

# A Study on Fertility Transition in India and Major States from 1971 to 2020: Using Reproduction Rates.

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## Abstract

*Reproduction is measured by gross reproduction rates or net reproduction rates that generally indicate the ratio between the sizes of the daughter's and mother's generations. Reproduction rates are most useful to analyze the fertility condition of a nation also it can be used to project the population. When the Net reproduction rate tends to one and Total fertility rate tends to two, then the region attains its replacement level of fertility. According to the world population prospects 2019, Out of 201 countries and dependent territories estimated by UN, 109 have a fertility rate more than the population replacement level of 2.1 births per woman. In 2020, the net reproduction rate for India was 1. The net reproduction rate of India fell gradually from 1.87 in 1975 to 1 in 2020. The study about reproductive rates will help to understand the demographic situation as well as the stage of fertility transition in a region. Here, this study aims to estimate the changes in reproductive measures in India and major states from 1971 to 2011. Also, to understand the percentage of decline in reproductive measures and the Reproduction survival ratio in India and the major states. Percentage of changes in reproductive measures such as GRR, NRR, MAC (mean Age of Childbearing), and RSR (Reproduction Survival Ratio) in India had shown GRR has declined to 64 percent over the decade 1971 to 2020. NRR showed 48.32 percent from 1971 to 2020, MAC declined to 2.03 percent, and RSR is a 33 percent increase in the survival ratio from 1971 to 2020. All these indicators showed that, the reproductive rate declines gradually from 1971 to 2020 except MAC, because; MAC declines up to 2011, then there was a gradual increase that*

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*happens in 2020. But the decline in reproduction rates was not uniform throughout the country, hence it is necessary to prioritize the implementation of policies and programs according to the fertility situation of each state. In order to attain the stabilization of population growth, uniform changes in the fertility rates are compulsory. It can be concluded that, the level of fertility rate in India can be estimated by using the appropriate reproductive measures. Hence, the changes happening in reproductive rates are very useful measures to explain the fertility transition of a country.*

## **INTRODUCTION**

The reproduction of the population refers to a change of a generation into a new one. Reproduction is measured by gross reproduction rates or net reproduction rates that generally indicate the ratio between the sizes of the daughter's and mother's generations. Reproduction rates are most useful to analyse the fertility condition of a nation; also, it can be used to project the population. When the Net reproduction rate tends to one and Total fertility rate around two, then the region attains its replacement level of fertility. According to the world population prospects 2019, out of 201 countries and dependent territories estimated by UN, 109 have a fertility rate more than the population replacement level of 2.1 births per woman. In 2020, the net reproduction rate for India was one. The net reproduction rate of India fell gradually from 1.87 in 1971 to one in 2020.

The fertility rate at a given age is the number of children born alive to women of that age during the year as a proportion of the average annual population of women of the same age. By extension, the fertility rate is the ratio between the number of live births in a year and the whole female population of childbearing age (average number of women between 15 and 50 years of age over the years). Unlike the total period fertility, the fertility rate is partly dependent on trends in the age structure of women between the ages 15 and

50. The most commonly used metric is the Total Fertility Rate (TFR) or often simply 'fertility rate,' which measures the average number of children per woman. As health improves and the mortality in the population decreases, we typically see accelerated population growth. This rapid population growth then comes to an end as the fertility rate declines and approaches two children per woman. The level of education in a society, of women in particular, is one of the most important predictors for the number of children families have. As the education of women in a society increases, the decline in the number of children per woman also increases. There is, in fact, much evidence that the sharp decline in fertility rates that has taken place in the more literate states in India has been much influenced by public discussion of the bad effects of high fertility rates especially on the lives of young women and also on the community at large (Amartya Sen: 1996).

The fertility transition shows that the fastest decline in fertility is in the southern region of India compared to the northern region of India. Transition in fertility is strongly related to the demographic transition (James M. Raymo, (2015)). Similarly, the reproductive rates are varying among the Indian society. The fastest decline in reproduction rate happened in the southern region of India compared to the northern parts of India. The change of fertility is a prime example of changing social norms. In many places around the world, the practice of having more than 5, 6, 7, or 8 children, which was the norm for millennia, was replaced by the norm of having 2 children or fewer. The impact of Family planning program declines the fertility rates and it also shows the additional effect on the health and nutritional status of children (Joshi and Schultz, 2013). Women's education has the largest impact on the fertility decline and more concretely that "a very important role in the fertility

decline is played by changes in attitudes towards the feasibility and acceptability of birth control” (Van Ginneken and Razzaque, 2003).

The Government-sponsored family planning programme was launched in 1952 to slow down population growth. It initially faced challenges in terms of a faulty strategy that led to women largely using contraceptives. The total fertility rate, which was as high as 6 or more in the 1950s, has decreased to 2 and India has achieved a total fertility rate below the replacement level. And, it is happening without any coercive two-child norm; it is happening voluntarily. Yet, India’s overall population size will not shrink immediately. The country is experiencing a population momentum as a result of a demographic transition. India has a high proportion, about 30.9 percent, of young persons in the age group of 10 to 24 years who are in the reproductive age group or will soon be. Even if this cohort produces one or two children per couple, there will still be an absolute increase in total population (Poonam Muttreja, executive director of the Population Foundation of India, 2021).

The study about reproductive rates will help to understand the demographic situation as well as the stage of fertility transition in a region. Here, this study aims to estimate the changes in reproductive measures in India and major states from 1971 to 2020. Also, to understand the percentage of decline in reproductive measures and the Reproduction survival ratio in India and the major states. The changes in the reproduction rate are likely to have various implications for social and economic development in the state and country. The study on fertility rates is very useful for the policy-making programs in the country. So that, it is relevant to the study on various reproductive measures and its changes on reproduction rates in India and its state. So far, the studies on fertility transition are based on usual fertility measures like CBR, ASFR, TFR. Hence,

this study is an attempt to study the fertility transition using reproductive measures.

## **OBJECTIVES**

- To estimate the various measures of reproductivity and observe their trends in India and its major states.
- To analyze the percentage of decline in reproductive measures and the Reproduction survival ratio in India and the major states.

## **HYPOTHESIS**

- The Mean Age at Child bearing (MAC) in India and its states have no significant variation throughout the study period.
- The reproduction survival ratio (RSR) is on progressing from 1971 to 2020.

## **DATA AND METHODOLOGY**

This study used the data from the published reports of Sample registration system (SRS) and life table constructed elsewhere for the period 1971 to 2020 are utilized for the analysis.

There are different reproductive measures are used to study the changes in reproductive rates of India and major states from 1971 to 2020. The measures of reproductivity like, Gross Reproduction rate (GRR), Net reproductive rate (NRR), Mean age of child bearing (MAC), and Reproduction survival ratio (RSR) are estimated in order to study the fertility changes and reproductive changes in India and major states. Total fertility rate (TFR), was also taken from the SRS publications, because TFR was used for the calculation of various reproductive measures. These fertility and reproduction rates are computed from data from SRS, census or using indirect techniques (RGI (1971 to 2020), Manual X-, 1983).

Analysis were done for India and major states. 15 major states are selected for this study. The states considered are, Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Madhya Pradesh, Maharashtra, Utter Pradesh, Rajasthan, Bihar, Punjab, Odisha, Assam, Gujarat, Haryana and west Bengal. Percentage of decline in reproductive rates of each state over the period is used for analysing the data. Graphical representation is also used for comparison. The distribution tables of reproductive measures from 1971 to 2020 explains the changes in reproductive rates and fertility rates.

### **Total Fertility Rate (TFR)**

The sum of annual age – specific fertility rates computed for each age group in the childbearing period. This measure indicated the number of children that would be born to a hypothetical cohort of 1000 women who follow a set of a current schedule of age – specific fertility rates, assuming that none of the women die before reaching the end of the childbearing period.

$$TFR = 5 * \sum ASFR$$

### **Gross Reproduction Rate (GRR)**

The average number of daughters born to a cohort of 1000 women who follow a set of a current schedule of age – specific fertility rates, assuming that none of the women die before reaching the end of childbearing period.

$$GRR = \sum n_w x / nW_x$$

where  $n_w x$  – number of female births &  $nW_x$  – number of women in the corresponding age group. If sex wise birth is not available,

$$GRR = TFR (1 / 1 + S), S \text{ is the sex ratio at birth.}$$

### Net Reproduction Rate (NRR)

The average number of daughters that a hypothetical cohort of females starting life together would bear if they experienced a given set of age – specific mortality and fertility rates.

$$\text{NRR} = \Sigma (\text{nw}_x / \text{nW}_x) * (\text{L}_x / \text{l}_0),$$

Where,  $L_x$  is the person years lived for females.

### Mean Age of Child bearing (MAC)

The mean age at childbearing is the mean age of mothers at the birth of their children if women were subject throughout their lives to the age-specific fertility rates observed in a given year. The Mean Age at Childbearing (MAC) is computed as the sum of age-specific fertility rates weighted by the mid-point of each age group, divided by the sum of the age-specific rates.

$$\text{MAC} = \frac{\Sigma_{15-19}^{45-49} (a * f(a))}{\Sigma_{15-19}^{45-49} f(a)}$$

Where,  $a$  represent the mid-point of each age group,  $a$  to  $a+5$ , in the reproductive period and  $f(a)$  represent the ASFR in the same age group.

### Reproduction Survival Ratio (RSR)

The RSR is approximately estimated using the formulae given below

$$\text{RSR} = \frac{\int_{a=15}^{49} p(a) f(a) da}{\int_{a=15}^{49} f(a) da}$$

Where  $f(a)$  is the ASFR in the age group and  $p(a)$  is the probability of surviving from birth to age group  $a$  to  $a+5$ . The RSR is the proportion of potential reproductivity that survives the effect of mortality.

## ANALYSIS AND FINDINGS

### 1. Total fertility rate (TFR) of India and major states: 1971-2020

Total fertility rate of India is higher in the beginning (1971) and it is gradually decline up to 2020. It clearly explains the fertility change of India. The following table (1) gives the changes in fertility rate and the percentage of decline in fertility rate.

**Table 1: percentage of decline in TFR of India and major states from 1971 to 2020**

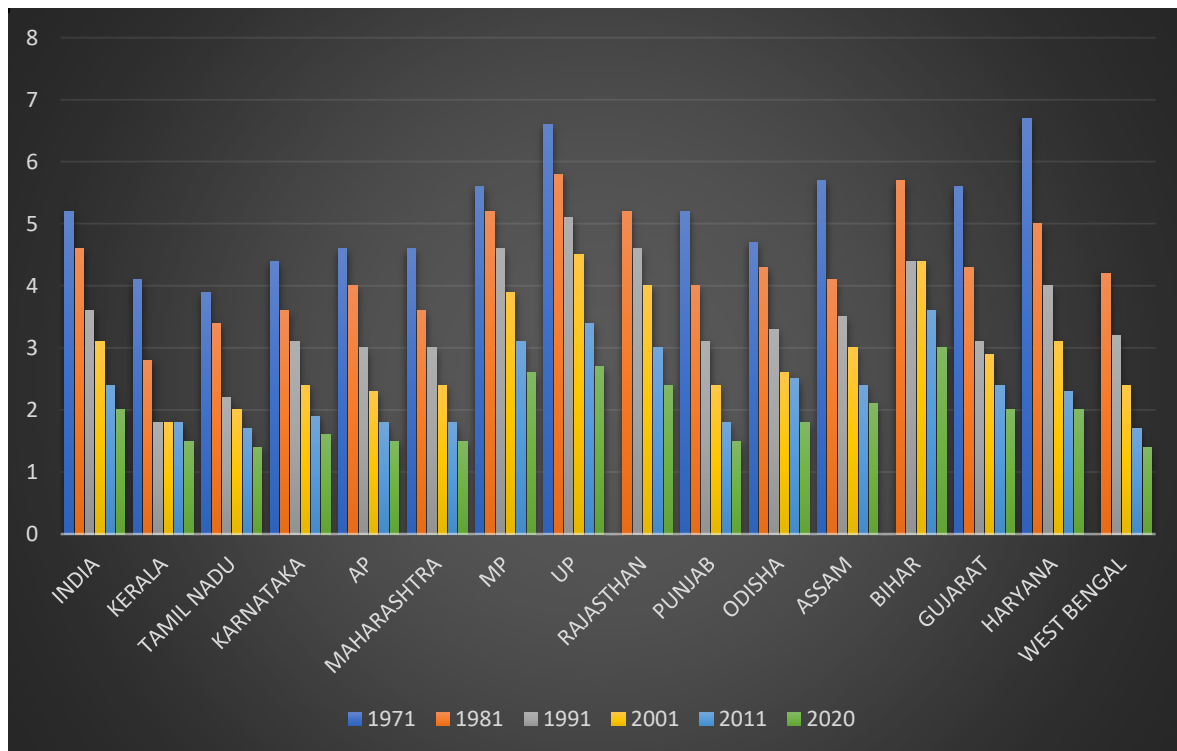
	1971	1981	1991	2001	2011	2020	% Decline from 1971 to 2020
<b>India</b>	5.2	4.6 (11.54)	3.6 (21.74)	3.1 (13.89)	2.4 (22.58)	2 (16.67)	61.54
<b>Kerala</b>	4.1	2.8 (31.71)	1.8 (35.71)	1.8 (0.00)	1.8 (0.00)	1.5 (16.67)	63.41
<b>Tamil Nadu</b>	3.9	3.4 (12.82)	2.2 (35.29)	2 (9.09)	1.7 (15.00)	1.4 (17.65)	64.10
<b>Karnataka</b>	4.4	3.6 (18.18)	3.1 (13.89)	2.4 (22.58)	1.9 (20.83)	1.6 (15.79)	63.64
<b>Ap</b>	4.6	4 (13.04)	3 (25.00)	2.3 (23.33)	1.8 (21.74)	1.5 (16.67)	67.39
<b>Maharashtra</b>	4.6	3.6 (21.74)	3 (16.67)	2.4 (20.00)	1.8 (25.00)	1.5 (16.67)	67.39



<b>MP</b>	5.6	5.2 (7.14)	4.6 (11.54)	3.9 (15.22)	3.1 (20.51)	2.6 (16.13)	53.57
<b>UP</b>	6.6	5.8 (12.12)	5.1 (12.07)	4.5 (11.76)	3.4 (24.44)	2.7 (20.59)	59.09
<b>RAJASTHAN</b>	NA	5.2	4.6 (11.54)	4 (13.04)	3 (25.00)	2.4 (20.00)	53.85
<b>PUNJAB</b>	5.2	4 (23.08)	3.1 (22.50)	2.4 (22.58)	1.8 (25.00)	1.5 (16.67)	71.15
<b>ODISHA</b>	4.7	4.3 (8.51)	3.3 (23.26)	2.6 (21.21)	2.5 (3.85)	1.8 (28.00)	61.70
<b>ASSAM</b>	5.7	4.1 (28.07)	3.5 (14.63)	3 (14.29)	2.4 (20.00)	2.1 (12.50)	63.16
<b>BIHAR</b>	NA	5.7	4.4 (22.81)	4.4 (0.00)	3.6 (18.18)	3 (16.67)	47.37
<b>GUJARAT</b>	5.6	4.3 (23.21)	3.1 (27.91)	2.9 (6.45)	2.4 (17.24)	2 (16.67)	64.29
<b>HARYANA</b>	6.7	5 (25.37)	4 (20.00)	3.1 (22.50)	2.3 (25.81)	2 (13.04)	70.15
<b>WEST BENGAL</b>	NA	4.2	3.2 (23.81)	2.4 (25.00)	1.7 (29.17)	1.4 (17.65)	66.67

[Figures in the brackets are % of change from previous period]

The above table (1) and the graph of the TFR shows the declining trend from 1971 to 2020. The total percentage of decline of India from 1971 to 2020 is 61.54%. The highest TFR of India occurs in 1971 (i.e., 5.2). The improved level of TFR of India happens in 2020 (i.e., 2.0), and the highest percentage of decline happens in 2011 (i.e., 22.58%). The lowest TFR occurs in Tamil Nadu and West Bengal (i.e., 1.4), followed by Kerala, Andhra Pradesh, Maharashtra, and Punjab (i.e., 1.5). Bihar shows the highest TFR in 2020 i.e., 3, and the percentage of decline in Bihar from 1971 to 2020 is 47.37%. The highest percentage of decline happens in Punjab (i.e., 70.15%).

**Graph 1: TFR of India and major states from 1971 to 2020**

In 1971, Haryana shows the highest TFR (i.e., 6.7) among all the major states described above in the table; then, there was a gradual decline that happened, and currently, the TFR of Haryana becomes 2.0 in 2020. West Bengal shows a marked variation in TFR from the 1980s. Tamil Nadu and Kerala show the lowest TFR in 1971 (i.e., 3.9 and 4.1, respectively). Kerala maintains the lowest TFR in 1991, 2001, and 2011 (i.e., 1.8 in each census year). Kerala and Tamil Nadu show the highest percentage decline in 1991 (i.e., 35.71 and 35.29, respectively). It implies that the fastest decline occurs from 1991. After 2001, there was a rapid decline in TFR in all the states. It is clear from the graph of TFR illustrated above. The table (1) and graph (1) show the clear picture of TFR in all the major states.

## 2. Gross Reproduction Rates (GRR) of India from 1971 to 2020

The average number of daughters born to a cohort of 1,000 women who follow a set of a current schedule of age – specific fertility rates, assuming that none of the women die before reaching the end of childbearing period. In India, the gross reproductive rate is gradually decline from 1971 to 2020. The following table (2) shows the Gross Reproduction Rate and its percentage of decline during the period 1971- 2020.

**Table2: GRR and the percentage of decline in GRR for India and major states from 1971 to 2020**

	1971	1981	1991	2001	2011	2020	% Decline from 1971 to 2020
<b>India</b>	2.5	2.2 (12.00)	1.7 (22.73)	1.5 (11.76)	1.2 (20.00)	0.9 (25.00)	64.00
<b>Kerala</b>	2	1.4 (30.00)	0.9 (35.71)	0.9 (0.00)	0.9 (0.00)	0.8 (11.11)	60.00
<b>Tamil Nadu</b>	1.9	1.6 (15.79)	1.1 (31.25)	1 (9.09)	0.8 (20.00)	0.7 (12.50)	63.16
<b>Karnataka</b>	2.2	1.7 (22.73)	1.5 (11.76)	1.1 (26.67)	0.9 (18.18)	0.8 (11.11)	63.64
<b>Ap</b>	2.3	2 (13.04)	1.4 (30.00)	1.1 (21.43)	0.9 (18.18)	0.7 (22.22)	69.57
<b>Maharashtra</b>	2.2	1.7 (22.73)	1.5 (11.76)	1.1 (26.67)	0.8 (27.27)	0.7 (12.50)	68.18
<b>Mp</b>	2.7	2.5 (7.41)	2.2 (12.00)	1.9 (13.64)	1.4 (26.32)	1.2 (14.29)	55.56

<b>Up</b>	3.2	2.8 (12.50)	2.3 (17.86)	2.1 (8.70)	1.6 (23.81)	1.3 (18.75)	59.38
<b>Rajasthan</b>	2.3	2.3 (0.00)	2 (13.04)	1.6 (20.00)	1.6 (0.00)	1.2 (25.00)	47.83
<b>Punjab</b>	2.4	1.9 (20.83)	1.4 (26.32)	1 (28.57)	0.8 (20.00)	0.7 (12.50)	70.83
<b>Odisha</b>	2.2	2.1 (4.55)	1.6 (23.81)	1.3 (18.75)	1.1 (15.38)	0.8 (27.27)	63.64
<b>Assam</b>	2.7	2 (25.93)	1.7 (15.00)	1.4 (17.65)	1.1 (21.43)	1 (9.09)	62.96
<b>Bihar</b>	NA	2.7	2.1 (22.22)	2.1 (0.00)	1.7 (19.05)	1.4 (17.65)	48.15
<b>Gujarat</b>	2.8	2 (28.57)	1.4 (30.00)	1.3 (7.14)	1.1 (15.38)	0.9 (18.18)	67.86
<b>Haryana</b>	3.4	2.3 (32.35)	1.8 (21.74)	1.4 (22.22)	1 (28.57)	0.9 (10.00)	73.53
<b>West Bengal</b>	NA	2.1	1.5 (28.57)	1.2 (20.00)	0.8 (33.33)	0.7 (12.50)	66.67

[Figures in the brackets are % of change from previous period]

The above table (2) explains the level of GRR from 1971 to 2020. It is clear that, the GRR tends to decline over the period from 1971 to 2020. The GRR of India in 2020 was 0.9 and the total percentage of decline was 64%. The lowest GRR shows in Tamil Nadu, Andhra Pradesh, Maharashtra, Punjab and West Bengal in the year 2020 (i.e., 0.7). The above table revealed that, the highest decline in GRR occurs in Haryana throughout the period (i.e., 73.53%) followed by Punjab (i.e., 70.83%). In 2020, the highest GRR happens in Bihar (i.e., 1.4) and Uttar Pradesh (i.e., 1.3). The lowest percentage of decline occurs in Bihar (i.e., 48.15); it means that, the number of daughters born in Bihar was high level compared to other states. It is clear that, the GRR level of Kerala keeps 0.9 from 1991 to 2011, i.e., there was no changes happens in these periods. After that, in

2020 the GRR of Kerala becomes 0.8. The lowest GRR in 1971 happens in Tamil Nadu (i.e., 1.9) preceding by Kerala (i.e., 2.0). Similarly, the highest GRR in 1971 occurs at Haryana (i.e., 3.4) and Uttar Pradesh (i.e., 3.2).

The above table explains the drastic changes happens in GRR from 1971 to 2020 in a detailed manner.

### 3. Net Reproduction Rate (NRR) of India and Major states

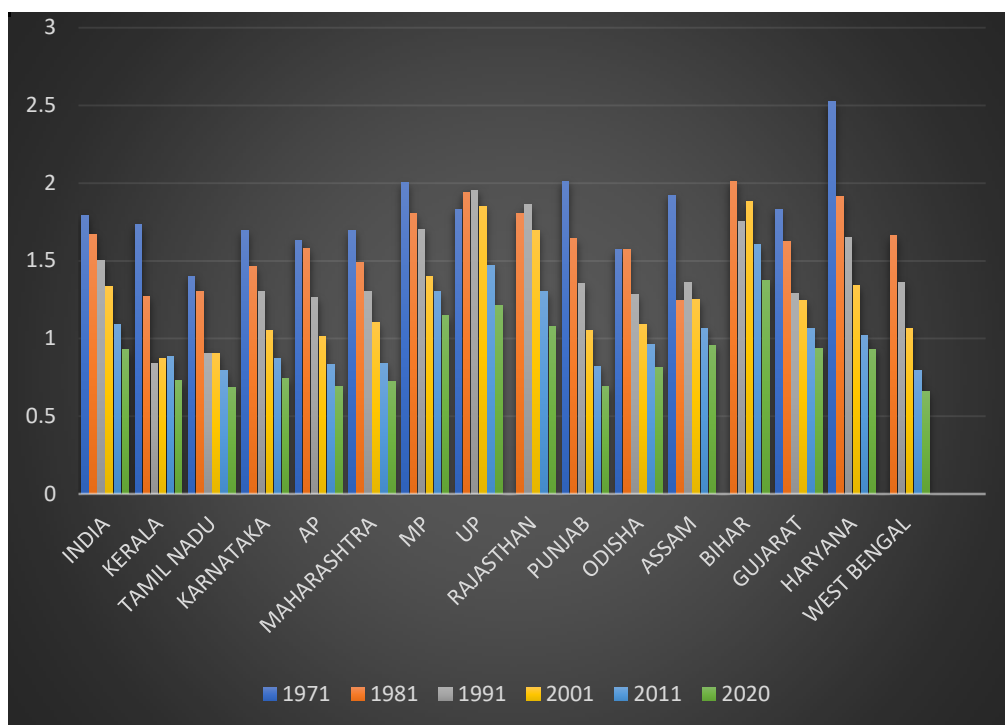
The net reproduction rate belongs to the kind of indicators defined as “classic measures” of population renewal. It represents the average number of daughters a hypothetical cohort of women would have at the end of their reproductive period if they were subject during their whole lives to the fertility rates and the mortality rates of a given period. It is expressed as number of daughters per woman. Here discusses the transition in NRR of India and Major states, using the following table (3).

**Table 3: percentage of decline in NRR of India and major states from 1971 to 2020**

	1971	1981	1991	2001	2011	2020	% Decline from 1971 to 2020
<b>India</b>	1.79	1.67 (6.70)	1.5 (10.18)	1.33 (11.33)	1.09 (18.05)	0.925 (15.14)	48.32
<b>Kerala</b>	1.73	1.27 (26.59)	0.84 (33.86)	0.87 (-3.57)	0.88 (-1.15)	0.727 (17.39)	57.98
<b>Tamil Nadu</b>	1.4	1.3 (7.14)	0.9 (30.77)	0.9 (0.00)	0.79 (12.22)	0.686 (13.16)	51.00

<b>Karnataka</b>	1.69	1.46 (13.61)	1.3 (10.96)	1.05 (19.23)	0.87 (17.14)	0.741 (14.83)	56.15
<b>Ap</b>	1.63	1.58 (3.07)	1.26 (20.25)	1.01 (19.84)	0.83 (17.82)	0.691 (16.75)	57.61
<b>Maharashtra</b>	1.69	1.49 (11.83)	1.3 (12.75)	1.1 (15.38)	0.84 (23.64)	0.721 (14.17)	57.34
<b>Mp</b>	2	1.8 (10.00)	1.7 (5.56)	1.4 (17.65)	1.3 (7.14)	1.144 (12.00)	42.80
<b>Up</b>	1.83	1.94 (-6.01)	1.95 (-0.52)	1.85 (5.13)	1.47 (20.54)	1.213 (17.48)	33.72
<b>Rajasthan</b>	NA	1.8	1.86 (-3.33)	1.69 (9.14)	1.3 (23.08)	1.077 (17.15)	40.17
<b>Punjab</b>	2.01	1.64 (18.41)	1.35 (17.68)	1.05 (22.22)	0.82 (21.90)	0.69 (15.85)	65.67
<b>Odisha</b>	1.57	1.57 (0.00)	1.28 (18.47)	1.09 (14.84)	0.96 (11.93)	0.815 (15.10)	48.09
<b>Assam</b>	1.92	1.24 (35.42)	1.36 (-9.68)	1.25 (8.09)	1.06 (15.20)	0.956 (9.81)	50.21
<b>Bihar</b>	NA	2.01	1.75 (12.94)	1.88 (-7.43)	1.6 (14.89)	1.369 (14.44)	31.89
<b>Gujarat</b>	1.83	1.62 (11.48)	1.29 (20.37)	1.24 (3.88)	1.06 (14.52)	0.932 (12.08)	49.07
<b>Haryana</b>	2.52	1.91 (24.21)	1.65 (13.61)	1.34 (18.79)	1.02 (23.88)	0.929 (8.92)	63.13
<b>West Bengal</b>	NA	1.66	1.36 (18.07)	1.06 (22.06)	0.79 (25.47)	0.66 (16.46)	60.24

[Figures in the brackets are % of change from previous period.]

**Graph 2: NRR of India and major states from 1971 to 2020**

The above table (3) explains the Net Reproduction Rate (NRR) of India and major states from 1971 to 2020. In 2020, the NRR was 0.925 and the highest NRR happens in 1971 (i.e., 1.79). The total percentage of decline was 48.32%. In the year 2020, it is clear that, the highest NRR occurs in Bihar and Uttar Pradesh (i.e., 1.369 and 1.213) and the total percentage of decline was 31.89% and 33.72%. Similarly, the lowest NRR happens in West Bengal and Tamil Nadu (i.e., 0.66 and 0.686) and the total percentage of decline was 60.24% and 51.00%. The NRR of Kerala shows a slight increase happens in the period 2001 and 2011. Among the states the highest total percentage of decline happens in Punjab (i.e., 65.67%) and the lowest percentage of decline happens in Bihar (i.e., 31.89%). From 2011 to 2020, there was a gradual decline happens all the states. The

NRR of Tamil Nadu, Kerala and West Bengal are shows an improvement from 1990's. All these changes can be easily explained through the graphical representation of NRR in graph (2).

#### 4. Mean Age of Childbearing (MAC) of India and Major states

The **Mean Age of Birth (MAB)** or **Mean Age of Childbearing (MAC)** in a given population over a given time interval is the arithmetic mean of the ages of mothers giving live births, for all live births that occur within that time interval. In India the Mean Age of childbearing of Mothers declined from 1971 to 2020. It shows the fertility decline in India. Here discusses the changes in MAC of India and Major states, using the following table (4).

**Table 4: MAC of India and major states from 1971 to 2020**

	1971	1981	1991	2001	2011	2020	% Of decline from 1971 to 2020
<b>India</b>	29	28.36 (2.21)	27.53 (2.93)	27.32 (0.76)	26.49 (3.04)	28.41 (-7.25)	2.03
<b>Kerala</b>	28.9	27.49 (4.88)	26.1 (5.06)	25.89 (0.80)	26.18 (-1.12)	28.11 (-7.37)	2.73
<b>Tamil Nadu</b>	28	27.24 (2.71)	25.67 (5.76)	25.49 (0.70)	25.61 (-0.47)	27.49 (-7.34)	1.82
<b>Karnataka</b>	28.63	8.12 (1.78)	26.23 (6.72)	25.23 (3.81)	24.74 (1.94)	28.02 (-13.26)	2.13
<b>Ap</b>	27.65	26.98 (2.42)	25.11 (6.93)	23.54 (6.25)	24.27 (-3.10)	26.86 (-10.67)	2.86



<b>Maharashtra</b>	28.81	27.15 (5.76)	25.64 (5.56)	25.36 (1.09)	25.04 (1.26)	27.28 (-8.95)	5.31
<b>Mp</b>	28.27	27.99 (0.99)	27.01 (3.50)	26.78 (0.85)	26.18 (2.24)	27.85 (-6.38)	1.49
<b>Up</b>	29.9	29.5 (1.34)	29.2 (1.02)	29.4 (-0.68)	27.9 (5.10)	29.76 (-6.67)	0.47
<b>Rajasthan</b>	NA	29.2	28 (4.11)	27.5 (1.79)	26.7 (2.91)	28.00 (-4.87)	4.11
<b>Punjab</b>	30.24	28.99 (4.13)	26.79 (7.59)	26.39 (1.49)	26.22 (0.64)	29.37 (-12.01)	2.88
<b>Odisha</b>	28.7	27.8 (3.14)	27.2 (2.16)	27.2 (0.00)	26.5 (2.57)	28.34 (-6.94)	1.25
<b>Assam</b>	28.41	28.34 (0.25)	28.11 (0.81)	27.5 (2.17)	26.95 (2.00)	29.02 (-7.68)	-2.15
<b>Bihar</b>	NA	29.05	29.17 (-0.41)	28.98 (0.65)	27.75 (4.24)	29.65 (-6.85)	-2.07
<b>Gujarat</b>	29.02	27.69 (4.58)	26.91 (2.82)	26.83 (0.30)	26.43 (1.49)	27.79 (-5.15)	4.24
<b>Haryana</b>	30.47	28.4 (6.79)	26.66 (6.13)	26.06 (2.25)	25.66 (1.53)	27.87 (-8.61)	8.53
<b>West Bengal</b>	NA	27.45	27.08 (1.35)	25.8 (4.73)	24.7 (4.26)	26.25 (-6.28)	4.37

[Figures in the brackets are % of change from previous period.]

The above table (4) shows the Mean Age of Child bearing (MAC) in India and major states from 1971 to 2020. In 2020 the MAC of India was 28.41 and the total percentage of decline from 1971 to 2020 was 2.03%. It is clear that, the MAC from 2011 to 2020, there was a gradual increase happens compare to preceding years. From 1971 to 2011 there was a gradual decline happens in MAC after that, all the states show a drastic increase in MAC. The highest MAC

occurs in Uttar Pradesh and Bihar (i.e., 29.76 and 29.65 respectively).

### 5. Reproduction survival ratio (RSR) of India and Major states

**Table 5: Reproduction Survival Ratio (RSR) from 1971-2020**

	<b>1971</b>	<b>1981</b>	<b>1991</b>	<b>2001</b>	<b>2011</b>	<b>2020</b>
<b>India</b>	0.7118	0.7565	0.8429	0.8821	0.9202	0.9464
<b>Kerala</b>	0.8633	0.9242	0.9684	0.9758	0.9797	0.9852
<b>Tamil Nadu</b>	0.7485	0.8071	0.8976	0.9255	0.9584	0.9744
<b>Karnataka</b>	0.7883	0.8409	0.8732	0.9103	0.9434	0.9627
<b>Ap</b>	0.7282	0.8218	0.8788	0.9073	0.9357	0.9567
<b>Maharashtra</b>	0.7721	0.8425	0.9012	0.9305	0.9623	0.9696
<b>Mp</b>	0.7036	0.7141	0.7787	0.7552	0.8838	0.9196
<b>Up</b>	0.6071	0.6909	0.7904	0.8379	0.8889	0.9138
<b>Rajasthan</b>	NA	0.7372	0.8259	0.8658	0.9059	0.9322
<b>Punjab</b>	0.7869	0.8487	0.8902	0.9132	0.9476	0.9575
<b>Odisha</b>	0.6794	0.7552	0.7977	0.8494	0.8971	0.9358
<b>Assam</b>	0.6915	0.628	0.8026	0.8464	0.8951	0.9311
<b>Bihar</b>	NA	0.7278	0.8139	0.8677	0.9104	0.9475
<b>Gujarat</b>	0.6776	0.7703	0.8559	0.8868	0.9201	0.9616
<b>Haryana</b>	0.7662	0.7857	0.853	0.88	0.924	0.9488
<b>West Bengal</b>	NA	0.8092	0.8749	0.9201	0.9472	0.9686

The lowest MAC occurs in West Bengal and Andhra Pradesh (i.e., 26.25 and 26.86). The highest percentage of decline happens in Haryana (i.e., 8.53%) and the lowest percentage of decline occurs in

Assam -2.15. The above table revealed that, in 1971 and 2020 shows the highest MAC in India and all other states. The RSR is the proportion of reproductivity that survives the effect of mortality. The following table (5) shows the variation happens from 1971 to 2020.

The RSR has been estimated and are presented in table (5). All the states had shown improvement in the RSR. All the southern and western states had more than 90 % RSR in 2020. The RSR of India in 2020 shows an improvement compared to 2011, that is 94.6%. It is clear that, in 2020, the highest RSR occurs in Kerala (98.5%) followed by Tamil Nadu (97.4%), it implies that, the survival status of women in Kerala and Tamil Nadu becomes higher. In 1971, the RSR of Kerala had more than 80%, it was the highest RSR at that period compared to national value and all other states. Uttar Pradesh had the low level RSR from 1971, after 2011 there was a drastic change occurs and the survival status improves. At the same time, the RSR of Madhya Pradesh shows almost higher value in 1970's, after that, the growth in RSR becomes slower. All the states gradually shown an improvement in the survival status of women. It is clear that, the RSR of Kerala becomes very high compared to all other states from 80's. Also, the states Punjab, Gujarat, Haryana and West Bengal had better survival chance for women in the reproductive period. Bihar (94%) and Rajasthan (93.2) had about 90 % chance, but the states like Madhya Pradesh (91.9%), Uttar Pradesh (91.3%), had just cross the 90 percent survival chance in 2020.

**Table 6: The TFR, GRR, NRR, MAC and RSR of India in the Census Years 1971 – 2020.**

<b>Year</b>	<b>TFR</b>	<b>GRR</b>	<b>NRR</b>	<b>MAC</b>	<b>RSR</b>
<b>1971</b>	5.2	2.5	1.79	29.0	0.7118
<b>1981</b>	4.6	2.2	1.67	28.36	0.7565
<b>1991</b>	3.6	1.7	1.50	27.53	0.8429
<b>2001</b>	3.1	1.5	1.33	27.32	0.8821
<b>2011</b>	2.4	1.2	1.09	26.49	0.9202
<b>2020</b>	2.0	0.9	0.925	28.41	0.9464

From above table revealed the changes in reproductive rates over the last five decades and the improvement in the survival chances of women in the reproductive period.

TFR of India and the states showed a declining trend. Among the state, Tamil Nadu, and Kerala had the lowest TFR (i.e., 1.4 and 1.5 respectively). Bihar had the highest TFR in 2020 (i.e., 3.0). The highest percentage of decline in TFR among the period happened in Haryana, because the TFR was highest in 1971 (i.e., 6.7 to 2.0). It shows a gradual decline in the state. A steady decline in the TFR was observed in these states. Especially, the southern states showed the fastest decline in all the fertility measures. West Bengal showed the improved level in all fertility measures, the fertility rate was declining over the decades.

Percentage of changes in reproductive measures such as GRR, NRR, MAC (mean Age of Childbearing) and RSR (Reproduction Survival Ratio), in India had shown GRR is declined to 64 percentage over the decade 1971 to 2020. NRR shown 48.32 percentage from 1971 to 2020, MAC declined to 2.03 percentage, and RSR is 33 percent increase in the survival ratio from 1971 to 2020. All these indicators showed that, the reproductive rate

declines gradually from 1971 to 2020 except MAC, because; MAC declines up to 2011, then there was a gradual increase happens in 2020.

Among the major states of India, the lowest GRR shows in Tamil Nadu, Andhra Pradesh, Maharashtra, Punjab and West Bengal in the year 2020 (i.e., 0.7). The above table revealed that, the highest decline in GRR occurs in Haryana throughout the period (i.e., 73.53%) followed by Punjab (i.e., 70.83%). In 2020, the highest GRR happens in Bihar (i.e., 1.4) and Uttar Pradesh (i.e., 1.3). The lowest percentage of decline occurs in Bihar (i.e., 48.15).

The highest NRR occurs in Bihar and Uttar Pradesh (i.e., 1.369 and 1.213) and the total percentage of decline was 31.89% and 33.72%. Similarly, the lowest NRR happens in West Bengal and Tamil Nadu (i.e., 0.66 and 0.686) and the total percentage of decline was 60.24% and 51.00%.

The highest MAC occurs in Uttar Pradesh and Bihar (i.e., 29.76 and 29.65 respectively). The lowest MAC occurs in West Bengal and Andhra Pradesh (i.e., 26.25 and 26.86 respectively), it may be due to the low age at marriage in these two states. The highest percentage of decline happens in Haryana (i.e., 8.53%) and the lowest percentage of decline occurs in Assam -2.15.

It is clear that, in 2020, the highest RSR occurs in Kerala (98.5%) followed by Tamil Nadu (97.4%), and Uttar Pradesh had the low level RSR from 1971 (i.e., 0.6071), after 2011 there was a drastic change occurs and the survival status improves (i.e., 0.9138 in 2020), That is the survival status of women is comparatively low. Kerala shows a marked variation in RSR from 1980's. RSR helps to explain the survival status of women in the reproductive period at national and state level. Hence, the survival status of women in Kerala is higher than other states.

To sum up, the lowest rate of fertility is an indicator of the development of a country. Hence it should be minimum. The TFR must decline to 2.1, then the country or region becomes attains the replacement level of fertility. But the decline in reproduction rates were not uniform throughout the country, hence it is necessary to prioritise the implementation of policies and programmes according to the fertility situation of each state. In order to attain the stabilization of population growth uniform changes in the fertility rates are compulsory. It can be concluded that, the level of fertility rate in India can be estimated by using the appropriate reproductive measures. Hence, the changes happening in reproductive rates are very useful measures to explain the fertility transition of a country.

## **CONCLUSION**

The reproduction of the population refers to a change in generations. Reproduction is measured by gross reproduction rates or net reproduction rates, indicating the ratio between the sizes of the daughter's and mother's generations. These rates are crucial for analyzing a nation's fertility condition and projecting its population. When the Net reproduction rate tends to one and Total fertility rate tends to two, the region attains replacement-level fertility. According to the world population prospects 2019, out of 201 countries estimated by the UN, 109 have a fertility rate exceeding the population replacement level of 2.1 births per woman. In 2020, India's net reproduction rate was 1, gradually declining from 1.87 in 1975.

The study on reproductive rates aims to understand the demographic situation and the stage of fertility transition in India. This study estimates changes in reproductive measures in India and major states from 1971 to 2020. It also examines the percentage

decline in reproductive measures and the Reproduction Survival Ratio (RSR) in India and the major states. The selected measures for analysis include Net Reproduction Rate (NRR), Gross Reproduction Rate (GRR), Mean Age of Childbearing (MAC), and Reproduction Survival Ratio (RSR). The study focuses on 15 major states: Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan, Bihar, Punjab, Odisha, West Bengal, Haryana, Gujarat, and Assam. Data is sourced from published reports of the Sample Registration System of India (SRS) spanning from 1971 to 2020.

The findings reveal that GRR and NRR gradually declined from 1971 to 2020, with Kerala exhibiting the fastest decline since the 1980s. All reproductive measures indicate that the national level values do not surpass those of Kerala. The total percentage decline in NRR for Kerala and India is 48.32% and 57.98%, respectively. Additionally, the Mean Age of Childbearing is comparatively higher in Uttar Pradesh, indicating higher fertility rates in the state compared to the national level. In contrast, the Reproduction Survival Ratio (RSR) shows a gradual increase in Kerala, displaying marked variation since the 1980s. This study explains the percentage decline in each reproductive rate for major states in India and the RSR at a detailed level, providing insights into the fertility levels of the country.

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