

Female married illiteracy as the most important continual determinant of total fertility rate among districts of Empowered Action Group States of India: Evidence from Annual Health Survey 2011–12

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ABSTRACT

Background: District level determinants of total fertility rate in Empowered Action Group states of India can help in ongoing population stabilization programs in India. **Objective:** Present study intends to assess the role of district level determinants in predicting total fertility rate among districts of the Empowered Action Group states of India. **Material and Methods:** Data from Annual Health Survey (2011-12) was analysed using STATA and R software packages. Multiple linear regression models were built and evaluated using Akaike Information Criterion. For further understanding, recursive partitioning was used to prepare a regression tree. **Results:** Female married illiteracy positively associated with total fertility rate and explained more than half (53%) of variance. Under multiple linear regression model, married illiteracy, infant mortality rate, Ante natal care registration, household size, median age of live birth and sex ratio explained 70% of total variance in total fertility rate. In regression tree, female married illiteracy was the root node and splits at 42% determined TFR ≤ 2.7 . The next left side branch was again married illiteracy with splits at 23% to determine TFR ≤ 2.1 . **Conclusion:** We conclude that female married illiteracy is one of the most important determinants explaining total fertility rate among the districts of an Empowered Action Group states. Focus on female literacy is required to stabilize the population growth in long run.

Keywords: Married illiteracy, regression tree, total fertility rate

Introduction

Total fertility rate (TFR) is one of the key health indicators for understanding the population growth and stability.^[1] The fertility rate directly influences maternal health, and eventually socioeconomic status of the people, family, society, and at large the economy of a nation.^[2-4] Recent London Summit on Family Planning 2020 is a step to revamp the activities of population stabilization including TFR.

In India, many states achieved replacement level fertility yet TFR is high among others. The Government of India emphasized on states with poor health indicators (classified as Empowered Action Group [EAG] and Assam) contributing highest in the fertility pool. This is also evident in Registrar General of India's series of Annual Health Surveys (AHSs) conducted to track and accelerate health outcomes in these EAG states.^[5-7]

The previous studies highlighted age at marriage, female literacy, and socioeconomic status as important determinants affecting

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TFR but none has focused on district-level determinants in EAG states.^{15,8,91} This study produces a comprehensive detail of demographic profile and key health indicators of 284 districts in EAG states. Our analysis aims to find the role of female illiteracy and other district level determinants affecting TFR among the EAG states where AHS was conducted during the year 2011-12.

Subject and Methods

Data sources

We analyzed secondary data from AHS (2011–12) captured for nine EAG states. AHS survey covered a total of 284 districts, with sample population of 18.2 million and 3.6 million households. Data analysis was done in June 2016.

Variables

We identified TFR as the dependent variable. Selected independent variables were household size, sex ratio, work participation rate, female married illiteracy, age of marriage, and age at first live birth. Other important covariates were infant mortality rate (IMR), antenatal care (ANC) registration, ANC utilization, and institutional delivery, and reach of family planning services to target population, i.e., unmet need for spacing, unmet need for limiting, and total unmet need.

Data analysis

Data for dependent and independent variables obtained from AHS was organized in Excel file and imported to STATA version 13.1 (StataCorp LP)¹⁰¹ and R software (The R foundation) for further statistical analysis.¹¹²

Univariate analysis was done using the linear regression model. Multicollinearity was reviewed using Pearson's correlation coefficients. Multiple linear regression model was manually built using forward stepwise method where the Akaike information criterion (AIC) value was reviewed on every change in explanatory variables. Smaller AIC value was considered as an indicator for

improved model. Simultaneously, coefficient of determination was also reviewed for improvement in explained variance in the model. Regression coefficients and 95% confidence intervals were tabulated to present the findings. Statistical significance was considered at 5% (0.05) in the study.

Regression tree

All statistically significant explanatory variables from multiple regression model were used in building regression tree. It was done in "R"¹¹¹ using "rpart"-package.¹¹² Tree pruning was done at 0.020 complexity parameter value after reviewing the x-error (estimates of cross-validated prediction error). However, as number of districts under analysis were smaller ($n=284$), we did not attempt in-depth interpretation of the regression tree.

Results

The estimated parameters were TFR (mean, 3.09 ± 0.71); illiteracy among married females (mean, $45.18 \pm 15.45\%$); age at first live birth (median, 22.01 ± 0.92 years); IMR (mean, 58.46 ± 13.96 per 1000 live births); ANC registration (rate, $70.16 \pm 11.95\%$); and total unmet need (mean, $23.76 \pm 8.68\%$). Under univariate linear regression married illiteracy, IMR, unmet need for spacing, unmet need for limiting, total unmet need, and household size were significantly associated with fertility rate of the districts whereas age of marriage (male and female), age of first live birth, work participation rate of females, ANC registration, more than three antenatal check-up, and institutional deliveries showed significant protective effect on TFR. Married illiteracy explained maximum variance (53%) for predicting the TFR. The characteristics of predictors and their corresponding regression coefficient with 95% confidence interval under univariate analysis are given in Table 1.

Multiple regression analysis

Under multiple linear regression, married female illiteracy, ANC registration, IMR, unmet need, household size, age of first live birth, and sex ratio were found to be statistically significant. This

Table 1: Summary of explanatory variables and result of univariate analysis

Explanatory variables	Mean±SD	Regression coefficient (lower, upper 95% CIs)	R ² (%)
Married female illiteracy (%)	45.18±15.45	0.03 (0.03, 0.04)*	52.63
Mean age at marriage of males (in years)	24.20±1.85	-0.22 (-0.26, -0.19)*	34.27
Mean age at marriage of females (in years)	20.99±1.11	-0.29 (-0.36, -0.23)*	21.53
Median age of female at first live birth	22.01±0.92	-0.32 (-0.40, -0.24)*	16.97
Household size	4.95±0.57	0.56 (0.43, 0.69)*	20.39
Sex ratio	954.20±66.67	-0.002 (-0.003, -0.001)*	4.45
Male work participation rate (%)	74.12±5.16	0.01 (-0.002, 0.03)	1.11
Female work participation rate (%)	18.36±14.28	-0.01 (-0.01, -0.003)*	3.12
ANC registration (%)	70.16±11.95	-0.03 (-0.04, -0.03)*	32.19
More than three ANC (%)	51.87±20.36	-0.02 (-0.02, -0.02)*	33.68
Institutional delivery (%)	61.01±17.82	-0.01 (-0.02, -0.01)*	13.32
IMR	58.46±13.96	0.02 (0.02, 0.03)*	21.18
Unmet need for spacing methods (%)	12.09±4.51	0.09 (0.08, 0.11)*	36.26
Unmet need for limiting methods (%)	11.64±5.46	0.03 (0.02, 0.05)*	5.40
Overall unmet need (%)	23.76±8.68	0.04 (0.03, 0.05)*	20.60

*Statistically significant at $P<0.05$. CIs: Confidence intervals; IMR: Infant mortality rate; ANC: Antenatal care; SD: Standard deviation

model produced least AIC value among different hierarchical models. And the model explained 70% of variance of TFR. The details of regression coefficients and corresponding 95% confidence interval are given in Table 2.

Classification and regression tree

Using statistically significant explanatory variables under final multiple linear regression model, the regression tree revealed married illiteracy as most important variables (root node) which later interacted with ANC registration, IMR, and unmet need to decide the extent of TFR. The explanatory variables of the pruned tree explained 66% of variance while full model with all seven explanatory variables explained 70% of variance. Female married illiteracy was found to be a root node and split was at 42% to determine the TFR ≤ 2.7 . In the next left split of married illiteracy at 23%, it further determined the TFR ≤ 2.1 .

Discussion

Our study found married female (15–49 years) illiteracy explaining maximum variance in TFR at district level among EAG states. The most pronounced effect of illiteracy was visualized under Classification and Regression Trees (CART) where married illiteracy is appeared as root node and found to be foremost correlates of higher TFR in the districts. In the same regression tree, in next branch at 23% of married illiteracy, it further reduced the TFR. This decline in TFR with improved literacy was in agreement with various previous publications in India.^[13-17] This signifies that literacy is still an important factor in determining TFR among EAG states. Female education usually helps in improving female autonomy^[18] which makes them aware of birth control methods, accessibility of maternal services, and better survival of their infant and children,^[19-21] and make them understand the importance of smaller family.^[22] However, in contrary to that another publication revealed that reduction in TFR is more due to increased contraception and alterations in reproductive behavior and not due to increased literacy among females.^[23] Higher ANC registration rate is one of the indicators of better accessibility of maternal health services, which shows improved contact between health system/health workers and beneficiaries and thus indication of improved availability of health services to females at various health institutions. ANC in India is an incentivized program through villages' level community health

volunteers, Accredited Social Health Activists. This also facilitates awareness, consultancy, and access services of family planning at various levels of health services, this higher ANC registration may translate into the reduction of TFR of the districts. In the regression tree, ANC registration was the second most important variable to decide the TFR of the district interacting with central node - married female illiteracy.

Improved (lower) IMR indicates better survival of infants which may also help the mother to feel more comfortable in achieving convincing family size quickly with lower fertility.^[24] Higher infant mortality, as determinants of higher fertility rates, is reported by some of the earlier publications.^[25-28] CART show IMR as the third important determinants to decide the TFR in interaction with ANC registration rate and female married illiteracy. The IMR of the district later interacted with unmet need to decide the TFR of the respective districts. We also found, unmet need for family planning is significant determinant for higher TFR, which is in agreement with the study conducted by Stover and Ross confirming reduced TFR with higher contraceptives use.^[29] Higher unmet need for family planning is an indicator of poor family planning services for spacing and limiting methods. Thus, higher unmet need might be reflected in the same way to keep TFR higher in the districts.

We found that increased age of live birth reducing TFR significantly alone after adjusting other variables. A similar finding was reported by National Family Health Survey-III (NFHS-III) which explained the age of live birth as an important indicator for fertility rate.^[30] Our finding is also supported by other studies documenting inverse association of age of the first live birth and fertility rate.^[31,32] Usually, age of the first live birth and age of marriage reduce the reproductive span and thus help in the decline of TFR.

Sex ratio is also positively associated with TFR in this study. The sex ratio is believed to be a proxy indicator of son preferences.^[30] Findings of this study are consistent with the findings of other publications where effect of son preferences on TFR are well established.^[15,28,33-35] Son preference and respective change in the fertility rate are also described by NFHS-III which supports the findings of this study.

Finally, we conclude that female married illiteracy plays an important role in determining the TFR of EAG states of India. Along with female married illiteracy, ANC registration, IMR, total unmet needs, household size, and age of the first live birth are some of the other important predictors of TFR. We recommend focusing on these covariates to improve TFR among EAG states at the district level.

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Conflicts of interest

There are no conflicts of interest.

Table 2: Regression coefficients for multiple linear model to explain total fertility rate of the districts

Variables	Regression coefficient (lower, upper 95% CI)
Married female illiteracy (%)	0.02 (0.01, 0.02)*
ANC registration (%)	-0.01 (-0.014, 0.004)*
IMR	0.01 (0.01, 0.02)*
Overall unmet need (%)	0.02 (0.01, 0.02)*
Average household size	0.20 (0.10, 0.29)*
Median age of female at first live birth	-0.10 (-0.16, -0.05)*
Sex ratio	-0.001 (-0.002, -0.00)*
Intercept	3.97 (2.47, 5.47)*

*Statistically significant at $P < 0.05$. CI: Confidence interval; IMR: Infant mortality rate; ANC: Antenatal care

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