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Research Article

Maternal Health: Which States are more Caring?

Aditi Chakraborty[1] & Dibyojyoti Bhattacharjee[2*]

Abstract

The health condition of women during pregnancy, childbirth and postpartum period is referred to as maternal health. Maternal health care is a clear indicator of basic health care services available at a place. Eighteen percent of maternal deaths in the world happen in India. India could not attain the Millennium Development Goal of diminishing the maternal mortality rate to 109 at the end of 2015. This calls for rigorous analysis of maternal mortality figures in the country and to identify regional variation in maternal health care, if any. As the matter of public health belongs to state list and maternity benefits is under concurrent list so state-wise variation in maternal health care is expected. This work looks into a state-wise analysis of maternal health care of both for rural and urban areas of India based on the fourth National Family Health Survey data.

Introduction

Maternal health refers to the health of women during pregnancy, childbirth and postpartum period. It is a concept that encompasses the health care dimensions of family planning, preconception, prenatal and postnatal care in order to reduce maternal mortality.[3] Preconception care can include providing education, health promotion, screening and interventions for women of reproductive age to reduce risk factors that might affect future pregnancies**.** Prenatal care is comprehensive care that women receive and provide for themselves throughout their pregnancy. Postnatal care issues include recovery from childbirth, concerns about newborn care, nutrition, and family planning (Naganahalli, 2014). Improvement in life expectancy and reduction in infant mortality rate are considered as indicators of progress of health. But the health problems of mothers directly affect the health of their children and mothers' health issues may be considered as an obstacle in the social and economic development of a nation. According to Radhkar and Parasuraman (2007) "Maternal deaths assume importance not only due to health reasons but also when the women dies there are significant social and economic losses. Children who lose their mothers suffer the most. The risk of death for children under five years increases if the mother dies." Reproductive and child health and mortality has been viewed as an indicator of socio-economic wellbeing. Thus, reducing maternal mortality becomes an important goal of public health programme throughout the world (Rajula, 2014). Maternal mortality indices show a great disparity between countries, much more than even infant mortality (Radhkar and Parasuraman, 2007).

Maternal health has been an integral part of the family welfare program in India, since the time of the First and Second Five-Year Plans (1951-56 and 1956- 61). But, India has recorded the most number of maternal deaths worldwide. In 2013, maternal deaths in India were about 50000 as reported by the United Nations. One of India's millennium development goals was to reduce its MMR by three quarters-from 437 deaths per 1,00,000 live births in 1990-91 to 108 by the end of 2015 (Kumar, 2010). Unfortunately, India could not reach the goal but was able to reduce the maternal mortality to 190.

India practices a federal form of government. The power is divided into the centre or union government and the state governments. The extent of which is discussed in details in Part XI of the

[1]Department of Health Statistics, Institute of Medical Science, Banaras Hindu University, Varanasi, India
[2]Professor, Department of Statistics, Assam University, Silchar, Assam, India
*Corresponding author: Dibyojyoti Bhattacharjee, Email: djb.stat@gmail.com
[3]Maternal Health (https://en.wikipedia.org/wiki/Maternal_health)

Indian Constitution. The power enjoyed by the governments is classified as legislative, administrative and executive powers. The legislative section is divided into three lists viz. Union list, States list and Concurrent list. The matter of public health belongs to state list and maternity benefits is under concurrent list, so a state wise variation in maternal health care is expected. In a vast country like India, the resource distribution could vary across geographical regions. Already the rural areas in India lack in terms of several basic facilities compared to their urban counterpart. Unequal distribution, even in basic health care facilities, may create a sense of neglect in the mind of the rural citizens towards the government. Thus, to justify the accountability of the governments' health related policies, quantitative indicators shall be utilized to identify the extent of health care facilities and their variation across the different states and also within the states.

The National Family Health Survey (NFHS) in India is large scale, multi-round survey conducted in a represented sample of household throughout India. The survey provide state and national information for India on fertility, infant and child mortality, the practice of family planning, maternal and child health, reproductive health, nutrition, anemia, utilization and quality of health and family planning services.[4] The latest round of NFHS was complete in 2015-16 and the fact sheets provide national, state as well as district level data related to child and maternal health care for both rural and urban area. The current work attempts to utilize this data to classify the states/UTs in terms of maternal health care facilities and also to study the urban-rural differential of the states/UTs.

The paper is divided into six sections. The next section of the paper provides a brief discussion on the literature related to maternal health care in India and tries to identify the research gap. The exact objectives of the study are spelled out in the following section. Section 4 of the paper discusses the methodology followed by the results of the study in the next section. The last section of the paper provides a discussion on the probable reasons of poor maternal health care in the states/UTs identified in the previous section of the study.

Review of Literature

The management of health problems during pregnancy and after delivery is important to maintain the health of the mother (Das and Shah, 2003). The use of maternal and child health services, such as prenatal care and professionally assisted delivery, improves the health and well-being of women and children (Short and Zhang, 2004).

Rich literature exists in connection to maternal health care services in India as several demographers are constantly working on various issues concerning this field. The entire available literature base in this regard can be broadly classified into four parts viz. estimation of maternal mortality in developing countries, study of effectiveness of several government schemes related to maternal and child health care, determinants of maternal health and regional disparities in maternal health care.

Considering the existence of a foggy data structure in connection to demographic information in developing countries, Borema (1987) addressed the issue of estimating maternal deaths for developing countries with the help of other available auxiliary information like general levels of mortality and fertility in a population, coverage of deliveries in hospitals and at home, general health facilities available etc. For countries in which reliable data on maternal deaths are sparse, Blum and Fargues (1990) deduced a process of estimating maternal deaths as an application of the life table that are available for each sex and deaths broken down by cause specially designed to estimate maternal mortality. Bhat (2002) presents estimates of maternal mortality for India from two indirect procedures, the sisterhood method and a regression method.

Different government schemes were floated time to time in independent India aiming improvement in maternal and child health in India. Demographers and researchers on public health have constantly put those schemes under scanner. Recognizing the fact that increase in the number of institutional deliveries leads to decrease in maternal mortality the Ministry of Health and Family Welfare in India launched a cash assistance program in 2005 with the title *Janani Suraksha Yojana (JSY)*. Bose (2007), critically analyzed the program. He suggested that, to improve institutional

[4]http://rchiips.org/nfhs/

deliveries and medical health care to mothers during pregnancy, the government shall improve health infrastructure and ensure road connectivity in the rural areas rather than provide money to poor families undergoing institutional deliveries. Jain (2010) is of the opinion of a possibility where cash incentive may disproportionately attract pregnant women without complications to institutions and women with complications not getting proper treatment. As a solution the need was felt to collect accurate time series data on the proportion of pregnant women with complications among institutional deliveries and case-fatality ratio among them. These data along with maternal mortality rate shall help in understanding the effect of *JSY* on maternal mortality. A survey on the status of maternal and child health was jointly conducted by UNICEF and Ministry of Women and Child Development (MWCD) in 2013–14 (RSoC) and was finally released in July, 2015. The survey showed that there is some positive development in indicators related to access to services because of the National Rural Health Mission and the JSY but the parameters related to maternal health care are slow in improving (Sinha, 2015). Though JSY has increased the number of institutional deliveries or maternal health care through professionals but several authors have questioned the quality of such services which has led to insignificant improvement in maternal health care indicators vis-à-vis maternal mortality (Rai and Singh, 2012; Kumar and Dansereau, 2014).

In connection to the determinants of maternal health Shiffman (2000) performed a cross-national regression of 64 countries and found that wealth of the nation explain only a portion of the variance in national maternal mortality levels. Other determinants of maternal mortality include women's educational levels, proportion of deliveries attended by trained health personnel, extent of urbanization (Mosley, Lincoln and Chen, 1984; Debarchana, 2006) and socio-economic factors like place of residence (Kanitkar and Sinha, 1989), religion, caste (Kavitha and Audinarayana, 1997), standard of living of the household (Ghosh, 2004) and quality of health care service (IIPS, 2000). Ram and Singh (2005) and Sugathan *et al.*, (2001) have found that antenatal care is a strong predictor of safe delivery in the rural areas of India. Based on data from the District Level Household Survey-Reproductive and Child Health conducted in Orissa during 2002-04, Ram and Pradhan (2007) found that with increase in the number of antenatal check-ups the percentage of safe deliveries increases substantially.

Some recent literatures related to regional disparity in India or within the Indian states in connection to maternal health care facilities include the following. Dwivedi and Kar (2011) based on the NFHS-2 data (1998-99) performed a region wise analysis of the impact of the community level socio-economic inequality on the maternal nutritional status of rural India. The sampled subjects (mothers) were classified based on their household standard of living and community standard of living and Body-mass index was considered as the criteria of maternal nutritional status and the analysis was performed by classifying the Indian states into six categories viz. North, Central, East, North-east, West and South. Lalmalsawmzauva and Nayak (2010), studied the status of antenatal health care in Mizoram and brought about an inter-district comparison based on the data available from NFHS 1 and Statistical Handbook of Mizoram 2004. The study showed huge disparity in antenatal health care in the different districts of the state though Mizoram enjoyed the best coverage in antenatal care amongst the North eastern states of India. Based on the data from a report by Ram and Sekhar (2006) disparities amongst the different districts of Orissa regarding certain indicators relating to maternal and child health care is quantified by Swain and Mohanty (2010).

With the availability of current data on maternal health care status of India, due to the recent NFHS, the present condition of maternal health care in the different states/UTs needs to be quantified. Unequal distribution of resources is always an issue in India and is the driving force of the study. Guided by the available literature and considering the various health indicators affecting the maternal health care status as provided in NFHS-4, an attempt is made to combine the state-wise disparity parameters related to maternal health care into a single index. The value of the index shall act as a reflection of the existing maternal health care situation in the states/UTs of India. Since, sufficient evidence is found in the previous studies with place of residence as one of the vital determinants of maternal health care so subsequently the study is lowered down to a rural-urban comparison across the states.

Objective of the Study

The paper is planned to attain the following objectives:

1. To develop a composite index based on several maternal health related parameters collected during NFHS-4.
2. Ranking of states and union territories based on maternal health care facilities available for rural population, urban population and over all.
3. Bringing about Urban-Rural comparison of maternal health care of the States and Union territories.

Methodology

Data Source

The data used in this study are collected from the National Family Health Survey (NFHS-4) fact sheets [http://rchiips.org/NFHS/factsheet_NFHS-4.shtml] that is conducted under the stewardship of the Ministry of Health and Family Welfare, co-ordinated by the International Institute for Population Sciences, Mumbai and implemented by a group of survey organizations and population research centers following a rigorous selection procedure.

Health Care Parameters

From the data source mentioned above the following parameters are identified that can be used as a measure of maternal health care.

- P_1-Mothers who had antenatal check-up in the first trimester (%)
- P_2-Mothers who had at least 4 antenatal care visits (%)
- P_3-Mothers whose last birth was protected against neonatal tetanus (%)
- P_4-Mothers who consumed iron folic acid for 100 days or more when they were pregnant (%)
- P_5-Mothers who had full antenatal care (%)
- P_6-Registered pregnancies for which the mother received Mother and Child Protection (MCP) card (%)
- P_7-Mothers who received postnatal care from a doctor/nurse/LHV/ANM/ midwife/other health personnel within 2 days of delivery (%)

All the parameters from P_1 to P_7 are having positive dimension i.e. higher the value better is the performance.

Algorithm of the Composite Index

- Shannon's entropy measure is used to determine the weights corresponding to the different parameters (P_1 to P_7). Weights are the relative importance of the corresponding parameters in the composite index.
- Here we are stuck in a multi-criteria analysis problem, where we are to rank the states/UTs in terms of maternal health care facilities based on several criteria[5]. TOPSIS method (Technique for Ordering Preferences by Similarity to Ideal Solution) is used for combining the data obtained for the different parameters into a composite index. Thus, each state/union territory shall be represented by one single value between 0 and 1. A lower value indicates better health care facility in the state/UT. Based on the values of the composite index the states/UTs are ranked. The ranks provide the relative position of a state/UT in terms of maternal health care.
- The same exercise is repeated for the rural figures of the states/UTs as well as for the urban figures of the states/UTs separately. On obtaining the values of the composite index of both

[5]Several methods are developed to solve such multi-criteria analysis problems. For details one may consult Hwang and Yoon (1981) and Olson (1996). The TOPSIS method is involved as it has the following criteria (i) the concept is rational and comprehensible (ii) the computation involved is simple (iii) the concept is capable of depicting the pursuit of the best performance of a state/UT for each parameter in a simple mathematical form (iv) the concept allows objective weights to be incorporated into the comparison process, and (v) it measures not only the shortest distance from the positive ideal solution but also considers the longest distance from the negative ideal solution. These criteria are pointed out by Zeleny (1982) and Deng, Yeh and Willis (2000).

rural and urban area the difference of the values of a given state/UT is computed. This difference indicates the disparity in the allocation of health care facilities in that state/UT.

- On identifying the distributional pattern of the difference between the composite index values of urban-rural area, the level of disparity in a state/UT is identified.

Determination of Weights of the Parameters

Shannon's Entropy Measure (φ), (Wu, Sun, Liang, Zha, 2010) is used to obtain weights to be assigned to the different parameters under study. Steps for computing φ are defined as follows:

- P_{ij} is the value of the i^{th} state/UT for the j^{th} parameter i.e. $i= 1, 2,..., n$ (state/UT) and $j = 1, 2,..., m$ (parameters).
- Next the closeness between P_{ij} and its ideal value is given by d_{ij}, where

$$d_{ij} = \frac{P_{ij}}{\underset{i}{Max}(P_{ij})} \quad (1)$$

  for $i =1, 2,..., n$ and $j = 1, 2,..., m$
- The entropy of the j^{th} parameter is defined as:

$$\varphi(j) = -\sum_i \frac{\theta_{ij} \ln(\theta_{ij})}{\ln(n)} \text{ where, } \theta_{ij} = \frac{d_{ij}}{\sum_i d_{ij}} \quad (2)$$

- Accordingly, the weights are calculated as:

$$w_j = \frac{1-\varphi(j)}{\sum_j [1-[\varphi(j)]]} \quad \text{for}, j = 1, 2, \ldots, m \quad (3)$$

TOPSIS Method of Computing the Composite Index

The Composite Indicator (CI) is computed using the TOPSIS method through the following steps:

- First the two components for ideal solution L(i, IDR) and negative ideal solution are computed L(i, NIDR)

$$L(i, IDR) = \sqrt{\frac{\sum_{j=1}^{m} \left(P_{ij} - \max_i (P_{ij})\right)^2 \times w_j}{\sum_{j=1}^{m} P_{ij}^2}} \quad (4a)$$

$$L(i, NIDR) = \sqrt{\frac{\sum_{j=1}^{m} \left(P_{ij} - \min_i (P_{ij})\right)^2 \times w_j}{\sum_{j=1}^{m} P_{ij}^2}} \quad (4b)$$

- Accordingly, the Composite Indicator (CI) for the i^{th} state/UT is given by:

$$CI_i = \frac{L(i, IDR)}{L(i, IDR) + L(i, NIDR)} \quad (5)$$

The value of CI is a ratio between 0 and 1, the smaller the value of CI better is the position of the state/UT in case of maternal health care facilities. Proceeding in the similar manner, the values of Composite Index for Rural (CIR_i) and Urban (CIU_i) for the i^{th} state/UT is computed. Here, CIR_i and CIU_i represent the values of composite index on maternal health care for the i^{th} state/UT. To visualize the relative position of each of the states/UTs based on the three values of composite indices viz. CI_i, CIR_i and CIU_i a bubble plot shall be used. The bubble plot is a graphical technique that can be used for representing three variables each of which takes numerical values. This plot can be considered as an extension of a scatter plot. The user chooses two primary variables that are represented along X-axis and Y-axis respectively. The (x, y) points are plotted in the graph paper but the plotting symbols are circles. The radius of the circles is proportional to the value of a third variable. Precisely speaking

the bubble plots represent the values of three variables by drawing circles of varying sizes at points that are plotted on the vertical and horizontal axes. Two of the variables determine the location of the data points, while the values of the third variable control the radius of the circles. The circles thus formed are kept colorless so that they remain transparent and the over lapping of points can be easily understood (Das and Bhattacharjee, 2008). The absolute value of the difference in the composite index for the rural and urban area for the i^{th} state is given by-

$$DI_i = |CIR_i - CIU_i| \quad (6)$$

The value of the difference index would tell us how much the maternal health care situation differs between the rural and urban areas of the i^{th} state/UT. The difference index score close to 0 is an indicator of very low difference between the rural and urban maternal health care situation and a difference index value close to 1 is an indicator of very high difference between the rural and urban condition based on the maternal health care parameters.

Kolmogorov Smirnov (K-S) Test

The Kolmogorov Smirnov (K-S) test statistic is used to test the distribution of the index of difference as the values are continuous in nature. This test is used to check if the random sample under consideration is drawn from a population with specified cumulative distribution function $F_o(x)$. Accordingly, the null hypothesis of the test is H_o: $F(x)=F_o(x)$ against the alternatives

$$H_1: F(x) \neq F_o(x) \quad (7)$$

Kolmogorov-Smirnov state that under null hypothesis the empirical distribution function $F_n(x)$ approaches the true distribution function defined by the null hypothesis i.e. $F_o(x)$. The test defined the test statistic as

$$D_n = \sup_x |F_n(x) - F_o(x)| \quad (8)$$

So, under the null hypothesis one would expect that the value of D_n to be small, while a large value of D_n may be taken as an indicator that the actual distribution is not $F_o(x)$ i.e. a violation of the null hypothesis. Thus, one would reject H_o, if and only if, the observed value of D_n for a given size of sample exceeds the critical value of D_n, for a given level of significance, α say. Let such a critical value be termed as $D_{\alpha,n}$ If the number of observations are 35 or more, as the case here, the critical value at 5 per cent level of significance ($D_{0.05,n}$) is $1.36/\sqrt{n}$. Thus, D_n value greater than $1.36/\sqrt{n}$, will indicate that the fitted distribution is significantly different from the theoretical distribution. The interval $[F(x) - D_{\alpha,n}, F(x) + D_{\alpha,n}]$ provides the $100(1-\alpha)\%$ confidence band for $F(x)$ which can be used as a visual tool for goodness of fit. After deciding about the probability distribution of DI it is important to find two real numbers c, d $\in$ [0, 1] to divide DI into three linear intervals namely [0, c], [c, d] and [d, 1] with the same probability weight of 33.33% as done in Bhattacharjee and Wang (2011) i.e.,

$$P[0 \leq DI \leq c] = 0.3333 \quad (9)$$

$$\text{and } P[0 \leq DI \leq d] = 0.6666 \quad (10)$$

Thus, $P[c \leq DI \leq d] = 0.3333$ using (9) and (10). These intervals have been used in this study to characterize the various stages of difference as follows:

(i) Low Difference if ($DI < c$)
(ii) Moderate Difference if ($c \leq DI \leq d$)
(iii) High Difference if ($d > DI$)

Calculation and Results

Based on the data available from NFHS-4 the weights corresponding to the different parameters are computed using the equations (1) to (3) above. This is done separately based on rural, urban and overall data.

Table 1: Weights for the different parameters participating in the composite index

	P_1	P_2	P_3	P_4	P_5	P_6	P_7
Over all	0.061152	0.152224	0.010234	0.272556	0.412325	0.02072	0.070788
Rural	0.066893	0.173065	0.011533	0.260389	0.396749	0.017083	0.074288
Urban	0.088529	0.123755	0.060628	0.238277	0.327868	0.074743	0.0862

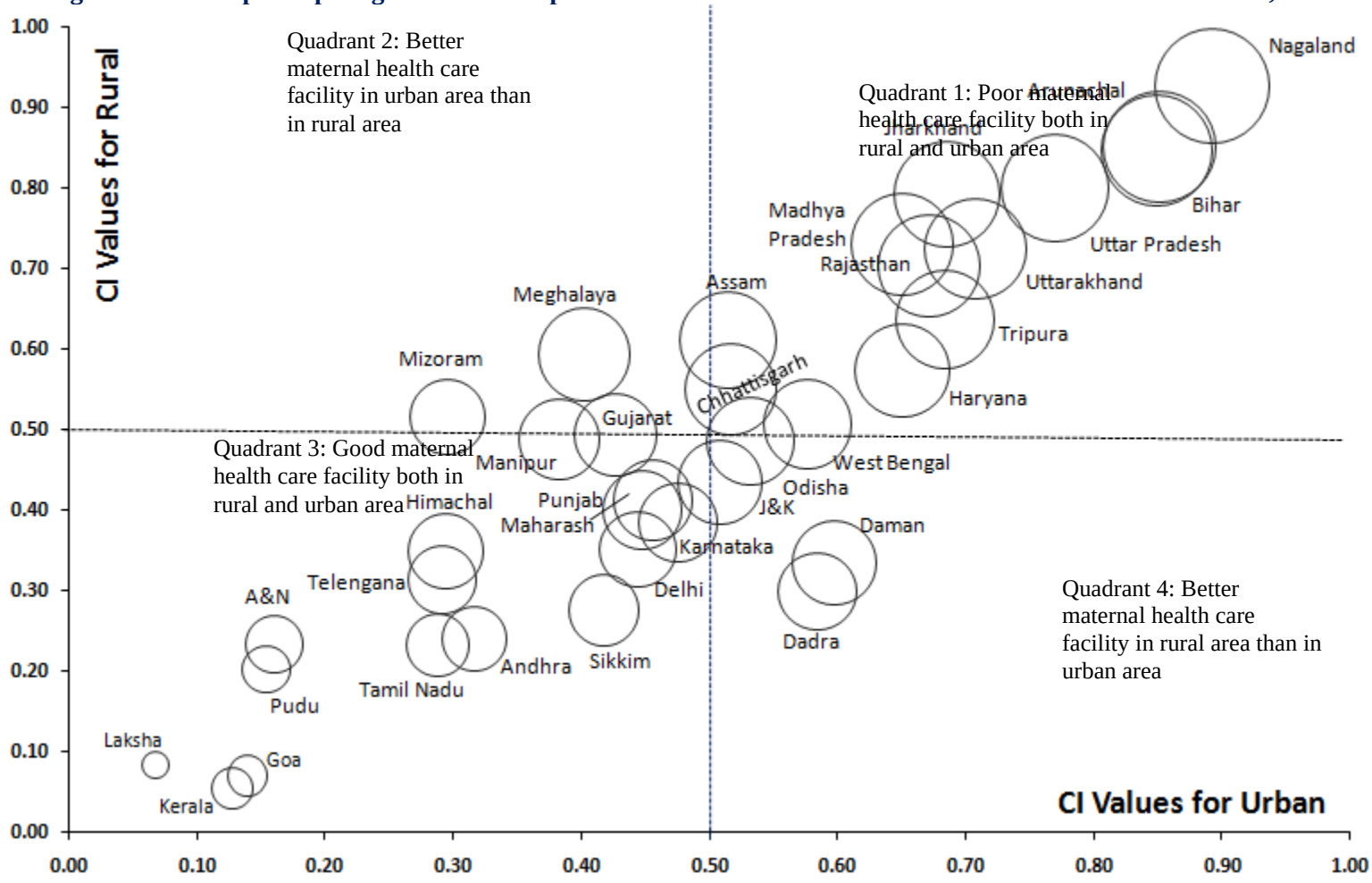
On obtaining the weights, the composite indicator values of maternal health care of all the states/UTs for rural, urban and overall data are computed. The values of the composite index of the states/UT for rural and urban area are presented in Appendix I. As indicated earlier lower the value of the composite index better is the performance of the state/UT. In this regard it is seen that Lakshadweep, Goa, Kerala and Puducherry are the top four states/UTs that are having better maternal health care. However, Nagaland, Bihar, Arunachal Pradesh and Uttar Pradesh are the four states/UTs that are poorest in maternal health care.

If the maternal health care facility in the urban parts are considered the ranking does not change much both at the top and at the bottom. The eight states/UTs mentioned above retain their top four and bottom four positions with minor interchange in ranks. This feature is also observed in case of rankings based on rural data of the states/UTs. However, in the middle some of the states/UTs show remarkable changes in the ranks. For example, Meghalaya which is raked 12 in maternal health care amongst urban area is raked 25 for rural values, Daman Diu (Rural rank 11, Urban rank 25), Dadra and Nagar Haveli (Rural rank 9, Urban rank 24) and Mizoram (Rural rank 22, Urban rank 8). For other details refer to Appendix I.

A bubble plot is drawn to represent all the three composite index values (i.e. urban, rural and overall) of maternal health care for each of the states/UTs. CIU_i and CIR_i values are considered along the x-axis and y-axis respectively. The overall values i.e. CI_i are considered as the third variable and value of which is represented by proportional radius of the plotted circle. Since, less the value of CI_i better are the health care facilities so a state/UT represented by a bubble of smaller size shall be preferable. The bubble plot thus obtained is divided into four quadrants by drawing perpendiculars to the axes at their mid points. Of the four quadrants, the third one is the most preferable. The bubbles of small size representing states/UTs falling in the third quadrant indicates of having better maternal health care facilities both in the urban and rural area as well as in overall figure. The most disliked quadrant shall be the first quadrant, which shall have bigger bubbles and shall represent states/UTs that has poor maternal health care facilities both in rural and urban area.

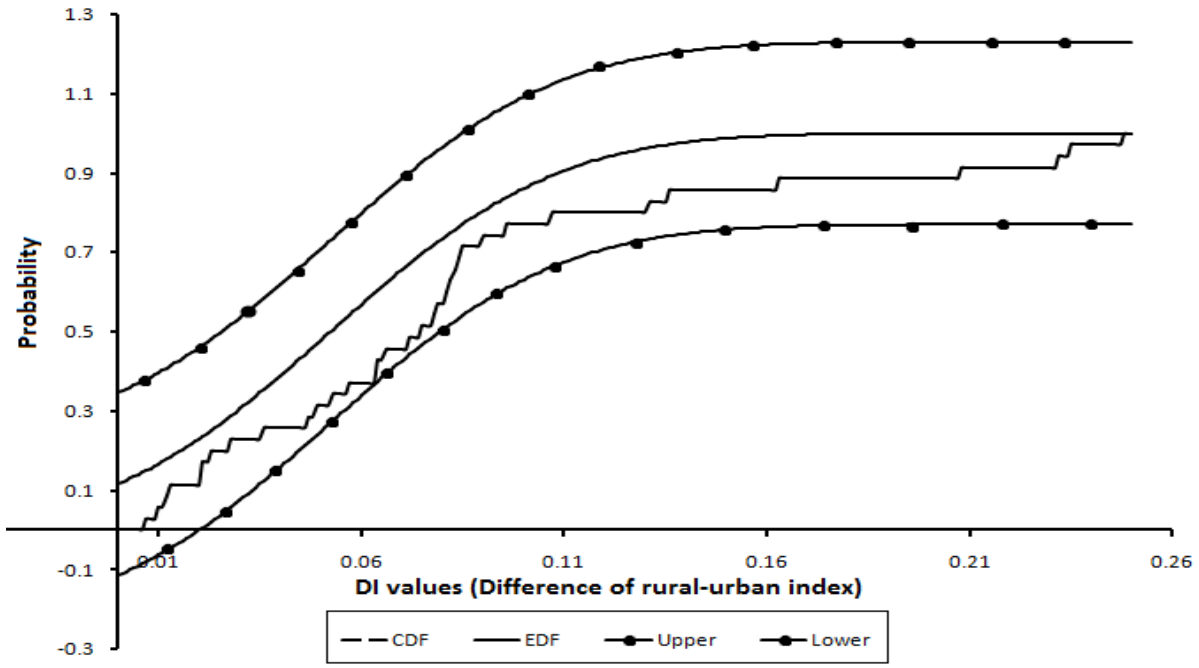
Thus from Figure 1, clearly states/UTs like Lakshadweep, Kerala, Goa, Puducherry, Andaman and Nicobar Islands, Telengana, Tamil Nadu and Andhra Pradesh falls in quadrant 3 with smaller bubble size and accordingly has better health care facility for mothers both in rural and urban area and overall. While states/UTs like Nagaland, Arunachal Pradesh, Bihar, Uttar Pradesh, Jharkhand, Madhya Pradesh, Rajasthan, Uttarakhand, Tripura and Haryana falls in quadrant 1 with bigger bubble size and indicating poor health care facility for mothers both in rural and urban area and overall.

Figure 1: Bubble plot dipcting values of Composite Index for maternal healtcare facilities in states/UTs- rural, urban and overall



The values of DI_i are computed. The values lie between 0 and 1. Under the hypothesis that the values follow normal distribution the K-S test is performed with parameters of the distribution estimated through the maximum likelihood estimator from data i.e. values of DI_i. The estimated values of mean ($\hat{\mu}$) and standard deviation ($\hat{\sigma}$) are 0.084 and 0.0649 respectively.

Figure 2: Visualizing the goodness of fit of DI values to normal distribution using empirical distribution function plot



The K-S test is then used to test if the DI_i values fit the normal distribution specified by the parameters already estimated from the data. The value of the statistic,
$D_n = \sup_x |F_n(x)-F_o(x)| = 0.208$ with corresponding p-value as 0.096. which is insignificant at 5 per cent level and it confirms that the DI_i values follow normal distribution.

To reduce potential subjectivity in the model selection, the empirical distribution function (EDF) plot is employed to visualize the result of the K-S test. The closeness of the step function (EDF) to the CDF curve, and the step function lying within the bounds, reconfirmed the model fitness to the data.

Given the distribution of DI to be N(0.084, 0.0649) the values of c and d as defined in (9) and (10) are found to be 0.05604 and 0.11195. Accordingly, the following stages of difference between the rural and urban are identified.

Table 2: Stages of rural-urban difference in maternal health care facilities

Stage	**DI values**
Low Difference	Less than 0.05604
Moderate Difference	Between 0.05604 to 0.11195
High Difference	Greater than 0.11195

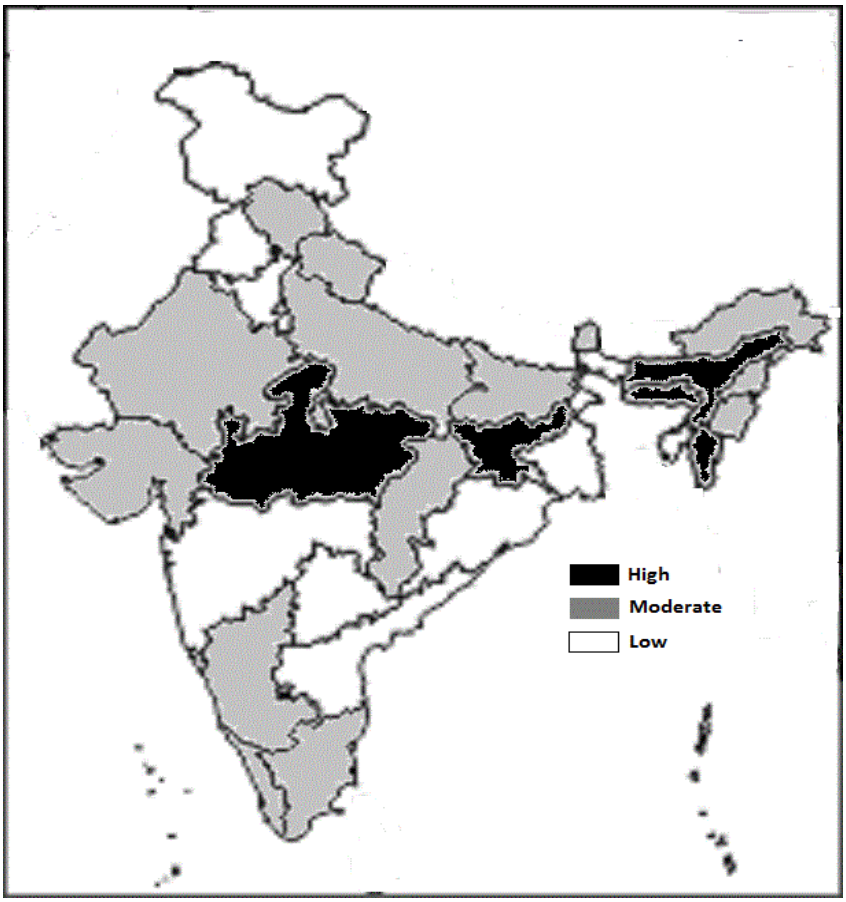
Accordingly, the following classification table is attained based on the extent of difference in maternal health care in rural and urban area of the different states/UTs.

Table 3: Classification of states/UTs based on rural-urban difference in maternal health care facilities

Stage	States/UTs
Low Difference	Lakshadweep, Puducherry, Andaman & Nicobar, Andhra Pradesh, Telengana, Punjab, Maharashtra, Jammu & Kashmir, Odisha, West Bengal, Haryana and Tripura
Moderate Difference	Goa, Kerala, Tamil Nadu, Sikkim, Himachal Pradesh, NCT Delhi, Karnataka, Manipur, Gujarat, Chhattisgarh, Rajasthan, Uttarakhand, Uttar Pradesh, Arunachal Pradesh, Bihar and Nagaland
High Difference	Mizoram, Dadra and Nagar Haveli, Daman and Diu, Meghalaya, Assam, Madhya Pradesh and Jharkhand

It is seen that amongst the states/UTs maximum difference between rural and urban facility in terms of maternal health care is noticed in Dadra and Nagar Haveli, Daman and Diu, Mizoram and Meghalaya. The minimum difference exists between Lakshadweep, Odisha, Punjab and Maharashtra. Amongst the states/UTs with maximum difference- it is interesting to note that Daman and Diu, Dadra & Nagar Haveli have better maternal health care facilities in the rural area than in the urban location. Figure 3 depicts the condition of the states/UTs in term of the level of difference in the rural and urban location as in Table 3.

Figure 3: Indian States/UTs classified by the level of difference between rural-urban in terms of maternal health care facilities



Conclusion and Area of Further Research

Although motherhood is often a positive and fulfilling experience but for many women it is associated with suffering, ill health and sometimes even death. Mothers carry the seed of the future generation during the maternity period and hence to ensure a better future of the country it is essential to ensure improved maternal health care. This study is devoted to identify which states/UTs are more caring towards their mothers and the states where mothers are the worst sufferers. A composite index is developed on the basis of the various maternal health care parameters and according to the values of the index the states/UTs are ranked. It has been observed that Lakshadweep, Goa, Kerala and Puducherry are the top four states/UTs that are having better maternal health care. However, Nagaland, Bihar, Arunachal Pradesh and Uttar Pradesh are the four states/UTs that are poorest in maternal health care. On considering the maternal health care facility in the urban parts the ranking does not change much for both the top and the bottom states. Similar feature is also observed in case of rankings based on rural data of the eight states/UTs. However, in the middle some of the states/UTs like Meghalaya, Daman Diu, Dadra and Nagar Haveli and Mizoram show remarkable changes between the rural and urban ranks (cf. Appendix I for details).

Among the states Nagaland is having the worst health care facilities for mothers followed by Bihar, Arunachal Pradesh and Uttar Pradesh. The overall status of maternity care and child immunization in Nagaland State is abysmally low, not even reaching half of India's average on most indicators. Within Nagaland, there are sharp regional disparities and the provision of healthcare remains highly skewed (ASN, 2017). The government of Nagaland is putting effort to expand and strengthen its existing 120 delivery points (2013-14) out of the 554 health units in the state. This health units (24×7 and non-24×7 delivery points) are equipped to undertake non-emergency deliveries, ensuring Ante Natal Care(ANC)/ Post Natal Care(PNC) services and referral services for high risk pregnancies to higher institutions and provision for financial assistance for institutional delivery to rural women (Thejotalu and Kikamerenr, 2015). Under the umbrella of NRHM Janani Suraksha Yojana (JSY) was introduced in 2005 to provide affordable and quality care for pregnant mother opting for institutional delivery in Public Health Institutions or Accredited Private Medical Facilities and under the Ministry of Health and Family Welfare (MoHFW) Janani Shishuhuraksha Karyakram (JSSK) was launched to eliminate out-of-pocket expenses for institutional delivery for mother and sick infant in all government health institution. Besides, these existing financial aids and the general awareness, many rural women still prefer for home delivery due to problems of transportation, distance of the health facilities and the non-availability of the health service providers in times of needs and emergencies, fear of hospitals, comfort of home and in addition to it the meager entitlement actually provided (NRHM, 2010-2011).

Bihar is ranked 34 in maternal health care amongst rural area and is ranked 33 for urban values, and is considered to have a very poor maternal health facility. As per Census 2011, Bihar was the second most populated state with population of 104.1 million. 88.7 per cent of population of Bihar resided in rural area. Women's literacy was 46.3 per cent for rural Bihar, some districts having less than 35 per cent women who were literate. There were studies in which women's literacy was found to be significantly associated with utilization of Antenatal Care (ANC) services. Illiterate women lack knowledge that might help them utilize health care services related to better maternal health (Brahmapurkar, 2017).

Moore (2009) finds that Arunachal Pradesh is one of the six states in India that has higher than-average rates of early adolescent child bearing. In 2008 nearly half of the women in Arunachal Pradesh did not make any prenatal visits (Singh *et al.*, 2009). The WHO estimates that about 11% of all infants are delivered via cesarean section in the developing world, a proportion in line with what is needed to achieve optimal health for both mother and children (WHO, 2009). In India as of 2006, 9% of women delivered their most recent baby via a cesarean. That proportion was about half the national average, just 4%, in Arunachal Pradesh.

Uttar Pradesh is the state with both urban and rural rank 32 indicating poor maternal health facility. Uttar Pradesh is one of the most populous states in India with a population of 199 million and one of the highest maternal mortality ratios (MMR), i.e. 359, about 1.7 times the national average. In Uttar Pradesh, about 78 per cent deliveries happen at home, less than one-third receive ante-natal care and less than 15 per cent receive post-natal care through the public health system. Most villages do not have government health facilities. Majority of the doctors who practice in rural areas are unlicensed or informally trained and are usually the first point of contact (Sharma and Mukherjee, 2014).

Unequal distribution of available resources is a common feature in a country like India. The urban area generally gets the major share of the available resources and the story of rural counterpart is that of gross neglect. This deprivation of rural areas is common in the distribution of most public facilities. This was the motivation for comparing the difference of maternal health care facilities between the rural and urban area across all the states. However, the study finds that the gap between rural and urban area in terms of maternal health care is not that alarming as generally found in case of other basic public facilities. The states/UTs with maximum difference between rural and urban facility in terms of maternal health care is noticed in Mizoram (10), Dadra and Nagar Haveli (14), Daman and Diu (21), Meghalaya (25), Assam (27), Madhya Pradesh (30) and Jharkhand (32). The figures in brackets indicate overall rank of the states/UTs in maternal health care. Thus, some of the middle and lower positioned states/UTs figure huge difference between rural and urban area. Also amongst these states/UTs with maximum difference, Daman and Diu, Dadra & Nagar Haveli have better maternal health care facilities in the rural area than in the urban location. This is something very different from usual.

Daman and Diu, a union territory in west India, consists of two separate areas divided by the Arabian Sea. In rural areas, the government delivers reproductive health and other health services through its network of Sub-Centres (SCs), Primary Health Centres (PHCs) and other health facilities. In addition, pregnant women and children can get services from private maternity homes, hospitals, private practitioners, and in some case non-governmental organizations (NGOs) and trust hospitals. In urban areas, reproductive health services are available mainly through government or municipal hospitals, Urban Health Posts (UHPs), Urban Family Welfare Centres (UFWCs), hospitals and nursing homes operated by NGOs, and private nursing and maternity homes. For the UT as a whole, 95 percent of pregnancy ends in live births, about three percent in induced abortions, two percent in spontaneous abortion and one percent in stillbirth. More pregnancies in rural areas end in live births (96 percent) than in urban areas (93 percent), while the incidence of induced abortion is more in urban areas (6 percent) than in rural areas (4 percent). (Reproductive and Child Health District Level Household Survey (DLHS - 2) Daman & Diu Union Territory (2002-04))

Dadra and Nagar Haveli is a union territory in Western India. It is composed of two separate geographical entities: Nagar Haveli wedged between Maharashtra and Gujarat, and, 1 km to the northwest, the smaller enclave of Dadra, which is surrounded by Gujarat. As per Census 2011 out of total population, 46.7 percent people lives in urban areas while 53.3 percent lives in the rural areas. Also the sex ratio of urban areas in Dadra & Nagar Haveli Taluka is 682 while that of rural areas is 863.[6] A large part i.e. 62% of the population of Dadra and Nagar Haveli is made up of Tribal groups and are mostly inhabitant of rural part of the states. The sex ratio is high in the rural part of the UT resulting in more deliveries. Thus, in Dadra and Nagar Haveli most maternal health care related programs are especially focused towards the rural areas. This might be a reason for index values of the rural part of this union territory dominating the index values of the urban part resulting in having better maternal health care facilities in the rural areas.

For future research, the model developed in this study can be used to conduct comparative study based on the parameters of child health, literacy, population and household profile etc. Some other basic parameters that are related to maternal health may also be included in the study and the weighted

[6]https://en.wikipedia.org/wiki/Dadra_and_Nagar_Haveli

composite index be calculated afresh. Shannon's Entropy method is used for assigning weights to the parameter under this study and TOPSIS method is used here for developing the composite index for ranking the states of India. In addition to this, further studies can be conducted for developing composite index based on other models such as WPM (weighted product model) and AHP (Analytical hierarchy process) model.

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Appendix I: Composite index values and ranks - overall, rural and urban for all the states and UTs in maternal health care

State/UT	CI_Overall (CI_i)	Rank Overall	CI_Rural (CIR_i)	Rank Rural	CI_Urban (CIU_i)	Rank Urban	Diff. DI_i
Lakshadweep	0.0516	1	0.0827	3	0.0753	1	0.0074
Goa	0.1162	2	0.0698	2	0.1342	3	0.0644
Kerala	0.1223	3	0.0542	1	0.1330	2	0.0788
Puducherry	0.1642	4	0.2024	4	0.1530	4	0.0494
Andaman & Nicobar	0.2302	5	0.2335	6	0.1881	5	0.0454
Tamil Nadu	0.2723	6	0.2322	5	0.2964	10	0.0642
Andhra Pradesh	0.2966	7	0.2405	7	0.2944	9	0.0539
Telengana	0.3226	8	0.3131	10	0.2779	7	0.0352
Sikkim	0.3497	9	0.2756	8	0.3830	11	0.1074
Mizoram	0.3946	10	0.5163	22	0.2848	8	0.2315
Himachal Pradesh	0.3959	11	0.3498	12	0.2775	6	0.0723
NCT Delhi	0.4074	12	0.3509	13	0.4337	17	0.0828
Chandigarh	0.4227	13					
Dadra & Nagar Haveli	0.4355	14	0.2993	9	0.5480	24	0.2487
Punjab	0.4401	15	0.4002	15	0.4120	15	0.0118
Karnataka	0.4410	16	0.3846	14	0.4601	19	0.0755
Maharashtra	0.4460	17	0.4128	16	0.4258	16	0.013
Manipur	0.4713	18	0.4886	19	0.4041	13	0.0845
Gujarat	0.4824	19	0.4947	20	0.4042	14	0.0905
Jammu & Kashmir	0.4918	20	0.4354	17	0.4567	18	0.0213
Daman & Diu	0.5017	21	0.3339	11	0.5688	25	0.2349
Odisha	0.5355	22	0.4859	18	0.4958	22	0.0099
West Bengal	0.5571	23	0.5067	21	0.5296	23	0.0229
Chhattisgarh	0.5778	24	0.5505	23	0.4685	20	0.082
Meghalaya	0.6000	25	0.5939	25	0.3858	12	0.2081
Haryana	0.6149	26	0.5735	24	0.6017	27	0.0282
Assam	0.6403	27	0.6118	26	0.4812	21	0.1306
Tripura	0.6740	28	0.6370	27	0.6156	29	0.0214
Rajasthan	0.7228	29	0.7045	28	0.6079	28	0.0966
Madhya Pradesh	0.7265	30	0.7313	30	0.5956	26	0.1357
Uttarakhand	0.7299	31	0.7253	29	0.6474	31	0.0779
Jharkhand	0.7949	32	0.7924	31	0.6291	30	0.1633
Uttar Pradesh	0.8137	33	0.7998	32	0.7185	32	0.0813
Arunachal Pradesh	0.8638	34	0.8477	33	0.7897	34	0.058
Bihar	0.8720	35	0.8522	34	0.7861	33	0.0661
Nagaland	0.9221	36	0.9274	35	0.8424	35	0.085

Source: Computed by the authors based on raw data collected from NFHS IV