

# **PROBABILITY & STATISTICS PROJECT WORK**

## **WOMEN AND MEN DIFFERENT BUT EQUAL?**

**Ankita Jain 2K19/MC/018**

**Anisha Jha2K19/MC/016**

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# Theory and Formulae Used

- **Mean** of a series of data is the value equal to the sum of the values of all the observations divided by the number of observations. It is the most commonly used measure of central tendency.

$$\bar{x} = \frac{\sum x}{N}$$

Here,

$\sum$  represents the summation

X represents observations

N represents the number of observations .

- **Median** The middle number; found by ordering all data points and picking out the one in the middle (or if there are two middle numbers, taking the mean of those two numbers).

$$\text{Median} = \left( \frac{n+1}{2} \right)^{\text{th}} \text{observation}$$

If the total number of the observations (n) is an even number, then the formula is given below:

$$\text{Median} = \frac{\left( \frac{n}{2} \right)^{\text{th}} \text{observation} + \left( \frac{n}{2} + 1 \right)^{\text{th}} \text{observation}}{2}$$

- **Mode** The most frequent number—that is, the number that occurs the highest number of times.
- **Standard Deviation** The standard deviation is a statistic that measures the dispersion of a dataset relative to its mean and is calculated as the square root of the variance. The standard deviation is calculated as the square root of variance by determining each data point's deviation relative to the mean.

$$\sigma = \sqrt{\frac{\sum (x_i - \mu)^2}{N}}$$

$\sigma$  = population standard deviation

N = the size of the population

$x_i$  = each value from the population

$\mu$  = the population mean

- **Coefficient of correlation** The correlation coefficient is a statistical measure of the strength of the relationship between the relative movements of two variables. The values range between -1.0 and 1.0.

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

r = correlation coefficient

$x_i$  = values of the x-variable in a sample

$\bar{x}$  = mean of the values of the x-variable

$y_i$  = values of the y-variable in a sample

$\bar{y}$  = mean of the values of the y-variable

- **Sex Ratio** Sex ratio In India, Sex ratio is defined as the number of females per 1000 males in the population, whereas in almost all the UN publications/International publications, it is expressed as males to per 100 females. In our project we have used the definition mentioned in Indian Census.

$$\frac{\text{Female Population} \times 1000}{\text{Male Population}}$$

- **Population Pyramid** is also called an "age-gender-pyramid". It is a graphical illustration that shows the distribution of various age groups in a population (typically that of a country or region of the world), which forms the shape of a pyramid and helps us to show how populations are composed and how they are growing.
- The **singulate mean age at marriage (SMAM)** is the average length of single life expressed in years among those who marry before age 50.  
(Number of women (within specific age group category) who have married / Number of women of all marital statuses)  $\times 100$
- **Annual Exponential Population Growth Rate**  $r = (\ln P(t+10) - \ln P(t)) / 10$ , where  $\ln$  stands for natural logarithm  $P(t)$  = Initial population;  $P(t+10)$  = Population after 10 years
- **Age-Specific Fertility Rate (ASFR)** Age-specific fertility rate is defined as the number of live births in a specific age group of women per thousand female populations of that age group.
- **Age-Specific Mortality Rate (ASMR)** Age-specific mortality rate is defined as the number of deaths in a specific age group per thousand populations in the same age-group in a given year.
- **Crude Birth Rate (CBR)** The Crude Birth Rate (CBR) is defined as the number of live births per thousand population.
- **Crude Death Rate (CDR)** The Crude Death Rate (CDR) is defined as Number of deaths per thousand population.
- **Neo-natal mortality rate** It is the number of neonatal deaths per 1000 live births  
A neonatal death is defined as a death during the first 28 days of life (0-27 days).

$$\frac{\# \text{ of neonatal deaths} \times 1000}{\text{Total } \# \text{ of live births}}$$

- The NMR is often broken down into early and late mortality rates. The Early Neonatal Mortality rate (ENMR) is calculated as follows:

$$\frac{\# \text{ of neonatal deaths 0-7 days} \times 1000}{\text{Total } \# \text{ of live births}}$$

- The late neonatal mortality rate (LNMR) is calculated as follows:

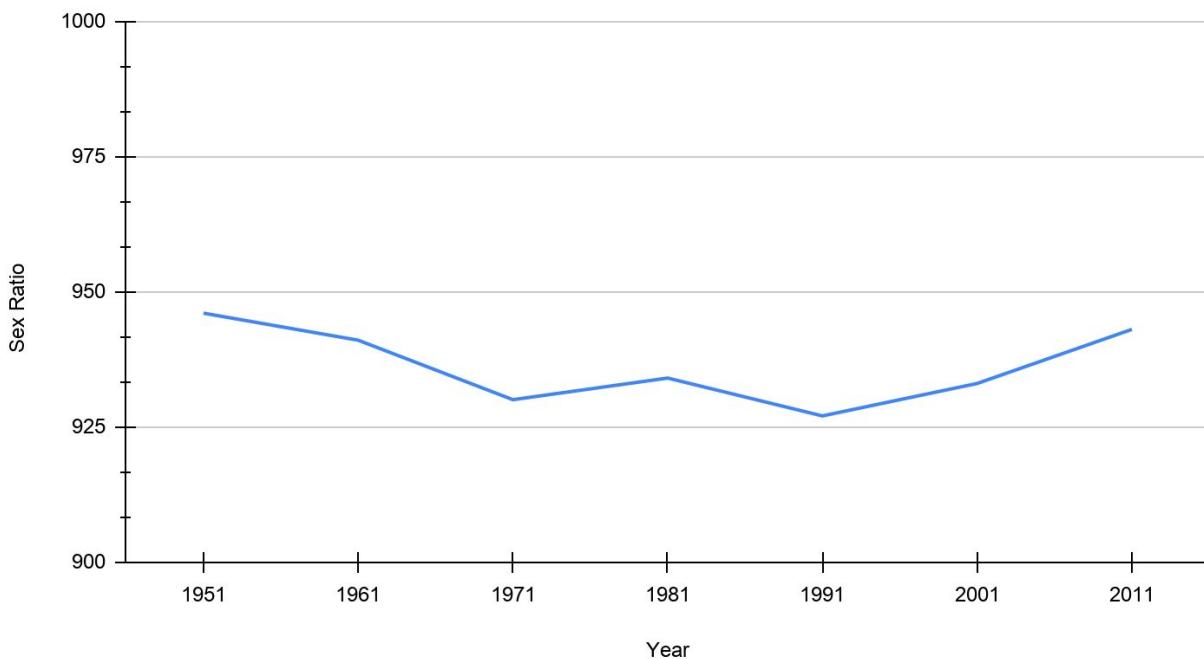
$$\frac{\# \text{ of neonatal deaths 8-27 days} \times 1000}{\text{Total # of live births}}$$

- **The Gross Enrolment ratio** determines the number of students enrolled in school at several different grade levels ( primary, upper primary, elementary, secondary, senior secondary and higher education). The data is defined as the percentage of student enrolment in primary and secondary school on gender basis.
- **Gender Parity Index** is the Ratio of girls to boys in primary, secondary and tertiary education .It is the ratio of the number of female students enrolled at primary, secondary and tertiary levels of education to the number of male students in each level. To standardise the effects of the population structure of the appropriate age groups, the Gender Parity Index (GPI) of the Gross Enrolment Ratio (GER) for each level of education is used.
- **Dropout Rate** A dropout is a pupil who leaves school before the completion of a school stage or leaving at some intermediate or non-terminal point of a given level of education (MHRD).
- **Definition of Literate** A person aged 7 years and above who can both read and write with understanding in any language was taken as literate. A person, who can only read but cannot write, is not literate. It is not necessary that to be treated as literate, a person should have received any formal education or passed any minimum educational standard. Literacy could also have been achieved through adult literacy classes or through any non-formal educational system. People who are blind and can read in Braille were also treated as literates. All children of age 6 years or less were treated as illiterate by definition, irrespective of their status of school attendance and the capability to read and write (ORGI).
- **Literate** A person is considered literate if he/she can read and write a simple message in at least one language with understanding.
- **Effective Literacy Rate (ELR)** The total percentage of the population of an area at a particular time aged seven year or above who can read and write with understanding. Here the denominator is the population aged seven years or more .

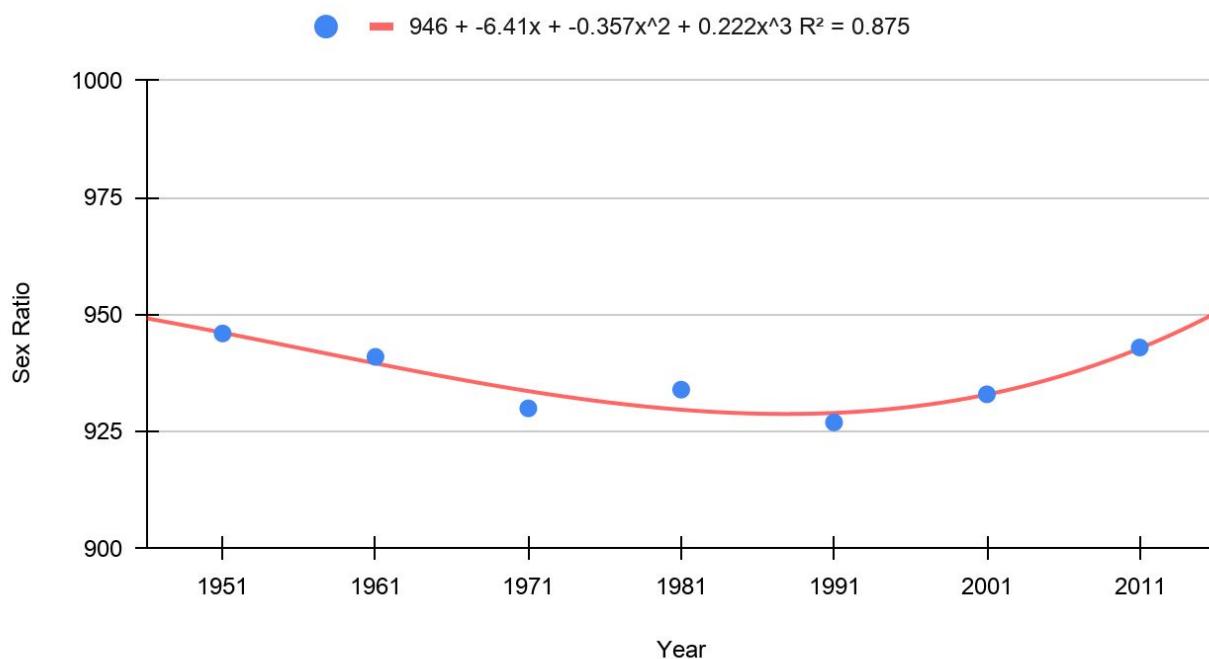
## **GENDER GAP BY NUMBERS**

- At all India level, the sex ratio has increased from 933 in 2001 to 943 in 2011(Figure 1.1) and is further likely to increase as is evident from Figure 1.2. During this period 19 States/UT's have recorded a significant increase in sex ratio. Notable increase in the sex ratio has been recorded in Delhi (5.7%), Chandigarh (5.3%), and Arunachal Pradesh (5.0%). Contrary to this, Daman & Diu has recorded a decline of 12.9% in sex ratio(Table 1.1).

**Figure 1.1 : Year wise Sex Ratio in Post Independent India**



**Figure 1.2 : Trend in Sex Ratio**



**Table 1.1 : Year-wise State-wise Sex Ratio in post-Independent India**

State/ Union Territory	1951	1961	1971	1981	1991	2001	2011	*2021 (Predicted)	% Improvement
India	946	941	930	934	927	933	943	948	1.1
Andaman & Nicobar Islands	625	617	644	760	818	846	876	880	3.5
Andhra Pradesh	986	981	977	975	972	978	993	982	1.5
Arunachal Pradesh	NA	894	861	862	859	893	938	982	5
Assam	868	869	896	910	923	935	958	916	2.5
Bihar	1000	1005	957	948	907	919	918	970	-0.1
Chandigarh	781	652	749	769	790	777	818	884	5.3
Chhattisgarh	1024	1008	998	996	985	989	991	820	0.2
Dadra & Nagar Haveli	946	963	1007	974	952	812	774	977	-4.7
Daman & Diu	1125	1169	1099	1062	969	710	618	794	-13
Delhi	768	785	801	808	827	821	868	598	5.7
Goa	1128	1066	981	975	967	961	973	868	1.2
Gujarat	952	940	934	942	934	920	919	909	-0.1
Haryana	871	868	867	870	865	861	879	915	2.1
Himachal Pradesh	912	938	958	973	976	968	972	870	0.4
Jammu & Kashmir	873	878	878	892	896	892	889	994	-0.3
Jharkhand	961	960	945	940	922	941	948	899	0.7
Karnataka	966	959	957	963	960	965	973	931	0.8
Kerala	1028	1022	1016	1032	1036	1058	1084	968	2.5
Lakshadweep	1043	1020	978	975	943	948	946	1077	-0.2
Madhya Pradesh	945	932	920	921	912	919	931	912	1.3
Maharashtra	941	936	930	937	934	922	929	915	0.8
Manipur	1036	1015	980	971	958	974	992	924	1.8
Meghalaya	949	937	942	954	955	972	989	956	1.7
Mizoram	1041	1009	946	919	921	935	976	986	4.4
Nagaland	999	933	871	863	886	900	931	911	3.4
Odisha	1022	1001	988	981	971	972	979	875	0.7
Puducherry	1030	1013	989	985	979	1001	1037	959	3.6
Punjab	844	854	865	879	882	876	895	1003	2.2
Rajasthan	921	908	911	919	910	921	928	901	0.8
Sikkim	907	904	863	835	878	875	890	923	1.7
Tamil Nadu	1007	992	978	977	974	987	996	865	0.9
Tripura	904	932	943	946	945	948	960	981	1.3
Uttar Pradesh	908	907	876	882	876	898	912	969	1.6
Uttarakhand	940	947	940	936	936	962	963	960	0.1
West Bengal	865	878	891	911	917	934	950	960	1.7

- In 2011, the Sex Ratio is lowest at 908 in the age group 0-19 years, but the same is 1033 for the age group of 60+ years. The economically active age group (15-59) has the sex ratio of 944. (Table 1.2). The mean Sex ratio for the age group 0-6 is 922 while the median is observed to be 926. The mean Sex ratio for the age group 0-19 is 903 while the median is observed to be 912. The mean Sex ratio for the age group 15-59 is observed to be 901 while the median is observed to be 921. The mean Sex ratio for the age group 60+ is observed to be 1047 while the median is observed to be 1033.

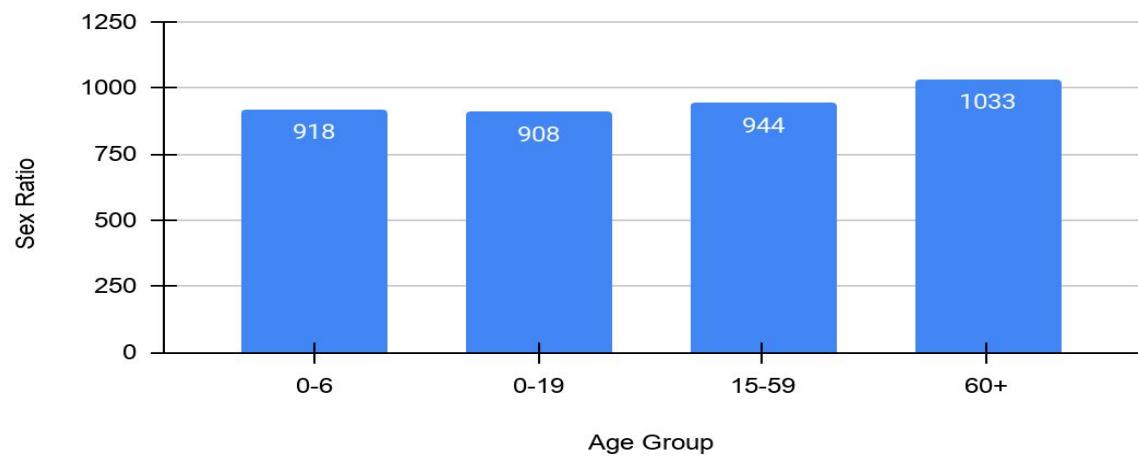
Early Childhood (0-6)			Childhood (0-19)		
N	Valid	21	N	Valid	21
	Missing	0		Missing	0
Mean		922.38	Mean		902.62
Median		926.00	Median		912.00
Mode		918 <sup>a</sup>	Mode		716 <sup>a</sup>
Std. Deviation		38.595	Std. Deviation		67.136
Variance		1489.548	Variance		4507.248
Range		138	Range		279

a. Multiple modes exist.  
The smallest value is shown

Economically Active(15-59)			Old Age (60+)		
N	Valid	21	N	Valid	21
	Missing	0		Missing	0
Mean		901.95	Mean		1046.76
Median		921.00	Median		1033.00
Mode		918	Mode		971
Std. Deviation		118.456	Std. Deviation		131.708
Variance		14031.748	Variance		17346.990
Range		584	Range		539

**Fig 1.3 : Sex ratio in various age-groups in the context of developmental planning**

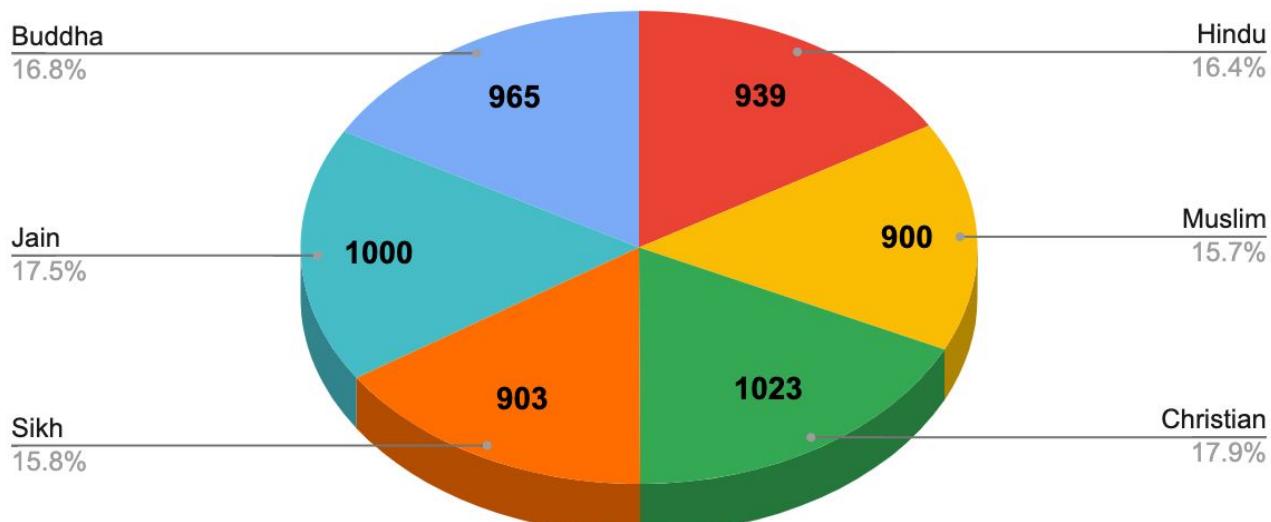


**Table 1.2 : State-wise sex ratio in various age-groups in the context of developmental planning**

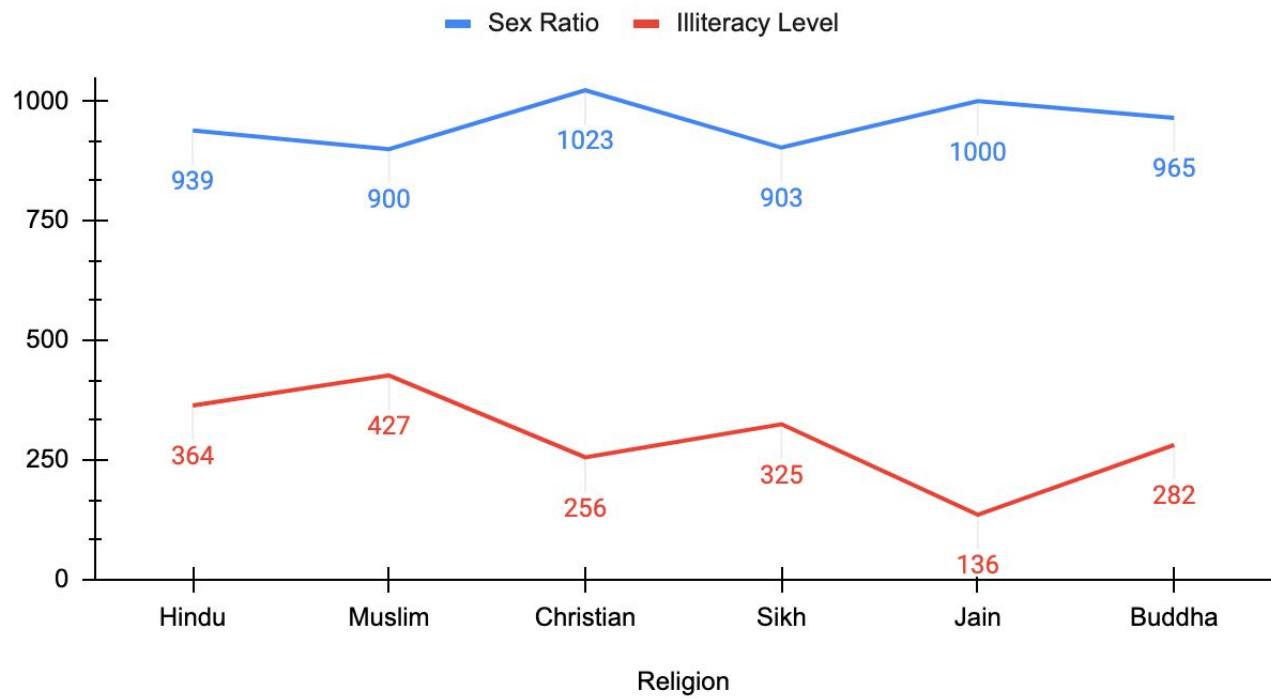
<b>State/Union Territory</b>	<b>Early Childhood (0-6)</b>	<b>Childhood (0-19)</b>	<b>Economically Active(15-59)</b>	<b>Old Age (60+)</b>
<b>India</b>	<b>918</b>	<b>908</b>	<b>944</b>	<b>1033</b>
Andaman & Nicobar Islands	968	948	856	792
Andhra Pradesh	939	940	995	1119
Arunachal Pradesh	972	978	918	917
Assam	962	951	956	971
Bihar	935	897	921	877
Chandigarh	880	807	800	926
Chhattisgarh	969	971	981	1159
Dadra and Nagar Haveli	926	846	694	1185
Daman and Diu	904	716	522	1331
Delhi	871	842	861	989
Goa	942	927	951	1200
Gujarat	890	876	914	1132
Haryana	834	817	888	1015
Himachal Pradesh	909	900	988	1062
Jammu & Kashmir	862	892	891	912
Jharkhand	948	931	943	994
Karnataka	948	938	966	1108
Kerala	964	963	1106	1226
Lakshadweep	911	995	928	971
Madhya Pradesh	918	912	918	1063
Maharashtra	894	887	918	1114
Manipur	930	952	1006	1004
Meghalaya	970	975	994	1075
Mizoram	970	969	978	998
Nagaland	943	937	935	875
Odisha	941	966	986	998
Puducherry	967	962	1037	1255
Punjab	846	811	914	985
Rajasthan	888	888	930	1102
Sikkim	957	968	868	813
Tamil Nadu	943	941	1008	1051
Tripura	957	962	952	1040
Uttar Pradesh	902	891	922	921
Uttarakhand	890	898	991	1039
West Bengal	956	949	940	1010

- In 2011, religion-wise sex ratio for Hindus, Muslims, Christians, Sikhs, Buddhists and Jains was observed to be 939, 951, 1023, 903, 965 and 954 respectively. From Figure 1.5 it can be observed that a dip in illiteracy level is accompanied by a significant increase in sex ratio for every religion indicating the elimination of gender biasness among literate population.

**Fig 1.4 : Religion wise Sex Ratio**

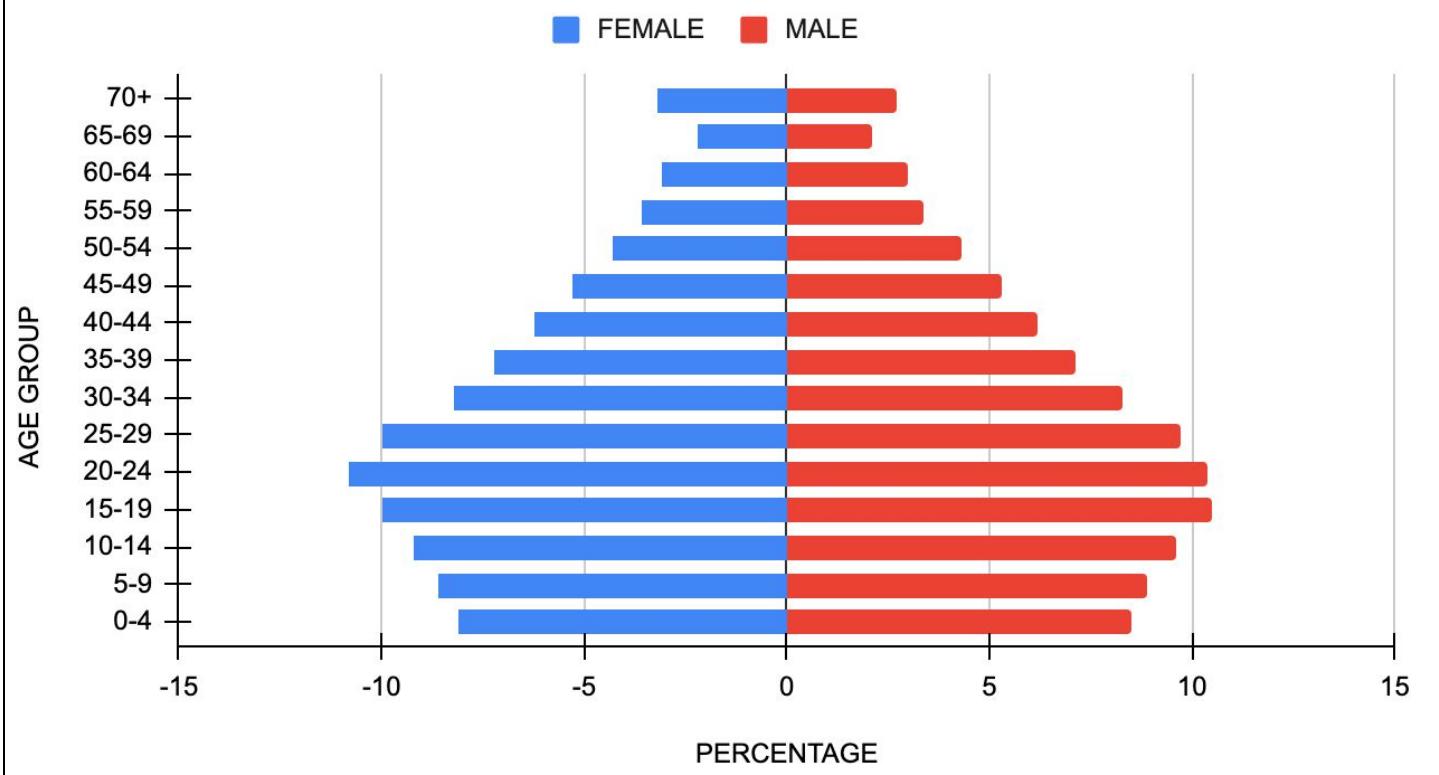


**Fig 1.5 : Religion wise Sex Ratio and Illiteracy level**

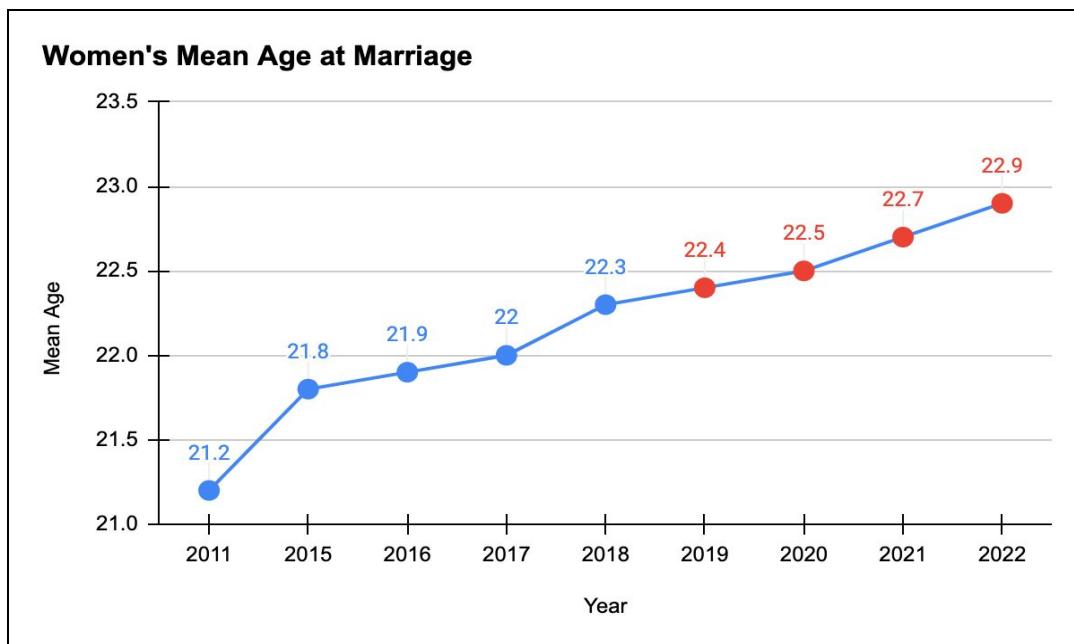


- Figure 1.6 depicts the population pyramid of India for the year 2017. Most of the population is clustered around the middle of the graph suggesting that India is a developing country. The wide base of the pyramid indicates a high birth rate which is mainly due to lack of family planning, high infant mortality rate and traditional status of women. The shape of the pyramid indicates a declining population suggesting that the country is changing from being a developed country and moving towards a developed country. The decline is due to a number of factors like education of mothers, improved status of women in society, better healthcare to name a few.

**Fig 1.6 : Population Pyramid, India, 2017**



- Figure 1.7 shows that the mean age of marriage of women in India has shown a constant upward trend. While the mean age of marriage of women in India stood at 21.2 years in the 2011 and improved to 22.1 years in 2017, the latest data for 2018 shows a further improvement to 22.3 years and is likely to increase in coming years.



- Correlation between mean age at marriage of females and enrollment in higher education of females across various states in India

**Correlations**

**Correlations**

		Mean Age at Marriage	% Enrollment in Higher Education(XII Beyond)
Mean Age at Marriage	Pearson Correlation	1	.627**
	Sig. (2-tailed)		.001
	N	23	23
% Enrollment in Higher Education(XII Beyond)	Pearson Correlation	.627**	1
	Sig. (2-tailed)	.001	
	N	23	23

\*\*, Correlation is significant at the 0.01 level (2-tailed).

**Nonparametric Correlations**

**Correlations**

		Mean Age at Marriage	% Enrollment in Higher Education(XII Beyond)
Spearman's rho	Mean Age at Marriage	Correlation Coefficient	1.000
		Sig. (2-tailed)	.717**
		N	23
% Enrollment in Higher Education(XII Beyond)	Correlation Coefficient	.717**	1.000
	Sig. (2-tailed)	.000	
	N	23	23

\*\*, Correlation is significant at the 0.01 level (2-tailed).

Table 1.3 : State wise Mean Age at Marriage of females and Percentage Enrollment in Higher Education

State	Mean Age at Marriage of females	% Enrollment in Higher Education(XII Beyond) offemales
Andhra Pradesh	22	29
Assam	22.3	18.3
Bihar	21.8	12
Chhattisgarh	21.8	18.1
Delhi	23.7	50
Gujarat	22.5	18.7
Haryana	22.5	32.4
Himachal Pradesh	23.4	44.9
Jammu & Kashmir	25.1	32.2
Jharkhand	21.9	18.7
Karnataka	22.3	29.4
Kerala	23.2	43.2
Madhya Pradesh	21.4	21.2
Maharashtra	22.5	30.3
Odisha	21.9	20
Punjab	23.5	34.3
Rajasthan	21.5	23
Tamil Nadu	23	48.3
Telangana	22	36.5
Uttar Pradesh	22.2	27.5
Uttarakhand	22.3	39.1
West Bengal	21.2	18.7
India	22.1	26.4

# GENDER GAP BY HEALTH

- In 2015, UTs like Chandigarh(14.9) Puducherry(10.2) Delhi (10.1)and Lakshadweep(14.6) have recorded highest obesity among Women with national average 5.1 while States like Andhra Pradesh(7.7),Sikkim (5.9),Mizoram(4.8) having maximum obesity amongst Men with national average 3.Women can be seen to be more likely to be obese as they suffer from infertility and adverse perinatal outcomes including abortion, preterm birth, and neonatal mortality. Maternal obesity is associated with childhood obesity as well.

Figure 2.1 Proportion of Adults who are obese

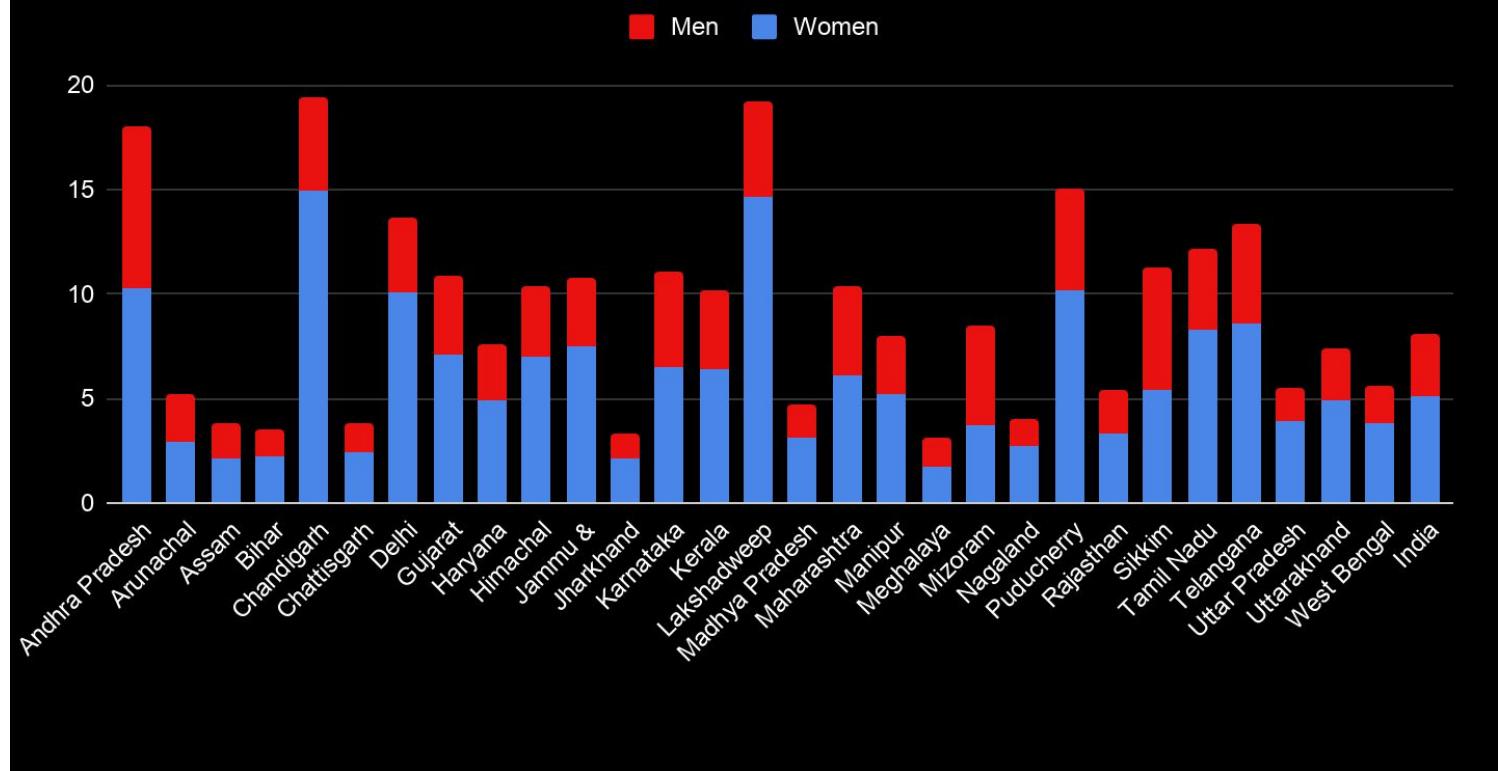


Table 2.1 : Proportion of Adults who are Obese, 2015-16		
State/UTs	Women	Men
Andhra Pradesh	10.3	7.7
Arunachal Pradesh	2.9	2.3
Assam	2.1	1.7
Bihar	2.2	1.3
Chandigarh	14.9	4.5
Chattisgarh	2.4	1.4
Delhi	10.1	3.6
Gujarat	7.1	3.8
Haryana	4.9	2.7
Himachal Pradesh	7	3.4
Jammu & Kashmir	7.5	3.3
Jharkhand	2.1	1.2
Karnataka	6.5	4.6
Kerala	6.4	3.8
Lakshadweep	14.6	4.6
Madhya Pradesh	3.1	1.6
Maharashtra	6.1	4.3
Manipur	5.2	2.8
Meghalaya	1.7	1.4
Mizoram	3.7	4.8
Nagaland	2.7	1.3
Puducherry	10.2	4.8
Rajasthan	3.3	2.1
Sikkim	5.4	5.9
Tamil Nadu	8.3	3.9
Telangana	8.6	4.8
Uttar Pradesh	3.9	1.6
Uttarakhand	4.9	2.5
West Bengal	3.8	1.8
India	5.1	3

- The crude birth rate(CBR) is the number of live births occurring among the population of a given geographical area in a given year, per 1,000 population. It has fallen from 21 in 2014 to 20.2 in 2017 at all India level . A steady decline in birth rates over the past decades can largely be attributed to the significant gains in women's freedoms, such as tackling forced marriage and child marriage, education for women and increased socioeconomic opportunities. Birth rates may have fallen due to the introduction of family planning clinics. Rural region can be seen to have 21.8 CBR against national average of 20.2 due to lack of awareness among women.

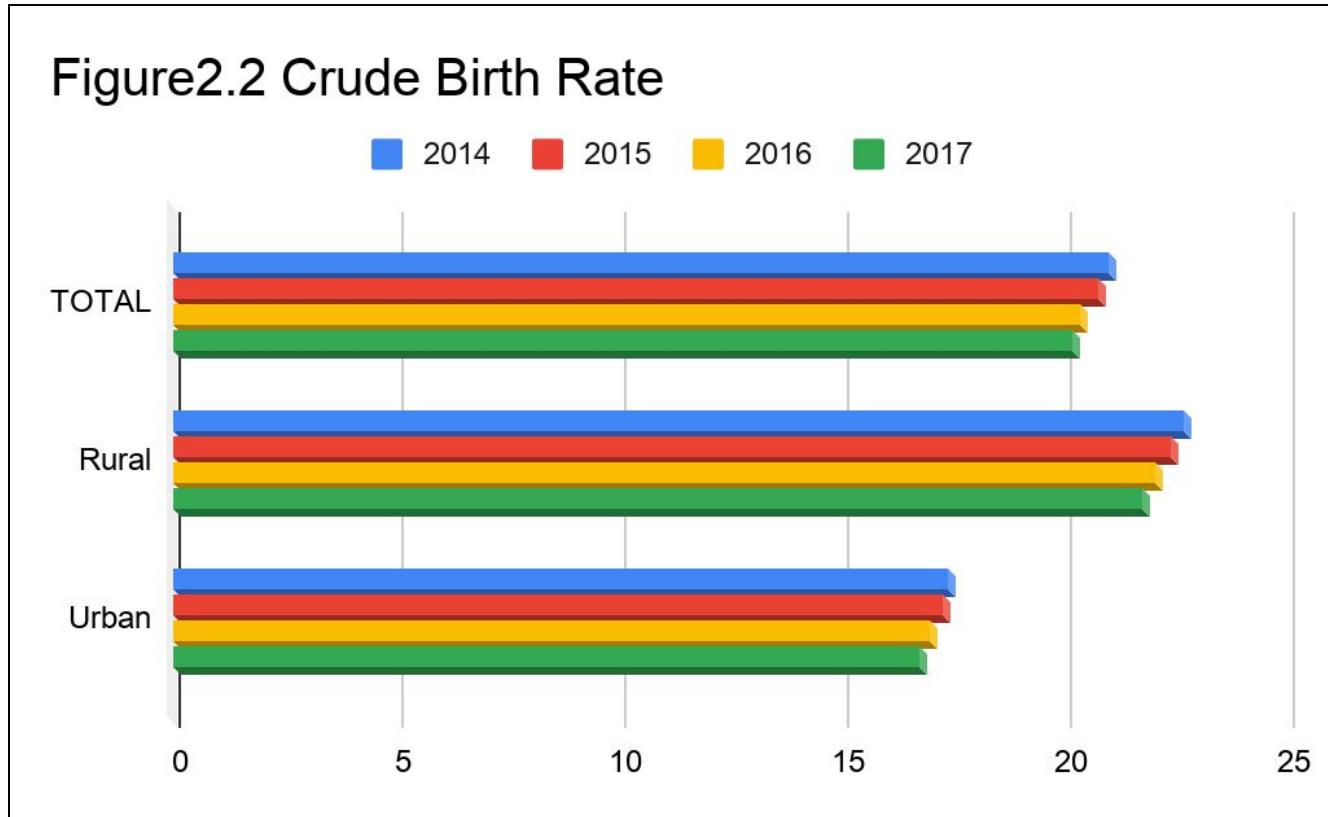


Table 2.2 : Crude birth rates

	2014	2015	2016	2017
TOTAL	21	20.8	20.4	20.2
Rural	22.7	22.4	22.1	21.8
Urban	17.4	17.3	17.0	16.8

- Figure 2.3 indicates that Percentage of women receiving medical treatment during their pregnancy which can be seen to significantly increase over the five years with 77.4 in rural areas and 94.4 in urban areas in 2017. It indicates that there has been improvement in the quality of maternal health services over the past five years with major emphasis on rural areas.

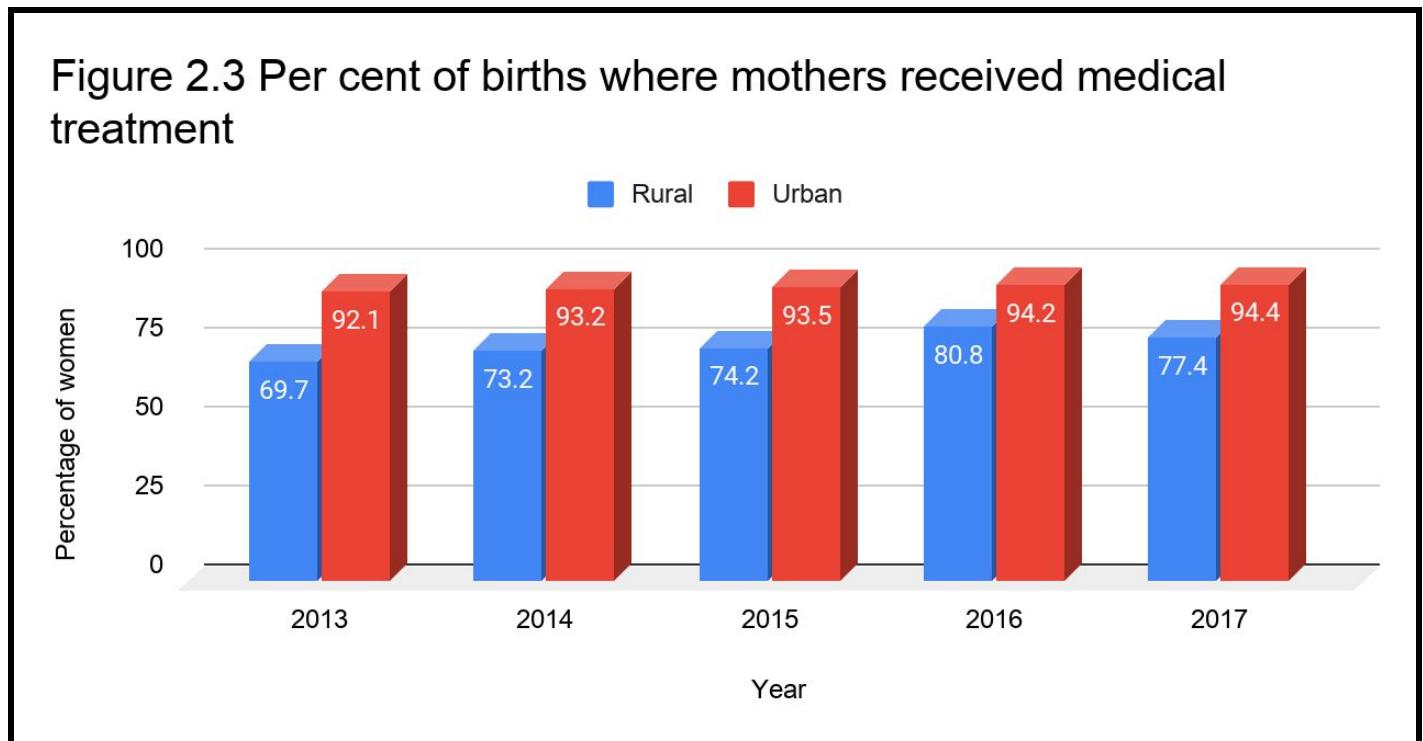
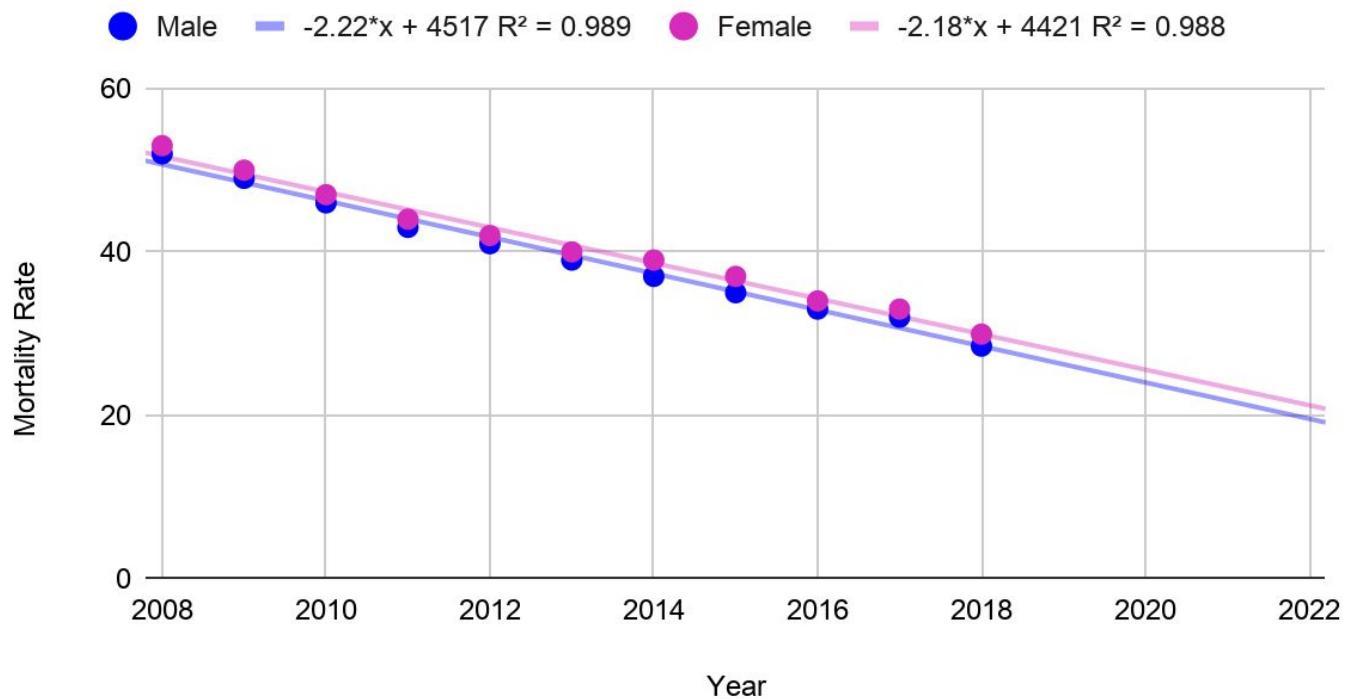


Table 2.3 : Percentage of women receiving medical treatment during their pregnancy

	Rural	Urban
2013	69.7	92.1
2014	73.2	93.2
2015	74.2	93.5
2016	80.8	94.2
2017	77.4	94.4

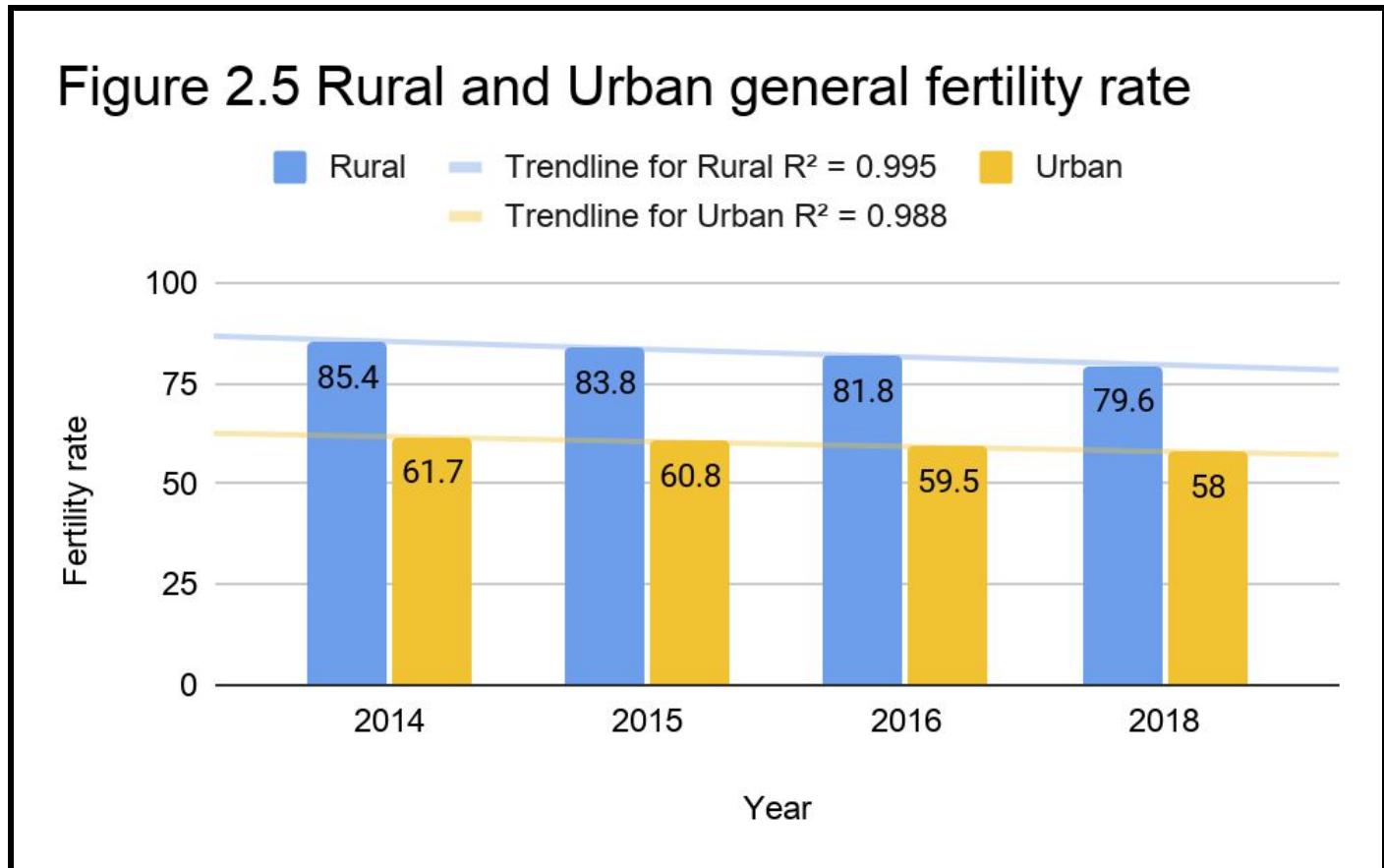
- Figure 2.4 illustrates the infant mortality rate for past ten years which has dropped significantly over years depicting improvement in health facilities, introduction of vital government schemes and consensus for family planning among adults.  $R^2(0.989, 0.988)$  for men and women respectively indicates the given regression is best fit for the given data.

Figure 2.4 Infant Mortality Rate for last 10 years



Year	Female	Male	Total
2008	55	52	53
2009	52	49	50
2010	49	46	47
2011	46	43	44
2012	44	41	42
2013	42	39	40
2014	40	37	39
2015	39	35	37
2016	36	33	34
2017	34	32	33
2018	37.04	28.46666667	29.93333333
2019	31.16	26.24242424	27.75757576
2020	29.17090909	24.01818182	25.58181818
2022	25.19272727	19.56969697	21.23030303

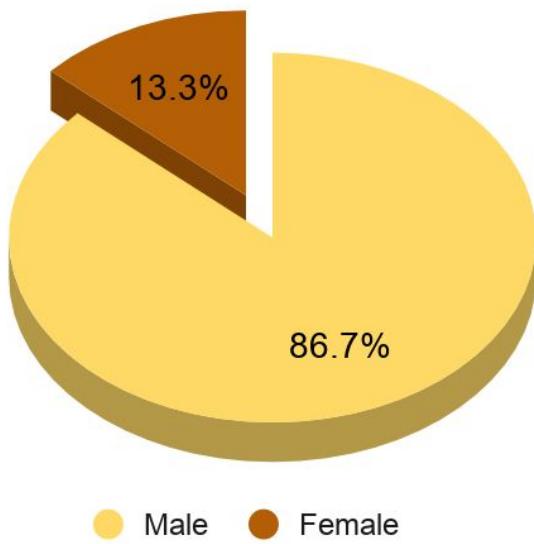
- Figure 2.5 highlights the fall in General fertility rate(GFR) over the period of four years. General fertility rate has gone through a considerable change of 5.6 ,3.7percent in Rural and urban areas respectively from 2014-18,suggesting Higher education, increased mobility, late marriage and financially independent women are all contributing to a falling GFR. Even though Rural areas have greater fertility than urban areas but have significant change of 5.6 in 2018 .



	Rural	Urban
2014	85.4	61.7
2015	83.8	60.8
2016	81.8	59.5
2018	79.6	58

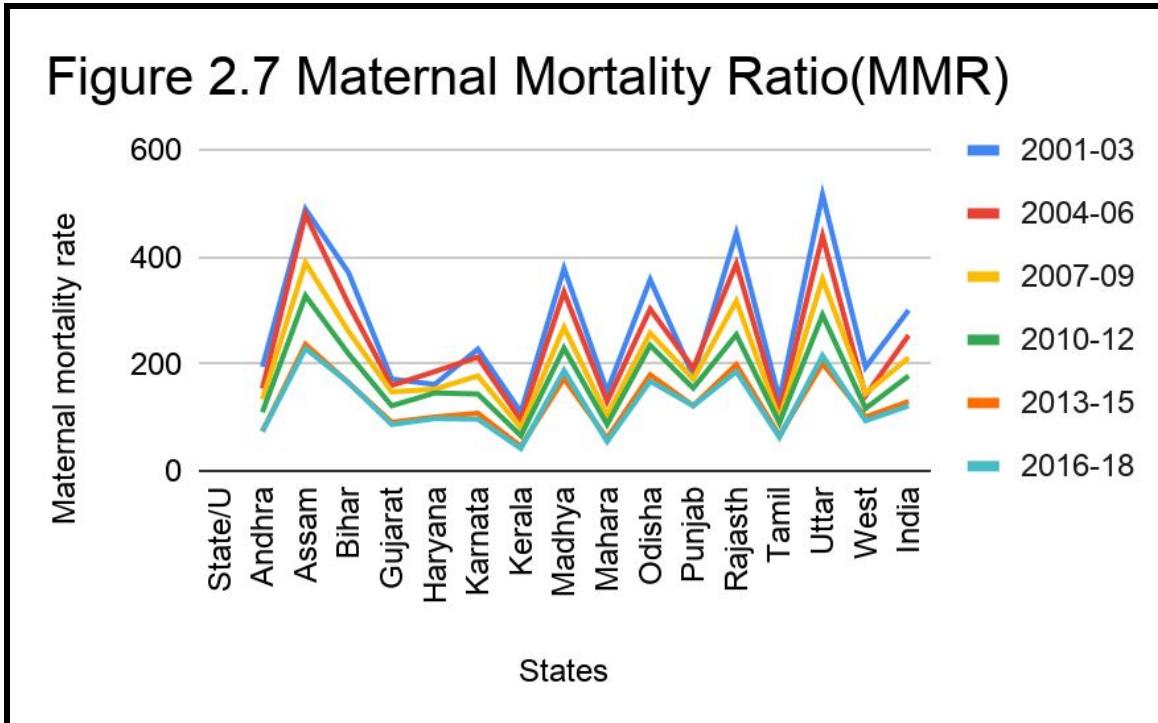
- As figure 2.6 shows the percentage of Tobacco consumers among men and women in total. It signifies that men consume tobacco six times more than women.

Figure 2.6 Percentage Of Current Tobacco Use Among Men And Women Aged 15-49 Years, 2015-16



Gender	Percentage Of Current Tobacco Use
Male	44.5
Female	6.8

- Figure 2.7 highlights the Maternal mortality(MMR) in states/UTs of India which is a measure of reproductive health of women in the area. As per the World Health Organization, maternal death is the death of a woman while pregnant or within 42 days of termination of pregnancy, from any cause related to or aggravated by the pregnancy or its management. Kerala(42) emerges as a state with minimum maternal mortality rate and Assam(229) having maximum. This crucially suggests that southern states like Kerala, Maharashtra and Tamil Nadu have already met the sustainable development goals target of 70 per 100,000 MMR.

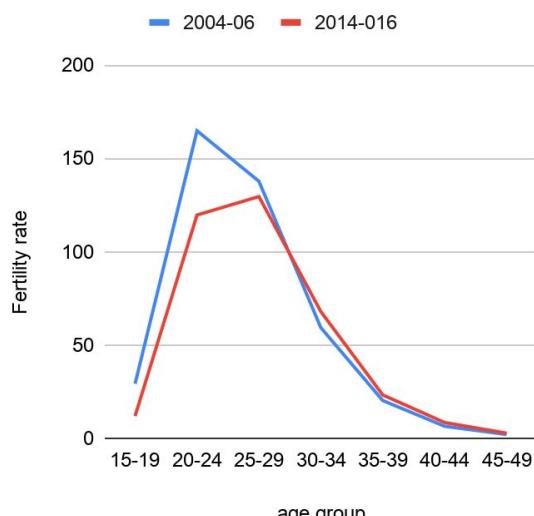


State/Union Territory	2001-03	2004-06	2007-09	2010-12	2013-15	2016-18
Andhra Pradesh	195	154	134	110	74	74
Assam	490	480	390	328	237	229
Bihar	371	312	261	219	165	165
Gujarat	172	160	148	122	91	87
Haryana	162	186	153	146	101	98
Karnataka	228	213	178	144	108	97
Kerala	110	95	81	66	46	42
Madhya Pradesh	379	335	269	230	173	188
Maharashtra	149	130	104	87	61	55
Odisha	358	303	258	235	180	168
Punjab	178	192	172	155	122	122
Rajasthan	445	388	318	255	199	186
Tamil Nadu	134	111	97	90	66	63
Uttar Pradesh	517	440	359	292	201	216
West Bengal	194	141	145	117	101	94
India	301	254	212	178	130	122

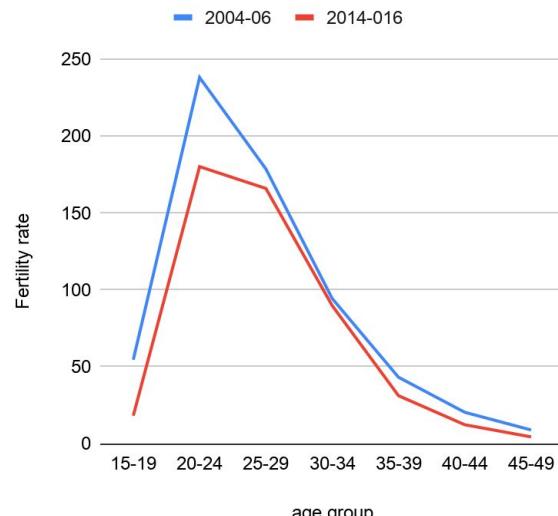
- Figure 2.8 highlights Percent change in Age Specific Fertility Rates by residence between 2004-06 and 2014-16, India. Figure 2.8.1 shows age specific fertility rate in urban areas while Figure 2.8.2 illustrates the same in rural areas.

The data also shows that while the fertility ratio has been falling among higher age groups among mothers aged above 35 –in rural areas. The main reason could be women delay marriage and pregnancy due to education and jobs.

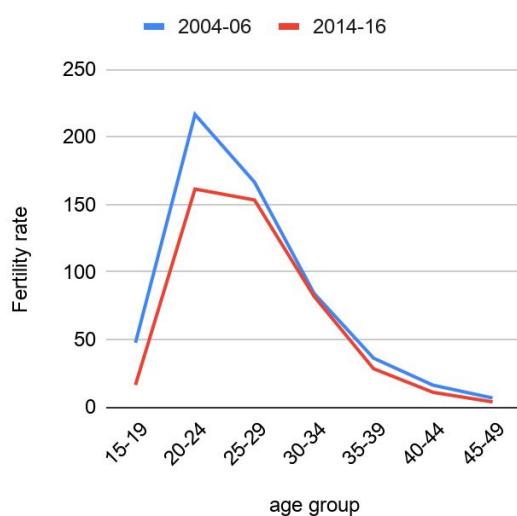
**Figure 2.8.2 Age Specific Fertility Rates in India, Urban**



**Figure 2.8.1 Age Specific Fertility Rates in India, Rural**



**Figure 2.8.3 Age Specific Fertility Rates in India, Total**



**Figure 2.8.4 change in Age Specific Fertility Rates in India**

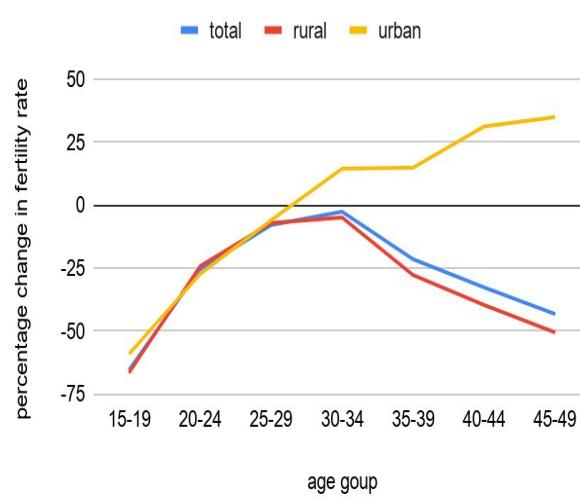
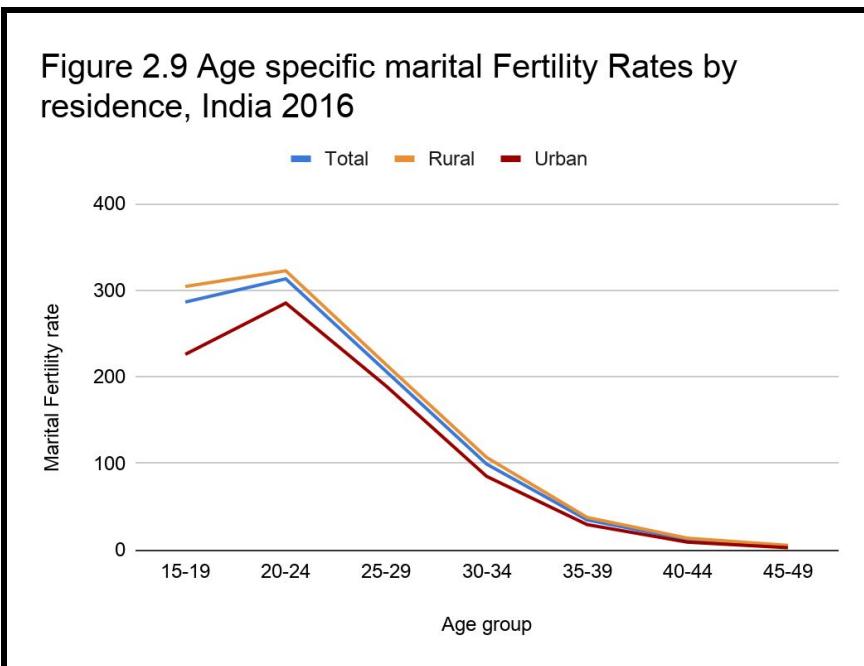


Figure 2.8 highlights Percent change in Age Specific Fertility Rates by residence between 2004-06 and 2014-16, India. Figure 2.8.1 shows age specific fertility rate in urban areas while Figure 2.8.2 illustrates the same in rural areas. The data also shows that while the fertility ratio has been falling among higher age groups among mothers aged above 35 –in rural areas. The main reason could be women delay marriage and pregnancy due to education and jobs.

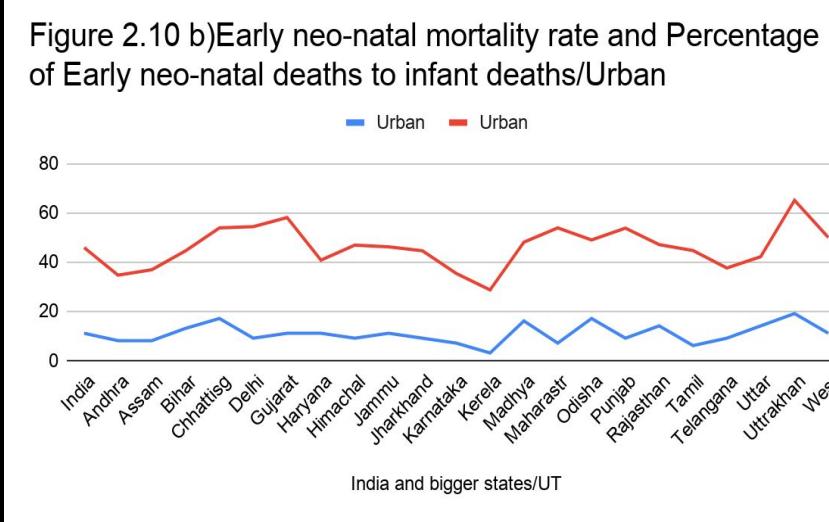
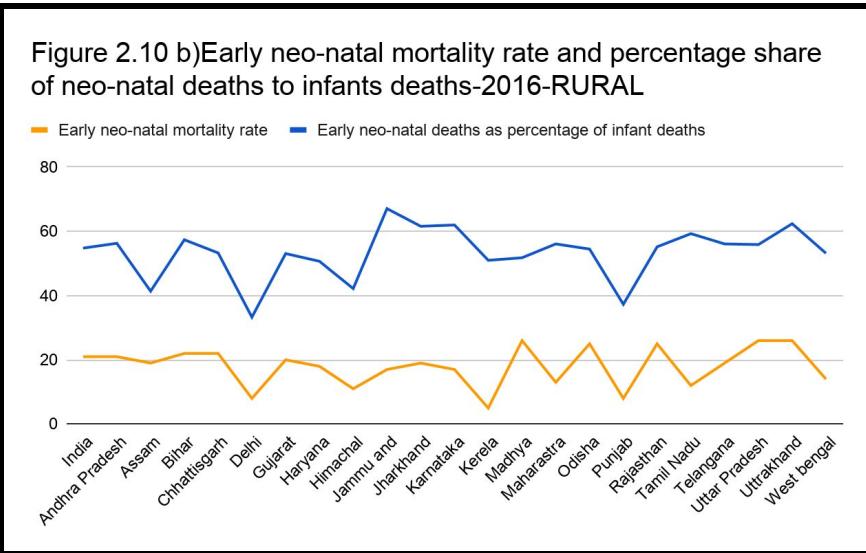
age group	Total			%change	Rural			Urban		
	2004-06	2014-016			2004-06	2014-016	%change	2004-06	2014-016	%change
15-19	47.6	16.4	-65.5	54.6	18.2	-66.7	29.2	11.9	-59.2	
20-24	216.6	161.4	-25.5	238.2	180.2	-24.3	164.9	119.7	-27.4	
25-29	166.5	153.3	-7.9	178.7	166	-7.1	137.8	129.6	-6	
30-34	84.2	82	-2.6	94.4	89.8	-4.9	59.3	67.9	14.5	
35-39	36.2	28.4	-21.5	43.2	31.2	-27.8	20.2	23.2	14.9	
40-44	16.2	10.9	-32.7	20.4	12.3	-39.7	6.4	8.4	31.3	
45-49	6.7	3.8	-43.3	8.9	4.4	-50.6	2	2.7	35	

- Figure 2.9 shows age specific Marital Fertility rates by ages Based on the distribution of live births by age of married females, age specific marital fertility rates (ASMFRs) are calculated. Figure 2.9 provides the estimates of the ASMFRs for India separately for rural and urban areas for the year 2016. Marital fertility is higher in rural areas than in urban areas in all the age groups. A perceptible decline in marital fertility is seen for females aged 30 years and above both in rural and urban areas.



Age group	Total	Rural	Urban
15-19	286.6	304.6	226.2
20-24	313.4	322.7	285.4
25-29	206.4	214.2	189.5
30-34	99.4	107.1	85.2
35-39	34.9	37.8	29.5
40-44	12.2	13.8	9.2
45-49	4.6	5.5	2.8

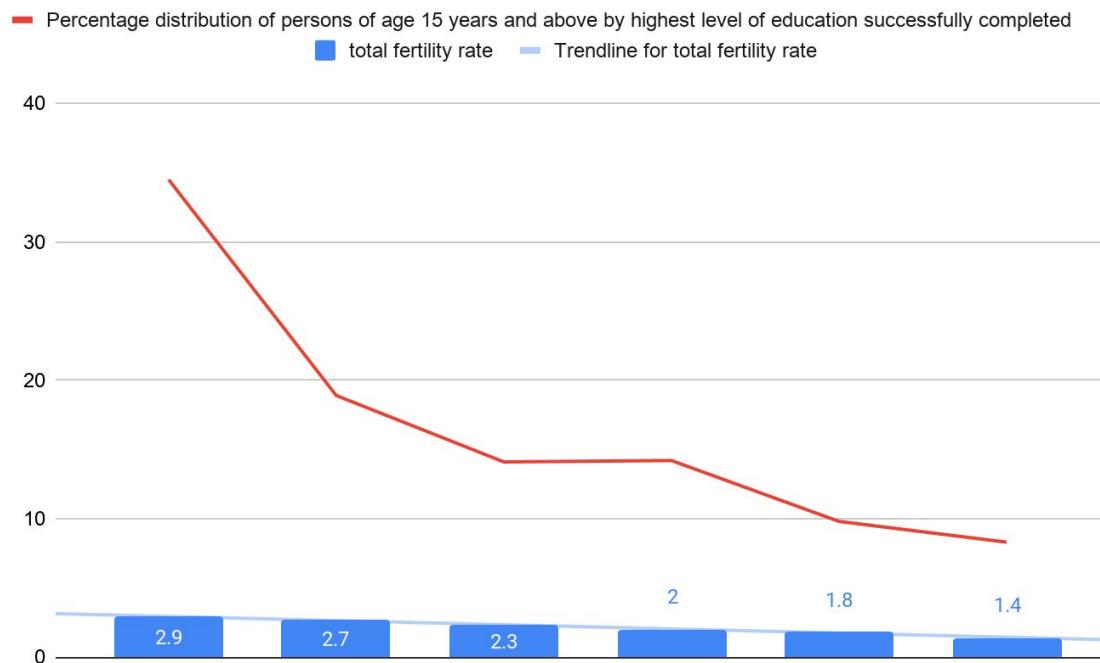
- Early neonatal mortality rate i.e. number of infant deaths less than seven days of life per thousand live births forms an important component of infant mortality rate and more specifically of the neo-natal mortality rate. Figure 2.10 presents the early neo-natal mortality rate along with the percentage of early neo-natal deaths to the total infant deaths. At the National level, the early neo-natal mortality rate for the year 2016 has been estimated at 18 and ranges from 21 in rural areas to 11 in urban areas. Among the bigger States/UTs, Kerala 4 and Madhya Pradesh, Odisha and Uttarakhand with 24 are the extremes. The percentage of early neo-natal deaths to the total infant deaths during the year 2016, at the National level, has been 53.2 and it varies from 54.8 in rural areas to 45.8 in urban areas. In this indicator, in most of the States, the rural proportion is relatively higher than the urban proportion except for Delhi, and Punjab. Among the bigger States/UTs the percentage for total, varies from 40.5 in Kerala to 62.9 in Uttarakhand.



India and bigger states/UT			Early neo-natal mortality rate			Percentage of Early neo-natal deaths to infant deaths		
		Total	Rural	Urban		Total	Rural	Urban
India		18	21	11		53.2	54.8	45.8
Andhra Pradesh		18	21	8		52	56.3	34.6
Assam		18	19	8		41.2	41.4	36.8
Bihar		21	22	13		56.4	57.4	44.5
Chhattisgarh		21	22	17		53.4	53.3	53.8
Delhi		9	8	9		53.5	33.3	54.3
Gujarat		16	20	11		54.5	53.1	58
Haryana		16	18	11		48.1	50.7	40.7
Himachal Pradesh		10	11	9		42.3	42.2	46.8
Jammu and Kashmir		15	17	11		62.5	67.1	46.1
Jharkhand		17	19	9		59.1	61.6	44.5
Karnataka		13	17	7		54.5	62	35.3
Kerela		4	5	3		40.5	51	28.6
Madhya pradesh		24	26	16		51.2	51.8	48
Maharastra		11	13	7		55.4	56.1	53.8
Odisha		24	25	17		54	54.5	48.9
Punjab		9	8	9		42.8	37.3	53.7
Rajasthan		22	25	14		53.8	55.2	47
Tamil Nadu		9	12	6		53	59.3	44.6
Telangana		16	19	9		50.5	56.1	37.5
Uttar Pradesh		23	26	14		53.5	55.9	42.1
Uttrakhand		24	26	19		62.9	62.4	65
West bengal		13	14	11		52.5	53.2	49.9

- Figure 2.12 indicates the total fertility rate and percentage distribution of 15+population by their level of education. The trend line of fertility rate can be seen to decrease significantly with increasing education level among women which shows that Women's education level could affect fertility through its impact on women's health and their ability to control birth by acquiring knowledge of different birth control methods as fertility rate changes by 1.5 for women educated above graduation level. Percentage of women attaining higher education also declines notably due to various social evils like child marriage and child labour.

**Figure 2.11 Total fertility rate and Percentage distribution of persons of age 15 years and above by level of education**



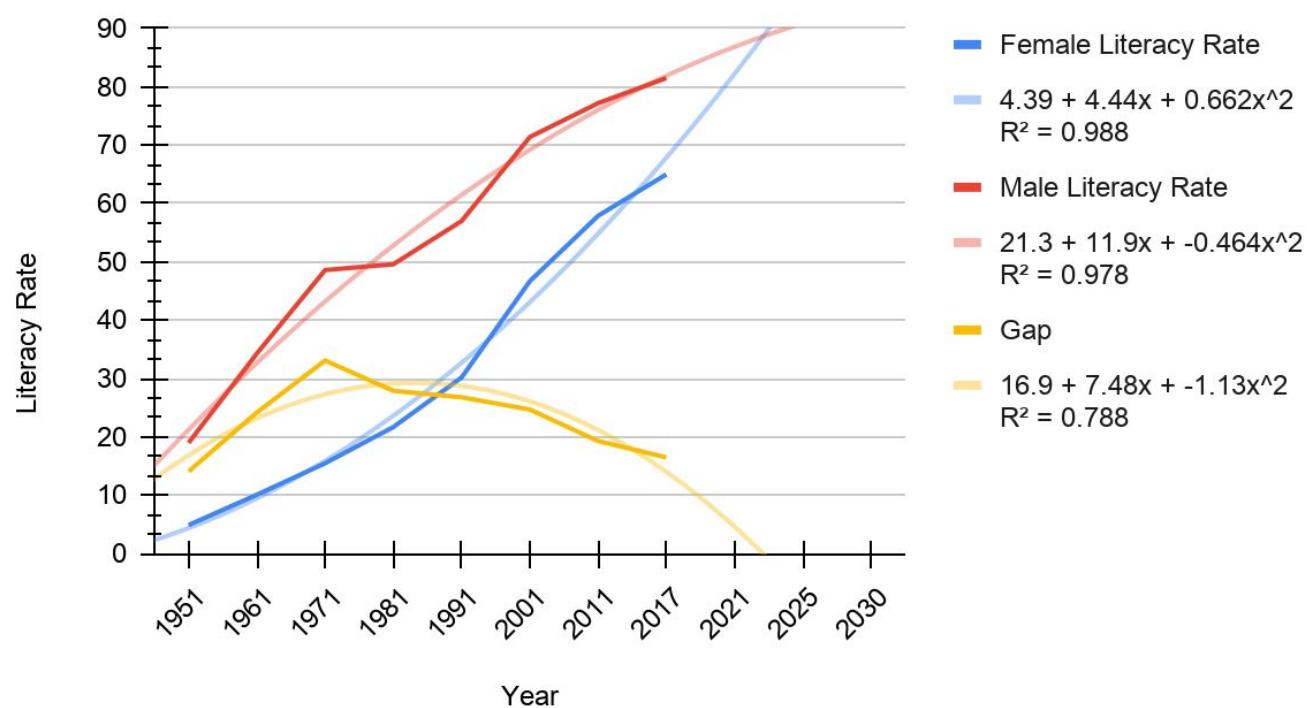
	illiterate	Primary	Middle	Class X	Class XII	Graduate and above
total fertility rate	2.9	2.7	2.3	2	1.8	1.4
Percentage distribution of persons of age 15 years and above by highest level of education successfully completed	34.5	18.9	14.1	14.2	9.8	8.3

# GENDER GAP IN LITERACY

As shown in figure 3.1, about three decades ago, the adult male literacy rate in India was almost twice that for adult females. While this gap has narrowed substantially over the years, the adult male literacy rate still surpasses the adult female literacy rate by 16.5 percentage points. To put these numbers in perspective, the current gender-gap in literacy in India is more than twice the 2017 global average(6%) and is also higher than the 2017 average for lower middle-income countries. This indicates that there are currently 186 million females in India who cannot even read and write a simple sentence in any language.

It is evident from figure 3.1 that India is on track to achieve universal literacy for youth by 2030. The need is to focus on education quality, digital literacy, and skilling.

**Fig 3.1 : Gender Gap in Literacy**

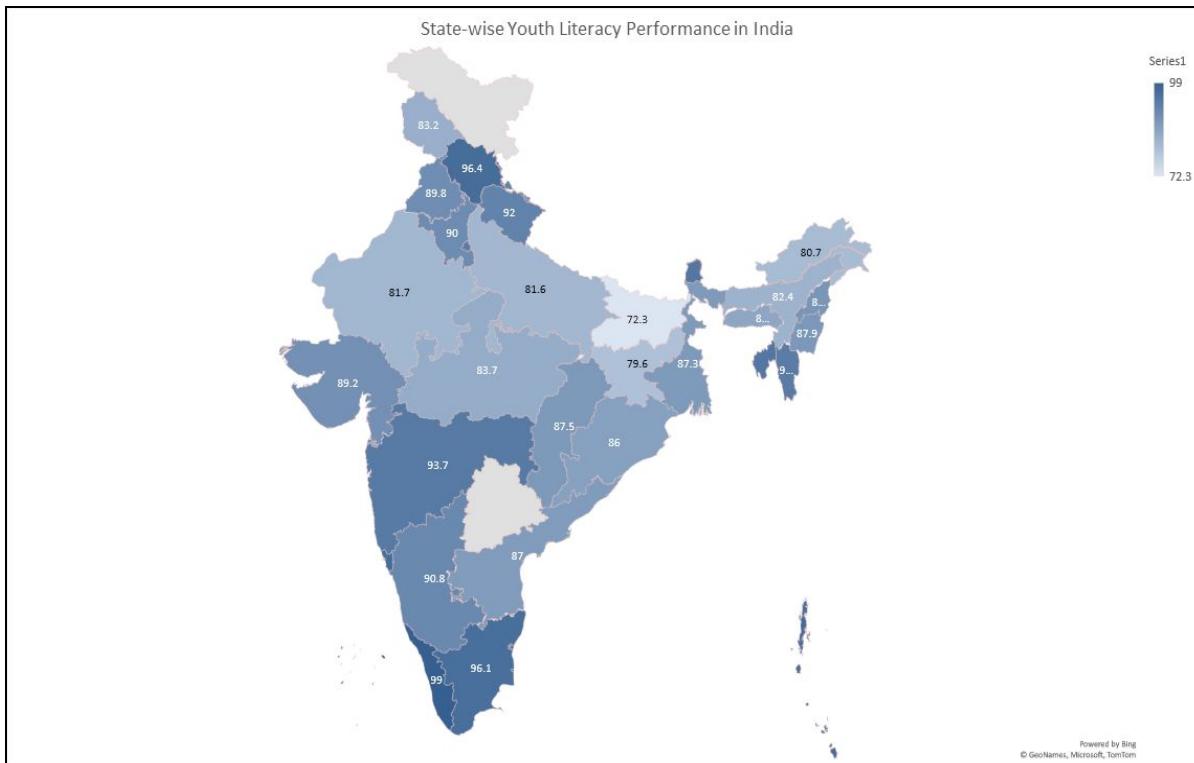


**Table 3.1 : Trend in Literacy Rates in Post Independent India**

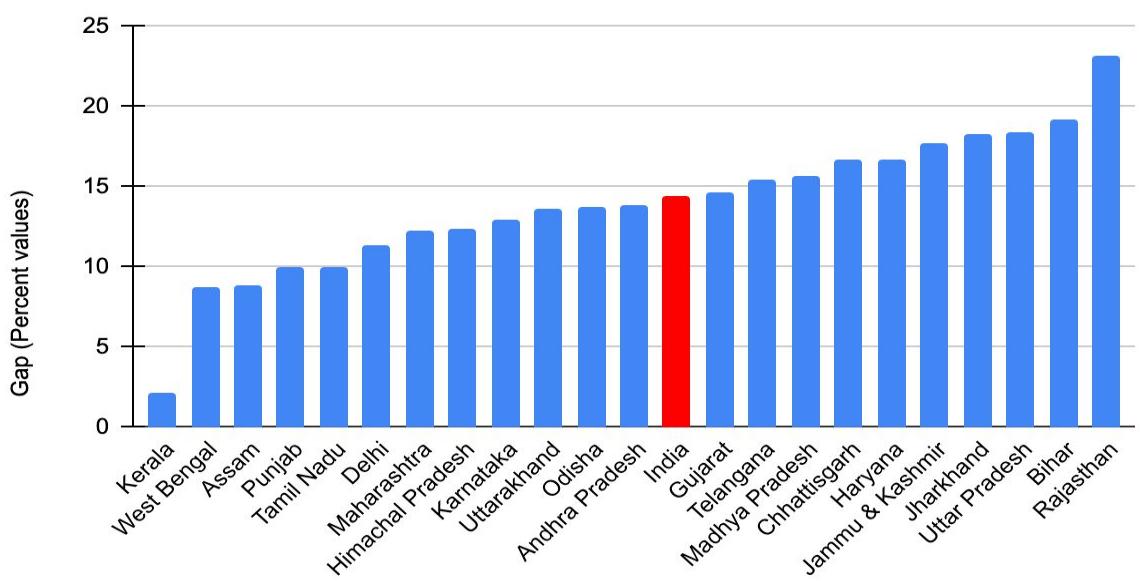
Year	Female Literacy Rate	Male Literacy Rate	Gap
1951	4.9	19	14.1
1961	10.1	34.3	24.2
1971	15.5	48.6	33.1
1981	21.7	49.6	27.9
1991	30.2	57	26.8
2001	46.7	71.4	24.7
2011	57.9	77.2	19.3
2017	65	81.5	16.5

### State-Wise Youth Literacy Performance

- From Figure 3.2, it can be observed that Rajasthan is the worst performer in terms of the literacy gender gap. At 23.2 percentage points, the literacy gender gap in Rajasthan is almost four times the 2016 global average gap. On the other end of the scale, Kerala, West Bengal and Assam have a literacy gender gap of less than nine percentage points, making them the top performers among all of India's states. Such exemplary performance by these states can be attributed to various historical and socio-cultural factors, and not solely the successes of specific policy initiatives.



**Figure 3.2 : Gender Gap in Literacy Rates (2017-18)**



**Table 3.2 : Literacy Rate of Youth in the Age Group of 15-24 Years**

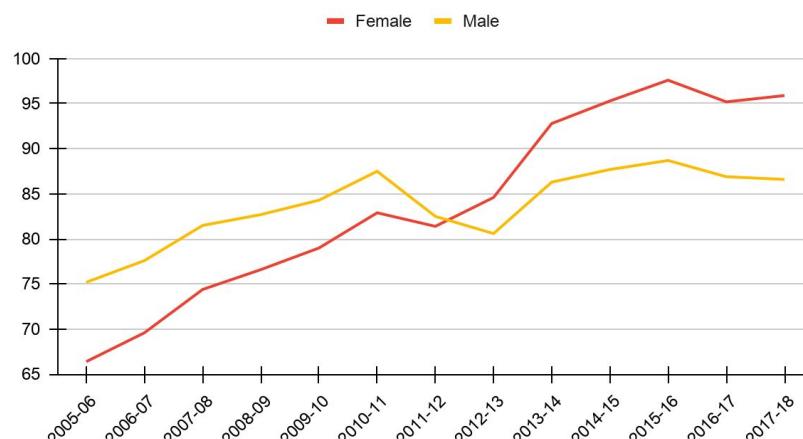
State	Male	Female	Gender gap
Andaman & Nicobar Islands	97.1	96.2	0.9
Andhra Pradesh	90.8	83.2	7.6
Arunachal Pradesh	84.9	76.4	8.5
Assam	85.2	79.6	5.6
Bihar	79.6	63.7	15.9
Chandigarh	93.2	91.1	2.1
Chhattisgarh	92	82.8	9.2
Dadra & Nagar Haveli	93.3	76.4	16.9
Daman & Diu	93.1	91	2.1
Delhi	94.2	91.9	2.3
Goa	96.7	95.6	1.1
Gujarat	92.8	85	7.8
Haryana	92.8	86.5	6.3
Himachal Pradesh	97	95.8	1.2
Jammu & Kashmir	89.6	76.3	13.3
Jharkhand	87.2	71.4	15.8
Karnataka	93.1	88.3	4.8
Kerala	99	99	0
Lakshadweep	98.3	98.3	0
Madhya Pradesh	89.1	77.6	11.5
Maharashtra	95	92.1	2.9
Manipur	90.3	85.5	4.8
Meghalaya	84	85.5	-1.5
Mizoram	95.1	91.7	3.4
Nagaland	89.1	87.3	1.8
Odisha	90.9	81.2	9.7
Puducherry	97.9	97.1	0.8
Punjab	90.4	88.9	1.5
Rajasthan	91	71.3	19.7
Sikkim	95	93.4	1.6
Tamil Nadu	97.2	95	2.2
Tripura	96.2	92.5	3.7
Uttar Pradesh	86.6	75.8	10.8
Uttarakhand	94	90	4
West Bengal	89.2	85.2	4
All India (Total)	90	81.9	8.1

- The **Gross Enrolment ratio** is defined as the total number of students enrolled in a given level of education. A higher GER indicates higher degree of participation. A GER value approaching 100% or more indicates that a country is able to accommodate all of its school age population. From fig 3.3, 3.4 and 3.5 it can be observed that Gross Enrolment Ratio (GER) for Primary has seen a steady decrease due to lower birth rates while for Upper Primary and Higher Secondary, there has been a steady increase over the years. While higher education and upper primary GER in India are on an increasing trend, they still lag when compared with other developing and developed countries. This is an issue which needs to be addressed by introducing suitable policies.

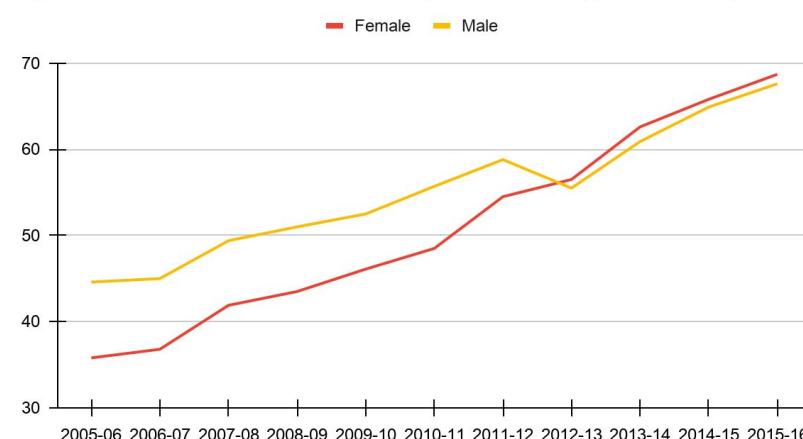
**Fig 3.3 : Gross Enrollment Ratio for Primary(6-10 Years)**



**Fig 3.4 : Gross Enrollment Ratio for Upper Primary(11-13 Years)**



**Fig 3.6 : Gross Enrolment Ratio for Higher Secondary(14-17 Years)**



**Table 3.3 : Gross Enrolment Ratio in Different Stages of Education**

Year	Primary ( I-V) 6-10 Years			Upper primary (VI-VIII) 11-13 Years			Higher Secondary Classes IX-XII (14-17 Years)		
	Female	Male	Total		Female	Male		Female	Male
2005-06	105.8	112.8	109.4	66.4	75.2	71	35.8	44.6	40.4
2006-07	108	114.6	111.4	69.6	77.6	73.8	36.8	45	41.1
2007-08	112.6	115.3	114	74.4	81.5	78.1	41.9	49.4	45.8
2008-09	114	114.7	114.3	76.6	82.7	79.8	43.5	51	47.4
2009-10	113.8	113.8	113.8	79	84.3	81.7	46.1	52.5	49.4
2010-11	116.3	114.9	115.5	82.9	87.5	85.2	48.5	55.7	52.2
2011-12	107.1	105.8	106.5	81.4	82.5	82	54.5	58.8	56.8
2012-13	107.2	104.8	106	84.6	80.6	82.5	56.5	55.5	56.8
2013-14	102.6	100.2	101.4	92.8	86.3	89.3	62.6	60.9	62.5
2014-15	101.4	98.9	100.1	95.3	87.7	91.2	65.8	64.9	65.3
2015-16	100.7	97.9	99.2	97.6	88.7	92.8	68.7	67.6	68.1
2016-17	96.4	94	95.1	95.2	86.9	90.7	NA	NA	NA
2017-18	95.4	93.1	94.2	95.9	86.6	90.9	NA	NA	NA

- **Gender Parity Index** in primary, secondary and tertiary education is the ratio of the number of female students enrolled at primary, secondary and tertiary levels of education to the number of male students in each level. GPI at various levels **reflect equitable participation of girls** in the School system. A **GPI of 1 indicates parity** between the sexes; a GPI that varies between 0 and 1 typically means a disparity in favour of males; whereas a GPI greater than 1 indicates a disparity in favour of females.
- From figure 3.6, 3.7, 3.8, 3.9, 3.10 it is evident that the **number of girls is more than the number of boys** at all levels of school education as the GPI is greater than 1. For higher education, it is evident from figure 3.10 that although there has been a steady increase in GPI, but it still less than 1 indicating the need of implementing suitable policies to increase female enrollment in higher education courses because in most of the cases parents are not very much interested in investing money in higher education of their daughters because girls will have to marry ultimately.

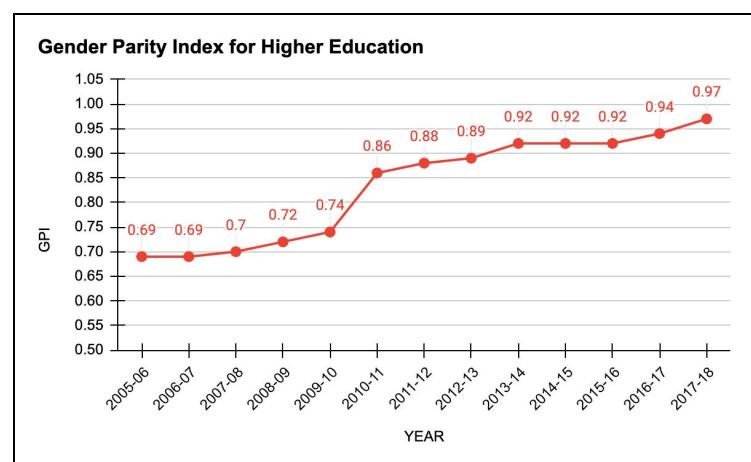
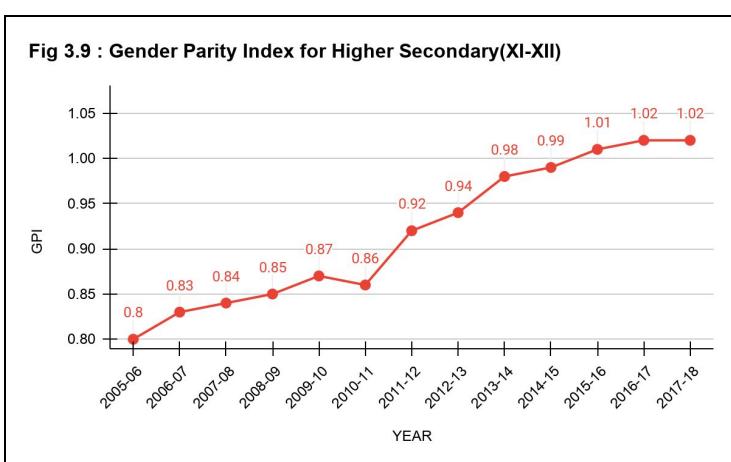
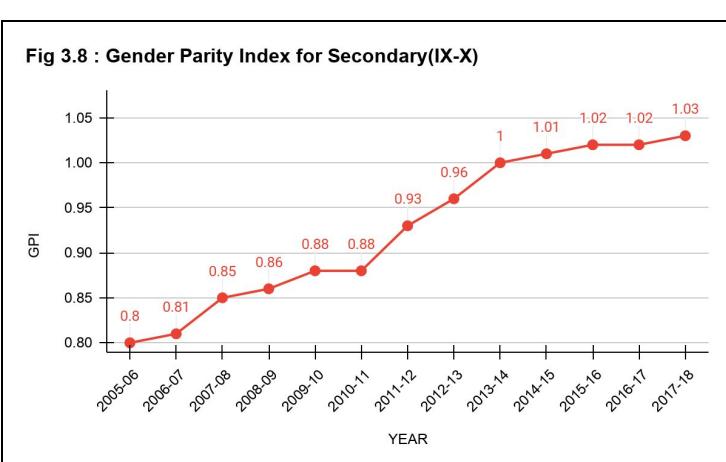
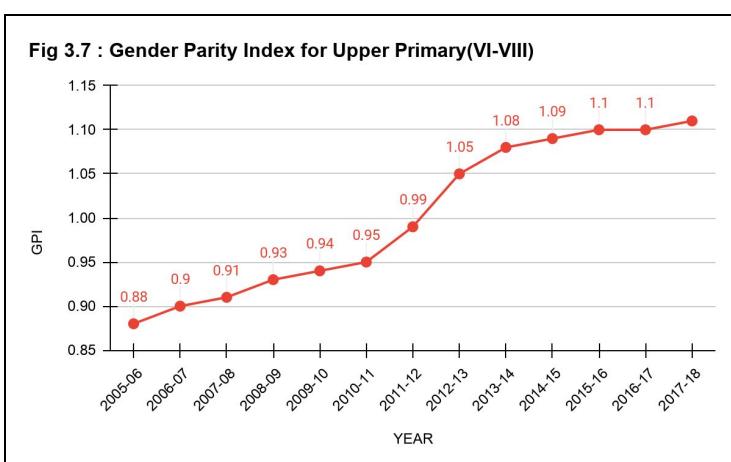
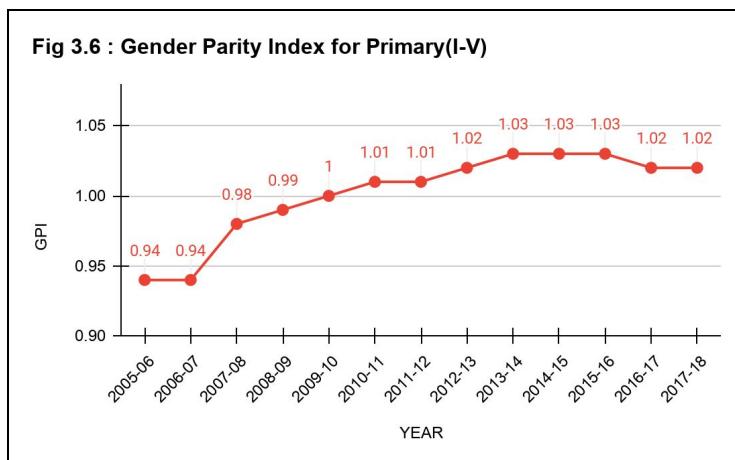
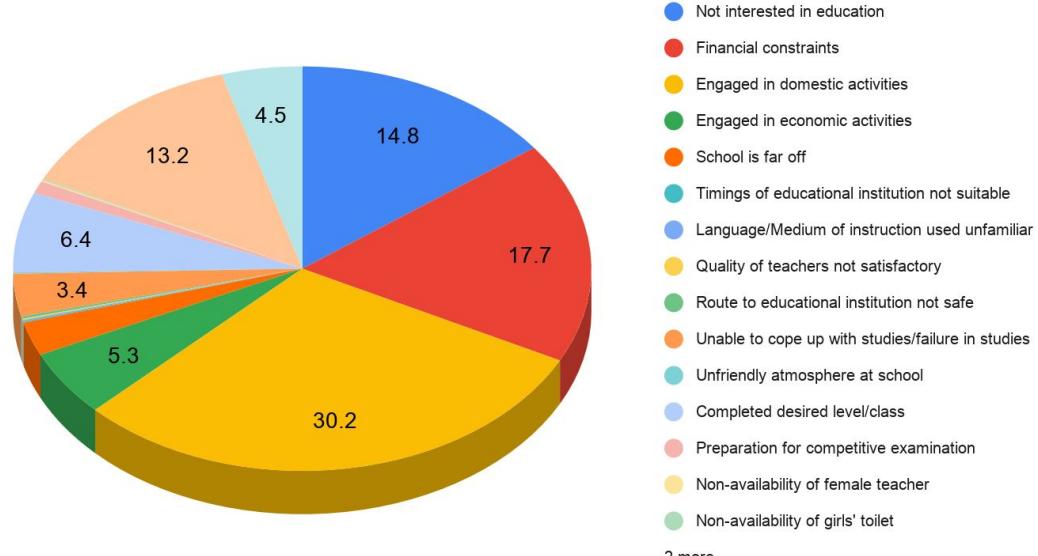


Table 3.4 : Gender Parity Index at various stages of education

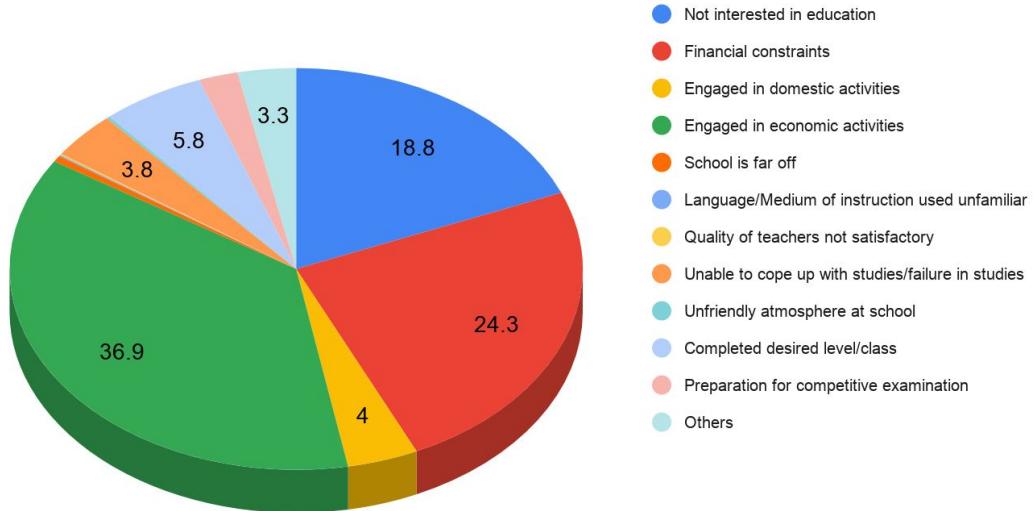
Year	Primary	Upper Primary	Secondary	Higher Secondary	Higher Education
2005-06	0.94	0.88	0.8	0.8	0.69
2006-07	0.94	0.9	0.81	0.83	0.69
2007-08	0.98	0.91	0.85	0.84	0.7
2008-09	0.99	0.93	0.86	0.85	0.72
2009-10	1	0.94	0.88	0.87	0.74
2010-11	1.01	0.95	0.88	0.86	0.86
2011-12	1.01	0.99	0.93	0.92	0.88
2012-13	1.02	1.05	0.96	0.94	0.89
2013-14	1.03	1.08	1	0.98	0.92
2014-15	1.03	1.09	1.01	0.99	0.92
2015-16	1.03	1.1	1.02	1.01	0.92
2016-17	1.02	1.1	1.02	1.02	0.94

- Fig 3.11 and 3.12 depicts the major reasons for dropouts from Education by males and females in the age group 3-35. It can be seen from the figure 3.11 that the major reason for dropout by males is engagement in economic activities indicating that males start working at an early age without completing their education in order to sustain the lives of other family members which are usually large in number. This is indirectly due to financial constraints. For females, the major reason is engagement in domestic activities which is considered as primary responsibility of girls in typical Indian families. For both males and females, Financial constraints remains the most prominent reason for dropouts.

**Fig 3.11 : Main Reasons for Dropout from Education by Females in the Age Group 3-35**



**Fig 3.12 : Main Reasons for Dropout from Education by Males in the Age Group 3-35**



# GENDER GAP BY PAY

We conducted a survey to analyse the difference in pay of female and male house servants. We got 39 responses in total pertaining to two populations (25, 14). Therefore, we decided to carry out **Two Sample T Test for Difference of Means.**

## Glimpses of G-Form Circulated and Responses obtained:-

The screenshot shows a Google Form titled "Pay Gap". It contains one question: "What is the gender of your househelp?". The options are "Female", "Male", and "Prefer not to say". The "Responses" tab shows 39 entries. The sidebar on the right includes icons for adding questions, attachments, and other form settings.

The screenshot shows the Google Form interface after collecting 39 responses. The top bar indicates "39 responses". A message states "Not accepting responses". Below it, a summary table shows the count of responses for each gender: Female (25), Male (14), and Prefer not to say (0). The "Individual" tab is selected. The bottom section displays the first few responses, starting with the question "What is the gender of your househelp?".

New Tab | Mean age | All your de | Blue and | Artificial | average m | SEXRATIC | (69) Wha | Google | Pay Gap | Response | +

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**Pay Gap**

Questions Responses 39

**39 responses**

Not accepting responses

**Message for respondents**

This form is no longer accepting responses

**Summary Question Individual**

**What is the gender of your household?**

39 responses

Gender	Percentage
Female	64.1%
Male	35.9%
Prefer not to say	0%

Female  
Male  
Prefer not to say

New Tab | Mean age | All your de | Blue and | Artificial | average m | SEXRATIC | (69) Wha | Google | Pay Gap | Response | +

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**Pay Gap**

Questions Responses 39

**What is the gender of your household?**

39 responses

Gender	Percentage
Female	64.1%
Male	35.9%
Prefer not to say	0%

Female  
Male  
Prefer not to say

**How much do you pay monthly?**

39 responses

Income Range	Count	Percentage
10,000	1	2.6%
10k	1	2.6%
15,000	1	2.6%
2000	4	10.3%
2200	1	2.6%
3000	3	7.7%
5000	6	15.4%
5000	7	17.9%
6000	1	2.6%
7000	2	5.1%
8,000	1	2.6%

Link to Response Sheet

<https://docs.google.com/spreadsheets/d/1NpVe4W630G34aEciELUgiumTApckOP8n2C1Z6FqD4U/edit?usp=sharing>

- **Two Sample T Test for Difference of Means.**

**Assumptions:-**

1. Samples are independent.
2. Population from where sample is drawn is normally distributed.
3. Sample variances are not equal.

**Sample Statistics( 1=Female and 2= Male)**

1. The provided sample means are shown below:-

$$\bar{X}_1 = 4424$$

$$\bar{X}_2 = 4850$$

2. Also, the sample standard deviations are:-

$$s_1 = 3340.81826$$

$$s_2 = 3225.08199$$

3. The sample sizes are  $n_1 = 25$  and  $n_2 = 14$ .

**(1) Null and Alternative Hypotheses**

The following null and alternative hypotheses need to be tested:

$$H_0: \mu_1 \leq \mu_2$$

$$H_a: \mu_1 > \mu_2$$

This corresponds to a right-tailed test, for which a t-test for two population means, with two independent samples, with unknown population standard deviations will be used.

**(2) Rejection Region**

Based on the information provided, the significance level is  $\alpha = 0.05$  and the degrees of freedom are  $df = 27.867$ . In fact, the degrees of freedom are computed as follows, assuming that the population variances are unequal. Hence, it is found that the critical value for this right-tailed test is 1.701. The rejection region for this right-tailed test is :-

$$R = \{t : t > 1.701\}.$$

### (3) Test Statistics

Since it is assumed that the population variances are unequal, the t-statistic is computed follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

$$= \frac{4424 - 4850}{\sqrt{\frac{3340.81826^2}{25} + \frac{3225.08199^2}{14}}} = -0.391$$

### (4) Decision about the null hypothesis

Since it is observed that  $t = -0.391 \leq t_c = 1.701$ , it is then concluded that the null hypothesis is not rejected. Using the P-value approach: The p-value is  $p = 0.6505$  and since  $p=0.6505 \geq 0.05$ , it is concluded that the null hypothesis is not rejected.

### (5) Conclusion

It is concluded that the null hypothesis  $H_0$  is *not rejected*. Therefore, there is not enough evidence to claim that the population mean that the population mean  $\mu_1 > \mu_2$  at the 0.05 significance level.

T-TEST GROUPS=Gender('Female' 'Male')  
 /MISSING=ANALYSIS  
 /VARIABLES=salary\_monthly  
 /CRITERIA=CI(.95).

**T-Test**

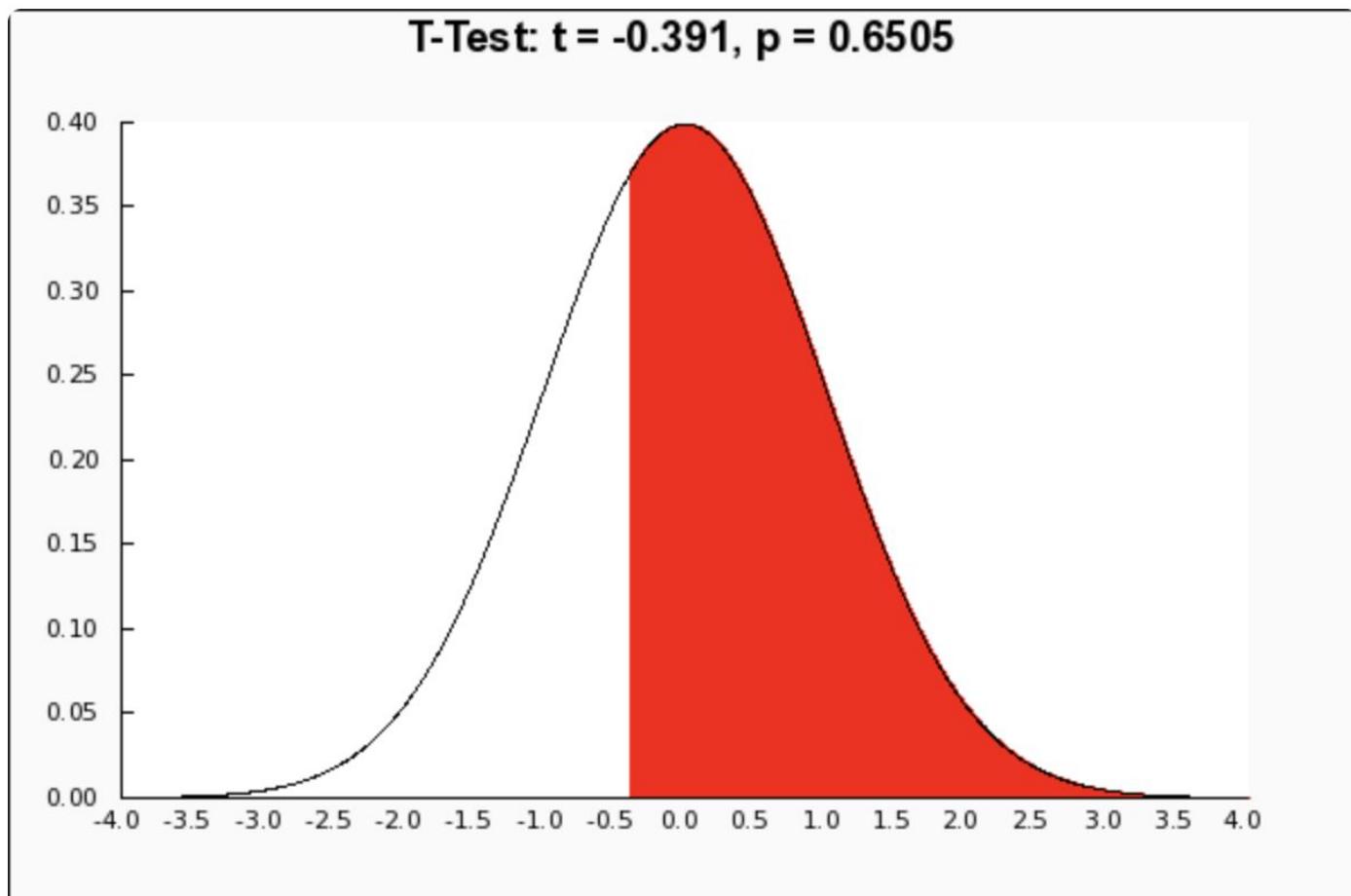
Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
salary_monthly	Female	25	4424.0000	3340.81826	668.16365
	Male	14	4850.0000	3225.08199	861.93942

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
salary_monthly	Equal variances assumed	.146	.704	-.387	37	.701	-426.00000	1101.77615	-2658.41053	1806.41053
	Equal variances not assumed			-.391	27.867	.699	-426.00000	1090.58802	-2660.44752	1808.44752

## (5) Confidence Interval

The 95% confidence interval is  $-2660.448 < \mu_1 - \mu_2 < 1808.448$ .

## (5) Graphically



## **Key references**

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