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**Health and Population:  
Perspectives and Issues**



आरोग्यम् सुखसम्पदा

राष्ट्रीय स्वास्थ्य एवं परिवार कल्याण संस्थान  
**The National Institute of Health and Family Welfare**

बाबा गंगनाथ मार्ग, मुनिरका, नई दिल्ली—110067

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# स्वास्थ्य एवं जनसंख्या परिप्रेक्ष्य एवं मुद्दे

## Health and Population: Perspectives and Issues



आरोग्यम् सुखसम्पदा

राष्ट्रीय स्वास्थ्य एवं परिवार कल्याण संस्थान

The National Institute of Health and Family Welfare

बाबा गंगनाथ मार्ग, मुनीरका, नई दिल्ली-110067

Baba Gangnath Marg, Munirka, New Delhi – 110067

**HEALTH AND POPULATION: PERSPECTIVES AND ISSUES**  
**VOLUME: 45, NUMBER 1, January-March 2022**

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## **Socio-Demographic Differences and Anthropometric Variations in Anaemia Prevalence amongst Out of School Adolescent Girls: Evidence from NFHS-4**

**\*Suresh Sharma and \*\*Purva Bhalla**

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### **Abstract**

*Adolescence is a developmental period of life during which patterns of development, advancement, and behaviour establish a framework for the wellbeing in the later part of life; and for the next generation. However, there is a little empirical evidence on the burden of anaemia amongst the out of school adolescent girls in India. The aim is to understand the socio-demographic-anthropometric differences amongst the out of school anaemic girls in India. Data analysis is done by Binary Logistic Regression and descriptive statistics. The objective is substantiated by regression model with background characteristics and also with BMI, and explanatory variable being prevalence of anaemia. It is found that there was an association between anaemia and socio-demographic characteristics amongst out of school adolescent girls. Our findings have revealed multiple common drivers of anaemia reduction among adolescent girls.*

**Key words:** Adolescent girls, Out of school anaemic adolescent girls, Socio-demographic factors, Body Mass Index

### **Introduction**

According to WHO, "Adolescents are the future generation of our nation. Adolescence, a second period of rapid growth may serve as an opportunity for compensating vacillated early childhood growth; however, the potential for significant gain is limited"<sup>1</sup>. Adolescent girls are an important part of the society as they are not only important citizens of this generation but also future mothers. Many factors such as socio-economic status, demographic factors, and environmental issues, attitude towards female child, ignorance towards nutritional requirement, hygiene and sickness are responsible for the present problematic nutritional status of adolescent girls<sup>2</sup>.

Poor nutrition before birth is conveyed into adult life and can extent to generations. Investing in nutrition during the course of the life-cycle will have both short-term as well as long-term social and economic benefits. It is important to know the basic nutritional status of adolescents in a country for planning proper interventions. Acknowledging the dietary status of adolescents will help to plan policies for fighting macro and micro deficiencies of future citizens. The growth pattern and menstrual characteristics are different between rural and urban adolescent girls and this is because of different lifestyles and nutritional choices between them<sup>3</sup>.

The prevalence of anaemia is excessively high in developing countries due to poverty, inadequate diet, certain diseases, pregnancy/lactation, and poor access to health services<sup>4</sup>. Nutritional anaemia is prevalent everywhere throughout the world, with an expected number of one billion individuals being anaemic. Adolescence is a time of fast development; and with inadequate and improper food habits, one is vulnerable to all kind of nutritional deficiencies. Adolescence, a period of transition from childhood to adulthood, involves a crucial situation in the life of people. This period is described by an uncommon quick pace of development. Adolescents are the best human resources but their health has been neglected for years because they were considered to be less effected by the anaemia than the other age groups of

children and old people. The global attention has been directed to the health of adolescents only in the last decade<sup>5</sup>.

Adolescence is a developmental period of life during which patterns of development, advancement and behaviour establish a framework for wellbeing in later part of life; and for the next generation<sup>6</sup>. Adolescent girls have a higher prevalence of anaemia than boys in almost all the states of India. Deficiency of iron and folic acid or prevalence of anaemia amongst adolescent girls is a significant reason for growth retardation, reduced physical and mental development, late menarche and poor future reproductive results<sup>7</sup>.

Anaemia during adolescence influences the development and growth of girls expanding their vulnerability to drop out-of-school. Thus, investing in adolescent girls who are suffering from anemia is important for their future growth and development. Anemia occurs because of the nutritional deficiency of iron, folate, nutrient B12, and some different supplements. Insufficiency of iron is the well-known form of malnutrition in India. Deficiency of Iron influences an approximately 50 per cent of the population of India<sup>8</sup>.

Adolescent girls are especially inclined to iron deficiency anemia because of the increased demands of iron by the body. Anemia not only influences the present status of health of the out of school adolescent girls, but also shows its harmful impact when these girls become mothers. Adequate hemoglobin status at the time of conception results in safe pregnancy and healthy child birth. This could be accomplished just only when the status of hemoglobin is improved in adolescent girls<sup>9</sup>.

Anemia, the deficiency of iron is yet to be a state of major global health concern for scientists and decision makers. Adolescence period is a basic time of life on the grounds that mental development spray requires adequate nourishment to achieve solid adulthood. The insufficiency of iron shows the condition of malnutrition in the adolescent girls. Its consequences are insufficient nourishment, blood loss, provocative and irresistible infections. Folic acid inadequacy happens as a result of less consumption and absorption of iron is the maximum widely recognized type of iron deficiency<sup>10</sup>.

Adolescent girls are vulnerable as they tend to stand between adulthood and childhood. More than often, however, their problems are largely disregarded. It has been noticed that a large number of adolescent girls are married off and become mothers even before they have a chance to understand their full potential. Even if the adolescent girls are not married, they are removed from the schools at the onset of puberty, it often drives them into taking up household tasks<sup>11</sup>.

According to MoHFW, “the education system or the school through its safety net mechanisms protects and nurtures the children and adolescents from various risks and vulnerabilities. Since the revision of RMNCH+A operations several programmes for the adolescents like:

- Rajiv Gandhi Scheme for Empowerment of Adolescent Girls (RSEAG) or SABLA,
- Scheme for Promotion of Menstrual Hygiene among Adolescent Girls (10-19 years) in rural India,
- Weekly Iron and Folic Acid Supplementation (WIFS),
- Iron Folic Anaemic (IFA),
- Rashtriya Kishor Swasthya Karyakram (RKSK),
- Rashtriya Bal Swasthya Karyakram (RBSK),
- Kishori Shakti Yojana (KSY),
- Adolescent Education Programme,
- National Nutritional Anaemia Control Programme (NNACP),

Several other programmes and services under National Health Mission (NHM, Rashtriya Madhyamik Shiksha Abhiyan (RMSA) within the school system contributes to comprehensive growth, development and participation of the adolescents. When the girls are out-of-school, they are deprived of these protective and rehabilitative services, benefits and thereby stays potentially vulnerable<sup>12</sup>.

Anemia prevalence is usually higher in rural regions than in urban regions. This burden the need to examine the factors associated with the prevalence of anemia. Prevention of anemia is viable when the strategy is focused right from adolescence for their future reproductive life<sup>13</sup>.

The current study was, therefore, planned to determine anthropometric, socio-demographic, and nutritional status of rural and urban OOS adolescent girls of India and also to study the factors affecting them. A literature review revealed that there is paucity of research in India which specifically focuses on OOS adolescent girl's nutrition.

Deficiency of Iron among adolescent and out of School adolescent girls is a well acknowledged issue in all the States of India. In India, anemia is a major issue for which proper healthcare planning must be implemented. If an adolescent girl who is anemic becomes pregnant, the risks are even greater since they have not yet achieved full growth. Anaemia in this age group is consequently a major concern because it has a direct and immediate effect on mental, behavioral functioning, social achievement and physical work capacity. This condition also has an indirect effect on the future growth of economy and the individual development.

The present study highlights the crucial factors of Out of School Anemic Adolescent girls in India. Measuring the socio-demographic profile and anthropometric differences at the State and Union Territory level, we will try to ascertain the prevalence of Anemia among Out of School Adolescent girls. The study tries to understand the anthropometric, socio-demographic, and nutritional status of rural and urban OOS adolescent girls of India and also to study the factors affecting them. A literature review revealed that there is paucity of research in India which specifically focuses on OOS adolescent girl's nutrition. At this juncture the role of Government is very important as they are operating several programmes for the adolescents.

## **Methodology**

The present research aims to assess and analyse the socio-demographic profile and socio-demographic-anthropometric differences among out of school anemic girls in India. The study incorporated crosstabs and applied layer of any Anemia variable with all the socio-demographic characteristics to see the variation in anemia prevalence with respect to socio-demographic variables.

The present study is based on the data collected from 4<sup>th</sup> round of National Family Health Survey (2015-2016) also known as Demographic and Health Survey (DHS) worldwide. In the study the NFHS data is used for comparing the prevalence of anemia among out of school anemic adolescent girls and to find out the association between the various other socio-demographic and anthropometric factors listed in the objectives. According to this survey among Out of School (OOS) adolescent girls in India, a total of 16806 cases of OOS adolescent girls were reported of which 16302 were tested for anemia and 9598 OOS adolescent girls were found to be anemic. Anaemia in India is a severe public health problem among adolescent girls.



All the 29 states of India and the seven union territories have come under this study. This study is planned to focus on anemia among out of school anemic adolescent girls. Data collection is just the starting point in the research. The way to manage data is the crucial factor in determining the success of report, as this information forms the basis of quantitative research. Logistic regression techniques are used to analyze the links between socio-demographic characteristics and also association with BMI of the adolescent girls of age group 15<sup>th</sup> – 19<sup>th</sup> years. The methodological approach adopted in the research for this particular topic is quantitative methods. The quantitative methods are used to investigate the quantitative properties and phenomena and their relationships. Data analysis has been done using SPSS V. 21.0.

$H_0$ : There is no association between socio-demographic status and anemia prevalence among OOS anemic girls. It was found that there is an association between anemia and socio-demographic characteristics among OOS adolescent girls, so null hypothesis was rejected.

## Findings

Table 1 depicts the socio-demographic profile of OOS Adolescent Girls and Adolescent Girls in the age group of 15-19 years. The table illustrates that adolescent girls across region, 79 per cent was Hindu and 16.4 per cent was Muslim. Among the girls, 70 per cent of the total out of school adolescent girls belonged to Hindu religion and 27.5 per cent was belonging to Muslim religion. It was observed that among the adolescent girls, 44 per cent was OBC, 21 per cent was Scheduled Castes and 10 per cent belonged to Schedule Tribes. Similarly, among the total adolescent girls, 44 per cent of the total OOS adolescent girls was OBC, 24 percent were Schedule Caste and 16 percent were Schedule Tribe. It was noticed that adolescent girls across residence, 70 per cent was from rural areas and 30 per cent was from urban areas. However, 81 per cent of the total OOS adolescent girls was from rural areas and 19 per cent was from urban areas. It was noticed that adolescent girls across wealth index, 23 per cent belonged to poorer families, 21.4 per cent belonged to middle families, 21 per cent belonged to the poorest families, 19 per cent belonged to rich families and 16 per cent belonged to the richest families. Furthermore, 49 per cent of the total OOS adolescent girls was from the poorest families, 27 per cent of the total OOS adolescent girls were from poor families and 14 per cent of the total OOS adolescent girls were from the middle class families. It was observed that adolescent girls across body mass index, 53 per cent was of normal BMI and 40.2 per cent was thin. However, 55 per cent of the total OOS adolescent girls were having normal BMI and 40.1 per cent was thin.

**TABLE 1**  
**Socio-Demographic and Anthropometric Profile of Adolescent Girls and OOS Adolescent Girls Aged 15-19 Years by Background Characteristics, India, 2015-2016**

Background Characteristics	Adolescent Girls 15-19 years	N	Out of School Adolescent Girls	N
<b>Age</b>				
15	20.2	24581	17.7	2975
16	20.1	24468	18.3	3076
17	19.2	23305	16.4	2759
18	22.2	27011	26.7	4483
19	18.3	22188	20.9	3513
<b>Religion</b>				
Hindu	78.9	95862	69.7	11706

Muslim	16.4	19918	27.5	4630
Christian	2.0	2391	1.1	185
Sikh	1.3	1575	0.6	104
Others	1.5	1806	1.1	181
<b>Caste/Tribe</b>				
Schedule Caste	21.3	25911	23.9	4008
Schedule Tribe	9.6	11609	15.5	2608
OBC	44.4	54029	44.3	7441
None of them	20.5	24890	12.8	2149
Don't Know	0.6	766	1.2	195
<b>Residence</b>				
Urban	30.4	36932	19.2	3219
Rural	69.6	84620	80.8	13587
<b>Marital Status</b>				
Never Married	83.6	101605	66.2	11124
Currently Married	15.2	18493	30.9	5192
Married, gauna not performed	1.0	1236	2.3	386
Others	0.2	219	0.6	103
<b>Pregnancy Status</b>				
No	96.3	117602	93.1	15652
Yes	3.2	3950	6.9	1154
<b>Region</b>				
North	13.3	16117	13.8	2324
Central	28.7	34891	38.4	6455
East	24.0	29142	31.9	5357
North-East	3.3	4049	3.3	549
West	13.1	15876	7.2	1203
South	17.7	21477	5.5	918
<b>Wealth Index</b>				
Poorest	20.8	25257	48.8	8202
Poorer	22.5	27378	26.8	4503
Middle	21.4	25999	14.2	2394
Rich	19.2	23379	7.5	1260
Richest	16.1	19540	2.7	447
<b>BMI</b>				
Thin	40.2	48805	40.1	6740
Normal Weight	52.9	64240	55.0	9244
Overweight	3.6	4320	2.1	351
Obese	1.0	1180	0.5	85
<b>BMI</b>				
Thin	40.2	48805	40.1	6740
Normal Weight	52.9	64240	55.0	9244
Overweight	3.6	4320	2.1	351
Obese	1.0	1180	0.5	85

Source: NFHS-4, 2015-2016: author's calculation

Table 2 depicts the percentage distribution of OOS adolescent anaemic girls by background characteristics. It was observed that among the OOS anaemic adolescent girls of age 15 years, 12.4 percent were moderately anaemic, 47 per cent were mildly anaemic and 39 per cent were not anaemic. It was found that

among OOS anemic adolescent girls, who belonged to Hindu religion, 1.4 per cent was severely anemic, 16 per cent moderately anaemic, 44 per cent mildly anaemic and 40 per cent was not anemic. It was noticed that among the OOS anemic adolescent girls who were pregnant, 1.7 per cent was severely anaemic, 25.3 per cent was moderately anaemic, 28.4 per cent mildly anaemic and 47 per cent was not anaemic. It was observed that among the OOS anemic adolescent girls who were obese, 12 per cent was having moderate anaemia, 54 per cent was having mild anaemia and 48.3 per cent was not anaemic.

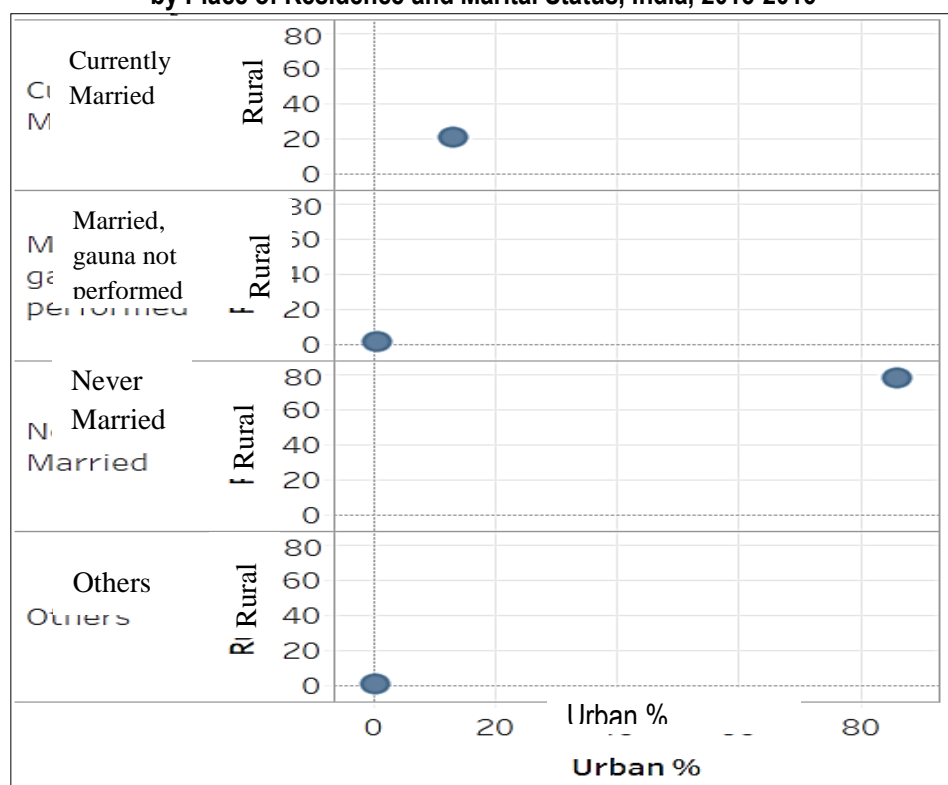
**Table 2**  
**Prevalence of Anaemia among OOS Adolescent girls by Background Characteristics India, 2015-2016**

<b>Background Characteristics</b>	<b>Severe</b>	<b>Moderate</b>	<b>Mild</b>	<b>Not Anaemic</b>	<b>Any Anaemia</b>	<b>N</b>
<b>Age</b>						
15	1.3	12.4	47.1	39.2	60.8	1741
16	1.1	13.5	42.6	42.9	57.2	1707
17	1.4	14.2	43.4	41.0	59.0	1577
18	1.1	15.0	43.2	40.7	59.3	2592
19	1.2	16.5	40.4	41.9	58.1	1982
<b>Religion</b>						
Hindu	1.4	15.5	43.5	39.6	60.4	6880
Muslim	0.8	11.8	42.0	45.4	54.6	2434
Christian	0.6	18.8	39.2	41.5	58.6	104
Sikh	1.0	13.6	45.6	39.8	60.2	62
Others	0.0	8.3	57.8	33.9	66.1	119
<b>Caste/Tribe</b>						
Schedule Caste	1.4	14.7	43.5	40.4	59.6	2322
Schedule Tribe	1.3	17.9	46.0	34.8	65.2	1648
OBC	1.3	14.0	42.3	42.4	57.6	4180
None of them	0.8	11.5	43.0	44.6	55.3	1141
Don't Know	1.2	14.6	43.2	41.0	59.0	96
<b>Residence</b>						
Urban	1.3	14.7	40.4	43.5	56.4	1747
Rural	1.2	14.4	43.9	40.6	59.5	7851
<b>Marital Status</b>						
Never Married	1.2	13.5	43.4	41.9	58.1	6252
Currently Married	1.2	16.6	43.0	39.2	60.8	3080
Married, gauna not performed	1.6	14.2	38.2	46.0	54.0	202
Others	1.0	9.0	54.0	36.0	64.0	64
<b>Pregnancy Status</b>						
No	1.2	13.6	44.3	40.9	59.1	8970
Yes	1.7	25.3	28.4	44.6	55.4	628
<b>Region</b>						
North	1.5	13.7	10.8	43.9	26.0	1263
Central	1.2	13.1	41.3	44.4	55.6	3512
East	0.9	14.9	49.9	34.3	65.7	3406
North-East	2.3	12.6	36.2	49.0	51.1	269
West	0.7	19.2	36.1	44.0	56.0	653
South	2.2	18.3	37.3	42.2	57.8	495
<b>Wealth Index</b>						
Poorest	1.3	14.7	45.8	38.2	61.8	4909

Poorer	1.1	14.2	42.5	42.1	57.8	2537
Middle	1.2	13.1	40.1	45.6	54.4	1263
Richer	1.2	15.3	37.9	45.6	54.4	667
Richest	0.7	17.0	34.7	47.6	52.4	221
<b>BMI</b>						
Thin	1.4	15.1	44.1	39.3	60.6	4022
Normal Weight	1.0	13.9	42.8	42.2	57.7	5345
Overweight	0.9	15.6	35.2	48.3	51.7	174
Obese	0.0	11.5	53.8	34.6	65.3	50

Source: NFHS-4, 2015-2016: author's calculation

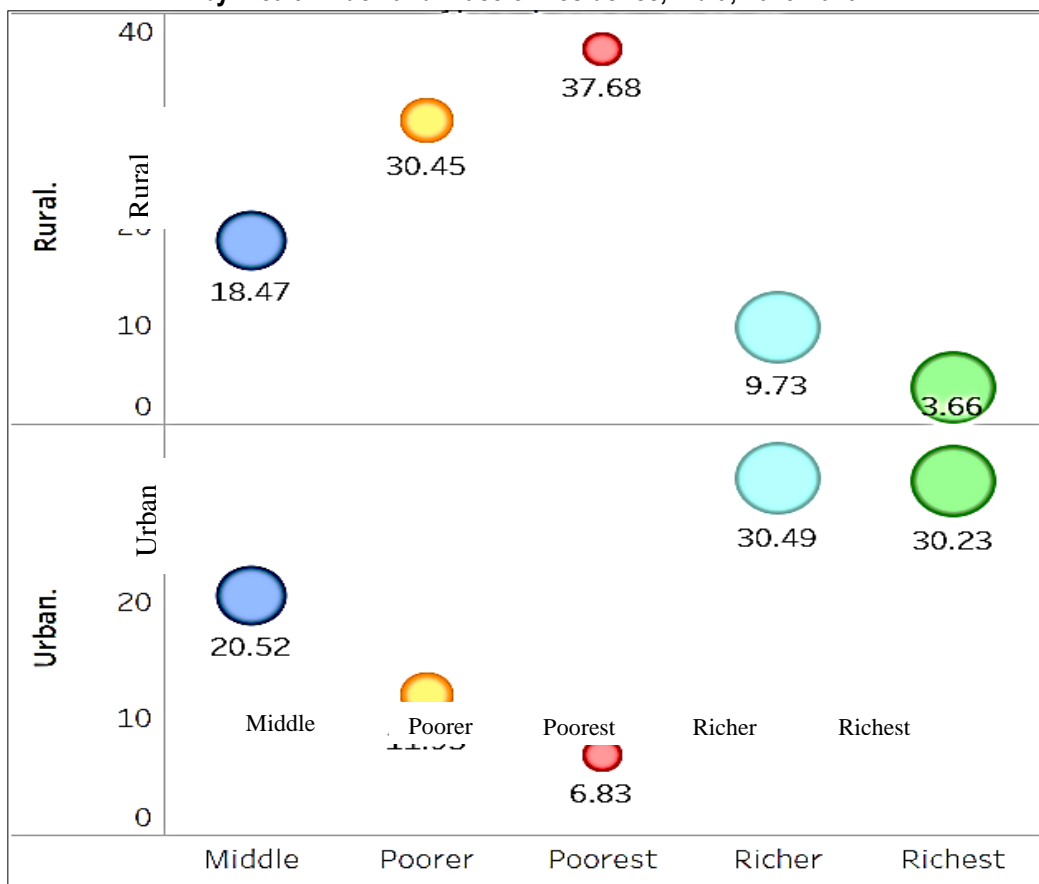
**Figure 1**  
**Percentage Distribution of Anaemic Out Of School (OOS) Adolescent Girls Aged 15-19 Years**  
**by Place of Residence and Marital Status, India, 2015-2016**



Source: NFHS-4, 2015-2016: author's calculation

Figure 1 shows the percentage distribution of anaemia among the OOS adolescent girls aged 15-19 years with place of residence and marital status in India. The study shows that the overall prevalence of anaemia was 86.1 per cent in urban areas among the OOS adolescent unmarried girls. Similarly, among the total OOS adolescent unmarried girls from rural areas, 77.7 per cent had anaemia.

**Figure 2**  
**Percentage Distribution of Anemia among OOS Adolescent Girls Aged 15-19 Years**  
**by Wealth Index and Place of Residence, India, 2015-2016**



Source: NFHS-4, 2015-2016: author's calculation

Figure 2 illustrates the percentage distribution of anaemia among the OOS adolescent girls aged 15-19 years with wealth index and place of residence in India. It was observed that among the total OOS adolescent girls in urban areas from the richer family were more anaemic (31%) than those OOS adolescent girls belonged to middle or poorer families. However, among the total OOS adolescent girls, girls from the poorest families in rural areas were more anaemic (38 %) than the middle or richer wealth index families.

The perusal of the Table 3 reveals the percentage distribution of OOS anaemic adolescent girls by States/ Union Territory. Among the total OOS anemic adolescent girls identified, 27.8 per cent belonged to Uttar Pradesh followed by Bihar (21.1%), Rajasthan (8.8%) and Madhya Pradesh (7.1%).

**Table 3**

Prevalence of Anemia among out of School Adolescent Girls by State/Union Territory, India, 2015-2016

State	Any Anemia	State	Any Anemia
Uttar Pradesh	27.8	Delhi	0.6
Bihar	21.1	Jammu and Kashmir	0.5
Rajasthan	8.8	Tamil Nadu	0.3
West Bengal	7.4	Meghalaya	0.3
Madhya Pradesh	7.1	Tripura	0.1
Gujarat	3.8	Arunachal Pradesh	0.1
Jharkhand	3.6	Himachal Pradesh	0.1
Odisha	3.4	Nagaland	0
Maharashtra	3.0	Dadra and Nagar Haveli	0
Assam	2.2	Manipur	0
Andhra Pradesh	2.0	Mizoram	0
Chhattisgarh	1.7	Chandigarh	0
Karnataka	1.6	Goa	0
Haryana	1.6	Sikkim	0
Telangana	1.2	Andaman and Nicobar Islands	0
Punjab	0.9	Daman and Diu	0
Uttarakhand	0.7	Kerala	0

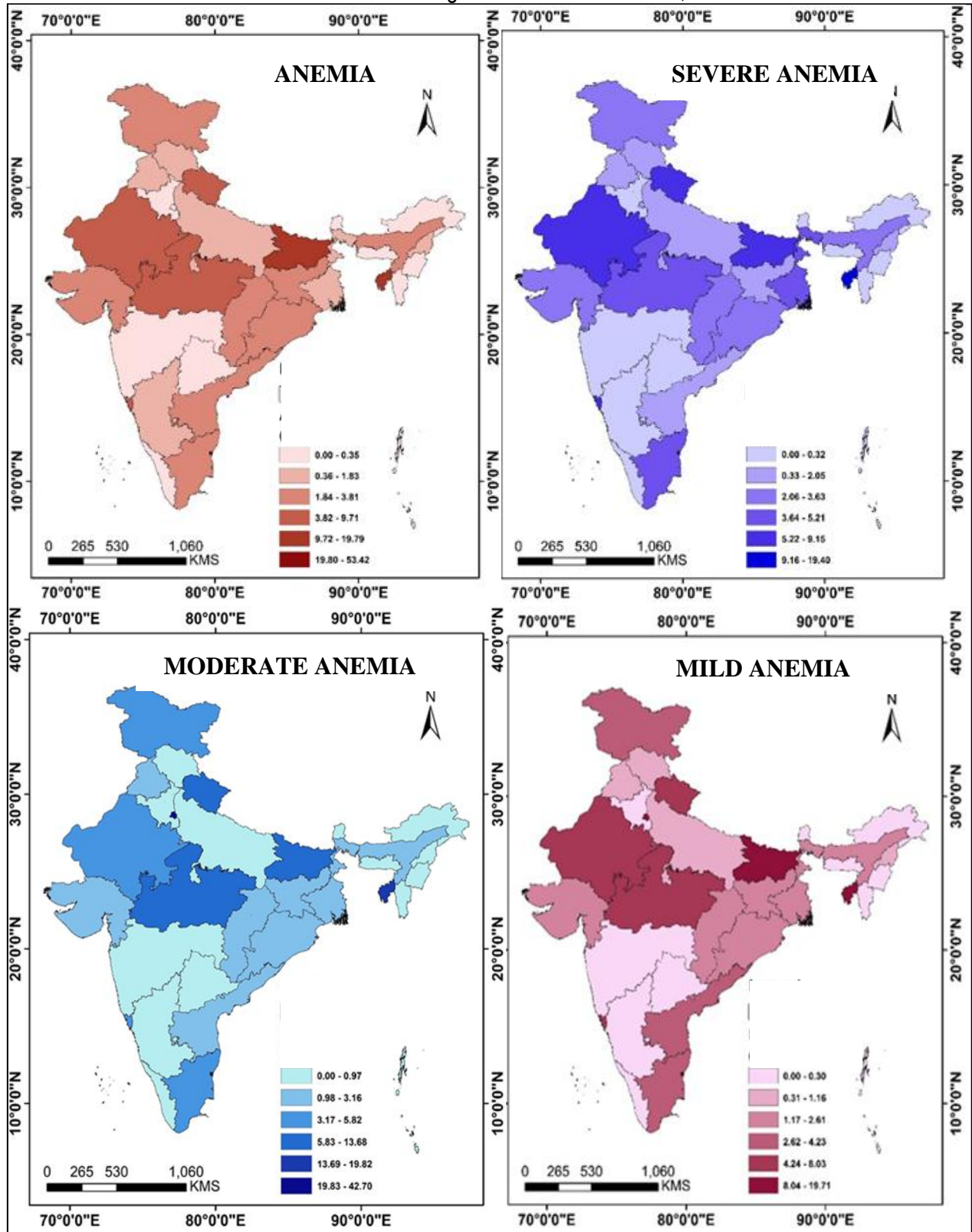
Source: NFHS-4, 2015-2016: author's calculation

Figure 3 depicts percentage distribution of anemia among adolescent girls in India. It was noticed that, in India among the total OOS anemic adolescent girls the maximum percentage belonged to Madhya Pradesh (53.4 percent), Uttar Pradesh (19.8%), Bihar (13.8%), West Bengal (9.7%) and Maharashtra (7.5%). However, it was observed that in India among the total OOS anemic adolescent girls the minimum percentage belonged to States and Union Territory of Uttarakhand (0.7%), Tripura (0.4%), Meghalaya (0.3%), Himachal Pradesh (0.2%) and Arunachal Pradesh (0.1%).

It was observed that in India among the total OOS severely anaemic adolescent girls, the maximum percentage belonged to the states of Uttar Pradesh (19.4%), Madhya Pradesh (9.1%), and West Bengal (8.5%). Similarly, it was noticed that, in India among the total OOS severely anemic adolescent girls, the minimum percentage belonged to the States and Union Territory of Delhi (0.8%), Himachal Pradesh (0.3%), Meghalaya (0.3%) and Tripura (0.2%).

It was found that, in India among the total OOS moderately anemic adolescent girls, the maximum percentage belonged to the states of Uttar Pradesh (19.7%), Bihar (14.8%), Goa (14.1%) and West Bengal (8%). Similarly, it was noticed that, in India among the total OOS moderately anemic adolescent girls, the minimum percentage belonged to the States and Union Territory of Tripura (0.3%), Kerala (0.2%) and Arunachal Pradesh (0.1%).

**Figure 3**  
Prevalence of Anaemia among Adolescent Girls in India, 2015-2016



Source: NFHS-4, 2015-2016; author's calculation

It was observed that, in India among the total OOS mild anemic adolescent girls, maximum percentage belonged to the states of Goa (43%), Uttar Pradesh (20%), Bihar (14%), West Bengal (10.2%) and Madhya Pradesh (8.2%). Similarly, it was noticed that, in India among the total OOS mild anaemic adolescent girls, minimum percentage belonged to the States and Union Territory of Delhi (0.6%), Tripura (0.4%) and Manipur (0.1%).

Table 4 depicts percentage distribution of anaemia among OOS adolescent girls with place of residence and States/Union Territories in India. A similarity is observed in every state/ union territory that among the total OOS adolescent girls who lived in rural areas was more anaemic than OOS adolescent girls who lived in urban areas.

Among all the States/Union Territories in India, the highest concentration of percentage distribution among the total OOS anemic adolescent girls was identified in Andaman & Nicobar Islands where 43 per cent belonged to urban region and 57.1 per cent belonged to rural region. Similarly, the second highest concentration of percentage distribution among the total OOS adolescent girls was in Andhra Pradesh where 28 per cent belonged to urban region and 72.1 per cent belonged to rural region.

The lowest concentration of percentage distribution of among the total OOS adolescent anaemic girls was recognized in West Bengal, 24.1 per cent belonged to urban region and 76 per cent belonged to rural region. Similarly, among the total OOS adolescent girls the lowest concentration of percentage distribution was seen in Telangana, 44 per cent belonged to urban region and 56.1 per cent belonged to rural region.

**Table 4**  
**State-wise Prevalence of Anaemia among out of School Adolescent Girls Aged 15-19 Years by Place of Residence and States/Union Territories, India, 2015-2016**

States	Place of Residence	Any Anaemia	States	Place of Residence	Any Anaemia
Andaman and Nicobar Islands	Urban	42.9	Madhya Pradesh	Urban	20.9
	Rural	57.1		Rural	79.1
Andhra Pradesh	Urban	27.9	Maharashtra	Urban	47.7
	Rural	72.1		Rural	52.3
Arunachal Pradesh	Urban	21.4	Manipur	Urban	38.5
	Rural	78.6		Rural	61.5
Assam	Urban	10.2	Meghalaya	Urban	14.9
	Rural	89.8		Rural	85.1
Bihar	Urban	11.3	Mizoram	Urban	46.2
	Rural	88.7		Rural	53.8
Chandigarh	Urban	95.8	Nagaland	Urban	37.5
	Rural	4.2		Rural	62.5
Chhattisgarh	Urban	18.0	Delhi	Urban	99.1
	Rural	82.0		Rural	0.9
Dadra and Nagar Haveli	Urban	26.7	Odisha	Urban	14.8
	Rural	73.3		Rural	85.2
Daman and Diu	Urban	50.0	Puducherry	Urban	72.7
	Rural	50.0		Rural	27.3
Goa	Urban	57.1	Punjab	Urban	34.5
	Rural	42.9		Rural	65.5
Gujarat	Urban	33.8	Rajasthan	Urban	18.7
	Rural	66.2		Rural	81.3
Haryana	Urban	34.9	Sikkim	Urban	30.8



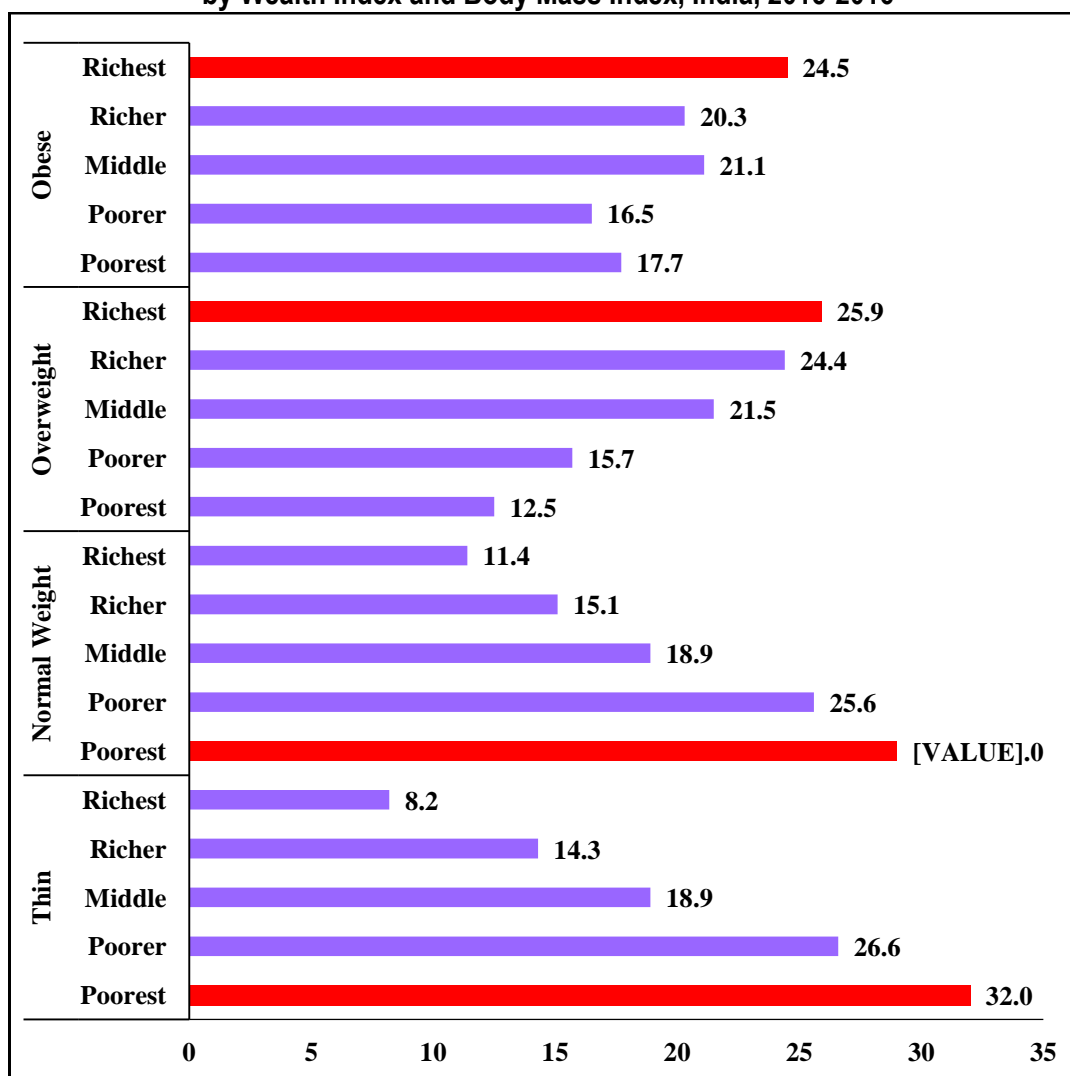
	Rural	65.1		Rural	69.2
Himachal Pradesh	Urban	8.9	Tamil Nadu	Urban	45.9
	Rural	91.1		Rural	54.1
Jammu and Kashmir	Urban	21.9	Tripura	Urban	20.2
	Rural	78.1		Rural	79.8
Jharkhand	Urban	20.6	Uttar Pradesh	Urban	22.2
	Rural	79.4		Rural	77.8
Karnataka	Urban	39.6	Uttarakhand	Urban	34.0
	Rural	60.4		Rural	66.0
Kerala	Urban	43.2	West Bengal	Urban	24.1
	Rural	56.8		Rural	75.9
Lakshadweep	Urban	0	Telangana	Urban	43.9
	Rural	0		Rural	56.1

Source: NFHS-4, 2015-2016: author's calculation

Figure 4 depicts that percentage distribution of among the total OOS adolescent girls from the poorest families who were thin (32%) and of normal weight (29%) were anaemic. It was observed that OOS adolescent girls belonged to richest families who were overweight (26%) and obese (25%) were anaemic.

Table 5 examines the adjusted association between anaemia and its selected socio-demographic characteristics among OOS adolescent girls. This method has been applied considering the dichotomous nature of the dependent variable i.e. anaemia (Yes=1), (No=0) as it represents the adjusted odds ratios from logistic regression model examining the association between anemia and its' socio-demographic correlates among OOS adolescent girls in India. Data from the regression analysis confirmed statistically significant association with anemia among adolescent girls with the variable age groups, religion, caste, marital status, pregnancy status, region, wealth index and BMI. It was found that there is an association between anemia and socio-demographic characteristics among OOS adolescent girls, so null hypothesis was rejected i.e., OOS adolescent girls aged 18 years, were significantly more likely to be anemic when compared with OOS adolescent girls aged 15, 16, 17, and 19 years. It was found that pregnant OOS adolescent girls were 22 times more likely to be anemic. It was observed that among OOS adolescent girls, who belonged to schedule tribe, were 44 times more likely to be anaemic (Figure 5). It was also found that among OOS anaemic adolescent girls who were physically thin, were significantly more likely to be anaemic than those who were obese.

**Figure 4**  
**Percentage Distribution of Anemia among OOS Adolescent Girls Aged 15-19 Years**  
**by Wealth Index and Body Mass Index, India, 2015-2016**



Source: NFHS-4, 2015-2016: author's calculation

**Table 5**  
**Results of Binary Logistic Regression Analyses Anaemia among Out of School Adolescent Girls**  
**(15-19 years) in India, 2015-2016**

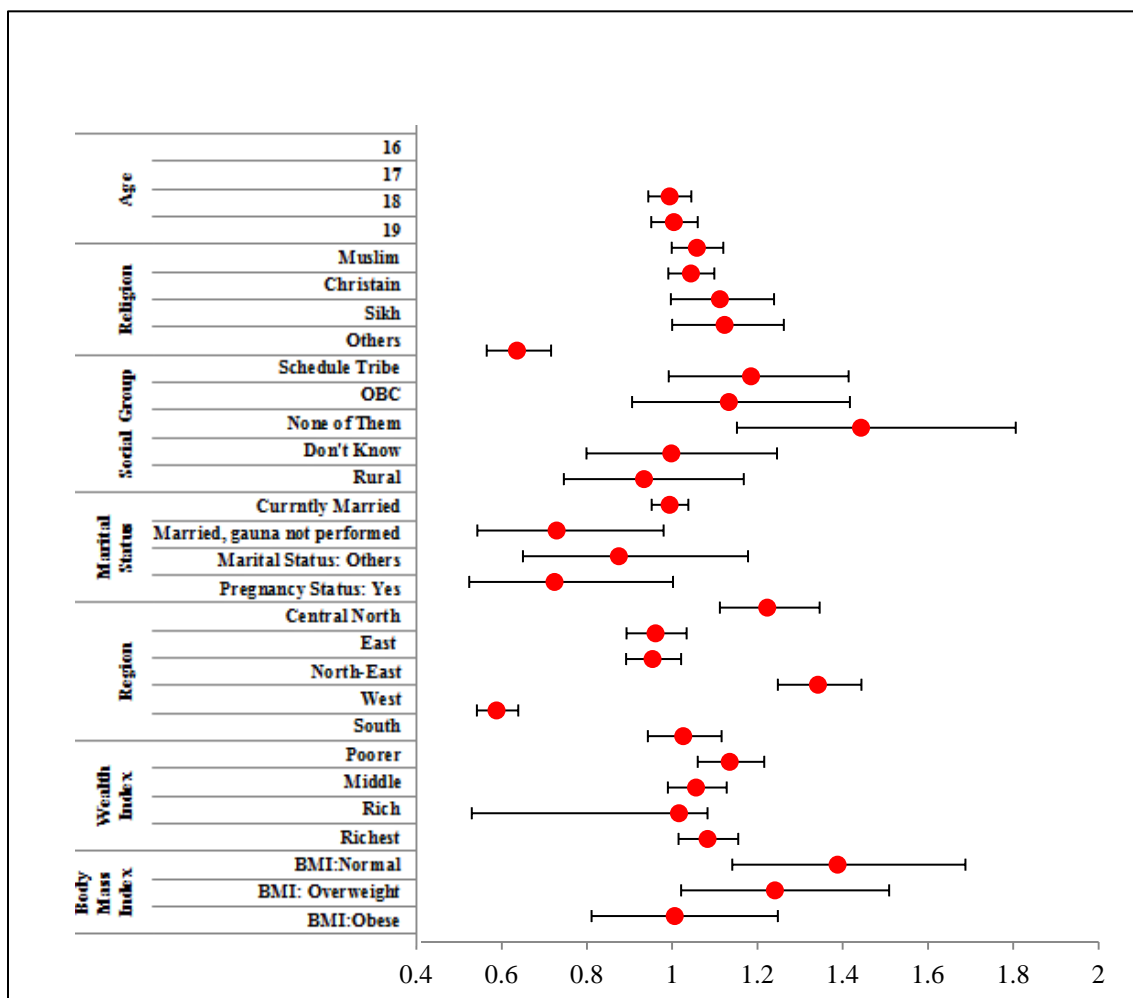
Background Characteristics	Odds Ratio	95% confidence Interval	
		Lower	Upper
<b>Age</b>			
15 ®			
16	0.994	0.944	1.045
17	1.004	0.951	1.06
18	1.058*	0.999	1.12

19	1.044	0.991	1.099
<b>Religion</b>			
Hindu ®			
Muslim	1.112*	0.997	1.239
Christian	1.123*	1	1.262
Sikh	0.636***	0.565	0.716
Others	1.185*	0.992	1.414
<b>Caste/Tribe</b>			
Schedule Caste ®			
Schedule Tribe	1.133	0.906	1.417
OBC	1.443***	1.152	1.806
None of them	0.998	0.799	1.246
Don't Know	0.934	0.746	1.168
<b>Residence</b>			
Urban ®			
Rural	0.994	0.952	1.038
<b>Marital Status</b>			
Never Married ®			
Currently Married	0.729**	0.543	0.98
Married, gauna not performed	0.875	0.65	1.178
Others	0.724*	0.524	1.002
<b>Pregnancy Status</b>			
No ®			
Yes	1.223***	1.112	1.346
<b>Region</b>			
North ®			
Central	0.961	0.893	1.034
East	0.954	0.892	1.021
North-East	1.342***	1.248	1.444
West	0.588***	0.542	0.639
South	1.026	0.943	1.116
<b>Wealth Index</b>			
Poorest ®			
Poorer	1.135***	1.06	1.216
Middle	1.056*	0.99	1.128
Rich	1.016	0.53	1.083
Richest	1.083**	1.015	1.155
<b>BMI</b>			
Normal Weight®			
Thin	1.462***	1.212	1.765
Overweight	1.232***	1.021	1.486
Obese	0.917	0.746	1.127

Note: \* P<0.10; \*\* P<0.05 & \*\*\* P<0.01 level of significance

®= Reference Category

**Figure 5**  
**Forest Plot: Regression Analysis**



### Conclusion and Recommendations

The study depicts that OOS adolescent girls who were married and anaemic, this shows a layered burden over the society and has the worst consequences on adolescent health. The highest number of anaemia cases was concentrated in the poorest wealth index. Among the total of OOS adolescent girls who were anaemic and belonged to the poorest wealth index, the maximum concentration was identified among the girls with higher BMI.

Despite the progress in the last decade for anaemia reduction in children, anaemia continues to be a major public health concern in India. The findings of this study have revealed multiple common drivers of anaemia reduction among the adolescent girls. To accelerate anaemia reduction, a holistic approach targeting the known underlying determinants of anaemia is needed. It is reassuring that the 2018 Anaemia *Mukt Bharat* guidelines take a more integrated approach than ever before. There should be the distribution of IFA tablets at all grounds through frontline workers to avoid the bottlenecks of the distribution of tablets amongst the adolescent girls attending schools; and who are OOS so that a proper integration can be formed at the community level. Investments in evidence-backed actions to reduce anaemia are important for Indians and are critical to achieve global anaemia reduction targets. To obtain additional in-depth understanding of

prevalence of anaemia and its causing trends, a grass root level study is recommended. The study can be extended to analyzing the prevalence of anemia among out of school adolescent boys in NFHS-4 (2015-2016).

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## The Mental Health Status of Covid-19 Infected Patients and Survivors Globally: A Systematic Review

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### Abstract

*The rapid transmission of COVID-19 in the community, allied high mortality affecting physical and mental wellbeing along with morbidities such as depression, post-traumatic stress disorder, anxiety, and panic disorder are challenging the feeling of wellbeing in the people. Limiting access to essential medication and support facilities affected individuals with mental health problems and surpass the population's capacity to deal with these circumstances. The persistent on quarantine, social isolation and distancing, personal hygiene and lockdown by the countries has led to stress among the entire population. COVID 19 infected persons are highly vulnerable to developing neuropsychiatric syndromes because of distancing from their families and friends, burden of carrier status, stigmatization and breakdown of social support systems, anxiety over the result and consequences of this infection and possibility of passing of the diseases onto loved ones, and these psychological distress can impair COVID-19 patient's mental wellbeing.*

*Thus, a systematic review of the existing literature has been carried out to have a deeper insight into the mental health status among the covid-19 affected persons and identify the gaps to scale up future actionable studies for enhancing mental health status among COVID-19 patients. Systematic review of the articles from December 2019 to February 2021 revealed that COVID-19 positive persons had some form of mental health issues which need intervention. Among the issues, the depression and anxiety was most commonly found in maximum number of people affected with COVID-19 and had survived. There are several factors: different perspectives on mask wear, misperceptions of culture, lack of personal protective equipment, skepticism about how the pandemic develops, and concern that it may be difficult to recover from disease were the cause for unhealthy feeling and though causing stress. Others had several thoughts of being a carrier of the disease or were worried about transmitting the disease to their loved ones and were concerned about their fate. Lack of clear information on COVID-19 lead to many apprehensions and unsure of being survive this deadly disease or not also aggravate the stress and anxiety. The challenges of mental wellbeing emerge from this covid-19 can lead to loneliness, shame and longer-lasting health problems. Global health action to tackle psychosocial stressors, favoring isolation/quarantine, anxiety and risk in the population affected needs to be initiated. A global integrated response contemplating patients and the general public in terms of mental wellbeing needs to be initiated to address these mental health issues among covid-19 affected persons.*

### Introduction

The novel coronavirus disease of 2019 (COVID-19) which was stated as a regional epidemic in China initially has expanded globally effecting at least 216 countries as a large pandemic of 21<sup>st</sup> Century. Being a highly contagious disease, it causes extreme acute respiratory infection in its primary stages and acute respiratory distress syndrome as well as other serious complications in some patients leading to higher morbidity and mortality. The rapid diffusion of COVID-19 in the community and associated high mortality equally affects physical and mental wellbeing often reflected with several morbidities such as depression, post-traumatic stress disorder, anxiety, and panic disorder.

The remedial measures for ceasing virus transmission resulted in physical isolation, closing of schools (which have undeniable effects on children's growth and well-being), widespread losses of employment and opportunity for income and economic support, back migration to resource scarce environment and increase

in substance abuse and domestic conflicts. According to WHO (2021) disruption of mental health care by limiting access to essential medication and support facilities overwhelmingly affected individuals with mental health problems. Pandemic is responsible for psychosocial conditions that can surpass the population's capacity to deal with these circumstances. The pervasive fear of quarantine and lockdown has led to unusual mass hysteria in many countries and somehow the entire population has been stressed<sup>2</sup>.

Literature appraisal revealed that previous research centered predominantly on COVID-19 affecting mental wellbeing of general population, medical personnel, infants, women who are pregnant from their marriage, persons with mental disease and persons in self-isolation. Limited studies have focused on the mental health of COVID-19 patients or individuals who have struggled with this lethal virus and survived.

Studies related to viral respiratory diseases such as SARS have shown that affected patient's presents differing degrees of mental health issues even after hospital discharge, suggesting responsiveness for their mental status. Viral infectious disease survivors are susceptible to depression, anxiety, adjustment disorder, acute stress-related disorder and post-traumatic disorder. COVID 19 patients are highly vulnerable to developing neuropsychiatric syndromes because of distancing from their families and friends, burden of carrier status, stigmatization and breakdown of social support systems, anxiety over the result and consequences of this infection and possibility of passing of the diseases onto loved ones, and these psychological distress can impair COVID-19 patient's mental wellbeing .

Thus, as an initiative a preliminary prospective of the study was planned to be conduct through systematic review of the existing literature to have a deeper insight into the problem and identify the gaps to scale up future actionable studies for enhancing mental health status among COVID-19 patients.

## **Methodology**

Systematic review of literatures was undertaken to fulfil the objectives. An extensive search for available literature demonstrating psychological impact, mental distress and mental health influence on COVID-19 patients and survivors due to COVID-19 pandemic was carried out from various research studies, scientific articles, internet, and web based published and unpublished materials from the period December 2019 to February 2021.

The search strategy involved step by step processes:

- Electronic databases like PubMed and Google Scholar were used to identify relevant literature published from December 2019 to February 2021; and
- The use of the reference lists of the chosen paper and some related summary papers and forward citation queries were also scanned by hand.

## **Inclusion criteria**

The inclusion criteria for the selection of articles were:

- Published articles in peer reviewed journals with full text available online.
- Articles which were published from December 2019 onwards.
- Target population was COVID-19 positive patients.
- Studies from every possible region.
- Language was English

## **Exclusion criteria**

Exclusion criteria for the selection of articles were:

- Type of studies- earlier conducted reviews on mental health status of COVID-19 patients.
- Articles written in other than English language.
- Articles which were published before COVID-19 era i.e. before December 2019.
- Articles of which full text was not available online.

## **Search strategy and study selection**

Search strings based on the three areas of interest were used for the database search. Search strings used were: COVID-19 OR coronavirus disease OR COVID-19 positive AND Patients OR Survivors OR people suffering AND Mental Health status OR Psychological status OR Distress OR Depression OR Anxiety

The results for each search string were sorted by relevance where possible and screened for the relevance to the objectives. Primary objective of selection was to seek information related to the study topic. Only articles giving relevant information regarding the topic of interest were selected. After the selection of articles, key characteristics were drawn out from the data on reviewing the articles.

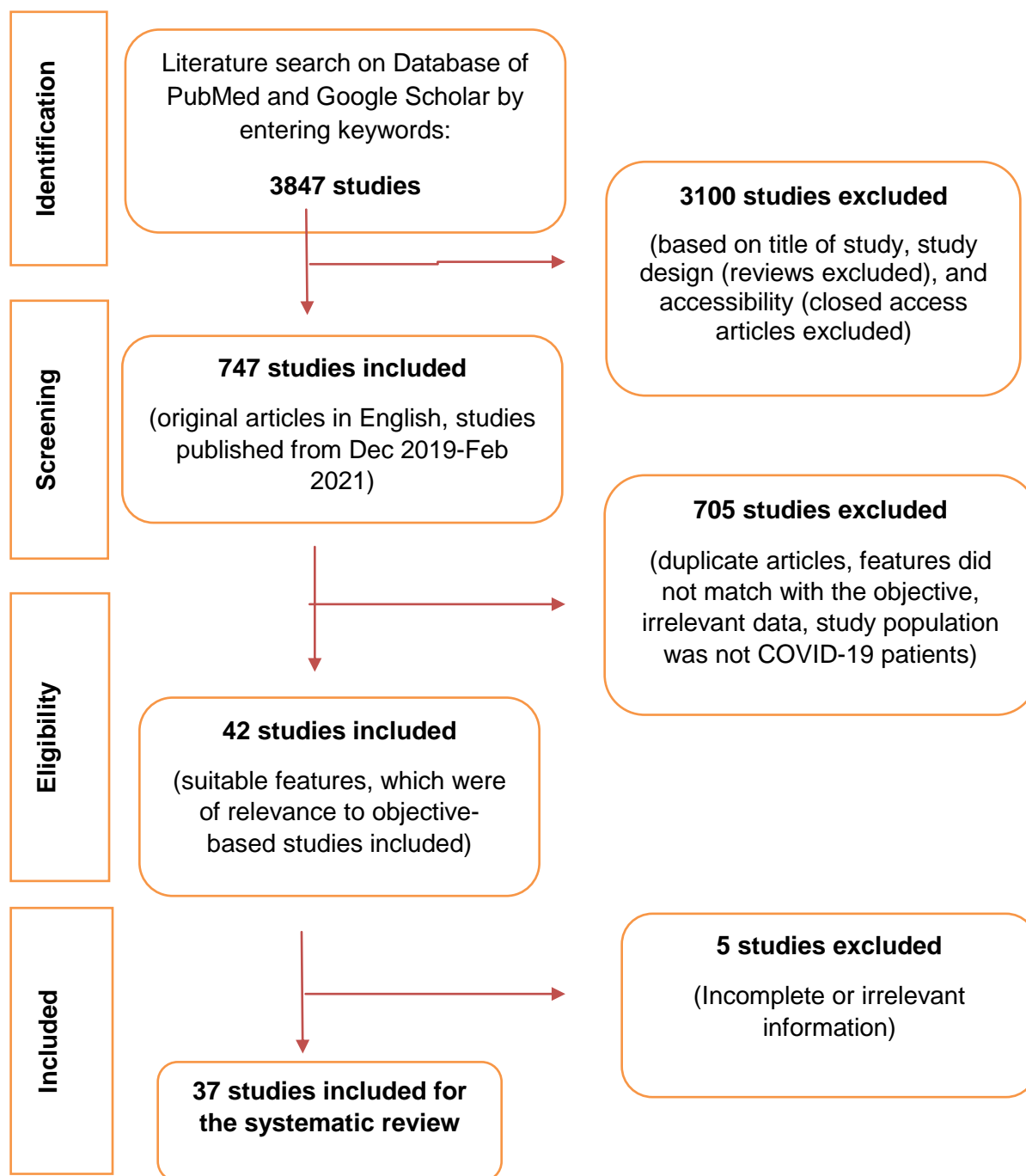
## **Data extraction and synthesis**

We draw out the following key attributes of the studies:

Author, year published, study design, sample size, age group, place of study, Depression among COVID-19 patients or survivors, anxiety, Stress, worry, any other Mental health condition seen in COVID-19 patients, factors affecting the mental health status of COVID-19 patients and survivors, Sleep quality and sleeping disorders experienced, psychological distress in family members of patients suffering from COVID-19, Psychological stress from isolation from family members and friends. Stress due to confusing information on COVID-19 disease and various coping strategies adopted by the patients to deal with stress and anxiety. Articles were reviewed and prime outcome data of all articles and its interpretation was extracted to a Microsoft Word. Full-text articles were identified and assessed for eligibility after applying the inclusion and exclusion criteria. Finally, total 37 articles were selected for current study based on inclusion and exclusion criteria. Critical appraisal of each study found eligible was done by the investigator.



**Figure 1: Summary of literature search and selection process**



**Figure 1**  
Summary of Literature Search and Selection Process

## Findings

The content analysis of the research articles included for the current study was done. The content was classified into various sub themes for a deeper exploration and interpretation. Each sub-theme classified and framed under the present study is listed below.

**Depression among COVID-19 patients and survivors:** Majority of studies examined showed depression among COVID-19 patients and survivors as the most frequently identified condition. From Italy in Milan, 11 per cent of patients reported with depression and it was independently associated with the persistence of physical symptoms in patients. According to a study from China<sup>4</sup>, population experienced depressive symptoms and its related factors were educational levels (secondary school or higher), smoking history, alcohol history, a family member confirmed with COVID-19, more than two present physical symptoms, and a low sleep quality. Another research found 20.5 per cent had mild, 12.8 per cent had moderate depression and 2.6 per cent were severely depressed and women displayed substantially higher depression than men, higher education, and the diagnosis of COVID-19 in family members was significantly linked to higher levels of depression. A study of Wuhan, China, recorded 28.47 per cent of depressed patients. More depressive problems were associated with less social support. Depression values in elderly (age >50) and those with poor educational attitudes were substantially higher.

In Hubei, China The prevalence of depression was 43.1 per cent and depressed patients were much older, woman, and those who used less social media to collect information relevant to COVID-19. A study which was conducted in Ecuador by Paz C et al. found that 20.3 per cent had mild to extreme depressive symptoms and showed fewer depression levels were seen in patients who maintained daily routines and did work out. A survey in Bursa, Turkey, found that the prevalence of severe depression in 24 per cent patients when linked with hypertension was more prevalent than non-hypertensive outpatients. Another study in Turkey found that 42% of the patients had depression and patients over 50 and female patients had more signs of depression. A study conducted in Israel, showed mean scores showing depression to be  $52.85 \pm 8.5$ . in Karaj, Iran, the association between employment status, education level, and the degree of depression in patients with COVID-19 was statistically significant . The mean depression level reported by studies included in this review was 36.21 per cent. Zandifar A et al.<sup>15</sup> in Karaj, Iran, reported highest level of depression among patients which was 97.2 per cent and Tomasoni D et al.<sup>7</sup>, in Milan, Italy, reported lowest level of depression which was 11 per cent.

**Anxiety among COVID-19 patients and survivors:** The Mean level of anxiety reported by the studies included in this review was 35.14 per cent. Zandifar A et al. in Karaj, Iran<sup>15</sup>, reported highest level of anxiety among patients which was cent per cent and Dong Liu et al., in Wuhan, China, reported the lowest level of depression of 10.4 per cent. In Milan, Italy <sup>7</sup> it was reported that anxiety was independently associated with fear and persistence of physical symptoms. In Wuhan, China, a study<sup>4</sup> showed that people with more physical signs and reduced sleep quality were more vulnerable to anxiety. Xue-Dan Nie et al.<sup>8</sup> reported that the rate of depression in women were substantially higher than in men. A study showed that in older people (age >50) and with low education, the anxiety was substantially greater<sup>9</sup>. Yanyu Hu et al. revealed 38.8 per cent had signs of anxiety and had higher female numbers (63.6%) and longer disease duration and a longer hospitalization. According to another study in China there has been an elevated risk of relative anxiety in survivors who remained in the hospital for more than 14 days.

Paz C et al.<sup>11</sup> showed that patients with lower levels of anxiety were seen in patients who maintained daily routines and exercised. Baris Sensoy et al.<sup>12</sup> carried out a study in Bursa, Turkey showing a prevalence of

severe Anxiety associated with hypertension, diabetes mellitus, and sex (Higher in Females). It was also found that anxiety was found to be correlated with number of children patients had. The anxiety in patients with COVID-19 was considerably higher (Mean =  $57.7 \pm 11.9$ ), sex (female), and ultraorthodox religiosity was associated with low anxiety in Israel<sup>14</sup>. In Karaj, Iran, all patients reported anxiety<sup>15</sup> while in Tehran, Iran showed mean scores of anxieties acc. to DASS scale to be  $17.5 \pm 4.8$ . Married patients had elevated anxiety. Anxiety and stress were found to have a positive strong correlation.

**Affect to sleep quality or experiencing sleeping disorders:** In the Wuhan, China, 84.7 per cent were found to have low quality of sleep were seen to be affecting anxiety and depressive symptoms<sup>4</sup>. People with insomnia disorder were more likely to be married, female, and to receive information relevant to COVID 19 via social media. Younger age was an insomnia risk factor. Another study conducted in the same region showed that poor sleep was associated with age of the patients ( $p=0.0019$ ). In Wuhan, China, a survey showed 54.1 per cent of participants had insomnia and a higher proportion (60.9%) of patients was females and participants had a longer hospitalization<sup>17</sup>. The sleep quality assessed by PSQI of COVID-19 positive patients was positively associated to gender and pneumonia severity in a study in China.

According to an Indian study, a sleep quality disruption was recorded in a total of 62 per cent of the patients (44% were males and the female were 56 %) <sup>6</sup>. As per the study conducted in Milan, Italy, Health Care Worker patients suffered more sleep disorders ( $p=0.019$ ) compared to other patients. The Mean level of affect to sleep quality or insomnia reported by the studies included in this review was 57.08 per cent. Wuhan, China, reported highest level of sleep disorders among patients which was 84.7 per cent<sup>4</sup> and Israel, reported lowest level of insomnia which was 41.3 per cent<sup>14</sup>.

**Other Mental Health Factors affecting COVID-19 patients and survivors:** 17.1 per cent of patients in Milan, Italy complained of cognitive disabilities<sup>7</sup> while 55.7 per cent had at least one psychopathological dimension (PTSD, depressed, anxious, OC symptoms. Females with a positive prior psycho diagnosis and patients, who were treated at home, had decreased scores. In Rome, Italy, 29.51 per cent reported psychological distress in which 11 were women and 7 were men and 82.4 per cent in patients showed a moderate to extreme psychological effect of COVID-19<sup>23</sup>. However, in Brazil, PTSD was reported by 17.3 per cent patients.

In Shenzhen, China psychiatric distress recorded among 54.8 per cent of the clinical cohort. Women were substantially higher in PTSD-SS than men (66 versus 60) and significant relationship with depression and PTSD-SS values, including intrusion, hyper-arousal, and avoidance values were observed. In Wuhan, China 12.4 per cent of patients provisionally diagnosed with clinical PTSD symptoms because of COVID-19<sup>16</sup>. In Jiangsu, China 44.9 per cent patients with general mental health disorders and were reported more in women, 12.2 per cent patients were with PTSD signs. A higher risk for PTSD symptoms in patients with a high negative coping style score was seen.

In Madrid, all patients experienced delusions (50% of them were strongly structured) followed by orientation/attention disturbances (60%), auditory and visual hallucinations (40% and 10%, respectively) . In 80 per cent of patient psychotic symptoms appeared more than two weeks after the first somatic manifestation attributed to COVID-19 and resolved in less than two weeks<sup>29</sup>. In Seoul, Korea, registered 10% patients with PTSD and high-perceived stigma patients appear to have higher values for PTSD. Health care worker patients showed a higher percentage of moderate and severe distress than other patients. 26.5 per cent showed clinically significant scores of obsessive compulsions.

**Psychological distress within family members (family members diagnosed with COVID-19):** 10

studies reported psychological distress due to diagnosis of COVID-19 in a family member. In, China study showed that, because of greater family burden and psychiatric trauma, and family members diagnosed with COVID-19 patients were more vulnerable to depressive symptoms<sup>4</sup>. It was observed from the reviewed literature that depression and anxiety were significant among patients with a family member diagnosed with COVID-19 and family who faced death, compared to those in families whose family members did not or did not die from COVID-19 or suffering from severe covid-19 infection<sup>8,10,14</sup>. On the contrary no psychological distress among family members infected from COVID-19 was reported<sup>20</sup>. In Shenzhen, China the presence of family members or close relatives infected was the strongest predictor for higher anxiety ( $p < 0.001$ ) and depression scores ( $p < 0.001$ )<sup>27</sup>. Study in Turkey showed anxiety and depression were lower among families who tested positive for COVID-19 and remained in the same room during treatment<sup>13</sup>.

**Fear of Rejection:** In a study conducted in Israel<sup>14</sup>, 10 per cent of the patients reported feeling isolated and avoided by others. A qualitative research was carried out in Iran to show that the less communication behavior of the others and medical personnel induced a sense of rejection in patients. In the group there was still a COVID-19 stigma present referred to unfavorable opinion and irritating sympathies of others. As a result, the fear of rejection among COVID-19 patients has increased. A study from Chongqing, China, found COVID-19 patients to have experienced moderate to very severe degree of discrimination. According to a study from Seoul, Korea, 40 per cent of survivors feared that they will suffer discrimination by neighbors because of their COVID-19 experience<sup>30</sup>.

**Confusion on information regarding COVID-19:** Many studies reported that lack of proper information or confusing information on COVID-19 was one of the main causes of psychological distress. In one study from Israel, 22.9 per cent patients reported lack of knowledge about infectiveness and virulence of COVID-19 and 24.4 per cent reported lack of knowledge about protection and prevention from COVID-19 virus<sup>14</sup>. Study conducted in Irbid, Jordan found that on receiving conflicting or confusing information on COVID-19 from the health-care providers, 18.2 per cent of the patients were found to have more depression symptoms. In a study conducted in Wuhan, China, 68.8 per cent of the patients had common knowledge and 19.8 per cent patients had deep knowledge about COVID-19 and had lower depression scores<sup>21</sup>. Doubts about the accuracy of the information provided by the media, being cluttered with information, and exacerbated anxiety by hearing conflicting news led to confusion among patients. Message of increased death, patients had a feeling of approaching death<sup>31</sup>.

**Health care support and its impact on the psychological feeling of COVID-19 patients:** In the review 69 per cent patients had a feeling of protection from by the hospital<sup>14</sup>. However, higher prevalence of depressive symptoms among patients related with issues of maintain privacy (10.6%), reaching out their doctor (30.3%)<sup>33</sup>. 95 per cent patients thought that their staff's attitude were good predicted lower anxiety scores and lower depression scores<sup>21</sup>.

**Coping strategies, Social support, or support from families:** A study from Israel reported in his study that 37.5 per cent of patients agreed that support from others helped them coping from COVID-19<sup>14</sup>. In an analysis of Irbid, Jordan<sup>33</sup>, patients indicated that during quarantine patients receiving sufficient support from their family (65.2%), peers (50%), or medical workers (39.4%) and were less likely to have symptoms of depression. In Wuhan, China, 62.5% of patients showed strong perceived social support, according to a survey<sup>9</sup>. Less social support to people with COVID-19 has been associated with more nervous and depressing symptoms. Another China (Shenzhen) study<sup>27</sup> showed that there was strong social support among 93 patients, i.e., 73.8 per cent. subject with strong social support were vulnerable to lower

depressive emotional and PTSDSS ratings, including intrusion, hyper arousal and avoidance scores than ones with weak social support. However, there were significant connections between social aid and SAS, SDS and other depression subscale values. According to another study done in China in Jiangsu region<sup>28</sup>, patients with a high negative coping style score was associated with a greater risk of PTSD symptoms in patients and high perceived support score was associated with a lower risk of anxiety and/or depression symptoms.

In a study conducted in Konya Turkey, it was observed that all the coping mechanisms in the patient population were both more adaptive and maladaptive than the HCs. The coping mechanisms of adaptive solutions include preparation and planning, the use of emotional support and religion coping; while the disengagement, self-distraction, venting and use of substances are maladaptive coping strategies. HADS ratings demonstrated statistically negative links with active coping, emotional assistance, planning, humor, recognition, and overall adaptive coping measures. In addition to trying and being comfortable, patients were found to be trying to maintain a daily routine, which involved proper workouts and the gaining knowledge of disease awareness in order to feel more empowered and in control<sup>32</sup>. Some patients developed means of making friends and mutual contacts with the other patients as a method of coping. In Seoul, Korea, 50 per cent patients reported that there was a need for support from their family members and 60% patients reported that there was a need for support from the neighbors as well<sup>30</sup>.

## **Discussion and Conclusion**

Systematic review of the articles revealed that, person's being COVID-19 positive have had an effect on their mental health status. The depression was one of the most commonly seen state found in maximum number of people affected with COVID-19 and had survived. The elucidation may be several factors: different perspectives on mask wear, misperceptions of culture, lack of personal protective equipment, skepticism about how the pandemic develops, and concern that it may be difficult to recover from disease. Many patients had several thoughts of being a carrier of the disease or were worried about transmitting the disease to their loved ones and were concerned about their fate. As the information on COVID-19 was not clear there were many apprehensions and they were not sure if they were going to survive this deadly disease or not.

Different studies used different scales for assessment of mental health and its variables. Some of the most common scales used by the studies included in the review are:

- For depression and anxiety – HADS, SAS, SDS, BDI, BAI, PHQ-9, GAD-7, DASS – 21
- For Sleep quality and insomnia – PSQI, ISI
- Other Mental health variables – PCL-5, PTSD-SS
- For social support –PSSS, SSRS

According to Tomasoni D et al., only 11 per cent patients reported abnormal HADS score and reported depression<sup>7</sup> which was similar to a study conducted by Dai L-L et al.<sup>4</sup>, which reported that 13.4 per cent patients had depressive symptoms which could be because of the time frame of the study conducted. In one similar study conducted in the same timeframe showed the similar results of depression in different population. This was because the government offered guidance on COVID-19 promptly and people had less depressive symptoms because they had advanced information about it. In India, 27 per cent of the COVID-19 patients displayed more agitation than others in depression, which is linked to seriousness of the disease and patients who have already had some comorbidity<sup>6</sup>. In studies conducted in Jordan<sup>33</sup> and

Turkey<sup>12</sup> both reported 44 per cent prevalence of depression which shows almost half of the patients suffering from COVID-19 suffered from depressive symptoms. On the contrary, study in Karaj, Iran, reported almost every patient with COVID-19 had some degree of depression (n=97.2 percent)<sup>15</sup>. This may mainly be because of the occupational status as a source of concern because the greatest prevalence of moderate to extremely severe depression was in the freelancer population of patients.

Further, along with depression, anxiety was one such state which was perpetually seen in the persons suffered from COVID-19 and survivors and it ranges from 21- 24 per cent and same amount of anxiety (21.4%) was seen in people who had symptoms and were suspected with COVID-19 and were waiting for their test report <sup>11,12</sup>. However, in India Anxiety was found to be 67 per cent in COVID-19 patients, and was severe in the patients with comorbidities<sup>6</sup>. In Iran each and every patient suffering from the disease (100%) reported anxiety with 99.1 per cent patients reporting very severe level of anxiety and was associated with marital status<sup>15</sup>. This could be because married patients might have been more worried about the state and condition of the family if by chance something happens to them due to this disease. Further, both depression and anxiety together were diagnosed in 24.3 per cent of patients to 33 per cent of patients infected with covid-19 and survived<sup>7, 8</sup>.

Apart from anxiety and depression, several more conditions were reported which were seen to be affecting mental health status in the population suffering from COVID-19 or those who had survived this disease. In the therapeutic spectrum 55.7 per cent of patients had at least one psychopathological dimension<sup>24</sup> (Post-Traumatic Stress Disorder, Depression, Anxiety, Obsessive Compulsive symptomatology), directly suffering from traumatic treatment. For example, the most important trauma in patients with COVID-19 is dyspnea, respiratory collapse, gatism, alteration in conscious status, death threats, and tracheotomy. The evidence also has a strong effect on fellow patients leading to PTSD as people suffer, fight and die from infectious disease. In a survey<sup>28</sup>, 43.9 per cent had general mental health issues and PTSD symptoms of 12.2 per cent. This was similar to the research carried out in Wuhan, China, in which 12.4 per cent were provisionally diagnosed as having clinically significant symptoms of PTSD due to COVID-19, seriousness of the disease was a main risk factor for it<sup>16</sup>. In another study conducted in Rome Italy it was seen that PTSD was prevalent in 30.2 per cent of patients after acute COVID-19 infection<sup>25</sup>.

A research in China has shown that 54.8 per cent of patients experience undue stress, as a result of lack of antiviral drugs with a certain efficacy and fear of recurrence of disease <sup>27</sup>. Moreover, the Internet provides patients with all manner of information, leading to more misunderstandings regarding the illness, needless concerns and fears. Sleep gives the brain time to recover and rejuvenate. A large body of literature has shown that traumatic activities, such as COVID-19, and infectious disease outbreaks, can influence the quality of sleep and induce insomnia. The level of sleep quality was low for 84.69 per cent and also these were more vulnerable to anxiety<sup>4</sup>. In general, the lower the level of sleep quality, the more severe it affects the mental health. On the contrary, a study conducted among the COVID -19 survivors in Anhui Province, China showed less prevalence of insomnia (26.45%) at two weeks after discharge. In addition, a study carried out in Wuhan, China, of which 54.1 per cent had insomnia-like symptoms, 45.9 per cent had normal, 32.9 per cent had mild, 17.6 per cent had a moderate and 3.5 per cent had extreme insomnia-typical symptoms<sup>17</sup>. Recent studies have shown the increased prevalence of insomnia and depression in COVID-19 patients attributable to social alienation, insecurity, poor health condition. Additionally, fast dissemination, high mortality and unfavorable COVID-19 reports will increase the risk of sleeplessness and depression, intensify the physical and mental disorder and further affect the everyday life and cognitive functions of the patient.

Our study also showed a significant finding that the signs of depression and anxiety in the female population were clearly increased. Various reports have mentioned this in our review. Women are more likely to develop anxiety and depression symptoms<sup>4</sup>. It is seen in a study that the rate of depression (0.50 vs. 0.42) and anxiety (47.9 versus 42.3) are considerably higher for women than for men<sup>8</sup>. Similar results were stated by Mazza MG et al.<sup>24</sup> that the majority of mental health measurements in females with a positive prior psychiatric diagnosis have seen increased score. Baris Sensoy et al.<sup>12</sup> reported that the prevalence of anxiety in females was also notable (65% n = 26; p <0.05) and also the sex (being a female) was associated with an increasing anxiety (=0.39, p <0.0001), as stated by Dorman- Ilan S et al. <sup>14</sup>. A research by Yu wang et al. <sup>20</sup> has shown that women have a higher risk of having insomnia. In a study done by Samrah SM et al.<sup>33</sup>, Depression symptoms were significantly more common among females than males [PHQ-9 score ≥10: 13 (92.9%) vs 1 (7.1%), respectively; p=0.004]. Several other studies in this review reported similar findings where females were psychologically more distressed than males. This could be because of the increased burden of caring for households and their children while they are down battling with this disease. These results show that women are more likely to have psychiatric illnesses, and they need to be taken care of more closely.

But in India, a completely opposite finding was reported, in which it was seen that depression and anxiety was more prevalent in the male population than in female population. Males reported more depression than women (21% vs 06%), and in 67 per cent of patients with COVID 19, 47 per cent were males, and 20 per cent were females<sup>6</sup>. The presence of economic challenges and the attention paid to economic prospects after the COVID-19 pandemic increased public anxiety about addressing the key needs and economic prosperity. Mental health problems, including depression, may be associated with this, especially in persons with professional activities which are more likely to be affected by these economic conditions. In this review, the studies included did not found socioeconomic status to be associated with depression, anxiety or any other mental problems. One study done in patients suffering from COVID-19 in India reported that, depression was not statistically significant with regard to socio-economic status<sup>6</sup>. On the contrary the employment status was significantly linked to symptoms of anxiety and depression, whereas the financial state was not<sup>13</sup> and there was a statistically relevant association between employment status and depressive severity among admitted COVID-19 patients (P-value: 0.006)<sup>15</sup>.

A strong statistical association between education level and depression (P-value: 0.001) were found<sup>15</sup> and anxiety and depression were considerably higher in those in low education<sup>9</sup>. The highest prevalence of people with moderate and serious depression was found in the group of illiterate patients and those who had a diploma. Further, the chances of depression in people with higher education, with medium or high socioeconomic status, eating healthy, doing more exercise and having a greater literacy compared to their peers, were considerably lower, finding rather or reasonably easy to pay for drugs (Nguyen HC et al. 2020). The use of coping mechanisms also influences the social adaptation and endurance of individuals. The coping involves understandings and behaviors that people use to deal with traumatic situations. Most studies have examined coping strategies of the general public and of health workers during past infectious disease outbreaks such as SARS and Ebola and during the current COVID-19 pandemic. These findings show that people who have been affected by these outbreaks who have used coping strategies often demonstrate better psychological adjustment<sup>34</sup>.

Active coping (coping with resources and activities, individual and community protection and care, treating patients at home where health services are not available), positive reframing (positive attitudes), faith (religions and priesthood), use of emotional and instrumental support (emotional and social support, complementary support of medicine) are a part of the common coping strategies. 37.5 per cent of patients

and 69.1 per cent of their family members agreed that support helped them<sup>14</sup>. <10.0 per cent of the patients and families identified other forms of coping including religious coping, constructive lifestyle approaches, artistic approaches (for example, listening to music, reading and the use of media). 27.3 per cent of relatives said that functioning and working was an effective way of handling. Another study stated that during the quarantine of their sample populations, encouragement and social contact with their relatives, peers and medical personnel were significant mitigation factors as higher distress levels were noted in those without such assistance<sup>33</sup>. Several coping mechanisms were identified like, they were comforted that the government and the medical personnel would do their utmost to help them. In addition, patients sought to develop a daily schedule that involved good workouts and an effective management of awareness of the disease to feel more motivated and regulated<sup>32</sup>.

Patients with COVID-19 quarantine and isolation can lead to a variety of problems. It can instill panic, terror, rage, worry about bad consequences, patients feel alone and guilty that they are not with their families in tough times. Therefore, owing to the neurological effects of the COVID-19 epidemic, fear and stress can be too debilitating. As health workers are afraid of transmission by direct contacts with COVID-19 patients, close, full face-to-face meetings are scarce between healthcare professionals and patients. This has generated a feeling of despair among the patients who with less opportunity to talk to their health providers are feeling disconnected and are not receiving appropriate amount of information about the disease as well as how are they doing in terms of battling this disease.

Further, one of the objectives of this study was to conduct meta-analysis of the literature reviewed. However, due to insufficient number of articles covering particular variables the meta- analysis could not be carried out in the current study. Each article included in the study varies with respect to age group, ethnicity/race, and level of mental health status as well as socio-economic and cultural aspect showing the vast heterogeneity. Hence, due to lack of homogeneity between the articles selected under the study only systematic thematic analysis was able to be conducted. Thus, for systematic meta-analysis on these subjects more research on each aspect need to be carried out which will help to draw scientific inference.

The patients and their family members were concerned about their condition and results. The feeling of being alive may have been both a blessing and a challenge as survivors returned home. While they were healed, their family, professional and social circle could also have been considered them to be infectious and excluded them. For COVID-19 patients, further monitoring and mental health interventions may be necessary. They should be given more social care and support from their families by non-discriminatory government programs as well as psychiatric therapy. At the present time, the global focus is on preventing COVID-19 infection spread, which is likely to divert public interest from the psychological and mental health effects of the pandemic on the infected population and the general population. The challenges of mental wellbeing emerge from this global occurrence that can lead to loneliness, shame and longer-lasting health problems. Global health action needs to tackle psychosocial stressors including isolation/quarantine, anxiety and risk in the population affected. A global integrated response should concentrate on patients and the general public in terms of mental wellbeing.

## **Limitations**

This review has certain limitations, firstly, only published articles were included which may lead to publication bias. Although efforts were made to identify all relevant recent articles but due to diversity of studies including all of them was not possible. Secondly, several studies have cross-sectional data and are correlation in nature, therefore failing to establish cause and effect or to determine long-term effects. Third,



individual variations like loss of work or loss of family members probably affect how mental health is affected. Further, differences like age, gender, personality as some people have a better coping power during crisis than others. Fourth, Studies included in the review includes different populations from different areas of different continents, therefore, findings may not be generalized, as different countries and places have different kind of populations with diverse socio-cultural and economic backgrounds which may give wider contrasting features than observed. Lastly, some data could be false due to language and illiteracy barriers, as taken from different populations. Due to social or cultural circumstances also, some people might have hesitated to speak openly about their mental status or conditions to an unknown person or possibly might have given false information.

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## Maternal Health and Health Care Of Women in Slums: A Micro Analysis

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### Abstract

*Delhi has an exceptional infrastructural layout for the delivery of MCH services in the community through a network of subcenters, primary health centers, community health centers, district hospitals, state medical college hospitals, and other hospitals in the public and private sectors. But, even after strong decentralized mechanism and network of institutions maternal health status and practices associated with it puts a question mark on the services being provided. Through an analysis of focus group discussion and quantitative data set on health seeking behaviour of women in slums of Delhi, we have examined that traditional birth attendants(TBAs), remains the key challenge to the diverse maternal health programmes of the government. TBAs are in continued demand for homebirths with the wide-ranging character and quality of their services. They did not consider their lack of formal training on matters of pregnancy and birthing to be a particular challenge to their work. Rather, they identified the non-cooperative and disrespectful attitudes of the doctors and nurses in hospital settings (government hospitals in particular) as the most pertinent issue. Efforts on this front is needed by the agencies to realise TBAs form an integral part of the health system (over the years it has become within the low income settings in the urban areas) and how lack of formal training among TBAs is a continued challenge to the system. The findings of this study call for urgent attention by India's Ministry of Health and local authorities to provide of quality health services in poor urban communities and the need to provide focused and sustained health education geared towards promoting use of obstetric services.*

**Keywords:** TBAs, Delhi, homebirths, continued, challenges

### Introduction

Decades of urbanization and the growing accessibility of medical technology notwithstanding, homebirths and maternal practices associated with it remain common in the developing world<sup>1-6</sup>. TBAs provide maternal and child health care services for the women and families particularly in the urban slums of Delhi which makes the condition of women more susceptible. However, studies in developing countries of Asia, Africa and Latin America reveal other problems such as delay in the referral for excessive post partum bleeding and unhygienic practices during delivery are have strong correlation with associated morbidity and mortality<sup>7-9</sup>. Hence, multilateral funding agencies such as the World Bank, World Health Organisation (WHO) and United Nations Population Fund (UNFPA) have implemented TBA training programs in developing countries to improve maternal and child health since the 1970s. However since the 1990s, the TBA training strategy has been increasingly seen as irrelevant, ineffective or, on the whole, a failure, as maternal mortality rate (MMR) in developing countries has not reduced<sup>10</sup>. Hence, many donor agencies providing funding for TBA training in developing countries withdrew funds and reallocated them to providing skilled attendants during delivery<sup>11-12</sup>. Further, TBAs have been blamed as incapable of benefiting from training due to their low level of literacy, knowledge and for causing maternal and infant health problems because of the harmful practices they adopt during home births and for deterring and delaying referrals<sup>13-15</sup>. In the most of the available literature, the role social capital among the slum members, the socio-physical intimacy of TBAs to their clientele, their easy accessibility and proximity with the family members, as well as the sensitivity of their services not only to the female counterpart but to the entire family triggers the continued role of TBAs in the slum

communities<sup>16-18</sup>. This paper also stands with the view that TBAs lack of scientific knowledge about pregnancy and related matter which does affect mortality and morbidity in the low income setting in urban slums of Delhi. The present paper draws on qualitative and quantitative data collected from TBAs in seven slums in Delhi. This study is important in context of poor maternal and child health care practices in slums of Delhi. It could enrich current knowledge of issues surrounding maternal health in developing countries and deepen understanding of women and health in the transition towards global health sustainability and accessibility. In this paper, we exhibit that seasonality is another factor that affects maternal health in low income setting. The findings from the qualitative and quantitative surveys indicate the fact that there is an urgent need to rethink on the strategies of safe motherhood programmes and involving TBAs in the health care delivery system and also considering the fact that seasonality as central factor that could pave way for institutional delivery.

## Methodology

Slums manifest the worst form of deprivation that transcends income poverty. They are characterized by acute congestion, unhygienic, harmful and dehumanizing living conditions. The issues pertaining to the health care needs to be examined in context of traditional practices in slums of Delhi by the TBAs and health seeking behaviour of dwellers in this context. In order to examine the role of TBAs and associated behaviour with regard to health we decided to choose slums with larger number of jhuggis. This paper is based on a primary analysis of qualitative data collected from TBAs in seven slums in Delhi as part of research conducted in 2017-2019. The original study took place in seven clusters in slums sought to clarify the issues surrounding health care utilization, practices of maternal health by TBAs, issues of seasonality in resource-poor setting. Data were collected from several groups, including men, community leaders, young and adult fathers and mothers, and community-based health care providers, including TBAs.

It may also be noted that the list of '*jhuggi-jhopdi*' colonies provided in the DDA (Delhi Development Authority) list is neither comprehensive nor exhaustive. Various illegal squatter settlements and marginal settlements located in various parts of the city are not necessarily covered by the list primarily slums have been included in the list. The list of notified slums was also obtained from the slum wing and then were identified in consultation with experts. A brief description of the sampling procedure used to select the 400 households is given below. In order to select the 400 sample slum households, we have used a two-stage stratified random sampling framework. The basic document we used for our sampling strategy, as mentioned above, is the list of slums called as '*jhuggi-jhopdi*' clusters (which gives the specific areas where the slums are located) provided by DDA for the year 1994. This is the latest document available, which lists the number of constituencies, the number of clusters in each constituency, and the number of slums in each cluster. In the first step, we divided Delhi into nine zones on the basis of the geographical location of the 70 constituencies given in the DDA list; thus, zones one through seven are respectively, north, north-east, east, south, west, and central Delhi.

**Selection of state:** The state of Delhi was purposively chosen for the study as it is National Capital Region with large number of slums. Delhi is known for migration of poor people from different states in search of economic opportunities. All these have led to demographic change in Delhi population. Hence, Delhi slums were purposively taken for the study.

**Selection of districts:** In the first step, we divided Delhi into seven zones on the basis of the geographical location of the 70 constituencies given in the DDA list; thus zones one through seven are respectively, north, north-east, east, south, west, north-west and central Delhi. Out of seven zones four

zones were selected purely on the basis of number of slum in these zones based on the report from MCD list.

**Selection of clusters:** A detailed of 400 households has been selected from four Non-notified and three notified slums spread across Delhi in four different directions in order to make the sample more representative. Total of 1997 persons were surveyed in all 400 households and to be precise 1,061 persons from Non-notified and 936 from notified were surveyed during the course of the study which includes males, females and children.

## Findings and Discussion

According to the report released by State of World's Mother 2015 report it that only 19% of pregnant women in Delhi's slums are likely to get help from skilled attendants during childbirth. This section focuses on result and analysis based on both the qualitative and quantitative datasets. The quantitative data was analysed on SPSS 25 while for the qualitative date we heavily relied on FGDs conducted with mothers, mother in laws and TBAs in slums of Delhi.

**Table 1**  
**Delivery Practices**

Delivery Practices	Categories	Number	Share (%)	Medical Practices (Standard)
Cleaning of the floor prior to Delivery	Yes	96	23.8	Yes
Washed hands with disinfectants	Yes	88	22	Yes
Boiled instruments used for cutting Cord	Yes	92	23	Yes
Boiled the thread for tying umbilical Cord	Yes	101	25.25	Yes and use of clamp
Wore gloves	Yes	43	10.75	Yes
Given hot milk and egg during Delivery	Yes	237	59.25	
Posture during delivery	Squatting Supine	213 187	53.25 46.75	Supine
Abdominal massage after delivery	Yes	157	39.25	Not ideal practice
Cord Cut	Blade Scissors	144 178	44.72 55.27	
Cord tied	Thread Cloth	228 172	57 43	
Cord application	Ghee Turmeric	213 187	53.25 46.75	No application
Resuscitation	Slapping	212	53	Slapping
	Tilting baby upside down	119	29.75	
	Ringing bell	69	17.25	
Encourage to walk before delivery	Yes	148	37	-
Oxytocis injected	Yes	131	32.75	-

Delivery on floor of slums	Yes	43	10.75	No
	No	357	89.25	
Multiple vaginal examinations	Yes	128	32	No
	No	272	68	
Manual removal of placenta	Yes	43	10.75	Trained personnel could do it.
	No	357	89.25	

**Table 2**  
**Traditional Birth Attendants and Their Advice**

Practices prevalent in slums	Predictor category	No	%	Ideal Practices
Visited Dai/ Health functionary	Did not make any visit neither to dai/doctor/any health functionary.	46	11.5	Should visit doctor and register themselves for ANC(Antenatal Care)
	Yes	248	62	
	NO(Visited when required)	106	26.5	
Antenatal Food Intake	No advice sought	133	33.25	Focus should be on intake of good homemade food and monitor their weight and BP regularly
	Care on Normal Diet	48	12	
	Focus on Nutritive Food	214	53.5	
	Reduce food Intake	4	1	
	Focus on Fruits and Milk	1	.25	
Physical activities	Don't know	134	33.5	For first few initial months rest is advised and lighter activities can follow up.
	Should Increase	6	16.75	
	More Bed Rest	167	41.75	
	Both Should Combine	32	8	
Sexual Intercourse	Don't know	135	33.75	Mostly doctor advise should stop
	Should stop	35	8.75	
	Can continue	230	57.5	
Pain in Abdomen	Don't know	133	33.25	If continues for long time should be followed by meeting doctor.
	Massage by ghee	155	38.75	
	Manage without medication	105	26.25	
	Take Home remedy	6	1.5	
Intake of Iron folic tablets during pregnancy	Don't know	27	6.75	Recommended by doctor for pregnant women
	never took iron tablets	199	49.75	
	1-3 Months	144	36	
	4-6Months	20	5	
	>6 months	10	2.5	
Took rest	No	125	31.25	Should take adequate rest.
	1-2 Months	154	38.5	
	3-4Months	121	30.25	

In obstetrics, the period from the onset of labor to the end of the third stage of labour is called the intrapartum period. In India, maternal mortality is estimated at 540 per 100,000 live births. The intrapartum period, although a limited time span, is of critical importance. At this stage, a seemingly normal labour can suddenly degenerate into a crisis. Among women with deliveries at home, self-reported postpartum morbidity was significantly associated with risk parity (primiparity or grand-multiparity of five or more births), poorest economic strata, under nutrition, anemia, and malposition of the infant. With regard to delivery practices, postpartum morbidity was significantly associated with having two or more vaginal examinations and reports of practices to expel the placenta or stop bleeding (forced gagging, applying hard manual pressure to the abdomen or pulling on the umbilical cord). Certain redundant birthing

practices like discarding colostrum, bathing babies immediately after birth, using unhygienic material to chop and apply on the cord and delayed weighing of babies still be practiced not only in home births but also in health institutions in India. The hazardous practices like abdominal massage, cord cut, cord tied and cord application is widely practiced in slums of Delhi which is against the standard medical practices. The above table highlights the various other kinds of malpractices which are prevalent in slums of Delhi. This paper highlights the importance of training to enhance TBAs' knowledge, alongside community awareness programs. Potentially detrimental cultural beliefs got to be addressed too, when TBA training programs are initiated so as to enhance maternal and child health outcomes.

Antenatal care has a huge impact on the health of the mother and child. However, good quality prenatal care is not evenly distributed in society. Advancements in technology have complicated the tertiary care available to those who can pay. At the same time, the gap between the rich communities and the poor, marginalized and underserved communities is increasing. Traditional birth attendants refer to traditional, independent community based health providers. These include both trained and untrained birth attendants. Traditional birth attendants are those who have acquired their skills informally through and assisting other TBA (Traditional birth attendants). TBA is not homogenous group and their profile varies considerably across time, space and setting. However, over the years the term skilled attendant was employed which exclusively refers to people with midwifery skills. The present table gives a detail account of all the practices in the slums areas which an expected mother undergoes during her prenatal care period.

As efforts to provide improve maternity services continue, analysis of acute maternal morbidity is an important tool in identifying areas where systems can be improved. For every woman who dies, there are a number that face organ failure or other serious conditions which can have long term consequences for their health. Pre-pregnancy counselling for women of childbearing age with pre-existing illness (including psychiatric conditions) with implications for pregnancy should be informed. Pre and post pregnancy counselling should be routinely commissioned as an integral part of local maternity services.

**Table 3**  
**Seasonality Affects Nutrition with Gravida**

Calories intake	No children		Primipara		Multipara		Grandpara		Total	
	Yes , Seasonality do affect	No, Seasonality do not affect	Yes , Seasonality do affect	No, Seasonality do not affect	Yes , Seasonality do affect	No, Seasonality do not affect	Yes , Seasonality do affect	No, Seasonality do not affect	Yes , Seasonality do affect	No, Seasonality do not affect
less than avg 581	26 96.3%	1 3.7%	40 85.1%	7 14.9%	41 97.6%	1 2.4%	124 91.9%	11 8.1%	231 92.0%	20 8.0%
>= avg 582	10 90.9%	1 9.1%	21 95.5%	1 4.5%	32 94.1%	2 5.9%	75 94.9%	4 5.1%	138 94.5%	8 5.5%
Total	36 94.7%	2 5.3%	61 88.4%	8 11.6%	73 96.1%	3 3.9%	199 93.0%	15 7.0%	369 92.9%	28 7.1%

Table 3 provides information on gravida of women in urban slums of Delhi. The term gravida can be used to refer to a pregnant woman. A "nullgravida" is a woman who has never been pregnant, a "primigravida" is a woman who is pregnant for the first time or has been pregnant one time, a "multigravida" or "secundogravida" is a woman who has been pregnant more than one time. From the above table, we are



trying to correlate how seasonality affects the income of the women, nutritional status along with their gravida. Another important factor that affects women work and income is seasonality. Under, this there are two arguments put forward. Firstly, opportunities of work were dependent upon season. Secondly, even within the season the work was not available throughout the year which leads to variation in income which finally makes significant impact on the nutritional status of women and children. Most of the income earned was spend on food and other essential household items. Household with economically dependent adults and larger household were most vulnerable. Thus, women under these circumstances can act as catalyst towards household nutrition as most of the surveyed women around 80% spent their income on food, followed by their children education and health. The amount of working hours, hard work does not commensurate income of the women which affects the nutritional status of women and children.

For measuring the calorie intake, 24-hour Dietary Recall (24HR) method was used as it provides comprehensive, quantitative information on individual diets by querying respondents about the type and quantity of all food and beverages consumed during the previous 24-hour period. The open ended data from the calorie intake was converted into two categories less than average and more than or equal to average. Individual-level quantitative dietary data can also be used to develop a better understanding of typical household food preparation, cooking methods, foods consumed within the household. Furthermore, if individual-level dietary data are collected in conjunction with information on socioeconomic status, education, and health, the data can be used to examine linkages between income levels and dietary choices, as well as dietary patterns and health outcomes. 24HRs provide quantitative estimates of individual food consumption and nutrient intake. The above table is a trivariate which shows interlinkages calorie intake, seasonality and gravida. The table highlights that irrespective of the levels of gravida 92.9 per cent of women seasonality does affect their nutrition levels of the entire household specially the children.

**Table 4**  
**Complications during pregnancy (N = 400)**

Complications during pregnancy	Non-Notified	Notified	Total
No problem diagnosed	29(14.5)	117(58.5)	146(36.5)
Night Blindness	5(2.5)	66(33)	71(17.75)
Blurred Vision	12(6)	17(8.5)	29(7.25)
Swelling On legs and Face	31(15.5)	0(0)	31(7.75)
Excessive Fatigue	44(22)	0(0)	44(11)
Anaemia	34(17)	0(0)	34(8.5)
Oligohydramnios	2(1.0)	0	2(0.5)
Urine Infection	2(1)	0	2(0.5)
Infection in Uterus	2(1.0)	0	2(0.5)
Problem In stomach	2(1)	0	2(0.5)
Pain In abdomen	20(10)	0	20(5)
Body Swollen	9(4.5)	0	9(2.25)
Pain in legs	2(1)	0	2(0.5)
Low BP	5(2.5)	0	5(1.25)
Jaundice	1(.5)	0	1(.25)
Total	200(100)	200(100)	400

*Note: Figure in the parenthesis shows percentage to their respective total.*

Table 4 provides information on various types of complications reported by women during their last pregnancy. Complications such as night blindness, blurred vision, swelling on legs and face, excessive fatigue and anaemia together accounted for 52.25 per cent of complications which women faced during their last pregnancy. Nonetheless, women in very miniscule proportion reported problems like anemia (8.5%), oligohydramnios (0.5%), urine infection (0.5), infection in uterus (0.5%), problem in stomach (0.5%), pain in abdomen (5%), body swelling (4.5%), pain in legs (1%), low blood pressure (2.5%) and jaundice (0.5%). Around 58.5% of women in notified slums faced complication during their last pregnancy while in the non-notified slums the corresponding figure was only 14.5 per cent.

**Table 5**  
**Types of Communicable and Non-communicable Disease among Women during OPD Visits**  
**(N = 400)**

Communicable disease		Non-Communicable		Total
Jaundice	132(65)	Kidney Problem	26(31)	158(55.05)
Pneumonia	21(10)	Respiratory Distress	18(22)	39(13.5)
Malaria	3(1)	Fracture in hand	1(1)	4(1.3)
Tuberculosis	8(4)	Pregnancy related Complication	3(4)	11(3.8)
Cough and Cold	24(12)	Operated	3(4)	27(9.4)
Gastroenteritis	2(1)	Brain Problem	4(5)	6(2.09)
Dengue	7(3)	Whitish discharge	1(1)	8(2.7)
Typhoid	5(2)	Infection in Heart	3(4)	8(2.7)
Diarrheal Problem	2(1)	Joints Pain	9(11)	11(3.8)
		Fit Problem	4(5)	4(1.39)
		Cancer	1(1)	1(.348)
		Problem in Uterus	2(2)	2(.696)
		Menopause Problem	1(1)	1(.348)
		Thyroid Problem	1(1)	1(.348)
		Anaemic	6(7)	6(2.09)
Total	204		83	287

*113 women did not make any OPD visit in 3monthspreceding the survey.*

*Note: Figure in the parenthesis shows percentage to their respective total.*

Table 5 shows various types of communicable and non-communicable diseases prevalent among women in slums in last three months preceding the survey. Out of 400 respondents 113 (28.25%) did not make any OPD visit in the last three months preceding the survey. Then above table shows various types of communicable and non-communicable diseases prevalent among women in slums in last three months preceding the survey. The above table shows various types of communicable and non-communicable diseases prevalent among women in slums in last three months preceding the survey. Out of 400 respondents 113 (28.25%) did not make any OPD visit in the last three months preceding the survey. From Table 4 it is very much evident that 65% of women suffer from jaundice, pneumonia (10%), malaria (1%), tuberculosis (4%) cough and cold (12%), gastroenteritis (1%), dengue (3%). typhoid (2%) and diarrheal problem (1%). Though women also suffer from non-communicable diseases the incidence is much lower compared with communicable diseases. Problems such as kidney disorder and respiratory distress account for around 51% of non-communicable diseases. The major reason of the spread of communicable diseases

in these low income households is the low quality water supply which makes them prone to water borne diseases. The lack of maintenance of proper sanitation and hygiene further adds to the agony of these low income settlements.

**Table 6**  
**Causes of Maternal Deaths in Slums**

<b>(Maternal Mortality)</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Direct Causes</b>	3	9.6
Abortion Related	4	12.9
Postpartum Haemorrhage	2	6.4
Eclampsia	4	12.9
Ruptured Placenta	3	9.6
Prolonged labour	6	19.3
<b>Indirect causes</b>		
Anaemia	7	22.9
Malaria	2	6.4
<b>Total</b>	<b>31</b>	<b>100</b>

Massive and strategic investments have been made under the National Health Mission for improvement of maternal health. Maternal health is an important aspect for the development of any country in terms of increasing equity and reducing poverty. The survival and wellbeing of mothers is not only important in their own right but are also central to solving large broader, economic, social and developmental challenges. The mother is the centre around which the health of the whole family revolves. Thus, it can be said that catering to the needs of mother one can improve the health of entire family. Woman is the epicentre of the family. Thus, indirectly looks after the needs of the entire family whether it is social, political, economic, psychological, nutritional and other associated issues of the family. The above table shows the causes of maternal death in slums of Delhi. In direct causes prolonged labour and indirect causes anaemia were the significant reasons for the deaths among women in the slums of Delhi.

### **Conclusion and Recommendations**

The study has revealed that more than 70 percent of women in the slum are suffering from various types of communicable and non-communicable diseases. One of the leading factors for illness among the slum women is poor environmental sanitation and lack of availability of safe drinking water. The pregnant and lactating women in the slum also suffer from various kinds of problem such as night blindness, blurred vision, swelling on legs and face, excessive fatigue and anaemia during their last pregnancy. The delivery being conducted by the TBAs needs to be checked and government has to be prompt in taking action on this front so as to check infant mortality, morbidity and delivery related maternal issues. Accountability of and to governments, district authorities, facilities, health leaders (including health care professional associations) and communities is often hampered by a lack of data, weak information systems, and lack of independent review mechanisms. The government should encourage to track performance, publish results and create internal accountability in the health system. The regular progress review against targets in the operational plan should be made public and discussed in national forums, including at multi stakeholder forums. To complement regular reporting, there should be periodic independent assessments of progress to validate routinely collected results. It is expected that this information will be used by and inform the accountability mechanisms managed by local communities to generate community-based case studies, tools and best practices. This will also enable community engagement in evidence-based budget advocacy and accountability to be scaled up so that the women at large should benefit.

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## SWOT Analysis of Indian National Biomass Cook Stove Initiative

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### Abstract

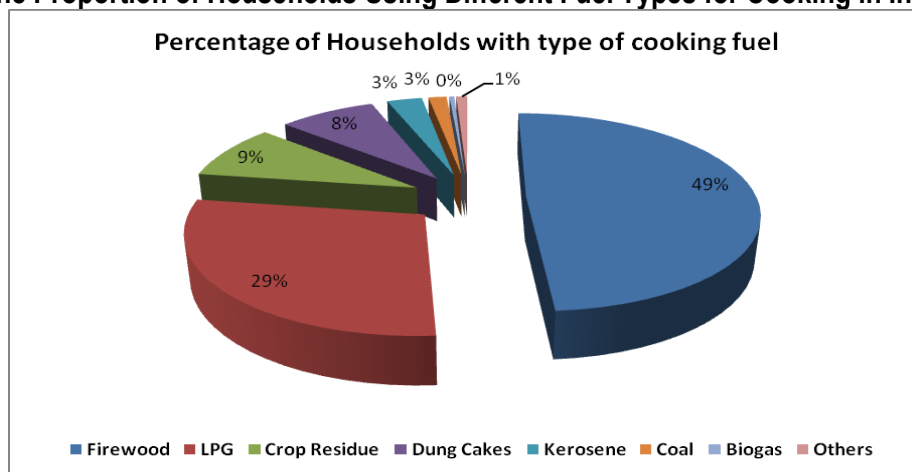
Cooking is central to human lives. A sizable portion of India's population still relies on biomass fuels, such as wood, animal wastes, and agricultural residues, to meet their energy needs for cooking. According to the 2011 census, 67.3% of the Indian population used biomass fuel for cooking. Also, the cooking devices used had poor thermal efficiency and posed a severe threat to health due to unclean combustion. The past few decades have seen immense efforts by the Indian Government to introduce improved cook stoves and cleaner cooking fuels; however, most of these interventions have largely failed to bring the much-needed transition. Learning from past experiences, the Government of India initiated the National Biomass Cook stoves Initiative (NBCI). This program uses a different approach based on the changes that have taken place in society and technology over the years. In the present paper, Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis has been done on NBCI to determine the extent to which the new programme is likely to ensure access to clean cooking energy for all.

**Key Words:** National Biomass Cook stove Initiative, Biomass fuel, Improved Cook stove, SWOT.

### Introduction

The use of biomass fuels like wood, dung cake, and crop residue for cooking is widespread in India, especially in rural areas. According to the latest Census conducted in 2011, 67.3 per cent of the population in India uses biomass as its primary cooking fuel, as shown in Figure 1<sup>1</sup>.

**Figure 1**  
**The Proportion of Households Using Different Fuel Types for Cooking in India**



Census of India, 2011

In India, the most commonly used stove for cooking is the traditional mud stove called a 'Chulha' adapted to burn all kinds of biomass fuels. When the solid biomass fuels are burnt in such stove, a major fraction of the fuel's available energy goes waste because of its low efficiency. Another problem associated with these cooking devices is their inability to vent smoke out of the kitchen, which results in smoke being trapped in

the kitchen leading to building-up of indoor pollution levels that are high enough to cause serious health problems<sup>2</sup>. In the context of the above-cited concerns, the Ministry of New and Renewable Energy (MNRE) launched the National Biomass Cook stoves Initiative (NBCI) in 2009. The present paper highlights the Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis of NBCI. This review will help determine the extent to which the new program is likely to overcome the weaknesses of similar programs initiated earlier and ensure access to clean cooking energy for all.

### **Government of India's Previous Improved Cook-stove Initiatives**

One of the most notable household energy programs in the past was the National Programme of Improved Chulahs (NPIC) launched in 1983 and ended in 2004<sup>3</sup>. The program had two primary aims, first to reduce demand on fuelwood to check widespread deforestation; and second, to improve health by removing smoke from kitchens. The program aimed to disseminate improved cookstoves in the community. A total of 33.8 million improved cookstoves were installed under this program with varying degrees of success in different regions of the country. Some models had better acceptability than others in specific areas. Some states, such as Haryana, Maharashtra, and West Bengal of the country, showed greater enthusiasm by the users to adopt new designs<sup>4</sup>. For a variety of reasons, the program brought a mixed bag of experiences<sup>5,6</sup>.

As with many improved stove programs worldwide, NPIC did not emphasize user interaction during the planning and implementation. An exception is perhaps the case of Haryana, where the Department of Women and Child Development (the NPIC implementing agency in that State) developed the improved stoves with direct inputs from its network of over 7,000 women's groups (Mahila Mandals). Besides, there were extensive interactions between the woman's group and the stove designers on designing various models of stoves. About 237,000 new cookstoves were installed in the State between the years 1995 and 2000. However, information on the health benefits of reduced kitchen smoke was not known<sup>7</sup>. The program was formally declared closed in 2004.

### **Drawbacks of the NPIC**

- The programme was heavily subsidized and employed a target-oriented dissemination approach<sup>7</sup>
- Although the program had robust technical back-up components, poor communication among policymakers, field staff, and users affected adoption rates.
- Since interaction with the users was minimal in the program, as a result, issues like cultural and fuel management practices and adoption of behaviour change communication strategies remained unaddressed.
- There was inadequate training on the construction and maintenance of the cook-stoves.
- It is unknown whether Household Air Pollution (HAP) was reduced since HAP levels were not monitored under the programme.

### **National Biomass Cook-stoves Initiative (NBCI)**

In the context of concerns over health, climate change, and energy security, the Ministry of New and Renewable Energy (MNRE), Government of India launched National Biomass Cookstoves Initiative (NBCI) in December 2009 with the primary aim to increase the use of improved biomass cookstoves<sup>8</sup>. The initiative stressed upon setting up of state-of-the-art testing, certification, monitoring facilities, and strengthening research and development (R&D) programs. The aim was to design and develop the most efficient, cost-

effective, durable, and easy-to-use cooking device. In India, the Department of Non-conventional Energy Sources (DNES), had initiated demonstration of improved cookstoves soon after its inception in 1982, followed by the launch of earlier National Programme on Improved Chulhas (NPIC) in 1983. In 1992, the DNES was upgraded as the Ministry of Non-conventional Energy Sources (MNES) and continued managing it. In 2009, the ministry was renamed as Ministry of New and Renewable Resources (MNRE). The current program of NBCI, which was launched by MNRE, has been structured differently from earlier. For instance, management of the stove program has been handed over to individual state agencies, whereas in the previous scheme, the responsibility of management was retained by the Central Government.

MNRE has kept a target of 2.75 million improved cookstoves to be disseminated in the current five year plan period (2012-2017) with a budgetary outlay of Indian Rs.2940 Million<sup>9</sup>. The programme is being implemented mainly through State Nodal/Implementing Agencies. State Departments of Education, State Rural Livelihood Missions, District Coordinators of Mid-Day Meal Scheme, District Level Officer of Anganwadis (daycare center for pre-school children), District Coordinators/Officers of Tribal/Schedule class/Backward Class Hostels and similar other departmental agencies where cook-stoves could be employed. NGOs/CSOs, manufacturers, business development organizations, etc. engaged in the implementation of renewable energy projects at grass root levels are also stakeholders in the programme. The target users are individual households in rural areas, who use biomass for cooking purposes. Kitchens of MDM scheme, Anganwadis, Forest Rest Houses, Tribal Hostels, and small business establishments (roadside *dhabas*, small hotels, and restaurants and a variety of cottage industries like textile dyeing, drying of spices, etc. They are to be supplied with improved biomass cook-stoves complying with improved standards prescribed by the Bureau of Indian Standards (BIS). The field monitoring of cook-stoves is carried out through the "Third Party Monitoring System" by a consortium of R&D/ academic institutions, professionals, and monitors identified by MNRE. Eventually, a web-based monitoring system will be developed wherein mobile camera-based photos of cook-stoves in use will be uploaded. The overall progress is reviewed by the Core Group on Biomass Cook-stoves of MNRE.

Four Biomass Cook-stoves Test Centres funded by MNRE for performance testing and certification of biomass cook-stoves industry from different country zones continued during the year 2014-15. These Test centers have test facilities with advanced equipment at par with international laboratories. These Test centers have been set up at-

- Indian Institute of Technology (IIT), Delhi;
- Institute of Mineral and Mineral Technology (IMMT), CSIR-Bhubaneswar, Orissa ;
- College of Technology and Engineering, Maharana Pratap University of Agricultural and Technology (MPUAT), Udaipur, Rajasthan and
- Sardar Swaran Singh National Institute of Renewable Energy (SSS-NIRE), Kapurthala, Punjab.

These centers carry out performance testing of different models of improved cookstoves as per the standard performance parameters given in Table 1. In keeping with commitments of the NBCI, MNRE, during the year 2012-13, took up a pilot-scale project for demonstration of 120,000 improved biomass cookstoves for domestic and large-sized community cooking in MDM schemes in government schools, and tribal hostels [MNRE, 2013].

## SWOT Analysis of the Programme

Since the NBCI has completed 5 years, it is worthwhile to assess the programme using the analysis of strengths, weaknesses, opportunities and threats (SWOT) to draw an analytical profile. This would help identify gaps and threats in the program so that the same could be utilized to improve the program's performance throughout the country.

### Strengths

**Multiple stakeholders:** There are many actors in the household energy sector in India. They include governmental agencies, Non-Government Organisations (NGOs), research institutes, multinational organizations, donor agencies, etc. NBCI is being implemented through R&D/academic institutions such as National Environmental Engineering Research Institute, Nagpur, Maharashtra; Shri Ram Institute of Industrial Research, New Delhi; Indian Institute of Petroleum (IIP), Dehradun, Uttarakhand; Central Building Research Institute (CBRI), Roorkee, Uttarakhand; Central Pollution Control Board (CPCB), New Delhi; the US Environmental Protection Agency Labs, USA, and University of California, Berkeley, USA. Besides this, the State Nodal/Implementing Agencies, State Departments of Education through District Coordinators of MDM Scheme, District Level Officers of Anganwadis, District Coordinators/Officers of Tribal/Scheduled /Backward Caste Hostels and similar departmental agencies where cookstoves could be employed. Also, the NGOs, manufacturers, business development organizations, etc. engaged in the implementation of renewable energy projects at the grass-root level are part of the programme.

**Huge market potential for improved stoves:** Despite rapid urbanization, about 70 per cent of Indians still reside in rural areas. Most villagers still depend predominantly on traditional fuels to meet their energy needs. The use of biomass fuels like wood, dung cake, and crop residue is widespread in rural areas. According to the 2001 census, 74 per cent of Indian households relied on biomass as their primary cooking fuel, which has come down to 67 per cent according to the latest Census conducted in 2011<sup>1&9</sup>. So, the target population is still above 50 per cent of Indian households.

**Multiple designs of improved cook-stove:** NBCI promotes many cookstoves' designs to give the users a basket of choices from which they can pick the stove that meets their needs the best in terms of the variety of cooking practices, fuels, and levels of affordability. Both engineering and non-engineering parameters are now taken into consideration in designing appropriately improved cookstoves. The majority of cookstoves in the market are tailored to provide a more advantageous cooking experience without requiring any fundamental change in user cooking habits.

### Strong performance monitoring

The field monitoring of cookstoves is carried out through the "Third Party Monitoring System" involving R & D/academic institutions and monitors identified by MNRE. In the new initiative, it is required that all the manufacturers in the distribution channel get their improved cookstoves certified before installation in the field.

The standard performance parameters for testing of cookstoves include-

- Thermal efficiency as a function of power input (or the fuel burning rate).
- CO, CO/CO<sub>2</sub> ratio, particulates (PM total and PM<sub>2.5</sub>), and Black Carbon as a function of fuel burning rate.



- Durability and safety tests.  
Eventually, MNRE plans to have a web-based monitoring system in place to monitor the actual usage of the cookstoves after installation.

**Indirect benefits of improved cookstoves:** The use of solid biomass fuels for cooking is the largest source of HAP in India, particularly in rural areas where more than 85 per cent of the households still depend on biomass for their daily cooking needs<sup>1</sup>. It is now widely recognised that improved energy services at the household level can reduce child mortality rates, improve maternal health. It reduces the time and the transport burden on women and young girls for cooking and fuel collection to have more time for education and other productive works<sup>10</sup>. It is also recognised now that effective household energy programs can lessen the pressure on fragile ecosystems<sup>11</sup>.

**Improved environment in the kitchen:** Complete combustion or the use of a chimney results in the kitchen being healthier. With the use of an improved cookstove, cooking time can be substantially reduced, and the time saved can be used productively for other purposes. Although improved stoves are not at par with Liquefied Petroleum Gas (LPG) in terms of efficiency or emissions. A country like India, where about 67% of households (equivalent to about 166 million households) remain wedded to solid fuels as their primary source of cooking fuel, a complete conversion to LPG is not feasible in the near future. Given that the majority of India's population is likely to remain young and rural over the next ten years, solid fuels will continue to play an essential role in the energy mix of households<sup>12</sup>

**Issues of cook-stove safety:** In the new designs of cookstoves, precautions have been taken against sparks and burns. Equal importance is given to stability against tilting while stirring the food during cooking, especially in the portable stoves. Therefore, the new, improved cookstoves are safer as compared to the previous models.

**Opportunity for employment generation at the local level:** Involving the local community in various operational aspects of the cook-stoves in the new program offers immense possibilities for their participation and entrepreneurship in the programme, especially for women through self-help groups. The community gets a sense of ownership as they are involved in various aspects of the programme.

## **Weaknesses**

**Lack of Awareness:** Research suggests that rural people are not concerned about cooking fuels and deforestation issues, mainly due to a lack of awareness. Householders are often unaware of the detrimental health and environmental effects of smoke from traditional cooking practices<sup>13</sup>. Therefore, they lack the knowledge of the health benefits from improved cooking stoves, especially to women and children. Recently, a pilot study conducted in three Indian states reported that only 14 per cent of households believed that adopting a clean stove could alleviate the adverse health effects of traditional cooking. Knowledge and belief that improved stoves could improve environmental outcomes such as forest preservation and protection of regional air quality were even lower<sup>14</sup>. The rural and urban households have different criteria for fuel switching, and factors like convenience, availability, awareness, and social values play significant roles in such decisions. Improving public awareness about household energy and health linkage will boost the demand and sale of improved cook-stoves.

**Socio-Cultural Factors:** Despite changes in the program, certain strong cultural factors prevent widespread use of efficient cookstoves. They include traditional cooking practices, and other benefits such as space heating by conventional cookstoves, and slow cooking when the women are out in the fields. It is essential to ensure that the improved cookstoves allow women to continue with their traditional cooking practices. The current program may not be able to overcome these forces. Studies show that sometimes problems emerged with cooking for large gatherings<sup>15</sup>. Another study reported problems with cookstove burners being too small for large pots<sup>16</sup> and difficulties lifting heavy containers onto the raised cooking surface<sup>17</sup>. Similarly, not feeling the need to change cooking habits<sup>18-20</sup> not being able to cook traditional foods<sup>16</sup> and not being familiar with the improved cookstoves<sup>18</sup> were other socio-cultural barriers reported by researchers.

**Multiple stakeholders:** While many levels of stakeholders are seen as strengths to the program, they also make the programme's administration cumbersome and fragmented. Coordination with all the concerned stakeholders is a challenging task for the implementing agency. Involving stakeholders is critical in understanding barriers to disseminating bio-energy technologies and is recognized as the key to the successful implementation of projects.

**Financial implications:** Although improved stoves save money in the long run, the initial investment required for a really clean stove may prevent poor people from purchasing it. Where communities were required to pay the full cost of the improved cookstoves, the price was reported as an important barrier among poorer households<sup>21</sup>. In the pilot study conducted in three states of India, the majority (63%) of randomly selected households cited cost as the least desirable aspect of the improved cookstoves<sup>14</sup>. Although consumers are willing to adopt new cooking approaches, the product must be cost-competitive with existing solutions such as LPG stoves.

**Lack of testing centers in the field:** Laboratory tests do not necessarily demonstrate the efficiency of stoves in actual use in people's houses; stoves that are efficient in the laboratory may not give similar results in the field as the laboratory tests are performed under controlled conditions. Field testing of their thermal efficiency and other operational factors must be ensured before the government-promoted installation of these stoves. The Government still does not have strong enough laboratory back-up and trained personnel appointed for this work in the field.

**Slow switch-over to cleaner fuels:** As income increase, households generally switch-over to cleaner and more efficient fuels for their domestic energy needs, i.e., move up the 'energy ladder.' However, in many rural areas, households often employ 'multiple models' of stove and energy use, and fuel substitution is often partial<sup>22,23</sup>. As a result, the full benefits of "clean" stoves are not achieved. As per the 2001 census of India, biomass fuel use in households was nearly 74 per cent, which came down to 67 per cent in the 2011 census<sup>1,9</sup>. While conversion to modern fuels has accelerated in urban areas, populations in rural areas have remained slow in moving away from solid fuels. It can act as a roadblock in the successful implementation of the programme.

**Programme lacks coverage:** Although there are a wide variety of cook-stove technologies in the market with extensive participation of both the private and NGOs, majorities of them are small scale players<sup>8</sup>. Slowly the Indian states are also coming up with a pilot demonstration of improved cook-stoves, but the progress is not uniform throughout the country. There is an urgent need to scale up the program for meeting the demand of 100 million stoves to cover the whole country. Despite the assurance of improved cook-stoves; adoption and use rates have remained low<sup>24</sup>. Some have researchers contended that stoves

are a “push” rather than a “pull” product (unlike a technology such as cell phones), suggesting that innovative methods are required for delivering stoves to households and convincing them about their utility<sup>25</sup>.

**Community need assessment:** Due to diversity in topography and demographics, food preferences in India are influenced by traditions, availability of local resources, and climate conditions. All these factors should be considered while designing and marketing the improved cook-stoves in a particular region; otherwise, it is unlikely to meet the user’s expectations.

**Greater emphasis on processed fuel:** The main technological improvements in cook-stoves are based on processed fuels. In contrast, the traditional stoves used by the majority of the Indian population depend upon unprocessed solid biomass fuels, which are usually available free of cost. Transforming biomass into processed fuels for use with improved cook-stoves usually incur a financial cost to the buyer. Moreover, such fuels will require a well established and continuous supply chain, which adds liability to the program<sup>26</sup>.

**Biomass Mapping:** The existing biomass resource data is quite old. An extensive study on the availability of biomass type, quantity, seasonal variations, costs, and suitability for pelletization is required to update the information.

**Launch of PMUY:** To promote clean cooking fuels in 2015, Government of India and the 3 oil marketing companies that market LPG in India started three major programs to actively promote LPG to the poor, each pioneering, and relying heavily on both sophisticated social marketing and (JAM) electronic bank accounts, biometric ID cards, and mobile phones. The first programme, *Pahal*, shifted to paying subsidy fuel payments into people’s bank accounts and thus all LPG is now sold at international rates in the market, greatly reducing diversion of LPG to the non-household sector. The second, “Give it Up,”persuaded middle-class households to give up their subsidies to connect the poor. The third, *Pradhan Mantri Ujjwala Yojna* (PMUY) which is underway now, provided 50 million connections to poor households by 2019.

## Opportunities

**Huge market potential:** Based on the overall population, fuel practices, and income segments, there is a big market for cook-stoves. India’s overall market size is about 166 million households (the equivalent of nearly 67% of the population), more than the total market sizes of many other developing countries combined.

**Opportunities for public-private partnership:** The NBCI Initiative opens up opportunities for applying the public, private partnership (PPP) model at all levels. If such alliances are implemented effectively, it can provide an opportunity for all stakeholders such as Government, industry, academic institutions, and social sector to benefit from each other’s expertise and resources. Micro-institutions such as NGOs, creditors, and retailers can also be vital for delivering improved cook-stoves in India<sup>27</sup>. When the local community is unsure about new technology, NGOs can serve as a channel for trust-building among the community<sup>28</sup>.

**Mid-day meal scheme offers additional opportunities:** The MDM programme is a scheme of India’s Government, designed to improve the nutritional status of school-age children<sup>29</sup>. The scheme provides free lunches for children in Primary and Upper Primary Classes in Government and aided schools on working days. Being the most extensive programme globally, the scheme allows utilizing the community cook-stoves for meal preparation<sup>29</sup>.

**Carbon finance on biomass cook-stoves:** Switching to clean biomass cook-stoves can reduce greenhouse gas emissions related to fuel burning. These avoided emissions can be sold as carbon offsets in the Clean Development Mechanism (CDM) markets. Cook-stove interventions are the most effective mechanisms to reduce CO<sub>2</sub> emissions per unit cost. To increase the affordability of cook-stoves for the poor, carbon finance may offer an effective mechanism for reducing the price. Wider use of cleaner cook-stoves is estimated to reduce India's black carbon emissions by about 0.15 million tonnes annually, one-third of the total black carbon emissions in India <sup>12</sup>

**Raised public awareness:** There is an increased awareness of air pollution and its health impact in India due to epidemiological research and greater media exposure. Therefore, there is a widely felt need for providing cleaner cooking options to improve household air quality in rural households at an affordable price<sup>30</sup>.

## Threats

**Slow progress of the programme:** Though NBCI has incorporated lessons learned from the earlier program, yet the development of the programs has remained slow so far. The country's NBCI's Initiative seeks to provide nearly 166 million improved cook-stoves to households currently using solid biomass fuel, which is too ambitious<sup>31</sup>. MNRE has proposed a target of 2.75 million improved biomass cook-stoves of family type and community size, to be installed in the remaining period of the 12th Five-Year Plan period. The current pace is quite slow in viewing the targets for a country like India<sup>32</sup>.

## Challenging rural market

Though the overall cook stove market size in India is vast, the easiest consumer segment to target would be mid and high-income biomass fuel users. A big challenge would be rural biomass fuel users who could make up about 85 per cent of the market<sup>12</sup>. Given that they do not have a habit of paying for fuel (as biomass is freely available in rural areas)<sup>33</sup>, it would be hard to break into this segment of the market. Therefore, it will be a real challenge for manufacturers to ensure that the cook-stove is affordable enough for end-level consumers in the chain, especially in rural areas.

## Inadequate coordination among key players

Cookstoves have become a popular focus area for donor agencies on financing and supporting research. Still, the Government needs to ensure that the programme's objectives may not get diluted due to the pressure of multiple agencies. Sometimes, administrative arrangements and the donor partner's requirements may work against market sustainability<sup>21,34</sup>. In particular, short term projects may not focus on sustainable use of improved technologies<sup>21</sup>. This lack of proper coordination among donors, programme coordinators, and stove users emerged as a barrier to creating sustainable change.

## Monitoring and Evaluation at Field Level

The field monitoring of cook-stoves is carried out through the "Third Party Monitoring System" by a consortium of R&D/academic institutions, professionals, and monitors identified by MNRE<sup>35</sup>. But, currently, the number of such institutions is limited and insufficient for covering a vast country like India. Moreover, these R & D/academic institutions do not have adequate laboratory networks and trained personnel to carry

out cookstoves' field monitoring. MNRE may identify more such agencies to carry out monitoring and evaluation, especially through field-level monitoring.

### **Role Clarity of Different Stakeholders**

As the programme has multiple stakeholders, each stakeholder's roles and responsibilities must be clarified right in the beginning else; it would result in overlapping of work or missing some critical aspect altogether. Effective strategies to reduce the burden of HAP require commitments from various sectors. Though different ministries (e. g. health, environment, rural development, MNRE, housing, poverty alleviation, oil and natural gas, women and child development) aim to address this issue, their efforts stand isolated. There is a need for an integrated approach and policy to manage this issue in a more coordinated manner.

### **Conclusion**

To address the HAP, the last few decades have witnessed many household energy initiatives taken by the Government of India. Still, the pace of switching over to clean fuel/stove has not been very encouraging. The SWOT analysis of the NBCI program suggests that it contains several promising elements as it has incorporated the concerns raised in the previous programs. The lessons learned from earlier experiences can be the guiding force in implementing a successful household energy program. The present program has some limitations too. Therefore, the MNRE (the implementing ministry) needs to develop its strategies to capitalize upon the programme's strengths and opportunities and draw up action plans to minimize its weaknesses and threats. If appropriately implemented, the program can ensure access to clean and sustainable cooking energy in India.

### **Policy Implications**

Considering the extensive use of biomass fuels in the countryside and their potential health hazards, immediate measures by all concerned are needed to be taken to reduce HAP.

- HAP is a multi-dimensional problem, and strategies to reduce its heavy toll on the health of rural families need to integrate knowledge and perspectives from different sectors. Therefore, multi-sectoral coordination, mainly involving the Ministries of Environment and Forests, Rural Development, Women and Child Development, Health, and the Department of Science and Technology, is needed along with community participation.
- Geographically and socio-culturally, India is a very diverse country, so one solution may not work everywhere. Therefore, we need to adopt multiple mitigation strategies that would include a range of technical options - cleaner fuels, better stoves, and improved kitchen ventilation, etc., targeted at different population groups.
- The administrators, policymakers, and the victims of HAP are largely unaware of the harm biomass fuels are causing on their health. Therefore, we need to raise awareness of the problem. Of cost-effective solutions among all stakeholders, especially women, their health becomes adversely affected, as demonstrated in most research studies.
- As long-term measures, the Government needs to consider providing cleaner fuel options such as LPG at an affordable price to the rural people. Other clean fuel options for cooking, such as solar cookers, biogas, briquettes, and gasifiers, may also be explored for use in rural areas.
- If necessary, the subsidy should be given to the below poverty line, as it will save money on account of the treatment of diseases associated with biomass cookstove use.

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## **Pradhan Mantri Jan Aarogya Yojana (PMJAY): The Step towards Amelioration of Health**

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### **Abstract**

*The government of India, (Ministry of Health and Family Welfare) launched Ayushman Bharat, a flagship scheme of government of India on 23<sup>rd</sup> September, 2018. Also known as Ayushman Bharat National Health Protection Scheme, that aims to provide free access of health insurance coverage to deprived families of India of 5 lakh per family per year. It is provided with a budget of 8088 crore rupees for 2021-2022 financial year. It is a joint venture of central and state governments, working in same direction to achieve Universal Health Coverage in country. The objective of this study is to find out the level of existing catastrophic health expenditure in India and the effect of PMJAY on it. The study based on secondary data such as NFHS-IV & NFHS V and available government published reports were used to understand the broad issue of catastrophic health expenditure in India. Information regarding working of PMJAY was collected and compiled to know the impact of implementing this scheme state wise. Important articles were collected in full text for further reference. Healthcare facilities in India after launching of PMJAY are paving the way for poor population. This seems to be an effective step, as recent reports proved it's expeditiously.*

**Keywords:** PMJAY, Catastrophic health expenditure, UHC, OOPE.

### **Introduction**

The Ayushman Bharat scheme launched by the government of India is an attempt to combat the triple burden of disease of India (backlog of infection, malnutrition and non communicable disease). As an attempt to navigate our resources towards the commitment of sustainable development goal's leaving no one behind theme and an attempt to achieve Universal health coverage in our nation. The Ayushman Bharat scheme is an attempt to ask for Comprehensive Health Care at primary, secondary and tertiary levels. It picks two places where it can be done. First being establishment of Health and Wellness centers and second being the Insurance sector in the form of PMJAY fully funded by the government of India. Every eligible family is given a health coverage of 5 lakh rupees per year in empanelled hospitals. The sharing pattern of PMJAY is in the ratio 60:40 in states and union territories with legislature as 60 for central government and 40 for state. For North Eastern states and three Himalayan states (J&K, Himachal Pradesh, Uttarakhand) it is 90:10. It subsumed RSBY launched in 2008.<sup>1</sup> It is known to be world's largest health assurance scheme launched in September, 2018. The targeted sector for PMJAY was selected through the socio economic caste census 2011 data. Over 10.74 crore vulnerable and poor families are entitled to get benefit without any restriction on family size, age and gender from day one of becoming beneficiary.<sup>1</sup>

The Out of Pocket Expenditure (OOPE) is defined as any direct payments made by individuals at the time of service use. It becomes catastrophic health expenditure when someone spends 5% to 20% of household income on health.<sup>2</sup> A study on catastrophic health expenditure in India from 1993 to 2014 states that proportion of catastrophic health expenditure increased from 1.47 fold between 1993-94 to 2011-12 expenditure survey. And it was 2.24 fold between 1995-96 and 2014 survey.<sup>3</sup> In 2015, approximately 8% of



Indian population had been pushed below poverty line by high out of pocket payment for health care.<sup>4</sup> This increasing expenditure pushed our policy makers towards creating a health assurance scheme that targets all of underprivileged population .

This paper aims to illustrate the impact of OOPE in India and the factors responsible for OOPE. The study also discusses the challenges that are being faced in implementation of PMJAY.

### Data & Methodology:

It is a descriptive study and the article is written based on the electronic search of data available on internet, National Family Health Survey (NFHS) IV & V India reports, published reports of *NITI Aayog* and literature review.

### Results & Discussion:

#### Status of PMJAY in India

The PMJAY is a central sponsored scheme and being implemented more than 30 states and UTs in India. The scheme covers poor and vulnerable families providing coverage upto Rs. 5 lacs per family per year for primary and tertiary hospitalization with no cap on family size, age or prevalence existing medical conditions. In spite of the huge diversity across state's health systems in all respects, from expenditures to human resources to health outcomes, the scheme shows a consistent growth and uptakes across the country. More than 14 crores families were enrolled till November 2021 in India, according to the PMJAY records.<sup>1</sup> The state level eligible number of families in PMJAY are given in table 1.

**Table 1**  
**Status of PMJAY by state and UTs**

State/UTs	No. of Eligible Families	State/UT	No. of Eligible Families
Andaman and Nicobar	21399	Lakshadweep	1465
Andhra Pradesh	1,44,79,557	Madhya Pradesh	1,08,61,653
Arunachal Pradesh	260217	Maharashtra	8363664
Assam	2696996	Manipur	273250
Bihar	1,08,11,015	Meghalaya	554131
Chandigarh	23678	Mizoram	194859
Chhattisgarh	5570919	Nagaland	233328
Dadra& Nagar Haveli and Daman & Diu	61950	Puducherry	103434
Goa	36431	Punjab	3957205
Gujarat	7588537	Rajasthan	10923867
Haryana	1545936	Sikkim	39738
Himachal Pradesh	478985	Tamil Nadu	1,47,00,000
Jammu and Kashmir	2054298	Telangana	8756842
Jharkhand	5710933	Tripura	490964
Karnataka	1,15,00,000	Uttar Pradesh	12528329
Kerala	4156111	Uttarakhand	1569468
Ladakh	39542	<b>India</b>	<b>14,05,88,701</b>

Source: [www.pmjay.gov.in](http://www.pmjay.gov.in)

Among the states, Tamil Nadu has the highest number of beneficiaries (1.47 crores) followed by Andhra Pradesh (1.44 crores) and lowest in state of Goa (36.4 thousand). Among the union territories the highest number of beneficiaries are in Puducherry (1.03 lacs) and lowest in Lakshadweep (1465).

### **Factors responsible for OOPE in INDIA:**

Many factors are found responsible for Out of Pocket Expenditure (OOPE) in India. The determinants for out-of-pocket expenditure were listed as highest for burns, road traffic accidents and medicines constituting 47 per cent of total expenses. The economic impact of injuries was high for out of pocket expenditure and productivity loss<sup>5</sup>. The report of *NITI Aayog*' India's Missing Middle states that the prevalence of catastrophic health expenses was found to be 14.8 5 per cent which was significantly associated with the lower socioeconomic status and chronic illness<sup>6</sup>. The OOPE was higher for male children of less than one year and people choose approximately 62 per cent of the private sector for treatment of children<sup>7</sup>. People face OOPE when they don't have any primary healthcare services in the village<sup>8</sup>. A study conducted by Mishra & Mohanty (2019), found that OOPE on institutional deliveries had very strong economic and educational factors. The distressed financing on institutional delivery was found to be higher in less educated poor and in private health centers<sup>9</sup>.

### **Significance of PMJAY in INDIA:**

PMJAY scheme offers a distinctive prospect to improve the health status of crores of Indians and eliminate a considerable source of poverty afflicting the country. The need behind changes in our health care system are well illustrated in a report of Planning Commission of India on UHC that made some recommendations regarding where we should be making changes in the healthcare system in our nation. Ensuring equitable access for all Indian citizens, resident in any part of the country, regardless of income level, social status, gender, caste or religion, to affordable, accountable, appropriate health services of assured quality (primitive, preventive, curative and rehabilitative) as well as public health services addressing the wider determinants of health delivered to individuals and populations, with the government being the guarantor and enabler, although not necessarily the only provider, of health and related services.<sup>10</sup> The study by Joseph et al (2021) on empanelment of hospitals Under PMJAY found that a majority of hospital empanelled under the scheme are in states with previous experience of implementing publicly funded Health Insurance schemes, with the exception of Uttar Pradesh. Reasons underlying these patterns of empanelment as well as the impact of empanelment on service access, utilisation, population health and financial risk protection warrant. While the inclusion and regulations of the private sector is a goal that may be served by empanelment, the role of public sector remains critical particularly in underserved areas of India<sup>11</sup>. It is also evident from the study that defines gaps between health priorities in different states.<sup>12</sup>

### **Challenges of PMJAY:**

All the facilities being provided by PMJAY are very eye catching, but their implementation is rather difficult in a nation with approx 50 crore beneficiaries. Many loop holes were found in implementing of PMJAY, but it has solutions too.

Brundtland (2018) mentined about India's health reforms that in creating this Surge in demand in India's Universal health coverage reforms will become unbalanced and favor expensive inpatient hospital care rather than cost-effective primary care. Keeping the fact in mind that government official's primary objective

of Ayushman Bharat Reform was to increase rates of hospital admission among the poor, so that they are similar to rates in India's affluent population. Putting such a high emphasis on expanding inpatient care does not seem appropriate when so many India's health priorities e.g. increasing immunization rates and tackling infections and non communicable disease would be better dealt in primary care settings.<sup>13</sup>

With the blaze of publicity for the launch of Health Insurance program there is a danger that Ayushman Bharat will become synonymous with Hospital insurance for many people in India. This perception could resist in people by passing Primary Health Care Services as they use their gold cards to access specialist care in hospital. It is likely to prove difficult to introduce gate keeping functions into primary care services once people are given instant access to tertiary care.<sup>13</sup>

It was seen that selecting multiple packages is not available in Ayushman Bharat scheme website. While treating patient's doctor have to perform multiple treatments. The process of generating the card for general procedure (1month) and emergency care (2hrs) is different. This resulted in patient paying from their pocket for procedures of emergency because their unique ID numbers are already registered in Ayushman Bharat database but the card is yet to be generated. It is found that sometimes the internet server crashes in incomprehensible areas. At the time it becomes difficult for patients to claim for care. There must be some offline solution for this. The shortage of staff on holidays and the presence of Aarogya Mitra on contract basis affect the functioning of scheme. The availability of medicines on time is also an issue. Approximately 171 cases of fraud are reported by National Health authority some empanelled hospitals are showing different procedure code on paper and claiming the amount. Some states are still not supporting the Ayushman Bharat scheme this can cause rivalry of one scheme against the other.<sup>14</sup> The states with higher needs (measured as poverty headcount) are utilizing the scheme less. Factors underlying this trend include eligibility rules, progress on beneficiary validation, hospital empanelment, long standing demand side barriers, state implementation capacity.<sup>15</sup> All political or non political issues that are not in favor of PMJAY should be resolved; it is the question of health of the population of India.

**Modification required for better performance:**

An analysis by Sanjayl (2020) on implementation efficiency of PMJAY illustrates that different states need a different strategy e.g. the state of Chhattisgarh needs improvement in I.T. infrastructure. Kerala needs improvement of all stakeholders; Madhya Pradesh needs improvement in network hospitals. State of Bihar needs strong strategy to prevent fraud. Maharashtra needs proper utilization of resources, smooth functioning of hospitals. Whereas Manipur needs inclusion of all stakeholders,<sup>16</sup> and the suggested changes required for better coverage and performance given in table 2.

**Table 2**  
**State wise Modification required for better PMJAY coverage**

State	Modification
Chhattisgarh	I.T. infrastructure reform
Kerala	All stakeholders involvement
Madhya Pradesh	Network hospital improvement
Bihar	Fraud prevention
Maharashtra	Utilization of resources
Manipur	Inclusion of all stakeholders

The study done by Keshri & Jagnoor ( 2021) states that India has only 67 burn centers and PMJAY covers only 40 per cent of population for burn management. Burn service coverage is restricted mainly to acute and hospitalized care, this situation need to expand the coverage and ensure adequate financial risk protection with patients with burns.<sup>17</sup>

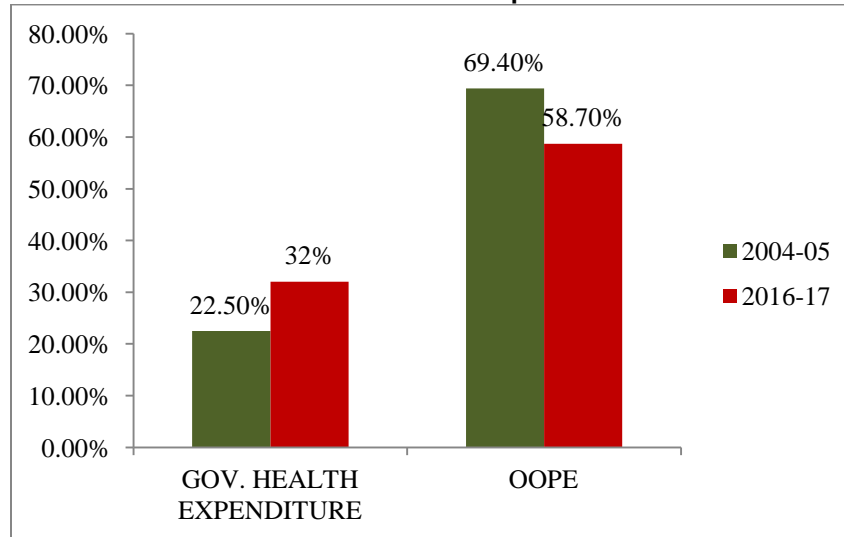
**Impact of PMJAY:** The findings of Ministry of Finance compare the data of NFHS 4(2015-16) and NFHS 5 (2019-'20), best to compare before and after implementation of PMJAY. It draws a comparison between data of West Bengal with neighboring states like Bihar, Assam and Sikkim. The health insurance increased in Bihar, Assam and Sikkim from 2015-16 to 2019-20 by 89 per cent while it decreased by 12 per cent over the same period in West Bengal. IMR decreased by 20 per cent in West Bengal whereas it reduced 28 per cent in neighboring three states. If we compare all states that adopted PMJAY and those that did not adopt we can see a significant difference in between them. States that adopted PMJAY had greater penetration of health insurance, reduced infant and child mortality rates, more utilization of family planning services. Proportion of household with member covered under health insurance increased by 54 per cent. Women with unmet family planning needs reduced by 31 per cent in PMJAY states while it was 10 per cent in non-PMJAY states. Delivery care indicators improved in PMJAY states. Knowledge of HIV increased by 13 per cent in PMJAY states, it was only 2 per cent in non-PMJAY states<sup>18</sup> (Table 3).

**Table 3**  
**Comparison of PMJAY states Vs Non-PMJAY states**

Variables	PMJAY States	Non PMJAY States
Health Insurance	increase 89%	decrease 12%
IMR	decrease 28%	decrease 20%
Women with unmet family planning needs	decrease 31%	decrease 10%
Knowledge of HIV/AIDS	increase 13%	increase 2%

**Reduction in OOPE of India:** The efforts to improve healthcare and reduce OOPE were initiated a long time ago. Taking lessons from their successes or failures, our policy makers are in a process of providing the best for our country. And in continuation of providing best healthcare services we are now with PMJAY. The scheme will make young India's population healthy, and when they all will be rest assured about not facing the OOPE for health, that eventually will make them wealthy too. The prior health assurance schemes were working in a positive direction in reducing the OOPE; this statement is well justified by the latest National Health Authority's 2019-20 report. It states that total health expenditure as a percentage of GDP has sharply declined from 4.2 in 2004-05 to 3.8 in 2016- 17. Over the years the share of government health expenditure has increased from 22.5 per cent in the financial year 2004-05 to 32% in 2016-17 (Figure 1) while that of OOPE has declined from 69.4 per cent to 58.7 per cent<sup>19</sup>. As if government spending will increase, the OOPE will eventually decrease. The launching of PMJAY will decline it more.

**Fig 1**  
**Effect of Government Health Expenditure on OOPE**



## Conclusion

Various studies suggested that our Nation's people were facing a high level of difficulty in getting health facilities due to financial issues. Out of pocket expenditure was pushing millions of people into poverty and those people were unable to take a stand in life again. All those factors pushed our policymakers to work in the direction of the health Assurance scheme and today we all are witnesses of the world's largest Health Insurance Scheme in the form of AB-PMJAY. The COVID-19 pandemic has pushed the world at the back front and in a developing nation like India the motive behind this scheme becomes clearer, as it is trying to stop people falling into poverty.

It is evident from various reports that our purpose behind such scheme will be achieved in due time. It will assure the people of this nation that they can devote their valuable time in upbringing of this nation. Much has been achieved and much is left to do. Now after successful implementation of the scheme we should be working towards successful functioning of the scheme too. Awareness generation is necessary as people still do not know about the benefits and process of PMJAY. The Eligible people must be informed about every possibility they can get. We need to develop policies that work in that direction. Lack of manpower is a roadblock for any best strategy implemented; we need staff to fulfill all the needs. Lack of medicines can be fulfilled by express delivery options available in market. Fraud prevention is necessary, without controlling the fraud this scheme will face financial distress.

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## Dimensions of Fertility and Estimation of Children Ever Born

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### Abstract

*It is widely known that fertility is determined by a complex set of biological, psychological, socio-economic, cultural, political and legal factors. These factors affect the fertility dynamics directly or indirectly. Although the past studies have suggested about a lot of variables for the estimation of total fertility rate, and various fertility models have been developed for estimating the fertility parameters, yet it is difficult to include all the determining variables in a single estimation technique conveniently. In the present study, authors have used a multivariate technique i.e. factor analysis to examine the underlying patterns and relationships for a number of variables which affects fertility behaviour of a population. Also, authors have tried to summarize the information in smaller sets of distinct factors to estimate the children ever born. Present study is based on the data obtained from the fourth round of National Family Health Survey, India (NFHS-IV) dataset. The key finding of the present study is that the selected fertility parameters are classified into three distinct factors with a valid justification. On the basis of these estimated factors, the children ever born are estimated for 443 districts of India which is significantly good estimate of children ever born.*

**Key-words:** Fertility, factor analysis, children ever born, NFHS.

### Introduction

Human fertility is regulated by a number of biological and behavioural factors which are themselves influenced by various socio-economic and cultural factors. For better understanding about the cause of variations and changes in fertility levels between populations over time, it is mandatory to understand the mechanisms through which all these different factors affect human reproduction process and fertility. Since, it is widely known that fertility is determined by a complex set of biological, psychological, socio-economic, cultural, political and legal factors and these factors affect the fertility dynamics directly or indirectly. Identification of these determining factors is essential for the study of fertility.

Since, the study of fertility is considered as a primary concern for a population, several models have been developed in order to understand and estimate the fertility pattern of populations. The first attempt in this development was done by Davis and Blake (1956)<sup>1</sup> who have identified a set of eleven 'intermediate variables' which directly affect fertility. They grouped these eleven intermediate variables into the following three categories-

1. Factors affecting exposure to intercourse (six intercourse variables),
2. Factors affecting exposure to conception (three conception variables),
3. Factors affecting gestation and successful parturition (two gestation variables).

Bongaarts (1978, 1982)<sup>2,3</sup> and Bongaarts and Potter (1983)<sup>4</sup> refined Davis and Blake's framework into seven important factors, which were termed as the proximate determinants of fertility, to understand variations in level of fertility between populations. Out of the seven proximate determinants of fertility, Bongaarts (1982)<sup>3</sup> showed that four determinants are most important in terms of explaining variations in fertility levels of populations:



1. Proportions of women married or in sexual union,
2. Contraceptive use and effectiveness,
3. Duration of postpartum infecundability (or postpartum insusceptibility),
4. Induced abortion.

The Bongaarts model is a tool for examining the relative contribution of each of the four factors to the inhibition of fertility from its theoretical maximum. It is an aggregate fertility model which describes the relationship between fertility and the four principal proximate determinants. To overcome the limitations and measurement problems, Stover (1998)<sup>5</sup> revised the Bongaarts model.

Coale and Trussell (1974)<sup>6</sup> published a model which is still fairly widely used today- it is a hybrid between an empirical and a parametric model. This is a model of fertility with four parameters. The Coale–Trussell model attempts to parameterize the differences in overall levels and age patterns of fertility from these natural fertility expectations in populations with varying levels of fertility control. The level of fertility is then captured by two parameters of the model, Coale and Trussell's index of fertility levels and their index indicating departures from a natural fertility age pattern.

All the above models are fundamental models of fertility which elaborate that the human fertility is a multidimensional process. Hence, identification of these dimensions and its deduction is necessary for the better understanding of the human reproductive process.

Apart from these, some of the previous studies<sup>7-9</sup> suggest about the use for factor analysis for identification and classification of different type of indicators such as socioeconomic, and developmental indicators. Also, the factors are obtained at state and district level in these studies. Factor analysis is a multivariate interdependence technique, whose primary purpose is to define the underlying structure among the variables in the analysis. It can also be used to achieve data reduction whose essential purpose is to describe, if possible, the covariance relationships among many variables in terms of a few underlying, but unobservable, random quantities called factors. Factor analysis is not a new method of data analysis. This technique has been used widely as a data analytic technique. Hence, in the present paper we have attempted to classify the dimensions of fertility by using the factor analysis on identified variables through literature review which explain the fertility.

In the traditional societies like India, marriage is considered as the beginning of fertility process because most of the births occur within marriage. Age at marriage is negatively associated with fertility. Late marriages of females lead to reproduce fewer children due to comparatively less exposure period. Nahar et al. (2013)<sup>10</sup> found that proportion of females with temporarily sterility decreases with the increase age at marriage. A number of studies<sup>11-16</sup> reveal that the females' age at first birth is also negatively associated with fertility. An early age at first birth might influence occupational attainment, marital stability, asset accumulation, female's health. However, female's age at last birth shows positive correlation with fertility. For the females with completed family, Varea (1993)<sup>17</sup> found that the family size does not depend on marital duration, but associated with age at first birth and age at last birth of female. Hence, the interval between age at first birth and age at last birth, generally termed as reproductive span, affects the fertility positively. More the number of children will be reproduced if the reproductive span is larger. In fertility studies, birth order and birth spacing are two important facets to understand trends and differentials in fertility. A large number of studies have been carried out in the past to analyse the birth order and birth spacing pattern among females<sup>18-24</sup> Larger proportions of females at higher parities indicate high fertility, while the longer duration of close birth interval lead to comparatively less number of children ever born. Apart from these, socioeconomic environment also influences the reproductive behaviour of females. Fertility behaviour of females is highly influenced by her education and wealth index. Usually females

having better economic conditions, go for higher studies. Also, females who study at higher level have tendency to be economically independent by choosing any profession, which lead them to marry at later ages.

## Methodology

In the context of the present study, the required information related to married females aged between 15-49 years has been extracted from the fourth round of National Family Health Survey (NFHS-IV)<sup>25</sup>. NFHS-IV provides district level data; hence the females residing in major states of India comprising 443 districts are included in the study. Also, there are some inclusion criteria for females to keep the adequate data for the study. Females should have consistent birth intervals to be included in the study. Also, females having open birth interval more than 120 months which indicates almost complete fertility level of females, are included in the present study.

From the literature review and intuition, some of the demographic and socio-economic variables have been considered in the study:

- i. Education of female (in single years),
- ii. Wealth index factor score,
- iii. Weight of female (in Kg.),
- iv. Height of female (in cm.),
- v. Number of living children,
- vi. Age at first marriage (in completed years),
- vii. Age at first birth (in completed years),
- viii. Age at last birth (in completed years),
- ix. Reproductive span (in months), [*interval between first and last birth*]
- x. Mean close birth interval (in months),
- xi. Proportion of females having 3+ birth order.

Since, the selected variables provide measures on different scales and units. Standardization process permits to compare scores among different types of variables. At first, the district wise mean estimates for selected variables has been obtained. Then the standardized values  $z_i$ 's are calculated by using the given formula:

$$z_i = \frac{x_i - \mu}{\sigma}$$

where,  $x_i$ 's are the observations,  $\mu$  is the mean and  $\sigma$  is the standard deviation of the observations.

**Factor Analysis:** Factor analysis is used as a multivariate technique to provide an appropriate classification for the selected fertility parameters. Factor analysis is a general term denoting a class of techniques mainly used for data reduction and summarisation. Factor analysis is used to reduce a large number of variables, usually which are interrelated with each other, into a convenient level. Relationships among groups of many inter-correlated variables are investigated and characterised in terms of a few underlying factors. Hence, factor analysis may be used to identify underlying dimensions that explain the correlations among selected variables and then categorize them into a smaller number of salient factors for using in subsequent multivariate analysis.

Data is the pillar of research. Hence, there is always a need to check whether the selected data is suitable for the study or not. Every model is based on some assumptions which are considered as the foundation of

the study. In factor analysis also, literature suggest about some statistical tests which should be performed for the suitability of selected data prior to the factor analysis. These tests are-

**A. Kaiser-Meyer-Olkin (KMO) Test for Sampling Adequacy:** KMO Test is a measure of adequacy of data for factor analysis. The test statistic indicates the proportion of variance in the observed variables that might be caused by underlying factors. The statistic for the KMO test is-

$$KMO = \frac{\sum_{i=1}^p \sum_{j=1, j \neq i}^p r_{ij}^2}{\sum_{i=1}^p \sum_{j=1, j \neq i}^p r_{ij}^2 + \sum_{i=1}^p \sum_{j=1, j \neq i}^p r_{ij}^2}$$

where,  $r_{ij} = R_{ij} / \sqrt{R_{ii} R_{jj}}$  are partial correlation coefficients, and  $r_{ij} = R(X_i, X_j)$  are Pearson's correlation coefficients.

Usually, KMO value of greater than 0.5 is desirable. For the present data, the KMO estimate is obtained as 0.777 indicating that the given data is suitable for the factor analysis.

**B. Bartlett's Sphericity Test:** The null hypothesis of Bartlett's test assumed the correlation matrix as an identity matrix, which would point towards no correlation among the variables. The chi-square value for Bartlett's test of sphericity is-

$$p(p-1)/22 = -n-1-2p+56 \times \ln R$$

where,  $p$  and  $n$  is the no. of variables and no. of observations respectively, while  $R$  is the determinant of correlation matrix. The approximated chi-square of Bartlett's sphericity test is obtained 8828.150 with 55 degree of freedom and it is significant at 5 per cent level of significance. Here, we reject the null hypothesis and state that the observed variables are correlated and suitable for structure detection in the present study.

**Mathematical Formulation of the Factor Model:** Let us assume that all the observed variables  $X_1, X_2, \dots, X_m$  are obtained as a vector  $X$  for each individual subject and sampled from a population with population mean vector and covariance matrix such that

$$X = \begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_m \end{bmatrix}, \quad \mu = \begin{bmatrix} \mu_1 \\ \mu_2 \\ \dots \\ \mu_m \end{bmatrix},$$

$$Cov X = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \dots & \sigma_{1m} \\ \sigma_{21} & \sigma_{22} & \dots & \sigma_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{m1} & \sigma_{m2} & \dots & \sigma_{mm} \end{bmatrix}$$

The variables  $X_i$ 's are being included due to some unobservable common factors  $F_1, F_2, \dots, F_n$  ( $n < m$ ), jointly denoted as vector  $F$ . However, each variable depends on these common underlying factors which collectively cannot explain everything about  $X_i$ 's. Therefore a series of multiple regression can be generated to obtain factor model such that

$$X_1 = 1 + l_{11}f_1 + l_{12}f_2 + \dots + l_{1n}f_n + 1$$

$$X_2 = 2 + l_{21}f_1 + l_{22}f_2 + \dots + l_{2n}f_n + 2$$

$$X_m = m + l_{m1}f_1 + l_{m2}f_2 + \dots + l_{mn}f_n + m$$

or,

$$\begin{bmatrix} X_1 \\ X_2 \\ \dots \\ X_m \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ \dots \\ m \end{bmatrix} + \begin{bmatrix} l_{11} & l_{12} & \dots & l_{1n} \\ l_{21} & l_{22} & \dots & l_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ l_{m1} & l_{m2} & \dots & l_{mn} \end{bmatrix} \begin{bmatrix} f_1 \\ f_2 \\ \dots \\ f_n \end{bmatrix} + \begin{bmatrix} 1 \\ 2 \\ \dots \\ m \end{bmatrix}$$

i.e.

$$X = \mu + LF + \varepsilon \quad (4)$$

$$X - \mu = LF + \varepsilon \quad (5)$$

Equation (5) is known as Factor Model where  $F$  and  $U$  are vectors of unobserved variables termed as common factors and unique factors respectively, while  $L$  is a matrix of unknown constants named as factor loadings.

**Estimation of Factor Scores:** Factor analysis provides the advantage of calculating the composite score or factor score of obtained distinct factors. It can be used further in subsequent multivariate analysis. Generally, factor score is a linear combination of the original variables. The factor score ( $F_i$ ) for  $i$ th factor can be estimated as:

$$F_i = W_{i1}X_1 + W_{i2}X_2 + W_{i3}X_3 + \dots + W_{im}X_m \quad (6)$$

where,  $W_{i1}, W_{i2}, W_{i3}, \dots, W_{im}$  are factor score coefficients.

**Estimation of Children Ever Born by using Factor Scores:** Multiple regression analysis is a general statistical technique used to analyse the relationship between a single dependent (criterion) variable and several independent (predictor) variables. A dependent variable is modelled as a function of several independent variables with corresponding coefficients, along with the constant term. The multiple regression equation explained above takes the following form:

$$y = 1x_1 + 2x_2 + \dots + nx_n + \varepsilon$$

here,  $i$ 's ( $i=1, 2, \dots, n$ ) are the regression coefficients, which represent the value at which the criterion variable changes when the predictor variable changes. In the present study, the dependent variable is children ever born to a female and independent variables are factor scores obtained from equation (6).

Hence, the obtained multiple regression equation is:

$$YCEB = 2.956 + 0.534 * F_1 - 0.148 * F_2 - 0.170 * F_3 \quad (7)$$

with

where  $F_1, F_2,$  and  $F_3$  are the estimated factor scores obtained from equation (6) and  $YCEB$  denotes the dependent variable children ever born. The district wise predicted values of children ever born are shown in Table 5

## Findings and Discussion

Table 1 shows a correlation matrix of selected variables. It indicates that many selected variables are significantly correlated with each other. A high and positive correlation is observed between age at first marriage and age at first birth (0.747). Age at last birth is highly correlated with reproductive span of females (0.894), number of survived children (0.841), and proportion of females with 3+ birth order (0.857). Similarly other variables indicate significant correlation with other variables.

The detailed results of total variance explained by the estimated factor model is given in Table 2 and it indicates that among the eleven observed variables, three factors have been estimated based on the initial eigenvalues of corresponding factor. It can be graphically illustrated in Figure 1 where the scree plot shows that only three factors have achieved the threshold eigenvalue of 1. Hence, three factors are obtained in the present analysis. The estimated three factors jointly explains 84 per cent variance of observations. However, the highest variance is explained by the first factor explains i.e. 36.4 percent.

In the Table 3, the component matrix for factor analysis is shown which is extracted by using principal component analysis. The component matrix classifies 11 selected variables into 3 factors, after applying Varimax rotation to minimize the complexity of the factor loadings to make the structure simpler to interpret. First factor is obtained by combining age at last birth, reproductive span (interval between the first birth and the last birth), number of survived children, and proportion of females with 3+ birth order. Second factor is

attained from four variables i.e. education, wealth index, weight and height of women, while age at first marriage, age at first birth and mean close birth interval forms the third factor.

Table 4 presents the results of multiple regression analysis on children ever born by considering factor scores of obtained factors as predictor variables. The p-value of model indicates the regression model is significant at 0.05 level of significance. Also, the given multiple regression model explains 98.2 percent variability of children ever born to the females.

The predicted values of children ever born using the regression equation is provided in Table 5 for 443 districts of India. The predicted values have a difference of less than 10 percent for all the districts while the difference between estimated values of children ever born using regression model and observed values is less than 5 percent for 423 districts out of 443 districts. The highest difference between observed and predicted value of children ever born is found in Balrampur District of Uttar Pradesh. In 08 districts namely Fatehpur (UP), Kushinagar (UP), Kabirdham (Chhatisgarh), Sehore (MP), Ahmadabad (Gujarat), Nizamabad (Telangana), Kasargod (Kerala), and Shivganga (Tamil Nadu), the predicted no. of children ever born to females is same as observed no. of children ever born in these districts.

### Conclusion and Recommendations

From the factor analysis on selected variables, it is observed that we have obtained three factors from eleven observed variables. The first factor is obtained from the variables age at last birth, reproductive span, number of survived children, and proportion of females with 3+ birth order. Since, all these four variables are almost linked with the entire birth history of females, it shows positive association with number of children ever born. Increment in these variables will progress for increment in number of children ever born. Second factor is attained from four variables i.e. education, wealth index, weight and height of women. All of these four variables are sociodemographic variables. Thus, the second factor can be labelled as factor of sociodemographic variables. Second factor has negative association with children ever born and it is clear that females having higher socioeconomic status go for small family size. The third factor is obtained from age at first marriage, age at first birth and mean close birth interval. Third factor can be labelled as factor of variables associated with the initial stage of fertility process. This factor shows negative association with children ever born. Late marriages, higher age at first birth, and higher duration between two successive births will obviously leads to lower number children ever born. The results of this study justify the labelling of estimated factors, and satisfy the impact of these factors on number of children ever born.

**Table 1**  
**Correlation Matrix for Selected Socio-Demographic Variables**

Variables	EDU	WIS	WGT	HGT	AFM	AFB	ALB	CBI	RPS	NSC	BO3
EDU	1.000	0.710*	0.653*	0.320*	0.713*	0.470*	-0.425*	0.277*	-0.646*	-0.639*	-0.654*
WIS		1.000	0.847*	0.564*	0.500*	0.257*	-0.458*	-0.026	-0.581*	-0.489*	-0.537*
WGT			1.000	0.594*	0.462*	0.296*	-0.379*	0.018	-0.519*	-0.437*	-0.479*
HGT				1.000	0.386*	0.235*	-0.317*	-0.031	-0.429*	-0.365*	-0.404*
AFM					1.000	0.747*	-0.312*	0.345*	-0.659*	-0.672*	-0.667*
AFB						1.000	0.243*	0.335*	-0.217*	-0.242*	-0.228*
ALB							1.000	0.096	0.894*	0.841*	0.857*
CBI								1.000	-0.059	-0.269*	-0.219*
RPS									1.000	0.959*	0.968*
NSC										1.000	0.975*
BO3											1.000

\*indicates correlation coefficients are significant at 0.01 level of significance.

Note: EDU = Education, WIS = Wealth Index, WGT = Weight, HGT = Height, AFM = Age at first marriage, AFB = Age at first birth, ALB = Age at last birth, CBI = Mean close birth interval, RPS = Reproductive span, NSC = Number of surviving children, BO3 = Proportion of females with 3+ birth order

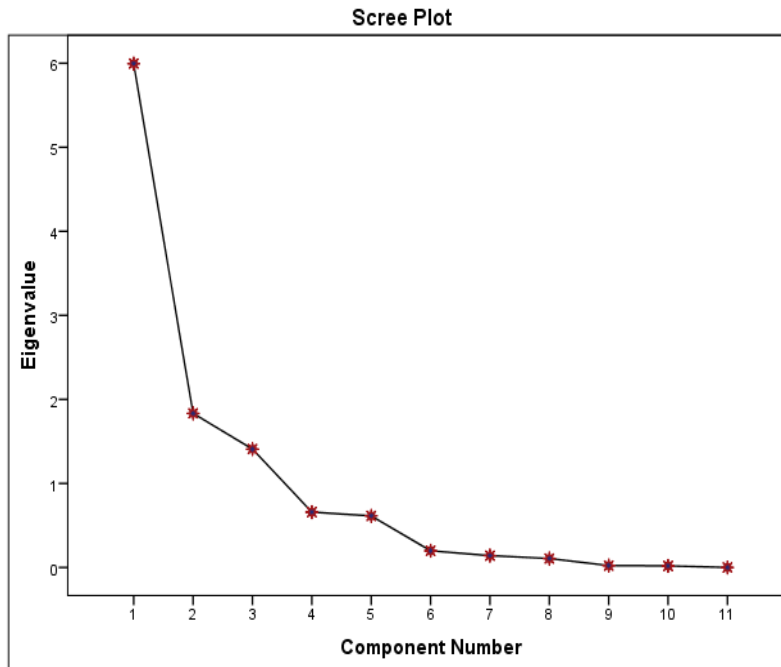
**Table 2**  
**Total Variance Explained by the Estimated Factor Model**

Factors	Initial Eigenvalues			Extraction Sums of Squared Loadings*			Rotation Sums of Squared Loadings#		
	Total	% of variance	Cum. %	Total	% of variance	Cum. %	Total	% of variance	Cum. %
1	5.996	54.506	54.506	5.996	54.506	54.506	4.003	36.395	36.395
2	1.834	16.674	71.180	1.834	16.674	71.180	2.948	26.800	63.195
3	1.409	12.809	83.989	1.409	12.809	83.989	2.287	20.793	83.989
4	0.659	5.991	89.979						
5	0.614	5.583	95.562						
6	0.199	1.809	97.371						
7	0.141	1.280	98.651						
8	0.107	0.971	99.622						
9	0.023	0.205	99.827						
10	0.019	0.171	99.998						
11	0.000	0.002	100.000						

\* Extraction Method: Principal Component Analysis

# Rotation Method: Varimax with Kaiser Normalization

**Figure 1**  
**Scree Plot for the Eigenvalues of Factors**



**Table 3**  
**Communalities and Factor Loadings for the selected variables**

Variables	Rotated Component Matrix		
	1	2	3
Education	-0.454	<b>0.541</b>	0.493
Wealth Index	-0.321	<b>0.857</b>	0.093
Weight	-0.235	<b>0.876</b>	0.120
Height	-0.183	<b>0.742</b>	0.020
Age at first marriage	-0.421	0.391	<b>0.726</b>
Age at first birth	0.104	0.323	<b>0.849</b>
Age at last birth	<b>0.948</b>	-0.202	0.235
Mean close birth interval	-0.121	-0.244	<b>0.740</b>
Reproductive span	<b>0.906</b>	-0.354	-0.156
Number of surviving children	<b>0.920</b>	-0.213	-0.290
Proportion of females with 3+ birth order	<b>0.915</b>	-0.274	-0.249

*Extraction Method: Principal Component Analysis  
Rotation Method: Varimax with Kaiser Normalization*

**Table 4**  
**Multiple Regression Analysis for Children Ever Born by using Factors as Predictors**

Multiple Regression Model Summary						
R	R Square	S.E. of the Estimate	F Statistic	Degree of freedom 1	Degree of freedom 2	Sig. (p-value)
0.991	0.982	0.07922	7896.075	3	439	0.000
Estimates of Multiple Regression Coefficients						
Model	Unstandardized Coefficients		t Statistic	Sig. (p-value)	95% C.I. for B	
	B	S.E.			Lower	Upper
Constant	2.956	0.004	785.333	0.000	2.949	2.963
Factor 1	0.534	0.004	141.832	0.000	0.527	0.542
Factor 2	-0.148	0.004	-39.331	0.000	-0.156	-0.141
Factor 3	-0.170	0.004	-45.001	0.000	-0.177	-0.162

**Table 5**  
**District-wise Predicted Number of Children Ever Born**

Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Ganganagar	2.73	2.868	2.711	3.024	4.8
Hanumangarh	2.84	2.908	2.751	3.065	2.3
Bikaner	3.07	3.108	2.951	3.264	1.2
Churu	3.39	3.512	3.355	3.669	3.5
Jhunjhunun	3.02	3.130	2.974	3.287	3.5
Alwar	2.92	3.050	2.893	3.206	4.3
Bharatpur	3.53	3.459	3.302	3.615	-2.1

Dhaulpur	3.86	3.808	3.652	3.965	-1.4
Karauli	3.69	3.853	3.696	4.010	4.2
Sawai Madhopur	3.46	3.508	3.352	3.665	1.4
Dausa	3.22	3.308	3.152	3.465	2.7
Jaipur	2.96	2.968	2.811	3.125	0.3
Sikar	3.11	3.297	3.140	3.454	5.7
Nagaur	3.03	3.208	3.052	3.365	5.6
Jodhpur	2.96	3.052	2.895	3.209	3.0
Jaisalmer	3.47	3.584	3.427	3.740	3.2
Barmer	3.67	3.760	3.603	3.916	2.4
Jalor	3.60	3.746	3.589	3.902	3.9
Sirohi	3.38	3.513	3.357	3.670	3.8
Pali	3.26	3.362	3.206	3.518	3.0
Ajmer	2.90	2.951	2.794	3.107	1.7
Tonk	3.24	3.320	3.164	3.476	2.4
Bundi	2.95	3.120	2.964	3.276	5.4
Bhilwara	2.94	3.127	2.971	3.283	6.0
Rajsamand	2.98	3.165	3.009	3.322	5.8
Dungarpur	2.98	3.132	2.976	3.288	4.9
Banswara	3.10	3.178	3.022	3.334	2.5
Chittaurgarh	2.63	2.703	2.547	2.859	2.7
Kota	2.89	2.963	2.807	3.119	2.5
Baran	3.20	3.302	3.146	3.459	3.1
Jhalawar	2.94	3.110	2.954	3.266	5.5
Udaipur	2.90	3.008	2.852	3.164	3.6
Pratapgarh	3.01	3.142	2.986	3.298	4.2
Saharanpur	3.57	3.435	3.279	3.591	-3.9
Muzaffarnagar	3.84	3.700	3.544	3.857	-3.8
Bijnor	3.99	3.819	3.662	3.975	-4.5
Moradabad	4.12	3.927	3.771	4.084	-4.9
Rampur	4.16	4.008	3.851	4.164	-3.8
Jyotiba Phule Nagar	3.80	3.743	3.586	3.899	-1.5
Meerut	3.67	3.499	3.343	3.656	-4.9
Baghpat	3.38	3.322	3.165	3.479	-1.7
Ghaziabad	3.34	3.252	3.096	3.409	-2.7
Gautam Buddha Nagar	3.64	3.516	3.359	3.673	-3.5
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Bulandshahr	3.71	3.626	3.470	3.783	-2.3
Aligarh	3.89	3.696	3.540	3.853	-5.2
Mahamaya Nagar	3.79	3.689	3.533	3.846	-2.7
Mathura	3.65	3.632	3.476	3.789	-0.5



Agra	3.73	3.577	3.421	3.733	-4.3
Firozabad	3.95	3.763	3.606	3.919	-5.0
Mainpuri	3.67	3.551	3.394	3.707	-3.4
Budaun	4.67	4.426	4.268	4.583	-5.5
Bareilly	4.07	3.874	3.718	4.031	-5.1
Pilibhit	4.05	3.916	3.760	4.073	-3.4
Shahjahanpur	4.07	3.985	3.829	4.142	-2.1
Kheri	3.95	3.905	3.748	4.061	-1.2
Sitapur	3.62	3.559	3.402	3.715	-1.7
Hardoi	3.70	3.715	3.559	3.872	0.4
Unnao	3.71	3.595	3.438	3.751	-3.2
Lucknow	3.05	3.026	2.870	3.182	-0.8
Rae Bareli	3.66	3.656	3.500	3.813	-0.1
Farrukhabad	3.64	3.503	3.347	3.660	-3.9
Kannauj	4.11	3.973	3.816	4.129	-3.5
Etawah	3.54	3.406	3.250	3.562	-3.9
Auraiya	3.36	3.312	3.156	3.468	-1.5
Kanpur Dehat	3.48	3.447	3.291	3.603	-0.9
Kanpur Nagar	2.98	2.914	2.758	3.070	-2.3
Jalaun	2.90	2.862	2.706	3.018	-1.3
Jhansi	2.94	2.955	2.799	3.111	0.5
Lalitpur	3.49	3.547	3.390	3.703	1.6
Hamirpur	3.04	3.124	2.968	3.280	2.7
Mahoba	3.37	3.396	3.240	3.552	0.8
Banda	3.46	3.585	3.429	3.741	3.5
Chitrakoot	4.02	3.932	3.775	4.088	-2.2
Fatehpur	3.56	3.558	3.402	3.715	0.0
Pratapgarh	3.79	3.761	3.604	3.917	-0.8
Kaushambi	4.32	4.352	4.195	4.509	0.7
Allahabad	3.82	3.811	3.655	3.968	-0.2
Bara Banki	3.69	3.783	3.626	3.939	2.4
Faizabad	3.54	3.493	3.337	3.650	-1.3
Ambedkar Nagar	3.64	3.687	3.531	3.843	1.3
Sultanpur	3.58	3.745	3.588	3.902	4.4
Bahraich	3.63	3.651	3.495	3.808	0.6
Shrawasti	3.46	3.718	3.562	3.874	6.9
Balrampur	3.07	3.316	3.159	3.473	7.4
Gonda	4.03	3.958	3.802	4.115	-1.8
Siddharth Nagar	4.44	4.377	4.220	4.535	-1.4
Basti	3.65	3.653	3.497	3.809	0.1
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Sant Kabir Nagar	3.70	3.778	3.621	3.934	2.1

Mahrajganj	3.57	3.784	3.627	3.940	5.6
Gorakhpur	3.55	3.555	3.399	3.711	0.1
Kushinagar	4.01	4.010	3.854	4.167	0.0
Deoria	3.84	3.845	3.688	4.001	0.1
Azamgarh	3.66	3.649	3.492	3.806	-0.3
Mau	3.95	3.943	3.786	4.100	-0.2
Ballia	3.39	3.483	3.327	3.640	2.7
Jaunpur	3.80	3.778	3.622	3.934	-0.6
Ghazipur	3.49	3.483	3.326	3.639	-0.2
Chandauli	3.66	3.745	3.588	3.901	2.3
Varanasi	3.28	3.196	3.040	3.352	-2.6
Bhadohi	4.16	4.079	3.922	4.235	-2.0
Mirzapur	3.45	3.520	3.364	3.676	2.0
Sonbhadra	3.41	3.508	3.352	3.664	2.8
Etah	3.93	3.756	3.600	3.913	-4.6
Kanshiram Nagar	4.37	4.168	4.011	4.325	-4.9
Pashchim Champaran	3.24	3.387	3.231	3.543	4.3
Purba Champaran	3.75	3.799	3.643	3.955	1.3
Sheohar	3.88	3.786	3.629	3.942	-2.5
Sitamarhi	3.89	3.906	3.750	4.063	0.4
Madhubani	3.45	3.484	3.328	3.640	1.0
Supaul	3.75	3.819	3.663	3.976	1.8
Araria	3.55	3.439	3.282	3.595	-3.2
Kishanganj	3.76	3.785	3.628	3.942	0.7
Purnia	3.38	3.457	3.301	3.613	2.2
Katihar	3.59	3.644	3.488	3.801	1.5
Madhepura	3.49	3.617	3.461	3.773	3.5
Saharsa	3.44	3.520	3.363	3.676	2.3
Darbhanga	3.36	3.511	3.355	3.667	4.3
Muzaffarpur	3.62	3.606	3.450	3.762	-0.4
Gopalganj	3.47	3.601	3.445	3.757	3.6
Siwan	3.51	3.640	3.484	3.796	3.6
Saran	3.51	3.513	3.357	3.669	0.1
Vaishali	3.46	3.435	3.279	3.591	-0.7
Samastipur	3.30	3.393	3.237	3.549	2.8
Begusarai	4.00	4.032	3.876	4.189	0.8
Khagaria	3.74	3.680	3.524	3.836	-1.6
Bhagalpur	3.38	3.374	3.218	3.530	-0.2
Banka	3.64	3.702	3.546	3.858	1.7
Munger	3.68	3.656	3.499	3.812	-0.7
Lakhisarai	3.94	3.783	3.627	3.939	-4.1
Sheikhpura	3.65	3.631	3.475	3.787	-0.5
Nalanda	3.43	3.506	3.350	3.663	2.2

Patna	3.20	3.156	3.000	3.312	-1.4
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Bhojpur	3.75	3.809	3.652	3.965	1.5
Buxar	3.50	3.506	3.350	3.663	0.2
Kaimur (Bhabua)	3.59	3.737	3.581	3.893	3.9
Rohtas	3.74	3.598	3.442	3.754	-3.9
Aurangabad	3.72	3.678	3.522	3.834	-1.1
Gaya	3.73	3.746	3.590	3.902	0.4
Nawada	3.50	3.637	3.481	3.794	3.8
Jamui	3.48	3.588	3.431	3.745	3.0
Jehanabad	3.50	3.615	3.459	3.771	3.2
Arwal	3.44	3.483	3.326	3.639	1.2
Darjiling	2.11	2.116	1.959	2.272	0.3
Jalpaiguri	2.45	2.460	2.304	2.617	0.4
Koch Bihar	2.52	2.510	2.354	2.667	-0.4
Uttar Dinajpur	3.09	2.988	2.832	3.144	-3.4
Dakshin Dinajpur	2.36	2.310	2.152	2.467	-2.2
Maldah	2.73	2.760	2.604	2.916	1.1
Murshidabad	2.70	2.625	2.468	2.782	-2.9
Birbhum	2.29	2.280	2.123	2.438	-0.4
Bardhaman	2.32	2.263	2.107	2.420	-2.5
Nadia	2.29	2.230	2.073	2.387	-2.7
North 24 Parganas	1.98	1.970	1.814	2.127	-0.5
Hugli	2.36	2.274	2.118	2.430	-3.8
Bankura	2.54	2.463	2.306	2.620	-3.1
Puruliya	2.88	2.810	2.653	2.967	-2.5
Haora	2.28	2.246	2.090	2.403	-1.5
Kolkata	2.36	2.330	2.174	2.486	-1.3
South 24 Parganas	2.87	2.808	2.652	2.965	-2.2
Paschim Medinipur	2.56	2.501	2.344	2.658	-2.4
Purba Medinipur	2.47	2.392	2.235	2.549	-3.3
Garhwa	4.13	4.061	3.905	4.218	-1.7
Chatra	3.83	3.717	3.560	3.873	-3.1
Kodarma	3.40	3.470	3.314	3.626	2.0
Giridih	3.29	3.313	3.157	3.470	0.7
Deoghar	3.32	3.292	3.135	3.448	-0.9
Godda	3.16	3.246	3.089	3.402	2.6
Sahibganj	3.23	3.235	3.078	3.391	0.1
Pakur	3.00	3.125	2.968	3.282	4.0
Dhanbad	3.03	2.991	2.834	3.147	-1.3
Bokaro	3.13	3.101	2.945	3.257	-0.9
Lohardaga	3.34	3.305	3.149	3.462	-1.0

Purbi Singhbhum	2.43	2.416	2.260	2.572	-0.6
Palamu	3.38	3.430	3.274	3.586	1.5
Latehar	3.38	3.406	3.250	3.562	0.8
Hazaribagh	3.44	3.475	3.318	3.631	1.0
Ramgarh	3.15	3.137	2.981	3.293	-0.4
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Dumka	2.58	2.695	2.538	2.852	4.3
Jamtara	2.89	2.955	2.798	3.112	2.2
Ranchi	3.10	3.056	2.900	3.212	-1.4
Khunti	2.83	2.952	2.796	3.109	4.1
Gumla	3.16	3.187	3.031	3.343	0.9
Simdega	3.25	3.326	3.170	3.483	2.3
Pashchimi Singhbhum	3.17	3.110	2.954	3.267	-1.9
Saraikela Kharsawan	3.05	3.015	2.859	3.171	-1.2
Bargarh	2.73	2.728	2.571	2.884	-0.1
Jharsuguda	2.59	2.580	2.423	2.736	-0.4
Sambalpur	2.68	2.675	2.519	2.832	-0.2
Debagarh	2.74	2.744	2.588	2.901	0.2
Sundargarh	2.64	2.649	2.493	2.806	0.4
Kendujhar	2.83	2.767	2.611	2.923	-2.3
Mayurbhanj	2.33	2.319	2.162	2.476	-0.5
Baleshwar	2.35	2.352	2.195	2.509	0.1
Bhadrak	2.80	2.740	2.583	2.896	-2.2
Kendrapara	2.57	2.520	2.364	2.677	-2.0
Jagatsinghapur	2.48	2.484	2.327	2.641	0.2
Cuttack	2.28	2.283	2.126	2.439	0.1
Jajapur	2.87	2.790	2.634	2.947	-2.8
Dhenkanal	2.69	2.650	2.494	2.806	-1.5
Anugul	2.56	2.555	2.399	2.711	-0.2
Nayagarh	2.68	2.565	2.408	2.721	-4.5
Khordha	2.41	2.376	2.219	2.533	-1.4
Puri	2.48	2.464	2.308	2.620	-0.6
Ganjam	2.81	2.799	2.643	2.955	-0.4
Gajapati	2.98	2.999	2.843	3.155	0.6
Kandhamal	3.28	3.272	3.116	3.429	-0.2
Baudh	3.19	3.250	3.093	3.406	1.8
Subarnapur	2.96	2.937	2.780	3.093	-0.8
Balangir	3.05	3.169	3.012	3.326	3.8
Nuapada	3.22	3.361	3.205	3.517	4.2
Kalahandi	2.95	3.064	2.907	3.220	3.7
Rayagada	3.07	3.112	2.955	3.268	1.3
Nabarangapur	3.08	3.129	2.973	3.286	1.6

Koraput	3.08	3.036	2.880	3.192	-1.5
Malkangiri	3.25	3.228	3.071	3.384	-0.7
Korea (Koriya)	2.88	2.914	2.758	3.070	1.2
Surguja	3.54	3.552	3.396	3.708	0.3
Jashpur	3.02	3.060	2.904	3.216	1.3
Raigarh	2.83	2.811	2.655	2.967	-0.7
Korba	3.05	3.000	2.844	3.156	-1.7
Janjgir - Champa	3.25	3.196	3.040	3.352	-1.7
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Bilaspur	3.10	3.054	2.898	3.210	-1.5
Kabirdham	3.66	3.659	3.503	3.815	0.0
Rajnandgaon	2.88	2.893	2.737	3.049	0.5
Durg	2.94	2.878	2.722	3.034	-2.2
Raipur	2.91	2.890	2.734	3.046	-0.7
Mahasamund	2.79	2.799	2.643	2.956	0.3
Dhamtari	2.99	2.950	2.794	3.106	-1.4
Uttar Bastar Kanker	3.02	3.016	2.860	3.172	-0.1
Bastar	3.18	3.093	2.937	3.250	-2.8
Narayanpur	3.19	3.250	3.093	3.406	1.8
Dakshin Bastar Dantewada	3.11	3.134	2.977	3.290	0.8
Bijapur	2.85	2.962	2.805	3.118	3.8
Sheopur	3.53	3.584	3.428	3.740	1.5
Morena	3.39	3.418	3.262	3.574	0.8
Bhind	3.26	3.277	3.121	3.433	0.5
Gwalior	3.19	3.177	3.021	3.333	-0.4
Datia	3.24	3.165	3.008	3.321	-2.4
Shivpuri	3.50	3.592	3.436	3.749	2.6
Tikamgarh	3.17	3.096	2.940	3.253	-2.4
Chhatarpur	3.88	3.721	3.564	3.877	-4.3
Panna	3.52	3.351	3.195	3.507	-5.1
Sagar	3.33	3.257	3.101	3.413	-2.2
Damoh	3.12	3.096	2.940	3.252	-0.8
Satna	3.25	3.255	3.099	3.411	0.2
Rewa	3.58	3.570	3.414	3.726	-0.3
Umaria	3.19	3.207	3.051	3.363	0.5
Neemuch	2.55	2.626	2.470	2.782	2.9
Mandsaur	2.53	2.602	2.446	2.759	2.8
Ratlam	2.70	2.742	2.586	2.897	1.5
Ujjain	2.66	2.715	2.559	2.871	2.0
Shajapur	2.70	2.845	2.689	3.001	5.1
Dewas	3.06	3.045	2.889	3.201	-0.5
Dhar	2.93	2.957	2.800	3.113	0.9

Indore	2.57	2.603	2.447	2.759	1.3
Khargone	3.23	3.129	2.973	3.285	-3.2
Barwani	3.62	3.523	3.367	3.679	-2.8
Rajgarh	3.13	3.228	3.072	3.384	3.0
Vidisha	2.99	3.097	2.941	3.253	3.4
Bhopal	2.89	2.969	2.813	3.126	2.7
Sehore	3.38	3.381	3.225	3.537	0.0
Raisen	3.49	3.435	3.279	3.591	-1.6
Betul	3.27	3.109	2.953	3.265	-5.2
Harda	3.29	3.214	3.058	3.370	-2.4
Hoshangabad	3.00	2.990	2.834	3.146	-0.3
Katni	2.88	2.956	2.799	3.112	2.6
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Jabalpur	3.10	2.970	2.815	3.126	-4.4
Narsimhapur	2.64	2.586	2.430	2.743	-2.1
Dindori	3.15	3.203	3.047	3.359	1.7
Mandla	3.15	3.156	3.000	3.312	0.2
Chhindwara	3.00	2.928	2.772	3.084	-2.5
Seoni	3.04	3.046	2.890	3.203	0.2
Balaghat	3.13	3.049	2.893	3.205	-2.7
Guna	3.66	3.643	3.486	3.799	-0.5
Ashoknagar	3.28	3.349	3.193	3.505	2.1
Shahdol	3.10	3.105	2.950	3.261	0.2
Anuppur	3.12	3.117	2.961	3.273	-0.1
Sidhi	3.10	3.201	3.045	3.358	3.2
Singrauli	3.47	3.480	3.323	3.636	0.3
Jhabua	2.98	3.080	2.924	3.236	3.2
Alirajpur	4.01	3.832	3.675	3.988	-4.7
Khandwa	3.66	3.497	3.341	3.654	-4.7
Burhanpur	3.24	3.166	3.010	3.322	-2.3
Kachchh	2.91	2.914	2.758	3.070	0.1
Banaskantha	3.38	3.501	3.345	3.657	3.5
Patan	2.97	2.956	2.800	3.112	-0.5
Mahesana	2.45	2.543	2.387	2.700	3.7
Sabarkantha	2.78	2.850	2.694	3.006	2.5
Gandhinagar	2.65	2.710	2.554	2.866	2.2
Ahmadabad	2.23	2.231	2.074	2.388	0.0
Surendranagar	2.72	2.733	2.577	2.889	0.5
Rajkot	2.36	2.356	2.199	2.513	-0.2
Jamnagar	2.62	2.642	2.486	2.799	0.8
Porbandar	2.43	2.508	2.351	2.664	3.1
Junagadh	2.53	2.579	2.423	2.736	1.9

Amreli	2.84	2.800	2.644	2.957	-1.4
Bhavnagar	2.70	2.742	2.586	2.898	1.5
Anand	2.51	2.463	2.307	2.619	-1.9
Kheda	2.72	2.608	2.452	2.764	-4.3
Panchmahal	2.73	2.754	2.598	2.910	0.9
Dohad	3.36	3.227	3.071	3.383	-4.1
Vadodara	2.46	2.405	2.249	2.561	-2.3
Narmada	2.78	2.760	2.603	2.916	-0.7
Bharuch	2.63	2.582	2.426	2.738	-1.8
The Dangs	2.99	2.946	2.789	3.102	-1.5
Navsari	2.34	2.278	2.122	2.434	-2.7
Valsad	2.41	2.373	2.217	2.529	-1.5
Surat	2.33	2.351	2.194	2.507	0.9
Tapi	2.39	2.323	2.166	2.479	-2.9
Nandurbar	2.90	2.874	2.718	3.030	-0.9
Dhule	2.66	2.585	2.429	2.741	-2.9
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Jalgaon	2.61	2.579	2.423	2.735	-1.2
Buldana	2.77	2.710	2.554	2.866	-2.2
Akola	2.87	2.739	2.583	2.894	-4.8
Washim	2.63	2.573	2.417	2.729	-2.2
Amravati	2.54	2.461	2.305	2.617	-3.2
Wardha	2.51	2.355	2.199	2.511	-6.6
Nagpur	2.59	2.473	2.317	2.629	-4.7
Bhandara	2.58	2.460	2.304	2.616	-4.9
Gondiya	2.56	2.494	2.337	2.650	-2.7
Gadchiroli	2.51	2.491	2.334	2.647	-0.8
Chandrapur	2.39	2.340	2.184	2.496	-2.1
Yavatmal	2.59	2.515	2.359	2.671	-3.0
Nanded	3.14	3.081	2.925	3.237	-1.9
Hingoli	2.81	2.811	2.655	2.967	0.1
Parbhani	3.03	3.009	2.853	3.165	-0.7
Jalna	2.92	2.937	2.781	3.093	0.6
Aurangabad	2.73	2.673	2.517	2.829	-2.1
Nashik	2.75	2.670	2.514	2.826	-3.0
Thane	2.32	2.338	2.182	2.494	0.8
Mumbai Suburban	2.39	2.446	2.290	2.602	2.3
Mumbai	2.14	2.153	1.996	2.310	0.6
Raigarh	2.30	2.245	2.089	2.401	-2.4
Pune	2.41	2.358	2.201	2.514	-2.2
Ahmadnagar	2.40	2.391	2.235	2.548	-0.4
Bid	2.66	2.703	2.547	2.860	1.6

Latur	3.04	3.001	2.845	3.158	-1.3
Osmanabad	2.69	2.633	2.476	2.789	-2.2
Solapur	2.77	2.717	2.561	2.874	-1.9
Satara	2.52	2.467	2.311	2.623	-2.1
Ratnagiri	2.30	2.329	2.172	2.485	1.2
Sindhudurg	2.30	2.279	2.122	2.437	-0.9
Kolhapur	2.29	2.192	2.036	2.349	-4.5
Sangli	2.31	2.238	2.082	2.394	-3.2
Adilabad	2.85	2.942	2.785	3.098	3.1
Nizamabad	2.68	2.679	2.523	2.835	0.0
Karimnagar	2.54	2.514	2.358	2.670	-1.0
Medak	2.43	2.444	2.287	2.600	0.6
Hyderabad	2.57	2.573	2.417	2.730	0.1
Rangareddy	2.35	2.308	2.151	2.464	-1.8
Mahbubnagar	2.66	2.709	2.552	2.865	1.8
Nalgonda	2.38	2.469	2.313	2.626	3.6
Warangal	2.34	2.311	2.154	2.468	-1.2
Khammam	2.36	2.343	2.186	2.500	-0.7
Srikakulam	2.29	2.314	2.158	2.471	1.1
Vizianagaram	2.34	2.345	2.189	2.501	0.2
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Visakhapatnam	2.28	2.263	2.106	2.419	-0.8
East Godavari	2.25	2.277	2.120	2.434	1.2
West Godavari	2.23	2.265	2.107	2.422	1.5
Krishna	2.28	2.284	2.127	2.441	0.2
Guntur	2.33	2.299	2.142	2.456	-1.4
Prakasam	2.45	2.479	2.322	2.636	1.2
Sri Potti Sriramulu Nellore	2.37	2.426	2.269	2.582	2.3
Y.S.R.	2.53	2.512	2.356	2.669	-0.7
Kurnool	2.73	2.762	2.606	2.919	1.2
Anantapur	2.38	2.459	2.303	2.616	3.2
Chittoor	2.22	2.232	2.076	2.389	0.6
Belgaum	2.43	2.490	2.334	2.646	2.4
Bagalkot	2.60	2.675	2.519	2.831	2.8
Bijapur	2.60	2.630	2.474	2.786	1.1
Bidar	2.87	2.830	2.675	2.986	-1.4
Raichur	2.65	2.680	2.524	2.836	1.1
Koppal	2.47	2.446	2.290	2.602	-1.0
Gadag	2.32	2.439	2.282	2.595	4.9
Dharwad	2.59	2.561	2.405	2.717	-1.2
Uttara Kannada	2.26	2.227	2.070	2.383	-1.5
Haveri	2.54	2.479	2.323	2.635	-2.5



Bellary	2.71	2.703	2.546	2.859	-0.3
Chitradurga	2.25	2.301	2.144	2.457	2.2
Davanagere	2.28	2.263	2.107	2.419	-0.8
Shimoga	2.12	2.127	1.970	2.283	0.3
Udupi	2.08	2.160	2.002	2.318	3.7
Chikmagalur	1.98	2.035	1.879	2.192	2.7
Tumkur	2.08	2.082	1.925	2.238	0.1
Bangalore	1.99	2.006	1.849	2.163	0.8
Mandya	2.14	2.144	1.988	2.301	0.2
Hassan	2.15	2.164	2.008	2.321	0.7
Dakshina Kannada	2.25	2.247	2.090	2.404	-0.1
Kodagu	2.15	2.191	2.034	2.348	1.9
Mysore	2.05	2.095	1.939	2.252	2.2
Chamarajanagar	2.02	2.141	1.984	2.298	5.6
Gulbarga	2.86	2.885	2.729	3.041	0.9
Yadgir	3.20	3.318	3.162	3.474	3.6
Kolar	2.33	2.358	2.201	2.514	1.2
Chikkaballapura	2.15	2.179	2.023	2.336	1.3
Bangalore Rural	2.27	2.233	2.076	2.390	-1.7
Ramanagara	2.02	2.136	1.979	2.292	5.4
Kasaragod	2.21	2.210	2.053	2.367	0.0
Kannur	2.11	2.087	1.929	2.245	-1.1
Wayanad	2.14	2.112	1.956	2.269	-1.3
Kozhikode	2.13	2.022	1.865	2.179	-5.4
Name of District	Observed CEB	Predicted CEB	95% C. I.		% diff.
			Lower	Upper	
Malappuram	2.62	2.577	2.421	2.734	-1.7
Palakkad	2.20	2.121	1.964	2.277	-3.7
Thrissur	1.95	1.905	1.748	2.063	-2.4
Ernakulam	1.87	1.807	1.647	1.967	-3.5
Idukki	2.07	2.054	1.895	2.212	-0.8
Kottayam	1.87	1.853	1.692	2.013	-0.9
Alappuzha	1.88	1.830	1.670	1.989	-2.7
Pathanamthitta	1.84	1.815	1.656	1.973	-1.4
Kollam	1.89	1.830	1.672	1.988	-3.3
Thiruvananthapuram	1.96	1.933	1.775	2.092	-1.4
Thiruvallur	2.22	2.205	2.048	2.361	-0.7
Chennai	2.03	2.034	1.877	2.190	0.2
Kancheepuram	2.19	2.187	2.031	2.343	-0.1
Vellore	2.36	2.370	2.214	2.526	0.4
Tiruvannamalai	2.38	2.398	2.242	2.554	0.8
Viluppuram	2.33	2.323	2.167	2.479	-0.3
Salem	2.08	2.097	1.941	2.254	0.8

Namakkal	2.07	2.092	1.935	2.248	1.0
Erode	1.93	2.022	1.866	2.179	4.6
The Nilgiris	2.08	2.087	1.931	2.243	0.3
Dindigul	2.09	2.103	1.947	2.259	0.6
Karur	2.05	2.063	1.907	2.220	0.6
Tiruchirappalli	2.36	2.279	2.123	2.436	-3.5
Perambalur	2.20	2.246	2.090	2.402	2.0
Ariyalur	2.26	2.273	2.116	2.429	0.6
Cuddalore	2.36	2.307	2.151	2.463	-2.3
Nagapattinam	2.39	2.381	2.225	2.537	-0.4
Thiruvarur	2.25	2.210	2.054	2.367	-1.8
Thanjavur	2.40	2.347	2.191	2.503	-2.3
Pudukkottai	2.40	2.376	2.220	2.532	-1.0
Sivaganga	2.25	2.249	2.093	2.405	0.0
Madurai	2.25	2.207	2.051	2.364	-1.9
Theni	2.11	2.175	2.018	2.331	3.0
Virudhunagar	2.12	2.211	2.055	2.368	4.1
Ramanathapuram	2.36	2.396	2.239	2.552	1.5
Thoothukkudi	2.31	2.361	2.204	2.517	2.1
Tirunelveli	2.29	2.321	2.165	2.478	1.3
Kanniyakumari	2.03	2.039	1.881	2.197	0.4
Dharmapuri	2.23	2.236	2.079	2.392	0.2
Krishnagiri	2.40	2.393	2.236	2.549	-0.3
Coimbatore	1.97	1.997	1.840	2.153	1.3
Tiruppur	2.03	2.061	1.904	2.217	1.5

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