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Facts and Reflections of Changing Child Sex Ratio in West Bengal during 2001-2011, India

Kakoli Das[1] and Utpal Roy[2]

[1] Assistant Professor, DDE, Vidyasagar University, West Bengal, India
[2]Associate Professor, University of Calcutta, Kolkata, West Bengal, India

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ABSTRACT

The present study attempts to understand the causes of increasing manifestation of low child sex ratio (CSR) in the districts of West Bengal. Using data from the fourth round of District Level Household and Facility Survey (2012-13) in congruence with Census of India 2011, and employing multivariate binary logit regressions we were able to confirm that differential stopping behaviour, particularly in those regions where total fertility rate (TFR) and CSR fall considerably, appeared to be the process of male-preferring stopping rules in West Bengal. Women start practicing son-targeting fertility behaviour (DSB) as soon as they have achieved their desired number of sons - by adopting contraception at first parity after having a boy or choosing modern methods over natural methods at second parity after having two successive boys – which have led to the contemporary decline in CSR in West Bengal.

Introduction:

Since 1980s, the persistent decline of Child Sex Ratio (CSR; Number of female children per 1000 male children in the age group of 0-6 years) in India has been a cause of concern among social scientists and policymakers. Despite concerted efforts to improve the coverage and age-misreporting, CSR in India has continued to decline. The decline in CSR in India was 17% between 1981 and 1991, which became marginally slow (14%) between 2001 and 2011 (RGI 2011). The Primary Census Abstract of 2011 unearthed that all the major states except Kerala, Tamil Nadu, and Karnataka had recorded an escalating decline in their child sex ratio. However, the adult sex ratio has increased during the same time mainly due to an increase in female life expectancy and improved enumeration (Navaneetham and Dharmalingam 2011).

The eastern state of West Bengal, a discontinuity between the popular North-South demographic dichotomies, had always maintained a better position in terms of CSR compared to the rest of India. That very situation slowly began to fade when the CSR started to drop by 27-points during 1981-1991, which reduced marginally to 960 in 2001 and further to 956 by the end of 2011 (RGI 1981-2011). The 4-points decline in CSR in West Bengal during 2001-11 cannot be compared with the 13-points decline at the national level. However, there were some pockets (districts) which showed a remarkably faster decline (more than/equals to 13-points) than that of India. Therefore, this study tries to articulate the plausible reason(s) which is (are) accountable for this contemporary trend in West Bengal, especially in those districts where CSR and fertility declined noticeably in recent times. Despite being a better-off state in terms of CSR, the imbalance that has set into this early age group is hard to remove and will remain as a nuisance in a state like West Bengal.

Glimpses of Prior Research

Social scientists and policymakers have almost unanimously identified the major underlying causes of declining CSR such as sex-selective abortion of female foetuses, female infanticide, excess female mortality

Correspondence to Kakoli Das
Assistant Professor, Vidyasagar University, Directorate of Distance Education, Department of Geography, West Bengal, India
E-mail address : kakolidas87@gmail.com

rates at infancy or early childhood, and the overall low position accorded to women in Indian society (Arnold et al. 1998, 2002; Basu 1989; Bhat and Xavier 2003; Dasgupta 1987; Kishwar 1993; Osmani and Sen 2003; Oster 2006).

Researchers in developing countries have found that couples prefer to practice DSB as son-targeting fertility behaviour, even in the absence of sex-selective abortion (Arnold 1997; Das 1987; Wen 1992). Women with at least one son are more likely to use modern/efficient means of contraception either to maintain an ideal sex composition or to avoid an unwanted sex composition of children, which reflects a strong son-preferring behaviour among them (Amin and Mariam 1987; Arnold 1997; De Silva 1993). Jayaraj and Subramanian (2004) noted that the regressive trend in CSR could be an outcome of both biological and socio-economic factors, that is, sex-neutral reduction in foetal wastage (SNRFW). According to them, in the conception period, a male embryo has a lesser probability of surviving despite being copious in numbers. Any increase in women's well-being could, therefore, decrease the probability of foetal loss/stillbirths of male children which may then increase the CSR (Jayaraj and Subramanian 2004; Bhaskar and Gupta 2007).

The performance of West Bengal in terms of fertility decline seems exceptional during the last four decades (Guilmoto andRajan, 2002; Khan 2013). Currently, West Bengal is one of the lowest fertility states in India (1.7children/woman; SRS 2017). Studies have found a strong and significant relationship between low-fertility and decreasing CSR. Couples can ensure a small family with at least one son either by practicing female foeticides or choosing effective means of contraception (DSB), given the son-preferring low-fertility behaviour (Dey and Chaudhuri, 2009; Mukhopadhyay 2013; Saha et al. 2015).

Notably, most of the aforesaid studies have concluded that female foeticide, infanticide, and discrimination during infancy are the proximate causes of decreasing CSR in India, though a few have argued in favour of DSB. Significant evidence of sex-selective abortion has never been encountered in the case of West Bengal (Paul and Kulkarni 2006; Guilmoto 2009). The scenario might not be the same at the district level, particularly where CSR declined recently. However, the SNRFW hypothesis has not been tested through rigorous empirical procedures in India nor did it gain much popularity among Indian social scientists. Furthermore, the majority of these studies were conducted at the national level overlooking the causes of decreasing CSR at the regional and sub-regional levels.

To bridge the differences, the present study attempts to understand the causes of increasing manifestation of low CSR in West Bengal by theorising four alternative hypotheses (selective abortion of female foetuses, sex-specific childhood care differentials, sex-neutral reduction of foetal wastage (SNRFW), and fertility transition) and employing a comprehensive framework for the state of West Bengal- a middle-ranking state of India in terms of human development indicators.

Data and Methodology

Data for the present research were obtained from the fourth round of District Level Household and Facility Survey (DLHS4; 2012-2013; IIPS 2014). DLHS is designed to assemble district-level data on reproductive and child health care issues in India. The present analysis is restricted to the currently married women aged 15-49 years who had at least one living child and were non-menopausal at the time of the survey. In West Bengal, information of 24,836 ever-married women aged between 15-49 years was collected through DLHS4. In addition to this, a 'Child' file was extracted from the mother's file, using CMC (Century Months Code).

The main response variable, district-level CSR, was calculated from the Primary Census Abstract of 2011 (RGI 2013). Data concerning the district-level TFR from 1991 to 2011were drawn from secondary sources – the IIPS (2005) and Guilmoto and Rajan (2013).

Analyses for the first two hypotheses were conducted at the district level. However, while carrying out the last two hypotheses, to avoid the problem of zero-cell in regression modelling arising out of an insufficient number of cases, districts were clubbed into three regions based on their change in CSR and TFR between 2001 and 2011. These regions were- the worse-off region (the group of districts with a decreasing trend of more than 10-points in CSR such as- Jalpaiguri, Cooch Behar, Uttar Dinajpur, Malda, Nadia, and Purulia), a region with stable-change (the group of districts with a marginal changing trend such as- Murshibadad, Barddhaman, Bankura, and South 24 Parganas), and the better-off region (the group of districts with an increasing trend such as- Darjiling, Dakshin Dinajpur, Birbhum, North 24 Parganas, Hugli, Haora, Kolkata, and Midnapore).

Considering the immense diversity in the data-file used and methodology employed, the study was carried out separately for each hypothesis, considering the state

weight, for the ease of interpretation. To execute the first hypothesis whether female foeticide has any bearing on the decline in CSR, bivariate analysis for antenatal check-ups (ANC) and induced abortion were conducted. The ordinary least square (OLS) model was used to explain how a supply-side factor, that is, the distance to avail the ultrasound testing facility (a proxy predictor variable of accessibility to selective abortion) may have resulted in the decline in CSR (response variable) in rural settings. The controlled variables were- economic infrastructure, availability of healthcare & personnel, and remoteness to town (*See Appendix A*).

While examining the second hypothesis, data regarding improvement in maternal well-being were pooled together (from the individual, household, and village-level data files) to construct the main predictor variable- the degree of maternal wellbeing, using PCA (Principal Component Analysis). It is a combined index of four other composite indices namely, degree of health risk of mothers arising out of the immediate household environment, biological maturity of mothers at the time of first birth, degree of maternal healthcare utilization, and the degree of reproductive health problem among mothers. A detailed description of these variables are given in *Appendix B*. Multiple regression analyses were then used- for rural and urban settings- to understand how improving maternal wellbeing (main predictor variable) could reduce the CSR (response variable). Along with different socio-economic variables (religion, standard of living, educational attainment, work participation), various supply-side variables such as village-level economic development, availability of healthcare infrastructure, and degree of remoteness (for rural areas; see *Appendix A*) were controlled in this analysis.

For examining our third hypothesis, we considered three dummy variables (no/yes): immunization (age 12-23 months), morbidity (diarrhoea or ARI), and treatment-seeking behaviour to highlight the sex-specific childhood care differentials. Evidence to this effect was found through the multivariate binary logistic models, controlling for several confounding socio-demographic, economic, and spatial variables- mother's age, education and work-status; household's socio-religious affiliation and standard of living; and place of residence.

In conducting the fourth hypotheses, the bivaite analysis for contraceptive prevalence, fertility decline, and that related change in CSR were carried out separately, for separate regions. However, to understand the fertility desire and contraceptive choice according to the gender-parity composition, adjusted marginal effects (ME; net differentials) were employed, using logit models. For gender-parity composition, women were categorized by the number and sex composition of living children at each parity as follows: parity 1 (0 son, 1 son), parity 2 (0 son, 1 son, 2 sons), parity 3+ (0 son, 1 son, 2 sons, 3 or more sons).

$$\log\frac{p}{1-p} = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 \ldots + b_8x_8 + b_kx_k$$

P denotes the predicted proportion of the response variable and the $x_1, x_2, \ldots, x_n$ is the predictor variable in a model.

And for multivariate regression:

$$y_c = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + e$$

y_c = response variable $x_1, x_2, \ldots, x_n$ = predictor variables, e = residual, a = constant

All the data were scrutinized using Stata Release 14 (statistical software). There are a few limitations of the study that need to be pointed out. First, the cross-sectional data, used here, could have been more suitable for tracing 'spatial outline' rather than a temporal analysis. Secondly, without loss of any generalization the difference between two survey-years (DLHS4; 2012-13 and Census 2011)could be minimised, acknowledging that the change in CSR and its associated causes were inconsiderable within this short interval. Nonetheless, the present study has the ability to flesh out one of the plausible reasons for the contemporary change in CSR in West Bengal, on which studies are limited.

Results and Discussion

Trends and patterns of changing CSR in West Bengal

Table 1 and Figure 1 show the trends and patterns of changing CSR in West Bengal from 1991 to 2011. Although the provisional population total of Census 2011 (RGI, 2013) showed a 10-points decline in CSR in West Bengal between 2001 and 2011, a revised estimation confirmed a 4-points decline during the same period- the CSRs rather improved marginally between 1991-2001 and 2001-2011 (2-points in rural areas and 6-points in urban areas and 4-points at state-level). However, the district level proportionate decline in CSR confirms a substantial decline (more than 13-points) in five districts of West Bengal during 2001-11 than during 1991-01. It was primarily due to a notable decline in CSR in rural areas of Uttar Dinajpur and Purulia, and in urban areas of Jalpaiguri, Cooch Behar, and Malda. A careful look suggests that out of 18

Table 1. District-level differential of child sex ratio in West Bengal, Census 1991, 2001, and 2011

Districts	Intercensal absolute change					
	Total		Rural		Urban	
	1991-2001	2001-2011	1991-2001	2001-2011	1991-2001	2001-2011
Darjiling	-14	-9	-8	-3	-35	-12
Jalpaiguri	-4	-14	-5	-12	-1	-21
Cooch Behar	-3	-16	-4	-14	14	-34
Uttar Dinajpur	-1	-12	-1	-15	0	19
Dakshin Dinajpur	-22	-9	-20	-9	-51	-3
Maldah	4	-14	4	-5	3	-62
Murshidabad	-5	-4	-6	-4	5	4
Birbhum	-13	-5	-8	-3	-57	-16
Barddhaman	-3	-5	-5	4	2	-18
Nadia	-11	-12	-19	-10	22	-14
N24 Parganas	-11	-2	-48	28	-1	1
Hugli	-9	1	-6	-3	-14	12
Bankura	-9	-4	-10	-5	6	-4
Puruliya	-5	-11	-4	-11	-16	1
Haora	-6	6	1	3	-16	12
Kolkata	-27	6	-	-	-27	6
S24 Parganas	-9	-1	-12	-1	4	2
Midnapore[a]	-2	6	-2	3	9	8
West Bengal	-7	-4	-6	-4	-7	-1

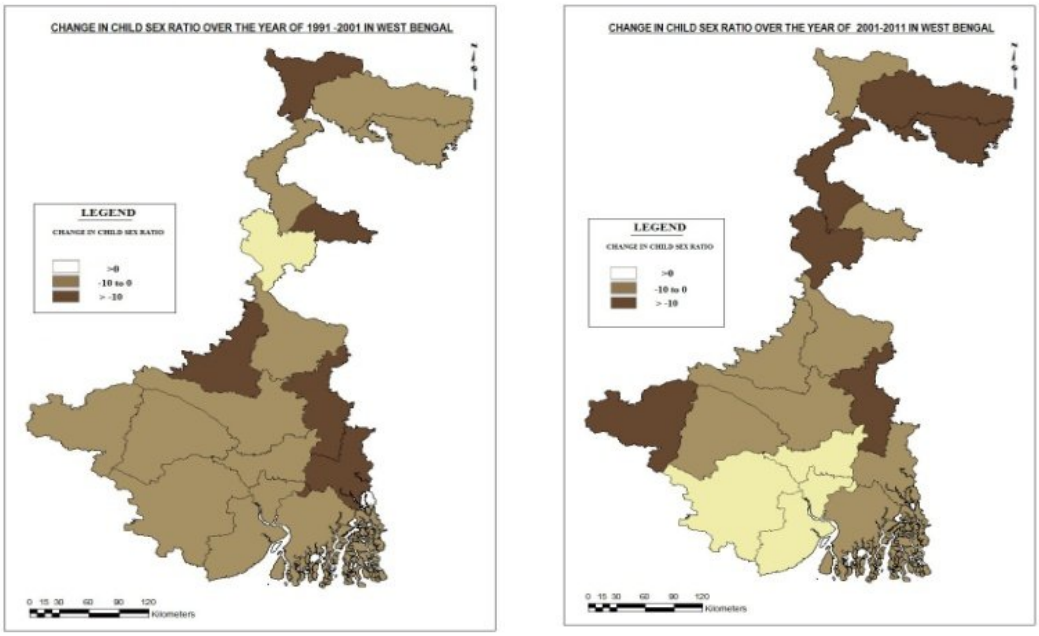

Fig. 1 : Spatial change (absolute) in child sex ratio from 1991 to 2001 and 2001 to 2011, West Bengal.
Source: Constructed from census, 1991, 2001 and 2011

districts, 11 districts of West Bengal registered an improved CSR between 1991-01 and 2001-11, of which the decline (absolute change) was higher in northern distracts than the southern.

Hypothesis 1: Female foeticide resulted in the decline in CSR

Out of all pregnancies in West Bengal, only 3.5 percent

Table 2. Percent of women (currently married aged 15-49) who received ultrasound test following induced abortion and their corresponding CSR, West Bengal, DLHS 4

Districts	Percent receiving ultrasound during ANC visit		Percent having induced abortion		Change in CSR between 2001-2011	
	Rural	Urban	Rural	Urban	Rural	Urban
Darjiling	52.56	68.38	1.92	3.42	-3	-12
Jalpaiguri	25.29	62.94	0.59	2.8	-12	-21
Cooch Behar	27.68	69.17	1.13	2.26	-14	-34
Uttar Dinajpur	33.33	67.53	4.44	0.65	-15	19
Dakshin Dinajpur	31.49	56.86	3.3	0.98	-9	-3
Maldah	38.65	70.97	2.9	3.23	-5	-62
Murshidabad	31.68	36.36	0.99	1.01	-4	4
Birbhum	39.66	56.03	1.68	0.5	-3	-16
Barddhaman	42.17	53.46	2.61	3.75	4	-18
Nadia	53.08	63.35	1.92	1.86	-10	-14
N24 Parganas	44.52	77.67	3.23	3.88	28	1
Hugli	49.08	76.79	0.92	0.89	-3	12
Bankura	32.78	47.97	3.33	4.05	-5	-4
Puruliya	22.5	52.51	1.25	4.47	-11	1
Haora	55.49	79.14	5.2	5.76	3	12
Kolkata	-	67.28	-	4.32	-	6
S24 Parganas	25.32	60.65	1.29	1.94	-1	2
Midnapore	36.14	62.39	1.55	8.3	3	8
West Bengal	37.6	61.82	3.85	2.84	-4	-1

Source: computed from DLHS4 (2012-2013) and Census, 2011

of currently married women had an induced abortion during 2012-13 and 38 percent of women underwent an ultrasound test during their antenatal check-ups. However, only 9.5 percent of currently married women had an ultrasound test before their last induced abortion.

Table 2 shows an inconsistent pattern of change in CSR, percent receiving ultrasound test and percent receiving an induced abortion in West Bengal during 2012-13. A positive correlation between CSR and the proportion of rural women who received an ultrasound test followed by induced abortion was found in North 24 Parganas. While Haora, Cooch Behar, and Jalpaiguri showed the opposite trend. A linear and supposed relation can be found only in rural area of Uttar Dinajpur and urban area of Maldah.

However, no statistically significant associations (See fig.2 and 3) were found among the proportion of urban women undergone ultrasound test, had induced abortion, and the district level change in urban CSRs (for ultrasound test and change in CSR $r = 0.25$; for induced abortion and ultrasound test $r = 0.09$). Although, rural areas showed a positive association among the variables (for ultrasound test and change in CSR $r = 0.23$; for induced abortion and ultrasound test $r = 0.57$; see fig. 2 and 3).

Evidence to the aforementioned result was further verified by employing ordinary least square (OLS) model for rural areas to establish the conjecture that socio-economically developed villages (village infrastructure, health facilities, proximity to the town, etc.) might have high accessibility to ultrasound testing facilities hence, were more likely to exposed to the process of sex selection and termination.

A positive and statistically insignificant correlation was found between distance to ultrasound testing facility and decline in CSR in 17 of 18 districts. It indicates that developed villages had high CSRs. Therefore, in line with the previous literature (Ghosh and Begum 2015; Roy and Chattopadhyay 2012), it is understood that the female foeticide hypothesis could not hold well in explaining the changing pattern of CSR in West Bengal.

Hypothesis 2: Improvement in maternal well-being resulted in the decline in CSR

Table 4 represents regression coefficients of maternal wellbeing of West Bengal according to the rural-urban

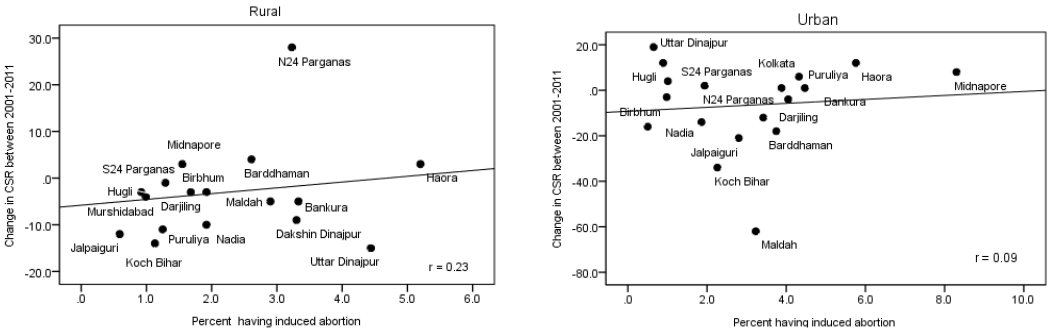

Fig. 2 : Relationship between ultrasound tests and child sex ratio, West Bengal, DLHS-4, and Census 2001, 2011

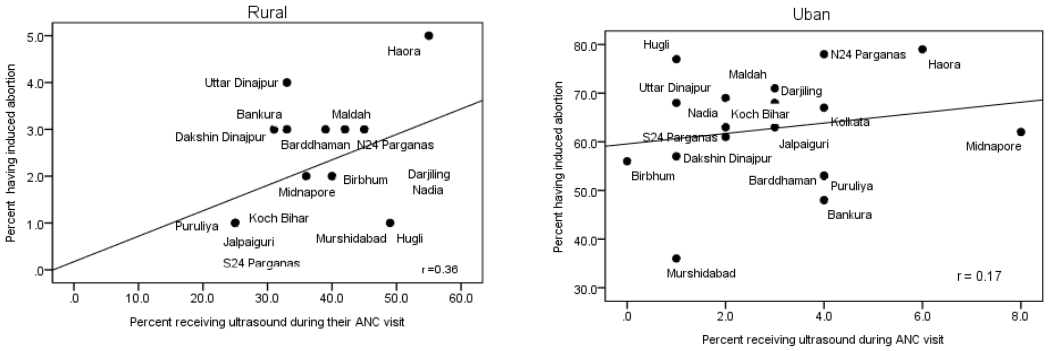

Fig. 3 : Relationship between proportions of women received ultrasound test followed by induced abortion, West Bengal, DLHS-4.

Source: Constructed from DLHS4 (2012-2013) and Census, 2011

Table 3. Degree of association between availability of ultrasound test for each district and their corresponding CSR, West Bengal, Rural, DLHS4

Districts	CF (Sig.)	R^2	Districts	CF (Sig.)	R^2
Darjiling	.085, (.670)	.107	Nadia	-.303, (.076)*	.106
Jalpaiguri	.140, (.467)	.101	North24 Parganas	.119, (.565)	.380
Cooch Behar	.118, (.446)	.087	Hugli	.073, (.611)	.443
Uttar Dinajpur	.124, (.418)	.154	Bankura	-.064, (.661)	.261
Dakshin Dinajpur	.116, (.494)	.077	Puruliya	.133, (.359)	.229
Maldah	.163, (.317)	.037	Haora	.197, (.379)	.184
Murshidabad	.200, (.223)	.134	South 24 Parganas	-.044, (.796)	.077
Birbhum	-.127, (.420)	.050	Medinipur	.007, (.952)	.034
Barddhaman	.086, (.679)	.009			

*p\0.10; *Source:* Computed from DLHS4 (2012-2013) and Census, 2011

Note: control variables are Index of remoteness (continuous), index of village infrastructure (continuous) and index of health infrastructure (continuous); R2: Coefficient of Multiple Determinations; CF: Regression Coefficients

residence during 2012-13. It can be found that out of 18 districts, urban areas of 16 districts and rural areas of 12 districts did not show any statistically significant associations between maternal wellbeing and change in CSR. In line with the supposition, negative and statistically significant associations were found only in rural areas of Cooch Behar, Dakshin Dinajpur, and South 24 Parganas, and in the urban area of Barddhaman. However, the degrees of associations rationally restricted us to conduct further analyses.

Table 4. Regression coefficients showing the degree of relationship between maternal wellbeing and their corresponding CSR, DLHS-4, West Bengal

Districts	Rural		Urban	
	CF (Sig.)	R^2	CF (Sig.)	R^2
Darjiling	-.023 (.564)	.045	.004 (.943)	.061
Jalpaiguri	.100 (.006)***	.026	.108 (.155)	.026
Cooch Behar	-.137 (.000)***	.065	.131(.158)	.133
Uttar Dinajpur	.002 (.930)	.044	.063(.428)	.071
Dakshin Dinajpur	-.079 (.023)**	.073	-.074(.390)	.178
Maldah	.007 (.798)	.103	.002(.987)	.292
Murshidabad	.007 (.775)	.157	.169(.043)**	.205
Birbhum	-.005 (.856)	.049	.091(.397)	.214
Barddhaman	.041 (.277)	.069	-.122(.024)**	.150
Nadia	.018 (.607)	.095	.098(.213)	.218
N24 Parganas	-.121 (.008)***	.169	-.015(.743)	.043
Hugli	-.082 (.030)**	.043	.011(.852)	.056
Bankura	.003 (.919)	.048	-.060(.572)	.180
Puruliya	-.018 (.531)	.128	-.087(.379)	.359
Haora	-.026 (.546)	.078	.039(.373)	.179
Kolkata	-	-	-.020(.607)	.019
S24 Parganas	.023 (.451)	.014	-.006(.931)	.172
Medinipur	.241 (.026)**	.155	.042(.846)	.039

*p\0.10;**p\0.05; ***p\0.001;Source: Computed from DLHS4 (2012-2013) and Census, 2011

Note: Main predictor variable is Maternal wellbeing and control variables are Index of remoteness, index of village infrastructure, and index of health infrastructure (continuous), religion [Hindu and Non-Hindu (binary)], caste [SC, ST, and Others (binary)], standard of living [Rich, Middle, and Poor (binary)], women work participation [Working and Non-working (binary)], and women education [actual years of school completed (Continuous)].

Hypothesis 3: Gender discrimination in immunization and childcare resulted in the decline in CSR

Table 5 explains whether immunization, prevalence of common childhood morbidities (diarrhoea and acute respiratory infections/ARI), and associated treatment-seeking behaviour have any anti-female bias which could cause undernourishment among girls, and resulted in excess girl child mortality compared to boys. A courser look can reveal that girls were more likely to be immunized and less likely to suffer from diarrhoea and ARI than boys- in two extreme regions (better-off and worse-off). However, girls who belong to the worse-off region were considerably less likely to seek treatment for those ailments. About 13 and 7.4 percent of girls were less likely to avail treatment for diarrhoea and ARI respectively.

Table 5. Percentage points of the total fully immunised Girls and percentage points of girls who sought advice/ treatment among them who suffered from diarrhoea and ARI, DLHS-4, West Bengal

	Better-off Region		Region with stable-change		Worse-off Region	
Immunisation rate[1] (12 -23 Months)	60.0		38.9		52.2	
	Diarrhoea	ARI	Diarrhoea	ARI	Diarrhoea	ARI
Suffered from Diseases (All Ages)	49.7	47.9	48.5	48.4	45.3	47.4
Treatment of Diarrhoea and ARI (All ages)	48.4	48.2	50.0	48.3	43.5	46.3

Source: Computed from DLHS4 (2012-2013) and Census, 2011

[1] BCG, three injections of DPT, three doses of Polio (excluding Polio 0) and vaccine against measles

Table 6. Sex differential in the odds ratio (OR) of children aged 11-23 months who received full Vaccination, their childhood diseases, and treatment-seeking, DLHS-4, and West Benga

Response Variables[a]	Better-off Region		Region with stable-change		Worse-off Region	
	OR	*P*	OR	*p*	OR	*p*
Fully Immunised[b]	1.142	.669	.812	.683	1.765**	.044
Suffered from Diarrhoea[c]	.842	.296	.986	.947	1.047	.763
Suffered from ARI[d]	.907	.345	1.000	1.000	.961	.711
Get treatment for Diarrhoea	.793	.203	1.041	.859	.986	.935
Get treatment for ARI	.644	.275	1.931	.273	1.555	.218

*p\0.10;**p\0.05; ***p\0.001; *Source:* Computed from DLHS4 (2012-2013) and Census, 2011

Note:[a] The principal predictor variable- sex of the child (coded 1 for male and 0 for female) – and several controls are Religion (nonHindu=1 Hindu=0), Cast [SC=1, ST=1, Others=1, Otherwise=0 (reference category- others)], Standard of living [rich=1, middle=1, poor=1, otherwise=0 (reference category- middle)], Biological maturity of a woman (>18=0 <18=1)Education of women (continuous variable based on actual years of school completed.),Women 's work participation (Worked in 12 months/7 days=1 No=0), Type of locality (Rural=1 Urban=0).

[b]BCG, three injections of DPT, three doses of Polio (excluding Polio 0) and vaccine against measles. [c d]Last two weeks prior to survey.

Table 6 unveils odds ratios (OR) and significance levels (*p*) as obtained from logit regressions, after controlling a range of potential confounders. It turned out that boys were 1.8 times (OR=1.76) more likely to receive full immunization than girls, in the region where CSR declined remarkably during 2001-11. The other two regions did not show any statistically significant association between immunisation and sex of the child. Additionally, neither the common childhood morbidities- such as diarrhoea and ARI- nor the treatment for those ailments confirmed a statistically significant relationship with childhood gender discrimination.

Hypothesis 4: Fertility decline, Differential stopping rules and decline in CSR

Table 7 suggests a simultaneous decline in TFR and CSR in most of the districts of West Bengal during 2001-11, except for a few (see table 7). The degree of correlation (r = 0.57) between absolute decline in TFR and absolute change in CSR also confirms a strong positive association between them.

Table 8 reveals that women of North Bengal (having a considerable decline in TFR and CSR) were more likely to use contraception and majority of them had restricted their childbirth after having two successive children, compared to women of South Bengal. However, fertility decline in the southern parts of West Bengal occurred much earlier, and currently, most of the couples have stopped childbearing just after having a single child (Ghosh and Begum 2015). Arguably, the issue related to contraceptive usage becomes redundant at a very low fertility situation (almost everybody started using

Table 7. Decadal change in total fertility rate and child sex ratio in West Bengal

Districts	Change in TFRs[1]	Change in CSRs[2]	Districts	Change in TFRs[1]	Change in CSRs[2]
Kolkata	-0.2	6	Jalpaiguri	-0.7	-14
Haora	-0.3	6	Nadia	-0.7	-12
Hugli	-0.4	1	Cooch Behar	-0.7	-16
Puruliya	-0.4	-11	Birbhum	-0.7	-5
Barddhaman	-0.5	-5	Murshidabad	-0.8	-4
Darjiling	-0.5	-9	South 24 Parganas	-0.8	-1
North 24 Parganas	-0.5	-2	Uttar Dinajpur	-1.1	-12
Bankura	-0.5	-4	Maldah	-1.1	-14
Medinipur	-0.6	6	Dakshin Dinajpur	-1.2	-9
Pearson's *r*		0.57			

Source: [1]Calculated from TFR Values of IIPS (2005) and Guilmoto and Rajan (2011)

[2]Census 2001 and 2011

Table 8. Percentage-point change of stopping childbearing at second order birth and contraceptive usage between third and fourth rounds of DLHS concerning the absolute change of TFR and CSR between 2001 and 2011, WB

Districts	Change in TFRs[a]	Change in 1st and 2nd order birth[b]	Change in contraceptive prevalence[c]	Change in CSRs[d]	Districts	Change in TFRs[a]	Change in 1st and 2nd order birth[b]	Change in contraceptive prevalence[c]	Change in CSRs[d]
Darjiling	-0.5	5.8	-3.9	-9	Barddhaman	-0.5	-0.4	3.5	-5
Jalpaiguri	-0.7	8.1	5.3	-14	Nadia	-0.7	7	-10.5	-12
Cooch Behar	-0.7	14.7	-0.1	-16	N24 Parganas	-0.5	11.7	-8.1	-2
Uttar Dinajpur	-1.1	15.4	8	-12	Hugli	-0.4	3.3	-9.7	1
Dakshin Dinajpur	-1.2	11.5	-0.2	-9	Bankura	-0.5	9.8	3.8	-4
Maldah	-1.1	17.2	6.4	-14	Puruliya	-0.4	6.5	14.7	-11
Murshidabad	-0.8	4.6	-4.8	-4	Haora	-0.3	8.6	-2.3	6
Birbhum	-0.7	9.7	-5.9	-5	Kolkata	-0.2	14.6	-8.2	6
North Bengal	**-0.85**	**10.9**	**0.6**	**-10.38**	S24 Parganas	-0.8	9.8	-1.8	-1
					Medinipur	-0.6	10.5	3.2	6
					South Bengal	**-0.49**	**8.14**	**-1.54**	**-1.6**

Source:Calculated from TFR Values of IIPS (2005) and Guilmoto and Rajan (2013) and Census 2001 and 2011

[a]Absolute change in Total Fertility Rate from 2001 to 2011, Calculated from TFR Values Guilmoto and Rajan (2013).

[b] change in Percent distribution of births, up to second order, to currently married women aged 15-44 years births in between DLHS3&4

[c] Change in Percent distribution of contraceptive methods used by currently married women aged 15-44 years; DLHS3 and DLHS4

[d] Absolute change in CSR from 2001 to 2011, from Primary Census Abstract of 2001 and 2011

contraception and some decline possibly attributable to sampling and non-sampling error).

Table 9 shows that women of the worse-off region have a high preference for sons, particularly up to the second parity. This preference became even strong if the couple already had a daughter at parity one. Hence, it can be argued that having only a daughter(s) was a less preferred sex-composition among the couples in West Bengal, especially where CSR declined substantially between 2001 and 2011. In the worse-off region, about 80% of women with one living daughter wanted to have another son, while it was 64% in the better-off region. Such likelihood existed up to the second parity (see table 9). For three or more parity, the likelihood of having a son decreased sparsely with an increased number of children. It could be due to the diminution

Table 9. Sex preference by currently married women (aged 15-44 years) according to their gender and parity composition, DLHS4, WB

Gender and parity Composition	Sex preference by Women							
	Better-off Region				Worse-off Region			
	Boy	Girl	Doesn't matter	Up to God	Boy	Girl	Doesn't matter	Up to God
No child	11.9	3.04	48.62	36.46	15.52	5.17	33.10	46.21
Parity 1								
One daughter	64.41	1.80	18.47	15.32	80.27	.68	7.48	11.56
One son	5.29	47.12	25.96	21.63	6.90	45.40	14.94	32.76
Parity 2								
Two daughters	77.14	11.43	2.86	8.57	87.10	3.23	0	9.68
One daughter & one son	11.11	0	55.56	33.33	8.33	0	41.67	50.00
Two sons	21.43	57.14	14.29	7.14	5.88	58.82	17.65	17.65
Parity 3+								
Three daughters	98.2	0	0	1.8	100	0	0	0
One son & two daughters	88.89	11.11	0	0	97.3	0	0	2.7
Two sons& one daughter	0	0	25	75	0	0	0	100
Three sons	0	100	0	0	0	66.67	33.33	0

*Source:*Calculated from TFR Values of IIPS (2005) and Guilmoto and Rajan (2013) and DLHS4

Pearson chi2 (p) = 0.000

of fertility desire and/or coital frequency among women, which stems from the attainment of higher ages together with reduced fecundity.

The aforementioned evidence support that differential stopping behaviour and its manifestation through contraceptive adoption and choice is mainly a son-preferring fertility behaviour (Ghosh and Begum 2015; Ghosh and Chattopadhyay 2017).

It can be seen from table 10 that in the worse-off region, the adoption of permanent methods increased by nearly 56 percentage-points among second parity women with two living sons, compared to first parity women with one living son. The difference was about 53 percentage-points in the case of better-off region. Adoption of a permanent method in better-off region (where the intercensal decline of CSR is low) increased (approximately) with increasing parity but not specifically with an increase in sons. It is possibly due to the dearth of a specific or rigid fertility choice or son preference *per se*.

With increased parity and increased number of sons, women of the worse-off region tend to shift to the modern or behavioral methods over permanent ones. There could be two reasons for this- first, couples began to use modern temporary methods over permanent sterilization, simply because they have not yet achieved their desired number of sons. Secondly, when the ideal numbers of sons remain unachieved, they moved to ineffective means of contraception, that is, they become reluctant to use any method or use only natural methods (Ghosh and Begum 2015; Ghosh and Chattopadhyay 2017).

The adjusted marginal effects (ME), obtained from the multivariate logit model, were estimated for parity by use of contraception (Table 11). Adjusted marginal effects were converted into percentages with one decimal place for ease of the interpretation.

Due to the inadequate number of cases, we made no distinction between modern temporary and permanent methods of contraception. For conducting multivariate analysis, distinction between these two methods seemed implausible and non-concave because of substantial differences regarding the choice between them.

At parity one, the probability of contraceptive use and choice of modern methods increased by 4 and 7 percentage-points respectively among women with one living son in worse-off region compared to their counterparts, who did not have a living son. While it increased only by 1 and 3 percentage-points respectively among women in the better-off region. At parity two, the likelihood of adopting a method or choosing modern methods increased evidently by 13 and 8 percentage-points respectively among women with two living sons in worse-off region compared to those who had two living daughters. The variation was only 5 and 2 percentage-points correspondingly among women in the better-off region.At parity three and above, the likelihood of adopting a method or choosing modern methods increased with an increased number of sons, except for those who had three or more sons.

Table 10. Adoption of different contraceptive methods by currently married women (aged 15-44 years) according to their gender and parity composition, DLHS4, WB

Gender and parity Composition	Better-off Region			Worse-off Region		
	Permanent[1]	Modern[2]	Behavioural[3]	Permanent[1]	Modern[2]	Behavioural[3]
Parity 1						
One daughter	2.77	60.08	29.42	6.90	52.30	40.80
One son	10.49	60.08	29.42	8.26	57.39	34.35
Parity 2						
Two daughters	44.29	44.29	11.43	30.19	49.06	20.75
One daughter & one son	58.68	29.28	12.03	50.99	31.28	17.73
Two sons	64.45	27.41	8.14	64.23	24.80	10.98
Parity 3+						
Three daughters	61.84	25	13.16	47.37	39.47	13.16
One son & two daughters	72.58	20.56	6.85	56.65	27.75	15.61
Two sons& one daughter	69.33	24.44	6.22	68.23	21.88	9.90
Three sons	67.24	25.86	6.90	61.22	18.37	20.41

Source : Calculated from TFR Values of IIPS (2005) and Guilmoto and Rajan (2013) and DLHS4

Pearson chi2 (p) = 0.000

[1]Includes female sterilization, male sterilization

[2] Intra-Uterine Device, pill, condom, female condom, emergency Contraceptive Pill and Injectables

[3] Rhythm method, Withdrawal method, contraceptive herbs, LAM and others

Table 11. Predicted probability of adoption and choices of different contraceptive methods by currently married women (aged 15-44 years) according to their gender and parity composition, DLHS4, WB.

Gender and parity Composition	Better-off Region		Worse-off Region	
	Using any contraceptive method	Using Modern[1] contraception	Using any contraceptive method	Using Modern[1] contraception
No Child (ref)	57.5	81.8	59.3	79.1
Parity 1				
One daughter	66.7**	70***	66.8**	61.4***
One son	67.5***	73.2**	70.6***	68.6*
Parity 2				
Two daughter	82.6***	88.9	66.8***	80
One daughter & one son	86.1***	87.6	77.2***	81.9
Two son	87.7***	91.3***	82.5	88.5**
Parity 3+				
Three daughter	76.3***	85.6	62.2	86.9
One son & two daughter	86.6***	92.1***	82.6***	82.9
Two son & one daughter	88.0***	92.9***	86.8***	89.3**
Three son	76.9**	91.4	82.2**	77.6

*p\0.10;**p\0.05; ***p\0.001; *Source:* Calculated from TFR Values of IIPS (2005) and Guilmoto and Rajan (2011) and DLHS4

Note: The table contains only one response variable; gender and parity composition and other controlled variables are age, age square, occupation of the respondent, place of residence, wealth index, socio-religious affiliation, media exposure. The predictor variables are those who are using any contraceptive method (binary) and those who are using modern contraceptive method (binary).

[1] Includes female sterilization, male sterilization and Intra-Uterine Device, pill, condom, female condom, emergency Contraceptive Pill and Injectables

It is evident that the DSB, as manifested through the adoption of a contraceptive method even after achieving a son at first parity and the switch to modern methods from the natural ones after achieving two successive sons at second parity could be one of the factors that have led to the recent decline in CSR in West Bengal.

The present study argues that within a region where fertility declines rapidly amidst a strong son preference, parents could ensure to have at least a son by (in the absence of female foeticide) adopting DSB. In this case, parents could stop their childbearing by using effective means of contraception as soon as they have achieved their desired number of sons or sometimes even before achieving desired sex composition. In other words, couples can stop childbearing even when the desired sex composition has not been achieved just to avoid a less preferred child (daughters).

Conclusion

In West Bengal, apart from pre-existing patriarchal normativity, two recent and interactive phenomena- a rapid decline in fertility (1.6 births per woman; SRS, 2013-15) and an intrinsically embedded or behavioural son preference make the situation more adverse for a girl child to be born and survive. By embedded we mean to say, son preference in West Bengal is not something in practice (no evidence were found to assist sex-selective abortion or gender differentials at early childhood care). However, couples somehow manage to achieve the sole desire of having at least one son by commencing differential behavioural rules in their use and choice of contraception. Women with fewer or no sons were less likely to use modern temporary means of contraception and wanted to have an additional son or continued to have children to achieve their desired number of sons- in the region where TFR and CSR declined sharply during 2001-11. Therefore, as fertility declined a positive impact of 'behavioral effect' mainly guided by covert son preference offset the 'parity effect' and consequently influenced the CSR.

Nonetheless, this work tried to portray a general idea of changing child sex ratio in West Bengal during 2001-11 and argued that the absence of sex-selective abortion or gender discrimination at childhood care did not prove that son preference among women has weakened over time. Low CSR can be seen as an impact of fertility decline as manifested through the contraceptive use dynamics. Some studies have started to argue that daughters are more dependable for emotional as well as for financial support (Visaria 1994), which may lead

to a phase where the son preference becomes weaker and the demographic consequence of son preference will no longer be influential in the declining child sex ratio. To add, the results are not conclusive *per se*, an in-depth and defendable analysis is further needed since this analysis is entirely based on the secondary sources of data. More definitive conclusions about the current trends of the child sex ratio requiresome primary data to be evaluated further.

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Appendix A:

Using data from Demographic Health Survey (DHS), PCA-based new variables were derived for every district in West Bengal. In the present analysis, four variables, namely, village infrastructure, remoteness to the nearest town, health care infrastructure, and use of ultrasound test were constructed by using the following sets of variables. First, data in categorical form were re-coded into dichotomous variables as dummy variables. Such an approach was used in order to ensure that all the data of interest for each village was measured. Descriptive analyses of all the variables were performed. Variables with a very high (more than 0.95) or a very low mean (less than 0.10) were excluded from the PCA since those indicators hardly have any variation at village level. PCA has been performed in stata software and the factor scores of the first principal component were retained. Finally, factor scores were standardised ranging from the 0 to 1 value. After that, a multivariate regression analysis was conducted.

List of dummy variables for each index:

village infrastructure: The following variables were considered: (1) source of drinking water (safe, unsafe), (2) availability of drainage facility (yes, no), (3) village electrification (yes, no), (4) covered by all-weathered road (yes, no), (5) availability of post/telegraph office (yes, no), (6) availability of STD booth (yes, no), (7) availability of pharmacy/medical shop, (8) availability of bank (yes, no), (9) availability of adult education centre (yes, no), (10) availability of youth club (yes, no), (11) availability of *mahilamandal* (yes, no), (12) availability of self-help group (yes, no), (13) availability of *paan* shop (yes, no), (14) availability of *haat*/market, (15) availability of *kirana*/general provision shop, (16) availability of credit cooperative society (yes, no), (17) availability of agricultural cooperative society (yes, no), (18) availability of milk cooperative society (yes, no) and, (19) availability of mills/small scale industries (yes, no), (20) availability of primary school (yes, no), (21) availability of middle school (yes, no), (22) availability of secondary school (yes, no), (23) higher secondary school (yes, no).

Remoteness to the nearest town: The following variables were considered: (1) Distance to nearest town (in kms), (2) distance to district headquarter (in kms), (3) distance to nearest railway station (in kms), (4) distance to nearest bus stoppage (in kms).

Heath care infrastructure: The following variables were considered: (1) availability of *Anaganwari* centre in the village (yes, no), (2) availability of sub-centre in the village (yes, no), (3) availability of primary health centre in the village (yes, no), (4) availability of private clinic in the village (yes, no), (5) availability of AYUSH health facility in the village (yes, no), (6) availability of *Anganwari* worker in the village (yes, no), (7) availability of village health guide in the village (yes, no), (8) availability of ASHA in the village (yes, no), (9) availability of trained birth attendant in the village (yes, no), (10) availability of ANM in the village (yes, no), (11) availability of lady doctor in the village (yes, no), (12) availability of private doctor in the village (yes, no), (13) availability of RMP in alternative medicine in the village (yes, no), (14) availability of traditional healer in the village (yes, no), (15) availability of untrained *dai* in the village (yes, no), (17) number of visits of Mobile Health Clinic in last three months preceding the survey in the village (in number), (18) number of health and family welfare camps in the last six months preceding the survey in and around village (in number).

Use of sonography/ultrasound test: The variable was considered: availability of sonography/ultrasound facility in the village or within 5 kms of the village (yes, no).

Appendix B:

Maternal wellbeing is the composite index of the following:

Health risks arising from environmental factors: The following variables were considered: (1) water treatment (yes, no), (2) toilet facility (yes, no), (3) Hazerdas cooking fuel (biogass) used (yes, no), (4) seperate room for kitchen (yes, no).

Maternal health care: The following variables were considered: (1) full ANC (yes, no), (2) safe delivery (yes, no), (3) post natal care within two weeks (yes, no).

Reproductive health problems: The variable was considered: 1) menstruation related problems in 3 months (yes, no),

(2) problem of not getting pregnant (yes, no), (3) last 3 months having abnormal vaginal discharge (yes, no), (4) problems during last 3 months-itching or irritation over vulvas (yes, no), (5) problems during last 3 months-boils/ ulcers/warts around vulvas (yes, no), (6) problems during last 3 months-pain in lower abdomen not related (yes, no), (7) problems during last 3 months-pain on urination or defecation (yes, no), (8) problems during last 3 months-swelling in the groin (yes, no), (9) problems during last 3 months-painful blister like lesions (yes, no), (10) problems during last 3 months-low backache (yes, no), (11) problems during last 3 months-pain during sexual intercourse (yes, no), (12) problems during last 3 months-spotting after sexual intercourse (yes, no).