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Interregional Variations of Fertility Contours in India: A multilevel modelling approach

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Abstract

Since India's independence, population stabilization has been one of the prime concerns in its development agenda. Although fertility decline in India has been underway since the 1970s, fertility levels in the northern and north-central states continue to be high. Using data from Census 2011 and other district level surveys and adopting the analytical approach proposed by Bhat (1996) the present study provides an explanation for interregional variations of fertility in India. Additionally, individual level data from National Family Health Survey-4 conducted during 2015-16 were used to compare and substantiate findings of district-level analyses. By employing multilevel linear regressions, we find that although factors representing socio-economic structure, ideational changes, and health and family welfare can adequately explain regional variations of fertility even in the present day Indian society, new forms of social entities are emerging which also contribute to fertility transition.

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We suggest that efficient implementation of family welfare programmes focusing on spacing methods for better child and maternal health outcomes is needed in the regions with high fertility. Further, propagating the benefits of small family size through mass media and community-based organizations, and socio-economic development at the macro level could play a catalytic role in this process.

Keywords: District-level fertility, Indirect Demographic Estimation, Multilevel Analysis, Regional Variation, Fertility Contour

Introduction

Since independence, population stabilization has always been one of the prime concerns of India's development agenda. A number of previous studies conducted in India and other developing countries have pointed out that limiting population growth could result in societal benefits, accelerated economic progress and overall well-being in the long run (Coale and Hoover 1958; Srinivasan 1998; Kelly 1988; Dyson 2004; Bhat 2004; Datta and Mohanty 2005). Despite various policies and programmatic efforts on maternal and child health, and family welfare, India's population has increased by more than threefold during the last six decades (Registrar General of India (RGI) 2011). As per the United Nations Revised Population Projection 2017, India shares 18 percent of the global population and would surpass China roughly by 2024 (United Nations 2017a). Although the long-term objective, as envisaged in the National Population Policy 2000,is to achieve population stabilization by 2045 (Ministry of Health and Family Welfare, 2000), recent studies have showed their concerns over uncertainty in achieving stabilization in the near future since the four larger states of northern and north-central India, namely, Uttar Pradesh, Madhya Pradesh, Bihar and Rajasthan continued to have high fertility (Das and Mohanty 2012). In a recent study, Ghosh (2018) has argued that although fertility has declined even among the northern and north-central

Indian states, significant regional divergence still persists.

Since 1990s, based on district-level analysis of census data, a number of studies have identified the variables which are responsible for stark regional fertility differentials (Malhotra et al. 1995; Murthi et al. 1995; Bhat 1996; Dreze and Murthi 2001; Guilmoto 2005; Bhattacharya 2006; Chakrabarty and Guilmoto 2005; Dommaraju and Agadjanian 2009; Das and Mohanty 2012; Mohanty et al. 2016; Singh et. al. 2017; Mohanty et. al. 2019). Among those, Bhat (1996), in his seminal work, estimated the district-level crude birth rate (CBR) and total fertility rate (TFR) for Indian major states by employing indirect methods of demographic estimation from 1981 and 1991 census data and also provided insights over the cause-effect relationship between TFR and socio-economic variables, ideational changes, and health and family welfare by adopting a holistic analytical approach. This paper is primarily focused on testing if previously identified factors by Bhat (1996) are still relevant.

In addition to the district-level analysis, the paper also examines fertility behaviour using individual level data from the fourth wave of National Family Health Survey (NFHS-4) conducted during 2015-16 to seek further validation of correlates that is used for interregional analysis. However, owing to our focus on explaining interregional variation in fertility and due to the limitation of space, coverage of discussion of individual level analysis is limited. Results of individual level analysis are attached as supplementary material (S1). The purpose behind focussing on district level analysis is to elicit the role of variables that are more relevant from the point of view of policy leverage.
It is understandable that analysis of fertility at individual level will give greater leverage to demographic and socio-economic variables in explaining the variation in fertility because these variables have higher variance at individual level when compared to district level. As a result of aggregation at district level, variance of these variables would be moderated in district

level analysis. We will elaborate on this issue while discussing findings.

In order to provide spatial insight of fertility, in this paper, we retained a number of variables that were used in one of the most cited studies in the area of India’s regional variation in fertility i.e., of Bhat (1996). Nevertheless,we have altered some of the explanatory variables because of their relevance and significance in the present-day society. The details have been discussed in subsequent sections. Further, procedure of indirect estimation of TFR and analytical model of multivariate analyses essentially differ with Bhat (1996). We deliberately restrict our analyses to the major states in India and exclude Jammu and Kashmir and north-eastern states with small territories primarily for the three following reasons. First, survey-based estimates of the districts of these states often have high standard error. Second, there is considerable intra-region variations across states of north-eastern region pertaining to different indicators used in this analysis. These two features together potentially destabilize our model estimates. Jammu and Kashmir was excluded from the analyses because of questionable data quality as found in deriving estimates of TFR, aas was found inearlier evaluations (Guilmoto and Rajan 2013; Ghosh 2018). Thus, our findings would not be compared with the aforementioned work of Mari Bhat.

Theory of fertility change

Demographic Transition Theory as propounded by Thompson (1929) and Notestein (1945) was criticised because later studies found an enormous empirical evidence suggesting thatthe origin, speed, and correlates of fertility decline vary widely across historical and geographical settings (Hirschman 1994; Mason 1997). Meanwhile, the sociological and economic explanations gained importance and it was emphasized that demographic transition itself is an integral part of the process of modernization (Kirk 1996). The importance of knowledge and preference in fertility change wasaddressed by Davis and Blake (1956).

Any change in fertility behaviour was mostly conceived in the economics literature as a result of changing costs and benefits associated with childbearing and childrearing which would lead to ‘quantity-quality trade-off’ (Becker 1960; Leibenstein 1974). Bongaarts (1978), and Bongaarts and Potter (1983) identified four factors, namely, proportion married, contraceptive adoption, induced abortion and postpartum infecundability as ‘proximate determinants of fertility’ and empirically demonstrated 95 percent of the variations can be explained by these four determinants. Mason (1997) emphasized mortality decline is a precondition for fertility decline.

In India, a number of studies tried to explain the effect of various socioeconomic factors on proximate determinants and their extent in explaining interregional variations in fertility (Jain and Adlakha 1982; Jain 1985; Rajan 2005). Later studies have found that female literacy and household poverty are significant predictors of fertility change (Jejeebhoy 1988; United Nations 1995; Parasuraman et al. 1999; Dreze and Murthi 2001; Mohanty and Ram 2011). Notwithstanding, some studies have also argued that fertility reduction is an outcome of increased acceptance of contraception in India among illiterate and poor (Bhat 2002; McNay et al. 2003; Arokiasamy 2009). Growth in availability and utilization of maternal healthcare services and increased child survival as crucial factor in declining fertility were also emphasized in some other studies (Guilmoto 2005; James and Subramanian 2005; Ramachandran and Ramesh 2005; Srinivasan and Kumar 2005). Malhotra et. al. (1995) found that level of fertility tends to vary according to socio-economic development of a district, gender bias and kinship structure. After analysing census data of 1981 and 1991, Bhattacharya (2006) found that nearly half of the decline in TFR between the mentioned censuses was caused by a reduction in child mortality, while female autonomy, female work force participation and female literacy had marginal impact in decline of TFR. However, later studies have argued that the relationship between female autonomy and fertility is not straightforward (McNay 2003; Rahman and Rao 2004; Dwivedi and Sigarwal 2008; Kalabikhina 2010).

Inadequacies in explaining determinants of fertility change give rise to the theories of diffusion and cultural lag (Carlson 1996; Casterline 2001). The concepts of innovation, diffusion and adoption were furthered to linguistic and cultural boundaries in the 1980s (Cleland and Wilson 1987). In Indian context, Guilmoto and Rajan (2002) propagated the idea of diffusion – a geographical spread from certain innovative nodal areas towards peripheries (for example, coastal areas to nearby inland and so on). Basu and Amin (2000) hypothesized social diffusion of fertility norms from 'urban elite' to 'rural masses'. However, Bocquet-Appel et al. (2002) argued that diffusion in India is a complex and non-geographical phenomenon – sudden and widespread change which was observed during 1971-81 actually occurred from centre and directed towards all information receivers irrespective of their geographical and social location. Thus centrally sponsored family planning programmes were emphasized as a driving force in fertility decline. Later Dommaraju and Agadjanian (2009) argued that changes in fertility desire and subsequent actualization in different areas and among different communities could be better understood in a broader socio-political context. According to them, a number of social and political movements in the southern states shook old foundations, enhanced individual and group security and ushered a sense of optimism which might have influenced aspiration for adoption of small family norms. On the other hand, lack of socio-political transformation, and individual and group mobility in the northern states could have resulted in stagnation of fertility desire.

In this paper, we would like to argue that although Mari Bhat's holistic approach to understand regional variations of fertility transition in India is still relevant in present-day Indian society, new forms of social institutions are emerging and would contribute to fertility transition in India in future.

Materials and Methods

Data and methods for estimation of district-level total fertility rates (TFRs)

District-level TFR was calculated by Ghosh (2018) using Census 2011 data on number of women by present age, and number of births in last year (before the Census year). First, state-level TFRs were estimated by using Arriaga variation of P/F ratio method and were compared with the state-level estimates of Sample Registration System (SRS). At the state-level, correlation between SRS estimates and estimates obtained from Ghosh (2018) were found to be 0.961. After finding such a high degree of correlation between the two estimates, Ghosh proceeded towards district-level estimation of TFR by using the same methodology. The district-level estimates were also compared with the estimates provided by Guilmoto and Rajan (2013) and a very close correspondence (correlation coefficient = 0.978) was found and results were thus validated. In the present analyses, we have used the estimates of TFR derived by Ghosh (2018). For details of assumptions and computation procedure please refer to Ghosh (2018).

Data and variables for multilevel analyses at district level

Data for the present study have been drawn from a variety of sources. TFR per 100 women as derived by using Arriaga version of P/F ratio method from census 2011 data were used as response or outcome variable in multivariate models.

Table 1 presents the description, data sources, means and standard deviations of the explanatory variables along with their expected relationships with fertility in a multivariate framework. These variables were calculated (or directly obtained) from census 2011, fourth round of District level Household and Facility Survey (DLHS) conducted during 2012-13 and Annual Health Survey (AHS) conducted during 2011-12. Since neither DLHS nor AHS data were available for the state of Gujarat for the aforesaid period, third round of DLHS which was carried out

Table 1: Description, mean and standard deviation of explanatory variables used in multivariate analyses and their expected relationship with total fertility rate

Variable name	Description along with data sources	Mean	Standard deviation	Expected relation-ship
Variables representing economic structure				
Male workers in agriculture	Proportion of agricultural workers among total male workers (Main),2011 Census	53.2	19.0	+
Agricultural labourers	Proportion of agricultural labourers among total agricultural workers (Main), 2011 Census	43.3	18.2	?
Female work force participation	Proportion of female main workers aged 7 years and over, 2011 Census	18.2	9.9	–
District level development				–
Bank account	Proportion of households has bank account, 2011 Census	58.3	15.6	
PDS shops	Proportion of villages in a district having PDS shops, 2011 Census	60.3	18.3	
Electricity	Proportion of households has electricity connection, 2011 Census	63.5	29.1	
Sanitation facility	Proportion of households has sanitation facility, 2011 Census	41.7	24.4	
Institutional delivery	Proportion of delivery that have taken place in institution, DLHS, 2012-13; AHS 2011-12	69.0	23.1	
Full immunization	Proportion of children of aged 12-23 months who are fully immunized, DLHS, 2012-13; AHS 2011-12	63.1	15.5	

Variable name	Description along with data sources	Mean	Standard deviation	Expected relation-ship
All weather road	Proportion of villages in a district covered by all-weather road, 2011 Census	37.2	24.8	
Variables representing social structure				
Joint/extended family	Proportion of households having more than one married couple, 2011 Census	18.4	5.9	+
Female age at marriage	Mean age at marriage among girls, DLHS, 2012-13; AHS 2011-12	20.8	1.3	–
Child sex ratio	Number of girls per 1000 boys of age group 0-6 years, Census 2011	921	42	–
Muslims	Proportion of Muslims, Census 2011	11.7	12.6	+
Scheduled castes	Proportion of scheduled castes, Census 2011	16.8	8.0	–
Scheduled tribes	Proportion of scheduled tribes, Census 2011	11.9	19.0	?
Variables representing Ideational factors				
Female literacy	Proportion female literate of age 7 or more, Census 2011	62.7	12.2	–
Media exposure				
Transistor/radio	Proportion of households having transistor/radio, Census 2011	18.2	8.4	
Television	Proportion of households having television, Census 2011	42.7	24.2	
Computer/laptop with internet	Proportion of households having computer/laptop with internet, Census 2011	2.1	2.9	

Variable name	Description along with data sources	Mean	Standard deviation	Expected relation-ship
Mobile phone	Proportion of households having mobile phones, Census 2011	51.3	14.1	
Self-help group	Proportion of villages having self-help group, Census 2011	67.0	27.2	
Variables representing health and family planning				
Under-five mortality	Under-five mortality rate, Ram et al. 2013	56.5	22.1	+
Unmet need	Proportion couple reported unmet need for contraception for limiting and spacing (total), DLHS-2012-13, AHS-2011-12	22.1	11.1	+
Availability of primary healthcare providers				
ASHA	Proportion of villages having ASHA, Census 2011	78.4	17.4	
Anganwari Workers (AWW)	Proportion of villages having AWW, Census 2011	80.8	14.9	
Paramedics PHC	Proportion of villages having paramedical staff of primary health centre, Census 2011	48.5	2.9	
Paramedics HSC	Proportion of villages having paramedical staff of health sub-centre, Census 2011	26.5	29.4	

Source: Conceptualized by the author

during 2007-08 were considered for the analyses. As mentioned earlier, although we have tried to keep the explanatory variables used by Bhat (1996) considering their importance in the Indian context even in the recent past, we have also excluded some variables because of their decreased importance over the time, while including some new variables due to their increased significance. For instance, proportion of child labour has reduced to a significant extent during last three decades or so and according to census 2011, 3.9 percent of the total child population were working either as 'main' or 'marginal' workers. For this reason, we have not considered this variable in the present study. On the other hand, we have incorporated mobile phone and computer/laptop with internet facility while computing degree of media exposure. Further, we have also considered percentage of villages having self-help group in a district as an explanatory variable due to its increased significance in fertility reduction. We have categorized the explanatory variables in the line of Bhat (1996). These categories are: (1) variables representing economic structure of the society, which would have significant bearing on fertility; (2) variables related to socio-demographic, cultural and gender differentials affecting fertility; (3) factors governing ideational change; and (4) indicators signifying child health and family welfare efforts.

Structural aspects of the economy conceivably are represented by the proportion of male agricultural workers, agricultural labourers, female workforce participation and level of development of districts. Lesser proportion of male agricultural labourer would likely to be related with higher level of industrialization and urbanization, which are essential pre-requisites for fertility transition according to classical demographic transition theory. Also, higher female workforce participation in wage earning sector activities should have negative association with fertility. However, in order to overcome high level of endogeneity between female workforce participation rate and other explanatory variables, the former was dropped while carrying out multivariate analyses. We have employed factor analysis to assess the level of development of districts with the following variables: proportion of households with bank account, electricity, sanitation facility; proportions of villages having shops pertaining to public distribution system (PDS) and all-weather roads; and proportion of institutional delivery and proportion of children(12-23 months of age) getting full immunization in a district. The resulting scores were normalized. The normalized factor score was intended as a rough proxy of overall development of a district and was expected to have a negative relation with fertility. Although traditional view suggests that poor (agricultural labourers are taken as a proxy) would breed more because of need of family labour, poor could also try to limit their family size in order to provide better life for their children when infant mortality declines and cost of fertility regulation is minimal (Kulkarni, 2011). Such ambiguous relationship should be examined in the present context.

We have tried to capture the influence of social structure and patriarchy on fertility through the following variables: proportion of households having more than one married couple (proxy for joint/extended family), female age at marriage, child sex ratio and proportions of Muslims, scheduled castes and tribes in the population. Joint/extended family system has a potential to promote high fertility because of lack of women's autonomy, particularly that of young women, in such households. Further, in such households the cost and care for children are often shared within the family itself. Female age at marriage is one of the important proximate determinants of fertility which directly influences supply of children in Indian context. Moreover, it is regarded as a powerful indictor of women's status in larger societal context. Presumably child sex ratio is another very important indicator which could reflectthe regional variations in gender discriminations against women and an appropriate measure of female autonomy. However, studies have also argued that sex ratio at birth and child sex ratio could be linked to sex neutral reduction of foetal wastage and differential stopping behaviour (Jayaraj and Subramanium 2004; Clark 2000; Das 2014). Fertility also varies across socio-religious affiliation in India. Though most of these studies have argued higher fertility among Muslims in India is a 'pure' religion effect (Alagarajan and Kulkarni 2008; Bhat and Zavier 2005; Dharmalingam et al. 2005; Dharmalingam and Morgan 2004), some studies have argued that systematically worse economic conditions could have resulted in higher fertility among Muslims (Shariff 1995; Jeffery and Jeffery

2000; Sahu et al. 2012; Haque and Patel 2016). Moreover, studies have found that fertility level within a religion varies substantially according to geopolitical space (development policy and programme implementation) (Ghosh and Chattopadhyay 2017; Sahu et al. 2012). Scheduled tribes (STs) are generally least influenced by the forces of 'modernization' because of their physical remoteness, lack of education and media exposure and thus conceivably have higher fertility compared to other social groups. At the same time, as Bhat (1996) argued that whenever tribes come into contact with modernization, they tend to accept family planning methods because of higher women's autonomy and perceived incentives. However, recent studies have shown that acceptability of contraception was substantially higher among scheduled castes (SCs) compared to STs (Ghosh and Siddiqui, 2017) and thus we can expect a negative association between fertility and proportion of SCs.

Female literacy and mass media exposure were classified into ideational variables as it is through education and media exposure that innovations and ideas are transmitted or diffused socially as well as geographically. It is a well-established fact the female literacy negatively affects fertility. Studies have also recognized the role of mass media exposure as an instrument of ideational change, which indeed influenced the fertility decline in developing countries including India (Westoff and Bankole 1999; Barber and Axim 2004). By employing factor analysis on the variables, namely, proportions of households having transistor/radio, television, computer/laptop with internet, and mobile phone, factor scores representing exposure to mass media were obtained. The scores were then normalized and used in multivariate models to ascertain its effect on fertility decline. Although there is little documentation in the Indian context on mapping the exact mechanism of ideational change and fertility behaviour brought about by the presence of self-help group in a village, available evidence do suggest that participation of women in self-help/microfinance groups has positive and significant effect on embracing contraception and fertility decline in India and Bangladesh (Basher 2007; Duvendack and Palmer-Jones 2016; Ghosh and Siddique 2017) and thus is being considered as a ‘catalyst’ to fertility decline in the present analysis.

We have considered prevalence of under-five mortality, unmet need for family planning and availability of grassroot level healthcare providers as variables representing health and family planning. It is a well-established fact that reduction in infant and child mortality has strong and positive influence on fertility decline as demand for children reduces when survival probability of children enhances. The district level estimates for under-five mortality were obtained from Ram et al. (2013). They had estimated mortality by pooling various survey data and thus error involved in such calculation is not likely to be correlated with error involved in fertility estimates from census and thus can be used. Although Bhat (1996) suggested using the instrumental variable approach for under-five mortality, it is often difficult to find data for variable(s) which is strongly correlated with child mortality but theoretically unrelated to fertility. In our multivariate analyses, we have retained this variable as we found exclusion of it reduces explanatory power of the model. However, reduced model estimates (i.e. after excluding under-five mortality) and distribution of total variance in the reduced model were given in the Appendix Tables A3 and A4 for comparison.

Although percentage of contraception demand satisfied (i.e., use of contraception among those who want to avoid pregnancy) would be a better proxy indicator to gauge performance of family planning programme, we could not use this variable because of informational constraint. Instead, we have considered unmet need of family planning as a proxy of performance of family planning programme and its regional variations in the present model. It is expected that areas with high unmet need for family planning would have high fertility rates as well.

Arguably, availability of grassroot level healthcare providers in villages would facilitate uptake of maternal and child healthcare services, positive health behaviour, contraceptive awareness and thus affect reduction of maternal and child mortality and in turn reduce fertility. Like mass media exposure, we have computed the normalized factor scores of primary healthcare providers for districts by employing factor analysis model on the variables representing availability of Accredited Social Health Activist (ASHA), Anganwari worker (AWW), paramedical staff at Primary Health Centre (PHC) and Health Sub Centre (HSC) at the village-level.

Since earlier studies (Rele 1987; Bhat 1996; Spoorenberg and Dommaraju 2012) have pointed out significant variations in fertility as well as different background characteristics according to region, five regions, namely, south, north, north-central, east and west have been created from 536 districts of 19 states. The districts of the states of Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Kerala formed ‘south’, while ‘north’ comprised of the districts of Himachal Pradesh, Uttarakhand, Punjab and Haryana. Districts of Gujarat, Maharashtra and Rajasthan formed the ‘west’, while ‘east’ comprised of the districts of West Bengal, Odhisa, Jharkhand and Assam. ‘north-central’ region consists of the districts belong to states of Madhya Pradesh, Chattisgarh, Uttar Pradesh, and Bihar. Districts belonging to states of North-east India except Jammu and Kashmir and other smaller states and union territories were not considered for the study for reasons described above.

Data and variables for multilevel analyses at individual level: Effort has been made to use all the relevant variables in the context fertility choice that are available in NFHS4 data. Obviously, a chunk of variables is common to district level correlates of district level analysis and some of the district level variables are replaced by either household level or individual level variables. For instance, district development index is replaced by household wealth index, variables representing media exposure at the household level are substituted by individual level exposure to television, radio and newspaper, district-level child mortality is replaced by number of child loss at the individual level etc. Important omission in case of individual level analysis is workforce participation because district-level module did not collect workforce participation for both females and males. The variable 'meet and discuss family planning during last three months' at the individual level is considered as proxy for 'availability of primary healthcare providers' at the district-level.

Multilevel analysis of district level dataset

Key motivation for employing multilevel modelling is that ordinary least square method (OLS) is prone to producing larger standard error of regression coefficients in presence of clustering of observations. Upon comparing standard errors produced under two methods, multilevel models indeed had smaller standard errors. Thus, multilevel model yielded conservative confidence intervals while retaining the explanatory power that was achieved under least square method.

Multilevel model was thus used recognising regionally clustered nature of units of analysis, i.e., districts clustered within regions. In addition to random component of individual districts, random component relating to regions within which districts are nested was introduced in order to capture unobserved variations that might be due to nesting of districts within regions. We avoided nesting of districts within states due to very high degree of similarity among districts falling within a given state leading to insignificant within-group variance.Nesting is employed because two districts from same region are likely to be more alike than two districts from two different regions. Multilevel model not only helps in correction of standard error of estimates in regression but also uses nesting as additional source of information (Merlo et. al. 2005). Such a model can be specified in following manner

$$y_{ij} = \alpha_0 + \sum_{1}^{K} \beta^k X_{ij}^k + \rho_j + \delta_{ij}$$

In the above equation y_{ij} represents fertility rate of district i in region $j.\alpha_0$ represents intercept, β^k is slope of coefficient of k^{th} independent variable, δ_{ij} is the random error term for individual district while ρ_j is the random intercept of region in which districts are nested as per our assumption.

Following the above specification variations in fertility across districts were modelled. Five multilevel linear regressions with different sets of independent factors were introduced in a step-wise or cumulative fashion. The first model was intercept only model, which did not include any explanatory variable. In other words, we examined the extent to which variance in dependent or outcome variable, that is, fertility per hundred women across districts can be attributed to its national mean, and two random components relating to districts and region respectively that were mentioned in specification.

In Model 1, two variables representing economic structure, namely, proportion of male workers in agriculture and agricultural labourers were included. Model 2 included normalized factor scores of district-level development along the variables of the model except for proportion of male workers in agriculture because of high multicollinearity between these two variables. In Model 3, variables representing social structure and ideational change were added to Model 2, except for normalized factor score of district level development and proportion of male workers in agriculture because of their multicollinearity with some of the variables representing social structure and ideational change. Model 4 incorporates variables indicating health and family welfare measures and includes normalized factor score of district-level development, while dropping normalized factor scores of media exposure because of multicollinearity amongst the aforesaid variable.

Estimating the models in this way allows testing the significance of the association of total fertility rate with economic structure, social structure, ideational factors, factors affecting health and family planning services after controlling for potential confounders in a stage-wise manner. Such modelling procedure also permits the identification of factors that reduced the significance of the variable of interest in each model and corresponding changes in R-square, region random effect and district random effect, hence enabling the identification of variables that are associated with fertility behaviour.

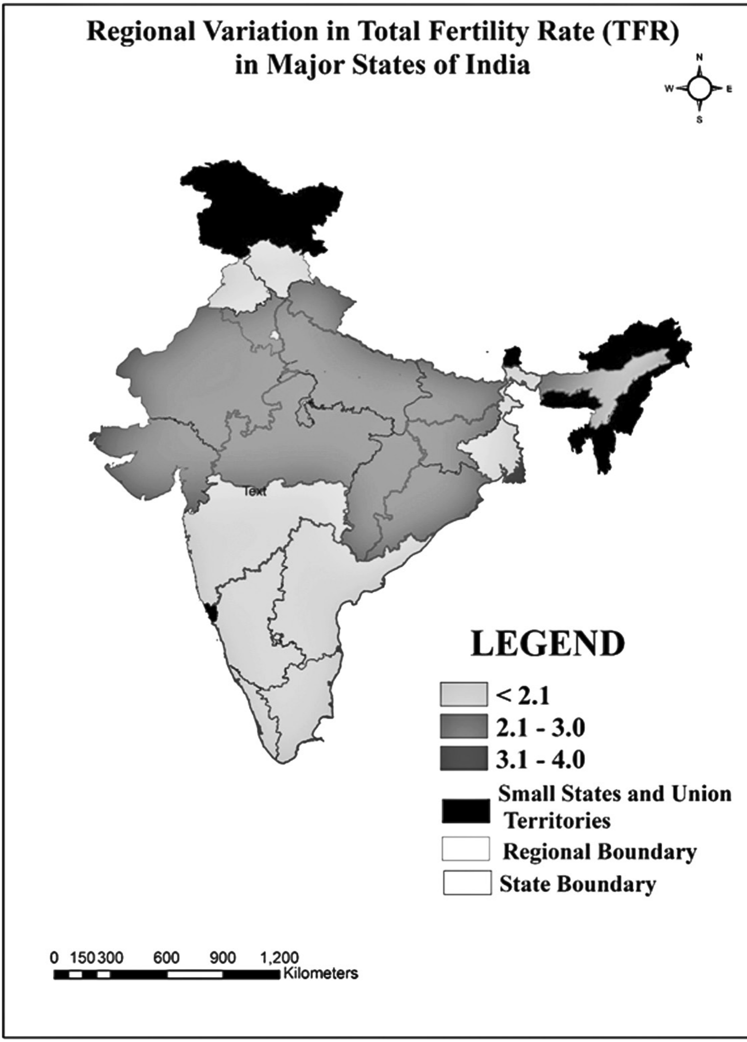
Multilevel analysis of individual level data

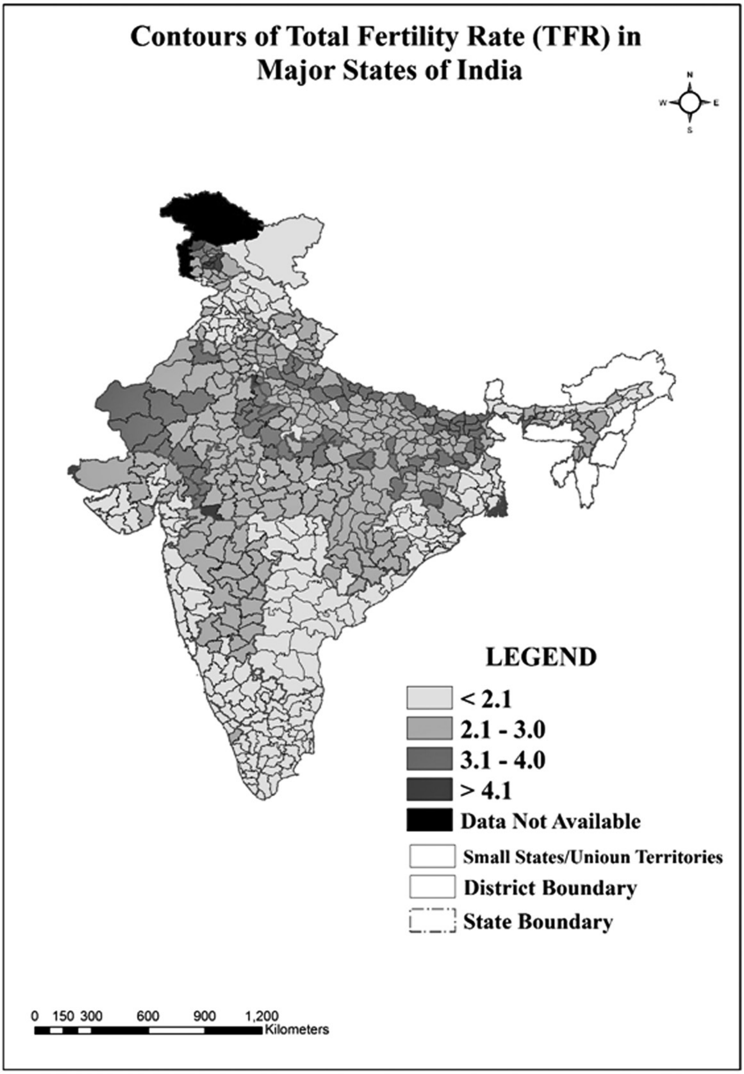
The eventual model i.e., Model 4 was also executed at individual mother level using the latest NFHS-4 data. However, random components or clustering schema in individual mother level model is different. In this model individual mothers were modelled as if they were clustered within PSUs (village or urban block) and further PSUs were also clustered within districts. Thus, individual level regression has two additional random components (three level regression) representing clustering effect of PSUs and districts on mothers' reproductive choices.

Results

Fertility contours in India

As mentioned earlier, district-level estimates of TFR were obtained from Ghosh (2018). Appendix Table A1 and Map 1 depict fertility contours in India. At the time of Census 2011, India had 640 districts, out of which 536 districts accounting for 97.6 percent of Indian population were considered for this study. Notably, more than 46 percent of 536 Indian districts under this study are at or below replacement level TFR. Decline in fertility is already underway in additional 43 percent districts (TFR lies between 2.2 and 3.0). Thus, 89 percent of 536 study districts has either achieved replacement level of fertility or has low TFR, though with substantial variations across states and regions, as revealed in Map 2.




Contours of Total Fertility Rate (TFR) in
Major States of India
N
W
E
S
LEGEND
< 2.1
2.1 - 3.0
3.1 - 4.0
> 4.1
Data Not Available
Small States/Unioun Territories
District Boundary
State Boundary
0 150 300 600 900 1,200
Kilometers

Map 2 reveals regional variation of fertility contours in India. All the districts of the two states of southern region, namely, Andhra Pradesh and Tamil Nadu and the state of Punjab of northern region are at or below replacement level fertility, while none of the districts in Bihar hasachieved such level. Except West Bengal, majority of the districts of north-central and eastern region are currently undergoing fertility decline. Notable inter-district variations in fertility was observed in the states of eastern region, Rajasthan and Gujarat of western region, Madhya Pradesh in north-central region and Himachal Pradesh in northern region.

Regional variations of explanatory variables

Variables representing social and economic structure, ideational factors, and health and family planning show a substantial regional variation and sometimes go against classical demographic transition theory (Appendix Table A2). For example, although majority of districts in southern region have undergone fertility transition, a very high proportion of workers were reported as agricultural labourers. Regarding the development indicators of districts, one can ascertain that the districts of south, west and north outperformed the districts of east and north-central.

Appendix Table A2 also revealed that mean age at marriage was marginally higher in northern and southern regions (21.6 and 21.2 years respectively) compared to other parts of India. Districts of eastern region have higher child sex ratio in favour of girls followed by the southern region, while districts of northern region and the western region (896.8 girls per 1,000 women) show anti-female bias in child sex ratio. Proportions of Muslims as well as STs were found to be the highest in eastern region, while northern region has the highest proportion of SCs.

Female literacy was found to be the highest – almost seven out of 10 women in the districts of south and north were literate, while it was found to be the least in the districts of north-central region (55.7 percent). Districts of south, north and west out performed the districts of north-central and east as per exposure to mass media. Notwithstanding, proportion of villages with self-help groups were found to be the highest in south followed by east and north-central.

Unmet need for the family planning was found to be the highest in north-central states and the lowest in the western region, whileunder-five mortality was found to be the highest in the north-central region and the lowest in the southern region (35 per 1,000 live-births).

Results of multilevel analyses

Table 2 presents coefficients and t-ratios of multilevel analyses while Table 3 describes distribution of total variance in TFR by components of different multilevel regressions models(in percentage).

Intercept only model is supposed to be a benchmark model for tracking changes in distribution of variance in dependent or outcome variable into different components of the models i.e, fixed and random components as we gradually introduce explanatory variables in the model. Essentially, our modelling distributes variance of TFR into three components, namely, fixed component, random component of region and lastly the random component of district itself. In Intercept only model, fixed component has only mean of dependent variable as explanatory variable. The fixed component in this specification explains only 6.7 percent of the total variance in dependent variable while region level random effect explains about 32.1 percent, while the remaining 61.2 percent (=100-6.7-32.1) of variance is attributable to district itself. Our interest, in addition to identifying significant independent factors affecting fertility, lies in examining changes in relative contribution of these three components in total variation of fertility rate as a new set of independent variables are introduced to the model in a gradual manner.

In Model 1, we have incorporated the variables representing economic structure, except normalized factor scores indicating level of development. In Model 1, proportion of male workers in agriculture has significant positive effect on TFR, while proportion of agricultural labourers has negative and significant effect on TFR. As a resultofthe introduction of these two variables in the model, the share of fixed effect in explaining total variance of dependent variable went up quite significantly – from 6.7 percent as reported in Intercept only model to 42 percentin Model 1 (Table 4). One the other side contribution of regional and district level random intercept effects reduced significantly – from 32.1 percent to 16.8 percent for regions and from 61.2 percent to 51.4 percent for districts.

In Model 2, when we have dropped proportion of male workers in agriculture and included normalized factor scores indicating district level development, it was found that apart from the proportion of agricultural labourers, normalized factor scores of district-level development also has negative and significant effect on TFR. As for distribution of variance into different components, fixed effect could explain higher percentage of total variance in dependent variable. It increased to 65.8 percent in Model 2 compared to 31.8 percent in Model 1. Both regional and district level random components declined further. Regional effect reduced to 6.9 percent compared 16.8 percent of Model 1. Similarly, district level effect fell from 51.4 percent (in Model 1) to 27.3 percent in Model 2.

In Model 3, we have found that in addition to the significant negative association of economic variable such as proportion of agricultural labourers, significant positive effect of proportions of joint/extended family and Muslim population was observed with TFR. As expected, proportion of SCs, existence of self-help groups, female literacy, and normalized factor scores of media exposure have significant negative effect on TFR. Upon adding variables relating to social structure, explanatory power of fixed effect increased by more than two percentage points while contribution of random components at both levels, that is region and district declined marginally.

Upon inclusion of variables representing health and family planning in Model 4, we found that higher under-five mortality and unmet need for family planning significantly facilitate higher number of children in addition to the variables indicating economic and social structure and ideational change. Model 4 is our final model. The fixed effect component of Model 4 explained about 73.4 percent of the total variation in TFR across districts of India. Regional random effect ended up with relatively small share, that is, 3.3 percent, while unexplained variation at district level still commanded 23.3 percent of the total variation in TFR across districts of India.

In a nutshell, it was found that almost all variables which were considered in different models comprising socio-economic structure, ideational change and health and family planning turned out to have significant relationship with fertility except female age at marriage, proportion of STs and normalized factor score indicating availability of grassroot level healthcare providers in village.

We have obtained more or less a similar result of multilevel models carried out at the individual level data which has been provided inTable S3 of Supplementary Material. Notable exception is female age at marriage. Female age at marriage is found to have significant negative influence on children ever born at the individual level, but not at the district-level. One can note that the coefficient of variation for female age at marriage for district level is 6.25 percent and corresponding value at individual level is 23.33 percent. At the same time, district level analysis allows us to use additional set of variables as correlates which have policy relevance but are not available in NFHS 4 dataset. For example, index of availability of primary healthcare providers, self-help

Table 2: Coefficients and t-ratios of multilevel multivariate linear regression model identifying factors associated with TFR

Fixed effects	Intercept only	t-ratio	Model 1	t-ratio	Model 2	t-ratio	Model 3	t-ratio	Model 4	t-ratio
Intercept	219.58	14.82***	189.436	14.40***	485.248	53.101***	559.667	55.250**	481.3249	52.620***
Economic structure Variables										
Male workers in agriculture			.991	9.17***	---	---	---	---	---	---
Agricultural labourers		-0.480	-4.10***	-0.569	-6.41***	-0.175	-1.89*	-.270	-2.93***	
Normalized factor score representing economic status					-1.728	-15.84***	---	---	-.984	-7.25***
Social structure										
Joint/extended family					2.31	7.95***	1.790	6.11*	1.913	6.98***
Female age at marriage					-2.236	-1.74*	-0.909	-0.65	-1.680	-1.29
Child sex ratio					-0.166	-3.36***	-0.200	-3.94 ***	-.158	-3.43***
Muslims					1.214	9.63***	1.039	8.23***	1.022	8.64***
Scheduled caste					-0.109	-0.49	-0.797	-3.38***	-0.601	-2.79***
Scheduled tribe					0.279	2.59***	.021	0.19	0.139	1.34

Fixed effects	Intercept only	t-ratio	Model 1	t-ratio	Model 2	t-ratio	Model 3	t-ratio	Model 4	t-ratio
Ideational factors										
Female literacy							-1.917	-10.57***	-0.994	-4.88***
Normalized factor score of mass media exposure							-.6329	-5.05***	---	---
Self-help group							-.261	-3.74***	-0.272	-4.24 ***
Health & Family Planning										
Under-five mortality									0.272	3.04***
Unmet need									0.383	3.11***
Normalized factor score of availability of primary healthcare providers									.134	1.72
Radom Variance of region	1075.935		562.1798		231.8903		186.9816		110.7321	
Random variance of District	2053.434		1723.909		914.6811		890.8205		779.4785	

Table 3: Distribution of total variance in Total Fertility Rate by components of multilevel regression for different (in %)

Components of Variance	Intercept only	Model 1	Model 2	Model 3	Model 4
Model ($\hat{Y}$) explained	6.65	31.80	65.80	67.85	73.44
Region random effect	32.10	16.77	6.92	5.58	3.30
District random effect	61.26	51.43	27.29	26.57	23.25

group memberships among women etc. which are important contextual variables and might have significant influence on interregional variation of fertility in India. Results from multilevel level modelling of individual level data substantiates this as random component associated with district absorbs around 5 percent of total variation in outcome variable (number of children ever born under alternative modelling scenarios). This implies that individuals' reproductive choices may get affected by such contextual variables. However, village level random component does not seem to absorb any significant proportion of variation in number of children ever born.

Discussion

Fertility transition in India is of great interest and significance to the experts because of it has significant influence on global statistics on fertility. There are three main findings that emerge from this study.

First, although fertility transition in India has started during 1970s, one can argue that the fertility decline has been relatively slower compared to Bangladesh and Sri Lanka, while faster than Pakistan and Nepal in the Indian sub-continent. Our findings suggest that about half of the districts have reached below replacement level of fertility, while another 40 percent have reached moderately low fertility. Despite observed reduction of fertility at the national level, majority of the districts of northern and north-central states of Rajasthan, Uttar Pradesh, Madhya Pradesh and Bihar continued to have moderately high fertility. According to the current estimates, TFR was found to be the highest in Mewat in Haryana (TFR=5.5 per woman) followed by Barwani and Alirajpur of Madhya Pradesh and, Barmer and Jaisalmer of Rajasthan (TFRs are 3.9, 3.8 and 3.7 respectively). This is not a healthy sign as earlier studies (Das and Mohanty 2012) have rightly pointed out that increased population pressure has a potential to nullify the developmental efforts at macro as well as at micro-level. However, it is interesting to note that despite relatively higher fertility rates in these states, overall TFR of India is expected to reach replacement level in near future because TFR in a number of states have declined to below replacement level and are expected to decline further before they stabilize. States like Gujarat in the west, Uttarakhand in the north, Chattisgarh in the central and Assam and Odisha in the east show such pattern.

Second, the results of multilevel linear regression analyses indicate that factors representing socio-economic structure of the society, ideational change and implementation of health and family welfare programmes as postulated by Mari Bhat two decades ago, are still relevant in explaining regional differentials in fertility transition. These factors are of particular importance because currently more than half of the districts are yet to reach replacement level of fertility. These factors have significant implications on fertility and its regional variations as revealed by earlier studies which were carried out by using district level data (Dreze and Murthi 2001; Bhat 2002; McNay et al. 2003; Guilmoto 2005; Chakrabarty and Guilmoto 2005; Bhattacharya 2006; Das and Mohanty 2012). This, in turn, implies that below replacement level fertility can occur despite slow and uneven socio-economic development and gender asymmetry at the macro level (Säävälä 2010). It is realized that improvement of socio-economic indicators like industrialization and women's workforce participation; ideational factors such as female literacy, mass media exposure etc. and reduction of child mortality and unmet need for family planning are necessary but not sufficient conditions of fertility decline. In other words, not only the endowments (or covariates), access to or quality of programmes which have been implemented (or returns to those endowments) at the macro-level – seemed to have important implications on fertility reduction. Das and Mohanty (2012), for example, have noted that despite rising female literacy in many north Indian states since last two decades TFR did not decline proportionately. They have instead emphasized on role of increase in contraceptive use, increase in age at marriage of women and reducing child mortality in reducing TFR in these states.

Notwithstanding, Säävälä (2010) has argued that these factors may not sufficiently explain fertility decline and also act in context-specific manner. For example, studies have established that fertility transition in India is primarily because of its decline among illiterate women (Bhat 2002; McNay et al. 2003; Arokiasamy 2009). These studies indicate possibility that idea of 'quantity-quality trade-off' in bringing up offspring has also penetrated among illiterate women, as they are increasingly embracing contraception. Experts hinge on increased exposure to mass media and significant increase in infant and child survival for explaining the hypothesisedquality-quantity trade-off at low level of literacy.

Women's age at marriage was identified as one of the proximate determinants of fertility (Bongraats 1978; Bongraats and Potter 1983) and has substantial bearing on their life-time fertility (Padmadas et al. 2004), though the present study could not find any significant effect of age at marriage on fertility. To note, successive rounds of large-scale survey data have revealed that age at first marriage in several states of India has been increasing very slowly and does not vary much across regions (Appendix Table A2). However, in spite of low age at first marriage and child bearing, fertility transition has taken place in various states in India in general, in Andhra Pradesh and West Bengal, in particular (IIPS and ORC Macro 2000; IIPS and Macro International 2007; Säävälä 2010; Paul and Kulkarni 2006). Studies have shown that in many states of India women tend to marry early, have their children narrowly spaced and opt for sterilization, which has led to dire compression of effective reproductive span (Padmadas et al. 2004; Matthews et al. 2009; Ghosh 2016a).

Additionally, owing to our unit of analysis being district instead of individual, variation in age at marriage shrinks massively. Female age at marriage ranges from 20.2±1.1 in the Western region to 21.6±0.9 in the Northern region giving it a very limited scope in explaining variation in fertility in presence of other independent variables that have larger variation at district level. However, we have observed significant negative effect of age at marriage on childbearing in our individual level analyses primarily because of such variation as mentioned earlier.

Thus, it can be argued that the current phenomena of fertility decline may not be effectively delivering the development dividends that are generally expected from such a transition i.e., improvements in maternal and child health and economic emancipation of women. This is because of over dependence on sterilization for contraception. According to fourth round of National Family Health Survey (NFHS-4), 2015-16, about 36 percent of women use terminal methods for contraception, which declined marginally from 2005-06 (IIPS and ICF 2017). This implies that, instead of promoting contraception for appropriate spacing between births for ensuring mothers' and children's health, public policy promotes it as an instrument for terminating possibility of further pregnancies once desired number and sex composition of off-springs are achieved by families. The policy rhetoric of informed choice for contraception is in sharp contrast to the incentive structure which clearly favours irreversible methods of contraception(Ghosh and Siddiqui 2017). Counter-argument could be that once age at marriage improves to some desirable extent and child bearing is restricted to two children, even if the children are closely spaced, it would not be that detrimental for maternal and child health outcomes. Further, effective termination of pregnancy through sterilization after two children during twenties frees up many adult years for women's economic activity. However, such argument has to be looked through the lens of women's reproductive right or alternatively, whether the policy is successful in enhancing the choice set available to women when it comes to reproductive decision making. For example, providing freedom to choose the timing of pregnancies should be considered as important as desired number of offspring. Further, issue of post-sterilization regret also needs attention. It may be noted that post-sterilization regret has increased from about 5 percent to nearly 7 percent between 2005-06 and 2015-16 (IIPS and Macro International 2007; IIPS and ICF 2017) and concerns of sterilized women must be addressed suitably (Ghosh 2016).

Further, our study could not find any evidence that increased availability of grassroot level healthcare providers reduces TFR. Murthi et al. (1995) also found that increased access to public health services reduced child mortality, but had no significant, independent effect on fertility. Other studies argued in favour of the strength of family welfare programme rather than increased availability of maternal and child health services in reducing fertility (Guha and Dutta 2008; Guilmoto 2005). However, contrasting findings were obtained by Srinivasan and Kumar (2005) in the context of Tamil Nadu. Perhaps-- availability of grassroot level healthcare provider is not a robust indicator in itself because it does not consider quality of care and thus could not adequately explain fertility differentials.

Meanwhile, new forms of institutions are emerging which have the potential to contribute in fertility change in rural India. For example, women-based SHGs in India and other South Asian countries initially evolved to address the issue of financial exclusion. However, the network externalities associated with such community-based organizations (CBOs) have also enabled them to gradually contribute to different aspects of social transformation including better health and nutritional outcomes for children and reduction of fertility (Kumar et al. 2017; Basher 2007). Studies have shown that CBOs in the developing countries have significantly contributed in increasing women's agency, increased economic importance of women in rural community and thereby enhanced women's bargaining power in the family (Fraser 2014; Kabeer et al. 2014; Ghosh and Chattopadhyay 2017). In congruence withthese studies, our study also finds that the SHG movement has a significant potential in transmitting the small family size norms in rural India.

The present study, however, has some limitations. First, as mentioned earlier, carrying out similar analyses for at least last three census periods, would pinpoint the contribution of different factors affecting temporal variation in fertility change. However, we could not accomplish such analyses because of territorial changes of a number of states and districts in successive censuses. Second, due to endogeneity problem and other theoretical considerations, listing main factors, which influence such regional variation of fertility, could not be ascertained.
Finally, although Bhat's (1996) analysis explained up to 90 percent variation in fertility, current analysis could explain only about 73 percent using similar set of explanatory variables. This, compression of explanatory power for 2011 data vis-à-vis 1991 data indicates over time reduction in effectiveness of fertility covariates. Corollary of the statement is, perhaps policies pertaining to regulation of fertility are more relevant in determining fertility now compared to past as mentioned earlier. For example, JananiSurakshaYojona (JSY) made a significant impact in increasing institutional delivery and thereby ensured greater child survival in the recent past (Lim et al. 2010; Carvalho et al. 2014), which plausibly indirectly assisted in reduction of TFR. Such hypothesis highlights the need of further research on effective measurement of policies pertaining to fertility reduction. In other

words, not only the endowments (or covariate effects), returns to those endowments (or coefficient effects), largely depending upon accessibility and quality aspects of government sponsored schemes, plausibly have implications on fertility reduction.

Close correspondence between inter-regional (district level) and individual women level analyses lends robustness to our study. Individual level analysis incorporated most covariates except for those that were not available. Covariates in individual level analysis demonstrated similar effects on outcome variable i.e., number of births without any exceptions. Additionally, individual level model also demonstrated that spatiality does play its own independent role in determining the reproductive choice. Obviously, a more detailed discussion of results from individual level analysis is warranted, however, owing to space constraint and purpose of the paper it has been kept at minimal level.
Nonetheless, we have successfully provided an update of district-level fertility estimates and factors that account for district and regional level variations. By updating Mari Bhat's (1996) study, we suggest that efficient implementation of family welfare programme focussing on spacing methods for better child and maternal health outcomes is indeed needed in regions with high fertility. Further, propagating benefit of small family size through media and SHG movement, and socio-economic development at the macro-level could play a catalytic role in this process. Recent evidence also suggest that women's own aspiration and aspirations for their children maylead to fertility decline across social and economic standing (Ghosh 2016b). Future studies may attempt to interrogate how such aspirations result in changes in fertility choice and their actualization in different politico-economic context in India.

End Notes

1. Scheduled Castes (SCs) and Scheduled Tribes (STs) are historically disadvantaged people in India and are subject to positive discrimination as par constitutional provisions in India.

2. A self-help group (SHG) is a community-based organization (CBO) usually comprises of 10-20 local women or men having similar social and economic background. It is organized either voluntarily or by the governmental agencies. The group generally assisted in developmental activities like savings, debt and income generation.

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References

Alagarajan, M., & Kulkarni, P.M.(2008). Religious differentials in fertility in India: Is there a convergence.Economic and Political Weekly, 43 (48), 44-53.

Arokiasamy, P. (2009). Fertility decline in India: Contributions by uneducated women using contraception.Economic& Political Weekly, XLIV (30), 55-64.

Arriaga, E. (1983). Estimating fertility from data on children ever born, by age of mother.International Research Document No.11, U.S Bureau of the Census, U.S. Government Printing Office, Washington, D.C., 20402.

Barber, J.S.,&Axinn, W.G. (2004). New ideas and fertility limitation: The role of mass media.Journal of Marriage and Family, 66 (5),1180-1200.

Basher, M. A. (2007). Empowerment of microcredit participants and its spill over effects: Evidence from the Grameen Bank of Bangladesh.The Journal of Developing Areas, 40(2), 173–183. doi:10.1353/jda.2007.0013.

Basu, A. M., & Amin, S. (2000). Conditioning factors for fertility decline in Bengal: History, languageidentity and openness to innovations.Population and Development Review, 26(4), 761–794.

Becker, G. (1960). Demographic and economic change in developed countries. New York: Columbia University Press.

Bhat, P. N. M.,Zavier, A.J. F. (2005). Role of religion in fertility decline: the case of Indian Muslims.Economic and Political Weekly,40 (5), 385-402.

Bhat, P.N. M.(1996). Contours of fertility decline in India: A district level study based on the 1991 census.InSrinivasan, K. (ed.), Population Policy and Reproductive Health. Hindustan Publishing Corporation (India), New Delhi.

Bhat, P.N. M.(2002). Returning a favor: Reciprocity between female education and fertility in India.World Development, 30(10), 1791-1803.

Bhattacharya, P. C. (2006). Economic development, gender inequality, and demographic outcomes: Evidence from India. Population and Development Review, 32(2), 263-292. doi: 10.1111/j.1728-4457.2006.00118x.

Bocquet-Appel, J.P., Rajan, Irudaya S., Bacro, J. N.,&Lajaunie, C. (2002). The onset of India's fertility transition.European Journal of Population, 18(3), 211–232.

Bongaarts, J. (1978). A framework for analyzing the proximate determinants of fertility.Population and Development Review, 4(1), 105-132.

Bongaarts, J.,& Potter, R. (1983). Fertility, Biology, and Behavior: An Analysis of the Proximate Determinants. New York: Academic Press. doi:10.1016/B978-0-08- 091698-9.50006-3.

Brass, W. (1964).Uses of Census and Survey Data for the Estimation of Vital Rates. United Nations, E/CN.14/CAS/7. November.

Brass, W. (1981).The use of the relational Gompertz model to estimate fertility.InProceedings of the International Union for the Scientific Study of Population Conference, Manila, 3, 345-361.

Brass, W., &Coale, A.J. (1968). Methods and analysis and estimation.In Brass, W., Coale, A.J.,Demeny, P. et al. (eds.) The Demography of Tropical Africa, Princeton University Press; Princeton, NJ, 1968.

Carlson, G. (1996). The decline of fertility: innovation or adjustment process.Population Studies, 20(2), 149–174. doi: 10.1080/00324728.1966.10406092.

Carvalho, N., Thacker, N., Gupta, S.S.,& Salomon, J.A. (2014). More evidence on the impact of India's conditional cash transfer program, JananiSurakshaYojana: Quasi-experimental evaluation of the effects on childhood immunization and other reproductive and child health outcomes.PLoS One 9, e109311. Public Library of Science.doi:10.4103/0971-5916.164251.

Casterline, J.B. (ed.) (2001). Diffusion Process and Fertility Transition: Selected Perspective. National Academies Press: Washington, ISBN: 0-309-50028-1, 288 pages, 6 x 9.

Chakrabarty, M.,&Guilmoto, C. Z. (2004). An analysis of the determinants of fertility behaviour in south India at the village level.InGuilmoto, C. Z. &Rajan, S. Irudaya (eds.) Fertility Transition in South India, Sage: New Delhi.

Clark, S. (2000). Son preference and sex composition of children: evidence from India.Demography,37(1), 97-108. Available http://www.jstor.org/stable/2648099 (accessed May 2016).

Cleland, J.,& Wilson, C. (1987).Demand theories of the fertility transition: An iconoclastic view. Population Studies,41(1), 5–30.

Coale, A.J.,& Hoover, E.M. (1958). Population Growth and Economic Development in Low-Income Countries: A Case Study of India's Prospect. Princeton University Press, Princeton: New Jersey.

Das, K. (2014). Changing child sex ratio: Tracing some evidences and causes from West Bengal. Unpublished MPhil Dissertation submitted to University of Calcutta, Kolkata.

Das, M.,&Mohanty, S. K. (2012). Spatial pattern of fertility transition in Uttar Pradesh and Bihar: A district level analysis. Genus 68 (2):81-106 DOI:10.4402/genus-467.

Datta, P.,&Mohanty, S. K. (2005). India's future population and its socio-economic implications by 2015.Demography India, 34(2), 167-184.

Davis, K.,& Blake, J. (1956). The decline of fertility: Innovation or adjustment.Economic Development and Cultural Change, 4, 211–235. doi:10.1086/449714.

Dharmalingam, A.,& Morgan, S.P. (2004). Pervasive Muslim-Hindu fertility differences in India.Demography, 41(3), 529-45.

Dharmalingam, A., Navaneetham, K.,& Morgan, S.P. (2005). Hindu-Muslim fertility differences: evidence from National Family Health Survey – II. Economic and Political Weekly, 40(5), 429-36.doi:10.1086/214874.

Dommaraju, P.,& Agadjanian, V. (2009). India's north-south divide and theories of fertility change.Journal of Population Research, 26, 249–272. DOI 10.1007/s12546-009-9014-5

Dreze, J.,&Murthi, M. (2001). Fertility, education and development: evidence from India.Population and Development Review,27(1), 33-63.

Duvendack, M.,& Palmer-Jones, R. (2016). Micro-finance, women's empowerment and fertility decline in Bangladesh: how important was women's agency?.Journal of Development Studies, 53(5), 664-683.

Dwivedi, L. K., & Sogarwal, R. (2008). Understanding contraceptive adoption in India: Does women's autonomy matter? Journal of Family Welfare, 54(1), 24–34.

Dyson, T. (2004). India's Population: The Future.In Dyson, T.,Cassen, R.,&Visaria, L. (eds.), Twenty-First Century India: Population, Economy, Human Development, and the Environment. Oxford University Press., Oxford.

Feeney, G. (1998). A new interpretation of Brass' P/F ratio method applicable when fertility is declining.http://www.gfeeney.com/notes/pfnote/pfnote.htm Accessed on 22 June 2014.

Fraser, R. S. (2014). The fluid complexity of woman and child valuation in rural Bangladesh.PhD dissertation.University of Missouri, Columbia.

Ghosh, S.(2016a). Exploring post-sterilization regret in an underdeveloped society of rural West Bengal, India.Journal of Indian Anthropological Society, 51,96-116.

Ghosh, S. (2016b). Second demographic transition or aspirations in transition: An exploratory analysis of lowest-low fertility in Kolkata, India.Asian Population Studies, 13(1), 1-25, DOI:10 .1080/17441730.2016.1203211.

Ghosh (2018). Hindu-Muslim fertility differentials in India: Indirect estimation at the district level from census 2011. Indian Journal of Human Development, 12(1), 37-51.

Ghosh, S.,&Chattopadhyay, A. (2017). Religion, contraceptive method-mix and son preference among Bengali-speaking community of Indian subcontinent.Population Research and Policy Review, 36(6), 929-59.

Ghosh, S.,&Siddique, Md. Z.(2017). Role of community and context in contraceptive behaviour in rural West Bengal, India: A multilevel multinational approach.Journal of Biosocial Science, 49(1), 48-68.doi: 10.1017/S0021932016000080.

Ghosh, S. (2016).Exploring post-sterilization regret in an underdeveloped society in rural West Bengal, India.Journal of Indian Anthropological Society, 51, 96-116.

Guha, M.,&Datta, S.(2008). Development, status of women and demographicoutcomes in Madhya Pradesh: A regional analysis.Journal of Social Sciences,16(1),1–12.

Guilmoto, C.Z.,&Rajan, S.Irudaya(2002). District level estimates of fertility from India's 2001 Census.Economic and Political Weekly, February 16, 665-676.

Guilmoto, C.Z.,&Rajan, S. Irudaya(2013). Fertility at the district level in India.Economic and Political Weekly, 48(23), 59–70.

Guilmoto, C. Z. (2005). Fertility decline in India: Maps, models and hypothesis.InGuilmoto, C. Z.,&Rajan, S. Irudaya (eds.) Fertility Transition in South India. Sage: New Delhi, 385–435.

Haque, I.,& Patel, P. P. (2016). Assessing Hindu-Muslim fertility differentials in West Bengal: insights for National Family Health Survey-3 data.Journal of Family History, 1-33, published online on March 5, 2016.doi: 10.1177/0363199016635216.

Hirschman, C. (1994). Why fertility changes. Annual Review of Sociology, 20, 203-233.

IIPS (International Institute for Population Sciences) &ICF(2017). National Family Health Survey, India, 2015-16, IIPS, Mumbai.

IIPS (International Institute for Population Sciences) & ORC Macro (2001).National Family Health Survey, India, 1998-99, IIPS, Bombay.

IIPS (International Institute for Population Sciences)& Macro International Inc. (2007). National Family Health Survey 2005–06 (NFHS-3), India. Mumbai: IIPS.

IIPS (International Institute for Population Sciences)(2014). District Level Household and Facility Survey (DLHS-4), 2012-13: India. Various States: Mumbai: IIPS.

Jain, A. K. (1985). The impact of development and population policies on fertility in India.Studies in Family Planning, 16(4), 181-198.

Jain, A.K.,&Adlakha, A.L. (1982). Preliminary estimates of fertility decline in India during the 1970s.Population and Development Review, 8(3), 589-606.

James, K. S.,& Subramanian, S. V. (2005). Decline in fertility in Andhra Pradesh: A reexamination of conflicting arguments. InGuilmoto, C.Z.&Rajan, S. Irudaya (eds.) Fertility Transition in South India. Sage: New Delhi: 357–384.

Jayaraj, D.,& Subramanian, S. (2004). Women's well-being and the sex ratio at birth: Some suggestive evidence from India. Journal of Development Studies, 40(5): 91-119.

Jeffery, R.,& Jeffery, P. (2000). Religion and fertility in India. Economic and Political Weekly, 35 (35-36): 3253-59.

Jejeebhoy, S.J. (1995). Women's Education, Autonomy, and Reproductive Behaviour: Experience from Developing Countries. Clarendon Press, Oxford.

Kabeer, N., Huq, L., &Mahmud, S.(2014). Diverging stories of "Missing Women" in South Asia: Is son preference weakening in Bangladesh? Feminist Economics, 20(4), 138–163.

Kalabikhina, I.E. (2010). “Gender transition” and demographic development: some issues of population policy. Paper presented at European Population Conference 2010, Vienna, Austria, 1-4 September. URL: epc2010.princeton.edu/papers/100762 (accessed 7th October 2018).

Kelley, A.C. (1988). Economic consequences of population change in thethird world. Journal of Economic Literature, 27, 1685-1728.

Kirk, D. (1996). Demographic Transition Theory.Population Studies, 50, 361-387.

Kulkarni, P. M. (2011). Towards an explanation of India’s fertility transition.George Simmons Memorial Lecture delivered at 33rd Annual Conference of Indian Association for the Study of Population (IASP), Lucknow, November 11–13, 2011. Retrieved in January 2014, http://www.iasp.ac.in/pdf/simmonspercent20memorialpercent20Lecture.pdf

Kumar, N. et al. (2017). Pathways from women's group-based programs to nutrition change in South Asia: A conceptual framework and literature review.Global Food Security, Available online on December 8, 2017. https://doi.org/10.1016/j.gfs.2017.11.002, 1-14.

Leibenstein, H. (1974). An interpretation of the economic theory of fertility: promising path or blind alley? The Journal of Economic Literature, 12(2), 457–479.

Lim, S.S., Dandona, L., Hoisington, J.A., James, S.L., Hogan, M.C.,&Gakidou, E. (2010). India’s JananiSurakshaYojana, a conditional cash transfer programme to increase births in health facilities: An impact evaluation.Lancet 375, 2009–23.

Malhotra, A., Venneman, R.,& Kishore, S. (1995). Fertility dimensions of patriarchy and development in India.Population and Development Review, 21(2), 281-305.

Mason, K.O. (1997). Explaining fertility transitions.Demography, 44(4), 443-454.

Matthews, Z., Padmadas, S. S., Hutter, I., McEachran, J.,&

Brown, J.J. (2009). Does early childbearing and a sterilization-focused family planning programmein India fuel population growth?.Demographic Research,20, Article 28: 693–720.

McNay, K. (2003). Women's changing roles in the context of demographic transition. Paper commissioned for the EFA Global Monitoring Report 2003/4, The Leap to Equality. URL: https://pdfs.semanticscholar.org/747d/82d008d315a2d0c837da591363db16dad32f.pdf (accessed 7th October 2018).

McNay, K., Arokiasamy, P., &Cassen, R.H.(2003). Why are uneducated women in India using contraception? A multilevel analysis.Population Studies, 57(1), 21-40.

Merlo, J., Chaix, B., Yang, M., Lynch, J., &Råstam, L. (2005). A brief conceptual tutorial of multilevel analysis in social epidemiology: linking the statistical concept of clustering to the idea of contextual phenomenon. Journal of Epidemiology & Community Health, 59(6), 443-449.

Ministry of Health and Family Welfare (MoHFW) (2000).National PopulationPolicy 2000.MoHFW, Government of India, New Delhi.

Mohanty, S.K., Günther, F., Chauhan, R.K.& Canning, D. (2016). Distal determinants of fertility decline: Evidence from 640 Indian districts.Demographic Research, 34 (13), 373- 406. http://www.demographic-research.org/volumes/vol34/13/34-13.pdf

Murthi, M, A.,Guio, C.&Dreze, J. (1995). Mortality, fertility and gender bias in India: A district-level analysis.Population and Development Review,21(4), 745-782.

Notestein, F.W. (1945). Population: The long view.In Schultz, E. (ed.) Food for the World, Chicago: Chicago University Press, 36–47.

Office of the Registrar General and Census Commissioner, India. 2013. Annual Health Survey 2011-12 Fact Sheet, various states, Ministry of Home Affairs, Vital Statistics Division, Government of India.

Pachauri, S. (2014). Priority strategies for India’s family planning programme. Indian Journal ofMedical Research,140 (supplement), 137–146.

Padmadas S. S., Hutter, I.,& Willekens, F.(2004). Compression of women's reproductive spans in Andhra Pradesh, India. International Family Planning Perspectives,30(1),12–19.

Parasuraman, S., Roy, T.K., Radha Devi, D.Paswan, B., Arokiasamy, P.,&Unisa, S.(1999). Role of Women’s Education in Shaping Fertility in India: Evidence from NFHS, IIPS, Mumbai.

Paul, P.,&Kulkarni, P.M.(2006). The dynamics of fertility transition in West Bengal, India.Paper presented at the European Population Conference, Liverpool, United Kingdom, June 21–24, 2006.

Rahman, L.,&Rao, V. (2004). The determinants of gender equity in India: Examining Dyson and Moore’s thesis with new data. Population and Development Review, 30(2), 239–268.

Rajan S. Irudaya(2005). Emerging demographic change in south India.InGuilmoto, C.Z., Rajan, S. Irudaya (eds.) Fertility Transition in South India. SAGE: New Delhi.

Ram, U. et al. (2013). Neonatal, 1–59 month, and under-5 mortality in 597 Indian districts, 2001 to 2012: estimates from national demographic and mortality surveys.Lancet Global Health 2013, October, 1: e219-e226.

Ramachandran, P., & Ramesh, P. (2005). Fertility trends and differentials in Andhra Pradesh.InGuilmoto, C. Z. &Rajan, S. Irudaya (eds.) Fertility Transition in South India. Sage: New Delhi, 114–136.

Registrar General of India (RGI) (2011).Provisional population totals, paper 1 of 2011: Census of India 2011, Series 1- India. New Delhi: Controller of Publications.

Sahu, B., van Wissen, LJG.,Hutter, I., & Bosch, A. (2012). Fertility differentials among religious minorities: Cross-national and regional evidence from India and Bangladesh. Population, Space and Place, 18(5), 503-515.

Santhya, K. G. (2003). Changing family planning scenario in India: an overview of recent evidence.Population Council Working Paper No. 17. Population Council, New Delhi. URL: http://www.popcouncil.org/pdfs/wp/seasia/seawp17.pdf (accessed 12th November 2013).

Shariff, A.(1995). Socio-economic and demographic differentials between Hindus and Muslims in India.Economic and Political Weekly,30 (46), 2947-53.

Srinivasan, K. (1998). Population policies and programmes since independence(a saga of great expectations and poor performance). DemographyIndia, 27(1), 1-22.

Srinivasan, K., & Kumar, S.(2005). Significance of medical and paramedical personnel in demographic transition: an empirical analysis.InGuilmoto, C. Z.,&Rajan, S. Irudaya (eds.) Fertility Transition in South India. Sage: New Delhi, 309–323.

Säävälä, M. (2010).Below replacement-level fertility in conditions of slow social and economic development: A review of the evidence from south India.Finnish Yearbook of Population Research XLV, 45–66

Thompson, W.S. (1929).Population.American Journal of Sociology, 34(6), 959–974.

United Nations, Department of Economic and Social Affairs, Population Division. (2017a). World Population Prospects: The 2017 Revision, Key Findings and Advanced Tables, ESA/P/WP/248.

United Nations, Department of Economic and Social Affairs, Population Division (2017b). “Mortpak Version 4.3”http://www.un.org/en/development/desa/popul ation/publications/mortality/mortpak.shtml

United Nations (1983). Manual X: Indirect Techniques for Demographic Estimation (United Nations publication, Sales No. E.83.XIII.2). http://www.un.org/esa/population/

publications/Manual_X/Manual_X.htm

United Nations (1995).Women’s education and fertility behavior: recent evidence from the demographic and health surveys. New York: United nations, Population Division.

Westoff, C.F.,& Bankole, A. (1999). Mass media and reproductive behaviour in Pakistan, India andBangladesh.Demographic and Health Surveys Report No. 10, Macro International Inc: Maryland.

Yadav, A.K., & Ram, F. (2015).Assessment of completeness of birth registrations (5+) by Sample Registration System (SRS) of India and major states.Demography India, 44 (1&2), 111-118.

Zlotnik, H., & Hill, K. (1981).The use of hypothetical cohorts in estimating demographic parameters under conditions of changing fertility and mortality.Demography,18(1), 103-122.

Appendix

Table A1: Frequency distribution and selected descriptive statistics of district-level estimates of Total Fertility Rate (TFR), Census 2011

Major states	Total Fertility Rate				Descriptive Statistics*		
	≤2.1	2.2-3.0	3.1-4.0	>4.0	Total districts	Mean	Standard deviation
India@	249	231	55	1	536	2.3	0.579
South							
Andhra Pradesh	23	0	0	0	23	1.6	0.137
Karnataka	21	9	0	0	30	1.8	0.343
Kerala	13	1	0	0	14	1.8	0.202
Tamil Nadu	32	0	0	0	32	1.6	0.116
North							
Himachal Pradesh	11	1	0	0	12	1.7	0.438
Punjab	20	0	0	0	20	1.9	0.104
Uttarakhand	10	3	0	0	13	2.1	0.186
Haryana	11	8	1	1	21	2.3	0.762
North-central							
Uttar Pradesh	6	56	9	0	71	2.7	0.378
Bihar	0	22	16	0	38	3.0	0.262
Chattisgarh	2	15	1	0	18	2.4	0.277
Madhya Pradesh	3	38	9	0	50	2.7	0.456
East							
Assam	17	10	0	0	27	2.2	0.427
West Bengal	16	3	0	0	19	1.7	0.346
Jharkhand	3	14	7	0	24	2.7	0.432\
Odhisa	20	10	0	0	30	2.1	0.338
West							
Rajasthan	2	20	11	0	33	2.8	0.459
Gujarat	18	7	1	0	26	2.1	0.432
Maharshtra	21	14	0	0	35	1.9	0.300

Notes: @The all-India distribution is for the districts in the 19 major states only; *Not weighted by population size of the districts

Source: Ghosh (2018)

Table A2: Mean and standard deviations (in parenthesis) of the predictor variables according to different regions

Variable name	South		North		North-Central		East		West	
Variables representing economic structure										
Male workers in agriculture	42.3	(19.6)	41.0	(13.9)	64.6	(14.6)	51.2	(17.3)	54.1	(17.9)
Agricultural labourers	59.5	(13.8)	25.2	(16.2)	45.7	(13.5)	38.4	(15.1)	39.4	(19.2
Female work force participation	27.1	(8.6)	16.2	(10.3)	14.6	(8.5)	12.3	(4.9)	23.5	(8.8
Economic status										
Bank account	57.9	(12.2)	73.7	(12.3)	56.2	(16.5)	46.7	(11.9)	63.9	(10.5)
PDS shops	81.0	(13.9)	45.7	(18.1)	58.2	(8.0)	57.3	(13.6)	56.1	(23.3
Electricity	91.5	(3.8)	91.7	(7.3)	42.6	(25.8)	41.4	(19.1)	76.9	(15.4)
Sanitation facility	51.7	(25.7)	69.3	(13.9)	27.7	(15.7)	37.3	(25.5)	42.8	(20.0)
Institutional delivery	95.0	(6.7)	74.4	(14.6)	56.8	(20.5)	53.7	(20.4)	77.0	(17.3
Full immunization	66.5	(16.6)	66.2	(15.6)	56.5	(14.3)	66.3	(14.2)	66.5	(14.3)
All weather road	45.3	(22.9)	36.1	(27.3)	30.4	(23.4)	35.6	(20.2)	43.9	(28.0
Variables representing social structure										
Joint/extended family	13.4	(3.4)	22.3	(6.1)	19.7	(5.3)	14.7	(4.9)	22.5	(3.0)

Variable name	South		North		North-Central		East		Wes	
Female age at marriage	21.2	(1.4)	21.6	(0.9)	20.6	(1.1)	20.6	(1.4)	20.2	(1.1)
Child sex ratio	948.0	(17.5)	865.6	(46.7)	921.9	(33.0)	952.4	(21.6)	896.8	(32.6
Muslims	11.2	(10.0)	4.7	(11.0)	12.6	(11.3)	17.1	(19.1)	9.3	(5.3
Scheduled castes	17.3	(6.6)	24.7	(7.9)	17.1	(6.5)	14.5	(9.1)	12.7	(6.9
Scheduled tribes	4.8	(5.5)	3.2	(12.5)	11.6	(20.1)	21.2	(20.7)	15.9	(22.1
Variables representing Ideational factors										
Female literacy	69.9	(13.1)	69.2	(7.9)	55.7	(8.7)	62.4	(11.5)	64.0	(12.8
Media exposure										
Transistor/radio	19.0	(9.9)	18.4	(6.5)	20.0	(8.4)	16.9	(8.3)	15.1	(7.2
Television	68.8	(16.4)	70.4	(13.6)	26.6	(14.8)	26.3	(14.6)	43.4	(16.5
Computer/laptop with internet	3.1	(3.6)	3.9	(3.6)	1.2	(1.8)	1.4	(1.9)	2.3	(3.2
Mobile phone	55.6	(8.0)	63.6	(5.6)	49.1	(15.3)	39.2	(12.0)	54.9	(12.4)
Self-help group	93.4	(3.4)	46.9	(32.0)	64.8	(17.2)	71.2	(21.6)	53.1	(34.7
Variables representing health and family planning										
Under-five mortality	35.0	(15.9)	43.9	(11.6)	72.0	(14.8)	64.2	(22.2)	50.8	(18.3

Variable name	South		North		North-Central		East		West	
Unmet need	21.0	7.9	22.3	(9.9)	26.7	(14.8)	19.8	(7.2)	16.8	(5.2
Availability of primary healthcare providers										
ASHA	78.8	(20.5)	72.7	(16.8)	80.0	(15.6)	77.9	(18.1)	79.2	(16.5)
Anganwari Workers (AWW)	85.1	(12.1)	75.1	(18.3)	79.2	(14.0)	80.4	(14.3)	83.9	(15.3
Paramedics PHC	51.5	(3.7)	48.3	(2.3)	47.1	(1.9)	48.1	(1.9)	48.4	(2.4
Paramedics HSC	38.9	(31.9)	27.1	(32.3)	20.6	(31.1)	21.0	(22.5)	30.1	(22.9
Number of districts	**99**		**66**		**177**		**100**		**94**	

Source: Computed by the authors

Table A3: Coefficients and t-ratios of model #4 with under-5 mortality rate (U5MR)

Fixed effects	Model 4with U5IMR	t-ratio
Intercept	520.0084	51.59362
Economic structure Variables		
Agricultural labourers	-0.334	-3.70***
Normalized factor score representing economic status	-1.085	-8.15***
Social structure		
Joint/extended family	1.858	6.73
Female age at marriage	-1.357	-1.03
Child sex ratio	-0.175	-3.76***
Muslims	1.044	8.77
Scheduled caste	-0.556	-2.56***
Scheduled tribe	0.162	1.56
Ideational factors		
Female literacy	-1.140	-5.71
Self-help group	-0.253	-3.92***
Health & Family Planning		
Under-five mortality	Not included	Not included
Unmet need	0.3642	2.94***
Radom Variance of region	123.0278	
Random variance of District	792.2986	

Source: Computed by the authors

Table A4: Distribution of total variance in Total Fertility Rate by components of multilevel regression model #4 without Under 5 Mortality Rate (in %)

Variance Components	Model 4 without U5MR
Model (Y) explained	72.69
Region random effect	3.67
District random effect	23.64

Source: Computed by the authors

Supplementary Material

Table S1: Relevant Sample characteristics of currently married women (15-49 years) in India, 2015-16

Covariates	**Percentage**	**Samples**
Average number of children ever born	2.39 (1.62)[0-17]	4,99,627
Wealth Index		
Poorest	18.17	90,785
Poorer	19.73	98,592
Middle	20.47	1,02,260
Richer	21.01	1,04,986
Richest	20.62	1,03,003
Place of residence		
Urban	33.40	1,66,892
Rural	66.60	3,32,735
Type of family		
Nuclear	47.93	2,39,486
Joint/Extended	52.07	2,60,141
Mean age of respondents (years)	32.8 (8.5) [15-49]	4,99,627
Mean age at Marriage	18.5(4.2)[0-49]	4,90,270
Average Sex ratio of children (female/male)	83.4 (91.5)	3,73,429
Religion caste composition		
Hindu/SC/ST	26.40	1,30,206
Hindu/OBC	37.19	1,83,424

Covariates	Percentage	Samples
Hindu/Generals	17.55	86,569
Muslims/Others	18.86	93,049
Women's Education (years)(Mean)	6.1 (5.3)[0-20]	4,99,627
Exposure to TV		
Irregularly/no	30.34	1,51,571
once a week	9.78	48,858
Regular	59.88	2,99,198
Exposure to Radio		
Irregularly/no	90.32	4,51,247
once a week	5.79	28,947
Regular	3.89	19,433
Exposure to newspaper		
Irregularly/no	77.34	3,86,393
once a week	10.45	52,220
Regular	12.21	61,014
Mean number of Children Died (Child loss)	0.16 (0.5)[0-13]	4,99,627
Unmet Need (spacing+ limiting)		
No	86.9	34,235
Yes	13.1	65,392
Meet and discuss regarding FP during last three/six months		
No	95.9	4,78,876
Yes	4.2	20,751
Total	100.0	4,99,627

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WORKING PAPERS

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BOOKS

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