ORIGINAL RESEARCH ARTICLE

Predictors of Adolescent Pregnancy in Northeast India: A Cross-Sectional Analysis

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DOI: 10.55489/njcm.160520255117

ABSTRACT

Background: Worldwide teenage pregnancy marks a major public health concern that hits hardest in countries with lower and medium incomes. A recent national family health survey study shows adolescent pregnancy rates climbed in three northeastern states while other parts of the country recorded progress. Understanding the factors contributing to marital teenage pregnancy is crucial for improving the health status of both mother and new born.

Materials and Methods: The present study looked at teenage marital pregnancy trends and their risk factors in Northeast India based on NFHS-5 household data. Using Cox proportional hazard regression analysis, risk factors associated with teenage marital pregnancy was identified in the region.

Results: Findings reveal Tripura leads all states in northeast India with maximum teenage pregnancy cases and Assam ranks second. Results show that teenagers in rural areas who follow the Islamic faith and have lower education levels plus minimal media contact face higher chances of encountering pregnancy during teenage while peers do not.

Conclusions: The study recommends targeted interventions to improve access to educational opportunities along with awareness and family planning measures in rural areas to address cultural and religious factors that may influence attitudes towards child marriage and teenage pregnancy.

Keywords: Early Marriage, Teenage Pregnancy, Reproductive Behaviour, Northeast, Cox Proportional Hazard Regression

ARTICLE INFO

Financial Support: None declared
Conflict of Interest: The authors have declared that no conflict of interests exists.
Received: 25-01-2025, **Accepted**: 15-04-2025, **Published**: 01-05-2025
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How to cite this article: Roy D, Debnath A, Roy N, Sarma M, Paul S, Roy D, Das J. Predictors of Adolescent Pregnancy in Northeast India: A Cross-Sectional Analysis. Natl J Community Med 2025;16(5):507-513.
DOI: 10.55489/njcm.160520255117

www.njcmindia.com | pISSN: 0976-3325 | eISSN: 2229-6816 | Published by Medsci Publications

INTRODUCTION

Over the years, India has made considerable progress in all indicators of development. However, the health sector in India is still lagging behind the other developed nations.[1] In spite of the efforts of the government to improve country's healthcare infrastructure and services, the nation is struggling with several health-related challenges like teenage marital pregnancy.[2,3] In India, teenagers, especially young girls are often on the verge of health risks due to their physiological, social, and cultural factors. Existing literature highlighted that early marriages, teenage pregnancies, and poor nutritional intake are some of the leading causes of health problems among teenagers in India.[4] Teenage girls in India also face some additional challenges like poor access to healthcare, discrimination in educational opportunities and lack of awareness about sexual and reproductive health which further intensifies their health issues.[5]

Both mothers and newborn babies are affected negatively by the prevalence of early marriage and teenage pregnancy. The risk of complications related to pregnancy such as, pre-term labour and low birth weight incidences as well as infant mortality, is higher among teenage mothers. It is also evident that adolescent mothers lack the knowledge and resources that are essential for taking care of infants, making the children susceptible to growth problems long afterwards.[6,7] The implications of teenage pregnancy are not limited to a person or household, the impact can be detrimental to the growth opportunities of a developing economy like India. Most adolescent mothers are prone to school dropouts and this further denies them future education and job prospects. This, in turn, may limit their ability to earn, thus they may get caught up in a cycle of poverty, which in turn affects the economic development of the nation.[8,9] In addition to that, the social costs of health care related to teenage pregnancy and its consequences can further a developing country's health system which is already overloaded. Hence, both the problem of teenage motherhood and teenage marriages, especially in the case of, India, need addressing as it bears on the prospects of the country's growth and the welfare of its people. In contrast to the national scenario, certain states of North-Eastern India have shown higher incidences of child marriage and teenage marital pregnancy.[10,11] This is also because of a number of contributing factors which in this case include low-income levels, poor education and cultural beliefs that encourage early marriages and childbearing.[12] Additionally, the geographical constraint of the region including frequent natural disasters, hilly terrain and poor transportation infrastructure make it challenging to access healthcare facilities which further magnifies the health risks associated with teenage pregnancies.[13,14]

The distinct nature of this region including cultural, social, and economic conditions require customised need-based approaches that address the specific challenges encountered by teenage girls in the region. Specific interventions that target the root causes of teenage marital pregnancy are crucial for framing policies to reduce the prevalence of early marriages and teenage pregnancies in Northeast India. Also, addressing these challenges are crucial for ensuring better health outcomes of teenage girls which is linked to their educational and employment opportunities, as well as sustainable development of the region. Given this context, the present study aims to explore the extent of teenage pregnancy in Northeast India and to identify the predictors associated with teenage marital pregnancy using the Cox Proportional Hazard Regression analysis.

METHODOLOGY

Data Source: The data for this study was extracted from the fifth round of the National Family Health Survey (NFHS-5) – a nationwide, household-level survey with a focus on demography and health in India. This survey was carried out in two waves and the study period is 17 June 2019 to 30 April 2021 which covered a total of 636,699 households and 724,115 currently or ever married women aged 15-49 years. The survey yielded data on a range of topics including but not limited to infertility, maternal and child health, family planning, nutrition and dietary practices, as well as health-seeking behaviour. This study did not delve into all the data collected. Rather, we focused our analysis on a smaller sample data set comprising of 17,382 married women aged 15 – 19 years. More detailed information about the sampling methodology used in the NFHS 5 survey is available on the official website.

Variable of Interest and Statistical Analysis: In this study, teenage pregnancy was defined as the incidence of women aged 15 to 19 who had given birth to a live child or were currently expecting their first child. Respondent's age was considered as the "time to event" and incidence of teenage pregnancy was considered the status or failure variable with non-experiencers being treated as censored. Descriptive statistics were used to present the prevalence and trend of teenage pregnancy. Furthermore, the "YRMODA" function of SPSS was used to extract information on each woman's birth date and pregnancy date in this study. The YRMODA function converts year, month, and date of a date into a day representation. This data provided insight into each woman's age at the time of pregnancy. The study then tried to identify predictors of teenage pregnancy, accounting for a range of demographic, socioeconomic, and geographical variables described in the literature. Using the Cox proportional hazard regression model, factors associated with teenage pregnancy were identified. We opted for this method due to missing data and uncertainty regarding data distribution, enabling model evaluation without distribution assumptions.

The following Cox Proportional Hazard Regression Model was estimated to obtain the risk factors associated with teenage marital pregnancy in the North-east region of India.

$$h(t) = h_0(t)e(\beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_p x_p) \quad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where t stands for time, x_is denotes the covariates, β_is are the regression coefficients of the predictors and $h_0(t)$ is the baseline hazard function, i.e. the hazard function under $x = 0$. Here, the predicted hazard is incidence of teenage pregnancy in India.

RESULTS

Spatial Variations in Teenage Marital Pregnancy across Regions: Teenage pregnancies continue to be a serious public health issue that affects all countries, regardless of the level of development.[7] Unfavourable pregnancy outcomes represent 23% of the overall illness burden in girls aged 15-19 years. Over 90% of teenage pregnancy problems are observed in underdeveloped nations. In the year 2018, the WHO reported that every year, more than 16 million women aged 15-19 years and approximately one million under the age of fifteen, become pregnant and deliver babies. Most of them reside in low-income countries and in some middle-income countries across the globe.[15] Considering the potential adverse effect on child health, which is an important predictor of human resources in future, it becomes imperative to examine the issues of teenage pregnancy in a developing country such as India. Due to social, institutional and cultural variations, one can also expect variations in the rate of teen pregnancy among regions and states. The incidence of teenage pregnancy across regions in India has been presented (Table 1).

Table 1: Percentage of Teenagers Who Have Begun Childbearing Across Regions in India (% per 1000)

Country / Region	NFHS-3 (2005-06)	NFHS-4 (2015-16)	NFHS-5 (2019-21)
India	16.0	7.9	6.8
North	7.4	3.6	3.0
North-East	11.9	9.3	8.3
Central	14.2	5.3	3.7
East	23.1	12.5	11.2
West	10.0	5.9	5.2
South	12.2	6.9	6.7

Source: Compiled by authors from the National Family Health Survey reports

According to the data obtained from the National Family Health Survey 3 (NFHS-3) conducted during the period 2005-06, adolescent pregnancy was found to be prevalent among 16 percent of women aged 15 to 19 years, at a national level. This figure varied among different states in India with the Northern region having the lowest at 7.4 percent and Eastern region having the highest incidence at 23.1 percent. Next were the Central region and the North eastern region at 14.2 percent and 11.9 percent respectively. However, a marked decline was recorded in the prevalence of teenage pregnancy in the next survey NFHS 4 (2015-16) with the overall national figure being 7.9 percent. Every state of the Indian subcontinent also showed commendable improvement in the reduction of this problem. However, the Eastern region still recorded the highest prevalence of teenage pregnancy at 12.5%. This was then followed by the North eastern region at 9.3%.[16]

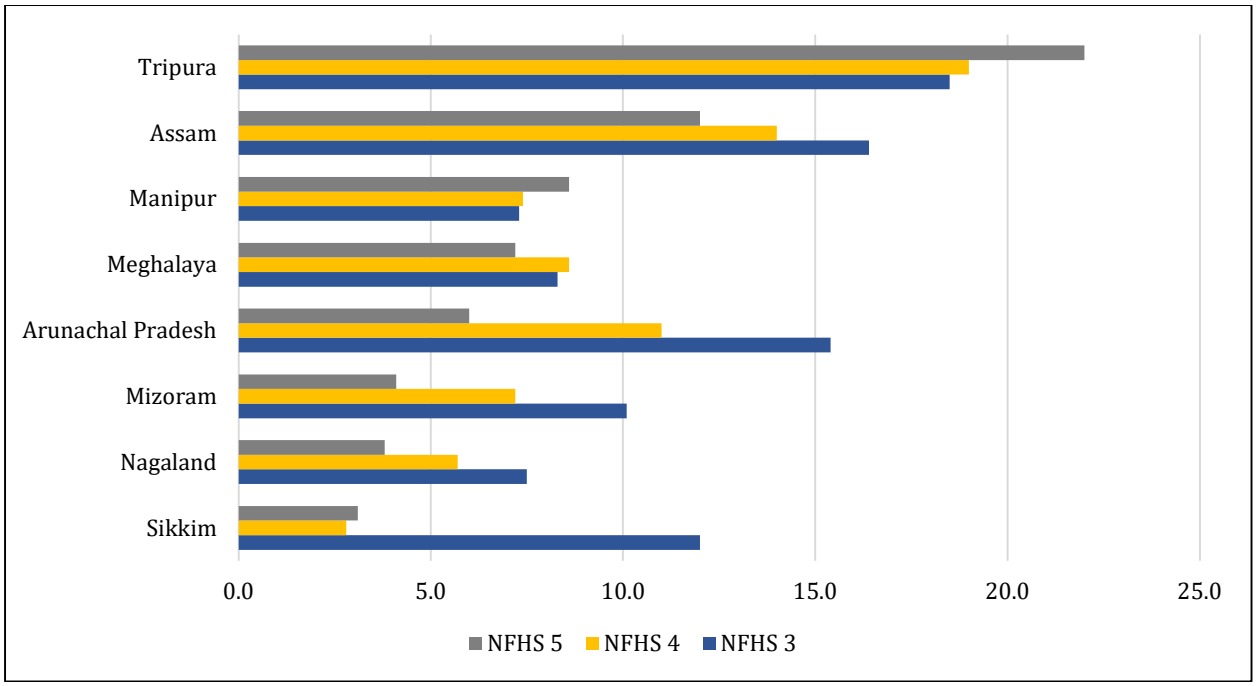
A comparison of the NFHS 5 report with previous findings revealed that the rate of teenage pregnancy among the adolescents in the country was on the reductive phase with the figure being recorded at 6.8 percent. However, even with the improvement, the highest proportion of teenage pregnancy cases was recorded in the eastern region at 11.2 percent, followed by the northeast region at 8.3 percent. It is noteworthy that while the Northeastern region also witnessed a decline since 2015–16, it moved from fourth place to having the second-highest incidence of adolescent pregnancy among all regions.

Incidence of Adolescent Marital Pregnancy across States in the North-Eastern Region: Additional scrutiny of the NFHS 5 report reveals that the prevalence of teenage pregnancy varied significantly among states in the Northeastern part of India. Figure 1 provides an illustration on the detailed variations.

Over the decades, the occurrence of teenage pregnancy in the majority of the states of the North-eastern region has shown a downward trend apart from the states of Tripura and Manipur. The worrying state is Tripura where the prevalence grew sharply between 2005-06, where it was at 18.5 percent, and 2015-16, where it was 19 percent, and even increased again to 22 percent in 2019-21. Similar trends were observed in Manipur, where there was a slight rise in the teenage pregnancy rate over the period, from 7.3 percent in 2005-06 to 8.6 percent in 2019-21.

Some more favourable trends can however be observed in certain states where a significant improvement has also been registered in tackling the problem of early marriages and pregnancies. For example, Assam witnessed a decline from 16.4 percent in 2005-06 to 14 percent in 2015-16 and further down to 12 percent in 2019-21. Similarly, Arunachal Pradesh and Sikkim demonstrated noteworthy progress, with a considerable drop from 15.4 percent and 12 percent adolescent marital pregnancy in 2005-06 to 6 percent and 3.1 percent respectively in 2019-21. Notably, Sikkim stood out with the lowest incidence of adolescent pregnancy in 2019-21 among all the states in the region.

Risk Factors Associated with Teenage pregnancy in North-East India: We used the Cox proportional hazards model to identify the risk factors associated



Source: Prepared by the authors from National Family Health Survey Reports

Figure 1: Teenage Marital Pregnancy Across States in North-East India

Table 2: Regression Result: Cox Proportional Hazard Regression (n = 17382)

Variables	Hazard Ratio	Z value
Place of Residence (RES) Rural	1.21	2.81***
Religious Affiliation (RA) Muslim	1.24	2.71***
Caste (CT) Backward	1.03	0.59
Educational Attainment [C] (EA)	0.87	-11.82***
Access to Media (AM) Yes	0.88	-9.85***
Household Size [C]	1.05	5.49***
Wealth Index Poor	1.36	5.65***

Time to Event Variable: Age of the Respondent; Status Variable: Teenage pregnancy
Reference category for RES 'Urban', for RA 'Non-Muslim', for CT 'Others', for AM 'No', and for Wealth Index 'Middle & Rich'
Diagnostic statistics: Log pseudo-likelihood -13818.53; Wald Chi- square 586.53***
Test of proportional-hazards assumption: Chi- square 24.04***
***represents 1% level of significance; C in the superscript denotes continuous variable
Source: Computed by the authors

with teenage pregnancy in India using equation (2) and the regression result has been presented in table 2.

$$h(t) = h_0(t)e[\beta_1 RES + \beta_2 RA + \beta_3 CT + \beta_4 EA + \beta_5 AM + \beta_6 HS + \beta_7 WS] \quad \ldots\ldots(2)$$

Here, RES signifies place of residence; RA signifies religious affiliation of the respondents, CT stands for social class or caste of the respondent, EA signifies educational attainment of the respondent; AM signifies access to media, HS signifies household size and WS signifies household wealth status.

The information presented in Table 2 includes the Hazard Ratios computed with the Cox Proportional Hazard model and the z values to assess the significance of particular predictor on adolescent marital pregnancy. Prior to analysing the results of the regression, it is pertinent to state that all diagnostic statistics including Log pseudo-likelihood (-13818.53), Wald Chi-Square (586.53), the test of proportional-hazards assumption provided by Chi-square (24.04) were significant at the 1% level and therefore justifies the use of this regression model in this study.

As outlined in table 2, the analysis of the regression results shows that, the odds of early pregnancy were 0.21 times higher among adolescents living in rural settings than those living in urban areas. Religion was also significantly associated, as Muslims adolescents were 0.24 times more likely to experience marital pregnancy, likely due to underlying socio-religious conventions and preferential access to reproductive health information. However, educational attainment proved to be the strongest protective factor against early pregnancy. We observed that adolescents with higher levels of education were 0.13 times less likely to experience early pregnancy. Household size was inversely associated with the risk of menarche; adolescents from smaller households had 0.05 times lower odds of being pregnant. Wealth status also proved a key determinant; those

from poorer households were 0.36 times more likely to experience pregnancy early.

Caste or social group had no substantial impact which means that in the North-Eastern context, ethnic diversity might be greater than caste-based influences. Mass media exposure also showed an important influence: adolescents with access to mass media were 0.12 times less likely to become pregnant, highlighting how informational outreach can transform reproductive behaviours. In summary, the results indicate that the risk factors of teenage pregnancy are multifactorial and requires targeted interventions that address educational, media, economic, and geographic risk factors.

Discussion

The decline in adolescent marital pregnancy nationwide over the last 20 years may be largely attributable to increasing public health awareness and interventions. The decline in adolescent marital pregnancy at the national level over the past 20 years may largely be attributed to increased public health awareness and interventions. However, the persistent regional disparities particularly in the Eastern and North-Eastern states indicate that simply meeting targets does not equate to real progress. These regions continue to report higher rates of adolescent marital pregnancy, influenced by socio-cultural norms that support early marriage and parenthood. These findings are consistent with previous studies, which highlight the significant role of regional contexts especially in socio-economically and institutionally weaker areas in shaping adolescent reproductive outcomes.[7,15]

The increase in Tripura and Manipur is alarming and reflects the ineffectiveness of current interventions in these states. On multilevel analysis, these trends can be explained by persistently high social conservatism, lower levels of education, restricted access to reproductive health services, and weaker enforcement of the legal age of marriage. In contrast, the marked improvements seen in Sikkim, Arunachal Pradesh, and Assam indicate that investment in girl's education, outreach programs, and wider development initiatives can make a difference.

Several key risk factors emerged from the regression analysis. Notably, adolescents living in rural areas continued to show a stronger association with adolescent pregnancy, which is likely due to poorer access to healthcare, education, and awareness campaigns in non-urban settings, as confirmed by earlier observations.[17,18] Religion also played a significant role, with a particular emphasis on Muslim communities, aligning with previous research highlighting how traditional norms and limited reproductive autonomy contribute to increased pregnancy risk among young adults.[19,20]

To our surprise, caste proved to be insignificant in the North-Eastern case, which seems to suggest that the more ethnically and culturally heterogeneous social environment of the region is more impervious to caste stratification than elsewhere in India.[21,22] Education, however, emerged as a crucial protective factor. Many studies also documented an inverse association between education and adolescent pregnancy by demonstrating that a higher level of education is positively correlated with delayed marriage and sounder productive decision-making.[20,23]

Media is a crucial source of information and evidence on contraception, and it provides detailed information on reproductive and sexual health concerns.[24,25] The present study also demonstrated that adolescent women who had access to mass media were 0.12 times less likely to have a marital pregnancy compared to their counterparts, and similar findings were reported in other studies.[17,20] This finding underscores the need to utilize mass media and digital platforms to reach adolescent audiences with sexual and reproductive health information.

Household structure and wealth status also influenced the outcomes. Adolescents from smaller and wealthier families were less likely to marry early and experience early pregnancy behaviors that, according to existing literature, are often driven by poverty and family pressure as major determinants of early marriage and childbirth.[26,27] Families, already strained for resources, are compelled to wed daughters young in order to cope, further driving up adolescent fertility rates.

Overall, the findings suggest that improvements in national efforts to reduce teenage pregnancy are having a positive impact, although targeted interventions addressing problems faced by rural populations, educational inequalities, religious and cultural norms, and economic vulnerabilities are still essential. Furthermore, regionally appropriate mechanisms addressing the specific determinants of adolescent pregnancy are largely absent from current policy frameworks and need to be incorporated into future strategies. In high-prevalence areas like North-East India, programs that promote adolescent education, build life skills among young girls, enhance media literacy, and support economically vulnerable families are likely to have the greatest impact.

Limitations

While this research reveals notable findings on the factors contributing to the extent of teenage pregnancy in Northeast India, it is also necessary to point out certain limitations. First, the geographic scope of this study is limited to the Northeastern region, and the findings may not be representative of the entire country. Therefore, caution should be exercised when generalizing the results to other parts of India. Additionally, a significant proportion of missing cases in the dataset may have affected the representa-

tiveness of the sample, potentially introducing bias into the research.

Conclusion

In North-East India, teenage marital pregnancy is still a significant public health issue, even with a down sloping trend. There are still large inter-state differences, with Tripura and Assam still being at high rates. Adolescents from rural, non-Muslim backgrounds, with low education, limited access to media, large family size, and economic vulnerability are at increased risk. Arunachal Pradesh and Sikkim have made significant progress. These findings demonstrate the conflicting socio-demographic and economic dynamics of the factors fuelling early childbearing in the region.

Policy implications

The study recommends some policy measures aimed at reducing the incidence of teenage pregnancy in Northeast India. To begin with, it is essential to enhance adolescent sexual and reproductive health knowledge and service access relatively within rural areas. This might be achieved through the provision of youth-friendly services such as age-appropriate sex education, and contraceptive provision. Secondly, interventions should focus on improving education for girls, particularly older adolescents who are at higher risk of early pregnancy, as education has been shown to be protective against early childbearing. This can be addressed through programs that encourage school attendance among girls and systems that support those at risk of dropping out. Thirdly, empowerment of women and eliminating gender imbalances have also been recognized as critical in addressing the issue of teenage pregnancy. This may be done through awareness programmes, skills development activities, and other programmes aiming at economic or social advancement of women. Finally, each component will require the implementation of a multisectoral response with collaboration between health, education, and social services to tackle the issue of teenage pregnancy. Implementing these policy recommendations can help address the issue of teenage pregnancies in Northeast India, while also promoting the overall well-being of youth in the region.

Individual Authors' Contributions: DR conceptualized the study, supervised the research process, and contributed to the methodology and analysis. AD refined the statistical models and interpreted the economic implications, while NR ensured theoretical alignment and provided critical revisions. MS contributed to statistical modelling and discussion. SP played a key role in data collection, cleaning, and preliminary analysis, along with contributing to the literature review. DR (Dipanjan Roy) provided medical insights. JD assisted in synthesizing literature, structuring the manuscript, and proofreading. All authors participated in writing, reviewing, and approving the final manuscript.

Availability of Data: Data is available online upon request from https://www.dhsprogram.com/data/

No use of generative AI tools: This article was prepared without the use of generative AI tools for content creation, analysis, or data generation. All findings and interpretations are based solely on the authors' independent work and expertise.

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Appendix A: Prevalence of Teenage Pregnancy Across States in North East India (% per 1000)

State	NFHS 3	NFHS 4	NFHS 5
Tripura	18.5	19.0	22.0
Assam	16.4	14.0	12.0
Arunachal Pradesh	15.4	11.0	6.0
Sikkim	12	2.8	3.1
Mizoram	10.1	7.2	4.1
Meghalaya	8.3	8.6	7.2
Nagaland	7.5	5.7	3.8
Manipur	7.3	7.4	8.6

Source: Compiled by the authors from National Family Health Survey reports

Appendix B: Description of the Selected Independent Variables

Variables	Description
Place of Residence (RES)	It takes value 1 for teenagers residing in rural area, 0 otherwise.
Religious Affiliation (RA)	Takes value 1 if the teenager belongs to Muslim religion, 0 otherwise.
Caste (CT)	Takes value 1 the child belongs to backward class, 0 otherwise.
Educational Attainment (EA)	Highest years of Education, Continuous
Access to Media (AM)	Teenagers who have access to media. Constructed by adding frequency of reading newspaper, listening to radio and watching television. Summing up, all values other than Zero (0) has been defined as "Access to media".
Household Size (HS)	Number of household members, Continuous.
Wealth Status (WS)	Takes value 1 the teenager belongs to poor household, 0 otherwise.