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Residual Technique to Estimate Births Averted due to Abortion in India

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ABSTRACT

Human fertility has a central importance in demographic analysis as the births are vital component of population growth. The study of fertility provides important information about women's reproductive behaviour and attitude. Factors which influence fertility are very crucial and provide the idea about the population change. Keeping in view, many studies have been carried out to study the factors which influence fertility. In this regards, Bongaarts (1978) have proposed a model considering four major factors such as marriage, contraception, induced abortion and lactational infecundabihty to explain overall variation in the total fertility. In the present study one more factor sterility is incorporated which plays an important role to explain total fertility. Estimation of induced abortions has its own complicacy. The major problem in estimation of abortion is the availabihty of reliable data for the developing country like India. Its study becomes even more complicated due to the variability of cultural and behavioral attitude of the females. Here a simple and modified model has been used to estimate the abortion index and which is further utilized to estimate the number of birth averted due to abortion for the different major states of India.

Key words: Fertility model, total marital fertility rate, abortion, birth averted, contraception, post partum amenorrhea, Bongaart's model

INTRODUCTION

Fertility is a very basic component of population growth. The worldwide rate of annual population growth has declined from just over 2% in the late 1960s to 1.5% during 1980-2001. It is projected to decrease to 1% during 2001-15. Though the world population increased from 2.5 billion people in 1950 to 6.3 billion in 2003 and is expected to rise to 7.1 billion by 2015 (UNICEF, 2003; World Bank, 2003).

Fertility levels and trends vary greatly between regions due to change in socio-cultural, biological, behavioral and other characteristics. Fertihty rates are lowest in low and middle income countries in East Asia and the Pacific, at 2.1 children per woman. Countries in Central Asia, Latin America and the Caribbean also have relatively low total fertility rates, at 2.5 and 2.6 children per woman, respectively. The Middle East and North Africa and South Asia have average total fertility rates of 3.4 and 3.3 children in 2001, respectively. Fertility rates are highest in Sub-Saharan Africa, at 5.2 children per woman (World Bank, 2003). Fertility rates in developing countries have

declined rapidly in the past 50 years, from more than 6.0 children per woman in the 1950s to about 2.8 children per woman today. Fertility rates remain high, however, in the 49 least developed countries, which had an average total fertility rate of 5.46 children per woman during 1995-2000 (UNICEF, 2003). In Indian context, current total fertility rate of 2.7 (NFHS-III 2005-06) is down slightly from 2.9 children per woman (NFHS-II 1998-99), but is still well above the replacement level of just over two children per woman. In urban areas, the TFR has reached replacement levels (2.1), but in rural areas it is still 3.0 children per women.

The fertility has declined continuously over time in India but still there in some societies the TFR is still high. This dramatic change in fertility has occurred without a substantial improvement in socio-economic status, health conditions and other factors thought to be needed to bring about a fertility decline. Some demographer has pointed out the reasons and gave evidence that this decline in the fertility level was achieved mainly because of a successful family planning programme held in the country (Cleland *et al*., 1994). Population development programmes have, no doubt, contributed to the fertility decline. India is a big country several biological, behavioral and cultural factors are also involved for declining fertility over time.

For knowing the factor influencing fertility, Davis and Blake (1956) suggested the factors affecting fertility can be classified into three groups: (1) Intercourse variables, (2) Conception variables and (3) Gestation variables. They identified the mechanism through which socio-economic and cultural and human behavior interact with the biological factors. However, the framework does not provide a mechanism for a quantitative analysis and the availability of data and obtaining the exact information for the variables in this framework is too difficult. Thus, a further study has been made by Bongaarts (1978), termed these factors the proximate determinants of fertility, since they directly affects the fertility; all other social, economic and environmental factors affect fertility through these variables. On the basis of the data of 41 developed and developing countries, Bongaarts and Potter (1983) further obtained that 96% of the variation in the TFR of these populations was explained by the four principal proximate determinants of fertility: Namely, marriage, contraception, induced abortion and postpartum infecundability. The framework of Bongaarts is more widely applied in fertility studies due to its flexibility for assessing quantitatively the effect of the proximate determinants.

Abortion has been influenced by many socio cultural factors and the reason for induced abortion is differs with respect to region in India. Induced abortion for northern Indian women is probably more often viewed as one of many forms of birth control, whereas, induced abortion for southern Indian women is probably more often viewed as a resolution of contraceptive failure (Bose and Trent, 2006). Fertihty rates are lower in the southern part of India in comparison to the northern part (Dreze and Murthi, 2001; Malhotra *et al*., 1995). Also the contraceptive practice is lower in the north than in the south. High desire of male child, a sex selective induced abortion are also believed to be partly responsible for a rising child sex ratio in India (Agrawal, 2004; Arnold *et al*., 2002; Bose, 2001; Gupta and Bhat, 1997; Nanda, 2006; Sen, 2003; Sudha and Rajan, 1999; Unisa *et al*., 2003, 2007; Visaria and Visaria, 1995).

For estimation point of view, some indirect techniques have been used in the absence of direct information about induced abortion. Some authors have used regression analysis and the basis of the regression approach is the observed extremely strong association between contraceptive prevalence rates and the number of lifetime induced abortions per woman (Marston and Cleland, 2003; Westoff, 2005). Assumption based on ratio of abortion to live birth has also been utilized for

estimation of abortion (Shah, 1966, Chhabra and Nuna, 1995). Some demographers utilized the socio, demographic characteristics associated with induced abortion to estimate number of induced abortion using regression technique.

Due to unavailability of reliable data on induced abortion, residual method technique has been applied to estimate induced abortion. Johnston and Hill (1996) has used Bongaarts proximate determinants model to estimate induced abortion rate. This model is based on the defined fact that socio-economic factors affect fertility through a set of intermediate variables starting from exposure to intercourse up to a pregnancy ending in a live birth as defined by Davis and Blake (1956) and Kanitkar and Radkar (2000). Females who are sterile also play an important role in fertility changes because it reduces the reproductive span. Thus, in the present study, a modified Bongaart method incorporating the sterility factor and with the help of residual method, number of birth averted due to induced abortion has been estimated.

MATERIALS AND METHODS

The main problem of this type of analysis is to get a reliable data for large country like India. Several family planning programs was implemented to control the population growth. To know the further changes in the family planning program according to the changes in the growth, many surveys have been conducted. After 1990s, Ministry of Health and Family Welfare, Government of India, implemented National Family Health Surveys (NFHS) to monitor and evaluate the success of its family planning and reproductive and child health programmes at both national and state level. The First NFHS (NFHS-I) was conducted in 1992-93. The survey collected information on population, health and nutrition, with an emphasis on women and young children. The Second NFHS (NFHS-II) was conducted in 1998-99 in all 26 states of India with added features. The most recent third NFHS (NFHS-III) was carried out in 2005-2006. Thus, the data has been taken from NFHS-III and according to the need of the study the current and reliable information at the state level has been extracted from this data.

For estimating the index of lactational infecundability, the mean duration of Post-partum Amenorrhoea (PPA) has been calculated from last closed birth interval to avoid recall lapse and censoring. Thus, for the information of lactational infecundability only those females have been considered who has given at least two births before the reference date of the survey.

Model for estimating TFR: In the Bongaarts model, the TFR is expressed as the product of four principal proximate determinants of fertility: namely, marriage, contraception, induced abortion and postpartum infecundabihty and their indices measuring their fertility-inhibiting effect and the total fecundity rate (TF). The total fecundity rate is the average number of live births expected among women who during their entire reproductive period remain married, do not use any contraception, do not have any induced abortion and do not breastfeed their children. In such a hypothetical situation the value of TF is found to vary between 13 and 17, but Bongaarts has suggested the mean value of 15.2 births while testing the model. According to the model:

$$TFR = C(m) * C(c) * C(a) * C(i) * TF$$

where, TFR is the total fertility rate, C(m) is the index of proportion of women married, C(c) is the index of contraception, C(a) is the index of induced abortion, C(i) is the index of postpartum infecundability and TF is the total fecundity rate.

In Bongaart Model only four factors are considered as the factor affecting fertility and TFR has been estimated with the help of these four indices. In the proposed model the proportion of female who are not able to give birth i.e. who are sterility has not been incorporated. The proportion of sterile females is also an important factor affecting fertility. Thus, the proportion of females who are sterile 'sterility index' has been incorporated in this model. According to above the modified model is as follows:

$$TFR = C(m) * C(c) * C(a) * C(i) * TF$$

where, C(s) is the index of sterility.

Estimation procedure of indexing parameters

Index of marriage: The index of marriage C(m) is estimated from the information on Total Fertility Rates (TFR) and Total Marital Fertility Rates (TMFR) as reported by the NFHS. The index of marriage is estimated as TFR/TMFR.

Index of contraception: The index of contraception C(c) is estimated from the information on method-specific contraceptive prevalence rates and use effectiveness of various methods. These data are converted into an equation: C(c) = 1 -1.08 u*e, where u is the contraceptive prevalence and e is the average effectiveness. The value of e is a weighted average, with method-specific prevalence rates as weights.

Index of postpartum infecundability: The index of postpartum infecundability, C(i) is derived from the estimates of mean duration of postpartum amenorrhoea (PPA) for the second last birth and by using a relationship:

$$C(i) = 20/(18.5+i)$$

Index of induced abortion: The index of abortion C(a) is estimated from the reported lifetime experience of induced abortions. This has been estimated in this study using the simple procedure explained further.

Index of sterility: The index of sterility has been estimated utilizing the information on proportion of females having no births in last five years and never using any type of contraceptives. This proportion is considered as s and index can be estimated using the relationship:

$$C(s) = 1-s$$

Estimation of index of induced abortion: In a hypothetical situation the value of TF is found to vary between 13 and 17, but Bongaart's has suggested the mean value of 15.2 births while testing the model. The modified model which is described above is:

$$TFR = C(m) * C(c) * C(a) * C(i) * C(s) * TF$$

The females consider in this study are currently married females. Thus, the value of index of marriage takes value 1 and the above model can be written as:

$$TMFR = C(c) * C(a) * C(i) * C(i) * C(s) * TF$$

The index of contraception C(c), index of postpartum infecundability C(i) and index of sterility has been estimated with the help of above mentioned estimation procedure.

Now the value of C(c), C(i), C(s) and TF is known and with this known quantities C(a) can be estimated very easily with the equation:

$$C(a) = \frac{TMFR}{C(c)*C(i)*C(s)*TF}$$

Estimation of No. of induced abortion: In the model of TMFR shown above:

$$TMFR = C(c) * C(a) * C(i) * C(s) * TF$$

Here, taking the value of C(a) = 1. This provides the total marital fertility if there is no abortion takes place. Thus this model reduced to:

$$TMFR\,|_{C(a)=1} = C(c) * C(i) * C(s) * TF$$

The difference between these two TMFRs gives the average numbers of births reduced to a female in her whole reproductive span if the female assuming current fertility scenario due to abortion. So this value gets multiplied with the exposed number of females to estimate the number of births averted due to abortion only:

$$\text{Birth averted} = (TMFR\,|_{C(a)=1} - TMFR) * \text{Exposed females}$$

RESULTS AND DISCUSSION

Before estimating the values of each of the proximate determinants of fertility for all the major states of India, the available information on the level and the observed interstate variations in the use of contraception, PPA and sterility which affect marital fertility has to be examined.

Table 1 shows the mean duration PPA period, current contraceptive use with weight taking as effectiveness, proportion of sterile female and total marital fertility rate for major states of India. The states Chhattisgarh, Bihar, Orissa and Jharkhand are showing high mean duration of PPA. Low mean PPA duration has been observed by the states Haryana, Punjab and Delhi. India shows the average PPA duration as 6.7 months.

The column of effective current contraceptive use has been calculated by taking effectiveness of contraceptives as a weight in proportion of different type of contraceptives use. The effectiveness of female sterilization has 99.5%, male sterilization has 99.85%, pills has 92%, IUD has 99.2%, Injectables has 99.8%, condom has 82%, other modern method has 80%, rhythms method has 75%, withdrawal method has 73% and folk method has 75% effectiveness of particular contraception ("Comparison of Birth Control Method", Wikipedia, www.wikipedia.org). The states West Bengal, Kerala and Himachal Pradesh show use of high effective contraception method. Low effectiveness of the contraception has been used by the states Bihar, Jharkhand, Uttar Pradesh and Rajasthan. These states show the use of effective contraceptive less than 50% which is less than all India estimates of effective current contraceptive as 56.3.

The sterility variation of different major states of India has been measured by proportion of married females having no births in last five years and never using any type of contraceptives in

Table 1: Variability of mean postpartum amenorrhea, effective current contraceptive use, proportion of sterility and total marital fertility rates for different major states of India

States	MPPA	CCU(u)	Sterility	TMFR
Karnataka	7.62	63.6	17.6	3.05
Chhattisgarh	12.14	53.2	18.1	3.54
Maharashtra	6.74	66.9	10.2	3.18
Gujarat	6.73	66.6	11.2	3.32
Himachal Pradesh	4.91	72.6	11.8	2.92
Madhya Pradesh	7.79	55.9	14.9	3.85
Jammu and Kashmir	6.33	52.6	20.1	4.14
Uttaranchal	6.31	59.3	15.3	3.62
Andhra Pradesh	5.85	67.6	17.5	2.42
West Bengal	6.67	71.2	7.6	2.97
Tamil Nadu	5.41	61.4	19.3	2.97
Kerala	4.75	68.6	12.6	2.84
Bihar	9.55	34.1	20.9	4.56
Uttar Pradesh	6.91	43.6	16.7	4.69
Orissa	8.28	50.7	21.3	3.38
Jharkhand	9.63	35.7	23.2	3.98
Haryana	3.60	63.4	12.4	3.42
Rajasthan	6.58	47.2	20.5	3.80
Delhi	3.54	66.9	10.4	3.40
Punjab	4.05	63.3	17.4	2.92
India	6.70	56.3	16.1	3.57

this period as well as prior to this period. This proportion of sterility is highest for Jharkhand. From the Table 1, it has been clearly seen that the states having high sterility are Jharkhand, Bihar, Orissa and Rajasthan (more than 20%) and lower sterility by the states Delhi, West Bengal, Maharashtra and Gujarat. If we consider India as a whole 16.1% females are observed to be sterile.

The total marital fertility rate is highest for state Uttar Pradesh followed by Bihar. The states Jharkhand, Madhya Pradesh and Jammu Kashmir also show high marital fertility rates. A lowest fertility rate has been shown by state Andhra Pradesh. India shows the total marital fertility rate 3.57.

Table 2 contain the index of postpartum infecundability, total fertility, total natural fertility, total marital fertility, index of contraception, index of sterility, estimated value of index of induced abortion and total marital fertility rate in the absence of induced abortion. The index of postpartum infecundabihty, contraception and sterility has been obtained with the help of estimation procedure of indexing parameters and the estimated value of induced abortion index has been calculated with estimation of index of induced abortion as discussed in methodology section.

The states Haryana and Delhi show high and Chhattisgarh shows low index of postpartum infecundability. TF is the total fertihty taken here as 15.2 suggested by Bongaart in his model. TN is the total natural fertility, which is a total fertility of the females when PPA is absent. Again high TN has been observed by the state Haryana and Delhi with more than 13. India has TN 12.06 and lowest TN has been observed by the state Chhattisgarh. Highest effectiveness of contraceptive index has been shown by state Himachal Pradesh followed by Andhra Pradesh. India has 0.43 index of contraception. Sterility index is lowest for Jharkhand and West Bengal shows highest. Uttar Pradesh sterility index is quite close to sterility index of India with index of sterility 0.83. index of induced abortion has been estimated for major states of India. From the Table 2, it

Table 2: Estimation of abortion index for different major states of India

States	C(i)	TF	TN	TMFR	C(c)	C(s)	Estimated Ca
Karnataka	0.7657	15.2	11.6386	3.05	0.32322	0.824	0.9839
Chhattisgarh	0.6527	15.2	9.9217	3.54	0.44587	0.819	0.9771
Maharashtra	0.7924	15.2	12.0444	3.18	0.30096	0.898	0.9769
Gujarat	0.7927	15.2	12.0491	3.32	0.32588	0.888	0.9522
Himachal Pradesh	0.8543	15.2	12.9859	2.92	0.26793	0.882	0.9515
Madhya Pradesh	0.7607	15.2	11.5633	3.85	0.41729	0.851	0.9376
Jammu and Kashmir	0.8055	15.2	12.2433	4.14	0.47645	0.799	0.8883
Uttaranchal	0.8061	15.2	12.2531	3.62	0.40645	0.847	0.8582
Andhra Pradesh	0.8214	15.2	12.4846	2.42	0.27493	0.825	0.8546
West Bengal	0.7946	15.2	12.0779	2.97	0.31167	0.924	0.8539
Tamil Nadu	0.8365	15.2	12.7143	2.97	0.34778	0.807	0.8323
Kerala	0.8602	15.2	13.0753	2.84	0.30323	0.874	0.8196
India	0.7937	15.2	12.0635	3.57	0.43042	0.839	0.8195
Bihar	0.7130	15.2	10.8378	4.56	0.65331	0.791	0.8142
Uttar Pradesh	0.7871	15.2	11.9638	4.69	0.58665	0.833	0.8022
Orissa	0.7468	15.2	11.3518	3.38	0.48227	0.787	0.7845
Jharkhand	0.7110	15.2	10.8070	3.98	0.61655	0.768	0.7778
Haryana	0.9050	15.2	13.7557	3.42	0.36671	0.876	0.774
Rajasthan	0.7974	15.2	12.1212	3.80	0.50985	0.795	0.7734
Delhi	0.9074	15.2	13.7931	3.40	0.35614	0.896	0.7725
Punjab	0.8869	15.2	13.4812	2.92	0.34033	0.826	0.7705

is clearly observed that Delhi, Punjab, Rajasthan and Haryana show lower index of induced abortion. This means that these states have high induced abortion rate. The state Bihar and Uttar Pradesh also been considered in the group of low index of induced abortion in comparison to India. The state Karnataka and Chhattisgarh have higher index of induced abortion. It shows that lowest induced abortion takes place in these states.

Table 3 provides the information of number of births averted due to induced abortion in different major states of India. This Table 3 contains TMFR, TMFR in absence of induced abortion, exposed females taken into for the study and birth averted. Bihar and Uttar Pradesh show this TMFR more than 5 and lowest TMFR in the absence of induced abortion has been observed by state Andhra Pradesh. TMFR in the absence of induced abortion for India is observed as 4.36. The difference between these two TMFR shows that on an average number of births averted due to induced abortion to a female in her whole reproductive span. The exposed females column shows the numbers of females who have been considered in this study. In the terms of number, highest births have been averted in state Uttar Pradesh and lowest in Karnataka. Proportion wise high births have been aborted in Punjab, Haryana, Delhi and Rajasthan and low births have been aborted in state Karnataka and Chhattisgarh.

Figure 1 shows the estimated value of index of induced abortion. This provides the information about the number of induced abortion takes place. The states showing higher number of induced abortion has low index of induced abortion and for the states having lower number of induced abortion show high index of induced abortion. There are 8 states which show higher induced abortions than India as a whole i.e. having lower index of induced abortion in comparison to India.

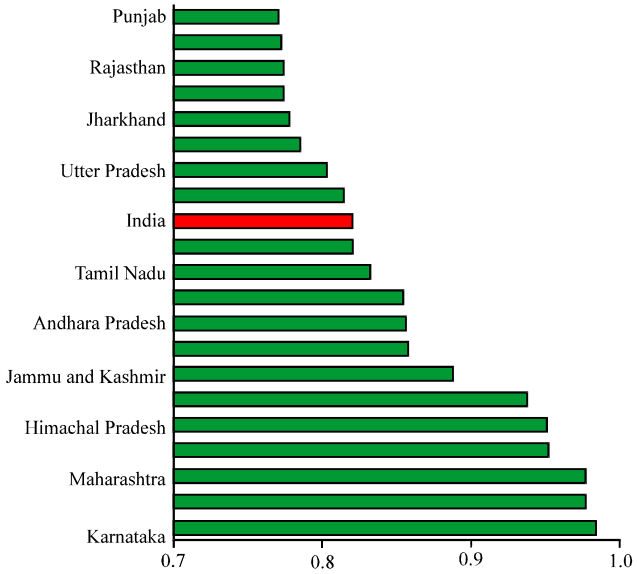

Fig. 1: Estimated Ca for different states of India

Table 3: Estimation of birth averted due to induced abortion for different major states of India

States	TMFR	TMFR (Ca = 1)	Exposed females	Births averted
Karnataka	3.05	3.0998	4354	217
Chhattisgarh	3.54	3.6231	2723	226
Maharashtra	3.18	3.2551	6329	475
Gujarat	3.32	3.4868	2829	472
Himachal Pradesh	2.92	3.0687	2255	335
Madhya Pradesh	3.85	4.1063	4923	1262
Jammu and Kashmir	4.14	4.6608	2044	1064
Uttaranchal	3.62	4.2183	2074	1241
Andhra Pradesh	2.42	2.8317	5153	2122
West Bengal	2.97	3.4782	4973	2527
Tamil Nadu	2.97	3.5684	4183	2503
Kerala	2.84	3.4653	2617	1636
Bihar	4.56	5.6006	2992	3114
Uttar Pradesh	4.69	5.8465	8973	10377
Orissa	3.38	4.3085	3260	3027
Jharkhand	3.98	5.1172	2295	2610
Haryana	3.42	4.4188	2134	2131
Rajasthan	3.80	4.9131	3044	3388
Delhi	3.40	4.4014	2352	2355
Punjab	2.92	3.7898	2634	2291
India	3.57	4.3564	87925	69141

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