

Recent trends in Total Fertility among different Religious groups of North East India based on Children Ever Born adjusted by Brass P/F ratio using data from Census 2011

Ksh. Anand Singh

Abstract

Estimates of population fertility characteristics are of critical importance for understanding short-term shifts in population age structure and related growth dynamics. As such, ethnic specific information on fertility among other demographic variables such as age, sex is often useful for planning purposes. In India, census or survey reports do not provide ethnic level estimates of fertility within the states. Using census 2011 data on fertility, this paper presents ethnic specific estimates of fertility in the eight North-East states identified by their religious background. The current age specific fertility rates are adjusted using the Brass P/F ratio method based on total children ever born. Total fertility rates, crude birth rates and general fertility rates are obtained from the adjusted rates for all ethnic groups identified by their religion. The adjusted rates shows underestimation of birth rates derived from current rates in all age groups. Results of TFR among ethnic groups consistently show that Muslim women tend to have higher fertility rates as compared to other religious groups. These results are in consistency as reported in NFHS-3.

Introduction

Estimates of population fertility characteristics are of critical importance for understanding short-term shifts in population age structure and related growth dynamics (Caswell H., 2001; Preston S, et al., 2003). While most demographers attempted to estimate fertility for the whole population and subpopulations defined by geographical areas, it is also vital to make attempts to estimate fertility for different groups of the population characterised by qualitative variables such as an ethnic group. Literally, an ethnic group is a social group that shared a common and distinctive culture, religion, language or the like. In every census or survey a question is generally asked to the respondent to report his or her ethnicity. In India, unlike the European countries where ethnicity mainly refers to racial background (such as the white and the black) or the country of origin, religion and language are important variables that can inform the ethnicity of the members of the group.

Ethnic specific demographic information such as age and sex etc. are often useful planning purposes, (Haskey 2002; Simpson 2002a). For example, knowledge of ethnic group size by age and locality can help in estimating demand for particular goods and services such as language support, design of housing and food choices. If we can estimate recent trends and project future population for ethnic groups, the debate about diversity and immigration level can be better informed.

Fertility Variations by Religious Groups

Evidence has emerged that cross sectionally or in completed family size fertility rates vary between ethnic groups. In India, the National Family Health Surveys (NFHS-1, 1992-93; NFHS-2, 1998-99; NFHS-3, 2005-06) reported variations in Total fertility Rate (TFR) between different religious communities. As such Muslim women tend to have higher birth rates as compared to any other religious groups (NFHS-3, 2005). Boyle (2003) has shown that the geography of fertility also matters in estimating ethnic specific fertility. Since the distribution of ethnic groups within and between the states differ, we expect to find the variations in ethnic groups spatially among the states.

Objectives

In this paper we attempted to estimate the fertility levels of different ethnic groups based on their religious background within and between the eight states of North East India, viz Manipur, Assam, Meghalaya, Mizoram, Nagaland, Arunachal, Tripura and Sikkim. We expect that these estimates can be used in sub national population projections and for programme planning specific to the area. Fertility indices like the ASFR, TFR, CBR, GFR are estimated using information on children ever born (CEB) using the census 2011 data. The Brass P/F ratio method based on total children for the adjustment of ASFR's is employed and finally a comparison is made.

Methods and Materials

Age specific fertility rates (ASFR) obtained by dividing the number of births by the number of women at different age groups are referred to as current rates as they are based on the births born in the year preceding a census or survey. If we obtain average number of children as the ratio of the children ever born to the number of women in different age groups, they are called retrospective rates as they are based on the past birth experience of women. Retrospective rates are often subject to adjustments which arise due to errors of omission of children and misclassification of age groups. For example, women tend to omit their children who reside to other households and those who died with the result that the omissions tend to increase with older age of mother. Other causes of error are inclusion of still births and when parity of a sizable proportion of women are not recorded.

The current rates and the retrospective rates can provide a powerful consistency check, in which the current fertility are cumulated and compared with the average parity. This comparison of lifetime fertility with current fertility can also provide a method of adjustment for cases where the data are distorted by typical errors discussed above. The method proposed by Brass (1964) which provides an adjustment for the lifetime fertility by using logical relationship between the current rates and retrospective rates is used to give adjusted estimates of fertility.

The method used in this paper requires data on

1. Children ever born classified by five years age group of women in different religious groups
2. Births born in the year preceding the census classified by age of women for different religious groups
3. Number of women classified by five year age group for different religious groups.

Census 2011 (Census data, Ministry of Home Affairs) provides data required for the present analysis. We consider data for the eight North-east states and estimates are obtained separately for different states and different religious groups within each state. Table 1 and 2 shows a typical data set for CEB obtained from census 2011 data of Manipur. The number of births born to women in different age groups in the year preceding the census can also be obtained.

Table 1: Data on Total CEB (All Religion, Manipur)

Present Age	Total Women	Total Ever Married Women	Total Children Ever Born		
			Total	M	F
1	2	3	12	13	14
All	14,17,208	6,87,039	19,10,929	9,96,974	9,13,955
Ages					
Less than 15	4,17,616	3,200	1,588	835	753
15-19	1,42,513	14,666	7,606	4,006	3,600
20-24	1,42,195	55,076	51,398	26,925	24,473
25-29	1,37,589	88,096	1,37,590	71,038	66,552
30-34	1,11,276	89,116	1,96,039	1,00,463	95,576
35-39	1,00,434	89,275	2,42,643	1,24,509	1,18,134
40-44	84,933	78,913	2,47,737	1,27,687	1,20,050
45-49	73,113	69,659	2,41,636	1,25,641	1,15,995

Table 2: Data on Total CEB (Hindu Religion, Manipur)

Religion	Present Age	Total Women	Total Ever Married Women	Total Children Ever Born		
				Total	M	F
Hindu	All Ages	5,85,656	3,15,249	8,17,278	4,23,461	3,93,817
Hindu	Less than 15	1,57,672	1,212	619	338	281
Hindu	15-19	49,253	5,950	2,972	1,545	1,427
Hindu	20-24	53,907	23,278	19,620	10,233	9,387
Hindu	25-29	57,803	38,836	52,604	26,999	25,605
Hindu	30-34	49,285	40,722	76,687	38,832	37,855
Hindu	35-39	45,473	40,826	94,306	47,722	46,584
Hindu	40-44	37,711	35,003	93,826	47,723	46,103
Hindu	45-49	32,264	30,624	92,387	47,557	44,830

Equations and Results

Age specific fertility rates (ASFR): These are the current rates obtained as

$$\text{ASFR (x)} = \frac{\text{No. of births born in the last year}}{\text{No. of women aged (x,x+5)}}, \quad x = 15, 20, 25, 30, 35, 40, 45.$$

P/F Ratio Method of Brass Based on Total Children

The essence of the P/F ratio method of Brass for estimating fertility is to adjust the age pattern of fertility calculated from recent births (e.g. Last year births) by the level of fertility implied by the average parity of women in the age groups 20-24, 25-29 and perhaps 30-34. The basis is that the current fertility rates which are assumed to present the true age pattern of fertility to agree with the level of fertility indicated by the average parities of women in the age groups lower than 30 or 35 which are assumed to be accurate. The method assumes that fertility has remained constant during the past years and these assumptions are validated by the NFHS reports for the eight North East states. (Table 3).

Table3: TFR North East States (NFHS-1 to 3)

States	Assam	Manipur	Nagaland	Mizoram	Meghalaya	Arunachal	Tripura	Sikkim
NFHS 1	3.5	2.8	3.2	2.3	3.7	4.2	2.7	2.7
NFHS 2	2.3	3.0	3.8	2.9	4.6	2.5	1.9	2.7
NFHS 3	2.4	2.8	3.7	2.8	3.8	3.0	2.2	2.0

Measures of average parity equivalents say F comparable to reported average parities say P are obtained from period fertility rates by cumulation and interpolation. Ratios P/F are calculated for each age group and an average of the ratios for younger women is used as an adjustment factor.

Equations

- The reported average parity of women in the age group i ($i=1,2,\dots,7$) for age groups 15-19, 20-24, ..., 45-49) denoted by $P(i)$ is obtained as

$$P(i) = \frac{\text{Total CEB}}{\text{Total women}} \quad \text{in the age group } i. \quad (i)$$
- The current age specific fertility rates (ASFR) based on the births born in the preceding year of census denoted by $f(i)$ are obtained as

$$f(i) = \frac{\text{No. of Births last year}}{\text{No. of Women}} \text{ in the age group } i. \quad (\text{ii})$$

3. The cumulated fertility schedule upto age group i denoted by $\Phi(i)$ is obtained as

$$\Phi(i) = 5 \sum_{j=1}^i f(j) \quad (\text{iii})$$

4. The average parity equivalents $F(i)$ are estimated by interpolation using current fertility in (ii) and cumulated fertility in (iii). $F(i)$ is obtained as

$$F(i) = \Phi(i-1) + af(i) + bf(i+1), \quad i=1,2, \dots, 6 \quad (\text{iv})$$

Where a and b are constants.

$$\text{And } F(7) = \Phi(6) + a^*f(6) + b^*f(7) \quad (\text{v})$$

Where a^* and b^* are constants.

A more accurate estimation of $F(i)$ based on equation (iv) is

$$F(i) = \Phi(i-1) + a(i)f(i) + b(i)f(i+1) + c(i)\Phi(7), \quad i=1,2, \dots, 7 \quad (\text{vi})$$

in which the constants $a(i)$, $b(i)$ and $c(i)$ are allowed to vary with f .

These constants were estimated by using least square regression to fit equation (vi) to a large number of fertility cases using the Coale-Trussel (1974) model. An additional constant term $c(i)\Phi(7)$ is introduced in equation (vi). This term is effectively an estimated coefficient $c(i)$ weighted by the observed TFR $\Phi(7)$. The constants a , b and c are extensively tabulated by Brass(1964).

The next step is the calculation of fertility schedule for conventional five-year age groups. When ASFR have been calculated from births born in the 12 months period classified by age of mothers at the end of the period, they are specific for unusual age groups shifted by six months. This is the case when we consider births born in the year preceding the census year and ages of women are classified according to the census year. A fertility schedule for conventional five year age groups denoted by $f^+(i)$ can be estimated by weighting the rates referring to the unusual age groups obtained in equation (ii) (i.e. $f(i)$) according to equations (vii) and (viii).

$$f^+(i) = (1-w(i-1))f(i) + w(i)f(i+1) \quad i = 1,2, \dots, 6 \quad (\text{vii})$$

The weighting factor $w(i)$ are calculated as

$$w(i) = x(i) + y(i) f(i)/\phi(7) + z(i)f(i+1)/\phi(7) \quad (\text{viii})$$

Where the values of $x(i)$, $y(i)$ and $z(i)$ were obtained by fitting equation (viii) by least square regression to the same model cases used above in deriving the coefficients a , b and c . No weighting factor is needed for $i = 7$, as childbearing is assumed to cease after age 50; and $f^+(7)$ is therefore taken to be $(1-w(6))f(7)$.

$$f^+(7) = (1-w(6))f(7) \quad (\text{ix})$$

Next we compute the ratios $P(i)/F(i)$. Ideally, these ratios should be fairly similar for all age groups although if older women tend to omit the children ever born to them these ratios tend to decrease with age of women. However, a recent decline in fertility tends to produce a sequence of these ratios that increase with age.

An adjustment factor k is reasonably chosen from the column of the P/F ratios. If the population is experiencing a fertility decline affecting mainly in the older ages the values $P(2)/F(2)$ or $P(3)/F(3)$ can be used as k . If the two are not very similar we can use a weighted average of the two, the weights being the proportion of the number of women in the corresponding ages as weights. Once k is chosen we obtain the adjusted ASFR $f^*(i)$ as

$$f^*(i) = k * f^+(i) \quad (\text{x})$$

Finally, the TFR is obtained as the sum total of all $f^*(i)$ multiplied by the length of the age interval i.e. Thus,

$$\text{TFR} = 5x \sum f^*(i) \quad (\text{xi})$$

Table 4: Adjusted ASFR (All Religion, Manipur)

Age	P(i)	B(i)	f(i)	$\Phi(i)$	F(i)	f+(i)	P/F	f*(i)
15-19	0.05337	1,851	0.01298	0.06750	0.02680	0.01655	1.99126	0.02338
20-24	0.36146	9,909	0.06968	0.41593	0.25353	0.07540	1.42569	0.10649
25-29	1.00000	13,753	0.09995	0.91571	0.71476	0.10057	1.39907	0.14204
30-34	1.76173	9,676	0.08695	1.35049	1.19063	0.08391	1.47966	0.11852
35-39	2.41594	5,313	0.05290	1.61499	1.51786	0.05023	1.59167	0.07095
40-44	2.91685	2,210	0.02602	1.74509	1.65751	0.02297	1.75977	0.03244
45-49	3.30496	1,703	0.02329	1.86156	1.83430	0.02473	1.80175	0.03493

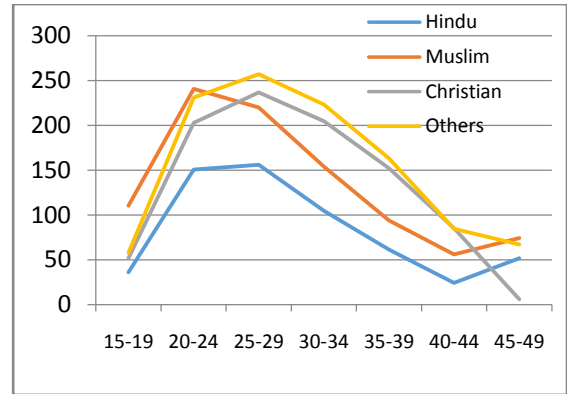
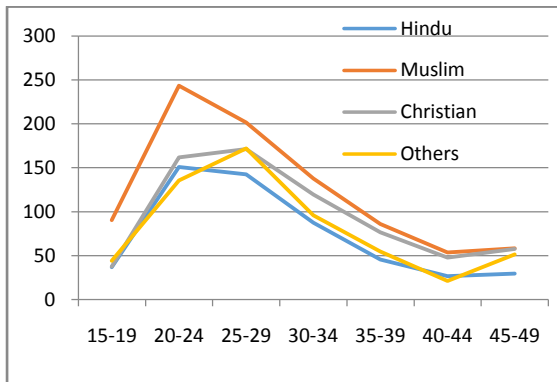
Results and Discussion

Following the computational steps discussed above we have arrived at the adjusted ASFRs for all the eight states of North East India. Table 3 shows adjusted ASFR for Manipur(all religious groups combined). Similar steps are followed to compute ASFRs for four major religious groups within each state viz. Hindu, Muslim, Christian and Buddhist/Others. Table 4 shows the adjusted ASFRs for the four religious groups in Manipur along with the TFRs at the bottom of the table. The group “others” refers to those religions or local beliefs which are widely uncommon or not recognised as the main religious group. However, this category constitutes a significant proportion of individuals in many states of India. In the eight North–East states, some religions do not have adequate number of women to compute a reliable fertility rate e.g. in Manipur the number of Sikhs, Buddhists and Jains are too few (<100) to calculate ASFR reliably. However, a sufficiently large number of women reported their religion as a local faith which is categorised as “others”. However, in Sikkim and Arunachal the number of women Buddhists are large enough to calculate the rates. Thus we have excluded those religious groups which have a small number of women from the present study. Tables for adjusted ASFR for the other states are not shown, instead we show the ASFR curves.

Table 5: Adjusted ASFR(per 1000) and TFR, Religious Groups, Manipur

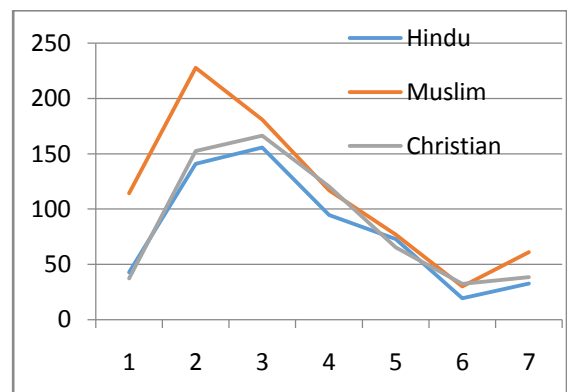
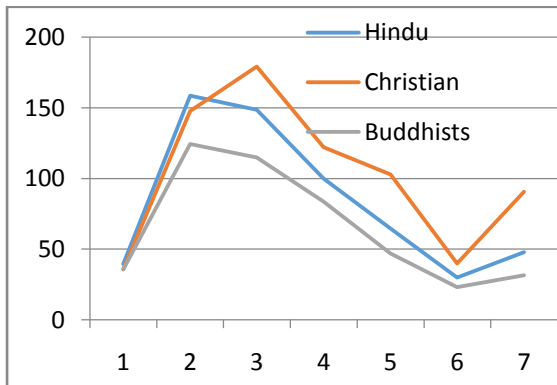
Age	All Religion	Hindu	Muslim	Christian	Others
15-19	23.386	24.150	47.323	18.448	24.742
20-24	106.49	106.05	184.25	92.267	106.63
25-29	142.04	130.44	211.03	137.05	143.48
30-34	118.52	106.63	153.57	123.59	113.03
35-39	70.949	59.456	92.744	81.033	66.253
40-44	32.448	25.383	49.875	40.194	24.396
45-49	34.939	26.409	59.588	32.414	33.413
TFR	2.64	2.26	3.69	2.46	2.39

ASFR Assam (TFR=3.24)



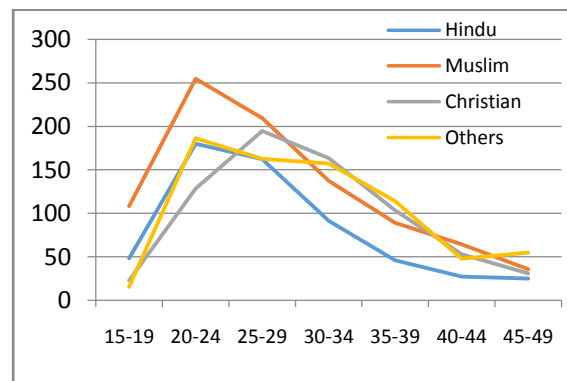
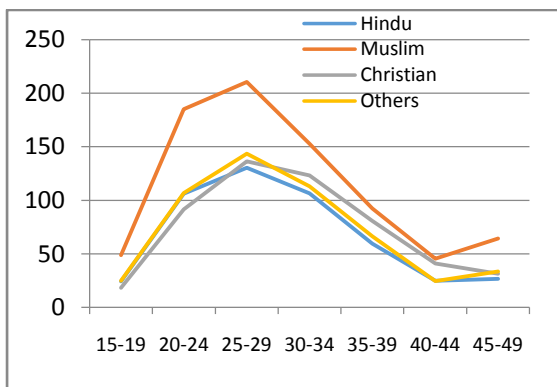
ASFR Mizoram (TFR=3.26)

ASFR Arunachal (TFR=3.04)



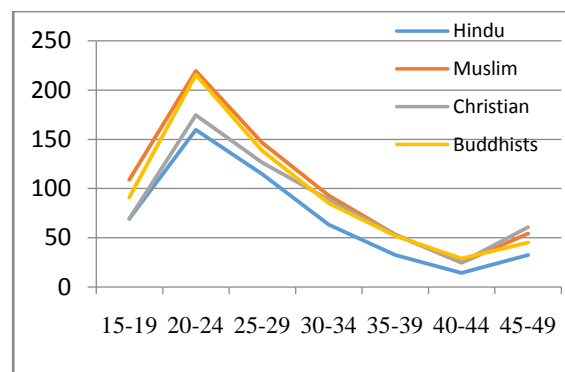
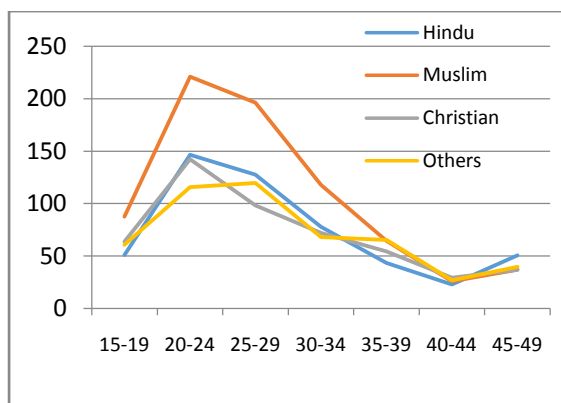
ASFR Nagaland (TFR = 3.45)

ASFR Manipur (TFR=2.62)



ASFR Sikkim (TFR = 2.44)

ASFR Meghalaya (TF R=4.72)



ASFR Tripura (TFR = 2.76)

In Table 5 the adjusted total fertility rates (TFRs) are presented for all the eight states in the column “All religion”. The ethnic wise TFRs are also computed within each state as indicated by the names of the religions in the column headings. The highest TFR of 4.72 is recorded in Meghalaya and the lowest TFR of 2.44 in Sikkim. The TFR for Muslim women stands highest in all the states except Arunachal where the TFR is not computed because of small number of Muslim women in the state. The Hindu women have the lowest TFRs in all the states with Christian and Buddhists/Others in between Muslim and Hindu. The results of TFRs computed in table 5 does not reveal any uncommon figures which may otherwise report inconsistency as compared to other survey reports like the NFHS.

Table 5: Adjusted TFR for Different Religious groups of North East States

	All Religion	Hindu	Muslim	Christian	Others/Buddhists
Assam	3.24	2.59	4.36	3.36	2.87
Arunachal	3.04	2.95	-	3.59	2.30(B)
Manipur	2.62	2.26	3.69	2.46	2.39
Meghalaya	4.72	2.93	4.74	4.69	5.42
Mizoram	3.26	2.79	4.04	3.06	-
Nagaland	3.45	2.90	4.49	3.48	3.69
Sikkim	2.44	2.59	3.74	2.49	2.48(B)
Tripura	2.76	2.43	3.49	2.99	3.27(B)

In this paper we also obtain the adjusted crude birth rates (CBR and GFR) using the equations

$$\text{Adjusted CBR} = \frac{\text{Total Births}}{\text{Total Population}} \times 1000 \quad (\text{xii})$$

$$\text{And adjusted GFR} = \frac{\text{Total Births}}{\text{Total Women aged 15-49}} \times 1000 \quad (\text{xiii})$$

The total no. of births in the numerator of both the equations (xii) and (xiii) above are obtained as the sum of the total births in each age groups obtained by multiplying the adjusted ASFR's $f^*(i)$ as in Table 3 by the corresponding no. of women of each age group. For the GFR (general fertility rate) the denominator is taken as the total women in the reproductive age interval which clearly reflects a more convincing measure of fertility.

TFR can be related to GFR in a form where one may insert the GFR function into the TFR function and just multiplied by the width of the interval to approximate the Total Fertility Rate. Summing across age intervals, as is the case with TFR, is unnecessary since the age intervals are simplified into one single age interval. Mathematically, the sum of the ratios (TFR) is different from the ratio of the sums (GFR), but empirically the results should be and are very similar.

$$\text{TFR} \approx 35 * \text{GFR} \quad (\text{xiv})$$

Table 6: Adjusted CBR and GFR for Religious Groups

State		All Religion	Hindu	Muslim	Christian	Others/ Buddhist
Assam	CBR	27.09	22.62	33.35	27.78	24.56
	GFR	102.26	81.02	140.05	101.74	88.46
Arunachal	CBR	31.19	26.12	-	36.14	29.83
	GFR	119.07	104.03	-	136.13	114.24
Manipur	CBR	22.28	20.48	32.13	21.68	22.31
	GFR	80.35	74.34	123.14	76.98	79.08
Meghalaya	CBR	35.42	24.15	35.73	36.08	37.74
	GFR	140.63	89.66	152.33	142.85	160.70
Mizoram	CBR	27.71	17.72	25.16	26.56	27.59
	GFR	102.89	131.23	153.84	96.41	99.90
Nagaland	CBR	27.79	22.44	32.46	28.13	19.79
	GFR	104.13	96.25	153.06	103.37	81.37
Sikkim	CBR	21.52	22.19	25.27	23.54	21.77
	GFR	77.92	81.83	129.95	79.91	77.95
Tripura	CBR	24.65	21.64	31.25	27.01	26.78
	GFR	88.58	64.86	116.99	121.43	103.72

Conclusion

The current fertility rates for women computed using the last birth data i.e. births born during the year preceding the census or survey which are subject to error as mentioned have been adjusted using the Brass P/F method. The f(i) column of Table 3 which gives the current ASFR may be compared with the last column of adjusted rates in the same table. All the adjusted rates are higher than the current rates which clearly indicate that without the adjustment factor there would have been an underestimation of the current ASFR. This would subsequently lead to underestimation of the TFR for each state.

Looking at Table 5, the highest fertility is reported from Meghalaya with TFR = 4.72, followed by Nagaland, Mizoram, Assam and Arunachal with respective TFRs 3.45, 3.26, 3.24 and 3.04. The TFR of Sikkim is 2.44 which is lowest among the eight states and is near replacement level of 2.1. This is followed by Manipur and Tripura whose TFRs are 2.62 and 2.76 respectively. Out of the eight North east states the TFRs of five states are still above 3.0 and therefore programme planners may give due attention to these states to further reduce the rate with proper modification and implementation of the Family welfare programmes.

Further we look into the fertility levels of different religious groups within each state as it is the main focus of the present paper. The last four columns of Table 5 gives the respective TFRs for major religious groups viz. Hindu, Muslim, Christian and others which constitutes a significant proportions of the population. In the last column of Table 5 with column name "Others/Buddhists" we computed TFR for religious groups which are either a local belief/faith or not recognised widely as such. However, for the states of Arunachal, Sikkim and Tripura this column shows TFR for Buddhist women as we got a sufficiently large number of Buddhist women who have reported their birth data. The TFR for Muslims in Arunachal and TFR for others in Mizoram are not computed as the number of women are very few. In all the North east states the number of women reporting birth data from religious groups like Sikhs, Jain etc. are very few and hence these religions are not considered thinking that the estimates could be biased due to fewer data.

It is quite evident from the reading of Table 5 that Muslim women tend to have higher fertility level as compared to women in other religious groups. This trend of higher fertility for Muslim women still persists in these states as is the case of other Indian states. The NFHS-3 (2005-06) reports also indicated the same at the national level. Hindu women have consistently lower fertility in all the states except Sikkim.

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Dr. Ksh. Anand Singh
 Assistant Professor
 Department of Statistics, Manipur University, Imphal
 Email: kshanandsingh_1@yahoo.com