels and Determinants, 2019-2021

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Abstract

The prevalence of anaemia in children and women in India and in most of the states/Union Territories and districts has increased between NFHS-4 (2015-2016) and NFHS-5 (2019-2021) despite focused efforts since 1970. Anaemia prevalence varies across India primarily because of sociocultural variations, food habits, utilisation of antenatal care (ANC) services, institutional deliveries, and other anaemia alleviation factors. This study explores patterns and determinants of anaemia prevalence across 36 states/Union Territories and 706 districts based on data from NFHS-5. The indicators of the prevalence of anaemia in children aged 6-59 months, pregnant and non-pregnant women aged 15-49 years, and adolescent women aged 15-19 years depict highly significant and positive inter-correlations. Principal Component analysis has been used to construct a composite score of anaemia in children and women. Mapping of composite score facilitated identification of contiguous belts of high anaemia in children and women which would facilitate devising region-specific anaemia-alleviation strategies. The analysis reveals that education of women, age at marriage, prevalence of exclusive breastfeeding, utilisation of maternal and child health care, especially consumption of IFA tablets, and tobacco consumption among women are significantly correlated with anaemia in children and women. Strengthening IEC components and region-specific anaemia-alleviation strategies can lead to optimal results for anaemia-control in India.

Introduction

Anaemia and iron deficiency affect billions of people worldwide, especially women in reproductive age and young children. Prevalence of anaemia is discerned to be relatively higher in South Asia and Central and West Africa than in other regions of the world. The World Health Assembly, in 2012, adopted a resolution endorsing a comprehensive implementation plan on maternal, infant, and young child nutrition which specified six global nutrition targets to be achieved by the year 2025 including 50 per cent reduction in the prevalence of anaemia in women of reproductive age (WHO, 2012). The World Health Assembly also noted that causes of anaemia across countries were different but more than half of the cases of anaemia were due to iron deficiency among women of reproductive age. WHO also recommended interventions for prevention and control of anaemia which include

diet containing adequate amounts of bioavailable iron, malaria control, deworming, delayed cord clamping (not earlier than 1 min after delivery), and focussed attention on adolescent girls especially in areas with high adolescent birth rates and prevalence of marriage of females at a young age. In India, the National Nutritional Anaemia Control Programme was launched in 52 districts of 13 states of the country in 1970 which provisioned weekly iron–folic acid supplementation for adolescent girls. The programme reached both school-going and not school-going girls aged 10–19 years. An evaluation of the programme indicated reduction in the prevalence of anaemia by 24 per cent after 1 year of implementation (Government of India, 1991).

Anaemia is a condition in which the number and size of red blood cells, or the haemoglobin concentration, falls below an established cut-off value which leads to the impairment of the capacity of the blood to transport oxygen. Anaemia is an indicator of both poor nutrition and poor health (WHO, 2012). Both, anaemia, and iron deficiency reduce the wellbeing of individuals and lead to fatigue and lethargy, breathlessness, chest pain, and headache, and impairs physical capacity and work performance and hence productivity. The manifestations of anaemia vary by its severity and ranges from fatigue, weakness, dizziness, and drowsiness to impaired cognitive development of children and increased morbidity. Anaemia in pregnancy is associated with post-partum haemorrhage, neural tube defects, low birth weight, premature births, stillbirths, and maternal deaths.

Common causes of anaemia worldwide are inadequate dietary iron intake and absorption. The need of iron is higher in women because of blood loss during menstruation. The need of iron is also higher in pregnant women because of dual requirement for their own health and for the growth of the foetus. Causative factors of anaemia also include infectious diseases, especially malaria, and nutritional deficiencies, especially folate and vitamins B_{12}, A and C. Genetic conditions including sickle cell disease, thalassaemia - inherited blood disorder - and chronic inflammation also lead to anaemia (Mayo Clinic, 2022). The complex interaction between nutrition, infectious diseases, and other factors presents a challenge to effectively address the problem of anaemia (Balarjan et al, 2013). Anaemia is disproportionately concentrated in low socioeconomic groups, and maternal anaemia is strongly associated with child anaemia (Government of India, 2022). Anaemia in children is possibly linked with nutritional deficiency, characterised by stunting, wasting and underweight, and with adolescent fertility resulting in low birth weight babies. Anaemia among women in their childbearing age, especially pregnant women is also a cause of low birth weight among newborn, and, therefore, higher neonatal and perinatal mortality and higher prevalence of diseases in later life. Furthermore, food habits like lack of millets in the diet due to overdependence on rice and wheat, insufficient consumption of green and leafy vegetables, and dominance of packaged and processed foods which are lacking in certain vitamins and minerals and thus low in nutrition could also be the reason behind the high prevalence of anaemia.

The National Nutritional Anaemia Control Programme launched in 1970 in the country has now been evolved as the Anaemia Mukt Bharat (AMB) Programme in 2018 with innovative strategies and budgetary provisions. The Programme is being implemented in all districts of the country through the existing delivery platforms as envisaged in the National Iron Plus Initiative (Kapil et al, 2019) and Weekly Iron and Folic Acid Supplementation

Programme for Adolescents (Government of India, 2012). The Government of India has also launched the National Nutrition Mission in 2018 with renewed budget and targets for reducing the prevalence of stunting, undernutrition, and anaemia among children, and prevalence of anaemia in women and adolescent girls and to reduce the incidence of low birth weight babies (Government of India, 2018). The Mission is now renamed as *Poshan Abhiyan* (Government of India, 2023). The Integrated Child Development Services (ICDS) launched in 1975 also provides health and nutrition services to children below 6 years of age and to pregnant women and lactating mothers (Kumar, 1999).

Despite all these focused efforts, the prevalence of anaemia in children, adolescent girls and women, especially pregnant women and adolescent mothers appears to have increased in recent years as revealed through the fourth (2015-2016) and fifth (2019-2021) rounds of the National Family Health Survey (Government of India, 2022). Across the 36 states/Unio Territories of the country, the prevalence of anaemia has gone up in 27 states/Union Territories which account for more than 84 per cent of the population of the country. The prevalence of anaemia in adolescent girls aged 15-19 years has increased in 25 states/Union Territories while the prevalence of anaemia in pregnant women has increased in 21 states/Union Territories. It is in this context that the present study attempts to delineate regions of high anaemia prevalence in India at state/Union Territory and district level. The study also purports to highlight determinants of anaemia using multivariate analytical techniques.

Data and Methods

The study is based on the data available through the fourth (2015-2016) the fifth (2019-2021) rounds of the National Family Health Survey (Government of India, 2017; 2022). The fifth round of the National Family Health Survey interviewed 724115 women aged 15-49 years and 101839 men aged 15-54 years (Government of India, 2022). The survey also elicited information on anaemia among children aged 6-59 months, adolescent women aged 15-19 years, pregnant and non-pregnant women aged 15-49 years, and men aged 15-54 years by haemoglobin testing using the capillary blood technique. A child was classified as anaemic is the haemoglobin level was less than 11 grams per decilitre (g/dl). A pregnant woman was classified as anaemic if the haemoglobin level was less than 12 g/dl. A non-pregnant woman was classified as anaemic if the haemoglobin level was less than 11 g/dl. Similarly, a man was classified as anaemic if the haemoglobin level was less than 13 g/dl. The same techniques and classification were used to classify children, pregnant women, non-pregnant women, and men as anaemic during the fourth (2015-2016) round of the National Family Health Survey. Based on these data, the prevalence of anaemia in children, non-pregnant women aged 15-49 years, pregnant women aged 15-49 years, all women aged 15-49 years, and women aged 15-19 years was estimated for the 706 districts and 36 States/Union-Territories of the country as they existed at the time of the fifth (2019-2021) round of the National Family Health Survey. These prevalence rates constituted the database for the present analysis. The list and the definition of indicators of anaemia employed in the present study are given in table 1. Descriptive statistics of the variation in the selected indicators of anaemia in children and women across the state/Union Territories

and districts of the country are provided in tables 2 and 3 respectively. Principal component analysis has been used to construct a composite score of anaemia in children and women based on the five indicators of anaemia in children and women and multivariate regression analysis have been used to analyse the variation in the composite score of anaemia in children and women across 706 districts of the country.

Table 1: Description of indicators of anaemia and other indicators used in the analysis.

Indicator	Definition of indicator
	Anaemia-Prevalence Indicators
Y_1	Per cent of children ages 6-59 months who are anaemic (<11.0 g/dl)
Y_2	Per cent of non-pregnant women aged 15-49 years who are anaemic (<12.0 g/dl)
Y_3	Per cent of pregnant women aged 15-49 years who are anaemic (<11.0 g/dl)
Y_4	Per cent of all women aged 15-49 years who are anaemic
Y_5	Per cent of women aged 15-19 years who are anaemic
	Other Socioeconomic and MCH Indicators
X_1	Per cent of women literate
X_2	Per cent of women with at least 10 years of schooling
X_3	Per cent of Women aged 20-24 married before reaching 18 years of age
X_4	Per cent of pregnant women aged 15-49 years who had 4 ANC checkups
X_5	Per cent of pregnant women aged 15-49 years who had consumed 100 IFA Tablets
X_6	Per cent of institutional deliveries
X_7	Per cent of children aged 12-23 months fully immunised
X_8	Per cent of children aged 6 months exclusively breastfed
X_9	Per cent of women who were consuming tobacco
X_{10}	Per cent of women who were consuming alcohol

Source: Government of India (2022)

Prevalence of Anaemia

The prevalence of anaemia in children and women in India and in its states/Union Territories is presented in the appendix table for the period 2015-2016 and 2019-2021. Summary measures of the variation in the prevalence of anaemia across states/Union Territories and districts are presented in table 2. The prevalence of anaemia in children and women in the country has increased during the period 2015-2021 despite all efforts to reduce the prevalence of anaemia in children and women. The prevalence of anaemia in children aged 6-59 months increased in 27 out of 36 states/Union Territories of the country. These 27 states/Union Territories account for 84 per cent population of the country. The prevalence of anaemia in children increased in 6 of the 8 Empowered Action Group (EAG) states, in 11 of the 13 other large states and in 10 of the 5 smaller states/Union Territories (Table 3). Similarly, the prevalence of anaemia increased in 24 states/Union Territories in women aged 15-49 years; in 21 states/Union Territories in pregnant women aged 15-49 years; in 24 states/Union Territories in non-pregnant women aged 15-49 years; and in 25

states/Union Territories in women aged 15-19 years. The states/Union Territories in which the prevalence of anaemia in different groups of women increased during 2015-2021 relative to the period 2015-2016 accounts respectively for 68 per cent, 54 per cent, 68 per cent and 66 per cent population of the country. On the other hand, identification of the districts where the prevalence of anaemia increased during 2019-2021 relative to 2015-2016 is not possible because the number of districts increased between 2015-2016 and 2019-2021.

Table 2: Summary measures of the distribution of different indicators of the prevalence of anaemia in women and children across states/Union Territories and districts in India, 2019-2021.

	States/Union Territories				Districts			
	Minimum	Maximum	Mean	Standard Deviation	Minimum	Maximum	Mean	Standard Deviation
Y_1	39.4	92.5	62.1	12.2	25.0	95.0	65.8	12.1
Y_2	26.0	93.7	54.2	13.7	16.0	95.0	56.2	12.0
Y_3	22.2	78.1	49.2	11.2	2.0	88.0	50.2	13.6
Y_4	25.8	92.8	54.0	13.6	15.0	94.0	55.9	12.0
Y_5	27.9	96.9	55.7	14.0	18.0	97.0	58.2	12.9

Source: Authors

Reasons for the increase in the prevalence of anaemia in children and women in are not known. The prevalence of anaemia in children and women has not increased in all states/Union Territories. There are states and Union Territories where the prevalence of anaemia in children and women has decreased. The analysis of the trend in the prevalence of anaemia in children and women in the districts could not be possible as the number of districts in the country at the fourth round (2015-2016) of the National Family Health Survey are different from the number of districts in the country at the fifth (2019-2021) round of the survey. Moreover, for the trend in different indicators of anaemia in children and women has been different in different states/Union Territories as may be seen from table 3.

Table 3: Number of states/Union Territories and districts in which prevalence of different indicators of anaemia increased during 2015-2021.

State/Union Territory/District	Y_1	Y_2	Y_3	Y_4	Y_5
All states and Union Territories N=36	27	24	21	24	25
EAG states (N=8)	6	6	2	6	6
Other large states (N=13)	11	10	11	10	9
Small states and Union Territories (N=15)	10	8	8	8	10

Source: Authors

The inter-state/Union Territory and inter-district variation in the five indicators of anaemia in children and women has been found to be highly correlated as may be seen from the simple zero order correlation coefficients between the variables based on either state/Union Territory level data or based on district level data (Table 4). Since the five indicators of anaemia in children and women are highly correlated, we have combined the five indicators into a signle composite score of anaemia in children and women through the

application of the principal component analysis technique. The composite score of anaelia in children and women generated through the application of the principal component analysis has been used for ranking states/Union Territories and districts within the country to reflect the problem of anaemia in children and women. The principal component analysis was carried out separately for the states/Union Territories and for the districts of the country for the period 2019-2021 so that the composite score of anaemia in children and women was estimated separately for the states/Union Territories and for the districts of the country.

Table 4: Simple zero order correlation coefficient among the five indicators of anaemia in children and women, 2019-2021.

	States/Union Territories				Districts			
	Y_2	Y_3	Y_4	Y_5	Y_2	Y_3	Y_4	Y_5
Y_1	0.778	0.668	0.778	0.868	0.647	0.504	0.650	0.677
Y_2		0.804	1.000	0.964		0.716	0.996	0.909
Y_3			0.810	0.770			0.738	0.621
Y_4				0.961				0.905

Source: Authors

Results of the application of the principal component analysis to state/Union Territory and districts level data separately are presented in table 5. Application of the principal component analysis using the data from states/Union Territories has revealed that the first principal component accounted for more than 87 per cent of the inter-state/Union Territory variation in the five indicators of anaemia in children and women. On the other hand, the principal component analysis using the district level data has revealed that the first principal component accounted for almost 80 per cent of the variation in the five indicators of anaemia in children and women across the districts of the country. Results of the principal component analysis suggest that the first principal component obtained from the application of the principal component analysis technique accounts for most of the variation in the five indicators of anaemia in children and women across the states/Union Territories as well as across the districts within the country. The component score of the first principal component, therefore, may be taken as the composite index that reflects the variation across states/Union Territories and across districts in the five indicators of anaemia in children and women used in the present analysis. It may be noted that the component score obtained from the principal component analysis is standardised score with mean 0 and standard deviation 1.

We have taken the component score of the first principal component as the composite index of anaemia in children and women. Since the component score is standardised, the composite index takes both negative and positive values and the higher the component score the more serious the problem of anaemia in children and women. The composite index is determined by the prevalence of anaemia in children aged 6-59 months, in all women aged 15-49 years; in non-pregnant women aged 15-49 years; in pregnant women aged 15-49 years; and in women aged 15-19 years. If there is a change in any of the five indicators, the value of the index will change. The index, therefore, can be used for ranking the states/Union Territories or districts in terms of the anaemia in children and women as reflected by the five indicators of anaemia in children and women.

Table 5: Results of the principal component analysis.

Particulars	State/Union Territory level analysis	District level analysis
Eigen value of the first principal component	4.373	3.979
Variance explained by first principal component	87.45	79.58
Component score coefficient of the indicators		
Y1	0.873	0.193
Y2	0.976	0.243
Y3	0.863	0.200
Y4	0.977	0.244
Y5	0.979	0.234

Source: Authors

Ranking of States/Union Territories

Ranking of States and Union Territories in terms of the composite index for the period 2019-2021 is presented in table 5. The composite index of anaemia in children and women is found to be the highest in Ladakh but the lowest in Nagaland. The composite index has also been found to be very high in West Bengal, Gujarat, Dadra & Nagar Haveli, and Tripura, but very low in Manipur, Kerala, Mizoram, and Lakshadweep. The composite index has also been found to be quite low in Himachal Pradesh and Tamil Nadu. Interestingly, in none of the EAG states, the composite index of anaemia in children and women is found to be either very low or very high. Among the EAG states, the composite index of anaemia in children and women is found to be relatively the lowest in Uttarakhand, but relatively the highest in Bihar. The composite index of anaemia in children and women is also found to be relatively very low in Uttar Pradesh but relatively very high in Jharkhand, Odisha, and Chhattisgarh. The four states – Bihar, Jharkhand, Odisha, and Chhattisgarh – where the composite index of anaemia in children and women is found to be very high are geographically continuous. A unique common feature of these states is that a high proportion of the population of these states is Scheduled Tribes population.

Ranking of Districts

We have also ranked 706 districts of the country as they existed at the fifth (2019-2021) round of the National Family Health Survey in terms of the composite index of anaemia in children and women as obtained through the principal component analysis. The inter-district variation in the composite index of anaemia in children and women is depicted in figure 1. The districts have been classified in five categories based on the composite index of anaemia in children and women – very low (VL); low (L); medium (M); high (H); and very high (VH) based on the composite index of anaemia in children and women. The distribution of districts by the level of the composite index of anaemia in children and women in different states and Union Territories of the country during 2019-2021 is presented in table 7.

Table 6: Ranking of states/Union Territories of India by the composite index of anaemia in children and women, 2019-2021.

States/Union Territories	Indicators of anaemia in children and women					Composite index	Rank
	Y_1	Y_2	Y_3	Y_4	Y_5		
EAG States							
Bihar	69.4	63.6	63.1	63.5	65.7	0.833	6
Uttar Pradesh	66.4	50.6	45.9	50.4	52.9	-0.150	21
Madhya Pradesh	72.7	54.7	52.9	54.7	58.1	0.294	16
Rajasthan	71.5	54.7	46.3	54.4	59.4	0.174	17
Jharkhand	67.5	65.7	56.8	65.3	65.8	0.754	9
Uttarakhand	58.8	42.4	46.4	42.6	40.9	-0.721	28
Chhattisgarh	67.2	61.2	51.8	60.8	61.4	0.446	13
Odisha	64.2	64.4	61.8	64.3	65.5	0.747	10
Other Large States							
Assam	68.4	66.4	54.2	65.9	67.0	0.764	8
West Bengal	69.0	71.7	62.3	71.4	70.8	1.155	2
Punjab	71.1	58.8	51.7	58.7	60.3	0.416	14
Haryana	70.4	60.6	56.5	60.4	62.3	0.577	11
Jammu & Kashmir	72.7	67.3	44.1	65.9	76.2	0.818	7
Himachal Pradesh	55.4	53.4	42.2	53.0	53.2	-0.305	24
Gujarat	79.7	65.1	62.6	65.0	69.0	1.093	3
Maharashtra	68.9	54.5	45.7	54.2	57.2	0.080	19
Karnataka	65.5	47.8	45.7	47.8	49.4	-0.314	25
Andhra Pradesh	63.2	59.0	53.7	58.8	60.1	0.324	15
Telangana	70.0	57.8	53.2	57.6	64.7	0.459	12
Tamil Nadu	57.4	53.6	48.3	53.4	52.9	-0.159	22
Kerala	39.4	36.5	31.4	36.3	32.5	-1.636	34
Small States/Union Territories							
National Capital Territory of Delhi	69.2	50.2	42.2	49.9	51.6	-0.209	23
Chandigarh	54.6	60.1	52.2	60.3	57.7	0.159	18
Goa	53.2	38.9	52.2	39.0	44.5	-0.771	29
Lakshadweep	43.1	26.0	52.2	25.8	31.4	-1.574	33
Puducherry	64.0	55.5	42.5	55.1	58.4	-0.004	20
Andaman & Nicobar Islands	40.0	57.6	52.2	57.5	44.9	-0.370	26
Dadra & Nagar Haveli	75.8	62.6	60.7	62.5	63.9	0.833	5
Sikkim	56.4	42.1	40.7	42.1	46.7	-0.782	30
Tripura	64.3	67.4	61.5	67.2	67.9	0.877	4
Mizoram	46.4	34.8	34.0	34.8	34.9	-1.491	32
Manipur	42.8	29.3	32.4	29.4	27.9	-1.869	35
Meghalaya	45.1	54.4	45.0	53.8	52.5	-0.405	27
Arunachal Pradesh	56.6	40.8	27.9	40.3	48.5	-1.028	31
Nagaland	42.7	29.3	22.2	28.9	33.9	-1.963	36
Ladakh	92.5	93.7	78.1	92.8	96.9	2.946	1

Source: Authors

Table 7: Distribution of districts across states and Union Territories by the level of the composite index of anaemia in children and women, 2019-2021.

State/Union Territory	Number of districts in which composite index is					Total
	Very low	Low	Medium	High	Very high	
EAG States						
Bihar	0	2	5	12	18	37
Uttar Pradesh	22	29	14	9	1	75
Madhya Pradesh	4	16	13	11	7	51
Rajasthan	3	9	7	12	2	33
Jharkhand	0	0	6	8	10	24
Uttarakhand	9	3	0	1	0	13
Chhattisgarh	1	4	11	4	7	27
Odisha	0	2	7	6	15	30
Other Large States						
Assam	0	3	5	13	12	33
West Bengal	0	0	1	5	14	20
Punjab	0	5	7	8	2	22
Haryana	1	1	6	10	4	22
Jammu & Kashmir	0	2	4	4	10	20
Himachal Pradesh	3	7	1	0	1	12
Gujarat	0	5	5	2	21	33
Maharashtra	3	12	12	6	3	36
Karnataka	13	9	6	2	0	30
Andhra Pradesh	0	2	6	5	0	13
Telangana	0	2	15	9	5	31
Tamil Nadu	8	12	6	6	0	32
Kerala	14	0	0	0	0	14
Small States/Union Territories						
National Capital Territory of Delhi	2	7	2	0	0	11
Chandigarh	0	0	1	0	0	1
Goa	2	0	0	0	0	2
Lakshadweep	1	0	0	0	0	1
Puducherry	2	0	2	0	0	4
Andaman & Nicobar Islands	1	2	0	0	0	3
Dadra & Nagar Haveli	0	1	0	1	1	3
Sikkim	4	0	0	0	0	4
Tripura	0	0	0	4	4	8
Mizoram	7	1	0	0	0	8
Manipur	9	0	0	0	0	9
Meghalaya	4	4	3	0	0	11
Arunachal Pradesh	16	0	1	2	1	20
Nagaland	11	0	0	0	0	11
Ladakh	0	0	0	0	2	2
India	140	140	146	140	140	706

Source: Authors

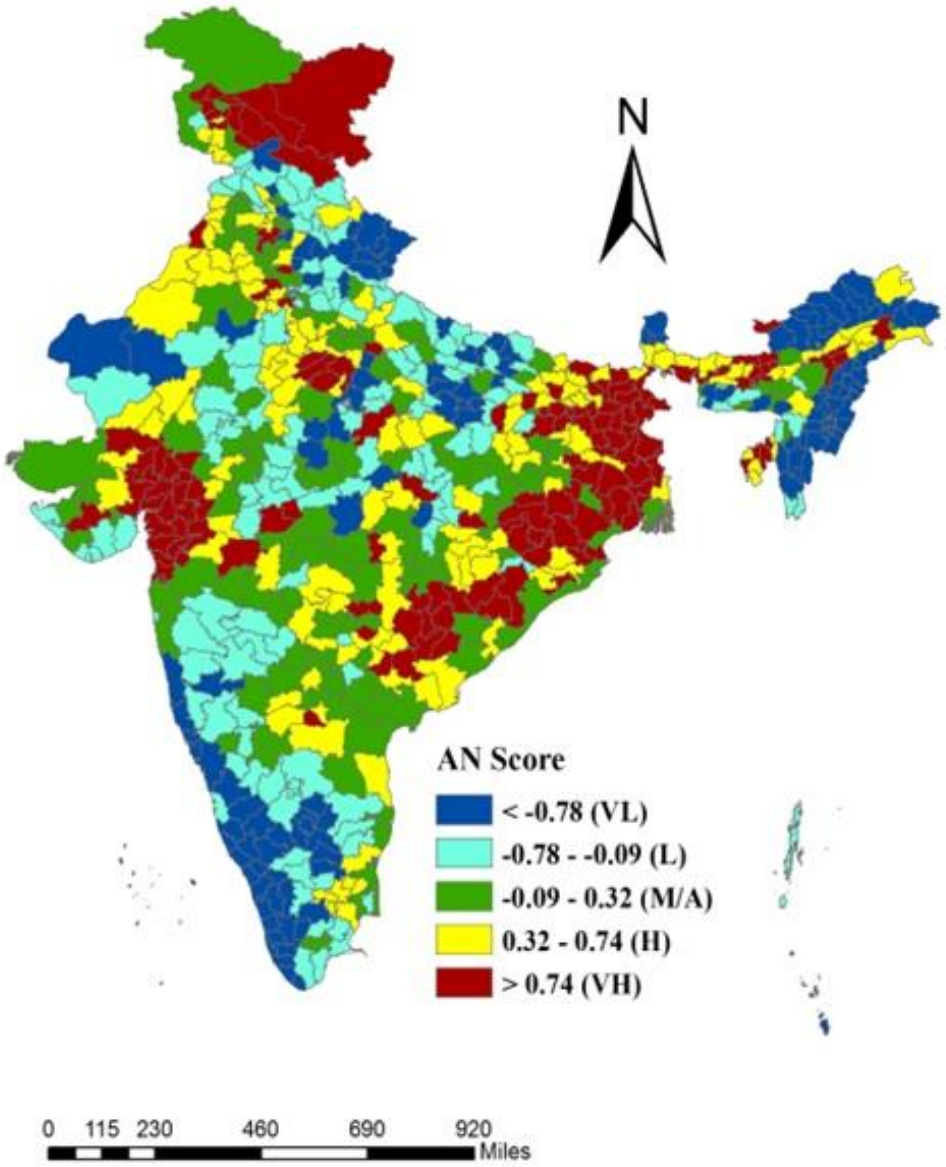

Figure 1: Inter-district variation in composite index of anaemia in children and women, 2019-2021.
Source: Authors

Table 7 reflects the concentration of districts with very high composite index of anaemia in children and women in selected states/Union Territories of the country. For example, the composite index of anaemia in children and women is found to be very high in 14 of the 20 districts in West Bengal and in 24 of the 33 districts in Gujarat. In Odisha, the composite index of anaemia in children and women is found to be very high in 15 of the 30 districts and in 10 of the 20 districts in Jammu & Kashmir. Similarly, the composite index of anaemia in children and women is found to be very high in 18 of the 37 districts in Bihar, 10 of the 24 districts in Jharkhand and 12 of the 33 districts in Assam. On the other hand, there is no district in Uttarakhand, Karnataka, Andhra Pradesh, Kerala, and Tamil Nadu where the composite index of anaemia in children and women is found to be very high. Among the small states and Union Territories, the composite index of anaemia in children and women is found to be very high in both the districts of Ladakh and in 4 of the 8 districts in Tripura.

At the other extreme, Kerala is the only state in the country where the composite index of anaemia in children and women is found to be very low in all the 14 districts of the state. In Uttarakhand, the composite index of anaemia in children and women is found to be very low in 9 of the 13 districts whereas the composite index of anaemia in children and women is found to be very low in 13 of the 30 districts of the state. Among the EAG states, the composite index of anaemia in children and women is found to be very low in 22 of the 75 districts in Uttar Pradesh and a small number of districts in Madhya Pradesh and Rajasthan. In Bihar, Jharkhand and Odisha, there is no district where the composite index of anaemia in children and women is found to be very low according to the fifth round of the National Family Health Survey. Among other large states of the country, the composite index of anaemia in children and women is found to be very low in only 1 district in 3 districts in Himachal Pradesh as well as in Haryana. In Assam, West Bengal, Punjab, Jammu & Kashmir, Gujarat, Andhra Pradesh and Telangana, there is not a single district where the composite index of anaemia in children and women is found to be very low.

Among small states and Union Territories, the composite index of anaemia in child and women is found to be very low in all districts of Goa, Sikkim, Manipur, and Nagaland and in 7 of the 8 districts in Mizoram and in 16 of the 20 districts in Arunachal Pradesh. In Tripura, there is no district where the composite index of anaemia in children and women is found to be very low. In Puducherry, the composite index of anaemia in children and women is found to be very low in 2 of the four districts and in 4 of the 11 districts in Meghalaya.

Table 7 also reveals that in states/Union Territories where the composite index of anaemia in children and women is either high or very high, there are districts where the composite index of anaemia in children and women is either low or very low. Similarly, in states/Union Territories where the composite index of anaemia in children and women is either low or very low, there are districts where the composite index of anaemia in children and women is either high or very high. These districts are anomalous districts in the state. There are 14 such states having at least one anomalous district. (Table 8). For example, Gujarat has a very high composite index of anaemia in children and women but there are five districts in the state - Devbhumi, Bhavnagar, Gir-Somnath,

Porbandar and Amreli – where the composite index of anaemia in children and women is very low. Similarly, the composite index of anaemia in children and women is very high in Bihar but districts Gopalganj and Paschim Champaran of the state have very low composite index of anaemia in children and women. (Table 8). On the other hand, the composite index of anaemia in children and women is very low in Arunachal Pradesh but there are 3 districts – Tawang, Dibang Valley and Changlang – where the composite index of anaemia in children and women is either high or very high.

Table 8: Anomalous districts in some states with respect to the composite index of anaemia in children and women.

Composite index of anaemia	States/UTs	Anomalous districts
Very High	Gujarat	Porbandar (L), Amreli (L), Bhavnagar (L), Devbhumi (L), Gir-Somnath (L)
	Bihar	Gopalganj (L), Paschim Champaran (L)
High	Assam	Cachar (L), Karimnagar (L), Hojai (L)
	Odisha	Khandmal (L), Baudh (L)
	Haryana	Ambala
	Telangana	Rajana Sircilla (L), Yaddari Bhuvanagiri (L)
Medium	Uttar Pradesh	UP: Kannauj (VH)
	Madhya Pradesh	Vidisha (VL), Chindwara (VL), Ashoknagar (VL), Jabalpur (VL)
	Rajasthan	Sikar (VL), Jodhpur (VL), Jaisalmer (VL)
	Chhattisgarh	Kabirdham (VL)
	Maharashtra	Ratnagiri (VL), Sindhdurga (VL) , Sangli (VL)
Low	Uttarakhand	Uttarkashi (H)
	Himachal Pradesh	Lahaul Spiti (VH)
Very Low	Arunachal Pradesh	Tawanag (VH), Changlong (H), Diband (H)

Source: Authors

Determinants of Anaemia in Children and Women

Inter-district variation in the composite index of anaemia in children and women is found to be statistically significantly associated with the inter-district variation in the proportion of women aged 15-49 years with at least high school level schooling; proportion of women aged 20-24 years who got married before reaching 18 years of age; proportion of women aged 15-49 years who received 4 antenatal checkups during their last pregnancy; proportion of women aged 15-49 years whose last delivery was institutional; and proportion of women aged 15-49 years who reported that they were consuming tobacco (Table 9). By contrast, inter-district variation in the proportion of women literate; proportion of women and 15-49 years who consumed at least 100 IFA tablets during their last pregnancy; proportion of children aged 12-23 months who were fully immunised; proportion of children below 6 months of age who were exclusively breastfed during the first 6 months of their life; and proportion of women aged 15-49 years who reported that they were

consuming alcohol is not found to be statistically significantly associated with the inter-district variation in the composite index of anaemia in children and women.

Table 9: Multivariate linear regression analysis of the composite index of anaemia in children and women with selected explanatory indicators.

Explanatory variables	B	Standard error	Beta	't'	P
(Constant)	-0.557	0.460		-1.210	0.227
X_1	-0.009	0.005	-0.112	-1.907	0.057
X_2	-0.029	0.004	-0.419	-6.828	0.000
X_3	0.012	0.003	0.146	3.467	0.001
X_4	-0.010	0.003	-0.211	-3.882	0.000
X_5	-0.003	0.002	-0.060	-1.187	0.236
X_6	-0.014	0.004	-0.173	-4.031	0.000
X_7	0.004	0.003	0.052	1.350	0.177
X_8	0.004	0.003	0.044	1.296	0.196
X_9	0.016	0.003	0.190	4.760	0.000
X_{10}	0.006	0.006	0.037	1.086	0.278
$N=706$; $R^2=0.580$					

Source: Authors

Conclusions and Policy Implications

We have developed in this paper a composite index of anaemia in children and women which is based on the prevalence of anaemia in children aged 6-59 months, pregnant women aged 15-49 years, non-pregnant women aged 15-49 years, all women aged 15-29 years and adolescent women aged 15-19 years to explore how the challenge of anaemia in children and women varies across the states/Union Territories and districts of India. The analysis reveals that the challenge of anaemia in children and women varies widely across states/Union Territories and districts of the country and in many states/Union Territories, the prevalence of anaemia in children and women has increased in recent years which is a cause of concern. There are districts where the challenge of anaemia in children and women is quite alarming whereas there are districts where anaemia in children and women does not appear to be a concern as the prevalence of anaemia in children and women appears to be quite low in these districts. The analysis presented in this paper has identified regions where anaemia in children and women is a major development challenge and calls for focused attention by adopting region-specific strategic anaemia-control policies and interventions to bring around optimal results at the national level. The analysis highlights strengthening of behaviour change communication component in the National Programmes for strict implementation of minimum age at marriage, promotion of higher education among adolescent girls, counselling of women on the health damaging effects of tobacco consumption, higher utilization of antenatal and natal services by women of reproductive age. There is a need to strengthen strategic nutrition supplementation and health-services programmes like ICDS, *POSHAN-Abhiyaan*, AMB, launched by the Government of India.

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Appendix Table: Indicators of the prevalence of anaemia in children and women in India, states, and Union Territories.

India/State/UT	Prevalence of anaemia (Per cent) in									
	Children 6-59 months		Non-pregnant women aged 15-49 years		Pregnant women aged 15-49 years		All women aged 15-49 years		Women aged 15-19 years	
	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021
India	58.6	67.1	53.2	57.2	50.4	52.2	53.1	57.0	54.1	59.1
EAG States										
Bihar	63.5	69.4	60.4	63.6	58.3	63.1	60.3	63.5	61.0	65.7
Uttar Pradesh	63.2	66.4	52.5	50.6	51.0	45.9	52.4	50.4	53.7	52.9
Madhya Pradesh	68.9	72.7	52.4	54.7	54.6	52.9	52.5	54.7	53.2	58.1
Rajasthan	60.3	71.5	46.8	54.7	46.6	46.3	46.8	54.4	49.1	59.4
Jharkhand	69.9	67.5	65.3	65.7	62.6	56.8	65.2	65.3	65.0	65.8
Uttarakhand	59.8	58.8	45.1	42.4	46.5	46.4	45.2	42.6	46.4	40.9
Chhattisgarh	41.6	67.2	47.3	61.2	41.5	51.8	47.0	60.8	45.5	61.4
Odisha	44.6	64.2	51.2	64.4	47.6	61.8	51.0	64.3	51.0	65.5
Other Large States										
Assam	35.7	68.4	46.1	66.4	44.8	54.2	46.0	65.9	42.7	67.0
West Bengal	54.2	69.0	62.8	71.7	53.6	62.3	62.5	71.4	62.2	70.8
Punjab	56.6	71.1	54.0	58.8	42.0	51.7	53.5	58.7	58.0	60.3
Haryana	71.7	70.4	63.1	60.6	55.0	56.5	62.7	60.4	62.7	62.3
Jammu & Kashmir	53.8	72.7	49.0	67.3	46.9	44.1	48.9	65.9	49.9	76.2
Himachal Pradesh	55.4	55.0	53.4	53.4	42.2	43.9	53.0	53.3	53.2	52.3
Gujarat	62.6	79.7	55.1	65.1	51.3	62.6	54.9	65	56.5	69.0
Maharashtra	53.8	68.9	47.9	54.5	49.3	45.7	48.0	54.2	49.7	57.2
Karnataka	60.9	65.5	44.8	47.8	45.4	45.7	44.8	47.8	45.3	49.4
Andhra Pradesh	58.6	63.2	60.2	59.0	52.9	53.7	60.0	58.8	61.1	60.1
Telangana	60.7	70.0	56.9	57.8	48.2	53.2	56.6	57.6	59.7	64.7
Tamil Nadu	50.7	57.4	55.4	53.6	44.4	48.3	55.0	53.4	54.2	52.9
Kerala	35.7	39.4	34.7	36.5	22.6	22.6	34.3	36.3	37.8	32.5
Small States/Union Territories										
National Capital Territory of Delhi	59.7	69.2	54.7	50.2	46.1	42.2	54.3	49.9	55.1	51.6

India/State/UT	Prevalence of anaemia (Per cent) in									
	Children 6-59 months		Non-pregnant women aged 15-49 years		Pregnant women aged 15-49 years		All women aged 15-49 years		Women aged 15-19 years	
	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021	2015-2016	2019-2021
Chandigarh	73.1	54.6	75.9	60.1	75.9	75.9	75.9	60.3	74.7	57.7
Goa	48.3	53.2	31.4	38.9	26.7	41.0	31.3	39.0	30.5	44.5
Lakshadweep	43.1	36.1	26.0	24.1	20.9	19.2	25.8	23.7	31.4	31.9
Puducherry	44.9	64.0	53.4	55.5	26.0	42.5	52.4	55.1	55.0	58.4
Andaman & Nicobar Islands	49.0	40.0	65.8	57.6	61.4	53.7	65.7	57.5	68.1	44.9
Dadra & Nagar Haveli	82.0	75.8	73.4	62.6	62.3	60.7	72.9	62.5	75.9	63.9
Sikkim	55.1	56.4	35.2	42.1	23.6	40.7	34.9	42.1	48.7	46.7
Tripura	48.3	64.3	54.5	67.4	54.4	61.5	54.5	67.2	52.2	67.9
Mizoram	19.3	46.4	24.7	34.8	27.0	34.0	24.8	34.8	21.3	34.9
Manipur	23.9	42.8	26.4	29.3	26.0	32.4	26.4	29.4	21.1	27.9
Meghalaya	48.0	45.1	56.4	54.4	53.3	45.0	56.2	53.8	52.1	52.5
Arunachal Pradesh	54.2	56.6	43.5	40.8	37.8	27.9	43.2	40.3	48.2	48.5
Nagaland	26.4	42.7	27.7	29.3	32.7	22.2	27.9	28.9	26.3	33.9
Ladakh	91.4	92.5	78.4	93.7	79.3	78.1	78.4	92.8	81.6	96.9

Source: Government of India (2017; 2022).

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Untouchability in India: Subaltern Questions

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Abstract

Untouchability and associated discrimination are major sources of social conflict and barrier in development processes in India. This study shows that the prevalence of social conflict emerging out of untouchability and discrimination is relatively higher at the place of residence than that at the level of the community. In the rural areas, conflicts resulting from untouchability and discrimination is found to be very high as compared to that in the urban areas. The study also shows that the resolution of the conflict emerging out of untouchability and discrimination is more common at the community level rather than at the individual level. The study identifies social class, level of education, and geographical area as the key factors that influence the experience of discrimination and untouchability. The study finds that untouchability is rooted in illiteracy and concludes that increasing the level of education in the population can be a powerful tool by way of minimising and ultimately eliminating untouchability and associated discrimination through increased opportunities of participation in productive activities and resulting increase in income levels.

Introduction

Justice is the first virtue of social institutions,
as truth is of systems of thought. – Rawls

Untouchability is a form of discrimination which is faced by the people based on their colour/creed, caste, gender, occupation, and cultural practices-norms. Ambedkar, the pioneer, who led the liberation movement of the untouchables argued that eliciting the consequences on the excluded groups was necessary to understand the nature of untouchability (Ambedkar, 1987). Untouchability is an intricate and omnipresent problem in India and can be found in different parts of the world also. The grammar of untouchability is something which has occupied anthropologists, sociologists, and Indologists for decades and debate over untouchability has focussed mainly on purity and pollution within the religious, symbolical, and ideological systems, and with reference to ideas of status and power (Daniel, 1984; Dumont, 1970; Marriot, 1976). The historical concept of religion and

caste has divided the society into thousands of smaller units and members of different units are characterised in terms of culture, values, norms, food habits, occupation, dress, mannerisms, and the way of life. According to the vertical scale of the Indian *Varna System*, the innumerable caste groups in India are divided into four major classes and the higher the class in the *Varna system* the purer the caste group. These concepts determined the attribution and intersectional association to decide the ranking of castes (Ambedkar, 2004; 2016; Anand, 2020; Rubin and Miles 2004; Cox, 1984). Although, the essential basis about the grouping of the society into castes has been its emphasis on social segregation and ritual purity, yet the caste system has also resulted in discrimination within the society (Chekki, 2017). Discrimination against groups of citizens based on the religion, caste, occupation, language, or national origin has long been a problem which grappled the societies (Moffatt, 2015; Mines, 2002; Omvedt, 1994). The "untouchables" have occupied the bottom-most place in the social hierarchy and have been subjected to various social, cultural, and other kinds of discrimination and exploitation in the society. The essential point is that "untouchables" live in consensus with the wider Indian culture and believes (Hiltebeitel, 2011; Deliege, 1992; 2017). The practice of untouchability has resulted in the marginalisation and neglect of the "untouchables" in the Indian society to an extent that their lives are marked by violence, indignity, and humiliation. Although, the practice of untouchability serves the severe form of social punishment and is harmful for the overall development of the untouchables, yet it remains an incredibly sensitive issue (Moffatt, 2015; Mika et al, 1999). The victims of untouchability often believe that they themselves are responsible for their own suffering and exclusion, thus internalising the beliefs that perpetuate the practice of untouchability (Thorat and Joshi, 2015).

In the Indian society, people start considering themselves superior to the others based on their religion and caste from childhood itself because of the prevailing family and social surroundings. In such a social scenario, untouchability gets associated with the birth of the child (Jalali, 2000) which perpetuates the hierarchy of caste system in deciding the occupational status of the people. The social, economic, and psychological traits often transmit to the next generation. Because of these reasons, the untouchables need to be seen from a qualitative lens which make them distinctly different from others in matters like explaining poverty (Chekki, 2017). The attitudes, values and behaviours of the untouchables are very different from others to constitute a separate way of life, a way which leads to an acceptance of poverty as their destiny (Thorat and Joshi, 2015). Sometimes, social depuration results in a generational cycle because of child rearing in the family and the nearby society (Shaun and Yanis, 2002).

The practice of untouchability and associated discrimination can be frequently observed in the rural and peri-urban areas (Lippert-Rasmussen, 2006; Desai, 2005; Deliège, 2017). Because of the continued menace of untouchability, the social and economic conditions of the untouchables continue to be vulnerable. They are devoid of basic needs and some civil rights and are subject to various offenses, indignities, and humiliations (Rekha, 2014; Desai, 2005; Dhanagare, 2004). Touch differs from the other modalities of perception in one important respect – it is always a mutual experience: "whatever you touch, touches you too" (Hsu 2000). This aspect makes touch a prominent sense for close relationships, such as love and aggression, while, at the same time, its absence makes for social boundaries and exclusion.

In the Indian caste system, the untouchables are primarily engaged in such occupations as cleaning, sweeping, sewage cleaning and even manual scavenging and this situation persists even after more than 75 years of independence. These occupations are associated with many occupational health hazards and are low-wage occupations as regards earnings for the livelihood (Agrawal, 2014; Thorat and Katherine, 2012; Deshpande, 2011; Eknoordeep, 2022; Gupta, 2005; Ram, 2004). The caste-based social and economic discrimination in India has largely been discussed in the context of labour markets and access to public goods (Hargreaves-Heap and Varoufakis, 2002). However, the struggle and challenges of the untouchables in the Indian society continue to persist.

During the colonial rule in India, various social and religious reform movements took place in the country which led to rising local and national consciousness and increasing spread of the generous concepts of the west. These movements also created an atmosphere which was sympathetic towards the untouchables (Pal and Dasgupta, 2020; Desai, 2005; Jaffrelot, 2005). These movements also forced the government to provide protective discrimination to the untouchables to pull them out of the traditional social segregation (Heyer and Jayal, 2009; Mosse, 2018). These movements tended to have a national scope and a programme of reconstruction among all social spheres. The social reformers of that time denounced all kinds of social inequalities and separatism and stood for equality and cooperation. They attacked the distinction-based heredity, and the doctrine of karma which supplied the religious, philosophical defence of the undemocratic, authoritarian caste institution (Pal and Dasgupta, 2020; Gupta, 1980).

The Indian struggle for independence was not only against the colonial rule but was also against the social evils including centuries old social inequalities, discrimination, and untouchability. The Constitution of India has, therefore, made specific provisions for the abolition and elimination of social evils and amelioration of downtrodden castes and social groups (Narula, 2008; Galanter, 1979). However, untouchability and associated discrimination remains a major challenge to social and economic development in India even in the contemporary times. Untouchability is a kind of overview of poverty and human misery in the Indian society (Judge, 2014). There are many studies that have highlighted that, although India has made significant development strides after the independence, yet low caste and the poor are still struggling for their fundamental and basic rights (Rekha, 2014; Sharma, 2005; Jaffrelot, 2005; Thorat and Katherine, 2012; Dasgupta and Pal, 2021, 2010; Shah, 2006; Seipel, 2003; Javaid et al, 2014). Even at the present times, the untouchables are not allowed into the temples or to use public well/tanks, and untouchability continues to be the most inhuman form of social oppression (Sooryamoorthy, 2008). Articles 15 and 16 of the Constitution of India talk of the reservation for safeguarding the interests of the untouchables, which remains to be one of the powerful obstacles by way of achieving personal and social development goal, unity, and solidarity (Desai, 2005; Eknoordeep, 2022) but incidences of discrimination on the grounds of caste and class are common. Individuals who have experienced untouchability and associated discrimination have often been found to be demotivated. They avoid participating in social activities at the workplaces (Guschke, 2023; Khadka et al, 2022). It is estimated that about 30 per cent of people from Scheduled Castes and Scheduled Tribes communities in India experience discrimination in employment (Oxfam India, 2022). The magnitude of untouchability, however, remains underreported, especially in the rural areas where cultural

practices are dominant and are perpetuated by traditional caste hierarchy (Thorat and Joshi, 2020; Chinnaswamy, 2023). The social division within the society remains one of the leading causes of social disparity in India (Cháirez-Garza, 2022).

The foregoing considerations constitute the rationale for the present study which seeks to assess the challenge of untouchability in the Indian society. The study also attempts to develop an empirical model to discriminate households practising untouchability from the households not practising untouchability. The study reveals that households practising untouchability can be discriminated from the households not practising untouchability in terms of selected household characteristics.

Materials and Methods

The study is based on the data available from the India Human Development Survey (IHDS) which was launched in the year 2005. The India Human Development Survey is a nationally representative, multi-topic household survey that covered 41,554 households in 1,503 villages and 971 urban neighborhoods of the country in 2005. The survey topics covered in the survey included health, education, employment, economic status, marriage, fertility, gender relations, and social capital. The 2005 survey was followed up by the follow up survey in 2012 (IDHS-II) that revisited the same households which were visited in the 2005 survey. This makes IHDS unique in India as a large-scale survey where results from two time periods can be directly compared. The present study is, however, based on the data available from IDHS-II as questions related to untouchability were not asked during the 2005 round of the survey. The IHDS-II collected information from 42,152 households from the same villages and urban neighbourhoods that were covered in the 2005 round of the survey (Charsley, 2004; Sherif, 2015).

IDHS-II is the first and the only large-scale survey in India in which questions related to untouchability were asked. The IDHS-II asked three questions related to untouchability. The first was whether any member of the household practiced untouchability. The households where no member of the household was practicing untouchability were coded as '0' whereas the households where at least one member of the household was practicing untouchability were coded as '1'. Among the households where no member of the household was practicing untouchability, it was further asked whether it would be a problem if someone who is from the Scheduled Castes community enters the kitchen or shares utensils. Finally, the last question was asked specifically from Scheduled Castes respondents about the experience of untouchability by any member of the household during the last five years. The present study is limited to the analysis of the response received about the first question only.

Bivariate and multivariate analysis techniques have been used for the analysis of the data collected during IDHS-II. The selection of the techniques was guided by Dalgleish (1994). The bivariate analysis comprised of estimating the proportion of households where at least one member of the household was reported to be practising untouchability at the time of the survey by selected demographic, social and economic characteristics of the respondents including place of residence, religion, social class, level of education,

occupation, household economic status and type of dwelling. On the other hand, the discriminatory power of selected covariates of the households where at least one member of the household was reported to be practising untouchability was examined through liner discriminant analysis. The STATA version 13 software package was used for the analysis. Weights were incorporated to ensure the representativeness of the sample. The dependent variable for the discriminant analysis was the practice of untouchability in the household. On the other hand, the explanatory or independent variables used in the construction of the discriminant model included place of residence (rural, urban), religion (Hindu, Muslim, Others), social group (Scheduled Caste, Scheduled Tribe, Other Backward Classes, Others), type of house (own, rented), standard of living (poor, non-poor), education (no education, primary, secondary and above secondary), occupation (cultivation, agricultural labour, non-agricultural labour, salaried, others), and regions of the country (North, Central, East, North-East, West and South).

Results

Table 1 shows proportionate distribution of household practising untouchability by selected background characteristics. The practice of untouchability has been found to be significantly higher in Hindu households compared to households of other religions. The practice of untouchability has also been found to be higher in poor households as compared to non-poor households, but the difference is not found to be very large. On the other hand, the proportion of households practising untouchability is found to be very low in Scheduled Castes households but quite high in households of Other Backward Classes and Other Castes which essentially constitute the upper castes in the Indian society. Similarly, the practice of untouchability has been found to vary widely by the primary occupation of the household – low in households with agricultural labour as the primary household occupation but high in households with cultivation as primary occupation. Thorat and Joshi (2015) have also reported that people who are engaged in cultivation and agriculture report higher experience of untouchability as compared to people engaged in other occupations. The proportion of households practising untouchability has also been found to vary widely across different regions of the country. In the central region of the country comprising of the states of Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand and Odisha, the proportion of households practising untouchability is found to be exceptionally high whereas the proportion of household practising untouchability is found to be very low in the southern region of the country comprising of the states of Kerala, Tamil Nadu, Andhra Pradesh, and Karnataka. Table 1 also shows that the distribution of households practising untouchability by the highest level of education in the household is highly skewed. At the national level, around one-fifth of the households were found to be practising untouchability and in almost two-third of these households, all members of the household were uneducated whereas in only about 7 per cent of the households, there was at least one household members having at least higher secondary level education. Interestingly, the proportion of households with at least one member having education above secondary practising untouchability, is found to be higher than the proportion of households in which at least one member of the household was having secondary level education irrespective of the background characteristics of the respondents.

Table 1: Proportion (per cent) of households practising untouchability by selected household characteristics in India, 2011-12.

Background Characteristics	Experienced untouchability (Per cent)	Educational status of those who experienced untouchability (Per cent)				N
		No education	Primary	Secondary	Above secondary	
Place of residence						
Rural	23.7	68.6	19.2	05.8	06.4	27579
Urban	15.3	43.4	21.9	11.6	23.1	14573
Religion						
Hindu	23.4	61.6	20.4	07.3	10.8	34402
Muslim	10.3	75.4	12.4	05.3	06.9	4928
Others	06.9	55.7	21.1	09.8	13.4	2822
Social Group						
Scheduled Castes	09.2	76.9	14.4	04.2	04.5	8941
Scheduled Tribes	18.5	78.9	13.5	03.9	03.7	3644
Other Backward Classes	24.7	67.0	19.6	06.3	07.1	17056
Others	24.5	48.1	23.3	10.0	18.6	12511
Type of house						
Own	21.4	63.1	20.0	07.0	10.0	38729
Rented	13.6	46.8	18.5	11.9	22.8	3423
Economic status						
Poor	22.4	76.2	16.0	04.1	03.7	35232
Non-poor	20.5	59.2	20.8	07.9	12.1	6917
Education						
No education	21.3					25569
Primary	20.5					8516
Secondary	19.5					3242
Higher than secondary	19.3					4825
Occupation						
Cultivation	29.1	67.3	21.1	05.5	06.1	10287
Agricultural labour	14.9	78.8	12.9	02.9	05.4	4643
Non-agricultural labour	17.9	75.8	16.5	04.8	02.9	9497
Salaried	18.7	44.9	22.2	10.1	22.9	11128
Others	19.7	51.8	21.7	12.0	14.5	6597
National region						
North	20.2	60.0	19.3	07.7	13.0	7156
Central	35.6	66.7	18.8	06.3	08.2	10978
East	18.4	57.9	22.8	08.1	11.2	6896
North-East	16.2	37.3	27.1	10.8	24.8	1887
West	13.6	51.2	24.2	09.9	14.7	5511
South	11.7	68.0	16.7	06.1	09.2	9727
India	20.8	62.2	19.9	07.2	10.6	42152

Source: Authors' calculations

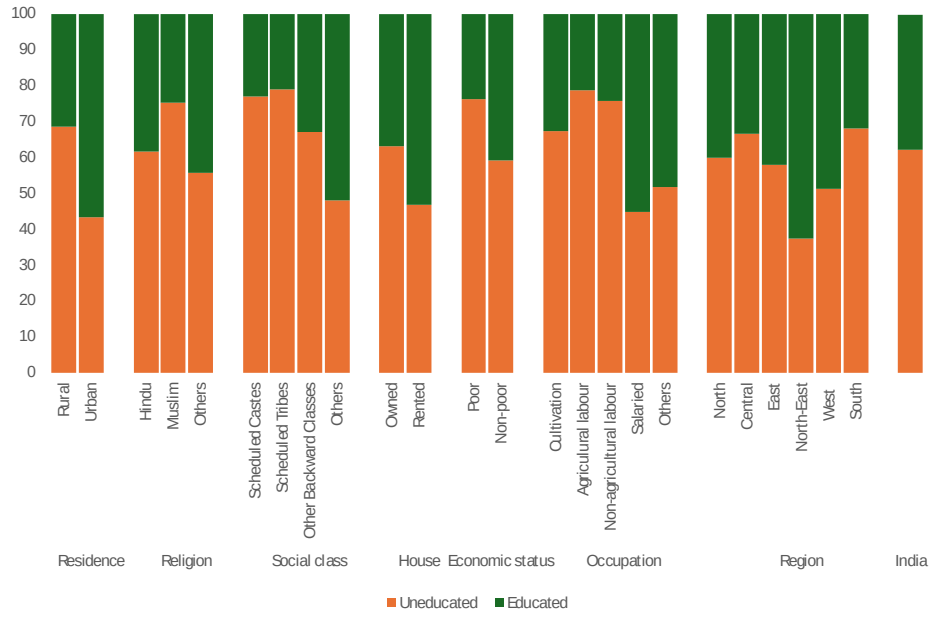

Figure 1: Educational status of respondents who reported experience of untouchability by background characteristics.
Source: Authors

There are other interesting variations also. For example, among the households practising untouchability, the proportion of households in which all members of the household were uneducated respondents is found to be higher in the rural areas as compared to the urban areas, but the proportion of households practising untouchability in which at least one member was educated was found to be higher in the urban areas as compared to the rural areas. Similarly, among the proportion of poor households practising untouchability, is found to be higher as compared to the non-poor practising untouchability. However, among the non-poor households practising untouchability, the proportion of households having at least one educated member is found to be higher than the proportion of households with no educated member. Table 1 shows that the distribution of the households practising untouchability by the highest level of education of at least one member of the household is not the same in households of different background characteristics which means that the impact of the educational status of the members of the household on the practise of untouchability in the household is conditioned by the background characteristics of the household (Figure 1).

Table 2 gives the group statistics of the distribution of households practising untouchability, and household not practising untouchability. It may be observed from the table that the group 1 comprising of household not practicing of untouchability has higher means than the group 2 comprising of households practising untouchability, in 7 of the 8 covariates or social, economic, and demographic characteristics of the household. It is only

in case of social class and the ownership of the house that the mean of the group 1 is found to be lower than the mean of group 2, although the difference in means of the two groups is only marginal in case of the ownership of the house. On the other hand, the mean of the group 1 is found to be very high as compared to the mean of the group 2 in case of the educational status of the household measured in terms of the highest level of education achieved by the members of the household. In case of occupation and region also, the mean of the group 1 is found to be substantially higher than the mean of the group 2. In case of other covariates also, the mean of the group 1 is found to be higher than the mean of the group 2, although the difference is not substantial. Table 2, therefore suggests that households practising untouchability and households not practising untouchability have different social, economic, and demographic characteristics. This observation is also supported by table 3 in which results of the testing of the equality of group means have been presented. The table suggests that the power of the model to discriminate between households practising untouchability and households not practising untouchability is different for different covariates and, for some covariates, the power of discrimination does not appear to be significant.

Table 2: Group statistics of selected covariates.

Experience of Untouchability	Background Characteristics	Mean	Standard Deviation	Valid N (listwise)	
				Un-weighted	Weighted
No	Place of residence	1.369	0.482	33390	33390
	Religion	1.289	0.602	33390	33390
	Social Group	2.707	1.122	33390	33390
	Education level	2.708	1.033	33390	33390
	Type of house	1.088	0.284	33390	33390
	House economic status	0.160	0.367	33390	33390
	Source of income	3.032	1.377	33390	33390
	National region	3.553	1.878	33390	33390
Yes	Place of residence	1.253	0.435	08762	08762
	Religion	1.102	0.368	08762	08762
	Social Group	3.085	0.890	08762	08762
	Education level	0.662	1.003	08762	08762
	Type of house	1.052	0.223	08762	08762
	House economic status	0.176	0.381	08762	08762
	Source of income	2.770	1.491	08762	08762
	National region	2.807	1.610	08762	08762
Total	Place of residence	1.345	0.475	42152	42152
	Religion	1.250	0.567	42152	42152
	Social Group	2.786	1.089	42152	42152
	Education level	2.699	1.025	42152	42152
	Type of house	1.081	0.273	42152	42152
	House economic status	0.164	0.370	42152	42152
	Source of income	2.978	1.405	42152	42152
	National region	3.398	1.850	42152	42152

Source: Authors

Table 3: Tests of equality of group means.

Groups	Wilks Lambda	F	df1	df2	p
Place of residence	0.990	416.032	1	42150	.000
Religion	0.982	772.347	1	42150	.000
Social Group	0.980	852.652	1	42150	.000
Education level	1.000	14.032	1	42150	.000
Type of house	0.997	118.864	1	42150	.000
House economic status	1.000	12.756	1	42150	.000
Source of income	0.994	237.564	1	42150	.000
National region	0.973	160.207	1	42150	.000

Source: Authors

Table 4 presents the eigenvalue and associated canonical correlation. The larger the eigenvalue the more the amount of the variance shared by the linear combination of covariates and hence the greater the power of the discriminating function to discriminate between the two groups – households practicing untouchability and households not practicing untouchability. On the other hand, the percentage of variance reveals the importance of the discriminant function while the cumulative variance provides the cumulative percentage of the variance. Since there is only one discriminant function, the percentage of variance is 100 per cent. Finally, the canonical correlation coefficient between discriminant scores on the discriminant function and each covariate shows the strength of association – the higher the canonical correlation the stronger the association. A value of '1' is considered as perfect. In the present analysis, the canonical correlation is estimated to be 0.287 which means that the discriminant function explains around 9 per cent of the total variance.

Table 4: Canonical discrimination functions – eigenvalue and canonical correlation.

Function	Eigenvalue	Percentage of variance	Cumulative percentage of variance	Canonical correlation
1	0.090	100.0	100.0	0.287

Source: Authors

Note: There are only two groups so there is only one discriminant function.

Table 5 presents the standardised canonical discriminant function coefficients and the classification function coefficients. The table suggests that households practising untouchability and households not practising untouchability have marked differences in terms of the place of residence, social group, religion, and the region of the country. By contrast, there appears little difference between the two groups in terms of household level of education, ownership of the house, household economic status, and the main occupation of the household. The discriminant scores are calculated using the standardised canonical discriminant function coefficients. They are calculated as the predicted value from the linear regression using the standardised canonical discriminant function coefficients and the standardised value of the covariates. It may be seen from the table 5 that in case of households not practising untouchability, place of residence, religion, level of education,

type of house, source of income, regions of the country have higher classification function coefficients whereas households practising untouchability have higher classification function coefficients in case of social group and household economic status. In addition, the classification function coefficient of the level of education is found to be negative in both groups.

Table 5: Standardised canonical discriminant function coefficients and discriminant scores.

Background Characteristics	Standardised canonical discriminant function coefficients	Classification function coefficients	
		Households not practising untouchability	Households practising untouchability
Place of residence	0.668	2.534	2.116
Religion	0.527	3.697	3.005
Social Group	0.626	1.975	2.404
Education level	0.048	-0.532	-0.566
Type of house	-0.048	12.317	12.186
House economic status	-0.062	3.453	3.576
Source of income	0.114	0.759	0.683
National region	0.507	0.977	0.739
Constant		-16.706	-16.791

Source: Authors

Discussion

The present analysis reveals that at least one-fifth of the households in India practice untouchability in the sense that at least one member of the household was reported practising untouchability at the time of IDHS-II. The analysis also reveals that the practice of untouchability is quite common in the households of the central region of the country comprising of the states of Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand, and Odisha. By comparison, in the southern region of the country, comprising of the states of Kerala, Tamil Nadu, Andhra Pradesh and Karnataka, the proportion of households practising untouchability is less than one-third of the proportion of households in the central region practising untouchability. The proportion of households practising untouchability has also been found to be different by the social, economic, and demographic characteristics of the households. An interesting observation of the present analysis is that in each population groups, the proportion of households practising untouchability is different in uneducated households and in educated households which confirms that universalisation of education may go a long way in dealing with the problem of untouchability in the country. Earlier studies have also shown that the level of education of the society is one of the most significant factors in deciding the practice of untouchability among the population. Universalising education expands employment opportunities and contributes to social and economic development and, therefore, leads to the reduction in the practice of untouchability and the associated discrimination. The practice of untouchability is more common in the rural areas relative to the urban areas because poverty, illiteracy and old

traditions are more prevalent in the rural areas (Agrawal, 2014). Untouchability, along with other social discrimination and social conflicts are major barriers in the progress towards developmental goals. Most victims of untouchability and associated discrimination belongs to the socially disadvantaged groups and have a higher probability living under adverse conditions (Thorat and Katherine, 2012; Omvedt, 1994), hence elimination of untouchability should be a priority in the development agenda of the country.

Untouchability is argued to be associated with the Hindu caste system that believes in the purity among the so-called upper castes. Since untouchability has religious and cultural roots in the Indian society, it is being practiced, since times immemorial, and is still quite common despite various efforts made by various social reformers and initiatives at the level of the government. The Constitution of India has made specific provisions to protect the rights and the dignity of the people to prohibit untouchability and associated discrimination, thanks to the pioneering efforts by Ambedkar (Anand, 2020). The philosophy of Ambedkar is twofold. One is directed towards the destruction of the unjust social order based on graded inequality and hereditary while the other is related to the liberation of the depressed classes, particularly the untouchables. Ambedkar advocated self-help, self-representation and self-elevation and vehemently opposed the ways that perpetuate oppression. The history of injustice can be overturned by awakening the oppressed and creating conditions within which the oppressed take charge of their liberation through their own exertion and actions (Sangole, 2022).

Conclusion

The present analysis reveals that the practice of untouchability is still quite pervasive in India as it has roots in the notion of purity and pollution of the caste in the Hindu religion and is embedded in the social and political settings of the Indian society as can be visualised in various forms like physical or social boycott from the society. Although, the primary pillar of the caste system, endogamy marriages remain intact, there has been steady growth of interfaith marriages. In the past, untouchability was legitimately practiced, but because of continued activism, action and awareness, the general perception in the society now is that it is an unacceptable and illegal concept and form of behaviour. The Indian state does not legitimise caste system and associated discrimination in any form. The present study emphasises the need of education for all to address the challenge of untouchability and associated discrimination. Universalising education may lead to new employment opportunities and social and economic progress which can impact the practice of untouchability as untouchability has roots in illiteracy and poverty. Addressing illiteracy and poverty, therefore, is the most effective way of addressing untouchability and associated discrimination that remains a deterrent to social and economic progress in India.

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Informed Choice and Use of Selected Contraceptive Methods in Scheduled Tribes Women in India

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Abstract

Family planning is one of the important public health initiatives implemented to stabilise population growth and reduce infant mortality. Though, since its inception, a greater level of differential among the social group has been observed in the utilization of family planning services. The present study tries to assess the level of informed choice of contraception use among the women from Scheduled tribe in India using the latest round of the National Family Health Survey (NFHS-5) data conducted during 2019-21. Bivariate and logistic regression technique has been used for the data analysis. Results demonstrated the dominance of female sterilization over other contraceptive methods among tribal women. The overall Method Information Index (MII) shows that only 54 per cent of the respondents were provided with the information related to methods they were currently using, and the MII value varied considerably by the background characteristics of the respondents. From a policy point of view, first and foremost, an important factor to improve the Contraceptive Prevalence Rate (CPR) is raising literacy rate among tribal couples. Secondly, constant efforts of health workers should be required to address the unmet need for contraception to ensure quality care to the receivers.

Introduction

India was the first country in the world to introduce official family planning programme in 1952 to control population growth. Since then, persistent efforts have been made to promote use of family planning methods not only to reduce fertility but also to improve maternal and child health. After the 1971 population census, the programme put a heavily focused on the use of permanent methods in the context of reducing fertility and curtailing rapid population growth which was characterised what was known as the target-based approach. This approach resulted in coercion and force in the implementation of the official family planning programme giving a bad name to family planning. In 1995, the target-based approach of implementation of the family planning programme in the country was replaced by the target-free or the community needs assessment-based approach of

implementation. The London Summit, 2012 rejuvenated the global commitment to family planning and set a goal of providing modern contraceptive methods to 120 million women and meeting the unmet need in 69 of the poorest countries by 2020 (Brown et al, 2014). In this context, India committed to providing modern contraceptive methods to 48 million additional women by 2020 and ensuring the quality of family planning services (Government of India, 2014). However, the vision FP2030 report of the Government of India acknowledged that the country could add up only about 24 million women during the period of 2012-2020 (Government of India, 2022a). The Government of India now aims at access to high quality comprehensive family planning services for all people of reproductive age group including those from marginalised groups by ensuring equitable, affordable, and appropriate choices and information till the last mile through improved health systems and community engagement within the framework of universal health coverage (Government of India, 2022a).

The use of modern contraceptive methods in India remains low by international standards. According to the latest round of the National Family Health Survey (2019-2022), only 56 per cent currently married women of reproductive age or their husband were using a modern contraceptive method in the country and there is substantial within-country inequality in the use of modern contraceptive methods. For example, only 55 per cent currently married Scheduled Tribes women of reproductive age or their husband were using a family planning method compared to 57 per cent of currently married Scheduled Castes women of reproductive age or their husband. Among Other Backward Classes and Other Castes, more than 56 per cent currently married women of reproductive age or their husband were using a modern contraceptive method (Government of India, 2022b). In the rural areas of the country the prevalence of modern contraceptive methods in Scheduled Tribes population is even lower. In this context, the present study focuses on the concept of informed choice as measured through the Method Information Index (MII) and its correlates among Scheduled Tribes women in India. The Method Information Index (MII) is a measure used to assess the quality of information provided to women about family planning methods. It reflects whether women were informed about other methods, potential side effects, and what to do if they experienced side effects. One key reason for the low use of modern contraceptive methods in India, particularly among tribal women, may be the lack of informed choice regarding these methods.

There are many studies that have raised concerns about the quality of family planning services in India and have argued that there is scope for improving the quality of family planning services in the country (Mavlankar and Sharma, 1999; Srinivasan, 2006). There is also strong evidence to suggest that despite the progress in improving access to healthcare services and increase in the social and economic status of the people, gender and regional inequalities in the use of modern contraceptive methods continue to persist (Balarajan, 2011; Baru et al, 2010; Mishra et al, 2020: Jungari and Chauhan, 2017). A similar case has been observed for contraception use among women in general (Pradhan, 2019; Chauhan and Prasad, 2021) and Scheduled Tribes in particular (Das, 2022). One component of the quality of family planning services is related to increasing the knowledge and awareness about different contraceptive methods to facilitate the potential contraceptive users to choose the method that suits them the most or the informed choice.

The present paper analyses the use of modern contraceptive methods and the prevalence of informed choice among the currently married Scheduled Tribes women of reproductive age in India. By the informed choice, we mean that the user of a modern contraceptive method is informed, in advance, about the possible side effects of using the method, what to do if there are side effects in using the method and other contraceptive methods available to meet the contraceptive need of the user. India has the second largest tribal population (104 million) in the world, next to China (106 million) (Hall and Patrinos, 2012). Tribal people are those whose social, cultural, and economic conditions are different from the other sections of society and their living is regulated wholly or partly by their own customs or traditions or by special laws or regulations (Anderson et al, 2016). According to the 2011 population census in India, the tribal population accounts for at least 8.6 per cent population of the country.

In this paper, the term "tribal" refers specifically to Scheduled Tribes as recognised in the Constitution of India. Scheduled Tribes are socio-economically the most deprived social group in India, characterised by low level of literacy and poor economic and living conditions (Prusty, 2014). They have limited access to healthcare and education. Tribal women have unique needs and obstacles to family planning services including cultural barriers. Understanding the cultural barriers to contraceptive use is crucial for designing effective interventions. By examining the use of modern contraceptive methods and informed choice among tribal women, the study contributes to improving family planning services for marginalized populations in India.

The paper is restricted to the use of modern contraceptive methods only because the traditional contraceptive use methods are not supported under the official family planning programme of the country. Although, use of contraceptive methods is a personal matter, yet and it is not easy to break social and cultural barriers when it comes to the use of modern contraceptive method among the tribal communities (Das et al, 2015). There are only a few studies that have focussed on the use of modern contraceptive methods by tribal women (Ladusingh et al, 2006). The present paper attempts to fill up this gap in the knowledge. It examines levels and differentials in the use of modern contraceptive methods by tribal women in India and examines levels and differentials in information that users of different methods received including potential side effects, information about what to do in case of side effects, and knowledge about alternative methods available.

Data and Methods

The data for the present study have been extracted from the fifth round of the National Family Health Survey (NFHS-5) conducted during 2019-21. The current research is based on currently married women who started using any modern contraceptive method (pill, IUD, injectable or sterilisation) during the last five years from the date of the survey. The study is restricted to the last three years to reduce the effect of recall lapses and learnings over the period. NFHS is the nationally representative household survey that provides a wealth of information on fertility, mortality, sexual and reproductive health, and a wide range of monitoring and impact evaluation indicators in the areas of population and health at state and district levels.

The NFHS-5 was organised under the stewardship of the Government of India, Ministry of Health and Family Welfare and was conducted by the International Institute for Population Sciences, Mumbai as the nodal agency for the survey. The methodology of the survey has been discussed elsewhere (Government of India, 2022b). The data, during the survey, were collected from a statistically representative sample of households selected using a stratified, two-stage cluster sampling design. The village and municipal ward list of the 2011 population census served as the sampling frame for the selection of the primary sampling units in the rural and urban areas of the country using the probability proportional to size sampling procedure. In the second stage of sample selection, 22 households were selected through the systematic sampling procedure in every selected rural and urban cluster or primary sampling unit. The response rate in the survey was 98 per cent for the households, 97 per cent for the currently married women of reproductive age, and 92 per cent for men.

Informed choice of the modern contraceptive methods is the main outcome variable of the present study. The women were asked during the survey that, when they started using the contraceptive method, whether they were informed about the side-effects of the method, what to do if they experienced these side effects, and what were other contraceptive methods that they could have used. In addition, women who opted for sterilisation were also asked whether they were informed before sterilisation that sterilisation was a permanent method of contraception and could not be reversed. Although, these questions do not cover all features of contraceptives related knowledge transfer from service providers to the users of contraceptive methods, yet they do capture some significant features. Based on these questions, the method information index (MII) was constructed for specific contraceptive methods that the women were using at the time of the survey.

On the other hand, the independent variables used in the present analysis include the current age of women (15-24, 24-34 and 34-49 years), place of residence (urban or rural), level of education of women (no education, primary, secondary, and above secondary), religion (Hindu, Muslim and others), wealth quintile (poorest, poor, middle, rich and richest), exposure to media (yes and no), exposed to family planning messages (no and yes), and the total number of members in the household (<6, and 6 and more). The analysis has not included the source of the method as an independent variable in the analysis for the oral contraceptive pill because a substantial proportion of pill users have been found to have obtained their last supply from a commercial outlet in which case there was little scope for counselling. Moreover, the survey did not collect information about the initial supply for oral contraceptive pill to the user.

Bivariate and multivariate statistical techniques have been used for data analysis. The bivariate analysis was confined to the cross tabulation of the response of the women surveyed by their individual characteristics. On the other hand, multivariate logistic regression was carried out to estimate the adjusted effects of the independent variables on method information index (MII) for specific methods - female sterilisation, oral contraceptive pill and IUD/PPIUD as well as method information index of all the three methods combined. The state sample weight has been used in the analysis. The analysis was carried out using the STATA version 14 software.

Results

The prevalence of female sterilization, oral pill and IUD/PPIUD among the currently married Scheduled Tribes women of reproductive age who started using the method sometimes during the five years preceding the survey is presented in Table 1. The female sterilisation is found to be the most preferred of the three contraceptive methods. The prevalence of all the three methods has been found to vary by the individual characteristics of the women. For instance, the prevalence of female sterilisation is found to be higher in women aged 25-34 years but the prevalence of IUD/PPIUD is found to be higher in women aged 15-24 years. The urban-rural difference in the prevalence of the three contraceptive methods has not been found to be large but education of the woman has a definite impact on the use of the three methods. The prevalence of sterilisation is found to be higher in women with no formal education and in women having primary level education but the prevalence of IUD/PPIUD is found to be higher among women with at least secondary level education. Similarly, the prevalence of IUD/PPIUD is found to be higher in women belonging to higher wealth quintiles group whereas prevalence of sterilisation is found to be higher in women belonging to lower wealth quintiles groups. The prevalence of IUD/PPIUD is also found to be higher in women having exposure to mass media as compared to women having no exposure to mass media.

Table 2 presents the distribution of women using female sterilisation by the information they received at the time of sterilisation and the method information index (MII) by their background characteristics. It may be seen from the table that the MII varies by the place of residence, by the exposure to the mass media and by the exposure to family planning messages. The prevalence of sterilisation was higher in women exposed to family planning messages relative to women who were not exposed to family planning messages.

Table 2, 3 and 4 gives the method information index respectively for sterilisation, oral pill and IUD/PPIUD by the background characteristics of Scheduled Tribes women using the three methods. In case of the method information index of sterilisation, the variation across different characteristics of the users is not vary large except in case of exposure to mass media and exposure to family planning messages. Women having exposure to mass media or to family planning messages have been found to have higher method information index compared to women not having exposure to mass media and to family planning messages.

In case of oral pill users, on the other hand, there is a gap in the method information index (MII) by the source of obtaining oral pills. Those Scheduled Tribes women who obtained oral pills from public health facilities have higher method information index (64 per cent) compared to those who obtained oral pills from a private source (48 per cent). Similarly, the level of education has a direct effect on the method information index – the higher the level of education, the higher the index. The same is the case with the wealth quintiles. The method information index has also been found to be higher in Scheduled Tribes women following the Hindu religion as compared to Scheduled Tribes women following the Muslim religion. The method information index has been found to be higher in women exposed to family planning messages as compared to women who were not exposed to family planning messages.

Table 1: Prevalence (Per cent) of female sterilisation, oral pill and IUD/PPIUD) among currently married Scheduled Tribes women of reproductive age who started using the method sometimes during the five years before NFHS-5, India.

Background characteristics of Scheduled Tribes women	Female sterilisation	Oral pill	IUD/PPIUD	N
Age				
15-24	18.7	13.3	7.9	3445
25-34	42.2	12.6	6.1	7131
35-49	37.5	14.5	5.4	1982
Place of residence				
Urban	33.3	10.6	7.4	1603
Rural	35.2	13.4	6.4	10954
Education				
No education	41.5	12.9	4.2	3948
Primary	41.3	13.3	5.7	1884
Secondary	30.7	13.8	7.9	5845
Above secondary	21.0	8.6	8.8	880
Religion				
Hindu	37.6	12.0	5.9	10910
Muslim	24.1	17.8	6.5	270
Others	16.5	20.9	11.5	1377
Wealth quintiles				
Poorest	34.5	14.6	5.7	5939
Poor	35.9	12.9	7.2	3101
Middle	38.2	10.4	7.3	1798
Rich	34.1	11.7	6.4	1084
Richest	27.8	9.6	8.8	636
Exposure to media				
No	36.4	13.4	5.3	4551
Yes	34.2	12.9	7.1	8006
Exposure to family planning messages				
No	37.5	13.1	5.8	5778
Yes	32.9	13.1	7.1	6779
Number of family members				
Less than 6	31.4	15.4	6.9	6849
6 and more	39.3	10.3	6.0	5708
Total	35.0	13.1	6.5	12557

Source: Authors.
Note: Weighted estimates. Numbers may not be the same because of missing values.

Table 2: Method Information Index (MII) for sterilised Scheduled Tribes women.

Background characteristics	Informed about side effects	Informed about what to do if there are side effects	Informed about other methods	Method Information Index	N
Source of method use					
Public	62.9	56.2	66.2	50.6	4015
Private	62.6	56.7	65.2	49.8	423
Others	30.1	23.9	25.2	23.9	14
Age					
15-24	59.4	51.3	63.5	45.5	659
24-34	63.7	57.7	66.9	51.9	3037
35-49	60.0	52.8	63.0	47.6	775
Place of residence					
Urban	66.5	59.3	67.1	52.9	548
Rural	61.9	55.4	65.5	49.9	3923
Education					
No education	62.5	55.0	64.8	50.0	1673
Primary	61.2	56.8	66.1	51.1	793
Secondary	63.2	56.5	65.7	49.8	1819
Above secondary	59.6	54.1	72.3	52.6	186
Religion					
Hindu	62.4	55.9	65.6	50.1	4173
Muslim	67.7	63.0	68.8	59.7	67
Others	62.3	53.7	67.0	49.4	232
Wealth quintile					
Poorest	61.0	55.0	64.6	49.1	2094
Poor	62.6	55.3	64.8	50.0	1129
Middle	64.8	57.1	69.4	52.5	696
Rich	63.6	56.9	66.4	50.8	376
Richest	67.5	62.3	68.3	55.0	177
Exposure to mass media					
No	60.3	53.7	62.5	47.5	1696
Yes	63.8	57.2	67.7	51.9	2776
Exposure to family planning messages					
No	57.3	50.8	60.2	44.4	2211
Any exposed	67.5	60.8	71.1	56.0	2260
Number of family member					
Less than 6	62.8	56.8	65.5	50.8	2203
6 and more	62.1	55.0	65.9	49.7	2268
Total	62.4	55.9	65.7	50.2	4471

Source: Authors

Note: Percentages and numbers are weighted. Numbers in different categories may not be the same because of missing values.

Table 3: Method Information Index (MII) for Scheduled Tribes women using oral pill.

Background characteristics	Informed about side effects	Informed about what to do if there are side effects	Informed about other methods that can be used	Method Information Index	N
Source of method use					
Public	73.0	65.5	84.9	63.9	997
Private	59.1	50.3	69.1	48.5	535
Age					
15-24	67.1	58.2	77.8	56.3	472
24-34	67.5	60.1	79.0	58.6	908
35-49	64.6	55.1	73.6	52.5	289
Place of residence					
Urban	64.4	53.1	73.0	51.6	174
Rural	67.2	59.4	78.3	57.5	1495
Education					
No education	67.4	57.8	80.2	55.4	517
Primary	62.2	53.2	70.9	49.9	254
Secondary	67.1	60.1	78.2	59.1	820
Above secondary	76.1	68.0	79.3	65.4	78
Religion					
Hindu	68.6	61.2	79.7	59.4	1326
Muslim	58.6	40.9	74.3	39.8	51
Others	60.4	50.5	69.6	48.2	292
Wealth quintile					
Poorest	65.0	56.9	77.9	54.8	880
Poor	69.3	60.8	77.4	59.0	405
Middle	66.8	59.6	76.4	57.8	194
Rich	68.0	60.8	76.6	59.9	128
Richest	75.1	63.9	84.1	63.5	61
Exposure to mass media					
No	61.8	54.8	76.8	52.1	621
Yes	69.9	61.0	78.3	59.7	1047
Exposure to family planning message					
No	60.3	51.9	73.8	49.6	764
Yes	72.4	64.5	81.1	63.1	904
Number of family member					
Less than 6	65.8	57.6	77.3	55.9	1071
6 and more	68.7	60.8	78.5	58.7	598
Total	66.9	58.7	77.8	56.9	1669

Source: Authors

Note: Percentages and numbers are weighted. Numbers in different categories may not be the same because of missing values.

Table 4: Method Information Index (MII) for Scheduled Tribes women using IUD/PPIUD.

Background characteristics	Informed about side effects	Informed about what to do if there are side effects	Informed about other methods that can be used	Method Information Index	N
Source of method use					
Public	76.5	69.2	79.4	63.5	751
Private	78.5	71.3	78.4	64.7	67
Others	76.7	76.7	88.6	76.7	1
Age					
15-24	77.6	69.8	78.4	61.2	274
24-34	76.3	70.0	79.9	65.2	435
35-49	75.9	66.0	79.9	63.4	110
Place of residence					
Urban	82.7	72.8	86.6	69.8	120
Rural	75.6	68.8	78.1	62.5	699
Education					
No education	76.1	67.3	80.2	63.1	168
Primary	75.0	63.4	77.8	56.1	109
Secondary	76.3	71.0	78.3	64.9	465
Above secondary	82.3	72.7	86.5	67.3	77
Religion					
Hindu	77.9	71.8	81.0	65.8	642
Muslim	77.6	72.6	88.0	70.7	17
Others	71.4	59.2	71.9	54.1	160
Wealth quintile					
Poorest	75.1	67.3	74.6	61.0	339
Poor	79.6	72.0	83.0	65.6	223
Middle	72.3	66.4	82.8	60.9	132
Rich	77.4	74.2	84.2	73.6	69
Richest	83.2	72.6	79.5	65.1	56
Exposure to mass media					
No	70.6	62.1	72.2	54.9	245
Yes	79.2	72.5	82.4	67.3	574
Exposure to family planning message					
No	73.7	65.5	74.1	58.5	339
Yes	78.7	72.1	83.1	67.2	480
Number of family member					
Less than 6	79.2	72.7	81.1	67.6	476
6 and more	73.1	64.8	76.9	58.0	343
Total	76.7	69.4	79.4	63.6	819

Source: Authors

Note: Percentages and numbers are weighted. Numbers in different categories may not be the same because of missing values.

Table 5: Results of the logistic regression analysis.

Background characteristics	MII	N	Odds ratio	CI
Source of method use				
Public®	54.8	5916		
Private	50.9	1066	0.710***	[0.590,0.856]
Others	39.1	152	0.415***	[0.269,0.638]
Method using				
Female sterilization®	50.2	4471		
Oral contraceptive pill	56.9	1669	1.597***	[1.375,1.855]
IUD	63.6	819	1.803***	[1.499,2.169]
Age				
15-24®	52.0	1477		
25-34	55.1	4484	1.245**	[1.069,1.450]
35-49	50.6	1196	1.069	[0.875,1.307]
Place of residence				
Urban®	55.0	863		
Rural	53.5	6293	1.046	[0.809,1.353]
Education				
No education®	52.3	2410		
Primary	51.7	1181	0.878	[0.742,1.040]
Secondary	54.9	3206	0.89	[0.771,1.027]
Above secondary	59.3	359	0.94	[0.665,1.327]
Religion				
Hindu®	54.1	6292		
Muslim	55.4	150	0.873	[0.614,1.241]
Others	49.7	715	0.748***	[0.641,0.872]
Wealth quintile				
Poorest®	51.9	3401		
Poor	54.4	1808	0.99	[0.859,1.141]
Middle	55.3	1052	1.016	[0.844,1.222]
Rich	56.0	595	1.074	[0.826,1.395]
Richest	59.6	301	1.216	[0.759,1.949]
Media exposure				
No®	49.6	2625		
Yes	56.1	4532	1.064	[0.924,1.226]
Exposed to family planning message				
No®	47.2	3392		
Any exposed	59.6	3765	1.619***	[1.424,1.841]
Number of family members				
Less than 6®	54.6	3851		
6 and more	52.6	3306	0.97	[0.864,1.085]
Total	53.7	7157		

Note- ® Reference ; Level of significant: * $p<0.05$, ** $p<0.01$, ***$p<0.001$

Source: Authors

The variation in the method information index of IUD/PPIUD with the background characteristics of women is found to be different from the variation in the index of sterilisation and oral pills as may be seen from table 4. The Scheduled Tribes women living in the urban areas have higher method information index as compared to women living in the rural areas. However, the method information index of IUD/PPIUD also increases with the increase in the level of education of the women as well as with the increase in the wealth quintiles. On the other hand, the method information index of IUD/PPIUD is found to be higher in Scheduled Tribes women following the Muslim religion as compared to Scheduled Tribes women following the Hindu religion. The method information index of IUD/PPIUD is also found to be higher in women who were exposed to family planning messages as compared to women who were not exposed to family planning messages. Similarly, women having exposure to mass media have been found to having higher method information index compared to women not having exposure to mass media.

Results of the bivariate logistic regression analysis are presented in table 5. The dependent variable is a dichotomous variables which is give a value '1' if the women received information about the side effects of the method, management of side effects, alternative family planning methods available and '0' otherwise. Results indicate that the probability of getting the required information about the method used was significantly lower in private sector users compared to public sector users (OR=0.710, $p<0.001$). Similarly, the odds of receiving method information are found to be significantly higher in case oral pill (OR=1.597, $p<0.001$) and IUD/PPIUD (OR=1.803, $p<0.001$) compared to sterilisation. Women aged 25-34 years are found to be more likely to receive method information as compared to women aged below 25 years. Women having exposure to family planning messages have also been found to be having higher probability of receiving method information as compared to women who were not exposed to family planning messages.

Discussions and conclusions

The present study shows the dominance of female sterilization over the other contraceptive methods among the Scheduled Tribes women in India. Social vulnerabilities such as lower education, wealth and high fertility preferences are some of the reasons of lower prevalence of modern spacing contraceptives methods among Scheduled Tribes women in India. The present study finds that prevalence of sterilization is higher among the uneducated or less educated Scheduled Tribes women and the prevalence of female sterilisation decreases with the increase in education and improvement in living conditions as reflected by the wealth index. One reason for the relatively high prevalence of female sterilisation is that female sterilisation has actively been promoted under the official family planning programme to fulfil family planning targets as the sterilization requires only one-time motivation whereas the motivation for the use of modern spacing methods requires continuous efforts. As Scheduled Tribes women have less opportunity of receiving information related to different spacing methods of contraception and, therefore, sterilisation becomes the method of choice (Oliveira et al, 2014). The living status of Scheduled Tribes population is also generally lower than that of other social classes in the

population and, therefore, the compensatory benefits associated with sterilisation is also an important reason for adopting sterilisation (Pandey, 2002).

This study has also analysed the method specific information provided to the users of female sterilization, oral pills and IUD/PPIUCD regarding the side effects of the method, management of side effects and information about other methods that may be used in lieu of the method being used in terms of the method information index. The study finds that the method information index is generally low in Scheduled Tribes women and the index varies considerably by socio-economic and demographic characteristics of the respondents. The method information index value is found to be relatively higher among IUD/PPIUD users, but low among users of female sterilisation. An important factor that regulates the advice to be given to the users is the socio-economic status of the users as it has been reported that even public health workers are very selective in providing treatment and advice to the richer section of the society (Singh et al, 2012). In the present study also, the method information index is found to be the lowest among the users who belong to the lowest wealth quintiles group.

The present study also reveals that the method information index is higher when the source of the method being used is the public sector than when it is private sector. Similar findings have been obtained in an earlier study (Pradhan et al, 2020). The Scheduled Tribes mostly prefer the public health system and Scheduled Tribes women prefer to go for female sterilisation which results in higher chances of contact with public health workers. On the other hand, one reason of low method information index when the source of method is the private sector is that the source of the method is usually shop or pharmacy, especially in case of spacing methods and the provider in these shops and pharmacies has little or no knowledge about such aspects as side effects of the method and how to manage side effects. Women who prefer to obtain contraceptive methods such as pill from a shop or a pharmacy, have less chances to come in contact with the health care providers and to receive the method related information. Economic and related opportunity costs also exclude the poor and the uneducated women from valuing modern contraceptive methods (Oliveira et al, 2014).

The socio-demographic characteristics of the Scheduled Tribes women have also been found to affect the informed choice related to the use of different modern contraceptive methods. Scheduled Tribes population generally lives in the rural areas and are either uneducated or have low level of education. Their quality of life is also relatively poor. These women have limited exposure to mass median and to family planning messages so that they get only limited information about the contraceptive methods they use (Jain, 2017; Pradhan et al, 2020). The limited access to information, however, is a violation of the reproductive rights of women, especially young women and often results in unmet need for contraception, post-use health problems, unintended pregnancies, and induced abortions. It is, therefore, important that efforts are made to provide the information about the side effects of different contraceptive methods, management of the side effects and options of using other contraceptive methods so that Scheduled Tribes women can adopt the contraceptive method based on informed choice. This may include training of health/family planning workers about the reproductive rights and the technical aspects of different contraceptive methods.

The present study highlights the importance of informed choice in promoting the use of modern contraceptive methods among Scheduled Tribes women in India. Facilitating use of modern contraceptive methods among Scheduled Tribes women based on the informed choice is likely to improve the acceptance rate of these methods in Scheduled Tribes women. This is necessary for transiting family planning efforts from the population centric approach to reproductive rights-based approach. Such a transition is also necessary to realise the FP2020 vision of the country.

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Progress in Reproductive Health in India, 1992-2021: Evidence from National Family Health Survey

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Abstract

This paper highlights the progress in reproductive health in India during 1992-2021 based on selected indicators of reproductive health available from different rounds of the National Family Health Survey. The paper also analyses the disparity in reproductive health by wealth index quintiles groups. The progress in reproductive health has been discussed in the context of government policies and programmes that have been implemented from time to time to meet the reproductive health needs, especially of women, in the country. The paper also highlights the challenges by way of advancement in reproductive health in India. The analysis has been carried out for the country and for its constituent states and Union Territories.

Background

India has made considerable progress in reproductive health during the last three decades because of the focused attention of the government to meet the reproductive health needs, especially of women of the country. Concern about the health of women and children has always been a priority health agenda in India right since independence. During the first five-year plan (1951–1956), India launched a nationwide family planning program to reduce the birth rate and stabilize population growth and to promote maternal and child health. During this period, primary health centres were established in rural areas, and auxiliary nurse midwives (ANM) were trained in delivering maternal and child health (MCH) services (Government of India, 1951). In 1992, Government of India launched the Child Survival and Safe Motherhood (CSSM) with the objectives of enhancing child survival, preventing maternal mortality and morbidity, and increasing the effectiveness of service delivery (Government of India, 1992). In 1997, the CSSM Programme was expanded into the Reproductive and Child Health (RCH) Programme (Government of India, 1997). In 2005, Government of India launched the National Rural Health Mission with the RCH Programme as the lead programme of the Mission (Government of India, 2005). In 2013, the National Health Mission was launched in the country, and the RCH Programme remained the lead programme of the Mission (Government of India, 2013). The Government of India, now, follows the Reproductive, Maternal, Newborn, Child, and Adolescent Health (RMNCH+A) strategy to meet the reproductive health needs, especially of women (Government of India,

2013). These initiatives taken by the Government of India have resulted in marked improvement in the reproductive health situation in the country. For example, the maternal mortality ratio in the country has decreased from 212 maternal deaths for every 100 thousand live births during 2007-2009 (Government of India, 2011) to 97 maternal deaths for every 100 thousand live births in 2018-2020 (Government of India, 2021), However, despite significant gains in reproductive health in the country since 1990, challenges in meeting the reproductive health needs of the people of the country remain, particularly in rural areas and among marginalized communities. It is in this context that understanding the progress in reproductive health in India after 1990 becomes important. The present paper is an attempt in this direction. It analyses the progress in reproductive health in the country during the last three decades in terms of the trend in selected indicators of reproductive health for which estimates are available from different rounds of the National Family Health Survey. The paper also highlights the inequality in progress in selected reproductive health indicators within the country across states/Union Territories.

There are five sections in this study. The next section describes the data source used in the analysis and the methods adopted to analyse the progress in reproductive health. An outline of the data gathered, and the methodology applied in this investigation may be found in the next section. The third section of the paper analyses the advancement made in selected reproductive health indicators in India and in its constituent states/Union Territories. The income inequality of the progress in reproductive health has been analysed in the fourth section of the paper. The last section of the paper summarises the findings of the analysis and highlights their policy and programme implications.

Data and Methods

This paper is based on the estimates of selected indicators of reproductive health estimated from the data available through different rounds of the National Family Health Survey (NFHS). The NFHS programme was instituted by the Government of India in 1992. It is a multi-round household survey programme. The first round of the survey was conducted in 1992-93 (Government of India, 1995), followed by second round in 1998-1999 (Government of India, 2000), third round in 2005-2006 (Government of India, 2007), fourth round in 2015-2016 (Government of India, 2017), and fifth round in 2019-2021 (Government of India, 2022). Currently, the sixth round of NFHS is in progress. Details of the NFHS including the method of sample selection are given elsewhere (Government of India, 2022). The NFHS is based on a statistically representative sample of households which provides estimates of key reproductive health indicators right up to the district level. Prior to its fourth round (2015-2016), the NFHS provided estimates of key reproductive health indicators for the country and for its states/Union Territories only, but NFHS has provided estimates of reproductive health indicators for the districts also in its fourth and fifth rounds. The present paper, however, is limited to the analysis of the progress in reproductive health in the country and in its constituent states and Union Territories only. Analysis of the progress in reproductive health at the district level is difficult as the number of districts at the fourth round of the NFHS were different from the number of districts in the fifth round of NFHS.

We have used a set of the 24 indicators of reproductive health, grouped into four categories – fertility, timing of marriage and first birth, family planning, and care during pregnancy, at the time of the delivery, and after delivery during the postnatal period. The selection of the indicators was based on the relevance of the indicator to the reproductive health of women. The reproductive health indicators that have been selected for the present analysis are as follows:

1. Fertility
   - 1.1 Fertility of women aged 15-19 years.
   - 1.2 Fertility of women aged 20-24 years.
   - 1.3 Fertility of women aged 25-29 years.
   - 1.4 Fertility of women aged 30-34 years.
   - 1.5 Fertility of women aged 35-39 years.
   - 1.6 Fertility of women aged 40-44 years.
   - 1.7 Total fertility rate
   - 1.8 Total wanted fertility rate.
2. Timing of marriage and first birth
   - 2.1 Proportion of women 20-24 years married by 15 years of age.
   - 2.2 Proportion of women 20-24 years married by 18 years of age.
   - 2.3 Proportion of women 20-24 years married by 20 years of age.
   - 2.4 Proportion of women 20-24 years gave first birth by 15 years of age.
   - 2.5 Proportion of women 20-24 years gave first birth by 18 years of age.
   - 2.6 Proportion of women 20-24 years gave first birth by 20 years of age.
3. Family Planning
   - 3.1 Proportion of currently married women using a contraceptive method
   - 3.2 Proportion of currently married women using a modern contraceptive method
   - 3.3 Proportion of currently married women using a permanent contraceptive method
   - 3.4 Proportion of currently married women using a modern spacing method of contraception
   - 3.5 Unmet need of spacing
   - 3.6 Unmet need of limiting
   - 3.7 Total unmet need
   - 3.8 Total demand of family planning
4. Antenatal and postnatal care
   - 4.1 Proportion of women received antenatal care from skilled service provider.
   - 4.2 Proportion of women with at least 4 ANC visits
   - 4.3 Proportion of women received assistance from skilled health person at the time of delivery.
   - 4.4 Proportion of women who were checked up within two days of delivery.

The data for analysis have been retrieved from the Demographic and Health Surveys data repository using the STATcompiler tool (ICF, 2015) for the country and for its constituent states/Union Territories to analyse the within country disparity or inequality in progress in reproductive health.

The estimates of the reproductive indicators available from the NFHS refer to discreate points in time. We have assumed that the change in an indicator between any two rounds of NFHS is linear. We have measured this change in terms of annual per cent change (APC) to characterise the change in the indicator within the interval. The APC in the reproductive health indicator, a, between two points in time t_1 and t_2 ($t_2 > t_1$) is defined as

$$APC = \frac{1}{t_2 - t_1} \times \left(\frac{a_2 - a_1}{a_1}\right) \times 100$$

The APC in different time-segments of the trend period may not be the same. As such, we have calculated the average annual percentage change (AAPC) to characterise the trend during the entire trend period. The AAPC is the weighted average of APC in different time-segments with weights equal to the proportionate length of the time-segment. If w_i is the proportionate weight for the time-segment i, then AAPC is calculated as

$$AAPC = \sum_i w_i \times APC_i$$

The *AAPC* reflects the progress in reproductive health in a more appropriate manner than the conventional way of calculating the change by considering only the level of the reproductive health indicator at the beginning and at the end of the trend period (Clegg et al, 2009). *AAPC* takes into consideration different pace of change in different time-segments of the trend period.

When the annual per cent change (APC) in different time-segments of the trend period is not the same, the inequality in progress across different time-segments in the reproductive health indicator j can be calculated through the index of progress inequality, *PI*, which is defined as

$$PI_j = \frac{1}{AAPC} \times \frac{\sqrt{\sum (APC_{jk} - AAPC)^2}}{k}$$

where k is the number of time-segments in the trend period. It is clear that when the APC in all time-segments is the same, the index of progress inequality 0 and the larger the deviation of the index of progress inequality, *PI*, from its limiting value of 0, the larger the inequality in progress across different time-segments of the trend period. Higher value of the index of progress inequality, *PI*, reflects higher degree of in consistency in progress across different time segments and vice versa. The index of progress inequality has been calculated for each of the 24 reproductive health indicators separately.

We have also analysed the income inequality in different reproductive health indicators. For this purpose, all women were categorised into five income groups – poorest, poor, average, rich, and richest – on the basis of the household wealth index of the women and reproductive health indicators in different income groups have been compared with the corresponding indicator in the richest income group which has been taken as the reference. The difference in the value of the reproductive health indicator in different income groups from the value of the indicator in the richest income group has been summarised in terms of the index of income inequality. Let the value of the reproductive health indicator j in the income group i is a_{ji}, and a_{jr} is the value of the reproductive health

indicator in the richest income group. Then index of income inequality in the reproductive health indicator *j* is defined as

$$I_j = \frac{\sqrt{\sum \left(\frac{a_{ji}}{a_{jr}} - 1\right)^2}}{n-1}$$

where n is the number of wealth index quintiles groups. The limiting value of index I_j is 0 which signifies that the value of the indicator is the same in all income groups and is equal to the value of the indicator in the richest income group so that there is no income inequality in the reproductive health indicator *j*. On the other hand, the higher the value of the index I_j the higher the income inequality in the reproductive health indicator *j*. The index of income inequality has been calculated for each indicator separately for each round of NFHS to examine whether the income inequality in the indicator has decreased or not during the trend period.

Progress in Reproductive Health in India

Table 1 depicts the progress in selected reproductive health indicators in India during the period 1992-2021. It may be seen from the table that the decrease in the total fertility rate has been more rapid than the decrease in the total wanted fertility rate. Among women of different age groups, fertility decreased most rapidly in women aged 40-44 years, but the decrease has been very slow in the age group 25-29 years and 20-24 years. The decrease in the fertility of women aged 15-19 years has been faster than the decrease in fertility of women aged 20-29 years but slower than women aged 30 years and above. On the other hand, the decrease in the proportion of women aged 20-24 years who got married has been the most rapid compared to the decrease in the proportion of women aged 20-24 years who got married before 18 years and before 20 years. It may be pointed out that marriage of females before 18 years of age is an offence under the Child Marriage Prevention Act of the Government of India (Government of India, 1978). However, at least 22 per cent married women aged 20-24 years were found to be married before reaching 18 years of age according to the latest round of the NFHS (2019-2021). Similarly, the decrease in the proportion of women aged 20-24 years who gave first birth before 15 years of age has been the highest as compared to the decrease in the proportion of women aged 20-24 years who gave first birth before 18 years or before 20 years of age.

Table 1 also shows that the increase in the proportion of married women using any contraceptive method has been faster than the number of married women using a modern contraceptive method. This implies that the proportion of married women using traditional contraceptive methods has been more rapid than the proportion of married women using modern contraceptive methods during the period under reference. Similarly, the increase in the proportion of married women using modern spacing methods has been found to be more rapid than the increase in the proportion of married women using permanent methods of family planning. As the result, the decrease in the unmet need for spacing has been more rapid than the decrease in the unmet need of limiting.

Table 1: Progress in selected indicators of reproductive health in India, 1992-2021.

Reproductive health indicator	Annual per cent change (APC) during				AAPC	Progress inequality
	1992-1999	1999-2006	2006-2016	2016-2021	1992-2021	
Fertility						
Fertility of women aged 15- 19 years	-1.108	-2.270	-4.333	-3.137	-2.851	-0.417
Fertility of women aged 20- 24 years	-1.299	-0.068	-1.196	-2.065	-1.098	-0.651
Fertility of women aged 25-29 years	-2.269	-0.400	-0.791	-0.938	-1.079	-0.652
Fertility of women aged 30-34 years	-4.124	-1.449	-1.774	-0.392	-2.025	-0.675
Fertility of women aged 35-39 years	-5.195	-1.531	-3.200	-3.529	-3.335	-0.390
Fertility of women aged 40-44 years	-6.667	-1.786	-4.286	-5.000	-4.380	-0.401
Total fertility rate	-2.521	-0.510	-1.852	-1.818	-1.684	-0.433
Total Wanted Fertility rate	-2.747	-1.360	-0.526	-2.222	-1.556	-0.553
Time of marriage and time of first birth						
Women 20-24 years married by 15 years of age	4.708	-6.288	-5.877	-5.185	-3.302	-0.530
Women 20-24 years married by 18 years of age	-0.057	-1.571	-4.315	-2.372	-2.290	-0.621
Women 20-24 years married by 20 years of age	-0.552	-0.809	-2.607	-1.838	-1.544	-0.552
Women 20-24 years gave first birth by 15 years of age	-0.560	-4.373	-7.058	-6.000	-4.659	-1.381
Women 20-24 years gave first birth by 18 years of age	-0.353	-3.053	-5.714	-2.151	-3.164	-0.677
Women 20-24 years gave first birth by 20 years of age	-0.440	-1.668	-3.726	-2.069	-2.151	-0.536
Family Planning						
Married women using any contraceptive method	2.633	2.401	-0.497	4.935	1.894	1.048
Married women using modern contraceptive method	2.466	1.903	-0.144	3.598	1.625	0.860
Unmet need of spacing	-4.567	-3.787	-0.820	-5.714	-3.284	-0.567
Unmet need of limiting	-0.529	0.000	-0.769	-5.000	-1.255	-1.612
Unmet need of family planning	-2.956	-1.952	-0.719	-5.426	-2.368	-0.749
Total demand of family planning	0.773	1.311	-0.541	2.922	0.820	1.556
Antenatal, natal, and postnatal care						
Antenatal care from skilled provider	2.834	3.098	0.830	1.382	1.957	0.490
Antenatal care (4+ visits)	1.587	2.762	4.078	2.976	2.969	0.300
Assistance during delivery from skilled health person	3.184	1.702	7.516	1.645	4.055	0.605
First Postnatal checkup within 2 days after delivery	NA	NA	9.320	4.962	7.867	0.292

Source: Authors' calculations based on the data available from different rounds of NFHS.

Table 2: Income inequality in selected indicators of reproductive health in India.

Indicator	Period				
	1992-1993	1998-1999	2005-2006	2015-2016	2019-2021
Fertility					
Fertility of women aged 15- 19 years	NA	NA	1.653	1.569	1.442
Fertility of women aged 20- 24 years	NA	NA	0.811	0.893	0.867
Fertility of women aged 25-29 years	NA	NA	0.598	0.592	0.521
Fertility of women aged 30-34 years	NA	NA	0.787	0.619	0.441
Fertility of women aged 35-39 years	NA	NA	1.633	0.966	0.576
Fertility of women aged 40-44 years	NA	NA	6.344	3.758	0.992
Total fertility rate	NA	NA	0.845	0.819	0.657
Total Wanted Fertility rate	NA	NA	0.673	0.676	0.611
Time of marriage and time of first birth					
Women 20-24 years married by 15 years of age	1.286	1.751	6.554	3.504	2.456
Women 20-24 years married by 18 years of age	0.751	1.055	2.682	2.034	2.690
Women 20-24 years married by 20 years of age	5.325	6.328	1.573	1.503	1.517
Women 20-24 years gave first birth by 15 years of age	1.264	1.994	3.819	2.816	3.882
Women 20-24 years gave first birth by 18 years of age	0.669	0.763	1.817	1.758	1.922
Women 20-24 years gave first birth by 20 years of age	0.979	0.753	1.135	1.187	1.178
Family Planning					
Married women using any contraceptive method	0.625	0.633	0.398	0.440	0.475
Married women using modern contraceptive method	0.708	0.667	0.400	0.437	0.476
Unmet need of spacing	0.773	0.592	0.865	0.571	0.558
Unmet need of limiting	0.407	0.473	0.762	0.587	0.587
Unmet need of family planning	0.440	0.440	0.799	0.579	0.566
Total demand of family planning	1.209	0.938	0.443	0.460	0.485
Antenatal, natal, and postnatal care					
Antenatal care from skilled provider	1.752	2.071	0.374	0.421	0.453
Antenatal care (4+ visits)	0.710	0.602	0.224	0.343	0.399
Assistance during delivery from skilled health person	0.040	0.047	0.261	0.435	0.465
First Postnatal checkup within 2 days after delivery	NA	NA	0.217	0.403	0.444

Source: Authors' calculations based on the data available from different rounds of NFHS.

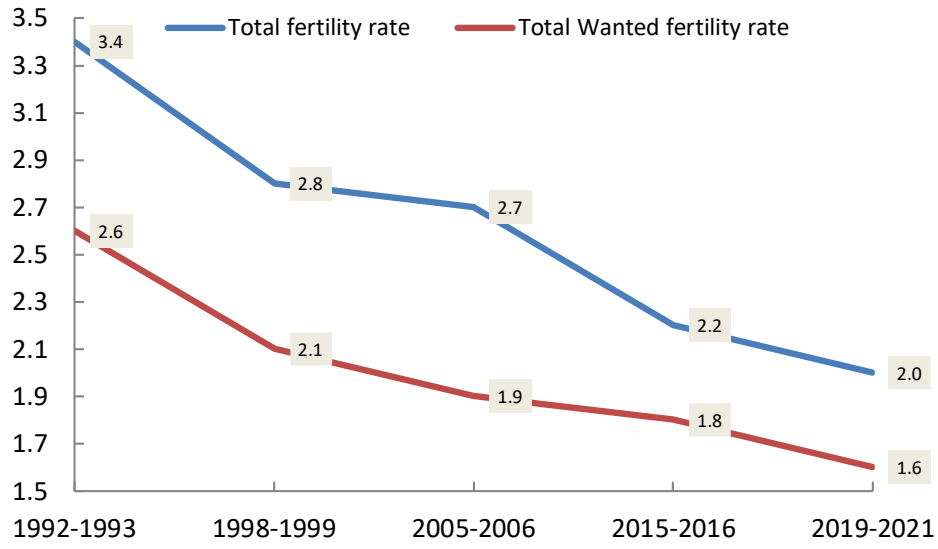

Figure 1: Trend in total fertility rate and total wanted fertility rate in India, 1992-2021
Source: Authors

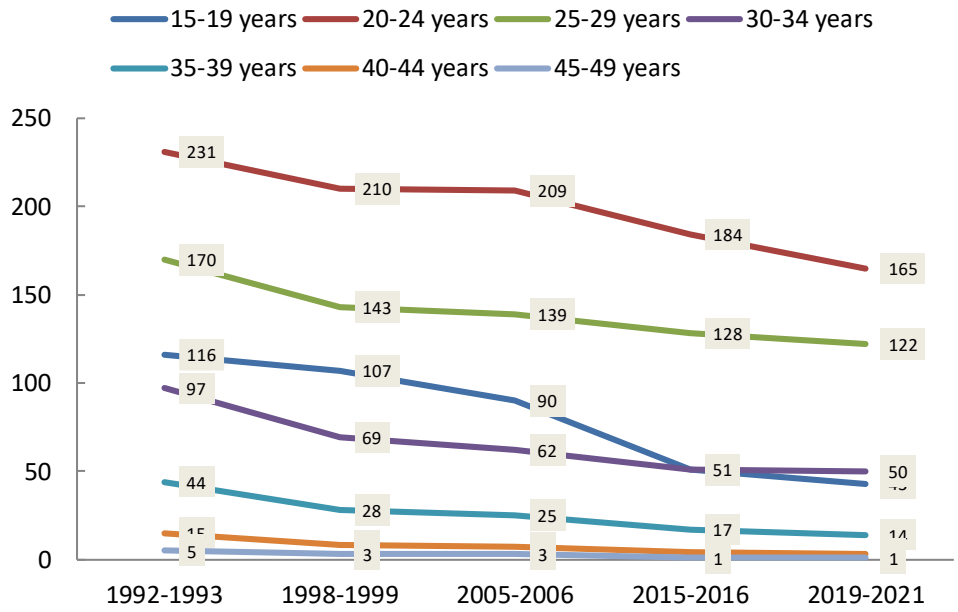

Figure 2: Trend in age-specific fertility rates (per 1000) in India, 1992-2021.
Source: Authors

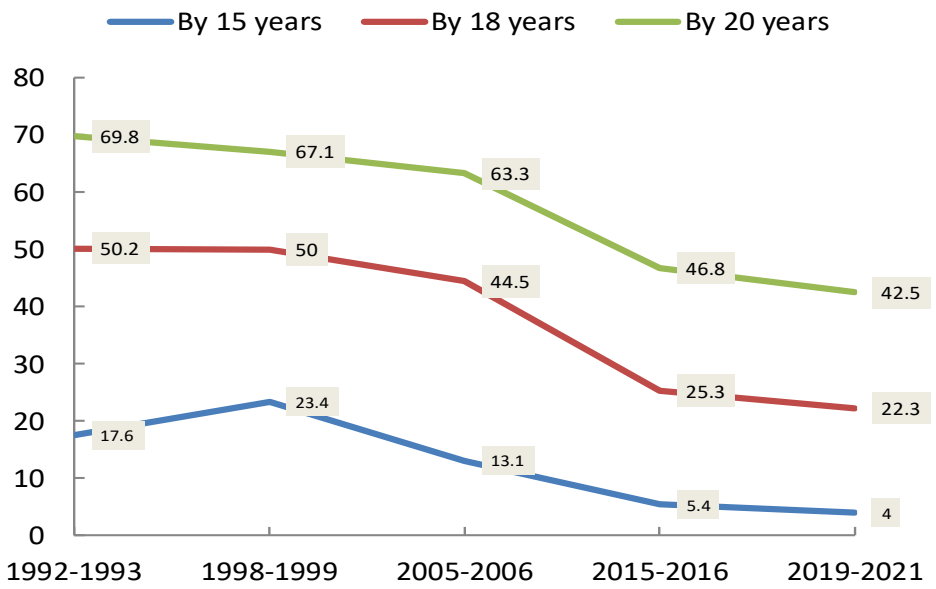

Figure 3: Trend in the proportion (per cent) of women 20-24 years married by 15 years, 18 years, and 20 years of age.
Source: Authors

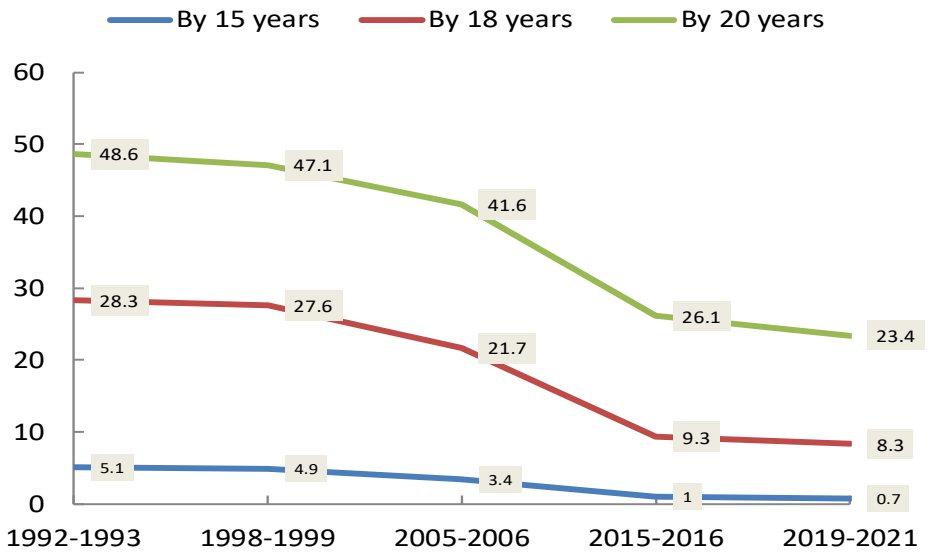

Figure 4: Trend in the proportion (per cent) of women 20-24 years gave first birth by 15 years, 18 years, and 20 years of age.
Source: Authors

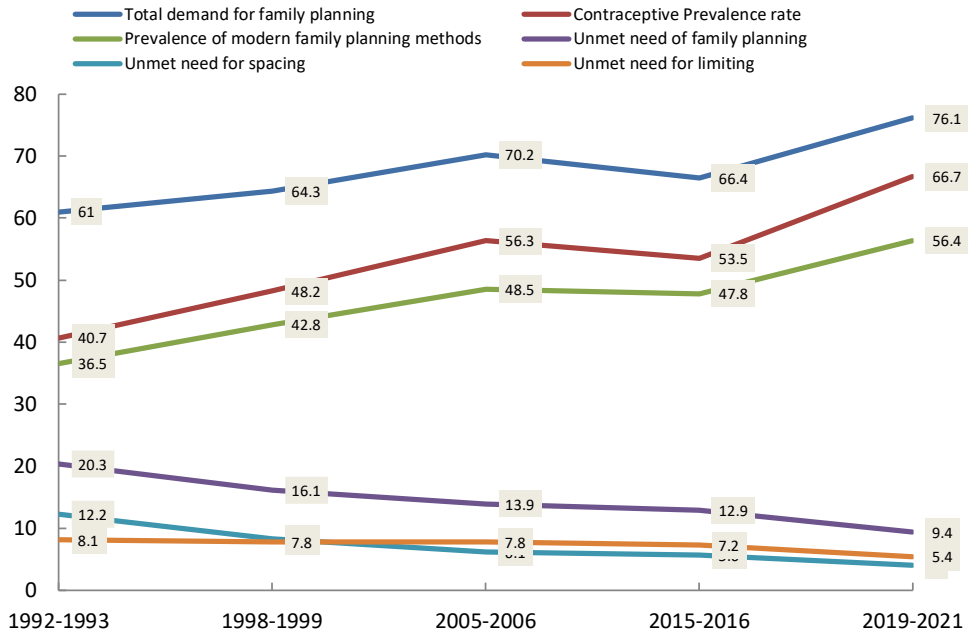

Figure 5: Trend in indicators of family planning in India, 1992-2021.
Source: Authors

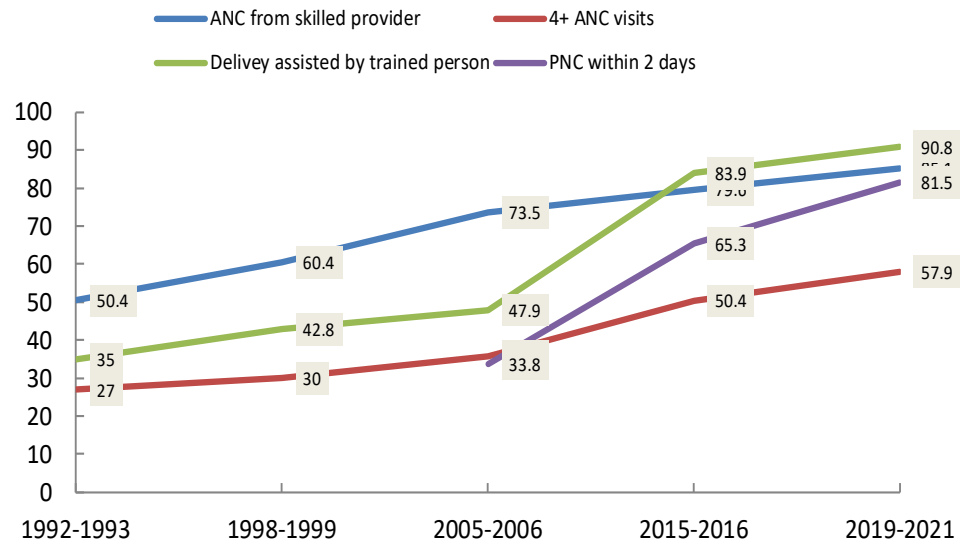

Figure 6: Trend in indicators of antenatal, natal and postnatal care in India, 1992-2021.
Source: Authors

In case of antenatal, natal, and postnatal care, table 1 reveals that the progress has been the most rapid in the proportion of deliveries assisted by a skilled health person but the slowest in antenatal care. The proportion of institutional deliveries has increased from 35 per cent during 1992-1993 to 90.8 per cent during 2019-2021. On the other hand, the increase in the proportion of women who received first postnatal checkup with 2 days of delivery slowed down during the period 2015-2021 relative to the period 2005-2016.

It is also evident from table 1 that the progress in all the reproductive health indicators has varied considerably across different time-segments of the period 1992-2021 as reflected through the variation in the annual per cent change (APC) in different time-segments. The index of inequality in progress across different time-segments has been found to be the highest in the unmet need of limiting followed by the total demand for family planning and the proportion of women aged 20-24 years who were married before reaching 15 years of age. This means that progress in these indicators has been highly inconsistent in different time-segments of the period 1992-1993 through 2019-2021. In contrast, the index of inequality in progress has been found to be the lowest in the proportion of women who received at least 4 ANC visits during their last pregnancy and in the fertility of women aged 35-39 years which reflects that the progress in reproductive health in terms of these indicators has been relatively more consistent across different time-segments of the period 1992-1993 through 2019-2021.

Reproductive Health Inequality

The index of income inequality in different reproductive health indicators in India is presented in table 2. The table shows that the trend in the income inequality in different reproductive health indicators used in the analysis has been different and no common trend emerges. The income inequality in the total fertility rate, as measured by the index of income inequality, has always been higher than the index of income inequality in the total wanted fertility rate during the period under reference. However, the decrease in income inequality has been more rapid in total fertility rate as compared to that in total wanted fertility rate if the change in the index of income inequality is any indication. On the other hand, the index of income inequality has been the lowest in the fertility of women aged 25-29 years but the highest in the fertility of women aged 40-44 years. However, the decrease in the income inequality in fertility of women aged 40-44 years has been very rapid whereas the decrease in the income inequality of fertility of women as 25-29 years has, at best, been marginal. The index of income inequality in the fertility of women aged 15-19 years has also been quite high and the decrease in this inequality has been marginal.

The trend in the index of income inequality in different indicators related to the time of marriage and time of first birth of women aged 20-24 years has been different. In case of the proportion of women aged 20-24 years who got married by 15 years of age, the index of income inequality first increased and then decreased. However, in case of the proportion of women aged 20-24 years who got married by 18 years and 20 years of age, the index of income inequality appears to have increased in recent years. On the other hand, the income inequality in the proportion of women aged 20-24 years who gave first birth by

18 years of age increased consistently during the period under reference. This has, however, not been the case in the proportion of women aged 20-24 years who gave first birth by 15 years of age or by 20 years of age. The income inequality in the proportion of women aged 20-24 years who gave first birth by 15 years of age appears to have increased in recent years while that in the proportion of women who gave first birth by 20 years of age has decreased, albeit marginally.

The income inequality in different indicators of family planning also reveal different trend during the period under reference. The income inequality in both proportion of married women using any contraceptive method and proportion of married women using a modern contraceptive method has increased since 2005-2006. However, the income inequality in the unmet need of family planning has decreased consistently since 2005-2006. The income inequality in the indicators related to the unmet need of family planning was very high during the period 2005-2006. On the other hand, the income inequality in the total demand for family planning decreased very rapidly during the period 1992-1993 through 2005-2006 but has increased after 2005-2006.

The income inequality in all the four indicators related to the care during antenatal, natal, and postnatal period has increased during the period 2019-2021 as compared to the period 2015-2016. Moreover, the income inequality in the proportion of women who had at least 4 ANC visits during their last pregnancy decreased quite rapidly during 1992-1993 through 2005-2006 but increased thereafter. On the other hand, the income inequality in the proportion of women who were assisted by a professionally trained person at the time of their last delivery has increased quite rapidly since 1992-1993. The income inequality in the proportion of women who were checked up within two days of their last delivery has also increased over time.

State Level Analysis

The progress in reproductive health, revealed through the average annual per cent change (AAPC) in different reproductive health indicators, varies widely across the constituent states and Union Territories of the country as shown in the appendix table. The AAPC in different states/Union Territories is based on different time-segments as data from all the five rounds of NFHS are available for only 20 states so that AAPC during the period 1992-1993 through 2019-2021 could be calculated for these 20 states only. Summary measures of the variation in AAPC across 20 states in different indicators of reproductive health are presented in table 3. The median AAPC during 1992-2021 in the total fertility rate across the 20 states has been 1.772 per cent. The AAPC in the total fertility rate has been the fastest in Arunachal Pradesh but the slowest in Kerala. On the other hand, the median AAPC across 20 states in the total wanted fertility rate has been -1.432. The AAPC in the total wanted fertility rate has been the most rapid in Arunachal Pradesh but the slowest in Kerala. In case of fertility in women aged 15-19 years, the median AAPC is estimated to be -2.841. The decrease in fertility of women aged 15-19 years was the most rapid in Haryana whereas in Goa, Manipur and Tripura, fertility of women aged 15-19 years increased, instead decreased as the AAPC in these states has been positive, not negative. The median AAPC in fertility of women aged 20-24 years has been -1.321. The decrease in

fertility of women aged 20-24 years has been the most rapid in Arunachal Pradesh but the least rapid in Meghalaya. The median AAPC in fertility of women aged 25-29 years has been -1.176. The AAPC has been the most rapid in West Bengal whereas fertility in this group of women increased instead decreased during the period under reference. The median AAPC in fertility of women aged 30-34 years has been -0.871. The AAPC has been the most rapid in West Bengal but fertility in this group of women increased in five states during the period under reference. Similarly, fertility in women aged 35-39 years increased in five states. The median AAPC in the fertility of these groups of women, however, is estimated to be -1.581 and -1.866, respectively.

Tables 3 also shows that the median AAPC in all the four indicators related to the time of marriage and the time of first birth among women aged 20-24 years has been negative during the period under reference. However, the AAPC in the proportion of women who were married by 15 years of age is found to be positive in five states. However, the proportion of women 20-24 years of age who were married by 18 years or by 20 years of age decreased all states but the pace of the decrease in these proportions during the period under reference varied widely across the 20 states of the country. A similar situation may also be observed in case of the proportion of women aged 20-24 years who gave first birth by 15 years, 18 years, and 20 years of age. In five states, the proportion of women aged 20-24 years who gave first birth by 15 years of age increased, instead decreased, during the period under reference. Similarly, the median AAPC in the proportion of currently married women using a contraceptive method or a modern contraceptive method has been positive suggesting increase in the use of contraceptive methods during the period under reference, there are states where the AAPC has been negative which indicates that the proportion of currently married women using a contraceptive method or using a modern contraceptive method has decreased in these states during the 27 years period between 1992-1993 and 2019-2021.Similarly, the AAPC in all the three indicators of the unmet need of family planning has been negative but there are states where the unmet need of family planning has increased, instead decreased during the period under reference as the AAPC has been positive in these states. The unmet need for spacing increased in two states but the unmet need for limiting increased in 7 of the 20 states so that total unmet need for family planning increased in 7 states. On the other hand, the demand for family planning increased in all but two of the 20 states during the period under reference. Finally, three of the 4 indicators related to antenatal, natal, and postnatal care increased in all states during the period under reference but the proportion of married women who received at least 4 ANC visits decreased, instead increased, in Kerala. The progress in the proportion of married women who received postnatal care within two days of delivery is measured during the period 2005-2006 through 2019-2021 as estimates of the indicator are not available from the first two rounds of NFHS.

Table 4 also presents the index of variation in AAPC in each of the 24 indicators across the 20 states. The index of variation in AAPC has been measured as the positive root mean square deviation from the median. The index of variation is similar to the coefficient of variation with arithmetic mean replaced by the median. Among the 24 reproductive health indicators included in the present analysis, the index of variation in AAPC across states is found to be the highest in the proportion of women aged 20-24 years who had first birth by 15 years of age followed by the proportion of women aged 20-24 years who

were married by 15 years of age. On the other hand, the index of variation in AAPC across states has been found to be the lowest in fertility of women aged 25-29 years followed by fertility of women aged 20-24 years. Inter-state variation in AAPC in the proportion of women who had first check-up within two days of the delivery has also been to be very high, but the AAPC in this indicator is based on the change in the period 2005-2021 and not in the period 1992-2021.

Table 4: Variation in AAPC in different reproductive health indicators across 20 states of India during 1992-2021.

Indicator	Minimum	Maximum	Median	Index of variation
Fertility				
Fertility of women aged 15- 19 years	-4.895	0.719	-2.841	1.531
Fertility of women aged 20- 24 years	-2.486	-0.697	-1.321	0.598
Fertility of women aged 25-29 years	-2.041	0.209	-1.176	0.572
Fertility of women aged 30-34 years	-2.948	1.308	-0.871	1.135
Fertility of women aged 35-39 years	-4.119	2.327	-1.581	1.757
Fertility of women aged 40-44 years	-4.848	4.632	-1.866	2.710
Total fertility rate	-2.405	-0.301	-1.722	0.624
Total Wanted Fertility rate	-2.060	-0.121	-1.432	0.624
Time of marriage and time of first birth				
Women 20-24 years married by 15 years of age	-6.168	6.615	-2.662	3.237
Women 20-24 years married by 18 years of age	-4.513	-0.602	-2.676	1.155
Women 20-24 years married by 20 years of age	-4.103	-0.162	-2.039	0.967
Women 20-24 years gave first birth by 15 years of age	-8.622	4.965	-3.588	3.762
Women 20-24 years gave first birth by 18 years of age	-5.508	-1.127	-3.404	1.293
Women 20-24 years gave first birth by 20 years of age	-4.028	-0.569	-2.702	0.949
Family Planning				
Married women using any contraceptive method	-1.514	8.615	1.419	2.276
Married women using modern contraceptive method	-1.495	6.801	1.434	1.883
Unmet need of spacing	-5.127	1.511	-1.989	1.615
Unmet need of limiting	-2.284	6.917	-0.793	2.526
Unmet need of family planning	-3.470	1.740	-1.636	1.579
Total demand of family planning	-0.764	2.137	0.577	0.696
Antenatal, natal, and postnatal care				
Antenatal care from skilled provider	0.015	5.932	1.092	1.438
Antenatal care (4+ visits)	-0.239	7.841	3.279	2.425
Assistance at delivery from skilled health person	0.329	8.224	3.484	2.239
First checkup within 2 days after delivery	0.525	24.573	5.821	6.008

Source: Authors

Discussion and Conclusions

India has undergone significant social and economic transformation during the last several decades including substantial gains in the fields of health and education. From being considered a lower-income country, it became a lower-middle-income country in 2009 and is on way to achieving the goal of becoming an upper-middle-income country (World Bank,

2022). The Human Development Index (HDI) of the country increased by 1.5 times between 1990 and 2021 as the result of different policies and reforms undertaken by the government. The present analysis suggests that the country has achieved remarkable gains in the reproductive health of women also. At the national level, all the 24 indicators of reproductive health considered in the present analysis have shown improvement during the last three decades, although the progress, as measured in terms of the average annual per cent change (AAPC), has been different in different indicators. This improvement in the reproductive health status of women during the last three decades is a reflection of the success of government efforts towards meeting the reproductive health needs of women. The analysis, however, reveals that the progress in reproductive health has not been consistent throughout the period under reference. Similarly, there exists significant income inequality in the reproductive health of women in the country as there are notable differences in all indicators of reproductive health by the level of income. The efforts and interventions directed towards improving the reproductive health of women needs to be focused more on the poorest and the most vulnerable section of the population to reduce the income inequality in the reproductive health status of women. The analysis also shows that, within the country, the progress in reproductive health of women has varied widely across the constituent states and Union Territories and there are states/Union Territories in which progress in some of the reproductive health indicators included in the present analysis has been negative. This may be a cause of concern to health policy makers and programme managers. Some of the variation in the progress in different indicators of reproductive health may be due to the fact that the reproductive health status of women is different states/Union Territories of the country. In any case, the reasons for the negative progress in some reproductive health indicators in some states/Union Territories of the country, as revealed through the present analysis needs to be looked into from the policy and programme perspective. There may be factors endogenous to the health care delivery system and factors exogenous to the health care delivery system that may be responsible for the negative progress in some indicators related to the reproductive health of women. These factors need to be addressed at both policy and programme levels as there is still considerable scope for improvement in the reproductive health of the women of the country. There is noticeable variation in the reproductive health of women within the country, across states and Union Territories. A reduction in the within country disparity in the reproductive health of women may go a long way towards an accelerated improvement in the reproductive health of women of the country.

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Appendix Table: Average annual per cent change (AAPC) in different reproductive health indicators during 1992-2021 in states/Union Territories.

State/ Union Territory	Reproductive health indicator																							
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.2	3.3	3.3	3.4	3.5	4.1	4.2	4.3	4.4
AN Islands	-4.76	-6.63	-0.52	6.73	-2.61	NA	-1.59	-6.67	-0.52	-2.25	18.52	4.44	-2.61	-3.42	6.56	4.32	-5.49	0.00	-2.87	4.40	-2.06	-1.67	-0.18	2.86
Andhra Pradesh	-4.28	-2.29	-0.59	5.85	11.11	NA	-1.23	-5.78	-2.11	-2.66	-9.15	0.99	-2.85	-1.39	0.51	0.45	-3.58	7.41	0.48	0.48	-0.46	-1.78	1.04	3.18
Arunachal Pradesh	-3.23	-2.49	-1.72	-0.77	-2.64	-1.55	-2.41	2.14	-2.56	-2.22	-1.41	-3.06	-2.76	-2.06	4.79	4.80	-1.18	-0.18	-1.56	2.01	2.05	3.05	6.44	8.96
Assam	-2.12	-1.26	-1.93	-2.39	-2.54	-3.98	-1.89	-3.28	-1.86	-1.02	-4.89	-3.27	-1.82	-1.42	1.45	3.44	-2.09	-1.59	-2.19	0.38	2.31	7.09	8.22	24.57
Bihar	-2.75	-0.38	-1.20	-3.10	-6.13	-5.17	-1.85	-4.91	-2.49	-1.43	-6.16	-3.19	-1.84	-0.54	7.05	4.91	-3.08	-3.40	-3.26	2.16	6.13	7.14	12.33	18.49
Chandigarh	-12.22	0.00	-6.59	6.57	-0.82	NA	-2.78	8.33	-4.11	0.00	NA	4.27	-5.02	0.00	1.02	-0.99	8.64	-0.49	2.12	1.11	-1.11	0.49	-0.30	-1.28
Chhattisgarh	-6.50	-1.62	-0.51	-1.90	-3.08	-5.86	-2.31	-7.85	-7.07	-4.67	-8.40	-8.03	-6.27	-1.75	1.79	1.67	-2.60	-0.81	-1.61	1.24	1.08	7.12	7.25	19.00
Goa	0.07	-1.83	-1.88	-0.85	1.07	1.14	-1.25	-5.28	-3.14	-3.14	-8.62	-3.34	-3.25	-0.99	4.13	3.90	-2.21	-0.87	-1.70	1.50	0.11	0.43	0.33	1.83
Gujarat	-2.80	-1.70	-0.80	-1.43	-1.85	-2.18	-1.56	0.35	-1.14	-1.42	-3.99	-2.34	-2.13	-1.44	1.53	0.74	-0.83	2.92	0.94	0.81	2.06	2.99	3.06	4.25
Haryana	-4.89	-2.08	-1.29	-1.85	-3.13	-4.08	-2.41	-3.62	-3.85	-2.49	-7.27	-5.20	-3.54	-2.00	1.54	1.21	-1.89	-1.35	-1.80	0.74	1.02	4.88	4.86	7.57
Himachal Pradesh	-3.19	-2.38	-1.19	0.79	-3.03	4.63	-1.82	-2.75	-4.51	-3.48	1.21	-4.91	-4.03	-1.15	1.16	0.86	-1.10	1.73	0.03	0.48	0.52	5.77	5.31	9.07
Jammu& Kashmir	-5.25	-3.90	-2.19	-0.40	-1.51	-2.85	-2.57	-3.28	-4.16	-4.47	-3.48	-4.14	-4.25	-1.67	0.71	1.06	-2.67	-1.74	-2.44	0.02	0.69	3.51	4.45	5.20
Jharkhand	-3.71	-0.99	-2.05	-2.73	-3.98	-4.84	-2.22	-6.01	-3.73	-2.08	-7.96	-5.15	-3.10	-0.66	4.54	3.63	-4.57	-4.00	-4.30	1.53	2.74	6.02	11.56	19.28
Karnataka	-3.59	-1.09	-0.78	-1.47	-2.14	-4.85	-1.63	-4.85	-3.01	-1.83	-5.81	-4.54	-2.85	-1.45	1.50	1.61	-3.50	-1.95	-3.15	0.48	1.46	0.77	2.43	3.50
Kerala	-2.25	-0.77	0.21	1.31	1.42	3.03	-0.30	-6.17	-4.44	-2.24	1.82	-5.51	-2.87	-0.12	0.00	-0.07	-0.22	1.56	0.42	-0.04	0.02	-0.24	0.34	0.52
Lakshadweep	-16.67	0.34	-8.68	0.80	-10.02	6.67	-4.94	NA	-7.02	1.29	NA	NA	-4.17	-5.56	17.13	20.38	-8.22	-0.52	-6.05	8.73	0.00	2.48	0.00	-0.59
Madhya Pradesh	-5.17	-1.78	-1.64	-3.66	-5.62	-5.17	-2.68	-8.06	-4.88	-2.95	-9.48	-6.52	-4.21	-1.75	2.17	1.79	-1.92	-3.21	-2.51	1.27	0.63	9.44	9.22	12.77
Maharashtra	-3.40	-1.49	-0.95	-0.65	0.00	0.00	-1.81	-4.97	-2.84	-1.86	-6.27	-3.90	-2.64	-1.40	0.78	0.73	-2.67	-0.09	-1.43	0.36	0.95	2.38	2.28	3.25
Manipur	0.58	-1.01	-1.14	-0.76	-0.10	2.38	-0.80	-1.03	-1.19	-1.77	0.13	-1.23	-1.78	-0.45	5.27	-0.16	1.51	0.78	0.37	1.22	1.47	6.16	3.19	4.03
Meghalaya	-1.36	-0.70	-0.60	0.93	-1.33	-0.36	-0.63	-2.19	-1.41	-1.45	-1.36	-2.05	-1.18	-0.72	1.11	1.57	-0.56	6.92	0.58	0.67	1.97	3.45	3.78	9.45
Mizoram	-1.32	-0.93	-1.00	0.34	2.33	1.28	-0.44	1.59	-2.43	-3.14	-2.77	-3.18	-3.43	-0.30	-1.51	-1.50	1.04	4.40	1.74	-0.76	0.55	0.51	1.32	2.49
Nagaland	-2.89	-2.02	-1.92	-1.37	-0.44	1.22	-1.87	2.18	-2.87	-4.10	-4.61	-3.47	-3.83	-2.01	8.62	6.80	-2.86	-2.05	-3.06	2.14	2.86	6.07	4.47	17.00
New Delhi	-3.32	-2.26	-1.56	-0.98	-1.50	-3.27	-2.11	-4.13	-3.46	-3.07	4.97	-4.39	-3.65	-1.75	1.16	0.30	-2.99	-0.71	-1.77	0.37	0.19	1.30	2.43	4.83
Odisha	-2.39	-1.27	-1.16	-1.71	-2.68	-3.52	-1.62	-4.73	-2.76	-1.78	-6.51	-3.63	-2.47	-1.45	2.89	1.31	-5.13	-1.65	-3.47	1.12	3.51	6.36	7.21	10.70
Puducherry	1.93	-8.15	0.78	5.82	3.70	-22.22	-2.61	7.41	-9.97	-11.11	-22.22	-17.09	-10.34	-4.17	1.47	0.33	-7.41	24.76	5.89	1.96	-0.25	1.01	-0.07	1.56
Punjab	-3.20	-2.38	-1.43	-0.06	0.22	-2.67	-1.94	6.61	-1.14	-2.33	4.00	-1.24	-2.62	-1.72	0.59	0.13	-0.57	1.04	0.23	0.26	0.17	3.12	2.70	4.46
Rajasthan	-3.47	-1.10	-1.15	-2.52	-4.06	-2.99	-1.89	-2.16	-2.59	-1.61	-5.03	-3.73	-2.37	-1.88	3.33	2.76	-3.80	-2.28	-3.19	1.57	5.93	7.84	6.74	12.31
Sikkim	-3.35	-4.22	-2.86	-2.36	-4.18	1.92	-3.84	-4.57	-3.71	-3.22	-0.31	-5.53	-4.57	-2.53	1.68	1.46	-1.56	-2.30	-2.40	0.34	1.01	5.79	6.49	4.94
Tamil Nadu	-2.92	-1.22	-0.24	0.08	-0.90	-3.33	-1.09	-5.25	-3.60	-2.51	-5.79	-4.28	-2.85	-0.34	1.38	1.55	-2.93	-1.19	-2.20	0.69	0.76	1.16	1.20	0.59
Telangana	-6.30	-0.63	2.00	13.07	0.00	0.00	-1.23	-8.62	-1.58	-0.80	-6.17	-4.64	-2.85	0.00	4.23	3.78	-5.85	0.00	-3.00	3.41	0.78	-0.54	0.56	0.90
Tripura	0.72	-0.99	-1.56	-0.89	-1.66	-2.61	-1.33	-0.93	-0.60	-0.16	-1.08	-1.13	-0.57	-0.80	0.92	2.34	-1.89	-1.04	-1.57	0.43	1.16	3.44	4.85	12.06

State/	Reproductive health indicator																							
Union Territory	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.1	2.2	2.3	2.4	2.5	2.6	3.1	3.2	3.3	3.3	3.4	3.5	4.1	4.2	4.3	4.4
Uttar Pradesh	-6.36	-2.50	-1.74	-2.49	-4.32	-5.93	-3.02	-7.38	-5.89	-4.09	-6.15	-6.68	-5.50	-1.58	2.86	3.35	-3.71	-3.33	-3.51	0.95	1.46	13.21	11.86	30.09
Uttarakhand	-4.57	-2.52	-1.06	-1.34	-1.26	-5.06	-2.09	-6.86	-4.79	-2.98	-9.95	-4.76	-3.61	-1.20	1.56	0.42	-1.40	-1.31	-1.39	0.77	2.49	6.05	6.28	10.96
West Bengal	-1.29	-1.37	-2.04	-2.95	-4.12	-1.06	-1.95	-2.57	-0.84	-0.43	-3.19	-1.88	-0.83	-1.53	0.98	1.89	-3.48	-2.17	-2.90	0.30	0.84	5.29	4.91	6.81

Source: Computed by authors from data available from different rounds of the National Family Health Survey.
NA Not available

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Trends and Predictors of the Use of Modern Contraceptive Methods by Sexually Active, Non-Pregnant Women in India, 2005–2021

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Abstract

We analyse trend and predictors of the use of modern contraceptive methods in sexually active, non-pregnant women of reproductive age in India based on the data available through the National Family Health Survey. The proportion of sexually active, non-pregnant women of reproductive age using selected modern contraceptive method has increased over time. The analysis also suggests that the increase in the use of selected modern contraceptive methods has been different in women with different demographic and socio-economic characteristics, although this difference appears to have decreased over time.

Background

India was the first country in the world to launch an official family planning programme way back in 1952. However, family planning for reducing birth rate and achieve population stabilization received attention only after 1971 population census (Ibarra-Nava et al, 2020). The use of modern contraceptive methods in India, however, remains low when compared to other countries. In 2022, almost 59 per cent of the currently married or in-union women in the world in comparison to 70 per cent in India (United Nations, 2022). The contraceptive prevalence rate in India is found to be lower than that in countries like Finland where it is around 79 per cent for the women aged 15-49 years. The increase in the use of modern contraceptive methods in India has also been slow as compared to other countries. The prevalence of modern contraceptive methods in India increased from 42 per cent in 1992-1993 to 56 per cent in 2019-2021 according to the National Family Health Survey (Government of India, 2022).

The term contraceptive prevalence is popularly used to reflect the use of family planning methods. The contraceptive prevalence is defined as the proportion of women of reproductive age (15-49 years) who are currently using or whose sexual partner is currently using at least one method of contraception. If a woman reports using more than one

method, only the most effective method is used to calculate contraceptive prevalence. As such, the overall use of contraceptive methods frequently used in combination with other methods may be underestimated. in many ways (United Nations, 2022). For analytical purposes, contraceptive methods are often classified as either modern or traditional. Modern contraceptive methods include female and male sterilization, intra-uterine devices (IUD), implants, injectables, oral contraceptive pills, male and female condoms, vaginal barrier methods (including the diaphragm, cervical cap and spermicidal foam, jelly, cream and sponge), the lactational amenorrhea method (LAM), emergency contraception and other modern methods. Traditional contraceptive methods include rhythm, withdrawal and other traditional methods (United Nations, 2022). The conventional definition of contraceptive prevalence does not distinguish between pregnant and non-pregnant women of reproductive age. The pregnant women are not exposed to the risk of pregnancy as they are already pregnant and, therefore, may not be using any contraceptive method. Similarly, there may be a proportion of reproductive age women who had never been engaged in a sexual activity and so are not exposed to the risk of pregnancy. It is, therefore, more pertinent to consider women of reproductive age who are sexually active and who are not pregnant in estimating the prevalence of contraception. However, the trend and predictors of the use of modern contraceptive methods in sexually active non-pregnant women are not available in India. The present paper is, therefore, focuses on the use of modern contraceptive methods in sexually active, non-pregnant women of reproductive age and its predictors.

In this paper, we analyse the trend and predictors of the use of selected modern contraceptive methods in sexually active, non-pregnant women of reproductive age in India during the period 2005-2021. Sexual activity in India is largely confined within marriage only, although women outside marriage may also be using a contraceptive method. The paper analyses the trend and predictors of the use of selected modern contraceptive methods in sexually active non-pregnant women only as the official family planning programme of the country is directed towards currently married women of reproductive age only. The modern contraceptive methods considered in the present analysis include oral pill, intra-uterine devices (IUD), injections, diaphragm, condom, female condom, foam or jelly, and male and female sterilisation.

Data and Methods

The paper is based on the third (2005-2006), fourth (2015-2016), and fifth (2019-2021) rounds of the National Family Health Survey (NFHS) organised by the Government of India and implemented by the International Institute for Population Sciences, Mumbai. Details of NFHS are given elsewhere (Government of India, 2022). The NFHS Programme was instituted in 1992-1993. The present analysis is limited to the last three rounds of NFHS only. During the third (2005-2006) round of the survey, 87,925 currently married women of reproductive age were covered. This number was 499,627 in the fourth (2015-2016) and 512,408 in the fifth (2015-2016) round of the survey. The number of currently married, sexually active, non-pregnant women of reproductive age covered during the three rounds of NFHS were, however, 79304, 448488 and 461288 respectively (Table 1). Weights were

used to calculate the proportion of currently married, sexually active, non-pregnant women of reproductive age using selected modern contraceptive methods.

Table 1: Categories of women of reproductive age covered in different rounds of NFHS.

Particulars	NFHS-3	NFHS-4	NFHS-5
Total women interviewed	124385	699686	724105
Women never had sex	29894	164940	173182
Women pregnant	5911	32420	28398
Unmarried	6545	35021	38376
Missing	2731	18817	22861
Final sample for the present study	79304	448488	461288
Proportion of total women interviewed (per cent)	63.76	64.10	63.70

Source: Authors

The dependent variable in the present paper is a dichotomous one. It has a value 1 if a currently married, sexually active, non-pregnant woman of reproductive age is using any one of the following modern contraceptive methods – female sterilization, male sterilization, oral pill, intra-uterine devices (IUDs), injections, diaphragm, condom, female condom, foam or jelly – and 0 otherwise. Other modern contraceptive methods have not been considered in the analysis as information about the use of these methods is not available for all the three rounds of NFHS. On the other hand, the variables used as predictors of the use of selected modern contraceptive methods include age of the woman, place of residence, household religion and caste, level of education of the woman, household wealth index, number of living children, exposure to media, awareness about family planning awareness, and zones of the country. Detailed description of the predictor variables is given in table 2. The entire country has been divided into six administrative zones for the present analysis as the use of modern contraceptive methods has been found to vary in different parts of the country.

Both bivariate and multivariate statistical analyses have been carried out to identify the predictors of the use of selected modern contraceptive methods by currently married, sexually active, non-pregnant women of reproductive age. The bivariate statistical analysis has been carried out to identify predictor variables which are statistically significantly associated with the use of the selected modern contraceptive methods. Based on the findings of the bivariate statistical analysis, predictor variables were selected for the multivariate statistical analysis. Since the dependent or the study variable in the present analysis is a dichotomous one, bivariate logistic regression was applied to test the association of selected predictor variables with the study variable or the dependent variable. Before the application of the bivariate logistic regression analysis, the multicollinearity in the dataset was examined. Multicollinearity refers to the linear relationship between explanatory or predictor variables. The variance inflation factor was calculated to test the multicollinearity among the independent or the predictor variables included in the present analysis. We found a variance inflation factor of close to 3 which indicates there was no harmful multicollinearity between the explanatory or the predictor variables (Thompson et al, 2017). The data used in the analysis were also examined for the presence of outliers. Results of the bivariate logistic regression analysis are given in terms of adjusted odds ratio.

Table 2. Description of predictor variables.

Variable	Categories	
Age (Years)	15-19	
	20-24	
	25-29 (Reference)	
	30-34	
	35-39	
	40-44	
	45-49	
Place of residence	Rural (Reference)	
	Urban.	
Religion	Hindu	
	Muslim (Reference)	
	Others	
Caste	Scheduled Castes/Tribes (Reference)	
	Other Backward Classes	
	Others	
Education	No education (Reference)	
	Primary	
	Secondary	
	Above Secondary	
Wealth Index	Poor (Reference)	
	Middle	
	Rich.	
Media exposure	Rare – women who rarely read newspaper/magazine, of listen to radio, or view television/cinema. (Reference)	
	Frequent – women who frequently read newspaper/magazine, of listen to radio, or view television/cinema	
	Regular – women who regularly read newspaper/magazine, of listen to radio, or view television/cinema.	
Family planning Awareness	No – women not aware of family planning (Reference)	
	Yes – women aware of family planning	
Number of Living children	0	
	1 (Reference)	
	2	
	3 and more than 3.	
Zones	North	Himachal Pradesh, Punjab, Chandigarh, Haryana, Delhi, Rajasthan, J&K, Ladakh (Reference)
	South	Andhra Pradesh, Karnataka, Kerala Tamil Nadu, Telangana.
	West	Gujarat, Goa and Maharashtra
	East	Bihar, Sikkim, Orissa, Jharkhand, West Bengal.
	Central	Uttar Pradesh, Uttarakhand, Madhya Pradesh, Chhattisgarh.
	Northeast	Assam, Nagaland, Meghalaya, Manipur, Mizoram, Tripura, Arunachal Pradesh.

Source: Authors

Results

Table 3 gives the proportion of currently married sexually active non-pregnant women using selected modern contraceptive methods in different rounds of NFHS. This proportion was 52.3 per cent in 2005-06 which decreased to 51.0 per cent in 2015-2016 but increased to 59.6 per cent in 2019-2021. The odds using selected modern contraceptive methods was 10 per cent higher than the odds of not using selected modern contraceptive methods in 2005-06 which decreased to 4 per cent in 2015-2016 but increased to 47 per cent in 2019-2021. By comparison, the proportion of currently married women of reproductive age using a modern family planning method in India, according to NFHS, was 42 per cent, 48 per cent, and 56 per cent respectively. This implies that the odds of using a modern contraceptive method by currently married women of reproductive age was 4.6 per cent higher than the odds of not using a modern contraceptive method by currently married women in 2005-06 which decreased to 2.02 per cent in 2015-2016 but increased to 19.10 per cent in 2019-2021. As expected, the use of selected modern contraceptive methods in currently married, sexually active, non-pregnant women is higher than the use of modern contraceptive methods in currently married women of reproductive age. The relatively higher use of selected modern contraceptive methods among sexually active, non-pregnant, married women is primarily due to their immediate need to prevent or postpone pregnancy. At the same time, all modern contraceptive methods have not been considered in the present analysis which may result in a lower use of modern contraceptive methods among currently married, sexually active, non-pregnant women.

Table 3 also shows use of selected modern contraceptive methods by the background characteristics of currently married, sexually active, non-pregnant women and the associated odds of using selected modern contraceptive methods. The impact of some of the background characteristics on the use of selected contraceptive methods is revealing. For example, there has been a marginal increase in the use of selected modern contraceptive methods in currently married, sexually active non-pregnant women in the rural areas between NFHS-3 and NFHS-4 but there has been a marked decrease in the use of these methods in the urban areas. On the other hand, the increase in the use of selected modern contraceptive methods between NFHS-4 and NFHS-5 has been more rapid in the rural areas as compared to that in the urban areas of the country. The odds of using selected modern contraceptive methods increased steadily which indicates that the probability of using selected modern contraceptive methods has increased over time in younger women. Most age groups saw an increase in odds from NFHS-3 to NFHS-5, with the odds generally rising more rapidly in the older age groups. Among Muslim women, odds of using selected modern contraceptive methods rose from NFHS-3 (0.66) to NFHS-5 (0.97), indicating an increase in contraceptive use, though the overall odds remained lower compared to other religious groups. In women with no education, the odds of use showed slight fluctuations but generally increased, reflecting rising contraceptive use. Among women with higher education, odds decreased in NFHS-4 but increased in NFHS-5, indicating a recovery in contraceptive use among highly educated women. In the context of any kind of media exposure over the period 2005-06 to 2019-21 odds remained high and have increased, indicating a strong correlation between media exposure and contraceptive use. In almost all zones, odds increased, indicating rising use of contraceptives.

Table 3: Use of selected modern contraceptive methods in India, 2005-2021.

Predictor variables	Proportion (per cent) of currently married, sexually active, non-pregnant women using selected modern contraceptive methods			Odds of using selected modern contraceptive methods		
	NFHS-3	NFHS-4	NFHS-5	NFHS-3	NFHS-4	NFHS-5
All	52.30	51.01	59.55	1.10	1.04	1.47
Residence						
Urban	59.18	54.34	61.00	1.45	1.19	1.56
Rural	49.15	49.33	58.88	0.97	0.97	1.43
Age						
15-19	8.12	12.23	22.55	0.09	0.14	0.29
20-24	30.97	27.97	37.07	0.45	0.39	0.59
25-29	52.88	45.83	53.58	1.12	0.85	1.15
30-34	63.66	57.91	64.35	1.75	1.38	1.81
35-39	64.90	61.49	68.80	1.85	1.60	2.21
40-44	61.29	60.78	67.81	1.58	1.55	2.11
45-49	59.33	57.44	65.84	1.46	1.35	1.93
Religion						
Hindu	53.76	51.96	60.99	1.16	1.08	1.56
Muslim	39.69	40.07	49.34	0.66	0.67	0.97
Others	56.46	58.92	57.37	1.30	1.43	1.35
Social class						
SC	50.87	52.60	60.30	1.04	1.11	1.52
ST	46.42	48.14	58.36	0.87	0.93	1.40
OBC	51.69	49.58	59.76	1.07	0.98	1.49
Others	55.44	53.41	58.86	1.24	1.15	1.43
Education						
No Education	49.08	51.41	62.18	0.96	1.06	1.64
Primary	57.16	55.80	64.42	1.33	1.26	1.81
Secondary	54.23	50.62	58.57	1.18	1.03	1.41
Higher	55.38	44.35	51.71	1.24	0.80	1.07
Standard of living						
Poor	42.97	44.30	56.42	0.75	0.80	1.29
Middle	53.52	53.73	61.54	1.15	1.16	1.60
Rich	60.10	55.69	61.44	1.51	1.26	1.59
Number of living children						
0	4.66	7.35	14.57	0.05	0.08	0.17
1	25.86	29.98	40.55	0.35	0.43	0.68
2	64.63	63.42	70.20	1.83	1.73	2.36
3 or 3+	62.79	59.25	67.97	1.69	1.45	2.12
Exposure to media						
Very Rare	41.60	38.93	53.68	0.71	0.64	1.16
Frequently	45.76	45.94	58.65	0.84	0.85	1.42
More frequently	58.13	54.91	62.39	1.39	1.22	1.66
Awareness about family planning						
No	46.72	45.89	56.59	0.88	0.85	1.30
Yes	56.42	54.03	61.20	1.29	1.18	1.58

Predictor variables	Proportion (per cent) of currently married, sexually active, non-pregnant women using selected modern contraceptive methods			Odds of using selected modern contraceptive methods		
	NFHS-3	NFHS-4	NFHS-5	NFHS-3	NFHS-4	NFHS-5
Administrative zones						
North	54.88	59.74	62.12	1.22	1.48	1.64
South	66.30	59.21	68.77	1.97	1.45	2.20
East	42.79	42.98	54.24	0.75	0.75	1.19
West	65.67	58.96	63.37	1.91	1.44	1.73
Central	41.21	42.61	54.60	0.70	0.74	1.20
North-East	32.27	36.26	43.51	0.48	0.57	0.77

Source: Authors

Table 4 shows the use of specific modern contraceptive methods by currently married, sexually active, non-pregnant women along with the corresponding odds at the three rounds of NFHS.

Table 4: Proportion (per cent) of currently married, sexually active, non-pregnant women using selected modern contraceptive methods in India

Method	Proportion (per cent) of currently married, sexually active, non-pregnant women using selected modern contraceptive methods			Odds of using selected modern contraceptive methods		
	NFHS-3	NFHS-4	NFHS-5	NFHS-3	NFHS-4	NFHS-5
Female sterilisation	40.46	38.85	40.72	0.68	0.64	0.69
Male sterilisation	1.10	0.29	0.33	0.01	0.00	0.00
Oral Pill	3.11	3.92	4.60	0.03	0.04	0.05
IUD	1.86	1.63	2.20	0.02	0.02	0.02
Injections	0.10	0.19	0.58	0.00	0.00	0.01
Diaphragm	0.00	0.00	0.01	0.00	0.00	0.00
Condom	5.63	6.01	10.02	0.06	0.06	0.11
Female condom	0.00	0.03	0.03	0.00	0.00	0.00
Foam or jelly	0.02	0.00	0.00	0.00	0.00	0.00

Source: Authors

Results of the bivariate logistic regression analysis are presented in table 5. In some cases, the adjusted odds ratios have decreased over time whereas in other cases, they have increased. For example, the rural-urban odds ratio has decreased over time and has become statistically insignificant. This means that the use of selected modern contraceptive methods in the urban areas relative to that in the rural areas has decreased and there appears little difference in the use in the two population groups during 2019-2021 as compared to 2005-2006. The reason is that the odds of using selected modern contraceptive methods increased more rapidly than the odds of using selected modern contraceptive methods in the urban areas as may be seen from table 3. Similarly, the odds ratio of the use of selected modern contraceptive methods in Hindu women and women of other religions relative to the use in Muslim women decreased over time because the odds

of using selected modern contraceptive methods increased more rapidly in Muslim women as compared to Hindu women and women of other religions. The odds ratio of use of selected modern contraceptive methods in women aged 30-34 years relative to that in women aged 25-29 years decreased over time but increase in women of other ages because the odds of using selected modern contraceptive methods increased more rapidly in women of other ages as compared to women aged 25-29 years. In case of other explanatory variables also, the odds ratio of the use of selected modern contraceptive methods relative to the reference group has decreased over time. This means that the differences in the use of selected modern contraceptive methods across different population groups have decreased over time.

The trend in the odds ratio of the use of selected modern contraceptive methods in different zones of the country relative to the use in the North zone has been different. The odds ratio of the use of selected modern contraceptive methods has decreased in the South Zone and the West zone but increased in other zones. the odds ratios of other zones have increased over time. In the south zone the odds of using selected modern contraceptive methods increased over time but the increase was slower than the increase in the odds of using selected modern contraceptive methods in the North Zone and so the odds ratio decreased. In case of the West zone, on the other hand, the odds of using selected modern contraceptive methods decreased over time whereas the odds of using selected modern contraceptive methods in the North zone increased and therefore odds ratio decreased. In other zones of the country, the increase in the odds of using selected modern contraceptive methods has been more rapid than the increase in the odds of using selected modern contraceptive methods in the North (reference) zone and so the odds ratio increased.

The study or the dependent variable in the present analysis is the sum of the proportion of currently married, sexually active, non-pregnant women of reproductive age using selected modern contraceptive methods. This means that the difference in the study or the dependent variable across different population groups is the sum of the difference in the use of different modern contraceptive methods included in the present analysis across population groups. This also means that there may be a situation where the direction of the difference in the use of one or more than one contraceptive method is opposite to the direction of the difference in the use of other contraceptive methods. For example, the urban-rural difference in the proportion of currently married, sexually active, non-pregnant women using selected modern contraceptive methods was 10 per cent points in 2005-2006 which decreased to 2 per cent points during 2019-2021 (Table 6). In 2005-2006, the direction of the urban-rural difference in female sterilisation was opposite to the direction of the difference in other contraceptive methods. On the other hand, the direction of the urban-rural difference in the use of female sterilisation, male sterilisation, oral pill and injections is found to be opposite to the direction of urban-rural difference in other contraceptive methods. The urban-rural difference in the use of female sterilization has been negative and increased by around 3 per cent points between 2005-2006 and 2019-2021 whereas the urban-rural difference in the use of IUD and condom has been positive and decreased between 2005-2006 and 2019-2021. It may be seen from the table that the direction of the urban-rural difference in the use of some contraceptive methods has not been the same in 2005-2006 and 2019-2021.

Table 5: Results of the bivariate logistic regression analysis of the use of selected modern contraceptive methods in different rounds of NFHS.

Predictor variables	NFHS-3			NFHS-4			NFHS-5		
	Adjusted OR	p		Adjusted OR	p		Adjusted OR	p	
Place of Residence									
Rural	Ref								
Urban	1.06	0.006	(1.02, 1.10)	1.00	0.636	(0.98, 1.01)	1.00	0.897	(0.99, 1.02)
Age-Group									
25-29	Ref								
15-19	0.39	0.000	(0.35, 0.44)	0.75	0.560	(0.71, 0.80)	0.94	0.000	(0.89, 0.99)
20-24	0.65	0.000	(0.62, 0.69)	0.75	0.000	(0.73, 0.77)	0.82	0.003	(0.80, 0.84)
30-34	1.36	0.000	(1.30, 1.43)	1.34	0.000	(1.32, 1.37)	1.27	0.000	(1.25, 1.30)
35-39	1.30	0.000	(1.24, 1.37)	1.46	0.000	(1.43, 1.49)	1.43	0.000	(1.40, 1.46)
40-44	1.04	0.194	(0.98, 1.10)	1.37	0.000	(1.34, 1.40)	1.32	0.000	(1.29, 1.35)
45-49	0.92	0.004	(0.86, 0.97)	1.18	0.000	(1.15, 1.21)	1.18	0.000	(1.15, 1.21)
Religion									
Muslims	Ref								
Hindu	2.27	0.000	(2.16, 2.40)	1.69	0.000	(1.66, 1.73)	1.70	0.000	(1.67, 1.74)
Others	1.90	0.000	(1.74, 2.07)	1.86	0.000	(1.80, 1.93)	1.32	0.000	(1.27, 1.37)
Caste									
SC/ST	Ref								
OBC	0.95	0.020	(0.92, 0.99)	0.90	0.000	(0.88, 0.91)	0.94	0.000	(0.93, 0.96)
Others	1.19	0.000	(1.13, 1.24)	1.08	0.000	(1.06, 1.10)	1.00	0.888	(0.98, 1.02)
Women's Education level									
No Education	Ref								
Primary	1.24	0.000	(1.18, 1.31)	1.12	0.000	(1.09, 1.14)	1.09	0.000	(1.07, 1.12)
Secondary	1.02	0.346	(0.98, 1.07)	0.92	0.000	(0.91, 0.94)	0.95	0.000	(0.93, 0.97)
Above Secondary	1.22	0.000	(1.12, 1.32)	0.83	0.000	(0.81, 0.86)	0.84	0.000	(0.81, 0.86)
Wealth Quintile									

Predictor variables	NFHS-3			NFHS-4			NFHS-5		
	Adjusted OR	p		Adjusted OR	p		Adjusted OR	p	
Poor	Ref								
Middle	1.21	0.000	(1.16, 1.27)	1.10	0.000	(1.08, 1.12)	1.03	0.001	(1.01, 1.05)
Rich	1.34	0.000	(1.27, 1.41)	1.13	0.000	(1.11, 1.16)	1.03	0.003	(1.01, 1.05)
Parity of Women									
1	Ref								
0	0.16	0.000	(0.14, 0.18)	0.19	0.000	(0.18, 0.20)	0.26	0.000	(0.25, 0.27)
2	4.74	0.000	(4.50, 5.00)	3.53	0.000	(3.46, 3.59)	3.02	0.000	(2.97, 3.08)
3 and more than 3	6.29	0.000	(5.94, 6.65)	3.65	0.000	(3.58, 3.73)	3.15	0.000	(3.08, 3.21)
Media Exposure									
Rare	Ref								
Frequent	1.18	0.000	(1.11, 1.24)	1.37	0.000	(1.33, 1.41)	1.21	0.000	(1.18, 1.23)
Regular	1.54	0.000	(1.47, 1.62)	1.71	0.000	(1.67, 1.74)	1.42	0.000	(1.30, 1.45)
Family planning Awareness									
No	Ref								
Yes	1.16	0.000	(1.11, 1.21)	1.17	0.000	(1.15, 1.18)	1.25	0.00	(1.23, 1.26)
Administrative Zones									
North	Ref								
South	2.01	0.000	(1.90, 2.13)	1.01	0.245	(0.99, 1.04)	1.40	0.000	(1.37, 1.43)
East	0.76	0.000	(0.72, 0.80)	0.61	0.000	(0.60, 0.63)	0.80	0.000	(0.79, 0.82)
West	1.73	0.000	(1.63, 1.84)	1.03	0.023	(1.00, 1.06)	1.10	0.000	(1.07, 1.12)
Central	0.59	0.000	(0.56, 0.62)	0.52	0.000	(0.51, 0.54)	0.71	0.000	(0.70, 0.73)
North-East	0.37	0.000	(0.34, 0.41)	0.42	0.000	(0.40, 0.44)	0.51	0.000	(0.49, 0.53)

Source: Authors

Remarks: Figures in brackets are 95 per cent confidence intervals.

Among different states/Union Territories of the country, the odds of using selected modern contraceptive methods by currently married, sexually active, non-pregnant women of reproductive age in 2005-2006 was the highest in Himachal Pradesh whereas it was the highest in Andhra Pradesh in 2019-2021. On the other hand, the ratio of the odds of contraceptive use in 2019-2021 to the odds of contraceptive use in 2005-2006 was the highest in Goa but the lowest in Mizoram which shows considerable inequality in the increase in the use of selected modern contraceptive methods during 2005-2021. One reason is that the odds of contraceptive use varied widely across states in 2005-2006 because of variation in the background characteristics of currently married, sexually active, non-pregnant women of reproductive age across the states and Union Territories.

Table 6: Urban-rural difference in the use of selected contraceptive methods in India.

	Proportion (per cent) of currently married, sexually active, non-pregnant women using selected modern contraceptive methods					
	2005-2006			2019-2021		
	Urban	Rural	Difference	Urban	Rural	Difference
Female sterilisation	40.2	40.6	-0.4	38.3	41.8	-3.6
Male sterilisation	1.1	1.1	0.0	0.3	0.4	-0.1
Oral Pill	4.0	2.7	1.3	4.0	4.9	-0.8
IUD	3.4	1.2	2.3	2.8	1.9	0.9
Injections	0.1	0.1	0.0	0.4	0.7	-0.2
Diaphragm	0.0	0.0	0.0	0.0	0.0	0.0
Condom	10.3	3.5	6.9	14.2	8.1	6.1
Female condom	0.0	0.0	0.0	0.0	0.0	0.0
Foam or jelly	0.1	0.0	0.0	0.0	0.0	0.0
All methods	59.2	49.1	10.1	60.1	57.8	2.4

Source: Authors

Discussion

The use of contraceptive methods can affect fertility level in any society over the period and thus can influence the size and the growth of the population. Because of this very reason, contraceptive use is recognised as one of the proximate determinants of fertility (Davis and Blake, 1956; Bongaarts, 1978). The increased use of contraceptive methods in India is argued to be one of the factors behind the decrease in the total fertility rate in India below the replacement level (Government of India, 2022). At the same time, estimates and projections made by United Nations suggest that the momentum gained from high fertility levels in the past suggest that population of the country will continue to increase in the near future despite achievement of below replacement fertility (United Nation, 2022a). These observations suggest that use of contraceptive methods will be very much relevant to population transition in India at least in the near future. It is in the above context that the present study was focused to understand the trend and predictors of modern method of contraceptive with other co-variate in the study among women aged 15-49 years in India.

Table 7: Variation in the odds of using selected modern contraceptive methods across states/Union Territories of India, 2005-2021.

State	Odds of using selected modern contraceptive methods			Odds ratio		
	2005-2006	2015-2016	2019-2021	2015-2016/ 2005-2006	2019-2021/ 2015-2016	2019-2021/ 2005-2006
Jammu & Kashmir	0.85	0.99	1.39	1.16	1.41	1.64
Himachal Pradesh	2.98	1.20	1.95	0.40	1.63	0.66
Punjab	1.45	2.34	1.10	1.61	0.47	0.76
Chandigarh	-	1.54	1.36	-	0.88	-
Uttarakhand	1.51	1.12	1.56	0.74	1.40	1.03
Haryana	1.69	1.79	1.77	1.06	0.99	1.05
Delhi	1.50	1.07	1.51	0.71	1.42	1.01
Rajasthan	0.92	1.34	1.90	1.46	1.42	2.08
Uttar Pradesh	0.47	0.53	0.90	1.12	1.70	1.90
Bihar	0.49	0.35	0.94	0.72	2.69	1.94
Sikkim	1.11	0.92	1.29	0.84	1.39	1.17
Arunachal Pradesh	0.66	0.40	1.01	0.61	2.52	1.53
Nagaland	0.33	0.29	0.99	0.86	3.45	2.98
Manipur	0.35	0.16	0.25	0.46	1.54	0.71
Mizoram	1.84	0.61	0.49	0.33	0.81	0.27
Tripura	0.91	0.82	1.09	0.89	1.33	1.19
Meghalaya	0.25	0.30	0.33	1.21	1.12	1.35
Assam	0.43	0.63	0.85	1.46	1.35	1.96
West Bengal	1.14	1.57	1.74	1.37	1.11	1.52
Jharkhand	0.52	0.66	1.10	1.26	1.67	2.10
Odisha	0.90	0.92	1.05	1.02	1.14	1.16
Chhattisgarh	1.12	1.40	1.86	1.24	1.33	1.66
Madhya Pradesh	1.33	1.14	2.25	0.86	1.97	1.69
Gujrat	1.52	0.83	1.29	0.55	1.56	0.85
Maharashtra	2.20	1.96	2.01	0.89	1.03	0.91
Andhra Pradesh	2.31	2.65	2.81	1.14	1.06	1.21
Karnataka	1.99	1.22	2.50	0.61	2.05	1.26
Goa	0.69	0.32	2.13	0.46	6.71	3.08
Kerala	1.64	1.17	1.25	0.71	1.08	0.76
Tamil Nadu	1.69	1.22	2.13	0.73	1.74	1.26
Telangana	-	1.49	2.29	-	1.54	-
Ladakh	-	0.00	1.15	-	-	-
Total	1.10	1.04	1.47	0.95	1.41	1.34

Source: Authors

In India, virtually all births are confined within the institution of marriage. Unlike the western society, births, outside the institution of marriage do not have acceptance in the Indian society. The present analysis shows that there is a substantial proportion of women of reproductive age who are not exposed to the risk of pregnancy because of various

reasons. A woman of reproductive age may not be exposed to the risk of pregnancy even if she is married because she may not be sexually active or because she is pregnant. It is, therefore, more pertinent, to analyse the trend and predictors of contraceptive use in currently married, sexually active, non-pregnant women of reproductive age rather than in all currently married women of reproductive age. The present analysis has, therefore, focused on the use of selected modern contraceptive methods among currently married, sexually active, non-pregnant women instead of the use of contraceptive methods in all currently married women of reproductive age as is the tradition. Our analysis has expectedly revealed higher use of modern contraceptive methods among currently married, sexually active, non-pregnant women of reproductive age.

The findings of the present analysis underline the need to build support among youth and their families for delaying marriage, to enforce existing laws on the minimum age at marriage and to encourage school, health and other authorities to support young women in negotiating with their parents to delay marriage (Santhya et al, 2010). Women from younger age group had lower odds of using selected modern contraceptive methods which clearly indicates that every woman prefers to have at-least one or two children. The analysis also reveals that the use of selected modern contraceptive methods is higher in the urban areas as compared to the rural areas. This may be attributed to the higher autonomy to the women, higher level of education, better knowledge of different modern contraceptive methods, and preference for smaller families.

The findings of the present analysis are in line with other studies that suggest that long-standing heterogeneity of India associated with religion and the caste system is still relevant in contraceptive choices. Hindu women and women of other religions always have upper hand in using modern contraceptive methods as compared to Muslim women (Singh et al, 2021). Old customs and traditions in different groups and communities form the basis for this gap in the use of modern contraceptive methods. Although, the use of a modern contraceptive method in Scheduled Castes/Tribes appears to have increased as compared to the use of modern contraceptive method in Other Backward Classes, yet use of modern contraceptive methods is still lower than the use in Other social classes which are also termed as Upper social classes.

The present analysis suggests that women with higher educational achievements have lower probability of using a modern contraceptive method as compared to women with lower educational achievement or women with no education. This observation is justified because the contraceptive method mix in India remains very highly skewed towards female sterilisation which is a permanent contraceptive method (Government of India, 2017; Government of India, 2022; Singh et al, 2021). Women with higher educational achievement have better knowledge about different modern contraceptive methods and have regular exposure to mass media and are more aware about family planning messages. This is usually not the case with women with no education. This finding suggests educating women about the effectiveness of different contraceptive methods and motivating them for the adoption of modern methods (Ghosh et al, 2021; Singh et al, 2021).

The analysis also reveals rich–poor gap in the use of modern contraceptive methods, although this gap has decreased over time. Rich women have better access to different modern contraceptive methods as compared to their poor counterparts

(Government of India, 2022a; Mohanty and Pathak, 2009). On the other hand, the number of living children has always been a decisive factor in the use of modern contraceptive methods. There exists direct relationship between the probability of using a modern contraceptive method and the number of living children which is in line with other studies not only in India but also in other countries of the world (Achana et al, 2015; Kumar et al, 2021).

Regional disparities in the use of modern contraceptive methods are also apparent through the present analysis. The use of modern contraceptive methods was relative higher in the southern region of the country in 2005-2006. However, in 2019-2021, the use of modern contraceptive methods is found to be the highest in the northern region of the country. This observation is in line with the fact that literacy is high in women of the southern region of the country which leads to better employment opportunities and high age at marriage (Singh et al, 2021). However, within each zone, the use of modern contraceptive methods is different in states/Union Territories that constitute the zone.

Strengths and Limitations

One strength of the present study is that it analyses the use of modern contraceptive methods in those women only who are exposed to the risk of a pregnancy – currently married, sexually active, non-pregnant women of reproductive age. It excludes those women of reproductive age who are not married or who are married but not sexually active and women who are pregnant. Including these women in the analysis of the use of modern contraceptive methods makes little sense as these women are not at the risk of a pregnancy and, therefore, have no motivation to use a contraceptive method either modern or traditional. Measuring the prevalence of modern contraceptive methods in terms of currently married women of reproductive age, therefore, underestimates the actual use of modern contraceptive methods in those women who are at risk of a pregnancy. The present analysis shows that use of modern contraceptive methods in women at risk of pregnancy is higher than the use of modern contraceptive methods in all currently married women of reproductive age irrespective of whether they are sexually active or pregnant.

The findings of the present study may, however, be interpreted under some limitations. First, the analysis is based on the response given by women during the household survey. It is well-known that the data available through household surveys is associated with a number of errors including response error, failure of memory to recall exact answers to few of the questions like age and number of pregnancies, and no response to some of the questions asked during the survey. There may be a possibility that a woman or her partner may be using more than one contraceptive method at the time of the survey. In such a situation, the practice is to record only that method which has the higher effectiveness in preventing a birth. This practice, however, leads to an underestimation of the use of contraceptive methods, either modern or traditional. The use of contraceptive methods may also be influenced by the incentive schemes launched by the government for promoting specific contraceptive method. These incentives may influence the use of different contraceptive methods. For example, there is incentive for female sterilisation but not for using condom.

Conclusions

The present study has attempted to examine important attributes affecting the use of modern contraceptive methods in current married, sexually active, non-pregnant women of reproductive age in India during the period 2005-2006 through 2019-2021. The use of modern contraceptive methods in these women has increased over time but the increase has not been consistent. The use of some modern contraceptive methods appears to have decreased during the period under reference while the use of other methods has increased. Another revealing finding of the study is that the trend in the use of modern contraceptive methods has varied by the demographic and socio-economic characteristics of women. More specifically, the urban-rural difference in the use of modern contraceptive methods has decreased over time and this difference is no longer statistically significant. The paper suggests the method specific analysis of trend and predictors of use.

From the policy and programme perspective, the findings of the present analysis reveal that

- Although use of modern contraceptive methods has increased over time but there are still some grey areas which requires better planning and coverage. Family planning efforts directed towards younger women can be helpful to both the mother and the child.
- Religion remains a dominating factor and hampers rights of women violating sustainable development goal (SDG) -3: good health and well-being, particularly SDG 3.7.1-rRelated to contraceptive use).
- There is a need to motivate public policy makers for formulation of programmes related to family planning which will positively affect women in the choice of modern contraceptive methods.
- There is a need to focus on the Northeastern region of the country, where the use of modern contraceptive methods is the lowest.
- There is a need of expanding basket of modern contraceptive methods to increase their use.

Disclaimer

The views expressed by Pragya Singh are her own and not that of Government of India.

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Chronic Conditions During Pregnancy: Guidance on Complications and Healthcare Options

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Abstract

This study investigates factors influencing awareness of pregnancy complications and appropriate healthcare facilities, focusing on pregnant women with chronic conditions. Using data from the latest (2019-2021) round of National Family Health Survey, the study reveals significant gap in healthcare services with marked inter-state variations. The study also reveals that women with chronic conditions are more likely to receive information about pregnancy complications but are not necessarily aware of where to seek help and are less likely to be informed about the importance of institutional delivery. Logistic regression results indicate that women with chronic conditions and higher educational levels are more likely to be informed about pregnancy complications. However, their condition does not affect the advice they receive about the importance of institutional delivery or where to seek help in case of complications. The findings of the study highlight the need for targeted education and support for pregnant women, especially those with chronic conditions for ensuring comprehensive care for mothers and infants, thereby improving maternal and child health outcomes.

Introduction

Chronic health conditions encompass prolonged diseases influenced by genetic, physiological, environmental, and behavioral factors (World Health Organization, 2023). Pregnancy induces significant hormonal and physiological changes, heightening risks of maternal morbidity and mortality when coupled with chronic illnesses. Women of reproductive age in India are particularly susceptible to multiple chronic health conditions, termed as multimorbidity (Singh et al, 2023). It has been observed that 32.2 per cent of pregnant women had at least one chronic health issue, while 8.7 per cent had experienced multimorbidity (Hossain et al, 2021). Chronic diseases such as cancer, heart disease, stroke, liver disorder, diabetes, and respiratory diseases accounted for nearly one-third (32.9 per cent) of the deaths among women aged 15-44 years in the United States in 2017 (Hayes et al, 2020). Similarly, the Public Health Agency of Canada (2020) reported that 27 per cent of the pregnancies were experienced by women with a chronic condition.

Women with chronic conditions are more likely to undergo caesarean sections than healthy women (Kersten et al, 2014). Women with chronic hypertension face almost

eight times higher risk of developing superimposed pre-eclampsia during pregnancy (Bramham et al, 2014). Pregnancy in women with heart disease is associated with increased risks of maternal mortality and diverse complications (Roos-Hesselink et al, 2019). Chronic diseases can lead to adverse reproductive outcomes, including pre-term birth, low birth weight, intrauterine growth retardation, congenital disabilities, caesarean sections, and, to a lesser extent, low Apgar score, stillbirth, neonatal and maternal death (Jølving et al, 2016; Al-Amran et al, 2012; Ralston et al, 2021). Pregnant women with chronic illnesses often experience increased healthcare needs and stress levels impacting perinatal outcomes (Tyer-Viola and Lopez, 2014). Babies born to women with chronic diseases face less favourable outcomes, with one in every ten women with at least one chronic disease giving birth prematurely, compared to one in thirteen healthy women (Kersten et al, 2014). Adverse neonatal outcomes are at least twice as likely in women with chronic conditions as in healthier women (Bramham et al, 2014).

High risk pregnancies, such as those involving pulmonary hypertension, heart failure, insulin-dependent diabetes, thyroid disorders, cancer, kidney disorders, substance addiction, and chronic intrauterine infections, require extensive medical attention and specialised care (Kersten et al, 2014; Kuppusamy et al, 2023; Ralston et al, 2021). Managing high-risk pregnancies necessitates additional medical care for women with known diseases. The World Health Organization recommends a minimum of four antenatal care (ANC) visits for risk assessment, prevention, and management of pregnancy and associated comorbidities (WHO, 2016). In India, ANC is often provided by field level health functionaries such as Auxiliary Nurse Midwives (ANMs), working with Accredited Social Health Activists (ASHAs), Anganwadi Workers (AWWs), and local Primary Health Centres (PHCs) (Government of India, 2010). Early detection, follow-up, and management of high risk pregnancies are crucial components of antenatal care (Government of India, *nd*).

Two-thirds of the population of India resides in the rural areas, where women face higher risks due to limited awareness and access to healthcare. Vulnerable populations, particularly in rural and impoverished communities, experience the highest rates of chronic diseases linked to maternal morbidity and mortality (Singh et al, 2023). According to UNICEF, access to essential health care services often hinges on economic status and the place of residence, leading to significant disparities between urban and rural areas, as well as among wealthy and the impoverished families (UNICEF, *nd*). In the urban areas, approximately 28 per cent of women suffer from multimorbidity (Singh et al, 2023). Factors contributing to multimorbidity include age, education, employment status, marital status, parity, menopause, religion, region, wealth, tobacco use, alcohol consumption, and dietary habits. High-risk pregnancies are prevalent among the rural women, those with no formal education, and those in the poorest wealth quintiles (Kuppusamy et al, 2023). The long-term health conditions of pregnant women can impede their ability to care for their babies, underscoring the need for extended postnatal support (Lee et al, 2023).

In this paper, we examine how the healthcare system in India provides the support to pregnant women with chronic conditions by fostering the awareness about the complications during pregnancy, advising them about where to seek help in case of complications during pregnancy, and advocating the importance of institutional delivery to address pregnancy complications.

Data and Methodology

This paper is based on the data available from the fifth round of the National Family Health Survey (NFHS-5), which was conducted during the period 2019-2021. The NFHS is a comprehensive multi-phase household survey designed to provide national and state level estimates of selected indicators of fertility, infant and child mortality, family planning practices, reproductive health, maternal and child health, nutrition, anemia, and the quality and utilisation of healthcare services (Government of India, 2022). This study specifically examines national level data to compare the healthcare experiences of pregnant women distinguishing between women having chronic conditions and women do not having chronic conditions. The sample comprises of 29,949 pregnant women, among whom 2,044 women were having at least one chronic condition at the time of the survey. The paper focuses on antenatal care, pregnancy complications, and advice received regarding institutional delivery. The paper also examines disparities in healthcare based on the socioeconomic status of women.

During the NFHS-5, data were collected on the pregnancy status of currently married women aged 15-49 years and about the chronic conditions such as diabetes, hypertension, heart and respiratory diseases, kidney disorders, cancer, and thyroid problems. A new variable, 'women with at least one chronic condition' was created from the data available from the NFHS-5. This variable was used to compare pregnant women with and without chronic conditions across several factors including the place of residence (rural/urban), level of educational (less than secondary/secondary and above), wealth index (poor/middle/rich – described in this paper as living standard – low/middle/high), registration for ANC (by ANM/ASHA/AWW/Other), ANC received during the last three months, type of examination conducted during the ANC visit, advice on institutional delivery, information provided about pregnancy complications, and advice on where to go in case of complications.

Weighted percentages were calculated to estimates the indicators of healthcare for pregnant women with and without chronic conditions. We have compared number of ANC visits, examinations conducted during the last ANC visit, information provided about pregnancy complications at the visit, facilities informed or recommended for seeking help in case of complications, and advice given about the importance of institutional delivery between pregnant women with chronic conditions and pregnant women without chronic conditions. For ANC visits and chronic conditions, data were also analysed at the state level but for other indicators of healthcare, analysis was conducted at the national and regional levels because the number of women with chronic conditions receiving ANC was very small in several states. In total, 740 pregnant women with chronic conditions who received ANC were included in the national sample. We have also investigated the influence of socioeconomic status of pregnant women on the information given to them about the complications during pregnancy and about the facilities where the services to address these complications were available at the time of ANC visit. Bivariate logistic regression analysis was carried out to analyse the impact of regional and socioeconomic factors on the likelihood of the pregnant women with chronic conditions being informed about the complications of pregnancy, advice given about where to seek help in such cases and endorsing the important of the institutional delivery.

Results

Most of the pregnant women (92 per cent) received antenatal care (Table 1). The southern region of the country demonstrated the highest performance with 98 per cent of pregnant women receiving ANC, while the eastern region showed the lowest performance with only 84 per cent pregnant women receiving ANC. In Andhra Pradesh, 100 per cent pregnant women received antenatal care, whereas in Nagaland only 76 per cent did so. In Arunachal Pradesh and Bihar, nearly 80 per cent pregnant women received ANC.

Table 1 also shows the proportion of pregnant women with chronic conditions. Less than 7 per cent of the pregnant women in India suffered from at least one chronic condition, and this proportion ranged from zero in Dadra & Nagar Haveli and Daman & Diu to 33 per cent in Ladakh. At the regional level, the proportion of pregnant women with chronic conditions varied from 5 per cent in the central region to 11 per cent in the northeastern region of the country.

Table 1: Proportion (weighted per cent) of the pregnant women who received ANC and who had chronic conditions, India, 2019-21.

Region/State	Pregnant women who received ANC	Unweighted N	Pregnant women with chronic conditions	Unweighted N
North	93.4	2232	8.3	5282
Chandigarh	*	8	*	20
Delhi	95.0	117	15.70	266
Haryana	97.7	405	7.00	903
Himachal Pradesh	93.6	109	7.70	230
Jammu & Kashmir	94.6	456	13.10	1327
Ladakh	(94.0)	37	33.20	143
Punjab	90.3	215	12.70	376
Rajasthan	92.6	677	6.20	1592
Uttarakhand	89.3	208	4.40	425
Central	93.9	3514	4.9	8026
Chhattisgarh	91.9	505	2.30	1133
Madhya Pradesh	95.2	937	4.20	1898
Uttar Pradesh	93.8	2072	5.40	4995
East	84.4	2394	5.4	6441
Bihar	80.1	1329	4.80	3822
Jharkhand	89.6	525	3.00	1357
Odisha	97.0	360	6.50	776
West Bengal	92.6	180	10.60	486
Northeast	92.4	1637	10.8	5615
Arunachal Pradesh	79.9	228	6.00	966
Assam	94.7	399	8.60	1122
Manipur	92.0	199	5.30	554
Meghalaya	92.7	427	20.40	1711
Mizoram	89.5	134	14.30	481
Nagaland	75.7	180	5.90	555
Sikkim	*	15	(5.00)	48
Tripura	83.4	55	14.80	178

Region/State	Pregnant women who received ANC	Unweighted N	Pregnant women with chronic conditions	Unweighted N
West	93.1	1012	5.8	2082
Dadra & Nagar Haveli and Daman & Diu	(100.0)	43	0.00	82
Goa	*	16	(7.30)	29
Gujarat	95.5	497	3.20	1056
Maharashtra	91.6	456	7.70	915
South	98.2	1446	8.6	2503
Andaman & Nicobar Islands	*	10	*	24
Andhra Pradesh	100.0	148	6.60	224
Karnataka	97.6	463	6.50	824
Kerala	98.9	111	15.80	280
Lakshadweep	*	11	(30.00)	26
Puducherry	(100.0)	33	6.20	56
Tamil Nadu	95.9	261	6.60	448
Telangana	99.5	409	11.50	621
India	91.7	12235	6.40	29949

Source: Authors

Note: Percentages are supressed, and an asterisk is shown if unweighted cases are less than 25. If unweighted cases are between 25-49, percentages are shown in parentheses indicating that the results need to be interpreted with caution. Pregnant women who received ANC include both with and without chronic conditions.

Nearly four-fifths of the pregnant women were registered for their pregnancy through ASHA and ANM (Table 2). However, a higher proportion of the pregnant women with chronic conditions were registered with ASHA. In the rural areas, ASHA and ANM played a crucial role in ensuring access to ANC for these women.

Table 2: Proportion (per cent) of the pregnant women registered for antenatal care and who met with a healthcare worker, India, 2019-21.

ANC registration and meetings	Pregnant women	
	Without chronic condition	With chronic conditions
Registered with		
Auxiliary Nurse Midwife (ANM)	39.1	33.7
Accredited Social Health Activist (ASHA)	42.5	45.6
Anganwadi worker (AWW)	15.0	13.4
Other	3.4	7.2
Met with a healthcare worker in the last 3 months	69.8	71.7

Source: Authors

Note: Health care workers include ANM, Lady Health Visitor (LHV), ASHA, AWW and other field level health workers.

The guidelines of the National Health Mission (NHM) emphasise the higher risk of pregnancies among women with chronic conditions and stress close monitoring of these women through regular checkup. Despite significant progress, the findings reveal that the country still falls short of meeting the NHM recommendations. Notably, 8 per cent of

pregnant women with chronic conditions did not receive antenatal care, posing a higher risk to themselves and their unborn child. As pregnancies progress, especially in the last trimester, close supervision becomes crucial. The data also show that in the last three months, nearly 70 per cent of the pregnant women without chronic condition and 72 per cent with chronic conditions interacted with healthcare workers, such as ANM, ASHA, AWW, LHV, or other field health workers.

Table 3 indicates that in the northern and central regions of the country, a lower proportion of pregnant women with chronic conditions received ANC as compared to other regions. In all regions, a higher proportion of pregnant women with chronic conditions were informed about pregnancy complications compared to those without a chronic condition. More than three-fourth of the pregnant women were advised about the place to go in case there was any pregnancy complication and there was hardly any difference between the two groups at the national level. However, in the eastern region of the country, less than 70 per cent of pregnant women (66 per cent with chronic conditions) were informed about the place to go in case of any complication.

A lower proportion of pregnant women with chronic conditions (84 per cent) received advice on the importance of institutional delivery compared to those without any chronic condition (87 per cent). This pattern was observed across all regions, except for the western region (Table 3). Institutional deliveries are crucial for managing complications and improving survival chance for both mother and child.

Table 3: Proportion (per cent) of pregnant women who received ANC, advice on pregnancy complications, and institutional delivery by region, India, 2019-21.

Country/ Region	Pregnant women without complications				Pregnant women with complications			
	Received ANC	Informed about pregnancy complications	Informed about where to go for complications	Advised institutional delivery	Received ANC	Informed about pregnancy complications	Informed about where to go for complications	Advised institutional delivery
North	93.7	75.7	78.9	87.6	90.4	89.1	80.9	82.3
Central	94.1	77.1	81.9	89.0	90.8	82.3	80.9	82.4
East	84.3	66.3	69.8	83.2	85.7	68.3	66.0	82.1
Northeast	92.1	74.7	75.0	82.7	94.9	91.2	81.0	78.5
West	92.7	76.8	76.0	83.7	98.4	78.7	84.0	86.5
South	98.2	75.9	83.3	80.5	91.5	86.9	97.4	81.0
India	91.6	73.8	77.7	78.2	87.1	83.7	92.1	80.1

Source: Authors

The remaining analysis focuses on national level data due to inadequate sample size in some states, which hinder meaningful estimates. Figure 1 compares antenatal checkup for pregnant women with and without chronic conditions, focusing on five types of examinations: abdominal examination, weight measurement, blood pressure check-up, urine analysis, and blood test. Most of the women (90 per cent or more) underwent each of these tests. The graph indicates that a slightly higher percentage of pregnant women with chronic conditions received these examinations compared to those without chronic conditions. This suggests more intense monitoring for women with chronic health issues, aligning with NHM guidelines in certain ways.

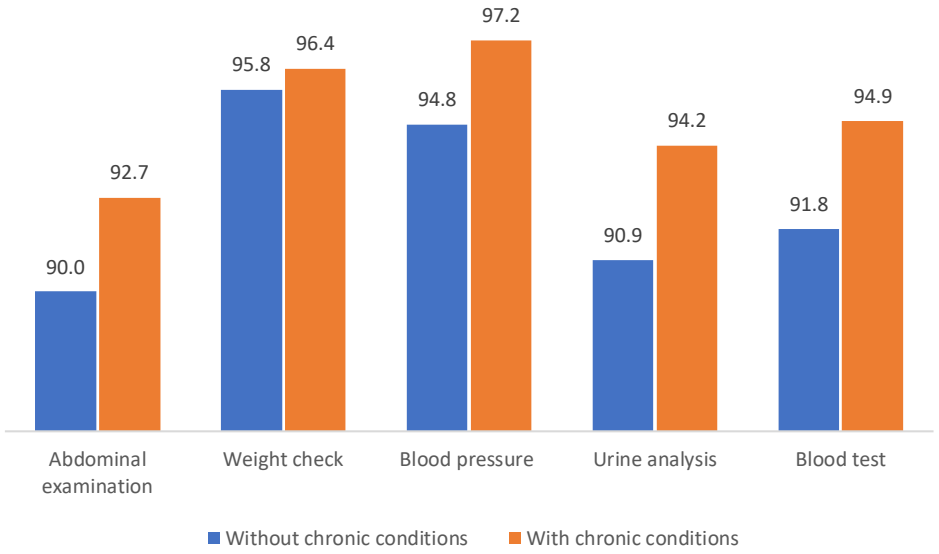

Figure 1: Proportion (per cent) of pregnant women who received antenatal checkup.
Source: Authors

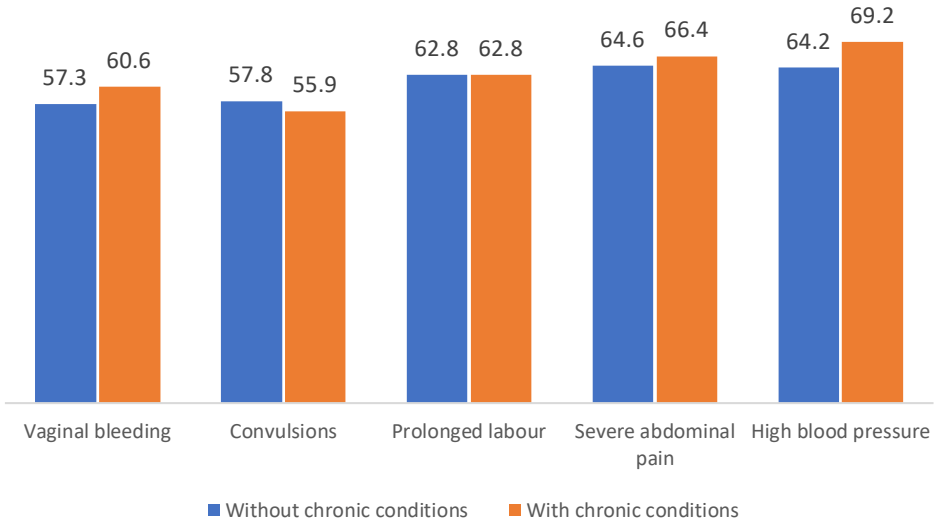

Figure 2: Proportion (per cent) of pregnant women given information about pregnancy complications.
Source: Authors

Although, majority of the pregnant women were informed about the complications during pregnancy (Table 3), a much smaller proportion (ranging from 56 to 69 per cent) were told about specific complications (Figure 2). A slightly higher proportion of pregnant women with chronic conditions were informed about issues such as vaginal bleeding, severe abdominal pain, and high blood pressure compared to pregnant women without any chronic condition. On the contrary, a smaller proportion of pregnant women with chronic conditions received information about convulsions. The difference between the two groups of pregnant women, however, is marginal.

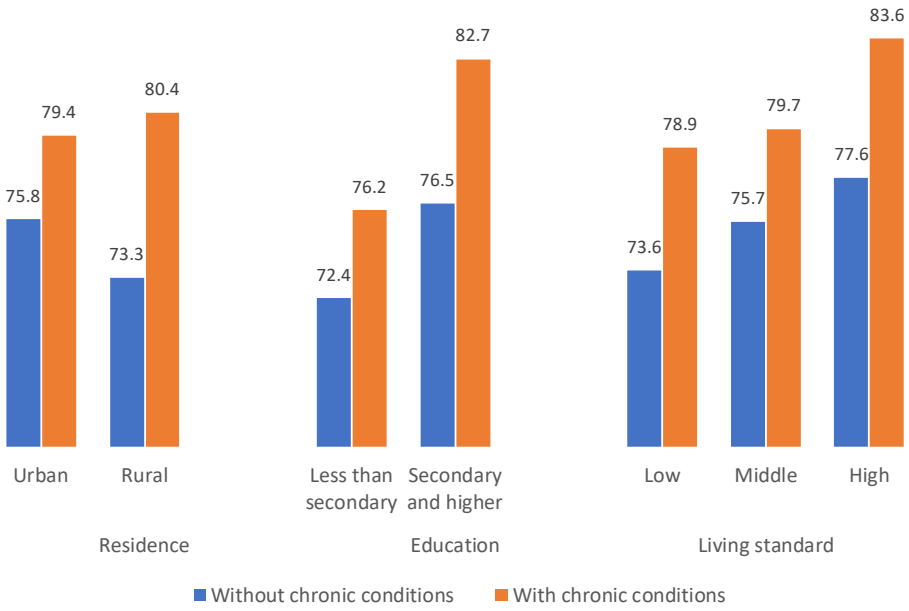

Figure 3: Proportion (per cent) of pregnant women informed about complications of pregnancy by residence, educational status and living standard.
Source: Authors

Further analysis revealed that nearly equal proportion (around 80 per cent) of pregnant women with chronic conditions were informed about complications of pregnancy regardless of their place of residence - rural or urban. This has not been the case with the educational status of pregnant woman as a higher proportion of pregnant women with chronic conditions having at least higher secondary level education reported that they were informed about the complications of pregnancy compared to pregnant women with chronic conditions having less than higher secondary education. Similarly, a higher proportion of pregnant women with chronic conditions having high living standard reported that they were informed about the complications of pregnancy compared to pregnant women with chronic conditions but having low or middle standard of living. Moreover, the proportion who received information about complications of pregnancy was higher in pregnant women

with chronic conditions as compared to pregnant women without chronic conditions irrespective of the residential and educational status and living standard. Women having high living standard often have better access to private healthcare facilities and services, which can improve their chances of safe delivery and survival.

The proportion who received information about complications of pregnancy was found to be higher in pregnant women with chronic diseases who received ANC at home as compared to pregnant women with chronic conditions who received ANC at a health facility, either public or private (Figure 4). Moreover, the proportion who received information about complications of pregnancy was lower in pregnant women without chronic conditions irrespective of the place where they received ANC. In summary, results indicate that pregnant women with or without chronic conditions but having lower educational levels and low standard of living and receiving ANC at a public healthcare facility are less likely to be informed about pregnancy complications, putting them at higher risk of adverse pregnancy outcomes.

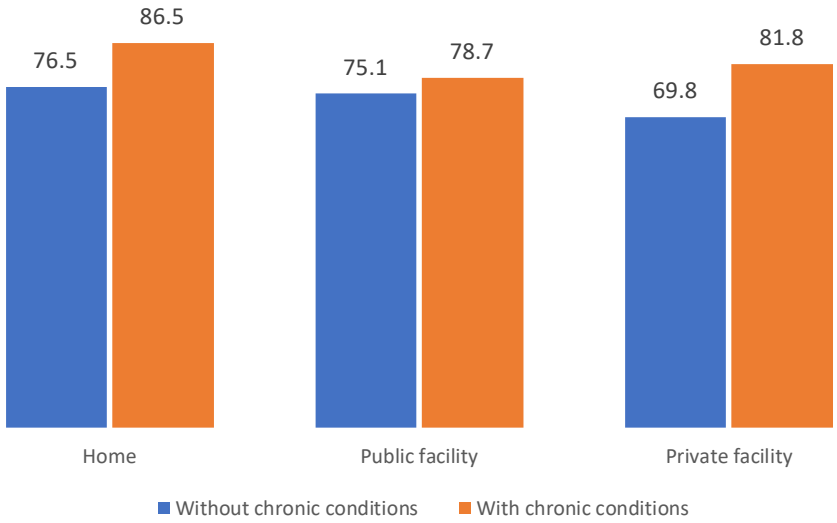

Figure 4: Proportion (per cent) of pregnant women who received information about complications of pregnancy by the place of ANC.
Source: Authors

Healthcare providers play a crucial role in informing and educating pregnant women about the appropriate healthcare facilities to visit in case of pregnancy complications, highlighting their importance in ensuring positive maternal health outcomes. More than three-fourth (78 per cent) of the pregnant women were informed about where to seek help if they encountered pregnancy complications and this proportion was found to be nearly the same in pregnant women with chronic conditions and pregnant women without chronic conditions.

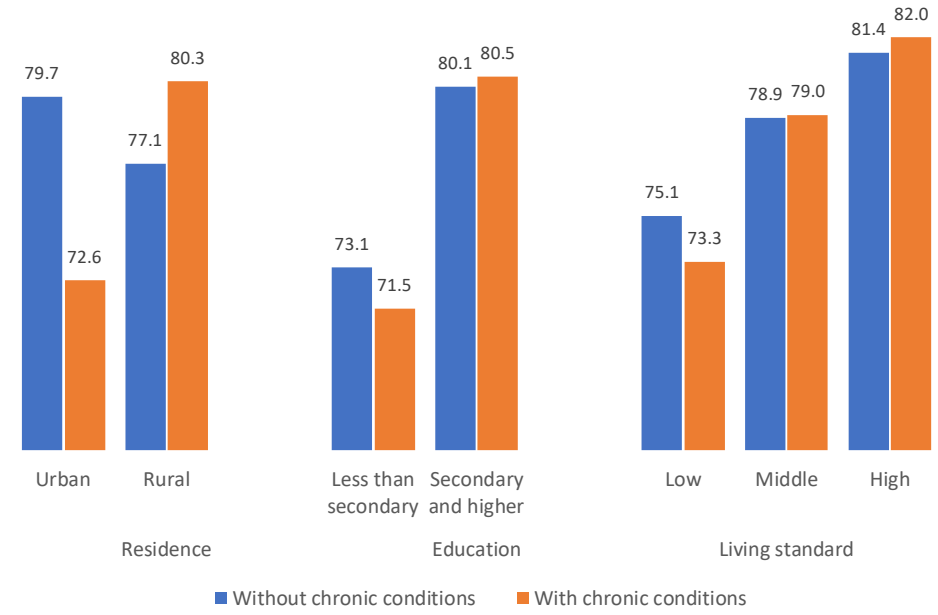

Figure 5: Proportion (per cent) of pregnant women who received information about where to go for pregnancy complications by residential and educational status and living standard. Source: Authors

Figure 5 shows how the place of residence, level of education and standard of living of women influence the information received about the place to go in case of pregnancy complications. In the urban areas, the proportion who received information about where to go in case of complications during pregnancy is found to be substantially lower in pregnant women with chronic conditions as compared to pregnant women without chronic conditions. A similar situation may also be seen in pregnant women with low educational level and low living standard. However, in the rural areas, the proportion who received information about where to go in case of pregnancy complications is found to be substantially higher in pregnant women with chronic conditions as compared to pregnant women without chronic conditions. The same situation prevails in pregnant women with at least higher secondary education and pregnant women with high living standard but the difference between pregnant women with complications and pregnant women without complications does not appear to be markedly different. These findings underscore the need of informing all pregnant women with or without chronic conditions, having low level of education, and belonging to low-income households about the place where facilities for treating pregnancy complications are available so that they can seek necessary medical assistance for addressing the complications of pregnancy as and when they occur during the course of pregnancy. Provision of such information is vital in ensuring positive health outcomes for the mother and the child.

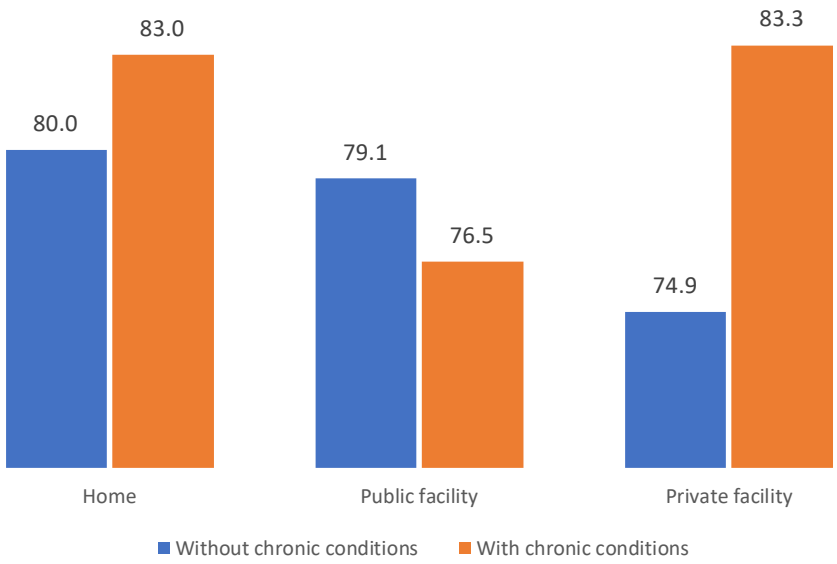

Figure 6: Proportion (per cent) of pregnant women who received information about where to go for pregnancy complications by the place of ANC visit.
Source: Authors

The provision of information about where to go in case of pregnancy complications was found to be associated with the place of ANC visit and whether pregnant women had chronic complications of not (Figure 6). Among pregnant women who received ANC at either home or at a private health facility, the proportion receiving information about the place to go for pregnancy complications was found to be higher in pregnant women with chronic conditions as compared to pregnant women without chronic conditions. However, in pregnant women who received ANC at a public health facility, this proportion was found to be higher in women without chronic conditions as compared to women with chronic conditions.

Bivariate logistic regression analysis was carried out to explore the impact of various confounding factors on the three outcomes related to healthcare information and advice during pregnancy. Results pertaining to the information about complications during pregnancy are summarised in table 4. The likelihood of being informed about the complications of pregnancy is found to be lower in the east, northeast, and south regions of the country compared to the north region as the odds ratio (OR) ranges from 0.573 to 0.762. Living in the rural areas does not have a significant effect on the likelihood of being informed about pregnancy complications compared to living in the urban areas. The standard of living also does not have a significant effect on being informed about pregnancy complications. However, having at least secondary education significantly increases the chances of being informed about pregnancy complications (OR=1.224). Pregnant women with chronic conditions are significantly more likely to be informed about pregnancy complications than women without chronic conditions (OR=1.420).

Table 4: Factors associated with the information on pregnancy complications provided to pregnant women.

Factor		B	SE	'p'	Exp (B)
Region	North - Ref				
	Central	0.038	0.069	0.587	1.038
	East	-0.526	0.073	<0.001	0.591
	Northeast	-0.557	0.078	<0.001	0.573
	West	-0.053	0.094	0.571	0.948
	South	-0.272	0.081	<0.001	0.762
Residence	Urban - Ref				
	Rural	-0.064	0.062	0.303	0.938
Living standard	Low - Ref				
	Middle	-0.023	0.059	0.701	0.977
	High	-0.018	0.062	0.775	0.982
Education level	Lower than secondary - Ref				
	Secondary and higher	0.202	0.047	<0.001	1.224
Chronic Conditions	No chronic conditions - Ref				
	With chronic conditions	0.350	0.098	<0.001	1.420

Ref – reference category
Source: Authors

Table 5 presents results of the bivariate logistic regression analysis of the information provided about where to go in case of pregnancy complications to the pregnant women. The likelihood of receiving information and advice about where to go if there are pregnancy complications is found to be higher in the central region as compared to the northern region of the country (OR=1.336). However, the likelihood of receiving information and advice about where to go in case of pregnancy complications is found to be lower in the east and the northeast regions of the country relative to the north region (OR=0.771 and 0.625, respectively). On the other hand, the likelihood of receiving information and advice about where to go if there are pregnancy complications is not found to be influenced by the place of residence of the pregnant women as the odds ratio is found to be statistically insignificant. The likelihood of receiving information and advice about where to go in case there are complications during pregnancy has, however, been found to be higher in pregnant women having at least higher secondary level education as compared to pregnant women having below secondary education (OR=1.293). The likelihood of receiving information and advice about where to go in case there are pregnancy complications has also been found to be virtually the same for pregnant women with chronic conditions and pregnant women without chronic conditions when other factors influencing the likelihood are controlled. Similarly, the living standard of the pregnant woman has not been found to have any influence of the likelihood of receiving information and advice about the place to go in case there are complications in the pregnancy as the odds ratios has been found to be statistically insignificant. Table 5 suggests that the main factors that influence the likelihood of the pregnant women receiving information and advice about where to go in case of pregnancy complications is the region of residence of pregnant women and their level of education.

Table 5: Factors associated with the receiving of information and advice about where to go in case there are pregnancy complications.

Factor		B	SE	'p'	Exp (B)
Region	North - Ref				
	Central	0.290	0.071	<0.001	1.336
	East	-0.260	0.074	<0.001	0.771
	Northeast	-0.470	0.078	<0.001	0.625
	West	0.041	0.094	0.664	1.042
	South	0.121	0.086	0.159	1.129
Residence	Urban - Ref				
	Rural	0.025	0.065	0.698	1.025
Living standard	Low - Ref				
	Middle	0.015	0.062	0.802	1.016
	High	0.090	0.065	0.168	1.094
Education level	Lower than secondary - Ref				
	Secondary and higher	0.257	0.049	<0.001	1.293
Chronic Conditions	No chronic conditions - Ref				
	With chronic conditions	-0.023	0.093	0.808	0.978

Ref – reference category
Source: Authors

Table 6: Factors associated with the advice received on institutional delivery.

Factor		B	SE	'p'	Exp (B)
Region	North - Ref				
	Central	0.222	0.103	0.031	1.249
	East	-0.290	0.108	0.007	0.748
	Northeast	-0.404	0.122	<0.001	0.667
	West	-0.148	0.135	0.270	0.862
	South	0.362	0.131	0.006	1.436
Residence	Urban - Ref				
	Rural	-0.061	0.104	0.556	0.941
Living standard	Low - Ref				
	Middle	-0.013	0.089	0.881	0.987
	High	0.165	0.100	.098	1.179
Education level	Lower than secondary - Ref				
	Secondary and higher	0.172	0.071	0.015	1.188
Chronic Conditions	No chronic conditions - Ref				
	With chronic conditions	-0.285	0.126	0.023	0.752

Ref – reference category
Source: Authors

Table 6 presents results of bivariate logistic regression analysis of whether pregnant women received information about the need of institutional delivery or not. The likelihood of receiving advice on institutional delivery by the pregnant women is found to be higher in the central and south regions of the country as compared to the north region (OR=1.249 and 1.436 respectively). However, in other regions of the country, except the

west region, the likelihood of receiving advice about the need of the institutional delivery is found to be lower than that in the north region. In the west region of the country, the likelihood of receiving the advice about the need of institutional delivery has not been found to be statistically significantly different from that in the north region. Table 5 also shows that the likelihood of receiving information about the need of institutional delivery is found to be statistically significantly higher in pregnant women with at least higher secondary level education as compared to pregnant women with lower than secondary level education (OR=1.188). However, contrary to expectation, pregnant women with chronic conditions are less likely to receive advice on the need of the institutional delivery (OR=0.752). The standard of living of the pregnant woman has, however, been found to have no effect on the likelihood of receiving information about the need of institutional delivery.

Discussion

Pregnancy can become more complex in women having certain medical conditions, but timely medical attention can ensure healthy outcomes (Johns Hopkins Medicine, *nd*). Community-level interventions that identify and counsel high-risk women early during the pregnancy may help mitigate the growing burden of cardiometabolic disorders (Nagraj et al, 2019). Chronic kidney disease (CKD) during pregnancy increases the risk of complications like preeclampsia, premature births, and low birth weight compared to pregnancies without CKD (Ibarra-Hernandez et al, 2019*).* It is, therefore, important to raise awareness about the implications of chronic health conditions to the pregnancy outcome among women and healthcare workers including long-term health implications of hypertension and diabetes (Nagraj et al, 2019).

Women with multiple chronic conditions (MCCs) experience poorest pregnancy outcomes, along with increased healthcare services utilisation, and higher hospital costs during pregnancy and at the time of delivery compared to women without chronic conditions (Admon et al, 2018). Policymakers must focus on the specific healthcare needs of these women. In India, high-risk pregnancies among women with chronic conditions are addressed under the National Health Mission. Under the Mission, First Referral Units (FRU) have been established, especially, in the rural areas with specialised services for emergency care (Government of India, 2004). However, challenges such as overcrowding, shortage of specialist doctors and paramedics, and an ineffective referral system hinder timely healthcare services and counseling of women with high-risk pregnancies (Godlee, 2015).

The present study, based on the data from the nationally represented National Family Health Survey has found that 74 per cent of the pregnant women were informed about pregnancy complications during the ANC visit and this proportion was higher in pregnant women with chronic conditions compared to pregnant women with no chronic conditions. However, a significantly lower proportion of women with chronic conditions were advised about the importance of institutional delivery, a crucial factor in reducing maternal and infant mortality. These findings highlight the need for interventions to improve advocacy for institutional delivery.

The paper also notes that a lower proportion of pregnant women with chronic conditions who received ANC at public facilities were informed about pregnancy complications compared to those who received ANC at home or in private facilities. It has been observed that providing care to high-risk pregnant women requires a team of specialists, including obstetricians, maternal-fetal medicine experts, cardiologists, nephrologists, diabetologists, and psychologists (Kuppusamy et al, 2013). Public healthcare providers in India often lack necessary resources and training to provide adequate care and advice to pregnant women with chronic conditions, leaving these women to seek treatment and care from private health facilities or private health care providers. However, private healthcare is often unaffordable for many.

Women face various medical interventions and challenges, both physical and psychological, during pregnancy, at the time of delivery, and during the postnatal period, (Lange et al, 2015). Given the high prevalence of hypertension, cardiovascular disease, and diabetes among the Indian women, there is a need of enhancing the knowledge and skills of the healthcare providers at the local level. There is also a need of creating facilities for the diagnosis of chronic conditions and standardising the testing and diagnosis of chronic conditions (Nagraj et al, 2019).

The present paper also highlights the importance of the level of education of pregnant women and their standard of living in receiving the information about potential pregnancy complications irrespective of whether they have chronic health conditions or not. Similarly, women with chronic health conditions who had higher educational level or having high standard of living are found to be better informed about where to seek help in case of pregnancy complications than women having low level of education and low or middle standard of living. The paper, however, reveals that there is virtually no effect of the standard of living once other confounding factors are controlled. A finding that is of concern is that pregnant women who receive ANC in public facilities are less likely to be informed about where to seek help in case of pregnancy complications. This underscores the need for improved training and resources for healthcare providers in the public healthcare facilities in the country.

The new antenatal care model recommended by the World Health Organization emphasises integrated delivery of all necessary antenatal care and stresses the importance of collaborative efforts and greater integration of allied fields (Lattof et al, 2020). In addition to antenatal, natal and postnatal care, the public healthcare facilities should also offer prenatal counseling to educate women on healthy pregnancy practices, such as proper nutrition, exercise, and childbirth preparation. Newborn care services are also provided to monitor the health of the newborn and ensure timely medical attention or support. It is crucial for the pregnant women to utilise these facilities for ensuring safe pregnancy outcomes.

Studies have shown that women from low-income households report poorer health outcomes compared to those from higher-income households, despite similar rates of chronic conditions (O'Neil et al, 2020). Limited resources pose significant barrier for economically disadvantaged women and prevent them from accessing essential healthcare services, especially in the private sector. Factors such as undernourishment, malnourishment, excessive workload, and lack of social support make these women highly

vulnerable to a range of health issues that may go undiagnosed and untreated (Saha and Saha, 2010). Addressing these disparities and reducing barriers to access to essential healthcare is crucial for improving healthcare utilisation among low-income and low-education mothers (Grand-Guillaume-Perrenoud et al, 2022). Creating a more equitable healthcare system that prioritises healthcare needs of these women is essential for ensuring maternal and child health.

Summary and Policy Implications

The present study has found that a large majority of pregnant women with chronic conditions from privileged backgrounds and higher level of education have been informed about where to seek help in case of the complications during pregnancy. In contrast, a notably lower proportion of pregnant women from poor families and having lower levels of education and with chronic conditions were informed about what to do in case there are complications during pregnancy. The study also found that advocacy regarding pregnancy complications was more effective when antenatal care was provided in private facilities or at home as compared to when ANC was provided at public healthcare facilities. These findings underscore the importance of educating women, at least up to higher secondary level, especially women with chronic conditions, so that they can effectively respond to potential complications and risks associated with the pregnancy and childbirth. The study also emphasises the need of tailored information and support to pregnant women with chronic conditions based on their educational attainment and regional context. Ensuring that all pregnant women, irrespective of whether they have a chronic condition or not, receive appropriate care and have access to necessary resources is crucial for promoting healthy pregnancies and reducing maternal and child morbidity and mortality which remains a critical public health concern in India.

The study also suggests that public healthcare facilities in the country should take more proactive measures to educate pregnant women, especially, with chronic conditions about potential pregnancy complications and the appropriate facilities for addressing these complications. Efforts should particularly be intensified in the east and the northeast regions of the country to ensure timely dissemination of the information regarding the importance of institutional delivery and the available support services for pregnancy complications to pregnant women. Ensuring equitable access to essential information and resources, regardless of social, economic, or regional backgrounds, is crucial for safeguarding maternal health and well-being during pregnancy.

Based on the findings of the present study, the following recommendations are proposed:

- Enhance training for healthcare providers by developing and implementing specialised training programmes for them, especially in the rural areas, to manage chronic illnesses during pregnancy. Training should include identification, monitoring, and treatment of common chronic conditions such as diabetes, hypertension, and cardiovascular diseases to enable timely interventions and complication prevention.

- Integration of antenatal care services and chronic disease management through routine screening for chronic illnesses during ANC visits and developing personalised care plans, especially, for pregnant women with chronic conditions. Implement home-based management of chronic diseases through field-based health functionaries to ensure regular care and monitoring of chronic disease conditions.
- Telemedicine and mobile health (mHealth) initiatives may be expanded to offer remote consultations and follow-up of pregnant women with chronic diseases to bridge the accessibility gap in the rural and remote areas of the country.
- Strengthening primary health care centres by providing the necessary infrastructure, equipment, and skilled personnel to manage chronic diseases in pregnant women. This includes ensuring availability of essential medications and diagnostic tools for effective care.
- Training and skill building of field-level health functionaries in the management of chronic diseases, especially, during pregnancy. The field-level health functionaries can provide education, conduct home visits, and facilitate referrals to higher-level healthcare facilities as and when needed, particularly in underserved rural and remote areas.
- Targeted health education campaigns may be launched to raise the awareness about managing chronic diseases during pregnancy. These campaigns may emphasise early detection, adherence to treatment, and the benefits of regular antenatal care visits to empower women and their families to seek timely healthcare.
- Financial support system such as conditional cash transfer or vouchers may be expanded to reduce healthcare costs for pregnant women with chronic diseases. The financial support may cover expenses like transportation, medications, and diagnostic tests to address the financial barriers that hinder access to healthcare services.
- A robust monitoring and evaluation framework should be established to monitor and evaluate interventions directed towards improving the access to healthcare by pregnant women, especially, pregnant women with chronic diseases. There is a need to track health and pregnancy outcomes, services utilisation, and patient satisfaction to identify gaps and to improve the efficiency and hence effectiveness of healthcare services delivery.

Improving access to healthcare services for pregnant women with chronic disease conditions requires a comprehensive approach that involves policy reforms, programmatic interventions, and community engagement. Addressing the unique challenges faced by pregnant women with chronic diseases can significantly contribute to improving both pregnancy and health outcomes and may contribute to broader public health objectives as a substantial proportion of pregnant women have been found to be having chronic diseases that may have an impact on the outcome of the pregnancy.

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