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Crude Birth Rate and Crude Mortality Rate in India: A Case of Application of Regression in Healthcare

Prisilla Jayanthi and Muralikrishna Iyyanki

Abstract

India's demographic transition in 1950 has led to decline of high birth and mortality rate to 6.5%, a drop of 0.6% in 2016–2017, as per the economic survey (2017–2018). The crude birth rate and crude mortality rate decreases with the occupation. In this study, the statistical parameter, confidence interval indicates the true range of the mean of the crude birth rate and crude mortality rate computed from the observed data in the study. Location and precision of a measure are made available with the confidence interval. In the study, the results for crude birth rate in 1984 were highest, 95% CI = 32.08–39.22, and in 2011, were lowest, 95% CI = 20.68–25.24, and the results for crude mortality rate in 1984 were highest, 95% CI = 32.08–39.22, and in 2011 were lowest, 95% CI = 20.68–25.24. A small standard error implies that the sample mean is a more accurate reflection of the actual population mean. The smallest standard error of crude birth rate is 1.08, and the smallest standard error of crude mortality rate is 0.50.

Keywords: crude birth rate, crude mortality rate, confidence interval, health

1. Introduction

In statistics, the two statistical values used to measure the growth or decline of a population are crude birth rate (CBR) and crude death rate (CBR). The growth or decline of a population is based on literacy and economic growth of any country. In India, several states have the need for developing itself in measure of health or in capital wise. Agriculture happens to be largest occupation in India where the children at very young age get to work in agriculture leading to large birth rates number in the rural states families. Under the age of 5 years, the crude mortality rate occurs due to preterm birth (18%), pneumonia (16%), inter-partum (12%), neonatal sepsis (7%), diarrhea (8%), malaria (5%) and malnutrition. In most of the undeveloped countries, the malnutrition is the major cause of child mortality. The present urban states have better health, hygiene and sanitation facilities in the area lead to decline in mortality rate. Literacy and the economical understanding have blended to lower the birth rate in both rural and urban.

2. Previous study

Golley and Toyer [1] suggested that China and India's demographic transitions timings and the implications of fertility developments were discovered using a global economic model and measures of dependency include the working over-aged and working age. China's labor force to begin to diminish, whereas India will increase fertility rate faster than its present population. The population plays a significant role in defining the relative magnitudes of labor force growth to total population growth and the change in dependency ratios, with a significant impact on per capita income growth. India, the world's most populous country by 2030, and its population policy continue to be directed toward promoting fertility decline. The lower fertility reduces GDP and increases per capita income in both countries, India gains more per capita income than China per unit change in fertility, resulting in India's higher youth dependency [1].

Roy and Jones [2] developed a technique for the prediction of health indicators for all the districts of India and examine the correlations between health and development. The two fundamental indicators of this research are the levels of electrification and district domestic product (DDP). The data with health metrics and the information from two night time satellite images were used to propose the models. The predicted the health indicators with less than 7–10% errors were successfully. The health metrics, like crude birth rate and maternal mortality rate were mapped for the whole country at the area level. These metrics showed very strong correlation with development indicators. In a socio-economic study, using Visible Infrared Imaging Radiometer Suite (VIIRS) satellite imagery, the observation showed a higher DDP and level of electrification for better health conditions [2].

Maitra and Pal [3] emphasized that the estimates of birth spacing on child mortality are different when fertility selection are not considered. A comparison study of the fertility behavior of households in the Indian and the Pakistani Punjab highlighted the differential nature of institutions on demographic transition in these neighboring regions. The study involved reported birth interval and not inter-conception interval, which implies that there were some measurement errors associated with this particular variable. The miscarriages, stillbirths and also premature births were not measured for measurement. The study identifies the bivariate probit model that estimates mortality after correcting for the self-selection in fertility decisions [3].

3. Discussions, empirical analysis and results

The true population value can be calculated using a confidence interval (CI) in statistics, an interval estimate, computed from the observed data [4]. The interval contains the true value of an unknown population parameter with $(1 - \alpha)\%$ confidence which quantifies the level of confidence that the parameter lies in the interval. And the confidence level represents frequency and that are constructed from an infinite number of independent sample statistics, the proportion of those intervals that contain the true value of the parameter will be equal to the confidence level.

The study was carried out using Stata 12.1 IC software to calculate the confidence interval to understand the crude birth rate and crude mortality rate in India in six different states namely Andhra Pradesh, Assam, Madhya Pradesh, Uttar Pradesh, Dadra & Nagar Haveli the data was taken from www.data.gov.in [4] and was collected from the year 1981 to 2011.

Year	Population	Crude birth rate	Crude mortality rate	Percentage decadal variation	Annual exponential growth rate (%)
1971	548.2	41.2	19	24.8	2.2
1981	683.3	37.2	15	24.66	2.22
1991	846.4	32.5	11.4	23.87	2.16
2001	1028.7	24.8	8.9	21.54	1.97
2011	1210.9	21.8	7.1	17.7	1.63

Table 1.
Crude birth and mortality rate in India from the year 1971 to 2011.

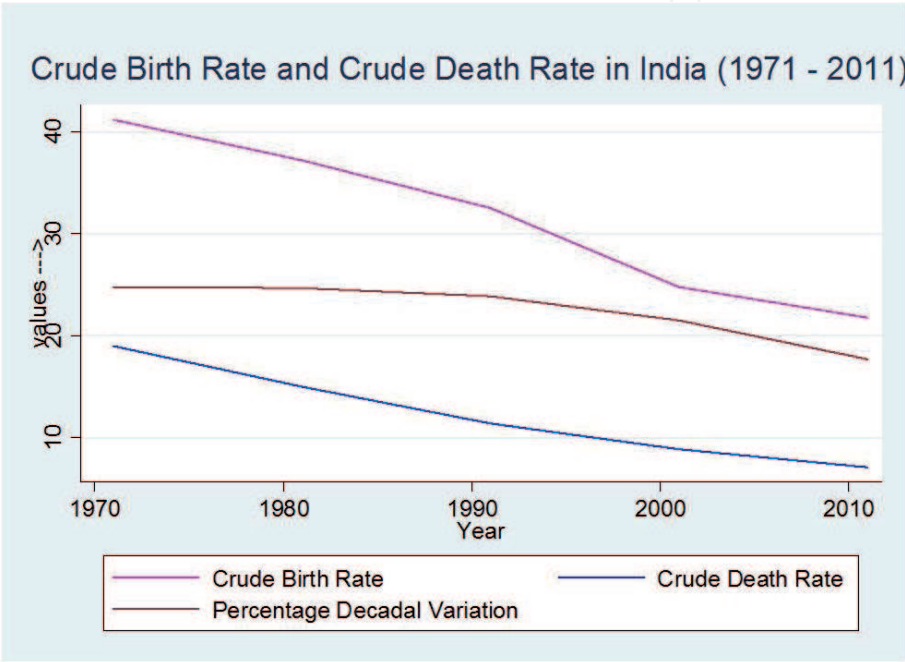


Figure 1.
Crude birth rate and crude mortality rate in India.

Table 1 shows the decrease in crude birth rate and crude mortality rate from 1971 to 2011 with the industrial rise. The graph in **Figure 1** shows the decline in crude birth rate (21.8) and crude mortality rate (7.1) in the year 2011.

From **Table 1**, the population mean = 865.17, SE = 2.37 with 95% CI = 860.52–869.83 and crude birth rate mean = 31.44, SE = 0.07 and 95% CI = 31.30–31.59. The crude mortality rate mean = 12.24, SE = 12.16 showed 95% CI = 0.04–12.33. The results of percentage decadal variation 95% CI = 22.44–22.54, mean = 22.49 and SE = 0.02. The results for annual exponential growth rate were 95% CI = 2.03–2.03, mean = 2.03 and SE = 0.01.

Figure 2 displays the crude birth and death rates for six individual states in India for the period (1971–2011). The peak crude birth rate can be seen in Dadra and Nagar Haveli with 27.7 births per thousand in urban areas. Interestingly, this State also had the lowest death rates in both urban and rural areas (**Figure 2**). The lowest crude birth rates were found in Pondicherry, where both rates were urban is 14 and rural is 13.6. There was greater variability in birth rates in both urban and rural locales than in death rates in either type of setting. The female literacy in any state shows that the crude birth rate and mortality rate is minimum (**Table 2**). Based on the census [5], the educated females take better reproductive and healthcare

Variable	Mean	Std. err	95% CI
Crude birth rate rural	21.31	2.25	15.50–27.12
Crude birth rate urban	19.13	2.17	13.5–24.71
Crude death rate rural	7.08	0.43	5.97–8.18
Crude death rate urban	5.18	0.49	3.90–6.46

Table 2.
CI of crude birth rate and mortality rate in rural and urban (1971–2011).

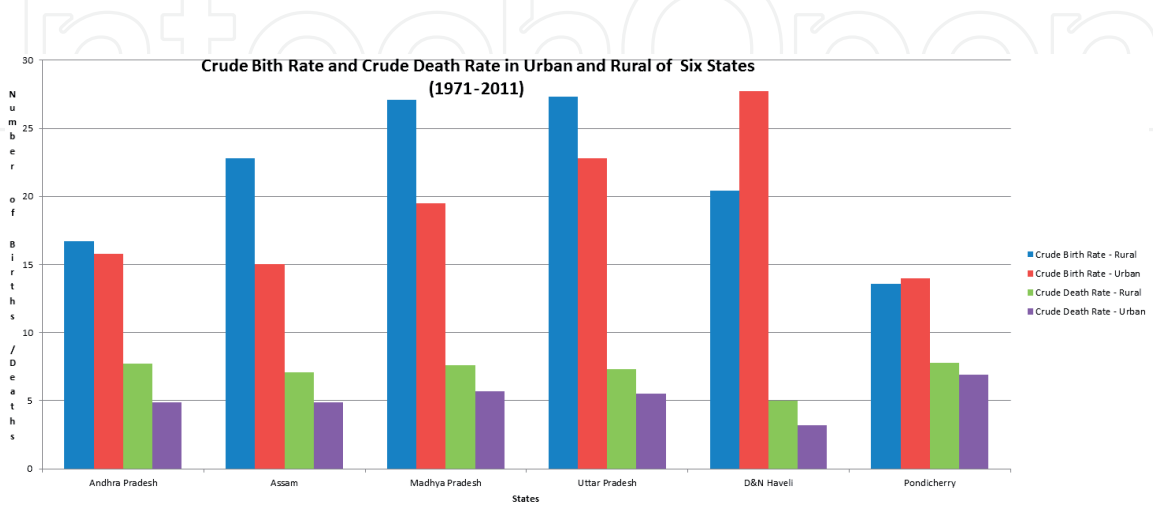


Figure 2.
The graph representing crude birth rate and crude mortality rate in urban and rural.

decisions. Further, this improves stabilization of population and better infant care with lower birth rates and infant mortality rates.

In **Figure 3**, the graph shows the highest crude birth rate in the year 1984 with 45.9 in Dadra and Nagar Haveli state and minimum in the year 2007 in Pondicherry. Similarly from **Figure 4**, the graph indicates the maximum crude mortality rate to be 17.8 in the year 1984 in Uttar Pradesh, and the minimum crude mortality rate was found thrice as 7, twice in the year 2001 and 2009 in Pondicherry and one time in Andhra Pradesh (2004).

In **Figures 5 and 6**, the graph represents the crude birth rate and crude mortality rate in rural and urban from the year 1981 to 2011. The standard error of the

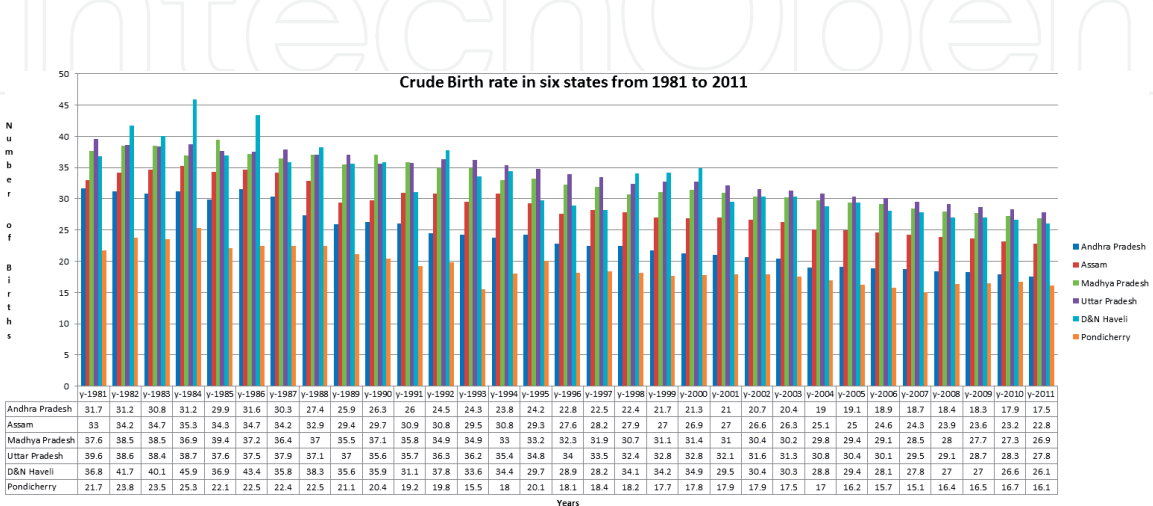


Figure 3.
The graph representing six states' crude birth rate.

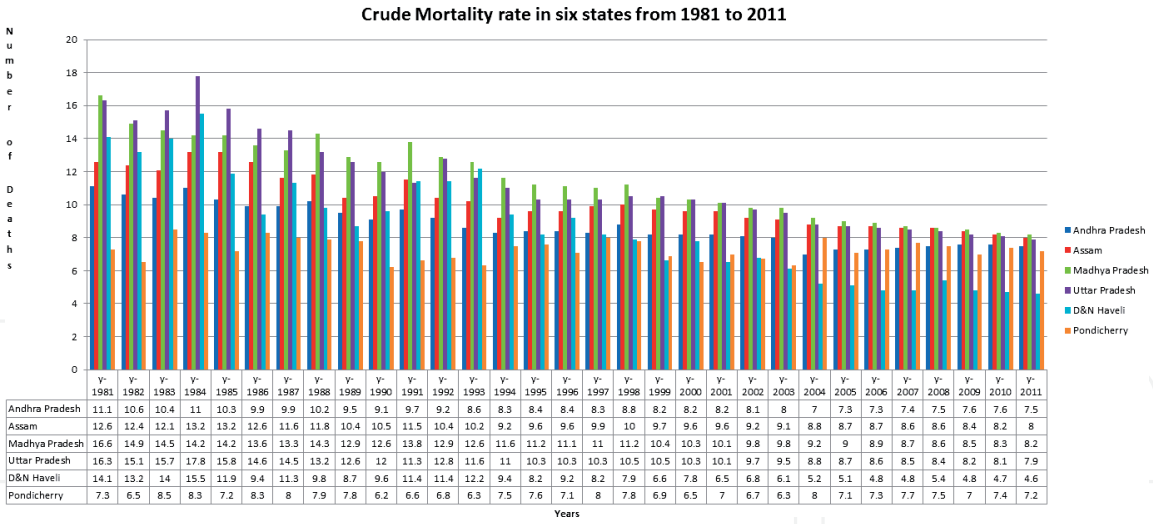


Figure 4.
The graph representing crude mortality rate in six states (1981–2011).

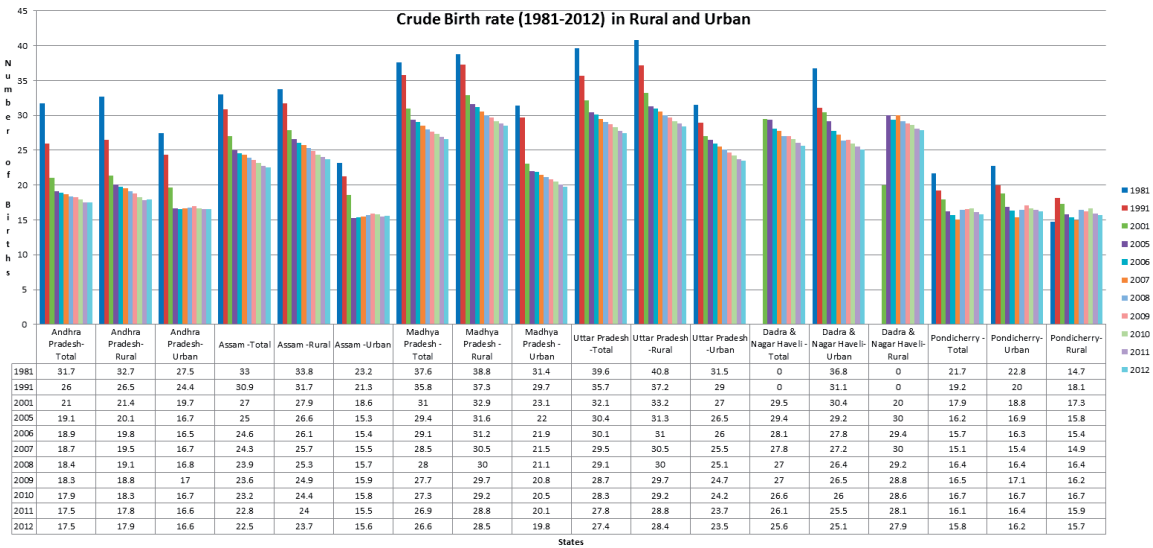


Figure 5.
The graph representing crude birth rate in rural and urban in six states (1981–2011).

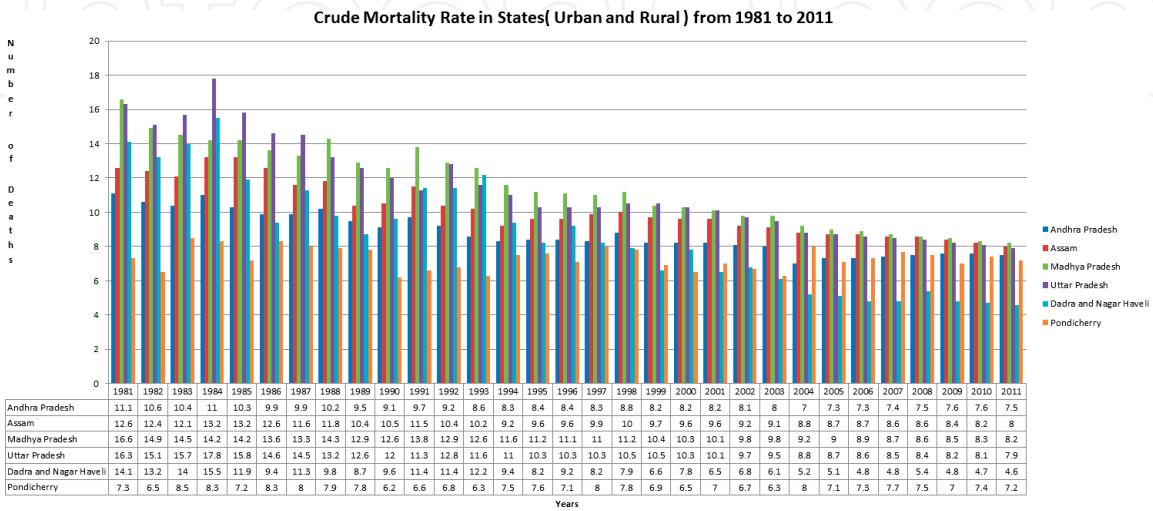


Figure 6.
The graph representing crude mortality rate in urban and rural in six states (1981–2011).

mean decreases as the size of observations increases. A small standard error implies that the sample mean is more accurate replication of the actual population mean. The crude birth rate with the least SE = 1.08 and in crude mortality rate, the least SE = 0.49. **Table 3** refers to highest crude birth rate 95% CI = 32.07–39.21 (1984) and least crude birth rate 95% CI = 20.67–25.23 (2011). Likewise, **Table 4** indicates highest crude mortality rate of 95% CI = 9.813–16.85 in 1984 and least crude mortality rate of 95% CI = 5.82–8.63 in the year 2011.

The crude mortality rate in children under the age of 5 years occurs due to preterm birth, pneumonia, neonatal sepsis, diarrhea, malaria and malnutrition. In undeveloped countries, malnutrition is the primary cause of child mortality.

In India, the highest total crude birth rate was in the year 1981 with 35.6 in rural and minimum in the year 2012 with 17.4 (urban).

Year	Mean	Standard error	95% conf. interval
1981	32.53	1.59	29.19–35.86
1982	34.32	1.59	30.99–37.65
1983	33.85	1.54	30.63–37.06
1984	35.65	1.71	32.07–39.21
1985	32.58	1.54	29.35–35.80
1986	34.03	1.77	30.32–37.72
1987	32.04	1.41	29.10–34.98
1988	32.34	1.49	29.21–35.45
1989	30.66	1.48	27.55–33.75
1990	30.54	1.55	27.30–33.77
1991	28.98	1.49	25.87–32.09
1992	30.65	1.67	27.15–34.15
1993	28.27	1.90	24.30–32.24
1994	28.86	1.63	25.45–32.25
1995	28.12	1.26	25.48–30.76
1996	26.85	1.37	23.99–29.72
1997	26.66	1.30	23.94–29.38
1998	27.6	1.45	24.56–30.63
1999	27.49	1.53	24.29–30.69
2000	27.70	1.56	24.43–30.97
2001	26.25	1.29	23.55–28.95
2002	26.23	1.29	23.53–28.92
2003	25.96	1.31	23.23–28.70
2004	25.13	1.28	22.44–27.81
2005	24.90	1.35	22.08–27.73
2006	24.30	1.33	21.52–27.09
2007	23.83	1.34	21.02–26.62
2008	23.81	1.17	21.37–26.24
2009	23.68	1.14	21.31–26.05
2010	23.45	1.08	21.19–25.71
2011	22.95	1.09	20.67–25.23

Table 3.
Mean, standard error and 95% confidence interval for crude birth rate in India, by year (1981–2011).

Confidence interval for crude mortality rate (1981–2011)			
Year	Mean	SE	95% conf. interval
1981	13	1.42	9.32–16.67
1982	12.12	1.31	8.74–15.49
1983	12.53	1.11	9.67–15.39
1984	13.33	1.36	9.81–16.85
1985	12.1	1.24	8.89–15.30
1986	11.4	1.03	8.72–14.07
1987	11.43	0.94	8.99–13.87
1988	11.2	0.96	8.72–13.67
1989	10.31	0.84	8.14–12.49
1990	10	0.94	7.58–12.41
1991	10.71	0.98	8.19–13.24
1992	10.58	0.95	8.13–13.03
1993	10.25	0.99	7.70–12.79
1994	9.5	0.64	7.86–11.13
1995	9.21	0.56	7.76–10.66
1996	9.28	0.57	7.80–10.76
1997	9.28	0.52	7.94–10.62
1998	9.36	0.57	7.88–10.84
1999	8.71	0.70	6.89–10.53
2000	8.78	0.62	7.17–10.39
2001	8.58	0.64	6.91–10.25
2002	8.38	0.57	6.91–9.85
2003	8.13	0.66	6.43–9.83
2004	7.83	0.61	6.24–9.41
2005	7.65	0.60	6.09–9.20
2006	7.6	0.63	5.97–9.22
2007	7.61	0.60	6.06–9.16
2008	7.66	0.49	6.38–8.94
2009	7.41	0.57	5.94–8.88
2010	7.38	0.55	5.95–8.81
2011	7.23	0.54	5.82–8.63

Table 4.
Confidence interval, mean and standard error for crude mortality rate in India.

4. Demographic transition in India

In India, when the country became a republic in the 1950s, it experienced a demographic transition from high birth rate and mortality rate to lower birth rate and lower mortality rate. The country revolutionized from pre-industrial to an industrialized economic system. This transition brought several changes in a lower fertility rate where smaller, independent families emerged and more resources saved and invested in capital and education. More investment contributes to economic growth. This transition led to rise in socio-economic relations, health impacts and India’s economic level.

5. Conclusion

From the above discussion the highest crude birth rate was 45.9 (1984) and minimum crude birth rate was 15.1 (2007) and the maximum crude mortality rate to be 17.8 (1984) minimum crude mortality rate was 7 (2004). The decline in crude birth rate (21.8) and crude mortality rate (7.1) in the year 2011 was found. Industrialization brought a drastic change in the economic growth of the people as they started to exchange ideas and get more involved in the change and development. This demographic transition in India led to enhanced education levels for women in India (2011) and hence decreasing crude birth rate and mortality rate. For the year 2011, the percentage distribution of second and higher order live births by interval between current and previous live birth has been shown in few states of India. The spacing between children in the rural and urban areas implies that about half of the birth should have spacing 36 months and above. Most of rural and urban areas now have 70% of births which have birth interval of 24 and more months. The study shows the confidential interval for the highest crude birth rate 95% CI = 32.07–39.21 (1984) and least crude birth rate 95% CI = 20.67–25.23 (2011). Likewise, the highest crude mortality rate of 95% CI = 9.813–16.85 in 1984 and least crude mortality rate of 95% CI = 5.82–8.63 in the year 2011 can be noted. These are the key factors for the crude birth and crude mortality rate to decline from 1981 to 2011. The confidence interval and lower SE helps to get the accurate mean of the population in a particular region with a range.

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