Understanding the nature of Demographic Transition and Population Cohort in India

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Abstract

The purpose of this study is to investigate the trend of demographic transition in India. In addition to this, the study explores the nature of population cohort in India. The study is completely based on secondary data compiled from the United Nation Reports, World Bank Reports and Census of India, different issues. The study found that India is now in the third stage of demographic transition. With the process of demographic transition, the fertility rate and mortality rate becomes smaller, which increases the share of the aged population in the country. It is observed that the share of the older population was 8.3 per cent and it is expected to rise up to 12.6 per cent in 2025 as per census 2011. Moreover, it is also seen that the share of the elderly female is more in comparison to the elderly male in India. Finally, the study concludes with suitable policy prescriptions.

Keywords: Demographic Transition; Population Ageing; Population Cohort; Feminisation of ageing, India.
JEL Classification: C26; J10; J11; J18; J19

1. Introduction

Population ageing is a worldwide phenomenon. It is a demographic process through which the demographic structure of the country gives greater weight towards the elderly population (Bloom, et al., 2010). It occurs when the median age of a country or region rises due to an increase in the life expectancy, decrease in fertility and increase in mortality etc. It is the most emerging issue which occupies the attention of many scholars and many countries, especially in developed countries. In fact, the process of population ageing has started also in developing countries. But there is a time lag in case of developing countries due to the variation in various factors like fertility, mortality, migration and life expectancy etc. It is worth to be mentioned here that the fertility, mortality, migration and life expectancy etc., are the factors which influence the process of ageing in any country.

In India, the process of population ageing also has started gradually (Singh, 2013; Bloom, et al., 2010; Panigrahi, 2007). It is faster in the southern state of India than the northern state

(Ponnapalli, et al., 2013) and among them, Kerala is the leading state (Gulati, 1993). In fact, the population ageing is relatively faster in developed states than developing states of India due to variation in the level of economic development (Acharjee, and Dutta, 2013).

The most significant reason behind the population ageing in India is the process of demographic transition. Demographic transition is the movement or shifting from high birth rate and high death rate to low birth rate and low death rate. The significant reasons for the increase in the life expectancy of Indian people are falling birth rates and death rate in both rural and urban areas of all the states. Along with this access to primary health centres, health personnel, medicines, roads, schools, etc., also contributed in increasing the life expectancy of Indian people (Vasant, 1994; Chakrabartiand Sarkar, 2011; Indira, 1999). Thus as a result of a fall in the fertility and the mortality, the proportion of the aged population has started to rise (Reddy, 1996). The consequences relating to elderly population are the critical aspects in recent time. Ageing involves various social and economic consequences and implications, like dependency, vulnerability, public health expenditures, pension schemes, and living arrangements (Sinha, 2017).

In India, the proportion of working age group to 65 and above for both males and females are high in rural areas compare to urban areas (Bharatiand Singh, 2013). In India, the aged people are not able to meet their basic requirements due to low-income earnings (Prakash, 2005). Because of their low income, they could not able to access proper medical facilities, proper food, and shelter etc., for their better livelihood. Due to this unhealthy lifestyle and lack of health facilities, the Indian elderly suffer from various health diseases. Health problems for aged groups are relatively higher than younger age groups and besides physical health problems; they also suffer from poor mental health because of senility, neurosis, and extent of life satisfaction (Rajan, 2006; Rao, 1981). The most common health problems aged people face include eyesight, hearing, joint pains, nervous disorders, weakness, heart complaints, asthma, tuberculosis, skin diseases, urinary problems and others (Prakash, 2005; Balamurugan and Ramathirtham, 2012). However, health problems are relatively high for elderly women compared to men (Balamurugan and Ramathirtham, 2012). Among all the state health problems for both male and female aged people are highest in Kerala and West Bengal while it is lowest in the case of Gujarat (Syam, 2011).

Given this background the objectives of the present study are twofold: firstly, to investigate the trend of demographic transition; secondly, to explore the nature of population cohort in India.

The structure of this study is as follows: Section 2 deals with the discussion of the data sources of this study and methodology. Results are analysed in section 3. Finally, section 4 concludes.

2. Data and methods

2.1. Data

The study is completely based on secondary data compiled from the United Nation Reports,

World Bank Reports, and Census of India, different issues. The data on age wise population from 1960 to 2016 are collected from World Bank Reports. On the other hand, the data on CBR, CDR, and population growth rate are collected from the United Nation Reports for the period of 1961-2011.

2.2. Methods
In this section, we are going to discuss the methods we have used to investigate each of the said objectives one by one.

2.2.1. Impact of natural change on population growth
The first objective of our study is to investigate the process of demographic transition in India. Birth and deaths are the natural causes of population change. The difference between the birth and the death rate of any country is called Natural Change. It is calculated by subtracting the death rate from the birth rate, that is,
Natural Change = Birth Rate – Death Rate
        (1)
In order to find the process of demographic transition, we have estimated the impact of Natural Change (NC) on population growth rate (PGR).For better understanding; we have presented the definitions of the included variables in table-1.

Table 1: Definition of the variables

Variables	Definition
Population growth rate (PGR)	Refers to an increase in a country's population during a period of time, usually one year. It reflects the number of births and deaths during the period and the number of people migrating to and from a country.
Natural change (NC)	refers to absolute increase in the number of population of a country, which is calculated as the difference between the birth rate and the death rate of a country or place during a particular period of time

Source: Compiled from World Bankand United Nation Report

In order, to understand the impact of natural change (NC) on population growth rate (PGR), we considered a simple two variables linear regression model as follows:
$$Y_t = \alpha + \beta X_t + u_t$$
        (2)
Where α is the intercept term, β is the slope coefficient, *Y* represents percentage change population size, *X* represents natural change, and u represents error component. The equation (2) represents a straight line relationship. As we are not using a log-linear regression equation we can expect the elasticity to be changed over time. The estimated value of the slope coefficient can be utilised to calculate the "*natural change elasticity of population growth*".

This calculated value of the elasticity will help us to understand the impact of natural change on population growth. In fact, a significant positive value of the coefficient β, indicates apositive elasticity and vice- versa. The formula for calculating the "*natural change elasticity of population growth*" is given below:

$$e_{NCPG} = \frac{\% \ change \ in \ Population \ Growth}{\% \ change \ in \ Natural \ Change} = \frac{d(\ln PG)}{d(\ln NC)}$$
(3)

Where e_{NCPG} =   *natural change elasticity of population growth*

Moreover, in order to explore the nature of population cohort we have used tables and figures.

3. Analysis of results
The results obtained by using the above-mentioned methodology are discussed in this section.

3.1. Demographic transition in India
Demographic transition refers to the movement from high birth and death rates to low birth and death rates as a country develops from a pre-industrial to an industrialised economic system. It involves five stages: Stage1- high stationary stage characterised by high birth and death rate, Stage2- early expanding stage characterised by very high growth of population as birth rate is very high compared to death rate, Stage3- late expanding stage characterised by high growth rate population and birth rate is higher than death rate, Stage4- low stationary stage characterised by stationary growth population, and Finally, Stage5- declining stage characterised by negative growth of population as death rate is higher than birth rate.

In order to investigate the trend in demographic transition, we consider simple regression model and regress natural change (NC) on population growth rate (PGR). But, as the variables are time series variables, we need to check the stationary property before estimating the regression model. This is so because if the data are not stationary then the results will not be reliable and can't be used for the prediction purpose. In order, to check the stationarity of both time series data, viz., natural change (NC) and population growth rate (PGR) we use the Augmented Dickey-Fuller test. From the table-2 it can be seen that both variables are stationary at levels. This implies that there is no unit root problem.

Table 2: Augmented Dickey-Fuller Unit root test

Variables	t Statistic	p-value
population growth	-4.16***	0.009
Natural Change	-2.32**	0.021

Source: Authors' own calculation based on World Bank and United Nation Report

We now present the regression result in table-3. The methodology for this result is discussed

in the earlier methods section. The OLS estimator of the slope coefficient is presented in table-3.

Table 3: Regression result

Variables	Estimated coefficient β	SE	t-statistics	p- value	r^2
Impact of natural change on population growth	0.109	0.001	105.308	0.000	0.99

Source: Authors' own calculation based on World Bank and United Nation Report
        *Note: ***significant at 1% level*

The regression result shows that natural change positively influences population growth.
In order, to identify the demographic transition in India we next calculate the "*natural change elasticity of population growth*" by using the estimated β coefficient. The formula for calculating "*natural change elasticity of population growth*" is presented in equation (3). The calculated values of the elasticity are presented in table-4. The table divulges that the "*natural change elasticity of population growth*" is fluctuating over time. During the time period, 1961 to 1966 e_{NCPG} showed an increasing trend. It then shows a sharp decline during the time period 1967 to 1977. Again, during 1979 1984 e_{NCPG} shows an increasing trend. During the time period, 1990 to 1996 e_{NCPG} remains static with a value 1.066 and/ or 1.067. The e_{NCPG} shows an increasing trend during the time period 1997 to 2008. After that, it again shows a decreasing trend.

**Table 4: Impact of change in Natural Change on Population Growth**

Year	Natural Change Elasticity of Population growth	Year	Natural Change Elasticity of Population growth
1961	1.085	1987	1.065
1962	1.087	1988	1.064
1963	1.089	1989	1.065
1964	1.090	1990	1.066
1965	1.089	1991	1.066
1966	1.088	1992	1.067
1967	1.087	1993	1.067
1968	1.082	1994	1.067
1969	1.073	1995	1.067
1970	1.063	1996	1.067
1971	1.055	1997	1.068
1972	1.049	1998	1.070
1973	1.046	1999	1.073

1974	1.045	2000	1.078
1975	1.047	2001	1.084
1976	1.050	2002	1.091
1977	1.052	2003	1.097
1978	1.055	2004	1.101
1979	1.058	2005	1.103
1980	1.062	2006	1.105
1981	1.065	2007	1.108
1982	1.067	2008	1.108
1983	1.068	2009	1.105
1984	1.068	2010	1.099
1985	1.067	2011	1.092
1986	1.066	-	-

Source: Authors' own calculation based on World Bank and United Nation Report

We next plot the elasticity figures in order to identify the demographic transition of India. The figure-1 depicts the demographic transition in India. During the 19th century, we observe a stationary picture of population growth, because of balance births over deaths. In the late 1800s, population growth slowly accelerated. In 1871, India's population was reached almost to 255 million. During that period India's population growth was contributed by the high-fertility and high-mortality. Duringthe early 20th century India's population grew quite slowly.

Figure-1: Demographic transition in India
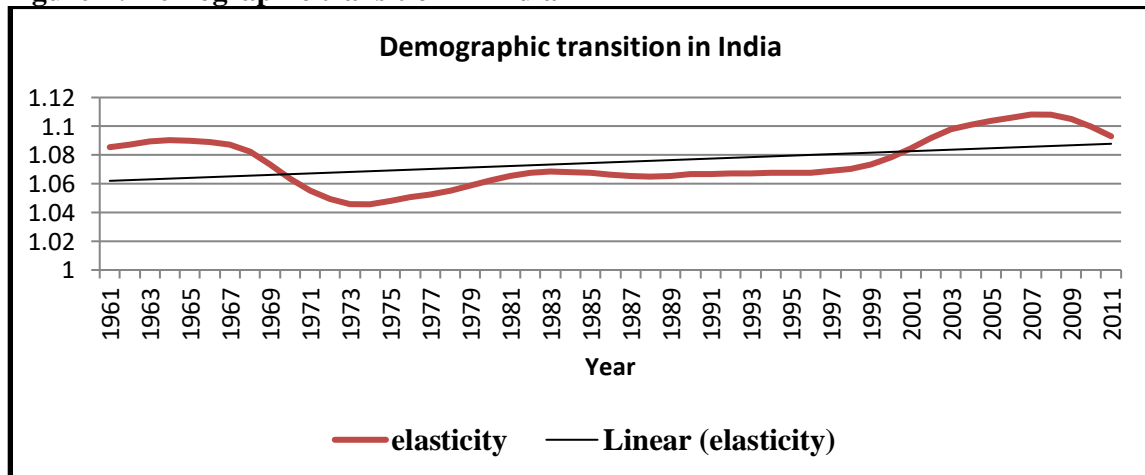
Source: Authors' own calculation based on World Bank and United Nation Report

In the above diagram, the pattern of the growth rate of India follows condition or stages of demographic transition. We can observe that demographic transitionrepeatsa similar trend over the study period. The pattern of values of elasticity (e_{NCPG}) during 2001-2011 is similar to that of 1961-69.

The period before 1962 may be regarded as the first stage of demographic transition because in this period both birth rates and death rates were very high. The main reasons for such high birth rates were illiteracy, lack of knowledge for proper family planning and birth control measures etc. Further, the period 1962 was characterised as an agricultural based society and children were considered as economic assets which were another reason for such a high birth rate. In that period, death rates were also very high as medical facilities were very rare and that period was characterised by periodic famines, outbreaks of lethal diseases such as cholera and smallpox, and endemic parasitic diseases such as malaria etc. Thus, in the period 1962, the gap between birth and death were almost zero and growth rate of population was stationary.

The second stage of demographic transition in India had started in the late 1960s. This period was characterised by the very high growth of population as the birth rate was higher than the death rate. The reduction of the death rates during this period was achieved because of the innovation of the medical facilities but birth rates remained high. As a result, the gap between birth rate and death rate increased significantly which accelerated the growth of population. Another important reason for that accelerated growth of population was the preference of a male child over a female child by the Indians'. The preference for male child caused more baby birth in the form of an unwanted girl child. Thus the period between 1963 and 1981 may be regarded as the second stage of demographic transition. This stage of demographic transition is termed as the early expanding stage.

The third stage of demographic transition in India was started in the late of 1980s. The growth rate of population was relatively lower than the earlier periods after 1990. During that period both birth rates and death rates showed a declining trend. But the gap between birth rates and deaths were still positive. Between 1991 and 2011, the population growth rate had significantly decreased due to the fall in the birth rate. This might because of the fact that approximately 25 percent Indians over the age of seven became illiterate (2011 census). Most importantly, during that time period, female literacy rate exceeded the male literacy rate. Further, people were familiar with the importance of birth control and the availability of various measures to control birth rates had also improved. On the contrary, the death rate had also reduced because of the improvement in various health and medical facilities. However, the reduction in the birth rate was higher than that of death rate and as a result, the gap between birth rate and death rate had started declining. This decline in population growth was achieved by various efforts and population control policies adopted by the government of India from time to time. One of the successful policies was "*National Population Policy 2000*".

**3.2. The nature of population cohort in India**

Population ageing is one of the serious issues in the recent period. Many developed countries are approaching an era of the ageing population due to an increase in longevity, a decrease in mortality rates and a decrease in fertility rates (Harper and Leeson, 2009). The decline in population growth has been visible since the mid-1970s when the adult working-age population in several countries outpaced child population (Mason and Lee, 2011). The process is now rapidly approaching to the developing world, and where India is not an exception. The table-5 represents the age wise distribution of population in India.

Table 5: Age wise distribution of population (in percentage)

Age group	0-14	15-64	65 and Above	Total
1960	40.30	56.63	3.05	100
1965	41.41	55.35	3.23	100
1970	40.84	55.83	3.31	100
1975	40.06	56.44	3.49	100
1980	39.24	57.12	3.62	100
1985	38.72	57.54	3.72	100
1990	37.92	58.24	3.82	100
1995	36.62	59.31	4.06	100
2000	34.73	60.86	4.39	100
2005	32.78	62.44	4.76	100
2010	30.89	63.99	5.11	100
2015	28.65	65.70	5.63	100
2016	28.19	65.99	5.80	100

Source: Compiled from World Bank

It is seen from the table-3 that, the share of the 65 and above population in the total population has increased from 3.05 to 5.8 percent and that of the share of 15- 59 age group has increased from 56.63 to 65.99 percent during 1960 to 2016. While at the same time the share of the 0-14 age group decreases from 40.3 to 28.19 percent. Population ageing is directly reflected in the population cohort. The population cohort was more or less static in the pre-independence period. But in recent times, the cohort suggests that the share of people in the age group 65 and above has started increasing from the early years of the last century. The same result is presented in terms of the figure-2.

Figure 2: Population Cohort
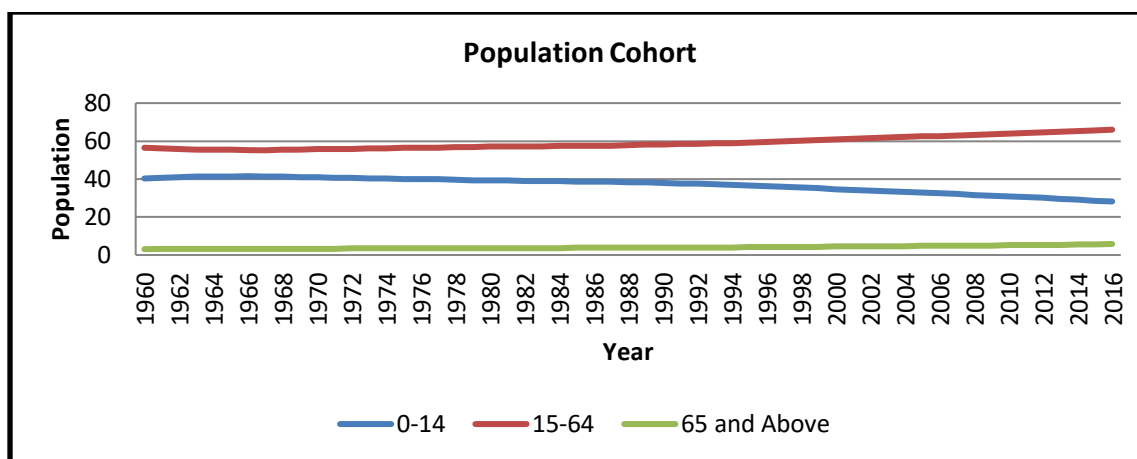
Source: Authors' own calculation based on World Bank and United Nation Report

A close perusal of the figure reveals that in India, over the study period the share of the elderly population in the total population is gradually increasing. On the contrary, the share of the working adult population in the total population (within the age-group 15-64) is declining over time. Finally, the share of the very young age (within the 0-14 age-group) population in the total population remains almost static over the study period. These indicated that, India is approaching towards the ageing era.

3.3. Sex-wise composition of the population

In order, to understand the elderly male-female population composition in India we consider the sex-wise age-specific distribution of population. This will enable us to understand the composition of the elderly population in India. The sex-wise composition of the population is presented in table-6.

Table 6: Sex-wise composition of population (in percentage)

Age group	Male				Female			
	0-14	15-64	65 and Above	Total	0-14	15-64	65 and Above	Total
1960	40.24	56.83	2.92	100	40.36	56.42	3.20	100
1965	41.45	55.43	3.11	100	41.37	55.26	3.36	100
1970	40.80	55.95	3.23	100	40.89	55.70	3.40	100
1975	39.97	56.61	3.40	100	40.15	56.25	3.58	100
1980	39.16	57.32	3.51	100	39.32	56.92	3.75	100

1985	38.69	57.71	3.59	100	38.75	57.36	3.87	100
1990	37.96	58.36	3.67	100	37.89	58.11	3.99	100
1995	36.81	59.33	3.85	100	36.43	59.28	4.28	100
2000	35.07	60.83	4.08	100	34.36	60.89	4.73	100
2005	33.26	62.37	4.36	100	32.27	62.52	5.19	100
2010	31.39	63.92	4.68	100	30.35	64.06	5.57	100
2015	29.14	65.69	5.16	100	28.13	65.72	6.13	100
2016	28.67	65.98	5.33	100	27.68	66.00	6.31	100

Source: Compiled from World Bank

A close perusal of table-6 reveals that among the age group 65 and above the share of the elderly female population is more in comparison to the elderly male population. On the contrary, in the age group 0-14 years, the proportion of male is higher than that of the female population. This indicates the sign of "*feminisation*" of ageing emerged in India. The "*feminisation*" of ageing is a process which occurs when the numbers of female veteran exceed the numbers of veteran male. This is mainly because of the better survival chances of veteran women relative to men, the sex ratio changes with age in favour of the former (Dutta, 2012). We can observe a faster rate of "*feminisation*" in the case of most of the developed countries of the world. The increase in the female older population involves various health and social consequences. Thus, the increasing proportion of women among the oldest old therefore confers some degree of urgency in scoping and planning health care services of the future (Richmond, 2008).

4. Conclusion
From this discussion, it is found that the process of demographic transition is playing a dominant role in changing population size and it is also observed that the pattern of population repeated over time. The study also discloses that India is now in the third stage of demographic transition. This implies that the Indian people are now more or less concern about the importance of small family and family planning. However, the trend in the growth of population is still positive in India and it is mainly influenced by the crude birth rate than crude death rate (Sinha, and Maity, 2017). Thus, the increase in population is actually reflected by an increase in the aged population.

India is the highest populated country in the world. With the process of economic development, the fertility rate and the mortality rate become smaller, which increases the share of the aged population in the country. According to census 2011, the share of the older population was 8.3 per cent, which is expected to rise up to 12.6 per cent in 2025. It is seen that the share of the 65 and above population in the total population has increased from 3.05 to 5.8 per cent and the share of 15- 59 age group has increased from 56.63 to 65.99 per cent during 1960 to 2016. While at the same time the share of the 0-14 age group decreases from 40.3 to 28.19 per cent. Moreover, if we observe the sex wise composition of the aged

population, it is seen that the share of the elderly female is more than that of an elderly male. The concept of population ageing involves many economic and social consequences. In recent times, India is experiencing a very fast process of population ageing. Even if India's population is still young in comparison to the developed countries but in absolute term, India is the second highest elderly populated country after China. So it may be stated that there is an urgent need to pay serious attention to the issues of population ageing and on the socio-economic effects of ageing. Further, the government should introduce suitable policies to enhance care and support for the elderly. The government should also take necessary steps to solve the emerging problems of the elderly.

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