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# Future Population Aging Through Demographic Transition in Bangladesh

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ABSTRACT

Demographic transition ends with an introduction of population aging in a society. This piece of work investigates the aging process in the light of demographic transition in Bangladesh. It tries to identify and observe trend, growth pattern of elderly and point out future time period of commencing aging crisis in this country. An upward linear trend over the period 1911–2011 has been observed. The logistic growth model fits well for elderly population during the ongoing demographic transition of this nation. The aged people will reach its carrying capacity level by the middle of the current century. So, it is a very crucial time to take sustainable aging policy for facing the upcoming inevitable demographic aging problem in Bangladesh.

## 1. Introduction

A process called demographic transition, shift from high birth and death rates to low birth and death rates, increases the proportion of elderly and finally produces population aging. Demographic transition has reshaped the age structure of the population in most of the region in the globe [1]. An uneven distribution of demographic transition as well as elderly persons exists in the world [2]. Historical improvement of average longevity increases the population aging in Bangladesh. This lower mortality does not necessarily mean more years in good health among elderly [3]. Developing countries are experiencing faster demographic transition process than developed countries. The East-Asia will enter into the era of aged societies in the early part of the 21$^{st}$ century. In this process, India will be a graying nation in the middle of this century [4]. Demographic transition as well as increasing aging process among different states in India is not same. The south Indian states are in comparatively more advanced in this process than their counter northern states [5]. Mauritius has completed its demographic transition in a short period of time. As a result, this country will experience a dramatic aging of its population during the coming three decades [6]. Contemporary societies in the world are now at different stages of their demographic transition. Developed world has greater percentage of older people than the developing countries [7]. Demographic transition in DIY (a special area in Indonesia) was related with epidemiological transition. The DIY is one of the earlier regions that completed its demographic transition and entered in to the aging place than other provinces in Indonesia [8]. Asia-Pacific today is aging more rapidly than all other regions except Latin America and the Caribbean. People in this region live far longer today than they did a half century ago. In 2015, seven Asian countries, namely Bangladesh, China, India, Indonesia, Japan, Pakistan and the Philippines, had 420 million people age 60 and above, which accounts for 47 percent of people aged 60 and older in the world. With the current pace of aging in Asia-Pacific countries have limited time to prepare for an older society [9]. Bangladesh will be an aging nation in the middle of the 21$^{st}$ century with relatively poor socioeconomic condition [10]. The average age of the Bangladeshi population will be stabilized at 40 years during the transition from stable (assumed in 2001) to ultimate stationary population [11]. A clear picture of future aging scenario is very important to take a sustainable population policy in Bangladesh. In this paper, an effort has been made to shed light in population aging process in future in the

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light of Malthus population theory explained with demographic transition model.

## 2. Data and Methodology

The secondary data on total population, elderly population (1911–2011), fertility, mortality over the period 1951–2011 have been collected from different publications of the Statistical Yearbook in Bangladesh [12]. Projected population data up to 1961–64 [13] has also been used for comparison.

Statistical techniques of linear trend analysis, multiple regression analysis have been applied here. Demographic transition theory has been discussed with the historical data to trace the nature of the population growth and demographic aging process. Finally, the logistic growth model is fitted to identify the future time point when the elderly population in Bangladesh will reach at the alarming level.

### 2.1. Carrying capacity of population with logistic growth model

Population, when unchecked, increases in a geometric ratio along with the arithmetic increase of subsistence [14]. For continuous population distribution this geometric progression can be explained with exponential growth function. The exponential growth rate of population is proportional to the population size. But it is unrealistic because of environmental restrictions in the growth of population. A comparatively more realistic notion is that the relative growth rate $P'/P$ decreases when $P$ approaches the carrying capacity ($K$) of the environment. This can be represented with the logistic differential equation [15]:

$$\frac{dP}{dt} = kP\left(1 - \frac{P}{K}\right) \tag{1}$$

where $P$ is the population size at time $t$, $k$ is the per capita population growth rate and $K$ is the carrying capacity of the population.

An analytical solution of this equation is

$$P = \frac{K}{1 + Ae^{-kt}} \tag{2}$$

where $A = \dfrac{K - P_0}{P_0}$, and $P_0$ is the initial population.

For three equidistant population $P_0$, $P_1$, and $P_2$ the value of $K$ and $k$ can be estimated as

$$K = \frac{P_1\left(P_1P_0 - 2P_0P_2 + P_1P_2\right)}{P_1^2 - P_0P_2} \tag{3}$$

$$\text{and} \quad k = \frac{P_0\left(P_2 - P_1\right)}{P_2\left(P_1 - P_0\right)} \tag{4}$$

## 3. Results and discussion

### 3.1. Trend in aging process

Long term (1911–2011) demographic aging at peak (measure on the person aged 60 and above) has observed in this study. An upward linear trend on aging process is found from the middle of the twentieth century. On an average 3.32 elderly ($b = 3.32$) per thousand populations are added in our country between each census period. So, we get a new aged person per thousand populations in every three years (Fig 1).

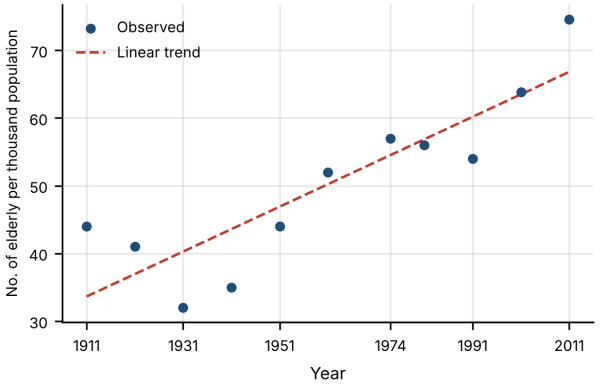



**Figure 1.** Trend of population aging in Bangladesh, 1911–2011.

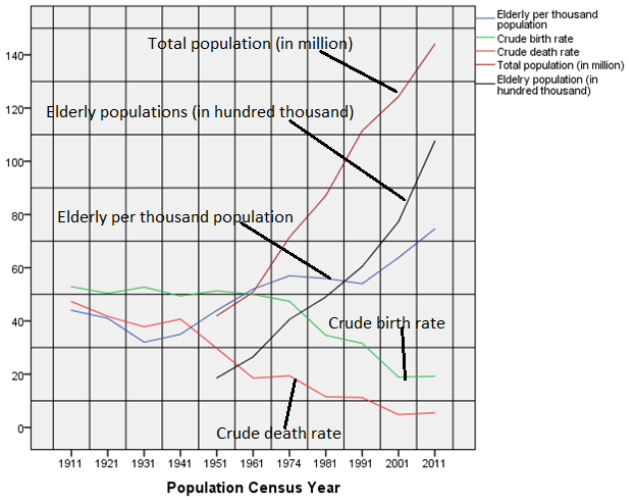



**Figure 2.** Demographic transition and population aging in Bangladesh.

### 3.2. Demographic transition and population aging

Generally, demographers try to discuss aging process with the help of demographic transition in a society. Fertility and mortality are the key sources of demographic aging. A long term movement from high degree of birth and death rates to low degree of them is known as demographic transition. During this period total population grows up and finally comparatively higher percentage of elderly persons is available as a byproduct of this transition process. Demographic transition in Bangladesh has been presented in Figure 2.

At the beginning of the 21$^{st}$ century, the fertility and mortality levels of Bangladesh were relatively high. Up to the middle of this century the gap between fertility and morality was almost similar and total population growth was stable. The period 1911–1951 can be considered as the 1$^{st}$ stage of the demographic transition process in Bangladesh.

During 1941–1961, death rate fell sharply whereas birth rate was steady. Therefore, The gap between birth and death rates was large and sharp population growth was observed. Elderly per thousand population as well as absolute number of elderly was slowly increasing. From 1961, the fertility rate was gradually falling. In the third quarter

**Table 1.** Population data on three selected time points

| Selected years | Total population (in million) | Elderly population (in million) |
|---|---|---|
| $P_0$ (1951) | 41.932 | 1.857 |
| $P_1$ (1981) | 87.120 | 4.9057 |
| $P_2$ (2011) | 114.044 | 10.7595 |

**Table 2.** Estimates on logistic population growth model

| Estimates | Total population (in million) | Elderly population (in million) |
|---|---|---|
| $K$ (carrying capacity) | 231.712 | 26.33501 |
| $k$ (growth rate) | 0.3667 | 0.331393 |
| Medium variant projected population (in year)* | 223.390 (in 2061) | 29.938 (in 2041) |
| $A$ | 4.5259 | 2.474121 |

*Assumption of medium variant population projection: A steady decline of TFR employs in the medium variant fertility level. Initiating from 2.3 in 2011, it assumes to be dropped to 2.1 in 2021, from 2026 TFR is assumed to be 1.9 and continued thereafter.

of the twentieth century both fertility and mortality rate were falling sharply. Therefore, Bangladesh completed the second stage of demographic transition between 1951 and 1981. In this stage, total population as well as elderly population grew very rapidly though the peak aging process (elderly per thousand populations) was almost stable.

From 1981 to 2011 both fertility and mortality were decreasing where birth rate decreased more than death rate. A steady narrow gap is observed between CBR and CDR within 2001–2011. Currently, Bangladesh is passing the third stage of demographic transition after commencing in the 1990s. In this third stage of this transition process, a rapid linear upward trend has been observed in the total population as well as in the absolute number of elderly population. A visible increasing population aging process has also been found during this ongoing third stage of the demographic transition period in Bangladesh. Now, we are in a position to complete the third stage within a short period of time. Bangladesh is yet to complete its fourth stage of demographic transition. Therefore, this nation is waiting for future gloomy population aging scenario.

### 3.3. Aging through logistic population growth model

The trend of total population as well as elderly population can be captured with the logistic growth model. Following table represents population figures at three selected census years in Bangladesh.

Under the logistic growth model the following estimates are available.

The carrying capacity of population under logistic model is compared with the medium variant projected population (BBS, 2015). Though the fertility of Bangladesh is now at almost replacement level, the population will grow up for more than 60 years because of population momentum. The projected total population will reach at carrying capacity level ($K$) after 2061 (Table 2). On the other hand, elderly population will touch its carrying capacity level ($K$) by the year 2041 (Table 2). From the above results it is clear that Bangladesh will have to face the demographic aging problem by the middle of the current century.

## 4. Conclusion

Demographic transition and population aging are two inseparable concepts. Population growth of a country is the outcome of the demographic transition process. Bangladesh will enter into the fourth stage of this process quickly. Due to the successful family planning program this nation able to manage its overall population growth. Mortality rate is decreasing with the advancement of medical facilities and life styles of the people. Therefore, Bangladesh will have to deal its population aging problem as a byproduct of country's ongoing demographic transition. This nation will touch its carrying capacity of elderly persons by the middle of the 21$^{st}$ century under the assumption of logistic growth. This finding is an input in future population planning and development. Therefore, it is a high time to take a sustainable population aging policy to face the future aging pressure of the country.

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