© 2017 IJSRSET | Volume 3 | Issue 6 | Print ISSN: 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Birth and Death Patterns Mirroring the Transformation in Human Dispositions and Health Management – A Study Across 100 years in an Indian Town

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ABSTRACT

This study was carried out to unfold the necessary facets of births and deaths over the last 100 years in Nagpur city, India. Trends were observed for the births and deaths taking place daily, monthly, season-wise, yearly and gender-wise; with focus being laid on the seasonal component. These were observed using Trend and Time series Analysis. The study also emphasises on vital statistics' parameters such as CBR, CDR and IMR. It was realized that while IMR and CBR showed improvements, CDR rose steeply. Other findings elucidate that rainy season is leading while summer season is trailing in the number of births; minimum births occur on Sundays and, male births and deaths are surpassing females. Hospital births gained predominance post 1960. It was observed that health management advanced during this period with average age at death rising from 42 to 57 years.

Keywords: Demography, Time Series Analysis, Forecasting, Trend, Decomposition

I. INTRODUCTION

Population comprises individuals residing in identical surroundings that change with time depending on; migrations, rates at which births and deaths take place and on social and environmental influences. Cities across the Indian sub-continent are experiencing unparalleled population boom, which is influencing its demographic pattern. Demography is known to be one of the most important factors influencing not only the social, but also the economic environment of a country (Engelhardt et al. 2009; Jones 2009; Bloom 2011; Popescu 2013). This lures analysts to delve deep into the study of births and deaths to discover the changes in birth and death patterns in human settlements. One such study was planned using 100 years of birth and death data for Nagpur city located in central India, belonging to the state of Maharashtra. The study culminated with interesting observations giving a deeper understanding of population dynamics of 100 years. 'Population dynamics is a study of short term and long term changes in the size and age composition of the population and the biological and environmental processes influencing those changes i.e. study of how population changes over time' (Pandey et al. 2015).

Through this study, an attempt was made to understand the changes that took place in the population structures over the years. Developing countries lack systematic health related information, which limits the studies based on population dynamics, thereby in implementing new policies (Al-Thani et al. 2014, Ritcher et al. 2009). One of the significant parameters is the birth rate, a key indicator of population reproduction. It is majorly affected by biological processes; followed by socio-economic processes, family traditions, day-to-day living conditions, natural disasters etc. (Engelhardt et al. 2009; Nobles et al. 2014; Yagudin et al. 2015). The rise in the population can be accredited to the fertility rates and it was stated by Dribe et al. 2017 that socio economic status plays a vital role with upper-class having lower fertility rates as compared to the lower class populace, universally. According to Krik (1996), the transition from higher to lower mortality and fertility is attributed

to improved health conditions and increased women empowerment where they have the freedom to choose smaller families. However, the latter is yet to show its dominance in India. Barricarte (2017) stated that deaths explain the decline in fertility. Studies from developed countries show decline in the birth rates. The large amount of costs involved right from birth to educating the child and the increased awareness of birth control lead to its decline (Krik, 1996; Anderson and Kohler, 2013; Cleland and Wilson, 1987). Moreover, higher educational level amongst women in these countries has lowered their tendency to bear children (Beaujouan et al. 2016; Brolchain and Beaujouan, 2012). This is contrary to the observations in developing countries, such as India.

Another parameter of concern is the sex ratio. Studies are incessantly being carried out globally to know the reasons behind more male births than female births. One such study from South America indicates that latitude gradient affects the sex of a new born i.e. more males are born in cooler regions (Grech 2013). Others state that males are more susceptible to illness and have higher mortality rates, so male births are higher (Mathews & Hamilton 2005); female foeticide cases are more in developing countries for which literacy has been suggested as an appropriate solution (Jones 2009; Gohel 2015). An increase in the sex ratio causes an increase in the 'doubling-time' i.e. time in which the population will double in size for a particular growth rate (Mathews & Hamilton 2005). In India, sex ratio is considered to be creating apprehensions over the past few decades. This study will unveil a novel aspect of it for Nagpur city.

Thus, the primary focus of this study was to retrospectively analyse the yearly trends of birth as well as death for last 100 years. Further, the interest was to decompose the yearly trends into seasonal, monthly and daily patterns. Moreover, the curiosity was to know the trends of key vital statistics parameters within the observation window. These parameters were also compared with that of Maharashtra and India. Forecasting of these parameters for the next five years was the secondary aim of the study.

II. METHODS AND MATERIALS

The analysis work flow is shown in Figure 1.

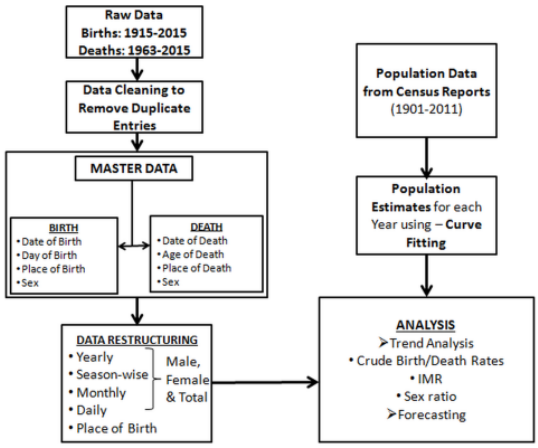

Figure 1: Analytical flow diagram

The data from 1910 to 2016 on births and deaths was made available by the In-Charge, Vital Statistics Unit (VSU) of Nagpur Municipal Corporation, Nagpur after approvals from higher authorities. The information on parameters like date of event, date of registration, gender, father's name, mother's name (deceased name, in case of death), age at death, place of event and religion were captured in the data. Information about parameters like age of mother, baby weight, parity, maternal and neonatal complications were discontinuous, and hence these parameters were ignored from the analysis. Also in the death data, cause of death was missing for quite a few years, hence was not considered for any analysis. Thus, only time and demographic parameters were emphasized and accordingly the analysis work frame was designed. In-depth scrutiny of data on these parameters led to fixing the observation window from 1915 to 2015 for births and from 1963 to 2015 for deaths. Both the data sets required partial cleaning to remove duplicate entries, which was performed using R Statistical Computing Platform ver. 3.2.3 (R-Core team, 2015).

After cleaning the data, it was transformed in a format suitable for downstream analysis. Summarization was done for the events (birth/death) according to gender, place of births/deaths, months and days, for each year. This facilitated extracting yearly, seasonal, monthly and daily trends for both the events in totality as well as according to gender. Death data also contained mean age at death for every year.

Population estimates for the city for every year in the observation window were obtained by referring to census data from Bombay Gazetteers Department, Government of Maharashtra and Office of the Registrar General and Census Commissioner. A polynomial of order 2 (quadratic model) fitted well to the data resulting into a R2-value of 0.992. Similar exercise was performed for male and female population giving R2-value of 0.991 and 0.988 respectively. The 95% confidence band was obtained for each predicted curve. The predicted values of total population returned by the model were used for estimating vital statistics parameters like Crude Birth Rate (CBR), Crude Death Rate (CDR) and Infant Mortality Rate (IMR). Crude Birth Rate is the number of live births per year divided by the average population in that year; while Crude Death Rate is the number of deaths per year divided by the average population in that year. Infant Mortality Rate is the total number of deaths that take place within one year of birth with respect to the total live births in the year. Sex ratio i.e. total number of females born per 1000 males was also obtained for every year and the trend was analysed.

Time Series Analysis was performed to decompose the time course data on births and deaths to understand the contribution of seasonal component on the occurrence of events. Decomposition of time series is a mathematical procedure to split the time series data into three main components viz., trend, seasonal and random. A finer analysis of birth/death trend revealed possibility of a seasonal component, which increased over the years. Accordingly, multiplicative model was opted for decomposition of both the series. The analysis was performed using decompose () function in R (stats). Moreover, forecasting of CBR and CDR was done using ARIMA model. The auto.arima() function from R (forecast) was used to predict the model, which returned values for next five years along with 95% confidence interval. The fitness of ARIMA model was ascertained during the analysis.

III. RESULTS AND DISCUSSION

Results:

The data was processed as per the analysis flow chart given in Figure 1. Raw data on births and deaths after cleaning was restructured according to years, seasons, months and days for both genders. The place of birth was organized according to years. Simultaneously, population census data for the city was modelled with quadratic polynomial, as evident from Figure 2.

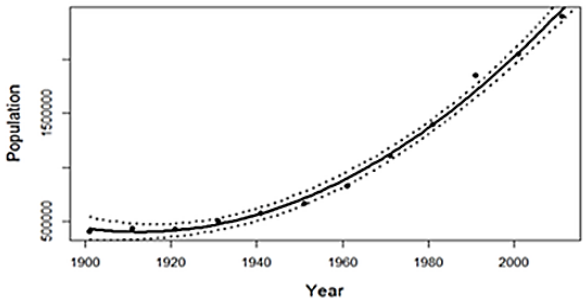

Figure 2: Quadratic model fit for population estimation
It shows the line of best fit along with 95% CI band. The population for intermediate years was estimated through this model.

Birth trends

The pattern of total number of births over 100 years for the city was obtained as shown through line plot in Figure 3(a).

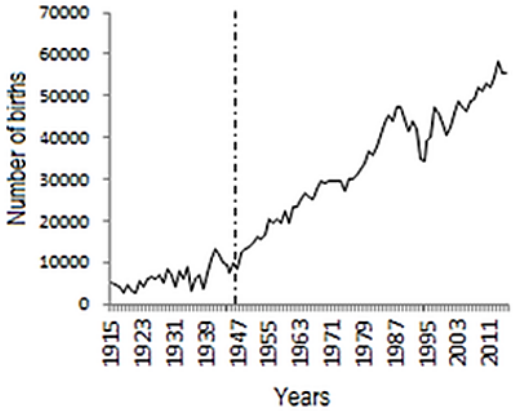

Figure 3(a): Trend for total number of births across study period

The trend was almost horizontal till mid twentieth century, but then, increased noticeably, as evident from the graph. The total births were split as per gender and the trends obtained are shown in Figure 3(b).

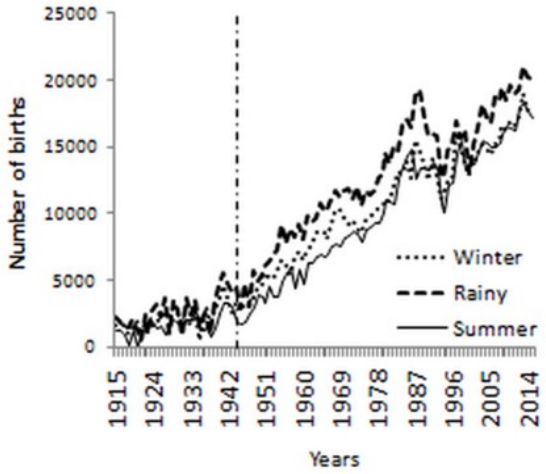

Figure 3(b): Trends for number of births according to seasons across study period

A good overlap of number of male and female births was observed till 1950. However, subsequently, the male births were consistently higher than female births. An alternate visualization of this data was obtained in the form of sex ratio as shown in Figure 3(c).

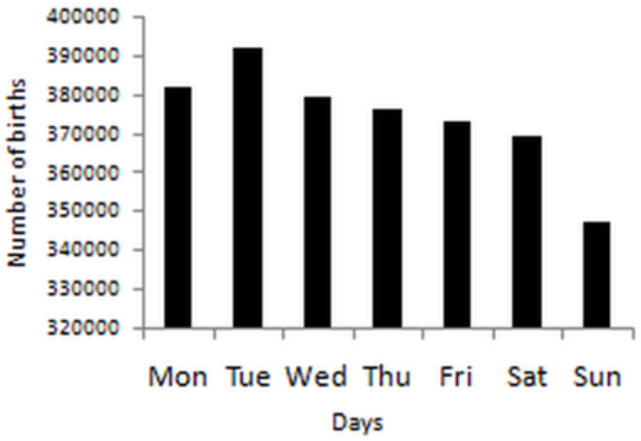

Figure 3(c): Trends for number of births according to days across study period

The plotted trend line for females shows a slight decline over the years indicating that the sex ratio marginally decreased, which supports the finding in Figure 3(b).

Total births were also analysed according to seasons. Nagpur primarily has three main seasons, viz. summer (Mar, Apr, May, Jun), rainy (Jul, Aug, Sep, Oct) and winter (Nov, Dec, Jan and Feb). The season wise trends are shown in Figure 3(d).

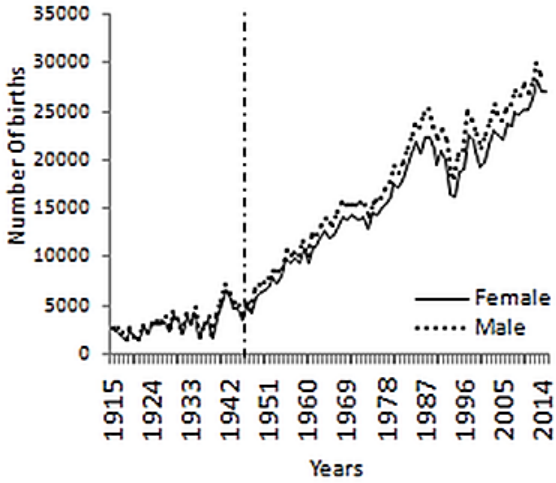

Figure 3(d): Trends for number of births according to gender across study period

Again, it is evident that till the mid 20th century, births were more or less same irrespective of season. But soon after, the occurrences in rainy season substantially increased as compared to the other two seasons. Summer reported the lowest number of births every year. The higher occurrences in rainy season were mostly contributed by September and October, and this has been further substantiated by time series decomposition. Day-wise total births were also obtained across years as shown through bar chart in Figure 3(e).

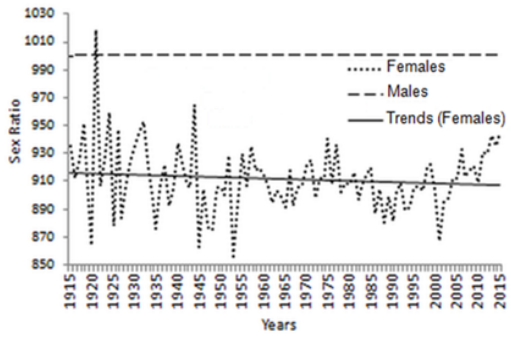

Figure 3(e): Trend for sex ratio across study period

There was no uniformity of occurrences within a week. More births were observed on early week days compared to the weekend. Sunday reported the least number of births across the years. Also, the hospital and house birth occurrences were observed over 100 years and depicted through line plot in Figure 3(f).

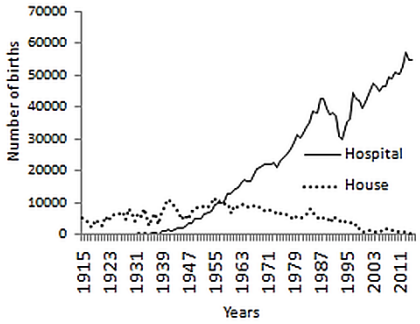

Figure 3(f): Trends for number of births according to place of birth across study period

It shows that till 1957, deliveries in houses were more as compared to hospitals. Subsequent to that, there was a sharp increase in the number of hospital births and decline in the house births.

Death trends

On similar lines, the total deaths during the observation period (from 1963 to 2015) were obtained as shown through line plot in Figure 4(a).

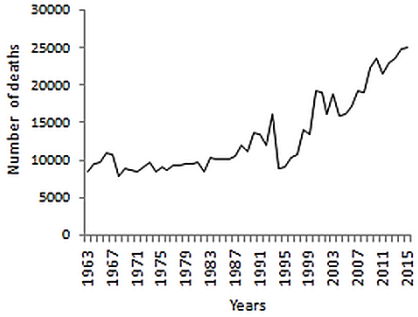

Figure 4(a): Trend for number of deaths according across study period

Until 1988, the trend was almost horizontal with annual number of deaths around ten thousand. In succeeding years, rise in the absolute number of deaths was sharp. The death occurrences were split as per gender and the trends are shown in Figure 4(b).

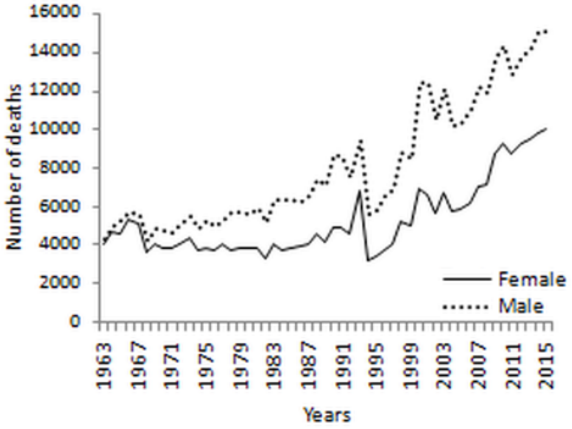

Figure 4(b): Trends for number of deaths according to gender across study period

Till late 60s, there was not much change in the occurrence of male and female deaths; however, in the later years, gap between number of male and female deaths widened in absolute sense as evident from the Figure 4(b). The proportion of deaths in different age categories was also obtained as shown graphically in Figure 4(c).

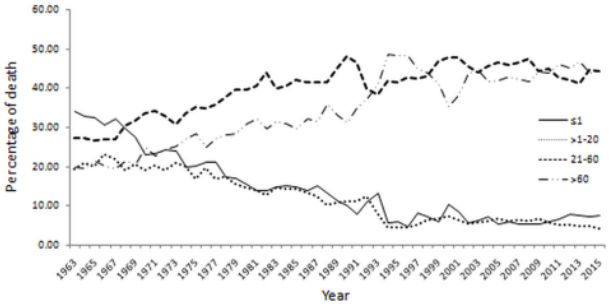

Figure 4(c): Trends for number of deaths according to age across study period

It is evident that the fraction of infant deaths was much higher (33%) during 1963, which in subsequent years gradually reduced to 7% in 2015. Similar declining trend was noticed for the age group of 1-20 years.

The mean age at death was obtained for every year.

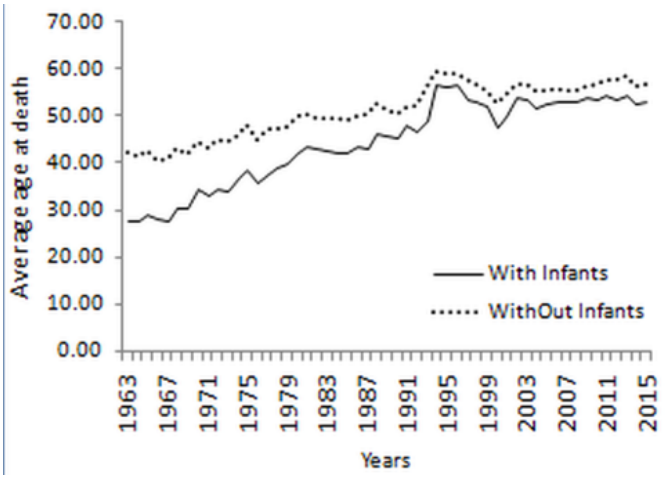

Figure 4(d): Trend for average age at death with and without infant across study period

Figure 4(d) provides the trend for mean age across the years. Plots were obtained with and without considering infants, as higher infant mortality tend to skew the mean age at death. Without infants, the mean age at death was

higher i.e. 42 years than with infants during 1963. Over the years, the mean age increased to 57 years by 2015, which is higher than that with infants. Figure 4(e) shows the increase in the number of deaths of senior citizens in the city. Where earlier it was seen to be as low as 20% in 1963, it rose to approximately 45% in 2015.

Vital statistics parameters

Crude birth rate (CBR): The number of births were expressed with respect to the average population of each year and plotted as shown in Figure 5(a).

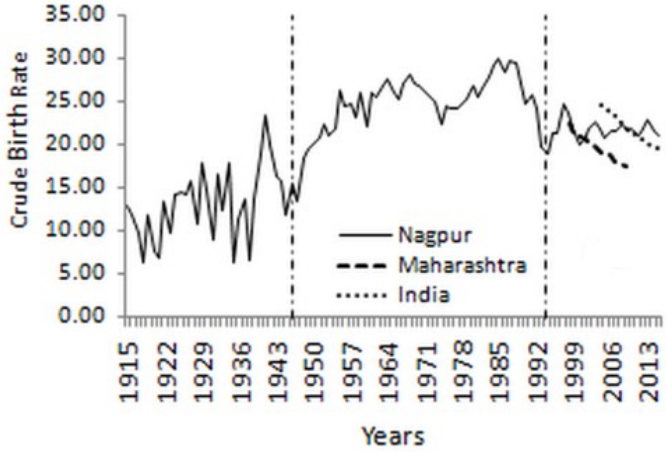

Figure 5(a): Trend of crude birth rate for Nagpur across study period

Till 1940, CBR exhibited fluctuations ranging from 5 to 20 and without any trend. Subsequently, there was an increasing trend till 1985 and again it showed a drop. Since 2000, the birth rate for the city is almost constant. In contrast, CBR for the state of Maharashtra and India from 2000 to 2015 indicated a drop.

Crude death rate (CDR): The number of deaths were expressed with respect to the average population of the city of each year and plotted as shown in Figure 5(b).

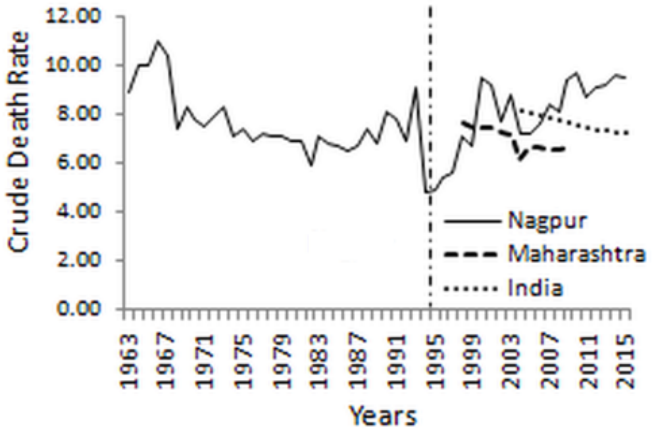

Figure 5(b): Trend of crude death rate for Nagpur across study period

It is evident that from 1963 to 1995, CDR showed a downward drift from around 10 to 6, while subsequent to that, it increased consistently, which is mainly contributed by the male mortality. In contrast, CDR for Maharashtra and India showed a drop from 2000 to 2015.

Infant Mortality Rate (IMR): The number of infants dying to the total number of live births was also obtained year wise and plotted as shown in Figure 5(c).

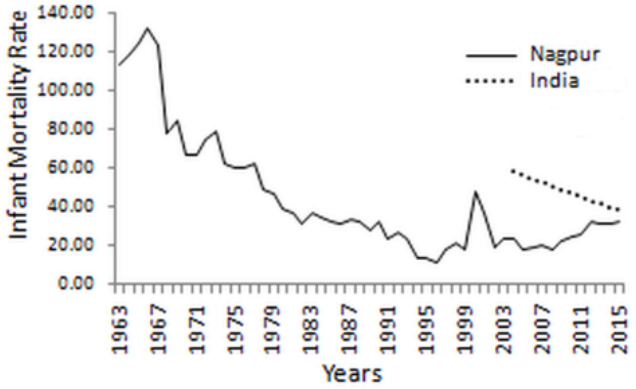

Figure 5(c): Trend of infant mortality rate for Nagpur across study period

It exhibited a steep decline from nearly 120 during 1963 to about 20 in 2000. Since 2000, there is an upward movement in IMR, which could be a cause of concern.

Time series analysis

The decomposition of birth and death time series data was performed independently to understand the contribution of seasonal component on the outcomes. Multiplicative model was used for decomposition of both birth and death time series data. A graphical representation for birth is given in Figure 6(a).

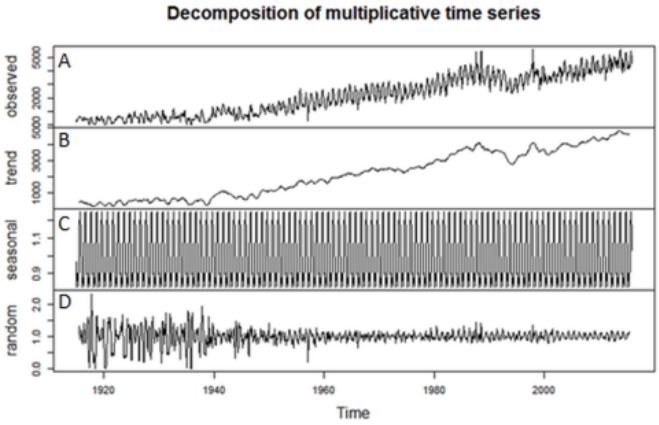

Figure 6(a): Decomposition of birth time series using multiplicative model

Panel A shows the observed number of births according to years, while panel B shows a 5 year moving average providing a smooth trend for births. Panel C shows that seasonality exists in the data; February had the minimum value of seasonal factor i.e. 0.82, while September and October had the maximum i.e. 1.23 and 1.24 respectively. This can also be ascertained through supplementary Figure 1S showing monthly occurrence of births aggregated over the years.

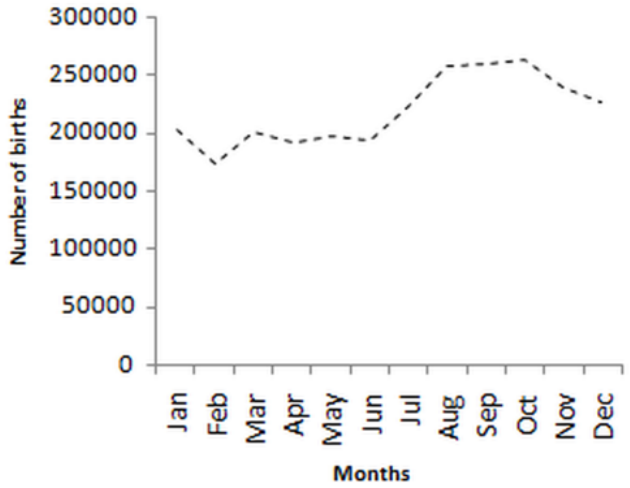

Figure 1S: Line plot showing number of births according to months pulled over 1915 – 2015

February showed the minimum number of births, while September and October showed the maximum. Panel D shows random component in the data, which connoted wide fluctuations till 1947; however subsequently indicated reduction in the amplitude.

On similar lines, the decomposition was obtained for death series, which is shown in Figure 6(b).

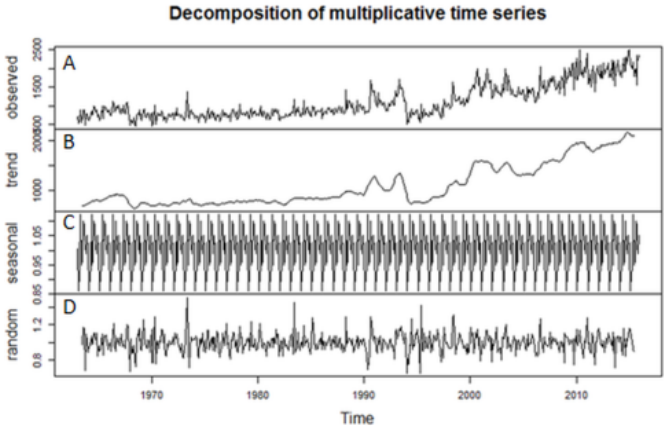

Figure 6(b): Decomposition of death time series using multiplicative model

Panel A and B displays the observed and trend component of death time series data in the observation window. The seasonal component in panel C indicated minimum value for February i.e. 0.85 and maximum for May i.e. 1.12, followed by August with a value of 1.10. This is also substantiated by number of deaths according to months over the years, as shown in supplementary Figure 2S.

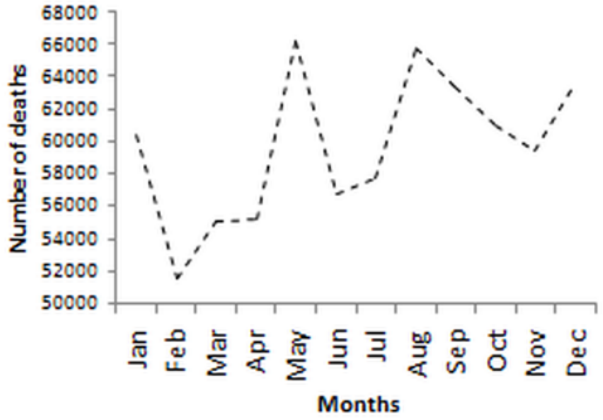

Figure 2S: Line plot showing number of deaths according to months pulled over 1915 – 2015

The random component was consistent across the observation window.

Forecasting of CBR and CDR

Auto regressive integrated moving average (ARIMA) model was used to forecast the CBR and CDR for the succeeding five years, after ascertaining the goodness of model fit.

Table 1: Predicted values of CBR and CDR for next 5 years based on ARIMA model

Parameter	2017	2018	2019	2020	2021
CBR	21.08	21.39	21.34	21.30	21.33
CBR: 95%(low)	14.97	14.42	13.66	13.24	12.67
CBR: 95%(high)	27.18	28.36	29.02	29.35	30.00
CDR	9.48	9.48	9.48	9.48	9.48
CDR: 95% (low)	6.17	5.75	5.30	4.88	4.51
CDR: 95% (high)	12.79	13.22	13.66	14.07	14.45

Table 1 provides the estimated values for both the rates along with 95% confidence limits and graphical representation through Figures 7 (a) and (b).

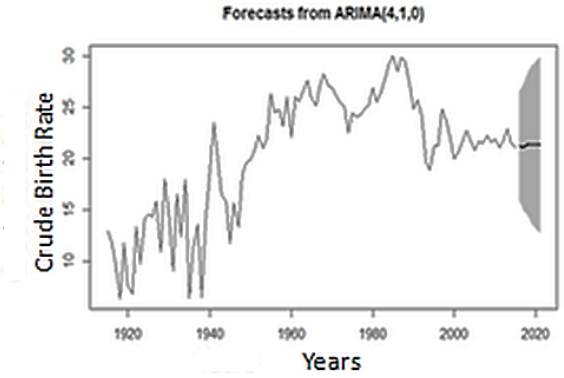

Figure 7(a): Prediction of crude birth rate for 2017-2020

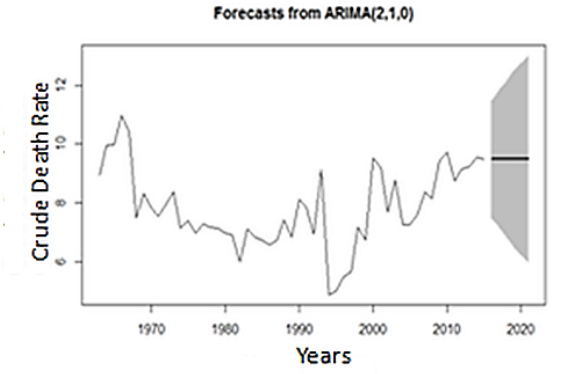

Figure 7(b): Prediction of crude death rate for 2017-2020

Short-term forecasts were also made for the number of births and deaths. For this, the HoltWinters () function was used in R. For the predictions, the *Forecast* package from R was used and the values were obtained for the next five years as shown in Table 2. The predictive model needed no further improvisations as indicated by the significance level. The forecasted value for the year 2016 was within the 95% confidence intervals

Table 2: Predicted values of Births and Deaths for next 5 years using HoltWinters() function

Parameter	2017	2018	2019	2020	2021
Birth	56648	56903	57157	57411	57665
Birth:95%(low)	42785	39361	36521	34028	31769
Birth:95%(high)	70512	74444	77793	80794	83561
Death	26955	27611	28268	28924	29581
Death:95%(low)	18278	16564	15173	13969	12884
Death: 95%(high)	35631	38658	41362	43880	46278

Discussion:

The analysis of 100 years of population data of Nagpur city revealed that the total population initially remained quite constant until 1920, it then started increasing up to the 1950s, after which there has been a steep rise (Figure 2). Pandey et al. 2015, also stated through their study that till the mid-20th century, death rates were higher than the birth rates in India; and that the population of India rose drastically after mid-20thcentury. In fact, this period was the turning point in Indian history as it was the beginning of post-independence era. This was also the period of partition when Pakistan was declared as an independent nation, resulting into enormous human resettlements in both India and Pakistan. Millions of people migrated from Pakistan to India and settled in different parts of the country. Nagpur was no exception and reported a good volume of immigrants from Pakistan. This disturbance gradually subsided and people started focussing on their livelihood. Agricultural activities, industrialization etc. gradually roared across India, so after1950 there was an abrupt rise in the population. The change was also realized in Nagpur, as reflected through the birth pattern post 1950. The increase in population has been reported through different studies across the world. However, Yagudin et al. 2015 and Rakibovna and Raphaelevich 2015, stated that the number of births in the Republic of Tatarstan, a federal subject of the Russian Federation, saw a decrease in the number of births in the last 10 years of the twentieth century and the first 5 years of the twenty-first century.

Sex ratio has risen from 935 in 1915 to 943 in 2015; however, the overall trend has shown a modest decline over 100 years as shown in Figure 3(c). One line of

thought behind the difference in the male-female births is that nature maintains its balance by having more males being born as compared to females because males are more prone to death at birth as well as at later stages of life. Another reason, as discussed earlier, is the effect of latitude gradient, but the sex ratio obtained for Nagpur has been comparable with various countries across the globe. Gender preferences too influence this ratio as male child is usually considered to be more desirable. Grech 2013 revealed that the sex ratio is increasing in South America and declining in Europe and North America. Mathews & Hamilton 2005 gave a comparative study of the sex ratio for few countries. He stated that there have been more male births in Belgium, Singapore, Macao and much more female births in Cayman Islands in 1994. He proclaimed that the sex ratio in almost all countries is in the range of 1050 to 1060 males per 1000 females and that it has remained in this range even for US from 1940 to 2002. Pandey et al. 2015 referred to 1901 to 2011 census population data for India and showed that sex ratio in India initially was close to 1000, after which it dropped and now again approaching 1000.A study in the State of Qatar by Al-Thani et al. 2014 also shows a stable male to female ratio. The data from Nagpur over 100 years also corroborates with above observations.

Birth occurrence was quite steady across months and no season turned out to be prominent till 1950, as indicated by the seasonal overlaps. However, in the later half, seasonality emerged, with rainy season showing maximum births and summer showing the minimum. Time series decomposition of births also revealed that before 1950, random component was significant with wide fluctuations; but as the seasonal component started dominating in the later half, the random component reduced. Rainy season showing maximum number of births constituted the month in which the seasonality component was maximum (October: 1.24). Similar analysis of death time series data showed consistently varying random component across the period from 1963 to 2015. Deaths were marginally influenced by seasonality component as also revealed by the overlaps of seasonal trends across this duration.

Post 1960s, births in houses lessened and births in hospitals showed a remarkable increase. This indicated a good change-over with citizens being more attentive about neonatal and maternal care. Another prominent shift during the same period of 60s was in the number of births across days, where weekends saw minimum number of births. An amalgamation of the two scenarios is giving noteworthy revelations about the health care centres for taking conscious endeavours to obliterate this bias. A study by Yagudin et al. 2015 contrasted this stating that the number of births that took place in hospitals in the Republic of Tatarstan had decreased from 2005 to 2013. A study conducted by Borja & Martin 2017 stated that most births in England and Wales took place during September and October, which demonstrate a strong concurrence with our study. Both studies, in accordance with each other, state that minimum births have taken place on Sundays during the week followed by Saturday; while Tuesday, Wednesday and Thursday reported the maximum. They also stated that these trends can be related to the transforming practices in hospitals where the rates of C-sections need to be explored.

Both birth and death trends showed a dip in the year 1995. After 1995, an increase in both births and deaths has been observed. It has been inferred that as the number of births started increasing, there was a proportionate rise in the number of deaths. Climatic conditions and epidemic infections cause maximum number of deaths in Nagpur. In May, Nagpur experiences peak summer with temperatures around $45^{o}C$ to $47^{o}C$, which majorly results in deaths due to sunstroke. Similarly, August falls in the rainy season during which various infectious diseases spread across the city. Few medical practitioners stated that their OPDs have minimum attendance during February when minimum deaths take place making it the safest season. Births are also minimum in February. Causes for more male deaths are that they are more prone to diseases, stress, less resistant to changes in climatic conditions and are not usually as combative as females when health aspects are contemplated.

During the early years, lack of adequate healthcare facilities caused large number of infant and youth deaths; however, investments, upsurge in quality of services for all, improvements in health care technologies and their implementations have resulted into a steep decrease in IMR and an increase in the deaths at later ages of life (Olanubi and Osode, 2017; Sanchez et al., 2017). The average age has risen from 42 years in 1963 to 57 years in 2015, ignoring the infant mortality. This suggests an increased endurance of the population in the city which was also observed by Rashid et al. 2016. Decrease in

IMR can also be attributed to the shift from house births to hospital births. Temporal trends in self-rated health were studied in China from 1990 to 2012 by Kwon & Schafer 2016. They stated that Chinese adults were in better health in 2012 than in 1990.Yagudin et al. 2015 showed an overall decrease in the neonatal morbidity in the entire Republic of Tatarstan, with an initial drop which then rose from around 2010. He also accredited this reduction to the improved health care facilities. Al-Thani et al. 2014 stated that IMR reduced to 8 per 1000 live births in Qatar, which is analogous with that of the entire UAE. The statistical surveillance report created from 2000 to 2011 for the residents of Leeds, Grenville and Lanark (LGL) showed that IMR had increasing and decreasing variability in this period in LGL, while in Ontario IMR was quite constant. IMR has also shown variability for these 11 years in Nagpur. Pandey et al. 2015 showed IMR of India reduced from 74 to 40 per 1000 from 1993 to 2013. He also stated that IMR has reduced for Maharashtra in the same period. The IMR of Nagpur reduced from 38 to 24 and has also been compared with Maharashtra. The trend for adolescents from 1963 to 2015 showed a gradual increase. However, a steep rise in the proportion of deaths of senior citizens from 20% to approximately 45%, was a noticeable observation in the study. The reasons for deaths have frequently been attributed to the transition in living styles, new prolonged and life-threatening disease patterns, inability to cope with changing temperatures, size of family, "empty nest syndrome", employment type of the mother, instable families etc (Downey 2001; Blake 1981; Becker 1976; Rataj et al. 2015; DeRose et al. 2017; Scalone et al. 2017). However, to curb the reasons for deaths of senior citizens, their involvement in recreational activities, awareness programs etc. can be put to practice (Smolik and Cenek (2017); Chen and Sun, 2012; Wu et al. 2016).

A study carried out in the State of Qatar by Al-Thani et al. 2014 for 5 years from 2007 to 2011 shows a reduced CDR and a stable CBR, which is coinciding with the study in Nagpur for the same time interval. The statistical surveillance report for the residents of Leeds, Grenville and Lanark (LGL) showed that CBR had reduced and in Ontario it was quite constant. The study in Nagpur is in agreement with the latter. Pandey et al. 2015 concluded that India matched European standards during the 1991 census and that in India for a period of 10 years, from 1993 to 2013, CBR reduced from 28 to 21 per 1000, CDR reduced from 9 to 8 per 1000.For Nagpur, CBR has risen from 20 to 21 and CDR from 9.1 to 9.5. Pandey et al. 2015 also stated that CDR and CBR have reduced for Maharashtra for the same period.

IV. CONCLUSION

This study throws light on some of the key aspects such as, the responsibilities of health care institutes, citizens and the government. Hospitals need to record and update vital statistics data on birth weight, mother's age at delivery, abnormalities in the new born, still births, the number of children at the time of birth. Such data will serve as the much-needed catalyst for a better living. Local government should take initiatives and unite with hospitals to spread awareness about the increasing birth and death rates and ways to curb them. To mitigate the increase in births, people should be schooled regarding family planning. To alleviate the problem of increasing deaths, people should be enlightened regarding the toxic and destructive effects of exorbitance of drugs and other chemicals.

Health care institutes should focus on the broadening gap between male and female deaths, learn about the reasons for more male deaths and mitigate them. As female births continue to be less than that of male births, people should be educated to counter gender differences and 'save the girl child'. Hospitals and the local government are to be appreciated for the reduction in the mortality rates; however, even after the reduction, the last 5 years have shown a slight increase, which are presenting the impending dangers. The government should focus on allocating adequate funds for healthcare services. The increase in CDR is alarming and requires immediate attention. CBR is constant and measures should be taken to either keep it constant or reduce it further. These rates for Nagpur are higher as compared to overall Maharashtra and India. We believe that such studies should be carried out at micro level to get the contribution of each such city / town / village in governing IMR, CBR and CDR of Maharashtra and for other states, which can then be consolidated to give a clear scenario in India with distinctions at the minuscule level.

V. Limitations and Future Scope

While analysing the birth data, parameters such as birth weight, mother's age at the time of delivery and number

of children before delivery, neonatal complications were fragmentary; as a result, they were not utilized in the study. However, in the recent past, the local government authorities have made it mandatory to capture this information for every single birth event. This will prove to be of utmost importance in carrying out further studies to understand the dominant conditions of the new born, of the mothers and the abnormalities prevailing in them. Birth weight is of primary importance as it is the basis for knowing the health of the new born, which can lead to policies and programs for the improvements in the health of "future generations". The problems associated with birth weight, if looked into at earlier stages, can save children of the frightful problems awaiting them in future. Mother's age at child birth is an important parameter as; deliveries after 35 years of age and before 18 years of age are associated with various complications. It is essential to record the number of children born before the present birth, to exhibit control over the population which is drastically increasing.

In the death data, an essential parameter - cause of death was ignored due to missing observations. In fact, the parameter can provide deep insights into the problems prevailing in the city. This parameter also has been made mandatory in the electronic reporting systems so that down the line, the information will be useful for the health institutes as well as the government for creating awareness amongst the citizens and planning strategies to mitigate most typical disease conditions leading to death.

VI. ACKNOWLEDGMENTS

We would like to extend our heartfelt gratitude to the honourable Mayor of Nagpur city, Mrs. Nanda Jichkar for her valuable time and the Commissioner of Nagpur city, Mr. Ashwin Mudgal. We are deeply indebted and thankful to them for their guidance. We would also like to thank Mr. Nimish Khandelwal, Director, MDS Bio-Analytics, for his continual encouragement and support.

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