Demography India
A Journal of Indian Association of Study of Population
Journal Homepage: https://demographyindia.iasp.ac.in/

Determinants of Fertility Stall in India: A State Level Analysis, 1992-93 to 2019-21

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Abstract

Throughout the world India's demographic scenario is a highly concerning issue for researchers and policymakers. Here fertility declined steadily for several decades but at a slower pace. To identify the actual scenario of a slower fertility pace, this study investigates the fertility stall condition at the state level of India from 1992-93 to 2019-21.A fertility stall is a situation where fertility is stagnant or increased after starting transitions. Using data collected by 1992-93, 1998-99, 2005-06, 2015-16, and 2019-21 rounds of the National Family Health Survey (NFHS), the study indicates that eight states during NFHS II to III, two states during NFHS III to IV and five states during NFHS IV to V experienced fertility stall. In general, increasing poor households, U-5 deaths, declining proportion of women in paid employment, the marginalized socio-economic category, higher son preference from the reproductive preference category, and increasing adolescent childbearing, unmet need for family planning from the family planning category significantly influence the fertility stall in Indian states. In spatial pattern, socio-economic variables are a more concerning issue for fertility stalls in northeastern states, meanwhile, son preference is more associated with the stall in low fertility provinces of southern India. This indicates that reaching low fertility in India will increase the likelihood of son preferences in the future. No significant link was observed between the presence of stall and trend in modern contraception and the desire for higher family size, though these factors were highly crucial for fertility stall according to the previous researches.

Keywords

Son preference, Fertility stall, India, NFHS, TFR

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Introduction

The demographic scenario changes from high mortality and high fertility to low mortality and low fertility, which have been experienced throughout the world. On 15th November 2022 world population touched a new milestone of human development i.e. 8 billion people. The constant rise in world population in the last two centuries is due to the continuous rise in human lifespan owing to improvements in public health, nutrition, medicine, and social awareness. In recent decades the world population is still increasing but ever more slowly (2.1% per year 1965-70 to 1.1% 2015-20); this happened due to the decline of the world fertility level almost from five in 1950-55 to below replacement level in 2022. It was predicted that the world population would continue to decline until the world population level off at around 10 billion in 2100 (Pison, 2022; Lutz et. al., 2001; UN, 2022).

Fertility transition started to fall in every country for several decades. Different scholars anticipate that the declining rate of fertility is not identical for every country. Some countries experienced a continuous decline in fertility, meanwhile, others were stagnant or increased in the middle of their transition. This stagnant or uptrend fertility situation is called a fertility stall. After examining different literature, it is observed that most of the researchers experienced fertility stalls (at TFR 3.2) for a longer period (more than 30 years) (Pantelides, 1996).

Following a review of relevant literature, it is observed that numerous influencing factors play crucial roles in fertility stalls in different countries. Kenya's fertility stall was caused by a plateau in contraceptive prevalence, wanting additional children, an increase in poverty, and a reduction in women's secondary-level education (Wastoff and Cross, 2006; Blacker, 2002; Odwe et. al., 2015). Eltigani (2003) works on the different fertility stalls in Egypt, where he found the reason for fertility stalls is increasing reproduction among women from high and medium economic groups. Some researchers use Demographic and Health Surveys to study fertility stalls in Sub-Saharan African countries. The finding demonstrates that the decline in women's education, contraceptive prevalence, age at marriage, female labour force participation and income, as well as an increase in child mortality, adolescent fertility, desire for a child, and child preference responsible for fertility stall (Shapiro and Gebreselassie, 2008; Garenne, 2009; Ezeh et al. 2009). Decelerated contraceptive use, increased marriage, reduced duration of breastfeeding, and child mortality all play important roles in Asian countries' fertility stagnation (Gendell, 1985; Kumar, 2016; Bongaarts, 2006; Islam, 2007).

In terms of the demographic standpoint, India is a major focus area for researchers as well as policymakers. It is a country with a population of 1.21 billion or 17% of the world's population at the time of its last census in 2011. The Sample Registration System (SRS) reveals that the TFR of India is declining at a slower pace, and it achieved replacement fertility (TFR 2.0) in 2022. In the world scenario, stall fertility is a barrier for many countries to bring down fertility levels. However, countries like India did not face any stall conditions at the national level (Bongarts, 2006). In contrast, some countries with similar demographic characteristics or neighbouring countries to India have seen fertility stalls at different periods of time. For example, in sub-Saharan Africa, countries like Guinea, Mozambique, Nigeria, Tanzania, and Zambia experienced stalling

fertility, and Brazil, Colombia, and Peru from Latin America exhibited stalling behaviour in the past (Shapiro et.al., 2010). These countries have almost similar demographic characteristics compatible with different Indian states. Meanwhile, neighbourhood countries like Bangladesh and Pakistan experienced fertility stalls several times (Bongaarts, 2006; Ismail 2007). These countries also have similar socio-demographic characteristics comparable with some Indian states (e.g., Bangladesh with West Bengal, Tripura).

Based on the above observation, it is hypothesised that, while India has not experienced fertility stalls at the national level, fertility stall conditions may be detected at the state level. Based on different countries' experiences, the present study is an attempt to look into the fertility stall conditions in different states of India at different periods and determine the role of socioeconomic conditions, reproductive preference, and use of family planning methods for fertility stalls.

Data and Methodology

In this study, data has been obtained from secondary sources. Data include all fifth rounds of the National and Family Health Survey (NFHS) (IIPS and Macro International, 1992-21) to assess the fertility transition and stall condition in different consecutive periods and analyse the main factors responsible for this condition. The NFHS is a widely used source of information for estimating fertility, mortality, women, and child health trends in each state and union territory. TFR, socio-economic condition, reproductive preference, and use of family planning methods are the indicators considered for this study. To ensure uniform comparison across states over time, bifurcated states are merged. So, this analysis includes 25 states during NFHS II to III and 26 states during NFHS III to V rounds and excluded the Union Territories (except Delhi). The number of eligible women interviewed in the first survey was 89,777 (in the 1992/93 survey) whereas it was 724,115 (in the 2019-21 survey) during the fifth survey with a response rate of 97%.

To understand the likelihood of experiencing fertility stall by selected background characteristics, each predictor has been classified in terms of its trend during the NFHS rounds as either "progressed" or "progressed stalled." This variable is said to be progressed if it changes in the expected direction during the study period or stalled if the variable fails to change in between the survey period. For analysis, the progress predictor is coded as 0, and the stalled variable is coded as 1.

Table 1 Basis of classification of trend as Progressed or Progressed stall

Predictors	Classified in terms of trend	
	Stalled if variable were	Progressed if variable were
Women with secondary education, women in paid employment, Used institutional facilities for delivery, Modern contraception, heard saw FP on TV/radio/newspaper,	No significant change, or significant decline	Significant increase
Poor household, under-five mortality. Infant mortality, Age at marriage, son preference, desire family size, unintended birth, adolescent childbearing, unmet need for family planning, Women in union	No significant change, or significant increase	Significant decline

The assumption of this probit model observed Brounouli's success or failure results from underlying normally distributed random variables but cannot be observed directly. Assume z is the underlying unobservable random variable and x_{i1}, x_{i2},, x_{i3},$\cdots x_{ik}$ are k predictor variables. Thus, the probit linear regression model can be expressed as follows,

$$\pi i=\Phi(zi)=\Phi(\beta_0+\beta_1 x_{i1}+\beta_2 x_{i2}+\cdots+\beta_k x_{ik})\cdots\cdots\cdots(i)$$

In the form of an inverse link, the equation (i) can be written as,

$$(\pi i)=\Phi-1(\pi i)=\beta 0+\beta 1xi1+\beta 2xi2+\cdots+\beta kxik\ \cdots\cdots\cdots(ii)$$

where π_i is the probability that z_i=1 and $\Phi^{-1}(\pi i)$ is the inverse of the cumulative distribution function. The parameters of the model (ii) were estimated using the method of maximum likelihood. Since probability ranges between 0 and 1, the (π_i) can take any value between $-\infty$ and $+\infty$. Although the coefficient analysis provides valuable information regarding the association of the predictors and outcome variables, the marginal effect calculation facilitates summarizing results more convincingly. The marginal effect delivers the fact on the change in response related to the change in a covariate. The marginal effect (ME) for xi can be given as,

$$ME(x_i)=\frac{\partial P(\pi i=1|xi)}{\partial xi}=\frac{\partial E(\pi i|xi)}{\partial xi}=\Phi(xi'\beta)\beta$$

In calculating marginal effect, two approaches are followed: i) computation of the marginal effect at the sample means of the data, and ii) calculation of marginal effect at each observation. The sample average of individual marginal effects is then calculated to obtain the overall marginal effect. Both approaches yield similar results for large sample sizes, but for smaller samples, averaging the marginal individual impact is preferred (Greene, 1997). As the probit regression model in this study has been applied to a smaller sample, the average of the individual marginal effects has been used to interpret the impact of change in predictors on response variable. In this analysis the problem of multicollinearity has been taken care off.

Stalling Fertility in India's States: Timing and Characteristics

India's total fertility rate (TFR) declined from mid-transition (TFR 3.4) in NFHS-I to below replacement fertility (2.0) in NFHS-V. Bongaarts (2003) categorised fertility transition into three phases as early stage of transition with TFR ranges between 5 to 6.9, the middle stage of transition where TFR ranges between 3 to 4.9, the late transition where TFR ranges between 2.1 to 2.9, and post-transition with TFR below 2.1 (Shapiro et al., 2010). India did not observe the early stages of transition in any of its states induring the initiation of the NFHS (Table 2). However, only a few states are in the mid-transition stage, with the others in late transition or post-transition during the rounds of NFHS data.

Table 2 shows that in the first survey (1992-93) 13 states were at mid-transition level, 7 states were at mid-transition level in the second and third surveys, and the fourth survey revealed that only one state (Bihar 3.2) was at mid-transition level and the remaining states were at the late transition or post-transition (TFR < 2.1) level. A total of eight states from NFHS II to III

Table 2 Trend and change in total fertility rate (TFR) in different states of India

Region	States	1st survey	2nd survey	3rd survey	4th survey	5th survey	Fertility change			Fertility trend		
		1992-93	1998-99	2005-06	2015-16	2019-21	2nd to 3rd survey	3rd to 4th survey	4th to 5th survey	2nd to 3rd survey	3rd to 4th survey	4th to 5th survey
North	Delhi	3	2.4	2.1	1.8	1.6	-12.5	-14.3	-11.1	Decline	Decline	Decline
	Haryana	4	2.9	2.7	2.1	1.9	-6.7	-22.2	-9.5	Decline	Decline	Decline
	Himachal Pradesh	3	2.1	**1.9**	**1.9**	1.7	-9.5	**0.0**	-10.5	Decline	**stall**	Decline
	Jammu & Kashmir	3.1	2.7	2.4	2	1.4	-11.1	-16.6	-30.0	Decline	Decline	Decline
	Punjab	2.9	2.2	2	**1.6**	**1.6**	-9.1	-20.0	**0.0**	Decline	Decline	**stall**
	Rajasthan	3.6	3.8	3.2	2.4	2	-15.8	-25.0	-16.7	Decline	Decline	Decline
Central	Madhya Pradesh	3.9	3.3	3	2.3	1.9	-9.1	-23.3	-17.4	Decline	Decline	Decline
	Uttar Pradesh	4.8	4	3.8	2.7	2.3	-5.0	-28.9	-14.8	Decline	Decline	Decline
East	Bihar	4	**3.5**	**3.8**	3.2	2.8	**8.6**	-15.8	-12.5	**stall**	Decline	Decline
	Odisha	2.9	2.5	2.4	2.1	1.8	-4.0	-12.5	-14.3	Decline	Decline	Decline
	West Bengal	2.9	**2.3**	**2.3**	1.8	1.6	**0.0**	-21.7	-11.1	**stall**	Decline	Decline
North-East	Arunachal Pradesh	4.3	**2.5**	**3**	2.1	1.8	**20.0**	-30.0	-14.3	**stall**	Decline	Decline
	Assam	3.5	**2.3**	**2.4**	2.2	1.9	**4.3**	-8.3	-13.6	**stall**	Decline	Decline
	Manipur	2.8	3	2.8	2.6	2.2	-6.7	-7.1	-15.4	Decline	Decline	Decline
	Meghalaya	3.7	4.6	3.8	3	2.9	-17.4	-21.1	-3.3	Decline	Decline	Decline
	Mizoram	2.3	**2.9**	**2.9**	2.3	1.9	**0.0**	-20.7	-17.4	**stall**	Decline	Decline
	Nagaland	3.3	3.8	3.7	2.7	1.7	-2.6	-27.0	-37.0	Decline	Decline	Decline
	Sikkim		2.8	2	1.2	1.1		-40.0	-8.3		Decline	Decline
	Tripura	2.7	**1.9**	**2.2**	**1.7**	**1.7**	**15.8**	-22.7	**0.0**	**stall**	Decline	**stall**
West	Goa	1.9	**1.8**	**1.8**	1.7	1.3	**0.0**	-5.6	-23.5	**stall**	Decline	Decline
	Gujarat	3	2.7	2.4	2	1.9	-11.1	-16.7	-5.0	Decline	Decline	Decline
	Maharashtra	2.9	2.5	2.1	1.9	1.7	-16.0	-9.5	-10.5	Decline	Decline	Decline
South	Andhra Pradesh	2.6	2.2	**1.8**	**1.8**	**1.8**	-18.2	**0.0**	**0.0**	Decline	**stall**	**stall**
	Karnataka	2.9	**2.1**	**2.1**	1.8	1.7	**0.0**	-14.3	-5.5	**stall**	Decline	Decline
	Kerala	2	2	1.9	**1.6**	**1.8**	-5.0	-15.8	**12.5**	Decline	Decline	**stall**
	Tamil Nadu	2.5	2.2	1.8	**1.7**	**1.8**	-18.2	-5.6	**5.9**	Decline	Decline	**stall**

(Bihar TFR 3.5 to 3.8, West Bengal TFR 2.3 to 2.3, Arunachal Pradesh TFR 2.5 to 3.0, Assam TFR 2.3 to 2.4, Mizoram TFR 2.9 to 2.9, Tripura TFR 1.9 to 2.2, Goa TFR 1.8 to 1.8 and Karnataka TFR 2.1 to 2.1), two states from NFHS III to IV (Himachal Pradesh TFR 1.9 to 1.9 and Andhra Pradesh TFR 1.8 to 1.8) and five states from NFHS IV to V (Punjab TFR 1.6 to 1.6, Tripura TFR 1.7 to 1.7, Andhra Pradesh TFR 1.8 to 1.8, Kerala TFR 1.6 to 1.8, Tamil Nadu TFR 1.7 to 1.8) experienced fertility stall. Among the eight stalling states during NFHS II to III, only one state was at the mid-transition stage, five were in late transition and two were at the post-transition stage. Furthermore, all states experienced fertility stall at a post-transition level during NFHS III to IV and IV to V.

The percentage change in socioeconomic indicators from 2005-06 to 2019-21 is depicted in Figure 1. The first figure (Fig 1.1) shows the percentage change of women with secondary and higher education significantly increases in all states, regardless of fertility stalling status during all rounds of surveys. During NFHS II to III, the changes in the proportion of Women with secondary and higher education remained unchanged only in one state (Arunachal Pradesh) out of eight. The proportion of women in paid employment (Fig. 1.2) has decreased in all stalling states from NFHS II to III except Goa (14.62) and Karnataka (2.27). Meanwhile, the percentage change of women in paid employment declined in the first three stalling states (- 6.59 Punjab, -7.02 Tripura, -3.90 Andhra Pradesh) and increased in the remaining two stalling states (1.31 in Kerala, 1.59 in Tamil Nadu) during NFHS IV to V. In contrast, only six of the seventeen fertility decline states (NFHS II to III) and five of the twenty-one (NFHS IV to V) have significantly reduced the share of women in paid employment. The change in the proportion of women using institutional delivery (fig 1.3) has increased in most of the states regardless of the fertility stall status.

Fig 2 depicts the percentage change of those socio-economic variables which were considered stall if the variable had shown no significant change or significant increase. In most of the states, the proportion change of poor households increased significantly or did not change significantly (Fig. 2.1). Among the stalling states, four out of eight during NFHS II to III (Mizoram 9.97, Tripura 29.72, Goa 14, Karnataka 0.18) one during NFHS III to IV (Himachal Pradesh 12.42), and four out of five during NFHS IV to V (Punjab 38.81, Tripura 16.49, Andhra Pradesh 19.13, Kerala 115.82) significantly increases (stalled) the percentage of change of poor households (appendix 1). Among the fertility progress states, the percentage ofpoor households has increas ed significantly in eight out of seventeen in NFHS II to III, ten out of twenty-four NFHS III to IV, and nine out of twenty-one from NFHS IV to V. Figure 2.2 depicts a drop in the proportion of marrying women before eighteen years of age almost in all the states over time. Whereas, only two states (one stalled- Arunachal Pradesh & one declined - Nagaland)during NFHS II to III and four states (two stalled – Punjab, Tripura & two declined- West Bengal, Manipur) during NFHS IV to V observed an increase in the proportion of change marrying before eighteen years of age among women.

Fig 1.1 Percentage change in women with secondary and higher education in different states of India

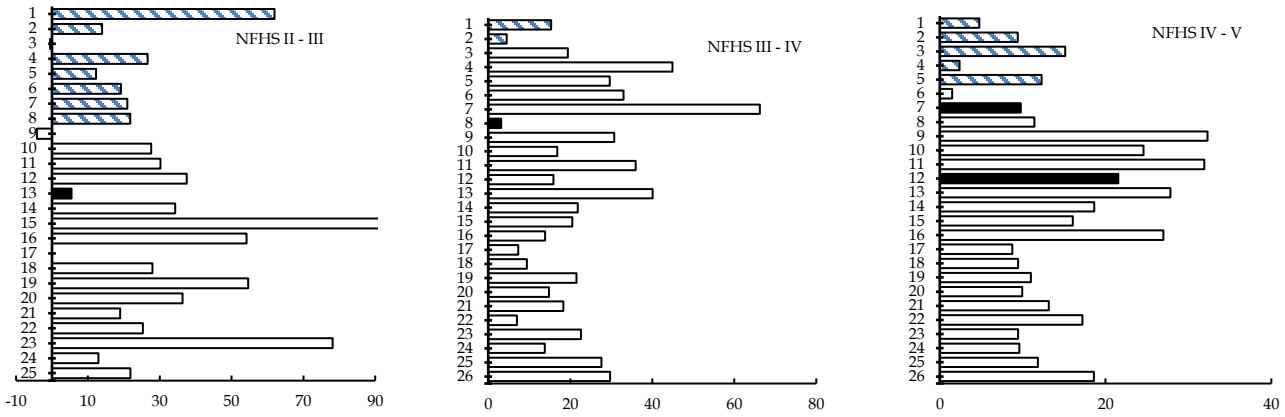


Fig 1.2 Percentage change of women in paid employment in different states of India

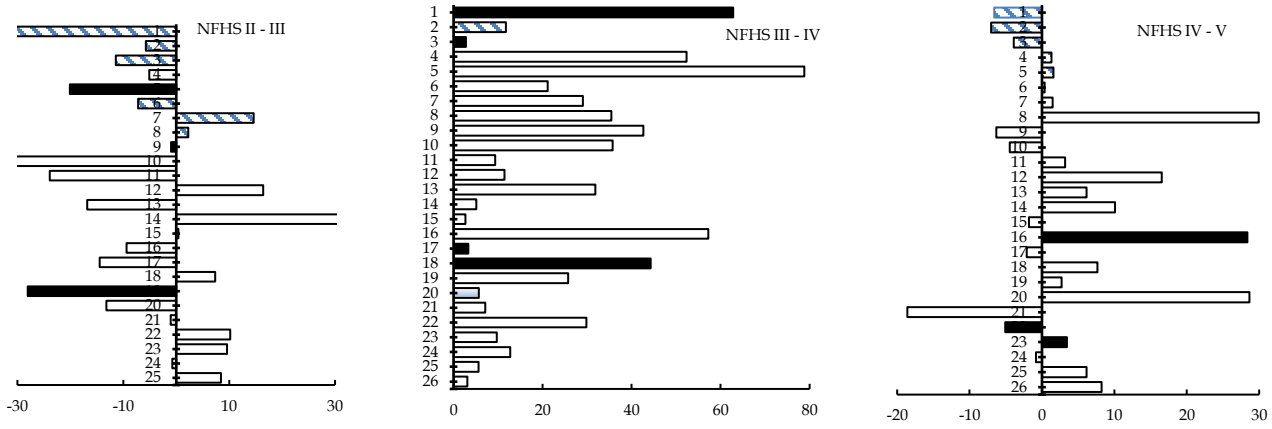


Fig 1.3 Percentage change of women used institutional facilities for delivery in different states of India

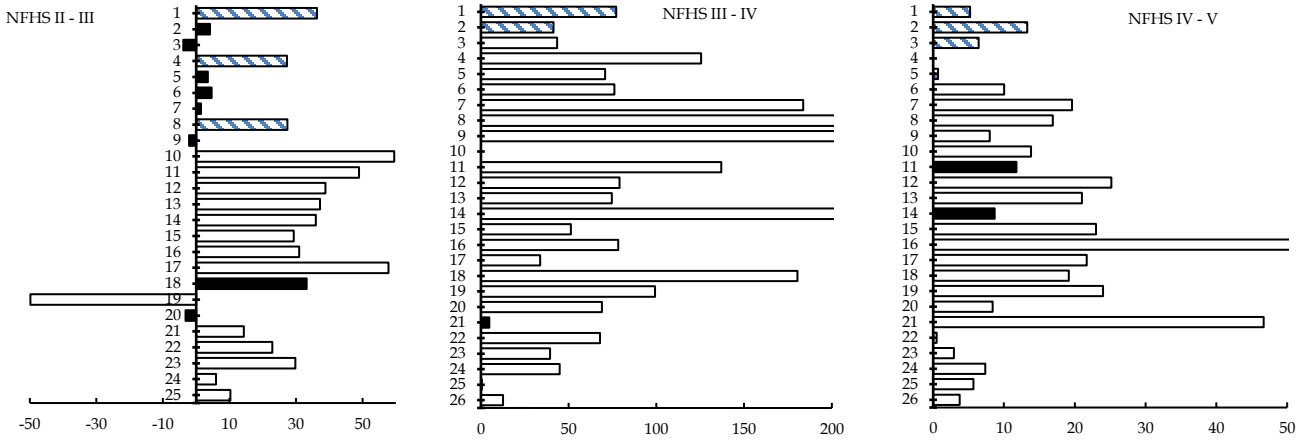


Fig 1 Socio-Economic Factors: Stall If Variable are no significant change or significant decline

Fig 2.1 Percentage change of Poor households in different states in India

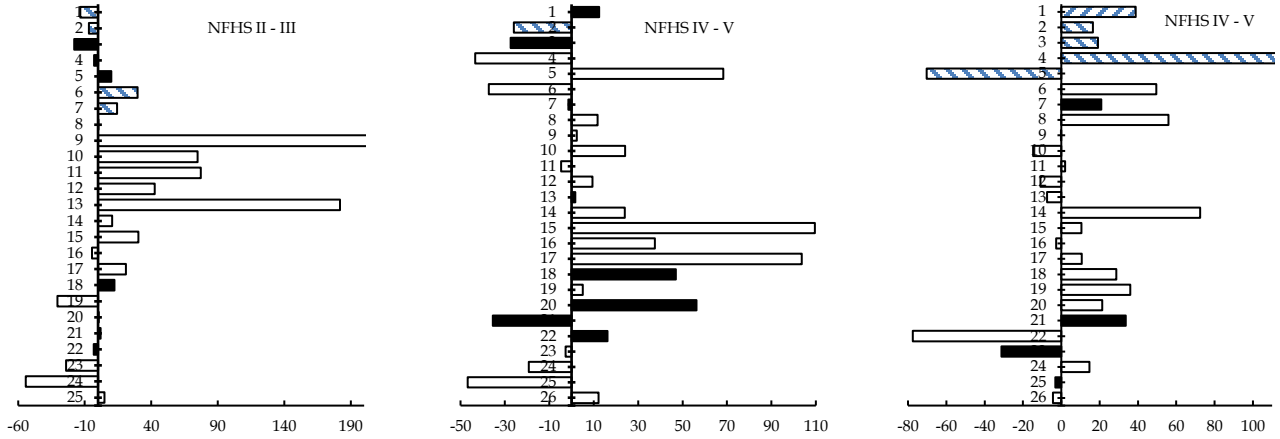


Fig 2.2 Percentage change of women marrying before 18 years in different states of India

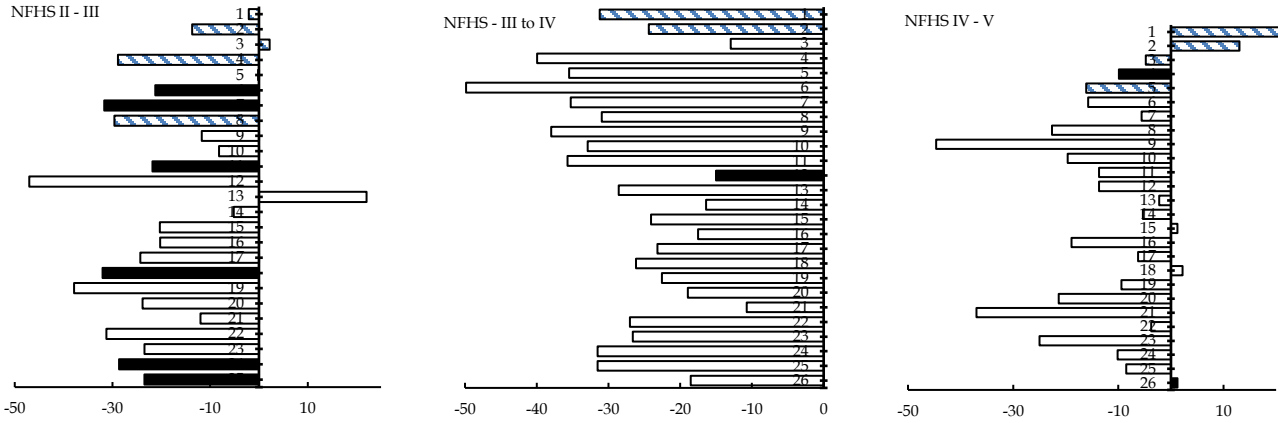


Fig 2.3 Percentage change of under-5 death in different states of India

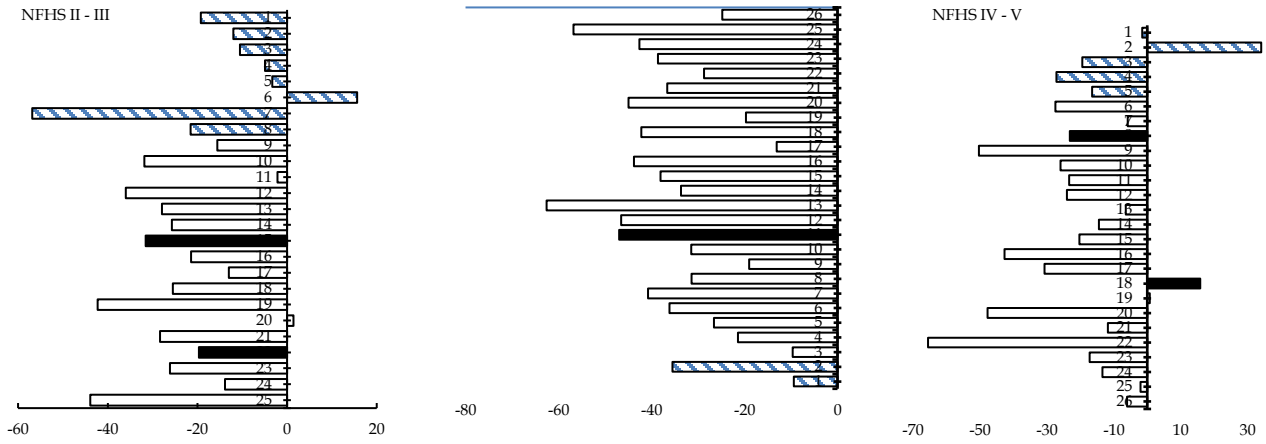
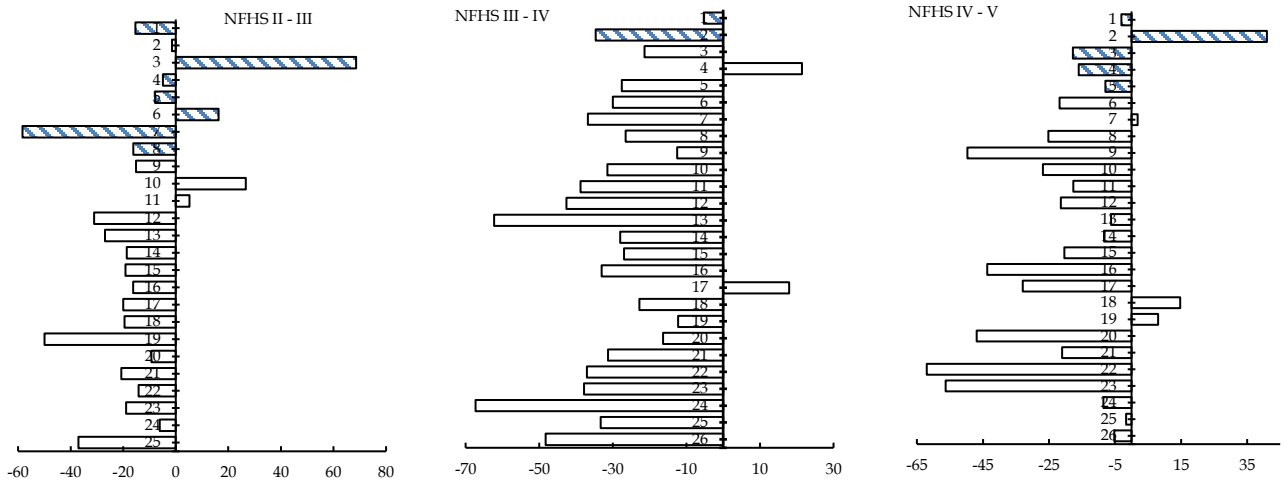


Fig. 2.4 Percentage change of Infant mortality Rate in different states of India



[*Fertility stall states* "▨"1.**Bihar 2. West Bengal 3. Arunachal Pradesh 4. Assam 5. Mizoram 6. Tripura 7. Goa 8. Karnataka]** ***[****Fertility Decline states* –"▭" 9. Delhi 10. Haryana 11. Himachal Pradesh 12. Jammu & Kashmir 13. Punjab 14. Rajasthan 15. Madhya 16. Pradesh 17. Uttar Pradesh 18. Odisha 19. Manipur 20. Nagaland 21. Gujarat 22. Maharashtra 23. Andhra Pradesh 24. Kerala 25. Tamil Nadu]

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▬ indicate not significant, other bars (▨, ▭) are significant

Fig 2 Socio-Economic Factors: stalled if variable were no significant changes or significant increase

Figures 2.3 and 2.4 represent the percentage change in under-5 death and infant death at the time of the onset of NFHS II to III, NFHS III to IV, and NFHS IV to V for 26 states.

Under-5 death increased significantly (stalled) in each survey in one stalling state (Tripura II to III & IV to V) and one progress state (Nagaland II to III, & Manipur IV to V). A similar pattern was noted in infant death, where two stalling states (Arunachal Pradesh 68.61, Tripura 16.29) and two progressing states namely, Haryana (26.63) and, HP (5.25) had shown an increasing trend, while the remaining 21 states (6 stalling, 15 progressing) observed decrease in this rate during NFHS II to III. In NFHS IV to V, one stalled state (Tripura) and two fertility decline states have shown increased IMR, remaining states (4 stalls, 18 progress) observed a decline in IMR.

Fig 3 shows different reproductive variables that were considered stall if no significant change or significant increase occurred. Figure 3.1 estimates the proportion change of women with son preference compared to the no and daughter preference for 26 Indian states. This proportion declines abruptly or slowly in all stalling states, except one state i.e. Mizoram 26% in NFHS II to 29% in NFHS III, Andhra Pradesh 9% in NFHS III

Fig. 3.1 Percentage change of Son preference in different states of India

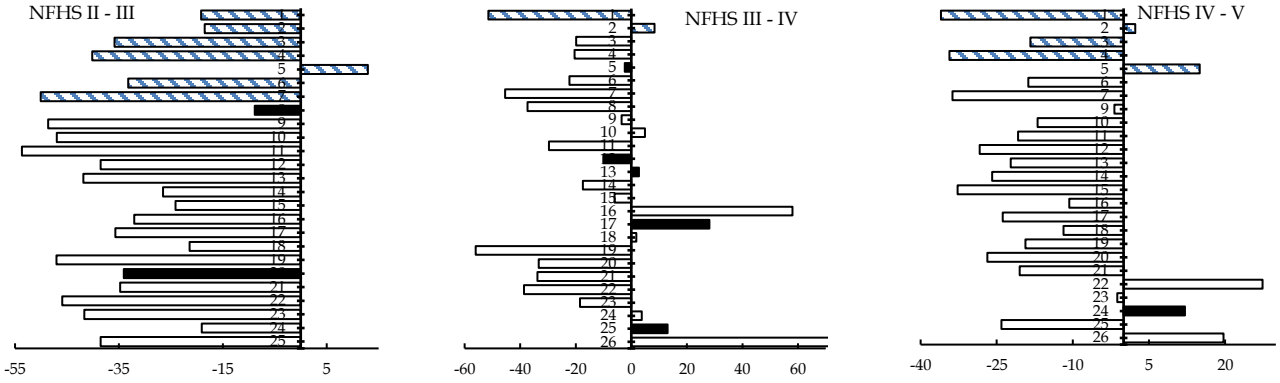


Fig 3.2 Percentage change of desire Family Size in different states of India

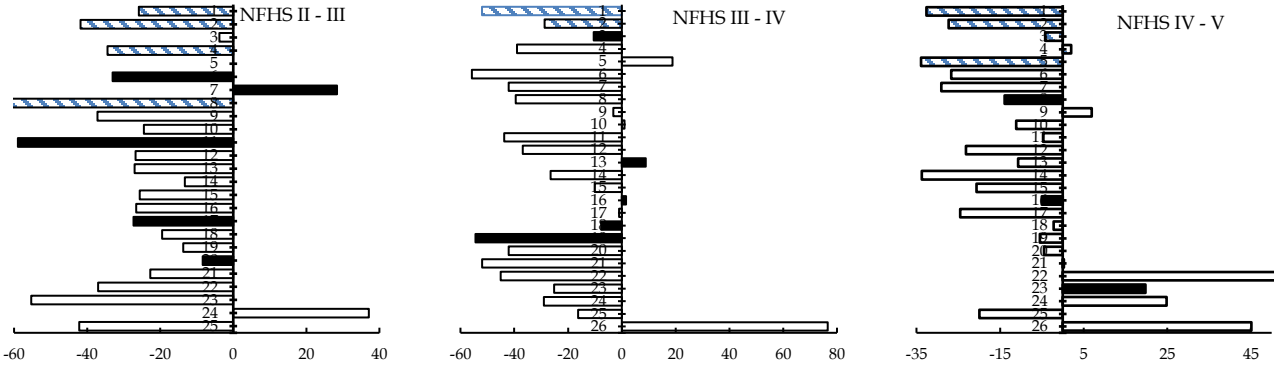
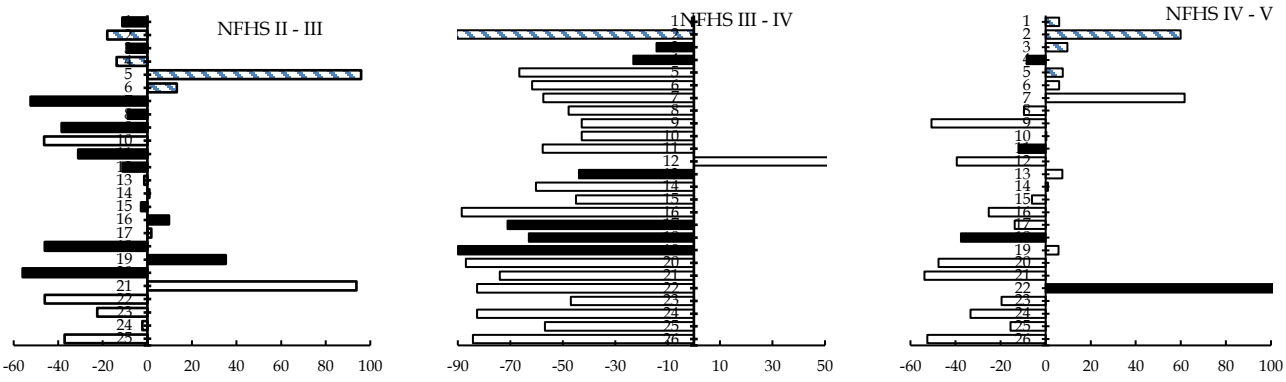


Fig3.3 Percentage change of Unintendent birth/Unwanted birth in different states of India



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indicate not significant, other bars (,) are significant

Fig. 3 Reproductive Preference: stalled if variable were no significant change or significant increase

to 10% NFHS IV and two stalled states Tripura 11% to 12% and Tamil Nadu 16% to 18% in NFHS IV to V respectively. According to Figure 3.2, the desire for more children falls almost in all states in every survey. The desire for more than mean family size significantly declined in five stalling states from NFHS II to III, and remaining two stalling states (Arunachal Pradesh, Goa) changes are insignificant, and Mizoram had zero changes in demand for higher family size. Except for West Bengal, all states in the III to IV survey, regardless of fertility stall or progress, had declined the desire for higher children. Similarly, NFHS IV to V only Kerala witnessed an increased proportion of the demand for larger family size among the five stalling states, and only four fertility decrease states out of twenty-one found to increase. As shown in Fig. 3.3, five stall states decline insignificantly and two north-eastern states significantly increase unwanted fertility from NFHS II to III. One stalling state (Himachal Pradesh) is almost constant at a specific rate of 17 and 17% in NFHS III to IV. During NFHS IV to V, four stall states significantly increase the percentage change of unintended birth (Punjab 6%, Tripura 60%, Andhra Pradesh 10%, Tamil Nadu 8%) out of five (- 8% Kerala).

Figure 4 represents different variables from the use of family planning which were considered stalled if variables were no significant change or significant decline. Fig 4.1 depicts the percentage change in modern contraceptive use among currently-married women for each of the last four surveys. The prevalence of women using the modern method increases in most of the states in all surveys. Among the fertility stall states only Himachal Pradesh (-26.64) during NFHS III to IV and Punjab (-22) during NFHS IV to V have shown a significant decline

in the percentage change of modern contraception.

The changes in media exposure are seen in Fig 4.2. Among the stalling states the proportion of mass media exposure significantly declined in Himachal Pradesh during NFHS II to III, and in Punjab and Andhra Pradesh during NFHS IV to V. While, among the fertility progress states eight during NFHS II to III, five during NFHS III to IV and ten during NFHS IV to V significantly decline this rate.

The family planning-related variables shown in Fig. 5 were regarded to be stalled if there had been a significant change or significant rise in the variable.

Figure 5.1 examines adolescent childbearing (15 to 19 age). The result showed that the proportion of childbirth among adolescent women in NFHS II to III increased in three stall states significantly. On the other hand among the fertility decline states only one in NFHS II to III and nine states during NFHS IV to V increased the proportion of adolescent childbearing. It is seen from Fig 5.2 that the percentage of women in the union declined in all states during the II to III survey. Whereas, increased this rate in one stalled state (Himachal Pradesh 5.37%) in III to IV and two stalled states (Tripura 5.11%, Kerala 0.79%) in the IV to V survey. The proportion change of unmet need for family planning in India's various states between the II to III, III to IV, and IV to V NFHS is shown in Fig. 5.3. The result showed that unmet needs for family planning decreased in the majority of states from one survey to the next. All the stalled states during NFHS II to III observed a significant decline in the unmet need for family planning, except Mizoram, which has observed an increase in this rate, though insignificant. In the subsequent survey, it was found that a very high increase in unmet need for family planning in one stalling state, Himachal Pradesh from 7% in NFHS III to 15% in NFHS IV, and two stalling states, Punjab 6% to 10%, Andhra Pradesh 4% to 5% during NFHS IV to V respectively.

Multivariate Analysis

In the binary outcome of the probit regression model, the association of fertility stalled states with the stall in the progress of different socio-economic characteristics, reproductive preferences, and family planning variables is explored. The main analysis uses fifteen factors to explore more consistent aspects. However, the probit model excludes three variables from each survey at the time of analysis: son preference, use of modern contraception, women in the union from NFHS II to III, institutional birth, adolescent birth, secondary and higher education from NFHS IV to V.

These variables either had shown increase or decrease in all states that experienced stall. Therefore, if a probit model is run with these variables, the coefficient value 0 or 1 is omitted. Furthermore, regression analysis could not be performed for the proportion value of NFHS III to IV due to the small number of stalled states (only two). Four separate models are used in Tables 3 and 4; the first three are individual models for socio-economic status, reproductive preference, and family planning, while the fourth model represents an overall probit analysis that has included all the variables.

Fig. 4.1 Percentage change of Modern Contraceptives in different states of India

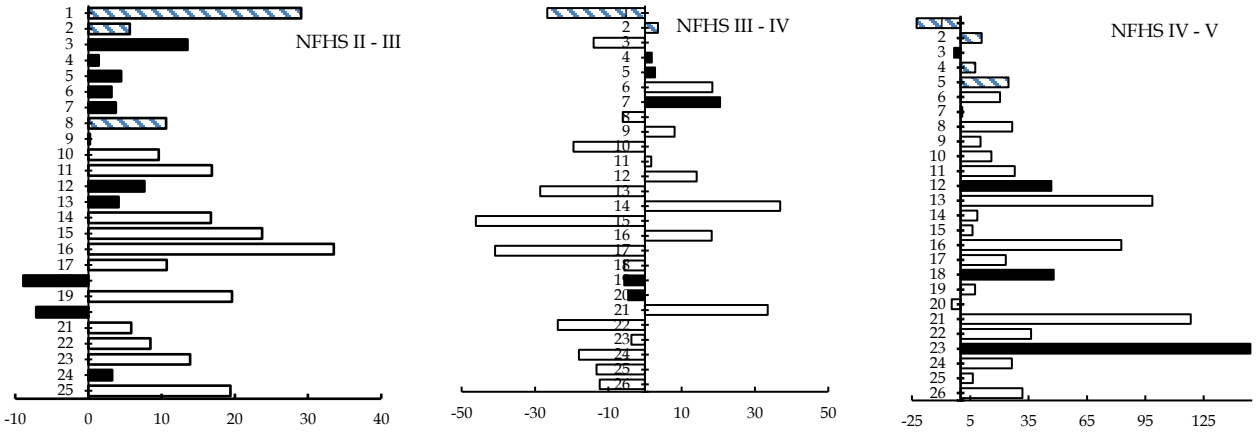


Fig. 4.2 Percentage change of heard saw FP on TV/radio/newspaper in different states of India

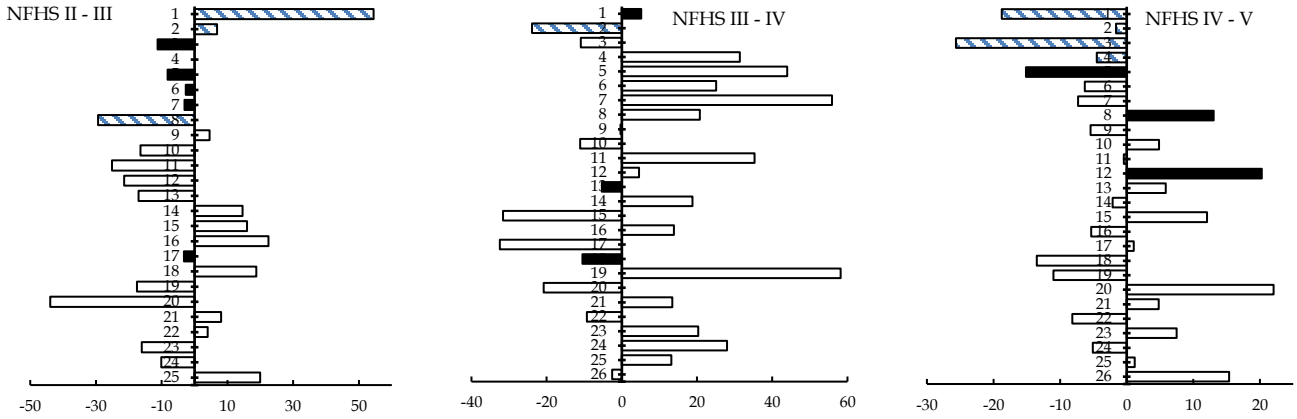
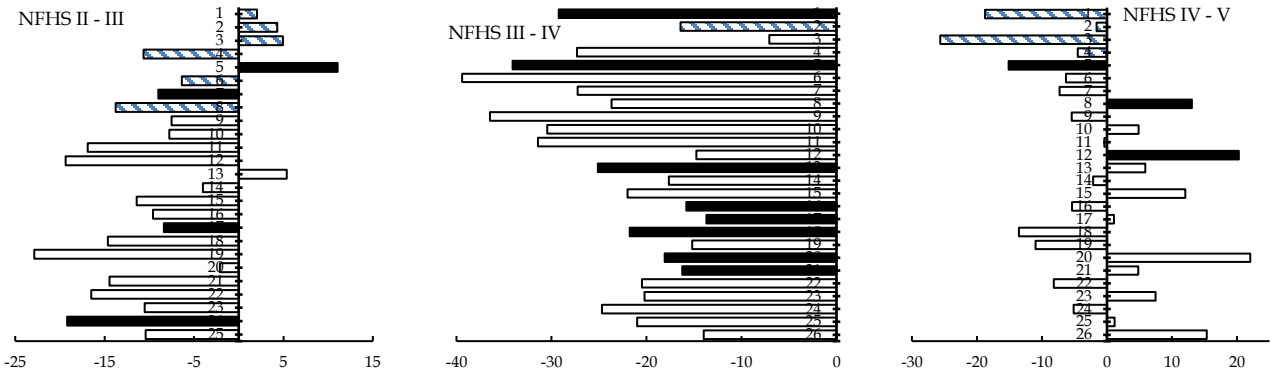
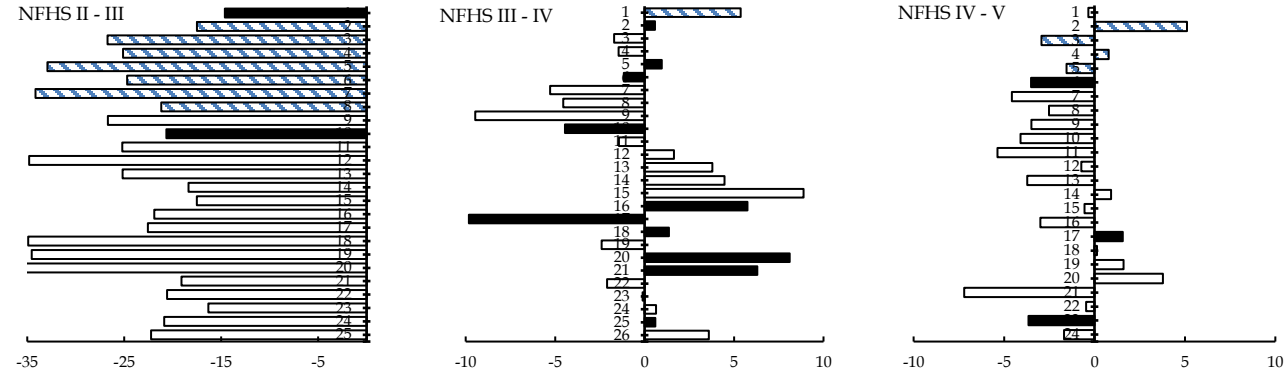


Fig. 4 Use of Family Planning: Stall If Variable are no significant change or significant decline

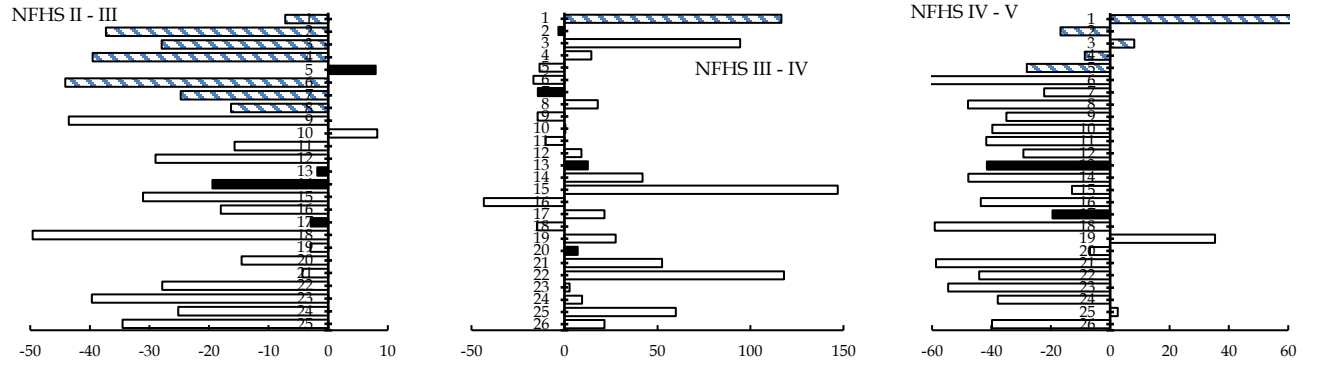
Fig 5.1 Percetage change of Adolesecent childbearing in different states of Infia



5.2 Percentage change of Women in Union in different states in India



5.3 Percentage change of Unmet need for family planning in different states in India



[*Fertility stall states* " "1. **Bihar 2. West Bengal 3. Arunachal Pradesh 4. Assam 5. Mizoram 6. Tripura 7. Goa 8. Karnataka]** [*Fertility Decline states* –" " **9.** Delhi 10. Haryana 11. Himachal Pradesh 12. Jammu & Kashmir 13. Punjab 14. Rajasthan 15.
Madhya 16. Pradesh 17. Uttar Pradesh 18. Odisha 19. Manipur 20. Nagaland 21. Gujarat 22. Maharashtra 23. Andhra Pradesh 24. Kerala 25. Tamil Nadu]

[Fertility stall states " " 1. **Himachal Pradesh 2. Andhra Pradesh** [*Fertility Decline states* –" " 3. Delhi 4. Haryana 5. Jammu & Kashmir 6. Punjab 7. Rajasthan 8. Madhya Pradesh 9. Uttar Pradesh 10. Bihar 11. Odisha 12. West Bengal 3. Arunachal Pradesh 14. Assam 15. Manipur 16. Meghalaya 17. Mizoram 18. Nagaland 19. **Sikkim* 20.** Goa 21. Gujarat 22. Maharashtra 23. Karnataka 24. Kerala 25. Tamil Nadu 26. Tripura]

[Fertility stall states " " 1. **Punjab 2. Tripura 3. Andhra Pradesh 4. Kerala 5. Tamil Nadu]** [*Fertility Decline states* –" " 6. Delhi 7. Haryana 8. Himachal Pradesh 9. Jammu & Kashmir 10. Rajasthan 11. Madhya Pradesh 12. Uttar Pradesh 13. Bihar 14. Odisha 15. West Bengal 16. Arunachal Pradesh 17. Assam 18. Manipur 19. Meghalaya 20. Mizoram 21. Nagaland 22. **Sikkim* 23.** Goa 24. Gujarat 25. Maharashtra 26. Karnataka]

indicate not significant, other bars (,) are significant

Figure 5 Use of Family Planning: stalled if variable were no significant change or significant increase

Table 3 represents the probit analysis of fertility stalls or progress states with the different variables from NFHS II to III. In model II, not a single factor was significantly associated with the fertility stall after controlling the other variables. The result of the marginal effect from model I indicates that in the states where secondary and higher education and under-5 death is stalled, the probability of experiencing a fertility stall increased by 66% and 64% respectively. According to estimates from Model-III, states that experienced a stall in adolescent birth are 53.3% more likely to experience a fertility stall than those who have shown an increase in adolescent birth. The overall result (model-IV) shows that secondary and higher education, women in paid employment, age at marriage, institutional birth, infant death, under-5 death, adolescent birth, unmet need, and mass media exposure for family planning are statistically significant in explaining fertility stall; remaining variables are not significant at least in 0.01 level. Among the significant variables, four are more likely to be associated with fertility stall (Secondary and higher education, women in paid employed, Under-5 death, adolescent birth, and mass media exposure), while other significant variables (age at marriage, used institutional facility for birth) are less likely to be associate with the same.

Table 3 Probit regression estimates in progress and progress stall of fertility determinants at individual categories in 25 states of India, 1998-99 to 2005-06

Category	Socio-economic factors		Reproductive preference		Used of family planning		Overall	
	Model - I		Model - II		Model - III		Model IV	
	B	*ME*	*B*	*ME*	*B*	*ME*	*B*	*ME*
Socio-economic factors								
Secondary & higher education	11.38*** [9.5,13.3]	65.9	-	-	-	-	25.46*** [18.2, 32.7]	68.2
Poor household	-0.91 [-2.0, 0.2]	-26.1	-	-	-	-	-1.26 [-3.8, 1.3]	-22.1
Women in paid employed	-0.06 [-1.3, 1.2]	-1.6	-	-	-	-	-1.36 [-4.0, 1.3]	-19.8
Age at marriage	1.29 [-0.4, 2.9]	38.6	-	-	-	-	- 6.61*** [-9.6, -3.6]	-26.8
Used inst. facility	-11.26*** [-12.5, -10]	-37.9	-	-	-	-	- 18.12*** [-22.9,-13.3]	-38.5
IMR	-0.37 [-1.5, 0.8]	-9.1	-	-	-	-	- 7.69***[-11.9, -3.4]	-27.9
U-5 death	6.85*** [5.7, 7.9]	63.6	-	-	-	-	14.16***[9.0, 19.3]	64.2
Reproductive preference								
Desire family size	-	-	0.57 [-1.4, 2.5]	21.6	-	-	-0.37 [-3.5, 2.8]	-6.0
Unwanted pregnancy	-	-	-0.21 [-1.4, 1.0]	-7.1	-	-	0.9 [-1.3, 3.1]	67.5
Used of family planning								
Adolescent birth	-	-	-	-	1.62** [-0.2, 3.4]	53.3	6.44*** [3.9, 8.9]	40.8
Unmet need for FM	-	-	-	-	0.55 [-1.4, 2.5]	16.8	8.58*** [3.81,13.4]	60.2
Heard/watching/read FP	-	-	-	-	0.84 [-0.3, 1.9]	22.6	8.2***[5.0, 11.4]	67.4
Cons	-0.06 [1.3,-1.2		0.46 [-1.1,0.1]		-5.52*** [-6.0,-5.0]		-5.5 [-6.0,-5.0	
Number of observation		25		25		25		25
Likelihood Ration		7.94		0.42		6.2		16.31
Pseudo ***R2***		0.2535		0.0134		0.1977		0.52

After adjusting for the variables, table 4 reveals that women in paid employment (B 7.6, ME 44%), under-5 death (B 8.8, ME 64%) from model-I, son preference (B 0.32, ME 6.5%) from model-II and unmet need for family planning (B 0.70, ME 11.4%) from model-III are more likely to be associated (B) or have experienced (ME) a fertility stall than those that have progressed. The overall model (Model-IV) indicates that the probability of experiencing a fertility stall increased in states by 39% for poor households, 48% for employed women, 61% for U-five mortality from the group of socio-economic factors, 21% for son preference from reproductive preference and 61% for unmet need for family planning, 57% for mass media exposure from family planning than the states that have made progress in these variables.

Table 4 Probit regression estimates in progress and progress stall of fertility determinants at individual categories in 25 states of India, 2015-16 to 2019-21

Category	Socio-economic factors		Reproductive preference		Used of family planning		Overall	
	Model - I		Model - II		Model - III		Model - 4	
	B	*ME*	*B*	*ME*	*B*	*ME*	*B*	*ME*
Socio-economic factors								
Poor household	0.84***[-0.91,2.6]	18	-	-	-	-	13.3***[8.6, 22.5]	39.2
Women in paid employed	7.6***[2.3, 11.3]	44	-	-	-	-	18.7**[11.2, 34.3]	47.6
Age at marriage	-1.8[-3.3,1.7]	- 12	-	-	-	-	-5.4[-14.3, -1.3]	-17.6
IMR	0.37[-0.4, 1.2]	6.3	-	-	-	-	- 3.8[-6.6, -1.4]	-17.7
U-5 death	8.8 **[6.4, 10.2]	52.6	-	-	-	-	19.12***[12.7,-33.3]	61.2
Reproductive preference								
Son preference	-	-	0.32***[-2.3,2.1]	6.5	-	-	6.4**[2.3,11.2]	21.3
Desire family size			0.67[-0.8,3.2]	14.2			3.6[0.7,8.5]	17.5
Unwanted pregnancy	-	-	1.56[0.6,5.3]	38.9	-	-	11.7[3.2,15.4]	36.7
Used of family planning								
Used Modern contraception	-	-	-	-	- 3.2[-6.6, -1.6]	-9.3	-12.2[-19.1,-6.5]	-23.4
Women in Union					1.08[0.2,3.6]	16.8	12.5[8.6,16.8]	44.3
Unmet need for FM	-	-	-	-	0.70***[-0.7,2.4]	11.4	6.8***[3.2,4.3]	16.3
Heard/watching/read FP	-	-	-	-	12.6 [3.4,18.3]	42.4	23***[14.3,31.6]	56.8
Cons	1.2**[-1.2,4.3]		-1.80***[-2.5,-1.1]		-1.24[-2.4,-.08]		4.4[1.2,-9.3]	
Number of observation		26		26		26		26
Likelihood Ration		4.94		1.32		0.86		19.54
Pseudo $R2$		0.164		0.334		0.063		0.839

Discussion and Conclusion

National Family Health Survey data from 26 states of India is used to assess the fertility stalled condition and its underlying variables. However, eight states from NFHS II to III, two states from NFHS III to IV, and five states from NFHS IV to V experienced fertility stalls. The fertility stall in Indian states is significantly influenced by women with secondary and higher education, adolescent births from NFHS II to III, women in paid employed and unmet need for family planning from NFHS IV to V and poor households, under-five mortality, son preference, and mass media exposure in all the rounds of surveys (NFHS II to III, IV to V).

Among the socioeconomic factors, poor households, women in paid employment, and

increases in under-5 death significantly influenced the states from declining fertility into stall conditions mainly in the northeastern states. According to earlier studies (Shapiro and Gebreselassie 2008; Ismail 2007), there is a correlation between changes in the number of women living in impoverished households, the employment of women, and under-5 mortality as well as a stall in fertility in sub-Saharan Africa. Based on this observation, it is apparent that the government of India should emphasise more on the backward areas to reduce the demand for children and provide awareness for fertility transition.

The outcome demonstrates that the stall states are substantially influenced by reproductive preference, notably reflected by the increases in son preference. Son preference is more prominent in India's southern region, states like Karnataka during NFHS II to III, Andhra Pradesh during NFHS III to IV, and Tamil Nadu during NFHS IV to V experience fertility stalling. After examining different works on fertility stalled in various parts of the world, most studies conclude that increasing demand for son preference is an essential predictor for stalled fertility. (Wastoff and Cross, 2006; Blacker, 2002; Odwe et al., 2015). Among the responsible variables of fertility stall, son preference is a challenging issue in low fertility states. Many times it was observed that couples want one son, and when they have one son, they hardly go for another child unless he is their only living child (Gendell, 1985; Gangopadhyay & Das, 1996.) This indicates strong gender preference among couples. Another important predictor, the desire for more children could not observe a significant relation with fertility stall in India. Previously, some researchers found a well-established association between increasing desire for family size and stalled in different countries (Van de Kaa, 1998).

Among family planning determinants, increasing adolescent childbearing, unmet need for family planning and decrease in mass media exposure have significant links with the fertility stall, than those of transition states. Similar findings have been observed in earlier research works, where a rise in adolescent fertility, an unmet need for family planning, and an increase in the chances of unintended birth resulted in fertility stalling (Garenne,2009, Ezeh et al., 2009, Bongaarts 2006,2008; Westoff and Cross 2006). Here the use of modern contraception increased in all stalling states and the probit model is less likely to be associated with the fertility stall. Previous research, however, demonstrated a strong link between the declining use of modern contraception and fertility stall in African countries (Garenne, 2009).

This study advocated that multiple factors are responsible for fertility stalls in different states of India. From a policy perspective, this study suggests enhancing the education budget for enabling environment so that more women can continue in higher education. They can understand the consequences of having a large family, unwanted pregnancy, the benefits of using family planning methods, as well as being economically and socially independent. The under-5 death in India has been declining for decades, but it has yet to meet the target set by the Sustainable Development Goals (SDG). The key cause for high child mortality is that the declining rate is not uniform across states; and, in certain areas, this rate

is rather increasing. Addressing the under-5 mortality problem requires a more rapid scale-up of key effective, affordable interventions: care of a newborn and their mothers, infant and young child feeding, vaccines, prevention and case management of pneumonia, diarrhoea, sepsis, and malaria control (WHO 2015). The major problem identified in this paper and existing literature is the increase in child preference. Sons are preferred due to their higher wage-earning capacity (mainly in an agrarian economy), they continue the family line and as usual take responsibility for their parents in illness and old age (Hesketh, 2006). One article observed the local reason for son preference in India, mainly the prevalence of dowry (Das Gupta et al., 2003). The Indian government has already paid significant attention to gender equity by emphasising the implementation of social and economic rights. It may draw attention to the challenging issue that was faced in this work was the small sample size, despite that, it is worth attempting the analysis which may open up further analysis. However, the problem has not been resolved; as an implication, the government should be more focused on this. Some important aspects, like the couple's attitude and behaviour towards conceiving a child, are very important for their fertility decision (Billari et al., 2009; Ciritel et al 2019), but they could not be included in this study due to the limitation to data of NFHS on this aspect. This leaves scope for further studies regarding fertility stall with couple's behaviour and attitude.

Declarations

On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Askew, I., Maggwa, N., Obare, F. (2016). Fertility Transitions in Ghana and Kenya: Trends, Determinants, and Implications for Policy and Programs. Population and development review, 43, 289-307. https://doi.org/10.1111/padr.12010

Billari, F. C., Philipov, D., & Testa, M. R. (2009). Attitudes, norms and perceived behavioural control: Explaining fertility intentions in Bulgaria/Attitudes, normes et contrôle perçu du comportement: Une explication des intentions de fécondité en Bulgarie. European Journal of Population/Revue Européenne de Démographie, 439-465.

Blacker, J. (2002). Kenya's Fertility Transition: How Low Will It Go?. Semantic Scholar, 457-468

Bongarts, J. (2008). Fertility Transitions in Developing Countries: Progress or Stagnation?. Studies in Family Planning, 39 (2), 105-110. https://doi.org/10.1111/j.1728-4465.2008.00157.x

Bongarts, J. (2006). The causes of stall fertility transition. Studies in Family Planning, 37 (1), 1-16. https://doi.org/10.1111/j.1728-4465.2006.00079.x

Ciritel, A. A., De Rose, A., & Arezzo, M. F. (2019). Childbearing intentions in a low fertility context: the case of Romania. Genus, 75(1), 4.

Das, Gupta, M. Jiang, L. Xie, Z. (2003). Why is son preference so persistent in East and South Asia? A cross-country study of China, India and the Republic of Korea. The Journal of Development Stud, 40:153–87. https://doi.org/10.1080/00220380412331293807

Ezeh, A. C., Mberu, B. U., & Emina, J. O. (2009). Stall in fertility decline in Eastern African countries: Regional analysis of patterns, determinants and implications. Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 364(1532), 2991–3007. https://doi.org/10.1098/rstb.2009.0166

Eltigani, E. E. (2003). Stalled Fertility Decline in Egypt, Why?. Population and Environment, 25 (1), 41-59. http://dx.doi.org/10.1023/A:1025547622370

Ezeh, A. C., Bongaarts, J., & Mberu, B. (2012). Global population trends and policy options. The Lancet, 380(9837), 142–148.

https://doi.org/10.1016/S0140-6736(12)60696-5

Gangopadhyay, B., & Das, D. N. (1996). Transition of preferred sex combination of children and family size: An analysis of the behavioural mechanism. Journal of Family welfare, 42(1), 57-66.

Garenne, M. (2009). Situation of Fertility Stall in sub Saharan Africa. African Population Studies 2009, 23(2):173-188. https://doi.org/10.11564/23-2-319

Gendell, M. (1985). Stalls in the fertility decline in Costa Rica, Korea, and Sri Lanka. Population and Development Series no. 18, Washington DC: The World Bank (World Bank Staff Working Paper, 693).

Greene, W. H. (1997). Econometric Analysis (Third Edition). New Jersey: Prentice Hill.

Hesketh, T., Zhu, WX.,(2006). Abnormal sex ratios in human populations: causes and consequences. Proc Natl Acad Sci U S A;103 (36): 13271–5. https://doi.org/10.1073/pnas.060220310

Howse, K. (2015). What is fertility stalling and why does it matter?. Population Horizons, 12(1), 13–23. https://doi.org/10.1515/pophzn-2015-0003

Islam, M. M. (2007). Exploring the causes of recent stalling of fertility in Bangladesh. Paper presented at the 5th African Population Conference of Union for African Population Studies, Arusha.

Kumar, S. (2016). The causes of Indonesia's late fertility transition stall. Paper presented at the 81st Annual Meeting of Population Association of America, Washington, D. C.

Lutz, W., W. Sanderson, and Scherbov, S. (2001). The end of world population growth. Nature, 412, 543–546. https://doi.org/10.1038/35087589

Odwe, G., Agwanda, A., & Khasakhala, A. (2015). Trends in socio-economic differentials in fertility in Kenya. Paper presented at the 80th Annual meeting of the Population Association of America, San Diego.

Pantelides, E. A. (1996). A century and a quarter of fertility change in Argentina: 1869 to the present. In The Fertility Transition in Latin America. Oxford, Clarendon Press; 345-358.

Pison, G. (2022). World population: 8 billion today, how many tomorrow?. Population & Sociétés, 604, 1-4. https://doi.org/10.3917/popsoc.604.0001

Shapiro, D., Kreider, A., Varner, C., and Sinha, M. (2010). Stalling of Fertility Transitions and Socioeconomic Change in the Developing World: Evidence from the Demographic and Health Surveys. Annual Symposium in Demography at the Catholic University of Louvain" Belgium.

Shapiro, D., & Gebreselassie, T. (2008). Fertility transition in sub-Saharan Africa: falling and stalling. African Population Studies, 23(1). https://doi.org/http://dx.doi.org/10.11564/23-1-310

United Nations, 2022, World population prospects: The 2022 revision, New York, United Nations Department of Economic and Social Affairs, Population Division. https://population.un.org/wpp

Van de Kaa, D. J. (1998). Postmodern fertility preferences: from changing value orientation to new behaviour (Working Papers No. 74). Canberra: Research School of Social Sciences, The Australian National University.

Westoff, C. F., Cross, A. R. (2006). The Stall Fertility Transition in Kenya. DHS Analytical Studies 9. Calverton: ORC Macro.

World health report (2015). Reducing risks, promoting healthy life. Geneva, World Health Organization

Appendix 1 Trend in Secondary and higher education, and under-5 death in the states of India, II, III , IV and V survey, NFHS program 1992-93 – 2019-21

States	Secondary and Higher Education				Under-5 Death			
	II survey	III survey	IV survey	V survey	II survey	III survey	IV survey	V survey
Andhra Pradesh	24.13	43	44.93	51.73	85.4	63	41	32.8
Assam	36.72	46.5	56.67	61.62	89.4	85	56	39.1
Bihar	17.48	28.31	33.07	42.27	105	85	58	54
Goa	54.9	66.42	76.28	83.47	46.8	20	13	11
Gujarat	38.53	45.83	54.23	59.44	85	61	43	38
Haryana	32.19	41.09	59.54	65.36	76.7	52	41	39
Himachal Pradesh	46.93	61.1	70.47	78.51	42	42	38	29
Jammu & Kashmir	26.35	36.24	46.99	62.17	80	51	38	19
Karnataka	36.58	44.55	54.61	64.77	70	55	31	30
Kerala	72.4	81.77	93.05	95.27	19	16	7	5
Madhya Pradesh	19.13	37.18	38.35	50.59	138	94	65	50
Maharashtra	48.8	61.16	65.42	73.17	58	47	29	28
Manipur	45.85	58.67	70.72	77.4	56	42	26	30
Meghalaya	30.37	46.96	53.47	59.35	122	70	40	40
Mizoram	59.56	66.86	71.75	78.89	55	53	46	24
Nagaland	42.11	57.41	62.82	71.09	64	65	37	33
Orissa	25.65	35.43	48.18	57.16	104	91	48	41
Punjab	45.92	48.42	64.39	67.46	72	52	33	33
Rajasthan	15.67	21.05	35	43.6	115	85	51	38
Sikkim	31.56	49.12	59.7	69.96	71	40	32	11
Tamil Nadu	41.93	51.09	65.2	73.21	63	36	27	22
West Bengal	38.13	43.45	50.37	58.46	68	60	32	25
Uttar Pradesh	20.27	31.25	40.86	49.66	123	96	78	59
New Delhi	60.7	58.14	69.43	70.47	55	47	42	31
Arunachal Pradesh	31.96	31.8	44.56	56.58	98	88	33	19
Tripura	38.98	46.46	60.28	65.95	51	59	33	44

Source: NFHS, 1992-93 to 2019-21