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Does Brass Technique Gives Reliable Estimate of Mortality Indicators: An Assessment by Urban-Rural and Gender Differentials (Using 2001 and 2011 Census of India)

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Introduction

Globally 5.9 million children under the age of 5 dies and 4.5 million (75% of all under-five deaths) death occur within the first year of life (World health report 2015). In India 48 per 1000 deaths in under-five out of these, 34 deaths per 1000 (Sample Registration System bulletin 2016 December), occurred within the first year of life, 83% deaths happened in the first year of life out of under-five deaths. India confers to the highest number of fatalities among under-five children among the other South Asian countries (2.1 million deaths in 2006) and one-fifth of U5MR globally (United Nations, 2008).

Infant and child mortality are considered to be good indicators of health status and socio-economic condition of a country. They are the major components of the general mortality and are subject to the rapid change due to improvement in public health services and socio-economic condition. Infant, child and under-five mortalities are not uniform across the country. There are significant diversities within India regarding mortality levels. In South India, higher socio-economic groups have the lowest-low mortality like Kerala (infant mortality rate 12 per 1000 live birth, Sample Registration System bulletin 2016 December) as compared to the North Indian states. It should also

be borne in mind, sex differentials and place of residence differentials are the most basic dividing factors of child mortality. Still-births and infant mortality are affected by sex differentials because of the biological differences in males and females. Also, male children are more susceptible to certain kinds of diseases than girls in their childhood such as asthma (Johansen *et al;* 1992; Skobeloff *et al;* 1992; Luyt *et al;* 1993; Harju *et al;* 1996; de Marco *et al;* 2000). Moreover, the treatment and attitude of parents towards a baby boy and a baby girl might not be the same, especially in a country like India where son preference exists which at times might be proved to be crucial in their feeding practices which could indirectly promote child-death. Das Gupta (1990) emphasized on the importance of parental competence, stating that 'incompetent' parents give their children poorer care, are slower to recognize and respond effectively to their needs, and consequently lose children'. The availability of health care services has a negative impact (if any) on child mortality. Urbanization expedites better access to various types of relevant information in urban areas (Murthi *et al;* 1995).

Millennium Development Goal (MDG) 4 targets to reduce the under-five mortality rates by two-thirds between 1990 and 2015 (United Nations Children's Fund 2010, WHO 2012). Two of the key indicators of monitoring progress towards this goal are the under-five mortality rate (U5MR) and the infant mortality Rate (IMR) (UNDP 2003). It is documented in earlier studies that child health inequalities exist in India along with several dimensions and there are many disparities across the country in term of health outcomes, access to health services and utilization of health services (IIPS 2005-06; Tang *et al;* 2008).

Reliable vital statistics are essential for meaningful decentralized population planning. Unfortunately, the civil registration of India continues to be very poor mainly due to under-reporting of births and deaths. Hence, the vital statistics generated out of it do not seem very accurate and reliable. This necessitates the dependence on the indirect estimations of vital rates. Recognizing the need for reliable and correct information on fertility and mortality, the

Government of India commenced a large-scale demographic sample survey on a pilot basis in 1964-65 and started on a regular basis by 1969-1970 which is popularly known as the Sample Registration System (SRS). SRS is based on a dual recording system and aims to provide accurate estimates of fertility and mortality at the national and state-level separately for rural and urban sectors.

Indeed, in the last two decades, India was able to show significant progress in reducing its infant and child mortality (Registrar General of India 2009; International Institute for Population Sciences 2007). Yet India has to go travel a long way to be at par with other developed countries to set its child mortality rates at a decent level than the current alarming rates. Determining the state-level differentials in the lights of the place of residence and sex become very crucial to pull out the reduction. In this present study, an attempt has been made to estimate inter-state variations in Infant Mortality Rates and Under-five Mortality Rates in India focusing on sex and place of residence.

Study Setting, Data and Method

Data Source

The present study is based on the two subsequent rounds of Census of India, 2001 and 2011. The 14th and 15th Indian National Censuses were conducted by the Office of the Registrar General, Government of India between February 9 and 28, 2011 (population enumeration phase) which spreads across 35 states and union territories of India, the Census covered 640 districts and 5767 talukas. The fundamental principle is to cover the entire country systematically without omission or duplication. The information was collected on 35 items and 1.5 crore Census Schedules were canvassed in 16 Indian languages. Broadly, nation-wide information is collected on fertility, mortality and migration. However, this paper is based on data collected on Children Ever Born (CEB) and Children Surviving (CS).

Method

Brass (1964, 1975) was the first to develop a procedure for converting proportions dead of children ever born reported by women in different age groups of the childbearing period into estimates of the probability of dying before attaining certain exact childhood ages. He observed that the relation between the proportions of children dead by age group of mothers (D(i), i=1 for age group 15-19, i=2 for age group 20-24, …, i=7 for age group 45-49) and the probability of dying before age x [q(x)], is primarily influenced by the age pattern of fertility.

Outcome Measurements

The present study measures two outcome variables, namely, infant mortality rate (IMR) and under-five mortality rate (U5MR), as these are important indicators of health status and socioeconomic and demographics condition of any country. Infant mortality is defined as the probability of dying before completion of one's first birthday and under-five mortality is defined as the probability of dying before completion of one's fifth birthday (comprising of 0-60 months after birth).

We have highlighted the patterns and levels of infant and child mortality rates in EAG and non-EAG states. In India, the eight socioeconomically backward states of Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttaranchal and Uttar Pradesh, referred to as the Empowered Action Group (EAG) states, lag behind in the demographic transition and have the highest infant mortality rates in the country.

Analytical approach

The Brass method will be used for the estimation of infant and child mortality in India and its states. The United Nations South Asian Model was adopted as it appropriately represents the mortality patterns of countries in South Asia including India (Registrar General of India 2009). As per the assumptions by United Nations (1983), the child mortality patterns of women in the age groups 20-24 and 25-29 years were used as they appear to be most reliable. The average parity per woman is estimated by P (i) =CEB (i)/W (i) where CEB (i) denotes the number of children ever born to women belonging to the age group i and W (i) denotes the total number of women

belonging to the age group i irrespective of their marital status. The proportion of children dead for each age group of mothers is estimated by D (i) =CEB (i)-CS (i)/CEB (i) =CD (i)/CEB (i) where CS(i) denotes the number of surviving children reported by mothers belonging to the age group i and CD(i) denotes the number of dead children reported by mothers belonging to the age group i. The multipliers K (i)'s are calculated according to the Trussell's variant of the original Brass method.

Results

Estimates of Infant and Under-five mortality rates in India and States/Union Territories in 2001 and 2011

Table 1 presents the Infant Mortality Rates (IMR) and Under-five Mortality Rates (U5MR) per 1000 live births in India and states as per Census 2001 and 2011. The overall IMR decreased from 68 (per 1000 live births) to 58 (per 1000 live births) from 2001 to 2011. U5MR too experienced a decline from 96 in 2001 to 80 in 2011. Even though the aggregate estimates suggest a sharp decline in IMR and U5MR, regional diversities did exist in the measures. The highest IMR and U5MR were noted in Madhya Pradesh in 2001 (93 and 138 per 1000 live births respectively). However, Meghalaya showed the highest IMR and U5MR (77 and 111 per 1000 live births) in 2011. Kerala maintained its record of having the least IMR (37 and 26 per 1000 live births in 2001 and 2011 respectively) and U5MR (46 and 34 per 1000 live births in 2001 and 2011 respectively in the country in both the time points. However, Delhi, Karnataka, Goa and Pondicherry experienced increases in IMR and U5MR. Expectedly, in both the occasions, the non-EAG performed better than EAG states in terms of IMR and U5MR. In terms of overall IMR and UM5R, the highest decadal change was experienced by Madhya Pradesh.

Estimates of Infant and Under-five mortality rates in India and States/Union Territories by sex in 2001 and 2011

Table 2 presents the Infant Mortality Rates (IMR) and Under-five Mortality Rates (U5MR) by sex per 1000 live births in India and States as per Census 2001 and 2011. At the national level, the IMR and U5MR favoured the males. The IMR for male reduced to 58 (per 1000 live births) in 2011 from 63 in 2001. The U5MR for male reduced to 87 (per 1000 live births) in 2011 from 80 in 2001. Similarly, the females exhibited an IMR of 74 (per 1000 live births) in 2001 which reduced to 58 in 2011 and a U5MR of 106 (per 1000 live births) in 2001 which reduced to 79 in 2011. Pondicherry experienced the highest IMR for males in both the time points whereas Madhya Pradesh showed the highest IMR (97 per 1000 live births) for females in 2001 and Meghalaya showed the highest IMR (78 per 1000 live births) in 2011. Arunachal Pradesh experienced the highest U5MR (131 per 1000 live births) for males in 2001 whereas Pondicherry showed a sudden mammoth increase in U5MR in 2011 for males (123 per 1000 live births). The highest U5MR for females was observed in the state of Madhya Pradesh (148 per 1000 live births) in 2001. However, Meghalaya displayed a U5MR of 114 per 1000 live births in 2011. Kerala, on the other hand, experienced the least IMR and U5MR in both 2001 and 2011. For females, the least IMR was observed in Kerala in both the time points. U5MR was least in Goa in 2001 (46 per 1000 live births) and in Kerala (30 per 1000 live births) in 2011. Whatsoever, the EAG states showed female dominance in infant and under-five child mortality than the non-EAG states in both the time points. Talking about Goa, it as well witnessed the highest decadal change for IMRs of males but in the opposite direction. Arunachal Pradesh had undergone a positive highest decadal growth (21%) of IMRs and U5MRs for males. Madhya Pradesh, on the other hand, showed the highest (positive) decadal growth for both the IMRs and U5MRs of females.

Estimates of Infant and Under-five mortality rates in India and States/Union Territories by place of residence in 2001 and 2011

Table 3 presents the Infant Mortality Rates (IMR) and Under-five Mortality Rates (U5MR) by place of residence per 1000 live births in India and states as per Censuses 2001 and 2011. The rural

IMR decreased from 73 (per 1000 live births) in 2001 to 63 (per 1000 live births) 2011. But, the urban IMR only declined by 1 unit. There was a decline of U5MR from 105 (per 1000 live births) in 2001 to 87 (per 1000 live births) but the decline in the urban sector alike the IMR hardly declined. The highest IMR in the rural sector was noted in Madhya Pradesh (100 per 1000 live births) in 2001 and in Meghalaya (82 per 1000 live births) in 2011. In the urban settings, the highest IMR was observed in Lakshadweep (72 per 1000 live births) in 2001 and subsequently in 2011 were noted in Pondicherry (76 per 1000 live births). However, the highest U5MR was experienced by Lakshadweep (102 per 1000 live births) and by Pondicherry in 2011 (108 per 1000 live births). Even though most of the states and union territories had undergone a decline or remained at the same level when it comes to estimating IMR and U5MR by place of residence, interestingly, Pondicherry witnessed a sharp increase in both IMR and U5MR in both the time points. In the rural sector, the highest decadal changes between 2001 and 2011 for both IMR and U5MR were shown by Madhya Pradesh.

Estimates of Infant and Under-five mortality rates in Rural India and States/Union Territories by sex in 2001 and 2011

Table 4 presents the estimated infant and child mortality in Rural India in 2001 and 2011. At the national level for rural places, it was seen that the infant mortality for males had dropped from 68 per 1000 live births to 63 per 1000 live births whereas the reduction was higher for females (infant mortality for females dropped from 78 (in 2001) to 63 (in 2011) per 1000 live births. Similarly, for under-five child mortality, the rates dropped from 95 (in 2001) to 87 (in 2011) for males and the decline in under-five child mortality for females was higher (83 in 2011 from 114 in 2001). Kerala maintained its lowest infant and child mortality rates in the rural sectors for males (IMR of 33 per 1000 live births in both the time points and U5MR of 40 and 41 in 2001 and 2011 respectively). The highest infant mortality for males in rural places was noted in Meghalaya which exhibited a small decline from 84 per 1000 lives in 2001 to 81 per 1000 in 2011. For the females in the rural

sectors, the lowest infant and child mortality rates were shown by Kerala which showed a decline from 41 per 1000 lives in 2001 to 32 per 1000 lives in 2011. Meghalaya, again, exhibited the highest female infant deaths in 2011 (83 in 2011 and 88 in 2001 per 1000 live births). For under-five child mortality among females, Uttar Pradesh experienced the highest rates in 2011 whereas Kerala experienced the minimum rates in both the time points. For the EAG states, most of the states showed quite rampant declines in both infant and child mortality, but still the levels were quite high in 2011. For the males, Himachal Pradesh, Delhi, Gujarat, Karnataka, Goa, Tamil Nadu, Pondicherry and Andaman & Nicobar showed little to moderate increase in infant/child mortality. Delhi and Goa showed slight increases in female infant/child deaths.

Estimates of Infant and Under-five mortality rates in Urban India and States/Union Territories by sex in 2001 and 2011

Table 5 presents the estimated infant and child mortality in Urban India in 2001 and 2011. At the national level for urban places, it was seen that the infant mortality for males had increased from 47 per 1000 live births to 52 per 1000 live births whereas the reduction was higher for females (infant mortality for females dropped from 58 (in 2001) to 51 (in 2011) per 1000 live births. Similarly, the under-five child mortality for males rose to 63 (in 2001) from 51 (in 2011) per 1000 live births, whereas it declined for females (51 in 2011 and 58 in 2001 per 1000 live births). For the males, the highest and lowest infant/child mortality was observed in Pondicherry (IMR of 99 per 1000 live births in 2011 and U5MR of 150 per 1000 live births in 2011) and Kerala/Daman & Diu (IMR of 34 per 1000 and U5MR of 43 per 1000 live births) respectively. Among the females, Kerala/Daman & Diu (IMR of 32 and U5MR of 40 per 1000 live births) exhibited the lowest infant mortality but the highest rate was experienced by Uttar Pradesh (IMR of 65 and U5MR of 90 per 1000 live births). Himachal Pradesh, Delhi, Rajasthan, Bihar, Nagaland, Tripura, Meghalaya, Assam, Jharkhand, Gujarat, Dadra & Nagar Haveli, Maharashtra, Andhra Pradesh, Karnataka, Goa, Kerala, Pondicherry and Andaman & Nicobar showed moderate to high increases in infant rates among

males. Meghalaya, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Goa and Pondicherry exhibited surge in infant deaths among females.

Discussion

The time frame captured in the present study (2001 to 2011) helps to examine the impact of the National Population Policy (2000), National Health Policy (2002) and National Rural Health Mission (2005) which aimed to reduce infant mortality to 30 per 1000 by 2010. National Health Mission (2005) aimed to bring down infant mortality to 36 per 1000 live births. Moreover, the performance of the implementations of these policies which had a particular focus on the EAG states sould be assessed. The reduction in the infant and child mortality has been far from the goals of these policies. However, the decline was slow in many states and there were significant disparities in declines across different geographic regions of the country. The major concern is the clustering of high mortality in certain pockets of the country. It is unfortunate that India has not succeeded in achieving equitable levels of child mortality across the states.

Having a detailed and clear-cut idea about the current scenario of the country is obligatory to have befitting plans and policies for the population. The vital statistics derived from the civil registration system being weak and having Sample Registration System as the sole survey to estimate fertility and mortality rates across the country, there is a quirk need to have alternative ways to compare the reliability of the prevailing systems. On this note, this paper aspired to comprehensively capture certain gaps in estimating infant and under-five child mortality rates by estimating inter-state differentials by sex and place of residence for two different time points (2001 and 2011).

The fact that India and most of the states had undergone a reduction in infant and under-five child mortality is very appealing. A clear North-South Divide (Dyson and Moore, 1983) was noted at the national-level for infant and child mortality. Kerala perpetuated to have the least infant and child mortality over a decade. Madhya Pradesh has gone out-of-the-way to show vast improvement in curbing both infant and child mortality throughout the decade. However, the north-eastern states,

on an average, experienced lesser improvements than other states of the country. In 2011, many of the north- eastern states showed quite high infant and child mortalities as compared to other parts of India. In general, Delhi, Pondicherry, Goa and Karnataka were reported to have increased burden of infant and child mortality. When child mortality is decreasing all over the country, the above-mentioned states are showing an increase in child mortality which is not a very desirable situation. Policy makers should take proper care and try to explore where the shortfall lies. Whilst infant and child mortality was higher for females than males in most of the states, its decline was also higher. Except for Arunachal Pradesh, the changes in infant mortality of males were not very appreciable in the other north-eastern states. The performance of the EAG states have shown vast improvements especially after different policies were undertaken and implemented to promote reduction in infant and child mortality. Additionally, the EAG states also showed high declines in infant and child mortality of females but the levels still persist to be very high. Interestingly, the declines in the infant and child mortality on one hand is quite impressive, but the results when segregated by sex for rural and urban for both the time points provide certain concerns. On one hand we can say that the rural places for both the males and females have revealed the success of the policies. On the other hand, for urban areas, in most of the states and union territories (even at the national-level) for males the infant/child deaths have risen. Although, a few of the states and union territories for females have shown increases in infant and child mortality (focusing mainly on the EAG and North-Eastern states), most of the states managed to show better results for females as compared to males in both the rural and urban sectors.

Place of residence has been identified as a major factor in determining mortality analysis as it closely corresponds to population density. At the national level, in the rural settings there was a 10% decline in infant mortality but only a 1% change was noted in the urban places. In most of the north-eastern states the decline in infant and child mortality has been very less. The rural places in the EAG states showed a moderate decline in infant and child mortality but the urban places mostly

maintained the same levels of mortality. The fact that Karnataka, Goa, Delhi and Pondicherry in the rural settings experienced an increase in the burden of infant and child mortality is very distressful. In fact, what is more surprising is that the fact, in addition to the above-mentioned states and union territories, Nagaland, Meghalaya, Jharkhand, Madhya Pradesh, Gujarat, Dadra and Nagar Haveli, Maharashtra and Andhra Pradesh in the urban sectors were also observed to undergo an increase in infant and child mortality.

Conclusion

This study renders ways to broadly overview the ongoing policies and schemes such as the Reproductive and Child Health Program, Janani Suraksha Yojana under the National Rural Heath Mission in India. The recent decadal declines in infant and child mortality are no doubt very impressive, but scrutinizing it through inter-state differentials by sex and place of residence suggests major drawbacks. Although the EAG states and the north-eastern states are showing better results in reducing child mortality, they still need prioritization to continue the process. The diverging patterns of child mortality in urban places are a big concern. The sex differentials in child mortality cannot be controlled to some extent due to biological differences between males and females. However, the sex-differentials should not arise out because of deliberate ill-treatment of girl child and excessive preference for male children.

Policy Implications

The findings of this study have scope for providing the basis for a few policy implications. Some of the major reasons for high infant and child mortality is the mother's health, mother's ante-natal care, timing and duration of breastfeeding, malnutrition of mother's and child's health. Another considerable issue is the high level of child malnutrition present in the country. There is a strong correlation between child malnutrition and child mortality (Schroeder and Brown, 1994; Singh et al, 2011). The government has initiated several schemes and introduced policies to fight against high child and infant mortality. Promoting maternal and child health education among women and their

families and understand how to adopt scientific ways to tackle maternal and newborn care, and home-based treatment for newborn infections could significantly enhance child survival in the high priority states. In addition, effective consultations about specific maternal and child health care services needs should be provided to women during their antenatal care visit in order to ensure the utilization of ensuring maternal and child health care services. There should be proper monitoring and evaluation of the ongoing schemes undertaken.

The urban places have better access to health infrastructure which of course promote a reduction in mortality. Yet, the present study provided evidence that the levels of infant and child mortality have not reduced much. What is even more appalling is the increase in child mortality in some of the urban places of both EAG and non-EAG states including the north-eastern states.

Limitation of the study

Some of the recent studies have revealed the association between environment and child mortality (Balk *et al;* 2004; National Research Council 2001; Curtis and Hossain 1998; Findley *et al;* 2002). But the non-availability of the data restricted us to ignore the effects of environmental factor such as rainfall, climate, bio-diversity on child mortality. Also, the results obtained are strictly state-level and hence cannot be generalized for districts.

This study found that indirect estimates are generally consistent with direct estimates, after adjustment for fertility change and birth transference, but doesn't add substantial additional insights beyond direct estimates. However, choice of direct or indirect method was found to be important in terms of both the adjustment for data errors and the assumptions made about fertility.

Another limitation of this method is that it suggests to disregard the estimate of q(1), the probability of dying before age one, based on women aged 15-19, as this estimate is usually too high. This bias results from the fact that younger women have a high proportion of first births, which generally have above-average risks of mortality. Also the adolescent mothers tend to come from low socio-

economic status. However, this method has many appealing characteristics and has been found to estimate child mortality levels and trends over roughly a 10 year period rather well (Hill, 1991).

Census and SRS, the two sources could be differed significantly with respect to non-sampling errors. In SRS age distribution is based on de jure counts of the sample area population, while in census the extended de facto approach used. Though this may results in some undercount of the population at the adult ages in census, post enumeration survey do not support such a possibility (India, Registrar General, 1975, 1983a). SRS age distribution updating periodically baseline data using dates of events that occurred subsequently. Over period such a procedure would extract SRS age distribution incomparable with those from census because it may make age error in specific age group in periodically then lower proportion of the population recorded at adult and older ages in the SRS.

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Table 1: Indirect estimates of Infant and under five mortality rates (U5MR) per 1000 live birth in overall population India and states/union territories based on censuses 2001 and 2011

India/ states	India and States					
	IMR			U5MR		
	2001*	2011	% Decadal change	2001*	2011	% Decadal change
India	68	58	0.1	96	80	0.16
Punjab	57	48	0.09	78	63	0.15
Jammu & Kashmir	61	51	0.1	94	69	0.25
Himachal Pradesh	60	49	0.11	83	66	0.17
Chandigarh	61	41	0.2	85	54	0.31
Uttaranchal	62	48	0.14	87	65	0.22
Haryana	67	54	0.13	95	73	0.22
Delhi	53	56	-0.03	71	76	-0.05
Rajasthan	76	62	0.14	110	87	0.23
Uttar Pradesh	84	71	0.13	124	102	0.22
Bihar	71	61	0.1	100	84	0.16
Sikkim	63	48	0.15	81	64	0.17
Arunachal Pradesh	91	69	0.22	136	98	0.38
Nagaland	71	61	0.1	102	84	0.18
Manipur	52	43	0.09	70	57	0.13
Mizoram	57	52	0.05	78	71	0.07
Tripura	66	58	0.08	93	79	0.14
Meghalaya	81	77	0.04	118	111	0.07
Assam	72	61	0.11	103	84	0.19
West Bengal	68	46	0.22	96	61	0.35
Jharkhand	65	62	0.03	91	85	0.06
Orissa	82	66	0.16	119	93	0.26
Chhattisgarh	84	66	0.18	123	92	0.31
Madhya Pradesh	93	69	0.24	138	97	0.41
Gujarat	54	54	0	73	73	0
Deman & Diu	42	31	0.11	55	40	0.15
Dadra & Nagar Haveli	59	45	0.14	81	59	0.22
Maharashtra	47	46	0.01	62	61	0.01
Andhra Pradesh	52	53	-0.01	70	71	-0.01
Karnataka	54	57	-0.03	73	78	-0.05
Goa	33	52	-0.19	41	70	-0.29
Lakashwadip	70	56	0.14	99	76	0.23
Kerala	37	26	0.11	46	34	0.12
Tamil Nadu	57	46	0.11	78	61	0.17
Pondicherry	45	65	-0.2	59	92	-0.33
Andaman and Nicobar Islands	57	52	0.05	78	71	0.07

Source: *Office of The Registrar General, India Ministry of Home Affairs, Government of India New Delhi, 2001

Table 2: Indirect estimates of Infant and under five mortality rates (U5MR) by sex per 1000 live birth in overall population in India and states/union territories based on censuses 2001 and 2011

India/ states	Male						Female					
	IMR			U5MR			IMR			U5MR		
	2001*	2011	% Decadal change	2001*	2011	% Decadal change	2001*	2011	% Decadal change	2001*	2011	% Decadal change
India	63	58	0.05	87	80	0.07	74	58	0.16	106	79	0.27
Punjab	52	49	0.03	70	65	0.05	63	47	0.16	88	62	0.26
Jammu & Kashmir	62	52	0.1	86	71	0.15	72	50	0.22	103	67	0.36
Himachal Pradesh	57	56	0.01	78	76	0.02	62	43	0.19	86	56	0.3
Chandigarh	55	44	0.11	75	58	0.17	67	39	0.28	95	50	0.45
Uttaranchal	58	48	0.1	79	64	0.15	67	49	0.18	95	65	0.3
Haryana	60	54	0.06	82	73	0.09	75	54	0.21	109	74	0.35
Delhi	46	52	-0.06	62	71	-0.09	59	59	0	81	81	0
Rajasthan	70	62	0.08	98	85	0.13	82	63	0.19	122	88	0.34
Uttar Pradesh	70	69	0.01	109	97	0.12	92	74	0.18	140	106	0.34
Bihar	62	59	0.03	86	81	0.05	79	63	0.16	115	88	0.27
Sikkim	60	49	0.11	82	66	0.16	65	47	0.18	91	62	0.29
Arunachal Pradesh	90	69	0.21	131	98	0.33	93	69	0.24	141	97	0.44
Nagaland	62	58	0.04	86	80	0.06	80	63	0.17	117	88	0.29
Manipur	47	45	0.02	62	60	0.02	57	41	0.16	78	54	0.24
Mizoram	54	53	0.01	74	72	0.02	61	51	0.1	84	69	0.15
Tripura	63	58	0.05	87	80	0.07	69	57	0.12	97	78	0.19
Meghalaya	78	76	0.02	113	108	0.05	83	78	0.05	122	114	0.08
Assam	70	62	0.08	99	86	0.13	75	60	0.15	107	82	0.25
West Bengal	65	48	0.17	91	64	0.27	72	44	0.28	103	58	0.45
Jharkhand	59	63	-0.04	82	88	-0.06	70	60	0.1	100	82	0.18
Orissa	80	68	0.12	116	96	0.2	84	64	0.2	124	90	0.34
Chhattisgarh	84	69	0.15	121	98	0.23	84	62	0.22	115	86	0.29
Madhya Pradesh	88	70	0.18	128	99	0.29	97	68	0.29	148	96	0.52
Gujarat	48	54	-0.06	64	74	-0.1	60	53	0.07	83	71	0.12
Deman & Did	40	33	0.07	52	42	0.1	44	30	0.14	57	38	0.19
Dadar & Nagar	59	46	0.13	80	61	0.19	60	44	0.16	83	57	0.26
Maharashtra	43	47	-0.04	57	63	-0.06	52	45	0.07	70	59	0.11
Andra Pradesh	49	55	-0.06	66	74	-0.08	55	51	0.04	75	68	0.07
Karnataka	51	58	-0.07	69	80	-0.11	57	56	0.01	78	76	0.02
Goa	31	56	-0.25	38	77	-0.39	36	47	-0.11	46	62	-0.16
Lakashwadip	65	58	0.07	91	80	0.11	74	53	0.21	107	72	0.35
Kerala	33	29	0.04	40	37	0.03	41	23	0.18	54	30	0.24
Tamil Nadu	52	50	0.02	71	68	0.03	62	41	0.21	86	54	0.32
Pondicherry	92	85	0.07	55	123	-0.68	48	47	0.01	63	62	0.01
Andaman Nicobar	54	63	-0.09	61	121	0.050	61	41	0.2	84	54	0.3

Source: *Office of The Registrar General, India Ministry of Home Affairs, Government of India New Delhi, 2001

Table 3: Indirect estimates of Infant and under five mortality rates (u5mr) per 1000 live birth by place of residence in India and states/union territories based on censuses 2001 and 2011

India/ states	Rural						Urban					
	IMR			U5MR			IMR			U5MR		
	2001*	2011	% Decadal change	2001*	2011	% Decadal change	2001*	2011	% Decadal change	2001*	2011	% Decadal change
India	73	63	0.1	105	87	0.18	52	51	0.01	70	69	0.01
Punjab	61	54	0.07	85	73	0.12	49	43	0.06	66	56	0.1
Jammu & Kashmir	69	55	0.14	97	74	0.23	59	49	0.1	81	65	0.16
Himachal Pradesh	61	52	0.09	84	70	0.14	50	44	0.06	68	58	0.1
Chandigarh	73	59	0.14	104	81	0.23	59	43	0.16	81	56	0.25
Uttaranchal	66	52	0.14	92	70	0.22	51	46	0.05	68	60	0.08
Haryana	71	60	0.11	102	82	0.2	57	47	0.1	78	63	0.15
Delhi	53	58	-0.05	72	80	-0.08	52	58	-0.06	71	79	-0.08
Rajasthan	80	67	0.13	117	93	0.24	59	54	0.05	81	74	0.07
Uttar Pradesh	88	76	0.12	130	109	0.21	66	63	0.03	92	87	0.05
Bihar	72	63	0.09	103	88	0.15	55	55	0	75	75	0
Sikkim	64	51	0.13	89	68	0.21	57	45	0.12	78	60	0.18
Arunachal Pradesh	99	77	0.22	150	111	0.39	59	48	0.11	81	64	0.17
Nagaland	75	66	0.09	107	92	0.15	56	57	-0.01	77	77	0
Manipur	53	47	0.06	72	62	0.1	48	42	0.06	64	54	0.1
Mizoram	68	64	0.04	96	88	0.08	44	41	0.03	55	52	0.03
Tripura	68	61	0.07	95	84	0.11	54	51	0.03	73	68	0.05
Meghalaya	86	82	0.04	127	120	0.07	56	58	-0.02	76	80	-0.04
Assam	74	64	0.1	107	88	0.19	52	51	0.01	70	69	0.01
West Bengal	70	47	0.23	99	62	0.37	63	46	0.17	88	61	0.27
Jharkhand	69	66	0.03	97	93	0.04	47	50	-0.03	62	67	-0.05
Orissa	84	70	0.14	124	99	0.25	64	58	0.06	89	79	0.1
Chhattisgarh	88	70	0.18	130	99	0.31	62	55	0.07	87	74	0.13
Madhya Pradesh	100	74	0.26	151	105	0.46	67	81	-0.14	94	59	0.35
Gujarat	58	58	0	80	79	0.01	44	52	-0.08	59	71	-0.12
Daman & Did	44	39	0.05	57	50	0.07	38	33	0.05	49	41	0.08
Dadar & Nagar Haveli	65	52	0.13	91	70	0.21	38	40	-0.02	49	51	-0.02
Maharashtra	53	49	0.04	71	65	0.06	39	47	-0.08	50	62	-0.12
Andra Pradesh	55	55	0	76	75	0.01	40	50	-0.1	53	67	-0.14
Karnataka	59	61	-0.02	71	84	-0.13	41	55	-0.14	54	74	-0.2
Goa	38	58	-0.2	47	79	-0.32	30	52	-0.22	36	70	-0.34
Lakash Dip	68	54	0.14	96	73	0.23	72	59	0.13	102	81	0.21
Kerala	37	32	0.05	47	40	0.07	36	33	0.03	46	44	0.02
Tamil Nadu	59	52	0.07	82	69	0.13	54	44	0.1	74	57	0.17
Pondicherry	49	53	-0.04	66	72	-0.06	42	76	-0.34	55	108	-0.53
Andaman and Nicobar Islands	58	53	0.05	80	71	0.09	54	54	0	73	74	-0.01

Source: *Office of The Registrar General, India Ministry of Home Affairs, Government of India New Delhi, 2001

Table 4: Indirect estimates of Infant and under five mortality rates (U5MR) per 1000 live birth by sex in Rural India and states/union territories based on censuses 2001 and 2011

India/ states	Rural							
	Male				Female			
	IMR		U5MR		IMR		U5MR	
	2011	2001*	2011	2001*	2011	2001*	2011	2001*
India	63	68	87	95	63	78	83	114
Punjab	55	55	75	75	53	68	71	95
Jammu & Kashmir	56	64	76	89	54	74	73	106
Himachal Pradesh	59	58	80	80	45	63	60	88
Chandigarh	64	66	89	93	55	79	74	115
Uttaranchal	52	62	70	86	52	70	71	99
Haryana	60	63	82	88	60	80	83	117
Delhi	54	48	73	64	63	59	87	81
Rajasthan	66	74	91	105	68	87	96	129
Uttar Pradesh	73	80	104	116	79	96	114	147
Bihar	61	64	85	88	66	80	92	118
Sikkim	52	61	70	84	49	66	66	93
Arunachal Pradesh	77	96	110	143	77	101	111	159
Nagaland	62	65	85	91	69	84	98	124
Manipur	48	48	64	64	45	58	60	80
Mizoram	65	64	91	90	62	71	86	101
Tripura	61	65	84	91	61	70	84	100
Meghalaya	81	84	118	122	83	88	122	131
Assam	64	72	90	103	63	76	86	110
West Bengal	49	67	66	94	46	73	60	105
Jharkhand	68	64	95	88	65	74	90	107
Orissa	72	83	102	120	68	86	98	128
Chhattisgarh	74	88	106	129	66	89	93	133
Madhya Pradesh	74	96	106	142	73	104	104	162
Gujarat	59	53	81	72	56	64	77	90
Daman & Did	38	40	48	52	39	48	51	63
Dadar & Nagar Haveli	54	65	72	91	50	66	67	92
Maharashtra	50	48	70	64	48	57	63	78
Andhra Pradesh	58	53	79	72	53	58	79	80
Karnataka	62	56	87	77	60	62	82	86
Goa	62	35	85	42	53	41	72	53
Lakash Dip	55	64	74	88	53	73	72	105
Kerala	33	33	41	40	32	41	40	54
Tamil Nadu	57	55	78	74	46	65	61	90
Pondicherry	62	48	86	64	44	51	58	68
AndamanNicobar	61	56	84	77	45	61	58	84

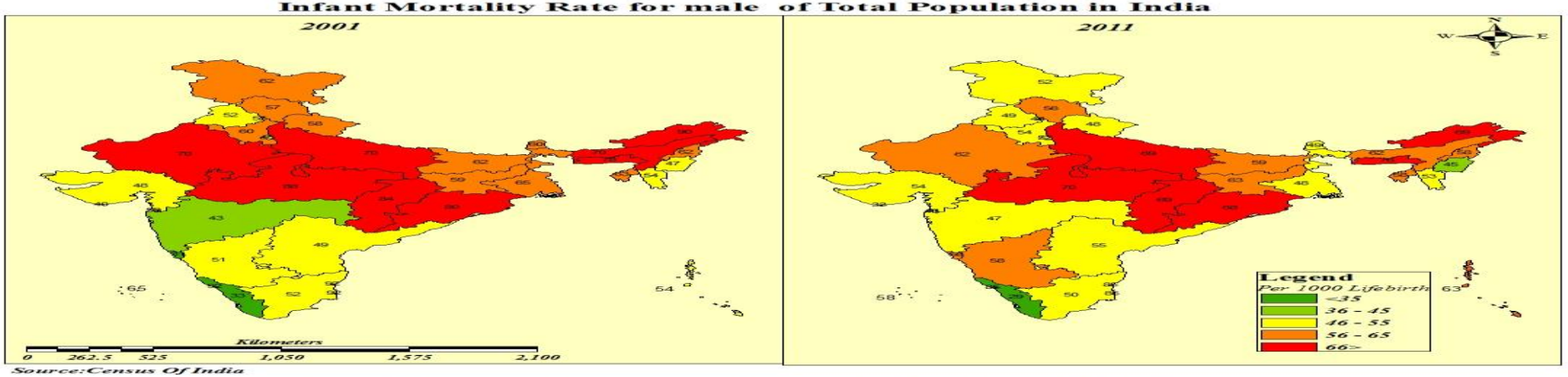
Source: *Office of The Registrar General, India Ministry of Home Affairs, Government of India New Delhi, 2001

Table 5: Indirect estimates of Infant and under five mortality rates (U5MR) per 1000 live birth by sex in Urban India and states/union territories based on censuses 2001 and 2011

India/ states	Urban							
	Male				Female			
	IMR		U5MR		IMR		U5MR	
	2011	2001*	2011	2001*	2011	2001*	2011	2001*
India	52	47	70	63	51	58	68	79
Punjab	44	44	57	58	41	54	54	73
Jammu & Kashmir	50	54	67	74	47	65	62	91
Himachal Pradesh	48	47	64	63	39	54	51	73
Chandigarh	45	53	60	72	40	66	52	92
Uttaranchal	45	46	60	61	49	57	59	77
Haryana	47	49	62	66	47	65	62	91
Delhi	55	46	74	61	61	59	85	81
Rajasthan	54	53	73	72	54	65	73	91
Uttar Pradesh	61	58	84	79	65	74	90	106
Bihar	54	48	73	64	56	61	76	85
Sikkim	46	55	60	76	44	58	58	79
Arunachal Pradesh	49	61	65	84	47	58	62	79
Nagaland	58	48	79	65	56	64	76	90
Manipur	45	44	50	58	37	55	48	74
Mizoram	41	41	53	53	41	48	53	64
Tripura	53	50	71	68	50	58	66	80
Meghalaya	54	53	73	72	63	59	83	81
Assam	52	48	69	64	51	56	68	76
West Bengal	47	59	63	81	45	67	59	95
Jharkhand	52	42	70	55	48	52	64	69
Orissa	59	61	82	84	56	67	77	95
Chhattisgarh	58	60	78	82	51	66	70	93
Madhya Pradesh	61	62	84	86	57	72	78	103
Gujarat	53	38	73	50	52	50	70	66
Daman & Did	34	41	43	53	32	38	40	48
Dadar & Nagar Haveli	41	36	53	47	38	39	49	50
Maharashtra	48	34	64	43	45	44	60	57
Andhra Pradesh	52	37	69	47	49	45	65	59
Karnataka	55	38	75	49	54	46	73	60
Goa	57	27	77	32	46	31	61	39
Lakash Dip	62	68	86	95	56	76	76	110
Kerala	34	31	43	38	32	41	40	54
Tamil Nadu	48	50	63	67	39	58	51	80
Pondicherry	99	39	150	50	51	46	69	61
AndamanNicobar	69	48	98	65	38	60	50	83

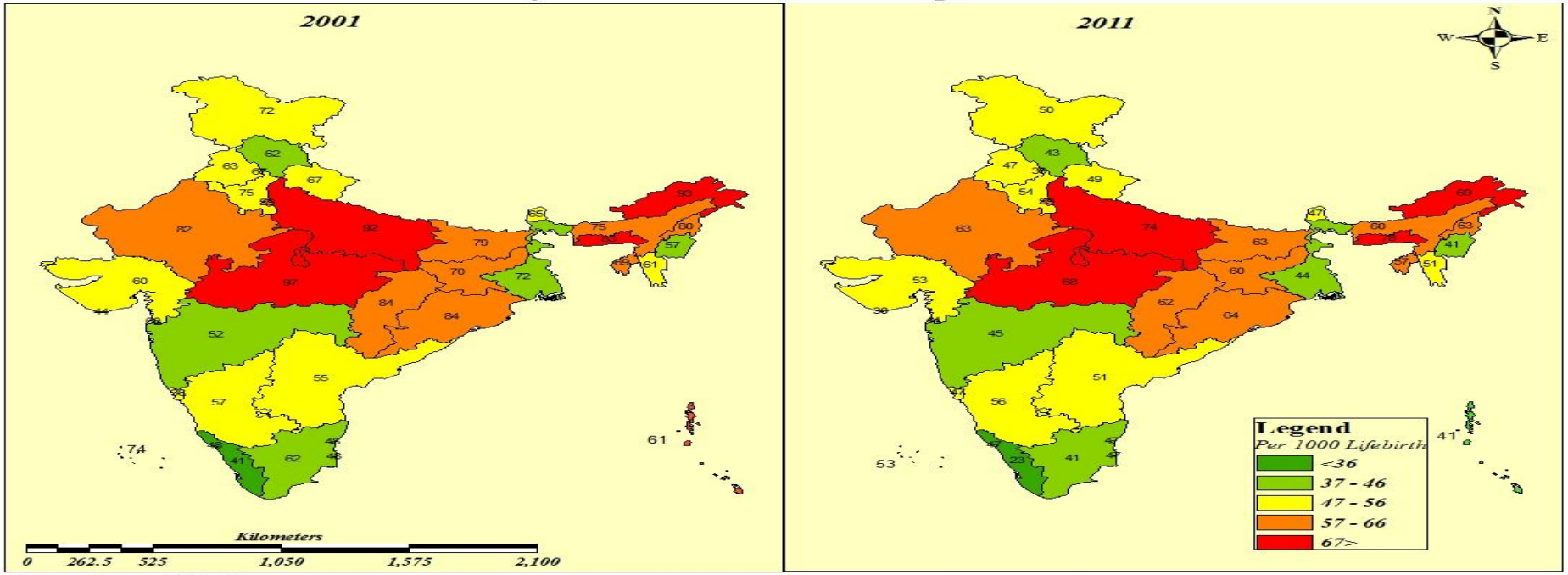
Source: *Office of The Registrar General, India Ministry of Home Affairs, Government of India New Delhi, 2001

Infant Mortality Rate for male of Total Population in India



Source:Census Of India

Infant Mortality Rat for total female Population in India



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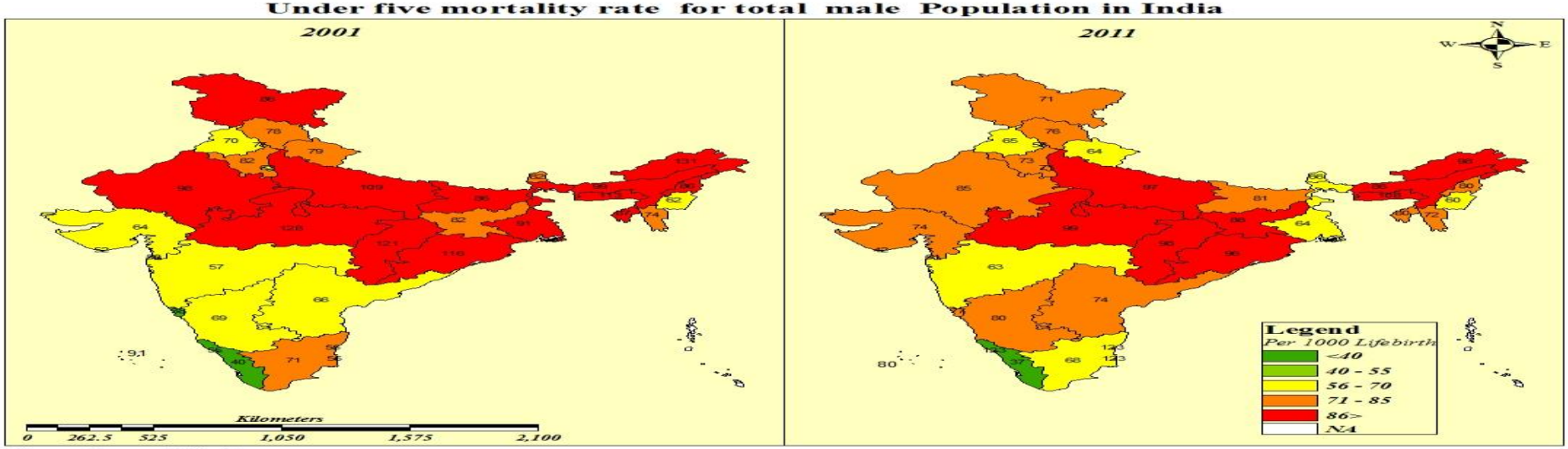

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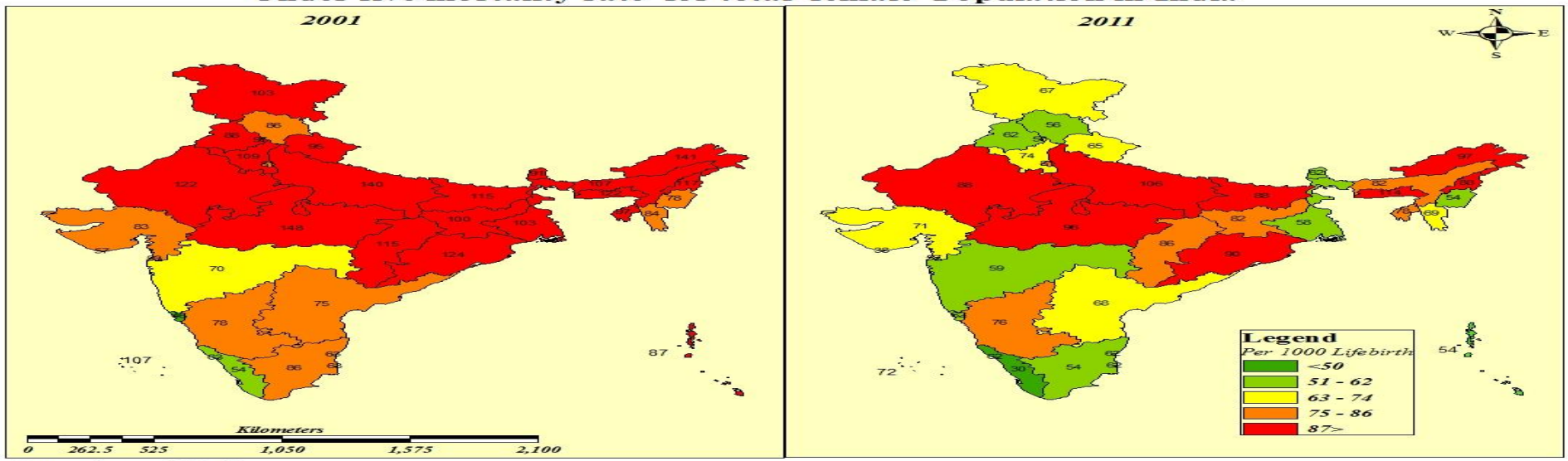
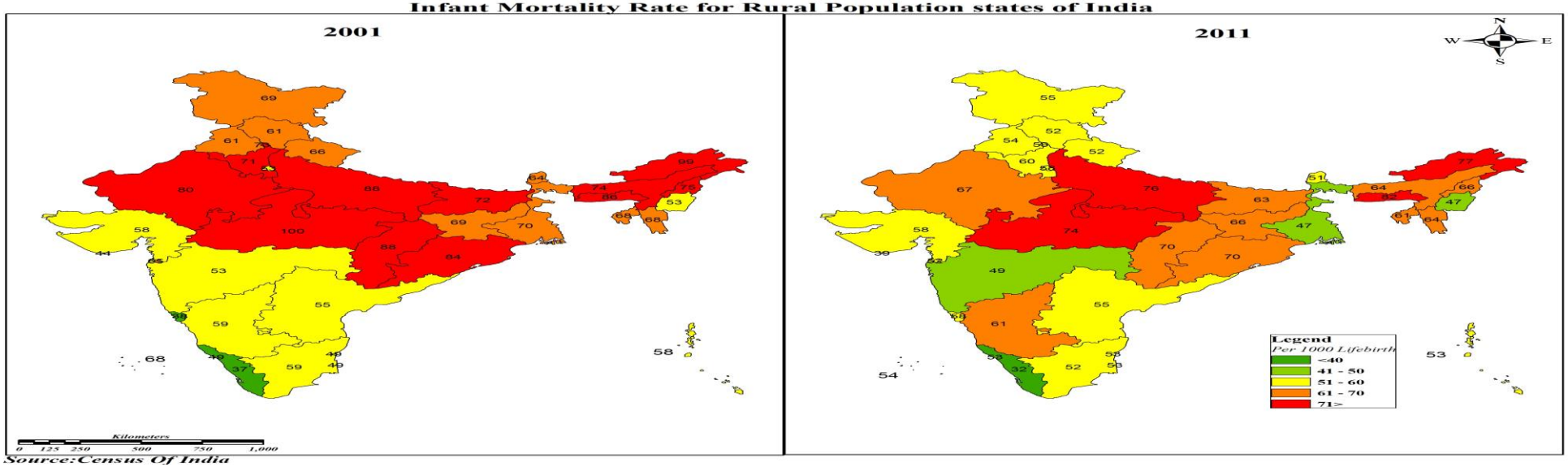


Source:Census Of India

Infant Mortality Rate for Rural Population states of India



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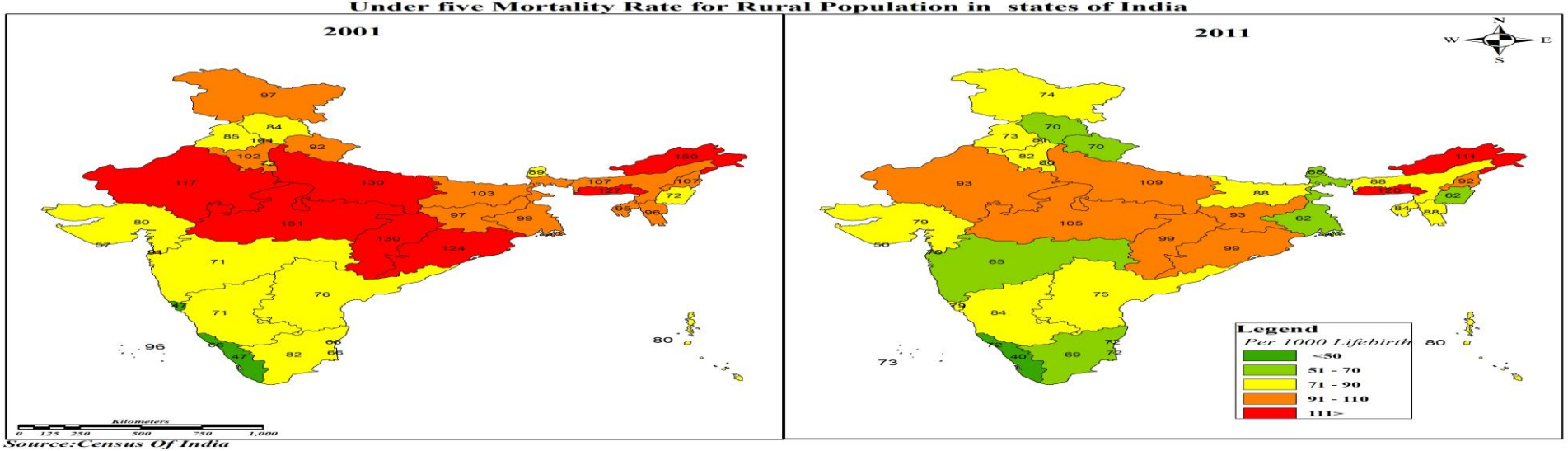
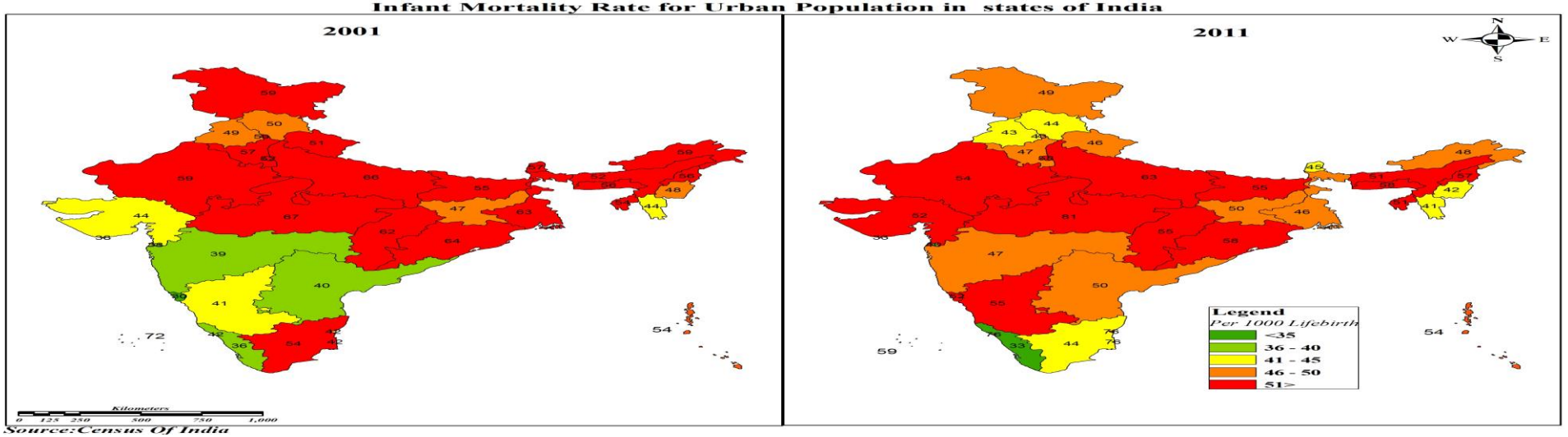


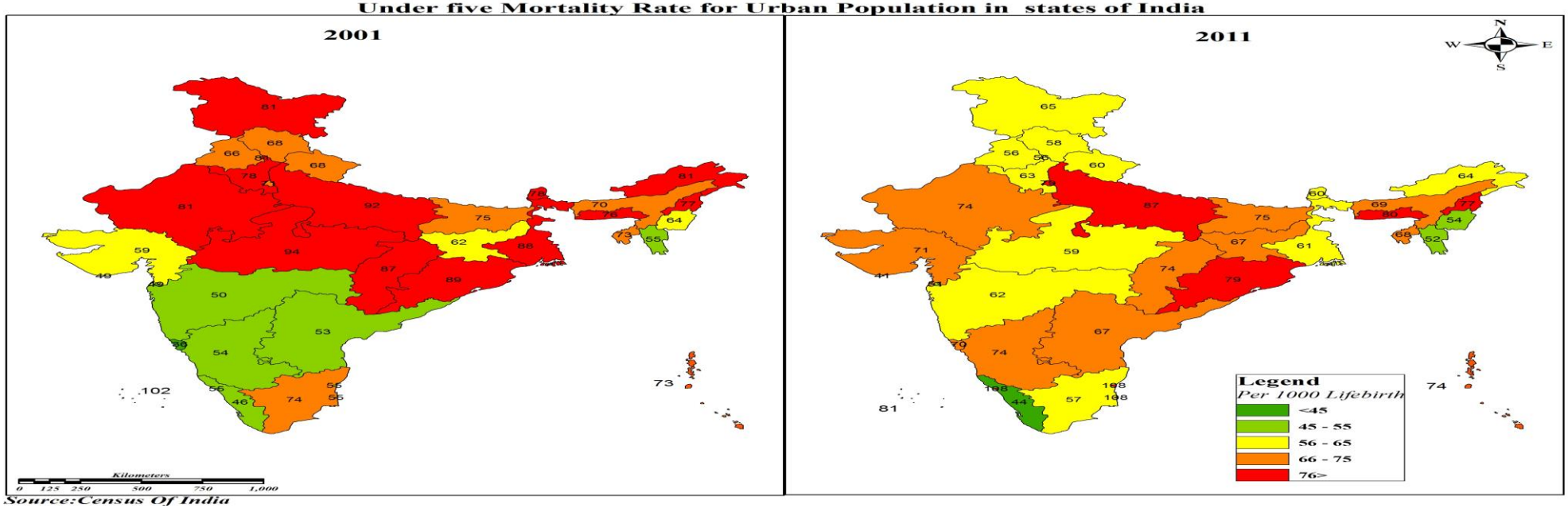
Source:Census Of India

Infant Mortality Rate for Urban Population in states of India



Source:Census Of India

Under five Mortality Rate for Urban Population in states of India



Source:Census Of India

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