Pakistan Journal of Social Sciences 3 (5): 700-704, 2005

Effect of Declining Fertility on Population Aging in Bangladesh: An Application of Coale's Analytical Model

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Abstract: In this pi ece of work, an attempt is made to gauge the effect of constantly declining fertility on population aging in Bangladesh through the application of an analytical model proposed by Ansley Coale (1972), which employs stable population theory. We have assumed a linear constant decline of fertility in Bangladesh to obtain NRR=1 by the year 2011. The projected age distribution of 2011 shows that the proportions of males and females 60+ will be 7.02 percent and 7.46 percent respectively. This means that there could be an increase of 18.98 percent and 55.4 percent in the proportion of males and females (60+) from 1991 to 2011. The median age of males increases from 17.65 to 26.27 years during the same period. For females, the increase is from 17.88 to 26.09 years.

Keywords : Crude birth rates, GRR, Aging, Bangladesh

INTRODUCTION

The population of the world will continue to grow older in the immediate future. The median age of the world population will increase rapidly during the twenty-first century. It must be assumed that disease control will be improved especially in those countries which currently have relatively high rates of infant and childhood mortality. It also seems that there will be increased use of contraceptive techniques, which will tend to moderate the worldwide birth rate. Each of these factors will have the effect of increasing the median age of the world population and producing increasing proportions of older people in many societies. However, in the coming decades, many Asian countries including Bangladesh will experience population aging and the aging population will be large in absolute terms. Bangladesh has been experiencing a major change in the age composition of its population, becoming a much more mature society than it was only a few years ago. The median age of the society has decreased from about 21.6 years in 1950 to 18.5 years in 1990 and again increased from about 18.5 years in 1990 to 20.9 years in 2000 and it is expected to go up to about 37.8 years by 2050(BPC, 1991).

Aging is one of the emerging problems in Bangladesh. This problem has been gradually increasing with its far reaching consequences. With the advancement of medical science and public health care services and other technological developments, the average span of life has become more than double in the present century. Although the aged population in Bangladesh was not very high in 1990. In this year the numbers of aged population of 60 years and above was 5.2 million (about 5 percent of the total population). This number will reach 14.6 million (about 9 percent of the total population) by the year 2025. In the past two decades, the mortality improvement in Bangladesh is remarkable resulting in the extension of life. This is expected to have effects on the retirement plans of the elderly people in near future. Moreover, fertility has also been declining. As a result of these demographic changes, Bangladesh will also experience rapid growth in elderly population (Hossain, 1998).

Bangladesh contains 1.09 percent of total world elderly population and 2.15 percent of total elderly in Asia in the year 1995. After a period of 25 years i.e. in 2020 percentage of elderly population of Bangladesh will be 1.38 percent of world's elderly and 2.41 percent of Asian's elderly population. According to United Nations projection proportion of elderly population has been 4.54 percent in 1995 and it will be 6.44 percent in the year 2020 an increment of only 1.9 percent in 25 years. But in terms of absolute number the increment of the elderly will be 0.864 million during 1995-2000 and 7.299 million during 2000-2020 in 20 years (UN, 1995).

The aging of population is thought to be the outcome of interplay between fertility and mortality. So is the case with Bangladesh. In the face of socio-economic transformations that are taking place in Bangladesh, it is assumed that the demographic transition what has been underway in the country in recent years affects the upper age spectrum of the population and has resulted in increase of the older persons of age 60 and over. However, the demographic consequences of changing

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population age structure and the growing number of older persons are yet to fully understood.

The crude birth rates were estimated from various sources and are of varying reliability. On the whole, however, they indicate that, probably until the 1970s, Bangladesh had spanned the second phase of the demographic transition and high fertility was needed to off set the high but declining mortality operating in the country. The crude birth rates fluctuated around 50 per 1,000 populations throughout the period until late 1960s. After 1971-1996, fertility declined from 47 to 26 per thousand. Crude birth rate took nearly a long 95 years to come down from 53.8 in the period of 1901-1911 to 25.6 in the period of 1991-1996, though the workers entrusted with achieving the objectives of family planning programs had fought tooth and nail over the last 2-3 decades to bring it into line. Recent surveys have however claimed that fertility level in Bangladesh has shown a further declining trend. It is not possible to be more precise about the onset of the fertility decline. The most dramatic decline in fertility has occurred in Bangladesh where in a span of 95 years the total fertility rate fall from an average of 6.78 children per women to 3.41(BBS,1978, 1992,1997).

The aging of population is a universal phenomenon, an inevitable result of declining fertility or births and improved chances of survival. Declining fertility reduces the proportion of the young in the population resulting in longer proportion of the 'aged'. Similarly improved survival and gains in life expectancy results in longer proportion of the aged in the population and to the aging of population (Karkal, 1998).

Population aging refers to the process of changes in the age structure that makes higher age groups proportionally larger and younger age groups smaller. This process starts primarily as a result of declining fertility. When fertility begins to decline, the youthful segment of the population is reduced and consequently, the proportion of older population increases. The population then starts aging mainly from the bottom of age pyramid through reduction in young cohorts. On the other hand, when fertility remains high, population swells from increase survivors during the early stage of life which may result in population that is becoming progressively younger. Since there are indications of faster declines of fertility many a third world country in the recent times, the phenomenon of population aging has become relevant in the third world as well. Within the next few decades, the most dramatic increase in the number and proportions of older population will be in the developing countries where about 70% of the people 60 years and older will reside by 2025(Rogers, 1982).

In this paper, an attempt is made here to see to what extent, a constantly declining fertility in Bangladesh will affect the aging population by the year 2011. Although proportional growth of aged in Bangladesh may not be alarming, its numerical dimension is quite tremendous.

MATERIALS AND METHODS

Stable population analysis, in general, provides the means by which demographers can examine the consequences of fixed levels of fertility and /or mortality on a population age structure. Following this, Coale(1972) has analyzed the sequence of births and the number of persons at each age that evolve when fertility continuously declines(or continuously rises) while mortality level remains fixed.

The approximate analytical formula for the age Sdistribution of the population at time t after a constant fertility decline of k is:

$$C_t(a,t) = \frac{b_t}{b_s} * e^{-\left(\frac{k}{2}\right)a+\left(\frac{k}{2T_0}\right)a^2} * C_s(a) \qquad (1)$$

Where:

$\frac{b_t}{b_s}$ = ratio between the birth rate of the projected population and that of the stable reference population at time t.

$C_s(a)$ = the age distribution(proportionate) at age 'a' of the reference stable population.

T_0 = mean age of the fertility schedule.

k = the rate of change in fertility.

Thus, according to this formula, the age distribution of a population with a history of changing fertility is equal to a constant (ratio of the birth rates) times the stable age distribution modified by a second order exponential term.

The ratio b_t / b_s is obtained in the following manner. Coale has fitted several curves to differing values of b_k / b_s calculated from several 'West' model stable populations and arrived at the following empirical relationship.

$$\frac{b_k}{b_s} = 1.0 + \left[3.807 - 1.039\frac{\bar{a}_s}{T} - 9.839\frac{\bar{a}_s}{T}\right]k + \left[(66.0 - 149.0)\frac{\bar{a}_s}{T}\right]k^2 \qquad (2)$$

refers to the mean age of the reference stable population at time t.

This equation provides estimates of b_k / b_s within about 1 percent of the true values over the stated range of

k except at very large values of $\bar{a}_s$ /T as accuracy is within the same margin for positive values of k upto 0.03(i.e. the change of fertility level to the tune of 3 percent per annum). For a detailed description of the methodology, see Coale(1972).

RESULTS AND DISCUSSION

For the present analysis, we have assumed that Bangladesh will attain NRR=1 by the year 2011 and the decline of fertility would be linearly constant. In order to apply the analytical formula (equation-1), we have to determine first the value of the parameter k or the amount of linear decline of fertility during the reference period. Change in the Gross Reproduction Rate (GRR) over the period is usually considered for determining the value of k. Here, we have considered the change in the GRR from 1991 to 2011 as shown below, while mortality level is fixed.

Year 1991		Year 2011	
GRR	= 2.06	GRR = 1.36 (corresponding to NRR=1 at 2011)	
$\bar{m}_0$ =T =	29	$\bar{m}_0$ =T =	29
e_0^0 (F)=	55.6 years	e_0^0 (F) =	55.6 years
e_0^0 (M) =	56.5 years	e_0^0 (M) =	56.5 years

GRR for 1991 is taken from Bangladesh Bureau of Statistics (BBS). In order to estimate the GRR for 2011 from the assumed NRR=1, we have used the Model Life Tables for developing countries(UN, 1982). The rest of the parameters are taken from West Model Life Tables (Coale, Demeny 1983).

A convenient way of determining k would be use the classical exponential rate of change i.e. $GRR_{2011} = GRR_{1991}(1+k)^{23}$

This yields a value of –0.018 for k. Or the decline (constant) of fertility anticipated is 1.8 percent per annum. Our text task is to compute the value of the ratio b_t / b_s. The parameters (for females) are:

K	= -0.018
k/2	= -0.009
$k/2T_0$	= -0.00031
/ T	= 35.00/29=1.241
T_0= T	= 29

Using Eq. 2, we get $b_t / b_s = 1.141$

Now, we have the values of all the parameters needed to use equation (1) which will yield the age structure of the female population at 2011. Table 1 gives the final age structure and the computations leading to it.

In the application of the analytical formula for the males, however, we had to make slight changes in the parameters mainly due to sex differentials in the expectation of life. Following are the parameter values for males corresponding to an unchanging(M)= 56.5 years (West Mode-males-level 16).

$\bar{a}_s$ = 34.45, $\bar{a}_s$ / T = 1.187

b_t / b_s = 1.132 , k= -0.018

$C_s(a)$ = Age structure of the stable reference population which relates,obviously, to mortality level 16 (males) of West Model Life Tables.

Table 2 gives the broad age group distribution of population of Bangladesh for 1991 and 2011. From table-2, the projected age distribution implies that in 2011, the proportion of males and females will be 7.02 percent and

Table1: Sex-wise age distribution of population of Bangladesh, 2011

	$e^{-\left(\frac{k}{2}\right)a+\left(\frac{k}{2T_0}\right)a^2}$	Stable age structure, C_s (a) (%)		Age structure (%), 2011 $C_t(a,t)=\frac{b_t}{b_s}*e^{-\left(\frac{k}{2}\right)a+\left(\frac{k}{2T_0}\right)a^2}*C_s(a)$	
Age group		Males	Females	Males	Females
0-1	1.0057	1.72	1.77	1.98	2.03
2-4	1.0755	7.04	7.13	8.58	8.75
5-9	1.0521	7.90	7.92	9.47	9.51
10-14	1.0645	7.81	7.80	9.43	9.49
15-19	1.0663	7.71	7.67	9.29	9.32
20-24	1.0466	7.57	7.49	8.97	8.95
25-29	1.0132	7.39	7.28	8.48	8.42
3034	0.9657	7.20	7.05	7.87	7.77
35-39	0.9063	6.98	6.80	7.16	7.03
40-44	0.8374	6.72	6.53	6.37	6.24
45-49	0.7619	6.40	6.23	5.52	5.42
50-54	0.6825	5.98	5.87	4.62	4.57
55-59	0.6021	5.44	5.41	3.71	3.72
60-64	0.5229	4.75	4.82	2.81	2.88
65-69	0.4472	3.89	4.06	1.97	2.07
70-74	0.3765	2.90	3.13	1.24	1.35
75-79	0.3122	1.85	2.05	0.65	0.75
80+	0.2289	1.31	1.58	0.34	0.41

Table 2: Broad Age Group Distribution of Population of Bangladesh, 1991 and 2011

	1991*		2011	
Age group	Males	Females	Males	Female
0-14	45.3	45.0	29.98	29.98
15-59	48.8	50.2	62.99	62.44
60+	5.9	4.8	7.02	7.46
Mean age	22.20	21.58	27.56	27.17
Median age	17.65	17.88	26.27	26.09

*Refer to Census Data

7.46 percent respectively. This means however, that there would be an increase of 18.98 percent in the proportion 60+ for males from 1991 to 2011. The corresponding change for females is more pronounced i.e. 55.4 percent. We observed that the major effect of a decline of fertility is in the young and middle age groups. The proportion under 15- the younger dependents are reduced considerably. The proportion of males below 15 is reduced from 445 percent in 1991 to 30 percent in 2011. Almost a similar reduction is found in the case of females below 15 too. These reductions, in turn, result in a swell in the economically active age group of 15-59. The proportion of males in that age group is increased from 49 percent in 1991 to 63 percent in 2011. For females, the corresponding increase is from 50 percent to 62 percent. Consequently, the old age dependency ratio is expected to increase from 10.81 percent in 1991 to 11.54 percent in 2011. The mean age of males increased from 22.20 years in 1991 to 27.56 years in 2011. As regards females, the increase is from 21.58 years to 27.17 years. Again the median age of males increased from 17.65 years in 1991 to 26.27 years in 2011. For females, corresponding increase is from 17.88 years to 26.09 years respectively. Although the proportional increase of aged is not very substantial, the absolute magnitude its implies is very large.

Aged population in the next decades will encounter different socio-economic circumstances and rapid technological change. Education is the best way to help develop themselves under the changing situation. As the number of aged people will increase dramatically in the future, support from family and government will be inadequate. They have to work in order to be more self-reliant and sustainable under the difficult circumstances of existing economic situation. Their education level will be higher than the aged at present so they have better chances and can develop skills more widely. Societal expectations about the aged need to be changed from negative to positive in order to have more opportunities for them to actively participate in economic and social activities at both family and community levels. Information on awareness and importance of aged population should be disseminated to the public through the mass media and other means.

Elderlies need care in all sorts of life for their remaining days of life. Such care in Bangladesh usually come from the family/household member, especially from spouses and children. This is possible only when elderlies live in joint family system. In this system, elderlies can also provide care to their three generation family member.

Thus proper planning could be made for the ever increasing number of old people. The presence of old people in a community need not be a burden but could be a boon as well. It gives us the opportunity to use the physically and mentally fit old people's wisdom and experience, it also makes demands on our resources. They can provided with status and facilities as a senior citizen of the elderly.

Furthermore, it is highly recommended that based upon comprehensive investigations and studies, a national programme should be formulated, as a part of the nation's long-term overall strategy for socio-economic development, to deal with population aging, especially productive aging in the coming decades.

Finally, there should be political commitment and legislation for the welfare of the elderlies. Political leaders, social workers and above all, government should think over the matter with due attention.

Nevertheless, it is observed that population policy formulation in Bangladesh cannot afford to neglect the implications of the expected increase in the aged persons in the coming years. While attention to reduce fertility must be given high priority for some more years to come, the growth of older population- an offshoot of fertility reduction itself should be viewed seriously, since it has far reaching implications in the development process.

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