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Estimation of Female Feticide Rate and Its Relationship with Other Related Parameters

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Abstract

The present paper is a generalization of the earlier studies on Female feticide of Biswas and Gurung (2000) and Biswas and Gurung (2004) where the following items of methodological investigation were undertaken: (i) Estimation of female Feticide rate from proportion of males at birth and the first, second year of life. (ii) Female Feticide rate as a parameter in the expression of the difference between Female and Male Infant mortality rates. (iii) Increasing Female Infant mortality rate with decreasing ratio of females at birth. (iv)Effect of female feticide and female Infant Mortality rate (IMR) on the Inter-live birth intervals using an extension of Perrin and Sheps model (Biometrics, 1964). (v) Effect of the difference in the mean conception rates (following a male or a female birth to the next birth) on the inter live birth interval. (vi) Effect of female feticide and Infant mortality rate on the expectation of life at birth and the first year of life; and the consequential relative increase in the female expectation of life while the hazards of female feticide and high female Infant mortality rates are eliminated. The present generalization comprises of re-estimating female feticide rates in different states of India as well as Indian Territory as a whole by parity with the details of sex of the births in sequence; and estimating female feticide and re-conception rates as a function of the sex of the previous births. Sex ratio has been treated as a dependent variable on the sequence of the nature of earlier births by sex for different states of India. Also, the impact of increasing Feticide rate on the number of Missing women and downfall in the sex ratios has been analyzed; apart from its role in widening the gap between Male and Infant mortality rates and the expectation of life at birth.

Keywords and Phrases: Female feticide; Sex-selective abortion; Sex ratio; Infant Mortality rate; Expectation of life; Monthly conception rate; Inter live birth Interval; Sheps and Perrin model; Conceptive delay; Life table mortality rates; Gestation Period; Period of Post-partum Amenorrhea (PPA); Expectation of life; Monthly conception rates: Conceptive Delays.

AMS Classification: 62P25.

1 Introduction

The sex ratio at birth conventionally defined as the number of male births per hundred female births is a biological constant, which undergo only slow changes and therefore a significant change is unexpected during a small interval of time. However, as Belloo Mehra (BellooMehra@sulekha.com) quotes from the Analysis of the Census data by Roy Chowduduri (2002) on the dramatic drop in the sex ratio of the female population in the 0-6 age group, from 962 girls to 945 girls and then to 927 girls per1000 boys in 1981,1991 and 2001 censuses respectively; showing consistent decrease in female Population indicating the positive role of sex-selective abortion (while getting prior information about the sex of the unborn fetus) by amniocentesis/ ultrasound/ material serum analysis, etc despite of the same practice recently banned in India. However, there are counter arguments that such drops in the female population are because of under enumeration of female children in Indian censuses; and prolonged apathy towards the raising up of female children causing high Infant and child mortality rates. Griffiths et al (2000) maintain that such high masculinity in the population may be the cumulative effect of slow but consistent differences in the sex ratios carried on for a long period of time; as Indian Censuses report increase of sex ratio for the population as a whole increasing from 102.9 to 107.5 during 1921 to 1981. Further 1991 Census recorded a further upraise in the sex ratio to 107.9 and recorded a slight downfall to 107.2 in 2001 Census.

On the other hand, Basu (1991), on the basis of the records of Medical termination of pregnancy (MTP) by the department of Family Welfare, Government of India, reports that 3 million cases of MTP since 1984-85 by the government registered institutions only. As assumed by her (which may be somewhat generous) that even a quarter of the above 3 million cases of MTP followed by earlier sex determination tests, they would account for still about 0.75 million less females other than already less female population than their male counterpart. Moreover, the above estimate does not take into account of the unborn number of Amniocentesis cum abortions that occurred outside the net- work of the government. In addition to these information, the RCH (Reproductive child health survey data (1998-99)) report the induced abortion rates in some of the Northern, Southern and Eastern states in India like Punjab (4% out of a total proportion of total abortion rate 4.4%), Tamil Nadu (3.8%), Goa (2.7%), Haryana (2.4%), Kerala and West Bengal(2.3%) etc. indicate grave concern for a growing apathy to curb the female children to see the light of the day; even half of the induced abortions are sex selective.

In the light of all these findings, it is not difficult to understand that the increase in sex ratio is primarily due to sex selective Abortions; as well as the prolonged social apathy in bringing up female children in default of not having the resources of undergoing such induced abortions. The documental evidence of such actions is reflected in the differential Infant mortality rate and child mortality rates by sex. For example, SRS data report IMR in 2001 to be 68 per 1,000 live births for females as against 64 per 1,000 live births for males. Even the earlier SRS data of 2000 reported female infant mortality rate to be 79.5 per 1,000 live births while the figure for their male counterparts reported as 69.8 per 1,000 live births. No doubt, such disparity between male and female Infant mortality rates is the outcome of positive actions based on the preconceived idea of a very large section of Indian Population; that raising up of female children is sheer disinvestments and it is like watering the plants, which do not belong to them. In our present investigation, it has been observed that proportion of male population is consistently higher than their female counterpart up to the age of twenty-five. However, after twenty- five, the proportion of male population start decreasing slowly and from fiftieth year onwards, proportion of females start exceeding their male counterpart. Curiously enough, despite of such hostile environment for a newborn female child, Life tables of India and states report high expectation of life at every age group (excepting 0-1) presumably because of better capacity of female babies to withstand the mortality force and superior life style in the future years of life.

In view of great social repercussions of female feticide causing demographic imbalance; and paucity of reliable data for the estimation of the same, we have attempted to undertake a methodological exercise to estimate the parameters affecting the Female feticide by using sources of indirect data; such as proportions of male children at birth, first and second year of life; difference between female and male infant mortality rates. Attempt has been made to link up feticide rate with the previous history of births i.e, the sequence of the sex of the previous births in order by using NHFS-2 and SRS data. By using an extension of Perrin and Sheps (1964) Model, the ramifications of female feticide in increasing the fertility status (by reducing the inter-live birth interval for preference to male children) is analyzed by obtaining the estimated difference in the interval between two male births and that between a female and a male birth; while taking cognizance of sex-selective abortions that may occur in between two live births. Two important findings have been reported in this study. Firstly, the inter live birth interval is very significantly reduced following a female birth irrespective of the previous pregnancy history. Secondly, the sex ratios at birth become extraordinarily high while achieving a male birth by hook or by crook after a repeated number of sex-selective abortions. Both of these features have been noticed in North as well as South Indian States using NFHS-2 as well as SRS data. Finally, an attempt has also been made to analyze the effect of Female feticide and differential Infant mortality by sex on the expectation of life.

Methods of estimating Female Feticide rate:

Notations:

p_i=observed proportion of males in ith year of life ($i = 0, 1, 2......$).
α=true probability of male birth in a specified population (a biological constant).
δ=probability of terminating a pregnancy into abortion which otherwise would have lead to a female birth.

$I_i(m)$, $I_i(f)$ are respectively the male and female mortality rates per person per year during $(i-1)$ and i^{th} year $(i = 1, 2, ...)$ and I_i stand for the probability of dying during $(i-1)$ to i^{th} year.

Then,

$$p_0 = \frac{\alpha}{(1-\alpha)(1-\delta)+\alpha} \tag{1}$$

$$p_1 = \frac{\alpha(1-I_0(m))}{(1-\alpha)(1-\delta)(1-I_0(f))+\alpha(1-I_0(m))} \tag{2}$$

$$p_k = \frac{\alpha(1-I_0(m))(1-I_1(m))\cdots(1-I_{k-1}(m))}{(1-\alpha)(1-\delta)(1-I_0(f))(1-I_1(f))\cdots(1-I_{k-1}(f))+\alpha(1-I_0(m))(1-I_1(m))\cdots(1-I_{k-1}(m))} \quad for\ k \geq 2 \tag{3}$$

Also,

$$I_i = \alpha I_0(m) + (1-\alpha)I_0(f) \tag{4}$$

A little simplification shows (vide Biswas and Gurung (2002), (2004))*(vide Appendix 1)

$$I_0(f) - I_0(m) = \frac{[2-(I_0(f)+I_0(m))][p_1(1-\alpha)(1-\delta)-\alpha(1-p_1)]}{\alpha(1-p_1)+p_1(1-\alpha)(1-\delta)} \tag{5}$$

It may be seen that Female feticide rate is estimable from (1) given the proportion of male infants at birth. If data on male and female infant mortality rates are given then the rate is estimable from (2). Along with the same if Age-sex specific mortality rates are given then Feticide rate is estimable from (4). However, more elegant result is given by (5) which expresses feticide rate as a parameter in the difference of female and Male infant Mortality rates.

Given the unadulterated natural sex ratio $\alpha = 106/206$ and assuming $p_0 = 107/207 = 0.5169082$, we get a provisional estimate of $\delta = 0.00934$ and using SRS (2001) data of male and female infant mortality rates as 68 and 64 per thousand live births per year, we have the estimate of $p_1 = 0.5177383$.

Using the following recurrence relation between p_i and p_{i+1} given by

$$p_{i+1} = \frac{p_i(1-m_i)}{p_i(1-m_i)+(1-p_i)(1-f_i)} \quad for\ i \geq 2 \tag{6}$$

where m_i and f_i represent the probabilities of dying in the age interval $(i, i+1)$ for a male and a female respectively, we have given in the following Table (Table 1) the proportion of males and females at exact age $i = 1, 2, \cdots, 50$ by using SRS Life table 1998-2002. Source: SRS analytical studies, Report No. 1 of 2005.

Table 1: Proprtion of Males and Females at exact Age from 0 to 50

Age	Proportion of Males	Proportion of Females	Difference in the proportion	Sex-ratio Per 1,000 Males
0	0.5169080	0.4830920	0.0338160	934.5802
1	0.5177383	0.4822617	0.0354766	931.4777
2	0.5200794	0.4799206	0.0401588	922.7833
3	0.5224197	0.4775803	0.0448394	914.1698
4	0.5247590	0.4752410	0.0495180	905.6367
5	0.5271015	0.4728985	0.0542030	897.1678
6	0.5273507	0.4726493	0.0547014	897.1679
7	0.5275998	0.4724002	0.0551996	896.2713
8	0.5278490	0.4721510	0.0556980	894.4812
9	0.5280981	0.4719019	0.0561962	893.5876
10	0.5283472	0.4716528	0.0566944	892.6948
11	0.5283974	0.4716026	0.0567948	892.5150
12	0.5284475	0.4715525	0.0568950	892.5150
13	0.5284976	0.4715024	0.0569952	892.1562
14	0.5285478	0.4714522	0.0570956	891.9765
15	0.5285979	0.4711279	0.1219839	891.2784
16	0.5291462	0.4708538	0.1238015	889.8369
17	0.5294204	0.4705796	0.125039	888.8580
18	0.5296945	0.4700314	0.1269343	887.3632
19	0.5299686	0.4697573	0.1281777	886.3870
20	0.5302427	0.4696465	0.1290251	885.7199
21	0.5303535	0.4695356	0.1295278	885.3257
22	0.5304644	0.4694247	0.1300309	884.9316
23	0.5305753	0.4693138	0.1305342	884.5376
24	0.5306862	0.469203	0.1310375	884.1440
25	0.530797	0.4692534	0.1311522	884.0544
26	0.5307466	0.4692534	0.1310448	884.1383
27	0.5306961	0.4693039	0.1308154	884.3176
28	0.5306456	0.4693544	0.1305862	884.4970
29	0.5305951	0.4694049	0.1303570	884.6763
30	0.5305446	0.4694554	0.1301278	884.8557
31	0.5301201	0.4698167	0.1283552	886.2458
32	0.5297588	0.4702412	0.1265682	887.6515
33	0.5293342	0.4706658	0.1246498	889.1657
34	0.5289728	0.4710272	0.1230196	890.4564
35	0.5286113	0.4713887	0.1213915	891.7492
36	0.527714	0.472286	0.1173611	894.9658
37	0.525919	0.4731835	0.1114479	899.7270
38	0.525021	0.4740812	0.1074495	902.9757
39	0.525021	0.4749790	0.1053562	904.6857
40	0.524123	0.4758770	0.1013833	907.9490
41	0.522850	0.4771500	0.0957770	912.5944
42	0.521577	0.4784232	0.0901996	917.2628
43	0.520303	0.4796968	0.0846501	921.9566
44	0.519029	0.4809706	0.0791292	926.6738
45	0.517755	0.4822446	0.0736365	931.4147
46	0.5141758	0.4858242	0.0583577	944.8601
47	0.5105951	0.4894049	0.0432979	958.4990
48	0.5071134	0.4929866	0.0286555	972.1427
49	0.5034309	0.4965691	0.0138184	986.3700
50	0.4998402	0.5001519	-0.000623	1000.624

The table and the adjoining graph shows that the sex ratio attains minima during the marriageable period of females. So a major social imbalance of the sex selective abortion and apathy towards female children cause consistent drop in the age-sex specific mortality especially till 25 years of age. The long term effect of the present Socio-economic culture now prevailing is thus warranting a great crisis in the marital system because of the paucity of the females in the marriageable age group. Below in Table 2, we present the state wise Female Feticide rate classified by parity, sex of the earlier births in sequence, Male and Female infant mortality and the sex ratio at the last birth.

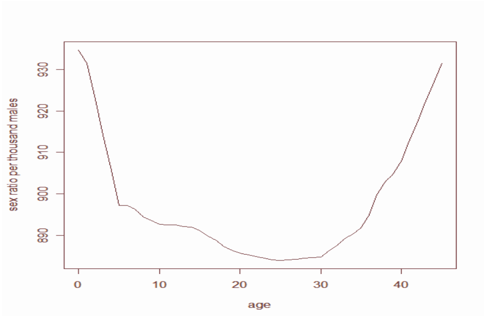

Figure 1: Sex Ratio of Indian Population in the Age group (0-45) based on the Life table of (1998-2002)- SRS analytical studies, Report No. 1; Source: SRS analytical studies, Report No.1 of 2005

Table 2: Showing the estimated Female Feticide in different States of India Classified by Male and Female Infant Mortality and The proportion of Males in the last birth.

State	Parity	State	Male Infant Mortality rate	Female Infant Mortality rate	Proportion of Male births in the last birth	Female Feticide Rate
Punjab	1	M	.0503.	.06625	0.5263	.029643
Punjab	2	M,M	.0503	.06625	0.6071	.302276
Punjab	2	F,M	.0503	.06625	0.5385	.076051
Punjab	3	F,F,M	.0503	.06625	0.6855	.505377
Punjab	3	F,M,M	.0503	.06625	0.6855	.186692
Punjab	3	M,F,M	.0503	.06625	0.6855	.191326
Rajasthan	1	M	.08239	.08682	0.5196	.015419
Rajasthan	2	MM	.08239	.08682	0.5941	.272275
Rajasthan	2	FM	.08239	.08682	0.5000	-
Rajasthan	3	FFM	.08239	.08682	0.5319	.062619
Rajasthan	3	FMM	.08239	.08682	0.5217	.023467
Rajasthan	3	MFM	.08239	.08682	0.5111	-
Haryna	1	M	.06376	.07839	0.5150	-
Haryna	2	MM	.06376	.07839	0.4694	-
Haryana	2	FM	.06376	.07839	0.4694	.42800
Haryana	3	FFM	.06376	.07839	0.5555	.13834
Haryana	3	FMM	.06376	.07839	0.6857	.50642
Haryana	3	MFM	.06376	.07839	0.5200	.00660
Andhra Pradesh	1	M	.06619	.06269	0.5081	*
AP	2	MM	.06619	.06269	0.4000	*
AP	2	FM	*	*	0.5100	*
AP	3	FFM	*	*	0.3775	*
AP	3	FMM	*	*	0.6500	.431362
AP	3	MFM	*	*	0.5000	*
Karnataka	1	M	.0649	05749	0.5152	.0104369
Karnataka	2	MM	*	*	0.4844	*
Karnataka	2	FM	*	*	0.5000	*
Karnataka	3	FFM	*	*	0.3500	*
Karnataka	3	FMM	*	*	0.5000	*
Karnataka	3	MFM	*	*	0.3835	*
Kerala	1	M	.01327	.01146	0.5000	*
Kerala	2	FM	*	*	0.5000	*
Kerala	3	FFM	*	*	0.6142	.335397
Kerala	3	FMM	*	*	0.6000	.294267
Kerala	3	MFM	*	*	0.4286	*
Tamilnadu	1	M	.04443	-	0.5256	-
Tamilnadu	3	FMM	*	-	0.6600	.4518324
Tamilnadu	3	MFM	*	-	0.5000	*

*Estimation failure because of inadequate sample size.

Effect of Female Feticide in the Inter-live birth interval:

As we have seen in the preceding section, the probability of a female feticide depends on the sex of previous births (i.e. whether it is female) as well as the number of female births in the previous pregnancy history. We shall establish in this section that immediately after a female birth there is a tendency to increase the monthly conception rate in pursuit of a male child. This reduces the inter live birth interval. Even by increase of monthly conception rate if there is a failure then the attempt of the couple is either a sex-selective abortion that considerably reduces the period of postpartum Amenorrhea (PPA); or in case of not succeeding to fulfill that purpose the couples inevitably start attempting to have a male child by abruptly increasing the monthly conception rate. We shall show from a slightly Generalized Sheps and Perrin Model (1964), the abrupt increase in the monthly re-conception rate by one or more female births than the usual re-conception rate following one or more male births by using NFHS-2 data.

Development of models of different categories of inter live birth intervals from Perrin and Sheps Model (1964):

Following Perrin and Sheps (1964) let S0, S1, S2, S3 and S4 respectively of being in the

(i) Non- pregnant fecundable state

(ii) Pregnant state

(iii) State of pregnancy being terminated into still birth

(iv) State of pregnancy being terminated into abortion or fetal wastage

(v) State of pregnancy being terminated into live birth

Denoting T_{ij}, the random time taken between S_i and S_j $(i, j = 0, 1, 2, 3, 4)$ with $E(T_{ij}) = \mu_{ij}$ which implies that T_{01}=Fecundable period; $T_{01}^{(1)}$ and $T_{01}^{(2)}$ are the respective waiting times for re-conception given that the previous birth is a male or female. T_{13}=Gestation period prior to a feticide. T_{14}=Gestation period prior to a live birth. T_{30}=Period of post partum Amenorrhoea following a feticide. T_{40}=Period of postpartum Amenorrhoea after a live birth.

It has also been assumed that $T_{13} = T_{14}$ since the feticide can only take place when the sex of the fetus is known because early prediction by Amniocentesis is not possible [Basu(1991)]. $T_{4(m),4(m)}$ and $T_{4(f),4(m)}$ are the random times between a male and a male; and between a female and male birth respectively. Using the above notation, Biswas and Gurung (2000, 2004) have shown*(vide Appendix 2) that the Interlive birth interval between two male births and between a female and male birth are given in the following relations (7) and (8) given below.

$$E[T_{4(m),4(m)}] = E(T_{40}) + \Lambda[g + \mu_{40} + \frac{1-\rho_2}{\rho_2}] + g + \mu_{40} + \frac{1-\rho_1}{\rho_1} \tag{7}$$

and

$$E[T_{4(f),4(m)}] = E(T_{40}) + E(T_{01}^{(2)}) + E(T_{14}) + \Lambda[g + (1-\delta)\mu_{40} + \delta\mu_{30} + \frac{1-\rho_2}{\rho_2}] \tag{8}$$

where

$$\Lambda = E(n-1) \ = \frac{\alpha}{1-(1-\alpha)^{k-1}} \sum_{n=1}^{k-1} (1-\alpha)^{n-1}(n-1).$$

$$= \frac{1-\alpha}{\alpha[1-(1-\alpha)^{k-1}]} \left\{1-(1-\alpha)^{k-1} - \alpha(k-1)(1-\alpha)^{k-2}\right\} \tag{9}$$

where $(n-1)$ (a r.v.) is the number of fetecides in between the two live births ($n = 1, 2.........5$) and k represents the maximum number of live births. We assume $k = 6$.

We have assumed $E(T_{40})$=PPA following live birth=3 Months $=\mu_{40}$
$E(T_{14})$=Gestation Period for live birth=9 months=g
δ=Feticide Rate (from Table 2);
$E(T_{13})$=Gestation period for Abortion=1 month

$$E\left(T_{01}^{(2)}\right) = \frac{1-\rho_2}{\rho_2}, \quad E\left(T_{01}^{(1)}\right) = \frac{1-\rho_1}{\rho_1} \tag{10}$$

ρ_1 and ρ_2 are the monthly conception rates following a male or a female birth respectively.

The above formulas we have estimated the re-conception rates conditional to previous birth history pattern (i.e. especially the sex of the preceding birth). The results are given below in Table 3. δ under parenthesis is given for each State (in Table 3). Apart from estimating Feticide rates depending on the previous history of the sex of the births in sequence, we have by using the equation (i) obtained the sex ratio at the time of last birth. Since the objective of the earlier Feticide (or sex-selective abortions) was inevitably to achieve a male baby by hook or by crook, therefore, the estimated sex ratios (per 100 female births) show exorbitantly high. This is shown in the last column of table 3.

Table 3: Inter live birth Interval, Re-conception rates and Sex ratios at birth in different States classified by the sex of the preceding births

INTER LIVE BIRTH INTERVAL RECONCEPTION RATE

State (1)	FM (2)	MF (3)	FFM (4)	MMF (5)	MFM (6)	FMM (7)	Re-conception Rate. (Male to Male) : ρ_1 (8)	Re-Conception Rate. (Female to Male) : ρ_2 (9)	Sex Ratio At Birth (Per woman) (10)
Punjab (FR)	27.74 (.0760)	32.0	29.3 (0.5054)	25.9	24.9 (.18692)	27.0 (.191326)	0.08074283 (FMM)	0.055392 (FMM) 0.1788 (FM) .0789963 (MFM)	1.376670 (FMM) 1.371758 (MFM) 1.49395 (FM)
Rajasthan (FR)	32.0	31.5	30.28 (.0626)	27.67	33.34	28.04 (.02347)	.07461701 (FMM)	**	1.549688 (FMM) 1.508207 (MFM)
Haryana (FR)*	30.61 *(.42800)	30.28	29.89 *(0.138)	29.18	26.04	27.56 *(.006)	.07774152 (FMM)	0.535504 (FFM)	1.117319 (FMM)
Andrha Pradesh (FR)	29.04	27.67	34.24	28.28	29.47	28.3 (0.4314)	0.05834374 (FMM)	**	
Kerala (FR)*	32.60	33.34	29.68* *(.3367)	26.92	28.93	30.44 *(.2943)	0.06337959 (FMM)	0.05427261 (FFM)	
Karnatak	35.72	31.79	25.67	27.78	43.00	34.25	**	**	
Tamil Nadu (FR)*	30.51	28.04	29.00	25.00	28.95	29.17 *(.4518)	0.06894003 (FMM)	**	

**Feticide rate could not be estimated because of the smallness in the sample size in these states. *Feticide Rates.

The basis of such findings is corroborated by the fact, that monthly probability of re-conception following a female birth (vide 8^{th} and 9^{th} column of the table) is more than one and half times than that of the cases which follow a male birth; inevitably irrespective of the sex-sequence of earlier births. These are shown in the 8^{th} and 9^{th} columns respectively.

Table 4: Showing the effect of increasing Feticide on the Number of Missing Women and the Sex ratio per 1,000 male births.

Probability of Feticide	Number of Missing women per billion population per year	Proportion of Females per 1000 persons	Sex ratio Per 1000 Males
0.005	2,427,185	483.0097	934.2723
0.006	2,912,621	482.5243	932.4579
0.007	3,398,058	482.0388	930.6465
0.008	3,883,495	481.5534	928.8390
0.009	4,368,932	481.0680	927.0348
0.010	4,854,369	480.5825	925.2336
0.015	7,281,553	478.1553	916.2790
0.020	9,708,738	475.7382	906.7166
0.025	1,213,592,0	473.3010	907.4440
0.030	1,456,311,0	470.8738	898.6176
0.035	1,699,029,0	468.4466	889.9083
0.040	1,941,748,0	466.0194	881.2715
0.045	2,184,466,0	463.5922	872.7272
0.050	2,427,184,0	461.1650	864.2776

Source: SRS analytical studies, Report No. 1 of 2005

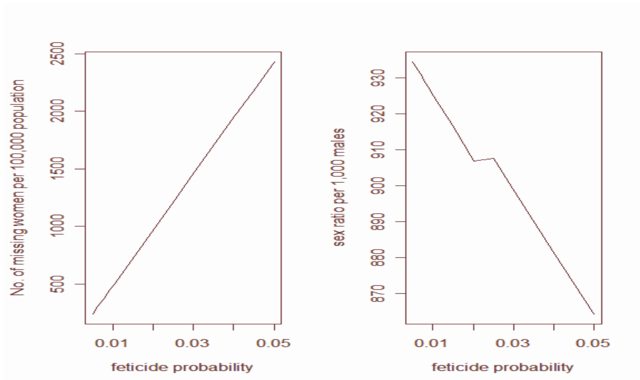

Figure 2: Effect of Increasing Feticide Probability on Number of Missing Women per 100,000 population and drop of Sex ratio per 1,000 Males.

Table 3 establishes our earlier surmised conjecture that the re-conception rate following a Female birth is consistently higher for the male birth; showing the social obsession for the cravings of Male children. Especially, significant is the Feticide rate 17.88% in Punjab in second parity following the incidence of a Male birth after a female birth (FM). No doubt, after the first birth being female a lot sex-selective abortions might have been attempted to get a male child!

Next we show the impact of increased Female Feticide probability on the Number of Missing Women (Vide Section 'Discussion') and Sex ratio.

Effect of Sex-selective abortion and Differential Infant mortality by sex on the Expectation of life of Female children:

With the usual Life table notations, we have by using the recurrence relation in the complete expectation of life given by

$$\in_x^0 = \in_{x+1}^0 p_x + \frac{L_x}{l_x} \tag{11}$$

Approximating L_x by $\frac{1}{2}(l_x + l_{x+1})$

we have for $x = 0$

$$\in_0^0 \cong \in_1^0 p_0 + \frac{L_0}{l_0} = \in_1^0 p_0 + \frac{1}{2}(l_0 + l_1)/l_0 = \in_1^0 p_0 + [l_0 + l_0(1 - I_0)]/l_0$$

(where I_0 is the Infant Mortality rate) $\Rightarrow \in_0^0 \cong \in_1^0 p_0 + (2 - I_0)$

Correspondingly

$$^{\mathrm{m}} \in_0^0 \cong {}^{m} \in_1^0 {}^{m}p_0 + [2 - I_0(m)] \tag{12}$$

Simlarly,

$$^{f} \in_0^0 \cong {}^{f} \in_1^0 {}^{f}p_0 + [2 - I_0(f)] \tag{13}$$

where m and f stand for male and female populations respectively.

Therefore,

$$[^{m}\in_0^0 - {}^{f} \in_0^0] = [^{m}\in_1^0 {}^{m}p_0 - {}^{f} \in_1^0 {}^{f}p_0] + [I_0(f) - I_0(m)] \tag{14}$$

Putting (5) in (14) we have,

$$[^{\mathrm{m}}\in_0^0 - {}^{f} \in_0^0] - [^{m}\in_1^0 {}^{m}p_0 - {}^{f} \in_1^0 {}^{f}p_0] = \frac{[2 - (I_0(f) + I_0(m))][p_1(1-\alpha)(1-\delta) - \alpha(1-p_1)]}{\alpha(1-p_1) + p_1(1-\alpha)(1-\delta)} \tag{15}$$

Note that, p_0 in the left hand side is the probability of surviving from 0 to 1 (Life table notation); whereas p_1 on the right hand side represents the proportion of males at exact age 1 in (15) represents a relation which can show how Female Feticide and Differential Infant mortality rates by sex can affect the difference in the expectation of life at birth and First year respectively.

Using $I_0(m) = .06726$ and $I_0(f) = .06938$, ${}^{\mathrm{m}}\mathrm{p}_0 = (1 - .06726)$ and ${}^{\mathrm{f}}\mathrm{p}_0 = (1 - .069838) = 0.930162$, $\alpha = 106/206$, $p_1 = 0.5138373$

and

$$\delta = \frac{p_1(1-\alpha)(1-I_0(f)) - \alpha(1-I_0(m))(1-p_1)}{p_1(1-\alpha)(1-I_0(f))} \tag{16}$$

[derived from (2)]

$= 0.02745126$ (Estimated All India Feticide rate) and $\in_0^m = 61.6$ and $\in_0^f = 63.3$ (from SRS All India Life table 1998 - 2002)under δ as given in (16) to estimate $({}^m\!\in_1^0\ {}^m p_0 - {}^f \in_1^0\ {}^f p_0)$ and compare the same with $\delta = 0$ to find out the effect of Feticide on the Expectation of life at the first year of life given the expectation of lives (for Males and Females) at birth and accordingly the R.H.S of (15) = 0.2292557.

L.H.S of (15) $= (61.6 - 63.3) - ({}^{\mathrm{m}}\!\in_1^0 [.93274] - {}^{\mathrm{f}} \in_1^0 [.930164]) = 0.2292557 =$ R.H.S

Assuming as per the SRS Life table (1998 - 2002), ${}^{\mathrm{m}} \in_1^0 / {}^{\mathrm{f}} \in_1^0 = 65.1/67.0 = 0.9716418$

we have ${}^{\mathrm{f}} \in_1^0 = 1.029186({}^{\mathrm{m}} \in_1^0)$.

Therefore, (15) $\Rightarrow$

$(-1.7) - {}^{\mathrm{m}} \in_1^0 (.93274 - 1.029186 * .930164) = 0.2292557$
$\Rightarrow (-1.7) - {}^{\mathrm{m}} \in_1^0 (-0.02457177) = 0.2292557 \Rightarrow (0.2292557 + 1.7)/0.02457177 =$

$${}^m \in_1^0 = 78.51513;\ {}^{\mathrm{f}} \in_1^0 = 78.51513 * 1.029186 = 80.80667 \tag{17}$$

Whereas, under $\delta = 0$, we have $(-1.7) - {}^m \in_1^0 (-0.02457177) = 0.2481581$

$\Rightarrow 0.2481581 + 1.7 = {}^m\!\in_1^0 (0.02457177)$
$\Rightarrow {}^{\mathrm{m}}\!\in_1^0 = (0.2481581 + 1.7)/0.02457177 = 79.2844$

and

${}^{\mathrm{f}} \in_1^0 = 79.2844 * 1.029186 = 81.5984$

Although because of some approximation error that may possibly occur because of taking $L_x \cong \frac{1}{2}(l_x + l_{x+1})$ making all the estimates at the First year of life still higher for testing the hypothesis $\delta = 0$, against $\delta \neq 0$, A comparison of the above result shows that Feticide plays a significant role in reducing both male and female expectation of life at the first year. It appears that lack of resources to undergo Female feticide (especially in rural areas) becomes instrumental in aggravating Female Infant mortality; which in turn plays its role in affecting the expectation of Life for females at successive years. Further, Feticide rate being a dependent variable in explaining the difference between Male and Female Infant mortality rate, it is not difficult to discern the impact of Differential Infant Mortality rate by sex and Feticide rate on the expectation of life, although not directly.

2 Discussion

Clasen and Wink (1991), following a debate initiated by Amartya Sen in respect of Gender bias in mortality under the title "Missing Women" which refers to the number of females of any age who have presumably died as a result of discriminatory treatment has given estimates of such victims in countries where such gender bias exist. (As West Asia, North Africa. parts of South Asia, China and India.). The estimated number of such victims lies between 60 to 107 Million. The study has also explored to find out whether there is any change in the social apathy leading to such gender bias leading to such recourse as sex-selective Abortion; deliberate attempt to escalate of Female child mortality by debarring them from most of the amenities, which a male child enjoys. The remedies of such evil consequences of Gender bias according to them is improved Female education, better employment opportunities to women and rising of overall income in the families. Further, deterioration of such Social set up is warranted by discrimination between male and female child and Sex selective Abortion. While their study has revealed that the status of China in this aspect is deplorable, the improvement in India is also meager. Our study has also revealed that a very imminent problem of Female Feticide and deliberate attempt to annihilate the survival of Female children considering them as a family liability is gradually leading the Female population in the age group to gradual extinction. (vide table No.5). It has been observed that the proportion of female population in the marriageable age group has attained a minima because of man made evil social customs; which if continue for a long period will bring a social pandemonium. As Marriageable male adults are growing at a much faster rate at the cost of their unfortunate female counterpart. The long established preconceived idea that a son will look after the parents during their old ages while daughter forlorn them once for all is not at all evidenced in the present Indian Society which is fast leading to rapid urbanization as well as Westernization. The deep rooted pre-conceived selfish notions and prejudices can no longer withstand the force urging a drastic change in the outlook and create a more humanistic social environment. While equal distribution of Family resources spontaneously to male and female children is the only solution of this kind of problem; bearing in mind that a female child is not a liability in the family but at least as much asset as that of a male child; the motivation of committing Sex-selective abortion and discriminatory treatment to a female child jeopardizing her very existence can be wiped off. The Statistical Analysis has revealed a perspective of unbalancing the Population is indeed very menacing in the long term. In this connection the proverb 'My son is my son till he gets a Wife; my daughter is my daughter till I survive' is very much contextual.

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Appendices

1. Proof of the result (5) i.e. Difference of Infant mortalities as a function of Feticide probability.

2. Expected Number of Feticide in between two live births (Result (9)).

1. Proof of the result (5): connecting difference of Female and Male Infant Mortality with Feticide rate.

From equation (2), we have by putting $I_0(m) = \lambda I_0(f)$

$$p_1 = \frac{\alpha(1-\lambda I_0(f))}{(1-\alpha)(1-\delta)(1-I_0(f)) + \alpha(1-\lambda I_0(f)) + \alpha(1-\lambda I_0(f))}$$

$$\Rightarrow \frac{p_1(1-\alpha)(1-\delta)}{\alpha(1-p_1)} = \frac{1-\lambda I_0(f)}{1-I_0(f)}$$

$$\frac{1-\lambda I_0(f) - 1 + I_0(f)}{1-I_0(f) + 1 - \lambda I_0(f)} = \frac{p_1(1-\alpha)(1-\delta) - \alpha(1-p_1)}{\alpha(1-p_1) + p_1(1-\alpha)(1-\delta)}$$

$$\frac{I_0(f) - \mathrm{I}_0(m)}{2 - [I_0(f) + \mathrm{I}_0(m)]} = \frac{p_1(1-\alpha)(1-\delta) - \alpha(1-p_1)}{\alpha(1-p_1) + p_1(1-\alpha)(1-\delta)}$$

$$\Rightarrow I_0(f) - \mathrm{I}_0(m) = \frac{[2 - (I_0(f) + \mathrm{I}_0(m))][p_1(1-\alpha)(1-\delta) - \alpha(1-p_1)]}{\alpha(1-p_1) + p_1(1-\alpha)(1-\delta)} \tag{5}$$

2. Proof of the Result (9) on Expected Number of Fetal Wastages between two live births.

$\Lambda = E(N-1) = \alpha \sum\limits_{n=1}^{k-1} \frac{(1-\alpha)^{n-1}}{1-(1-\alpha)^{k-1}}$ being the Mean of a truncated

Geometric distribution $f(n) = \alpha(1-\alpha)^{n-1}, \mathrm{n} \leq \mathrm{k}-1$

$$= \frac{1}{1-(1-\alpha)^{k-1}} \left[-\alpha(1-\alpha) \sum_{n=1}^{k-1} \{ \frac{d}{d\alpha} (1-\alpha)^{n-1} \} \right]$$

$$\frac{1}{1-(1-\alpha)^{k-1}} \left[-\alpha(1-\alpha) \right] \frac{d}{d\alpha} [1 + (1-\alpha) + (1-\alpha)^{2+} \ldots\ldots + (1-\alpha)^{k-2}]$$

$$= \frac{1}{1-(1-\alpha)^{k-1}} \left[-\alpha(1-\alpha) \right] \frac{d}{d\alpha} [\frac{1-(1-\alpha)^{k-1}}{1-(1-\alpha)}]$$

$$= \frac{(1-\alpha)}{\alpha[1-(1-\alpha)^{k-1}]} \left[1 - (1-\alpha)^{k-1} - \alpha(k-1)(1-\alpha)^{k-2} \right] \tag{9}$$