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Determination of Total Fertility Rate of Bangladesh using Bongaarts Model

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Abstract

Estimation of the total fertility rate (TFR) of Bangladesh for the year 2011 is taken into account in the present study. Determination of total fertility rate is very important for an overpopulated developing country like Bangladesh, as it indicates the average number of children, a woman would bear over her lifetime. We have used Bongaarts model to determine TFR by estimating the four indices associated with this model. For Bangladesh, it has been observed that the marriage and lactational infecundability have the vital role to reduce fertility, which are about 52.9% and 43.5%, respectively, followed by contraception use (41.1%). It has also been noticed that the TFR of Bangladesh for 2011 is very closer to 2.1, which is the replacement level of fertility.

Keywords: Index of marriage; Index of postpartum infecundability; Index of contraception; Index of induced abortion; Total fecundity and TFR

Introduction

Bangladesh is one of the overpopulated countries in the world. It is a country of about 150 million people living within an area of 147,570 square kilometer, and on an average, 920 persons lived per square kilometer. Day by day, this population size is increasing. Such a huge number of people living in this country create a severe pressure on its agricultural lands, forests and other natural resources; as a result, the country is unable to provide the basic needs, such as food, shelter, education, treatment etc. to its entire people. For this reason, it is essential to control the population growth rate of this country and establish a policy that can help to utilize its existing population. In order to control the population size, it is essential to assess the number of people currently living in this country, as well as its population growth rate. The total fertility rate (TFR) is an indicator to indicate the future population size of a country. Fertility also has a big impact on the socio-economic condition of a country. Understanding the level, pattern and the nature of fertility, the decision makers can take appropriate steps to prepare a suitable policy for a country.

Since independence in 1971, the governments of the People Republic of Bangladesh have taken several steps to control its population size. Because of the integrated efforts that have been taken by the government, Non-Government Organization (NGOs) and the people of this country, the total fertility rate is decreasing from 6.3 in 1975 to up to date. But it is still above the replacement level. The declining fertility rate in the present time that occurred in Bangladesh has created much interest among researchers, policy makers and academicians, because such a dramatic change in fertility rate is unusual without a substantial improvement in the socio-economic status and other conditions which are normally essential for fertility decline [1].

The total fertility rate is related to many variables, which are termed as intermediate fertility variables, as introduced by Davis and Blake [2]. They proposed a set of 11 intermediate fertility variables through which and only through which, socio-economic and cultural conditions can affect the fertility. Using the collected information from 41 developed and developing countries, Bongaarts and Potter [3] observed that 96% of the variation in the total fertility rates could be explained by four proximate determinants, because of this result, it seemed reasonable to avoid those "redundant" intermediate variables from subsequent analysis. The suggested four proximate determinants can be measured by four indices and based on these indices, Bongaarts had developed a model to calculate TFR.

According to Bongaarts' estimation of the total fertility rate of Bangladesh in 1975 was 6.34. From the Center for Policy Dialogue (CPD) report, we may observe that the total fertility rate decreases from 6.34 in 1975 to 3.4 in 1993/94, and it remain almost unchanged at a level of 3.3, as indicated in BDHS 1996/97 and 1999/2000 results. After that the total fertility rate remains at the vicinity of 3 for several years [4].

Bangladesh is committed to fulfill the Millennium Development Goals (MDGs) by the year 2015 which was set up by UNDP, adopted in 2002. Most of the achievements of the goals depend on its population growth rate. It will be essential for Bangladesh to achieve the replacement level of fertility (2.1 children per women) to fulfill the Millennium Development Goals. In this work, we have determined the total fertility rate for the year 2011 to see how far we are to achieve the replacement level of fertility, and in case of demographic transition in which stage we are now belonging.

In this paper, we have determined the indices of the proximate determinants of fertility of the Bongaarts model for the year 2011 of Bangladesh and using these indices, we have determined the total fertility rate for 2011 of Bangladesh based on the Bongaarts' model.

For estimating different indices of Bongaarts model, we have noticed that some of the real information which is essential to deal with Bongaarts' model is not available in BDHS2011 data; in that case, we have used the previous information as proxy information for 2011. In the case of determining index of marriage, we did not get the exact data for the number of age specific woman; in that case, we have estimated this data indirectly.

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Methodology

In this study, secondary data from different sources are taken into account. Mainly, the Bangladesh Demographic and Health Survey (BDHS) 2011 data is used, which may be considered as a survey that represents whole Bangladesh [5]. The National Institute of Population Research and Training (NIPORT), along with the local administration of Bangladesh government have carried out this survey. The methodology, data collection techniques and management are explained in survey report (BDHS2011) [6]. This survey includes men and women of reproductive age from 17,141 Bangladeshi households that the interviewers covered. The survey collected information from 17,842 ever-married women of age 12-49 of these households.

The Bongaarts Fertility Model

The Bongaarts model [7], which integrates the indices of the four proximate determinants of fertility is as follows:

$FR=C_m \times C_c \times C_a \times C_i \times TF$

where C_m=index of proportion married.

C_c=index of contraception.

C_a=index of induced abortion.

C_i=index of postpartum infecudability.

TF=Total fecundity.

Estimation of index of marriage

The index of marriage measures the reduction in fertility that is caused by the marriage. According to Stover [8], this index is intended to represent the effect of periods during which a woman is not sexually active. Since data on sexually activity are scarce, this index is often approximated by the proportion of women 15-49 that are married. This index can be determined as follows:

$$C_m = \frac{\sum f(a)}{\sum \frac{f(a)}{m(a)}}$$

Where $m(a)$ equals the currently proportion married among females, by age, and $f(a)$ is a schedule of age specific fertility rates.

It takes the value 0 if nobody is married and the value 1, if all women are married during the entire reproductive period.

Estimation of index of contraception

The index of contraception is intended to describe the fertility-inhibiting effects of contraceptive use. The index of contraception was specified by Bongaarts as follows:

$C_c=1-1.08\times u\times e$

Where, u is contraceptive prevalence among married women and e is the average effectiveness of contraception and 1.08 is the adjustment factor, which is designed to remove the infecund women from the equation. If no contraception is practiced, C_c equals 1.0, and if all nonsterile women in their reproductive ages are protected by 100% effective contraception, then C_c equals zero.

Estimation of index of induced abortion

The index of induced abortion determines the inhibiting effects of induced abortion on fertility. This index can be estimated by using the following formula:

$$C_a = \frac{TFR}{TFR + A} = \frac{TFR}{TFR + b \times TA} = \frac{TFR}{TFR + 0.4(1+u) \times TA}$$

Where u=prevalence of contraceptive use and TA=total abortion rate.

It takes the value 1 in the absence of induced abortion and the value 0, when all the pregnancies are aborted. In this study, due to lack of data, we consider the value of this index to be 1.

Estimation of index of postpartum infecundability

The index of postpartum infecundability measures the inhibiting effects of postpartum amenorrhea and breastfeeding on fertility. It is the ratio of the birth intervals due to the absence of breastfeeding and the presence of the breastfeeding. In the absence of breastfeeding, the birth interval is on an average about 20 months, the sum of 1.5 months of postpartum infecundability due to the absence of breastfeeding, 7.5 months of waiting time to conception, 2 months due to spontaneous intrauterine mortality and 9 months for full term pregnancy. In the presence of breastfeeding, the average birth interval, approximately 18.5 months (7.5+2+9), plus average duration of postpartum infecundability. This index can be estimated as follows:

$$C_i = \frac{20}{18.5 + i}$$

Where i=the average duration of postpartum infecundability.

If the direct estimate of i is not possible, then according to Bongaarts, it can be estimated as follows:

$i=1.753 \exp(0.1396\,\beta - 0.00187\,\beta^2)$

Where β=average duration of breastfeeding.

Total fecundity (TF)

Total fecundity is defined as the total fertility rate in the absence of the fertility-inhibiting effects of the proximate determinants. The values of TF in most of the populations fall within the range of 13 to 17 births per women, with an average of about 15.3.

Results

The index of marriage

In order to estimate the index of proportion married C_m, we need to know the age-specific proportion of women currently married $m(a)$. To calculate $m(a)$, we have to know the age specific number of married women and the age specific number of women. But BDHS 2011 data do not provide us the age specific number of women. We had to estimate this data. We know that BDHS 2011 data contain total number of households which is equal to 17,141, and from Population and Housing Census 2011, we may get the average household size which is equal to 4.35. Multiplying these two, we may estimate the total number of people participated in the survey at BDHS 2011, which may be approximately equal to 74,563. From the Population and Housing Census 2011, we may get the male to female sex ratio in 2011 was 99.68, so from this, we may estimate the number of women who had participated in the BDHS 2011 survey, which was approximately 37341. The BDHS 2011 data contains the number of married women at the age of 15 to 49, which was 17,750. Therefore, the ratio of the number of women and the number of married women is 2.104. Now, multiplying this ratio with the age specific number of married women, we may estimate the age

specific number of women, which may be used to find the age specific proportion of married women (Table 1).

Using BDHS 2011 data, values of $f(a)$ and $m(a)$ are estimated, and is presented in the following Table 2.

And, therefore, $C_m = \frac{\sum f(a)}{\sum f(a)/m(a)} = \frac{2.32}{4.88} = 0.471$

This indicates that 47% women were married during their reproductive age in 2011 and the proportion of married had 52.9% impact on fertility reduction.

The index of contraception

Using the BDHS 2011 data for proportion of contraceptive use (u_m) and the effectiveness of these methods (e_m) (Table 3).

Therefore, u=contraceptive prevalence among married women $= \sum u_m = 0.407$,

And e=the average effectiveness of contraception $= \frac{1}{u}\sum u_m e_m = 0.936$.

Therefore, c_c=1−1.08×0.407×0.936=0.589.

This means that according to 2011 BDHS data among total women,

Age	No. of married women	No. of women	Proportion of married women m(a)
15-19	1970	4144	0.475386
20-24	3514	7392	0.475378
25-29	3394	7140	0.47535
30-34	2654	5583	0.475372
35-39	2246	4725	0.4753439
40-44	2152	4527	0.47537
45-49	1820	3829	0.4253199

Table 1: Age-specific proportion of married women.

Age group	*f*(*a*)	*m*(*a*)	*g*(*a*)=*f*(*a*)/*m*(*a*)
15-19	0.118	0.475386	0.248
20-24	0.153	0.475378	0.322
25-29	0.107	0.47535	0.225
30-34	0.056	0.475372	0.118
35-39	0.021	0.4753439	0.044
40-44	0.006	0.47537	0.013
45-49	0.003	0.4253199	0.006

Table 2: Age-specific fertility rate and proportion of women married.

Methods	Proportion use (*um*)	Use effectiveness (e_m)	$u_m \times e_m$
Pill	0.272	0.94	0.256
IUD	0.007	1.00	0.007
Implants	0.011	0.97	0.011
Condom	0.055	0.81	0.045
Sterilization	0.062	1.00	0.062

Table 3: Contraceptive use and its' use effectiveness.

Indices of proximate determinants of fertility	Estimated value	Impact on fertility reduction
Index of marriage (c_m)	0.480	52.0%
Index of contraception (c_c)	0.589	41.1%
Index of induced abortion (c_a)	1.000	00.0%
Index of postpartum infecudability (c_i)	0.565	43.5%

Table 4: Estimates of the proximate determinants from BDHS 2011.

about 58.9% were not using contraceptive methods. Hence, we may comment that in 2011, contraception use had 41.1% impact on fertility reduction.

The index of postpartum infecundability

In BDHS2011 data, information about the duration of breastfeeding is not available. So we use the data of BDHS2007 as a proxy. Using data of BDHS2007, we found that the mean duration of breastfeeding of Bangladesh is 23.83 months. So, the mean duration of postpartum infecundability is

i=1.753 exp (0.1396 β–0.00187 β^2)=1688

And, therefore, C= $\frac{20}{18.5+i} = \frac{20}{18.5+16.88} = 0.565$

It indicates that the lactational infecundability has 43.5% impact on fertility reduction (Table 4).

Putting the values of the above indices in the Bongaarts model, we get the TFR is equal to 2.39.

Again, if we take the value of c_a equal to 0.959 as a proxy value, we get TFR equals to 2.2998 that can be approximated as 2.3.

Discussion

Fertility has an important role on the change of socio-economic condition of a country. Understanding the level, pattern and nature of fertility, decision makers can make decision and formulate the future policy of a country. The total fertility rate measures the fertility of a country. Achieving the replacement level of fertility is very important for the socio-economic development of a country. In spite of having many socio-economic and political problems, and lack of health conditions and other factors that are essential for fertility decline, the fertility rate of Bangladesh is decreasing dramatically. This decline trend has created much interest among researchers, policy makers and academicians. In this paper, we have estimated the total fertility rate of Bangladesh for 2011 using Bongaarts model. We also have determined the contribution of proximate determinants, which has a vital role to achieve this fertility rate.

We have estimated the index of marriage, which measures the effect of marriage on the total fertility rate. To assess this index, we have faced some problem due to data regarding the age specific number of women that we could not extract from BDHS2011 data. So, we had to generate this data based on the number of household participated in the survey, average household size in 2011, sex ratio in 2011, the total number of ever married women and the age specific number of ever married women in 2011. The determination of this index reveals that the marriage has 52.9% impact on fertility reduction, which is the largest factor among the other proximate determinants of fertility.

We have estimated the index of contraception that reveals the impact of contraception use on fertility reduction for the year 2011. From our analysis, it could be observed that the contraceptive use has 41.1% impact on fertility reduction.

We have discussed about index of induced abortion. Sufficient information was not available to estimate this index for 2011. In 2007, Tanha Majhabeen estimated the value of this index to be 0.959. For 2011, we consider the value of this index to be 1 due to lack of information (which means that induced abortion has no influence in fertility reduction for 2011 in Bangladesh, which is not the reality). We have determined the total fertility rate based on both 0.959 and 1, as the value of induced abortion index.

We have estimated the postpartum infecundability index. As the data is not available to estimate this index for 2011, so we have used the data of 2007 as the proxy. Using bivariate analysis, first we have determined the mean duration of breastfeeding in 2007 which was 23.83 months, and based on this result, we have determined postpartum infecundability index.

We have determined the total fertility rate of Bangladesh for 2011 using the four proximate determinants of fertility of Bongaarts model. We have also presented the total fertility rate of Bangladesh for the previous years, and have mentioned the phase of transition in which Bangladesh is passing in 2011.

Finally, based on BDHS 2011 data and other relevant information that we have analyzed, may make the following recommendations:

i. Since the use of contraception plays an important role in fertility reduction; a huge campaigning on this issue could be made.

ii. Steps against child marriage should be taken into account strictly.

iii. Special programs should be taken to encourage parents in breastfeeding, especially in the urban areas.

iv. Couples should be encouraged for permanent birth control system after having their desired number of children, in order to avoid further pregnancy.

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