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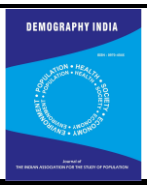

Early Marriage and Its Impact on Reproductive Health of Mothers in India

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Abstract

The present study aims to investigate the relationship between early marriage and its impact on reproductive health in India. The logistic regression model has been applied to analyse secondary data (NFHS-5(2019-21)) of 154,716 currently married women aged 15-30 years in India. The analysis demonstrates that women married at a young age, particularly those married before 14 and between 15-17 years, face higher odds of poor reproductive health outcomes among mother compared to women married at an adult age (18 years and above). The elevated risk for early-married women is attributed to factors such as early childbearing, pregnancy-related complications, unsafe sexual practices, and inadequate nutrition during pregnancy. Additionally, the study finds that household wealth and socioeconomic variables play a significant role in contributing to poor reproductive health outcomes among mothers. Policy implications include promoting educational attainment and economic opportunities for girls to delay age at first marriage and improve reproductive health of mothers.

Keywords

Early marriage, India, logistic regression, NFHS-5, Reproductive health index

JEL Classification: J12, J16, I14

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Introduction

Mother health problems are the biggest challenge in India. Reproductive health is defined as a state of complete physical, mental, and social well-being in all matters related to the reproductive system (WHO, 2023; Worku & Gebresilassie, 2008). Reproductive health is central to the development of any country in terms of increasing equity, reducing poverty, and building social capital (CRR, 2018; Paul et al., 2011; Ronsmans et al., 2010). Each year, more than five lakh married women suffer from reproductive health problems, and more than seventy percent occur in developing countries (WHO, 2020). In the NFHS-5, 38 percent of women suffer from reproductive health problems in the 15-49 age group of India. Moreover, poor reproductive health outcome among mothers not only affects their own health but also affects the health of children, who become more vulnerable to morbidity, mortality, and low birth weight among under-5-year-old children in India (Parsons et al., 2015; Raj et al., 2010; Cameron et al., 2022; UNFPA, 2013; Walker et al., 2013). As a result, both mothers and their children face worse health situations (Cameron et al., 2022; Raj et al., 2010). Moreover, the age at marriage of women is one of the main determinants of poor reproductive health outcome among mothers (Prakash et al., 2011; Parsons et al., 2015). Fan & Koski (2022) pointed out that women in child marriage have a higher effect on reproductive health problems and also create health inequalities in society. According to the Prohibition of Indian Child Marriage Act 2006, child marriage is defined as marriage or a union taking place before the age of 18 years.

Moreover, Chakravarty (2021) pointed out that the largest drop in the prevalence of early marriage has been in under-15 marriages, while marriages in the age group of 15–17 years continue to occur quite commonly in India. Researchers have used the term 'early marriage' rather than child marriage (Modak, 2019). According to the NFHS-5 (2019–2021) report, about 23.3 percent of married women below the age of 18 in 20–24 age cohorts. In addition, women with lower ages at marriage tend to have increased the problems of reproductive health outcome among mothers (Wells et al., 2022; Parsons et al., 2015). This is more prevalent in rural areas and disadvantaged communities in society, where early marriage persists. Therefore, it will create a difference in reproductive health outcomes between those who marry at an early age as compared to adults in India. The subsequent sections will present a literature review on the reproductive health of mothers between two groups of women. The next section provides the objectives of the study, data sources, and methodology. Finally, provide result and conclusion to explain this analysis.

Review of Literature and Research Gap

Early marriage, particularly among women, remains a prevalent and pressing social issue in India, with substantial implications for maternal and reproductive health (Santhya & Ram, 2018). Numerous studies have underscored that women who marry at a young age face heightened risks for complications during pregnancy, childbirth, and the postpartum period. For example,

early-married women often experience elevated rates of maternal mortality as well as increased incidences of obstetric complications such as premature birth, stillbirth, and low birth weight infants (Godha et al., 2011; Cameron et al., 2022).

Moreover, early-married women are more vulnerable to reproductive health risks such as sexually transmitted infections (STIs), including HIV/AIDS due to factors like limited knowledge about safe sexual practices and lack of access to contraception (Clark, 2004; Moyazzem et al., 2022). Additionally, insufficient nutrition during pregnancy attributable to young age and socio-economic constraints contributes to poor maternal health outcomes among early-married women (Cameron et al., 2022).

Socio-economic variables also play a crucial role in shaping the relationship between early marriage and adverse reproductive health outcomes in India. Studies have observed that household wealth can help mitigate some risks associated with early marriage; however disparities persist within wealth quintiles (Moraes et al., 2018). Furthermore, education levels and employment status significantly contribute to the reproductive health outcomes of married adolescents (Raj et. al., 2010). Existing literature has predominantly focused on establishing the association between early marriage and reproductive health outcome among mothers without adequately exploring potential mediating factors such as access to healthcare, family planning services, and cultural norms which could influence this relationship. While some studies have acknowledged regional variations, there is still a lack of comprehensive analysis specifically focusing on how different regions or states within India may exhibit varying impacts of early marriage on reproductive health outcome among mother due to differing socio-cultural contexts and policies. Many existing studies are based on older datasets such as NFHS-3 or NFHS-4; therefore, there is a need for more recent data sources like NFHS-5 to provide current insights into the impact of early marriage on reproductive health of mothers in contemporary Indian society. Addressing these gaps through empirical research will not only enhance our understanding but also provide valuable insights for policymakers and stakeholders seeking effective interventions aimed at addressing high levels of reproductive health outcome among mother associated with early marriages specific to diverse contexts within India's socio-cultural landscape.

The objectives of this analysis are to compare the reproductive health of mothers in early marriage with that of adult women in India, investigate the relationship between early marriage and the reproductive health of mothers aged 15-30 years, identify socio-demographic factors that impact the reproductive health of mothers in early marriages, and offer insights into promoting gender equality within the reproductive health context, particularly in relation to marital timing.

These objectives aim to contribute to a comprehensive understanding of how marital timing intersects with the reproductive health of mother in India, thereby providing valuable insights for relevant policy and intervention strategies.

Material and Methodology

Data

This analysis uses the National Family Health Survey (NFHS**),** conducted by the Ministry of Health and Family Welfare in collaboration with the International Institute for Population Sciences (IIPS), a nationally representative survey that provides crucial insights into various aspects of reproductive health of mothers in India. The data used is from the fifth round of the NFHS survey conducted in 2019-2021. The dataset utilised in this analysis includes information on a total of 154,716 currently married women aged 15-30 years in India. This paper chooses 15-30 age groups because women's reproductive health declined after the age of 30. This cross-sectional dataset allows for a comprehensive analysis of the reproductive health of mothers who were married at an early age compared to those who were married at an adult age in India. By utilising individual recoded data from NFHS-5. This analysis aims to provide valuable insights into the impact of early marriage on the reproductive health of mothers in India.

Methodology

To estimate the impact of early marriage on the reproductive health of mothers in India, this study employs a logistic regression model. The dependent variable (Y), representing the reproductive health status of the mother, is binary in nature—coded as 1 if the mother has poor reproductive health and 0 otherwise. The logistic regression method is used in the first model to examine how early marriage influences the likelihood of poor reproductive health among currently married women. Mathematically, the model can be expressed as:

$$\text{logit}\,(\Pr(Y_{i1}=1))=\theta_0 + \theta_1 i1\, X_1 i1 + \theta_2 i1\, X_2 i1 + \epsilon 1 \ldots\ldots\ldots\ldots (1)$$

In this equation, Y_{i1} denotes the reproductive health outcome for individual *i*, where the subscript 1 indicates the focus on reproductive health. The term θ_0 is the intercept. θ_1 and θ_2 are the coefficient of independent variables. The primary independent variable of interest is the age at marriage, categorized into two groups: women married at less than 14 years(X_1) and those married between 15–17 years (X_2), with women married at 18 years or older serving as the reference category (as described in Appendix A). The error term $\epsilon 1$ captures unobserved factors affecting reproductive health. This model allows us to statistically assess whether early marriage significantly increases the risk of poor reproductive health outcomes among mother in India.

In the second model, the analysis seeks to examine how both early marriage and household wealth jointly contribute to reproductive health outcomes among mothers in India. The second model can be written as,

$$\text{logit}(P\ \ r(Y_{i2}=1\ \ ))=\ \ \theta_0 + \theta_1 i1\, X_1 i1 + \theta_2 i1\, X_2 i1 + \sum_{w=1}^{3} \theta_{wi} x_{wi} + \sum_{k=1}^{3} \theta_{ki} x_{ki} + \sum_{m=1}^{3} \theta_{mi} x_{mi} + \epsilon 2 \ldots (2)$$

In this model, household wealth is categorized into three components: poor, middle, and rich $\left(\sum_{w=1}^{3} \theta_{wi} x_{wi}\right)$. To explore the joint influence of early marriage and economic status on reproductive health outcomes, interaction terms are created.

Specifically, women who were married at ≤14 years are classified into three groups based on household wealth: (i) early marriage with poor household wealth, (ii) early marriage with middle household wealth, and (iii) early marriage with rich household wealth ($\sum_{k=1}^{3} \theta_i x_{ki}$). Similarly, women married at 15–17 years are also categorized according to their household wealth: (i) early marriage with poor, (ii) early marriage with middle, and (iii) early marriage with rich household wealth ($\sum_{m=1}^{3} \theta_i x_{mi}$). These interaction terms allow the analysis to capture the compounded effects of early marriage and economic background on maternal reproductive health. The reference category in this model consists of women who were married at age 18 or above, irrespective of wealth status. The error term, denoted as $\epsilon 2$, captures all other unobserved factors affecting reproductive health outcomes.

In the third model, additional demographic control variables are introduced to build upon the second model, with the aim of better isolating the impact of early marriage and household wealth on reproductive health outcomes among mothers in India. This model is specified as:

$$\text{logit}\ (\Pr\ (Y_{i3}=1\ )) = \theta_0 + \theta_1 i1\ X_1 i1 + \theta_2 i1\ X_2 i1 + \sum_{w=1}^{3} \theta_{wi} x_{wi} + \sum_{k=1}^{3} \theta_{ki} x_{ki} + \sum_{m=1}^{3} \theta_{mi} x_{mi} + \theta_3 i1\ X_3 i1 + \cdots + \theta_{13} 1\ X_{13} i1. + \epsilon 3 \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

In this model, θ_0 presents the intercept term, and $\theta_1, \theta_2, \ldots \ldots \ldots \theta_{13}$ denote the coefficients of the explanatory variables. The third model includes a range of control variables to account for demographic and health-related factors that may influence reproductive health outcomes among mothers in India. Specifically, the control variables include: age of the woman (X_3), years of schooling (X_4), menstruation status in the last six months (X_5), currently working (X_6), receipt of antenatal care (X_7), women underweight (X_8), health check from anganwadi (X_9), modern contraceptive use (X_{10}), living children more than two (X_{11}), spousal age gap (X_{12}) and nuclear family (X_{13}). These variables are included to control for potential confounding effects and enhance the robustness of the model. The error term $\epsilon 3$ captures the unexplained variation in reproductive health outcomes.

Construction of the Reproductive Health Index (RHI)

Mother's health outcome is measured by the reproductive health **(**Mmusi et al., 2019; Slabbert et al., 2017). The reproductive health index (RHI) of mother is measured by a weighted composite index. The RHI uses eight reproductive health indicators: 1) Mother's age at first birth below 18 years or early fertility 2) Pregnancy complications 3) Wanted the last child 4) Abortion 5) Miscarriage 6) Stillbirth 7) Mother's underweight (<18.5 kg/m^2), and 8) Anaemia (Cameron et al., 2022; Prakash et al., 2011; Paul et al., 2011; Dixon, 1993; Benagiano, 1994). Separate weights are assigned to each variable. The weights are assigned such that women experiencing any unfavorable reproductive health indicator are coded as 1, whereas those experiencing favorable reproductive health outcomes are coded as 0. Similarly, a woman experiencing any pregnancy complications gets a weight of 1, while those who do not experience any pregnancy complications get a weight of 0In addition, women who first gave birth below

the age of 18 years are assigned a weight of 1, while those who first gave birth above the age of 18 years are given a weight of 0. Moreover, underweight women, abortion, and stillbirth for each variable are assigned 1 and 0 otherwise. All these variables are binary in nature. The selection of indicators was done on the basis of those factors that affect the reproductive health outcome among mothers. This analysis is restricted on the basis of recent birth (last child). The Cronbach's α value represents that the RHI is acceptable limits (α = 0.518), which suggests that the items are reliable, robust, and consistent with each other, as shown in Appendices B. RHI is used to measure the reproductive health outcome among mothers who were married at an early age as compared to adults in India.

Outcome variables: The outcome variable in this study is reproductive health among mothers, measured as a binary variable indicating whether the reproductive health is poor (coded as 1) or non-poor (coded as 0).

Regressor variables: In this analysis, the age at cohabitation[2] variable is used as a proxy for the age at marriage of women, because the age at marriage of women does not provide adequate information to calculate in this analysis (IIPS & ICF, 2017; Favara et al., 2016; Perelli-Harris et al., 2019; Guzzo, 2019). In the regressor variables, women in early marriage are classified into three categories: married less than 14 years (X_1), 15–17 years (X_2) and married above 18 years as the reference category.

[2] *Age at cohabitation is determined by the age when women began living with their spouse.*

Control variables: This paper uses control variables to capture the effect of early marriage on the reproductive health outcome among mothers in India. Here, control variables can be classified into four categories: individual, children, partner, and household-specific variables. The individual-specific variables include women's age, year of schooling, underweight, anaemia, and physical violence. The children-specific variable includes current age of child, female child, living child more than two, birth less than 24 months, and child health problems. The partner-specific variables include spousal age gap, partner agricultural occupation, and husband education. Finally, household-specific variables include whether the household belongs to a nuclear family or not and household wealth status. Here, this analysis provides some literature support for mentioning control variables in our analysis. Women's age is a control variable because the probability of reproductive health outcome among mother improved with an increase in women's age (Finlay & Lee, 2018). Moreover, women with more years of schooling are positively associated with the reproductive health outcome among mothers due to better knowledge among married women (Psaki et al., 2018). In addition, women's health is considered to be the main determinant of the reproductive health outcome among mothers. Women with underweight and anaemia are positively associated with the poor reproductive health outcome among mothers (Owais et al., 2021; Das et al., 2024). In addition, child characteristics such as child health problems have been positively related to the poor reproductive health outcome among mothers (Prakash et al., 2011; Charles, 2007). Moreover, household characteristics,

such as the structure of the house and the wealth of the house, are considered to be the main elements in determining the reproductive health outcome among mothers. Women with non-nuclear families and poor household wealth are positively related to the poor reproductive health outcome among mothers (Prata et al., 2017; Acharya et al., 2010). Finally, a higher spousal age gap indicates lower status for married women in the household, which is directly related to poor reproductive health outcome among mothers (Fafard et al., 2022; Sanneving et al., 2013).

Needless to say, reproductive health outcome among mothers has serious problems in India. The descriptive statistics are used to show differences in reproductive health outcome among mothers who were married at an early age as compared to adults in India. This paper examines the socioeconomic and demographic characteristics of women, such as place of residence, religion, caste, and household wealth status, as important variables to influence the reproductive health of mothers of early marriage women in India. This section can discuss these two groups of women.

Results

Table 1 presents the percentage distribution of currently married women aged 15–30, categorized by age at marriage and their corresponding Reproductive Health Index (RHI) in India. The reproductive health index of women is measured by using a weighted composite index. The RHI has seven reproductive health index: mother's age at first birth, pregnancy complications, wanted of last child, abortion, stillbirth, mother's BMI, and anaemia. The RHI is classified into three categories: poor, average, and high. Here, principle component analysis is used in the analysis to measure RHI index. The index is done in such a way that the lowest 33 percent of women are classified into poor RHI, the next 33 percent into average RHI, and the top 33 percent into high RHI. RHI is used in the analyses to understand the reproductive health outcome among mothers and the relationship with age at marriage at different category. The results of $\chi 2$ tests have shown a statistically significant relationship between the RHI and age at first marriage of women (significance at 1 percent level). The finding shows about 12.73 percent of women had initiated childbearing before the age of 15th birthday. An additional 16.8 percent started childbearing at the age of 15 years. Only 15.11 percent of women had their first birth at the age of 17 years. This compares with 99.29 percent of first birth after the age of 18 years among women who were married an adult age. The mean age at first birth was 17.27 years among those who married before the age of 15 years compared to 22.68 years among those who married after the age of 17 years. In addition, those women who married at an early age (≤14 years) were more likely than those who married at an adult age (≥18 years) to report pregnancy complications (59.46 percent vs. 55.08 percent) and unwanted births (9.2 percent vs. 4.32 percent). Again, women married below the age of 15 years were more likely than women married at 18 years or above to be underweight (28.48 percent vs. 21.25 percent) and to suffer from iron-deficiency anaemia (57.51 percent vs. 54.81 percent).

Table 1 Percentage of Currently Married Women Aged 15–30 Who Were Married at Different Ages by Reproductive Health Index in India

Individual Characteristics	Age at first marriage		
	≤14 years (%)	15-17 year (%)	≥18 years (%)
Age at first birth(years)***			
≤14	12.73	0.18	0.10
15	16.80	0.74	0.09
16	18.60	6.53	0.18
17	15.11	17.59	0.34
≥18	36.77	74.95	99.29
Mean age at first birth(year)(SD)	17.27(3.19)	18.70 (2.08)	22.68(3.30)
Mean number of children ever born	3.61(1.78)	2.83(1.58)	2.30(1.36)
Pregnancy Complication***			
No	40.54	41.91	44.92
Yes	59.46	58.09	55.08
Wantedness of child***			
Unwanted	9.20	6.46	4.32
wanted	90.80	93.54	95.68
Stillbirth***			
No	98.99	99.13	99.16
Yes	1.01	0.87	0.84
Abortion***			
No	97.25	97.4	97.99
Yes	2.75	2.60	2.01
Anaemia among women***			
Severe (<7.0)	1.21	1.16	0.92
Moderate (7.0-9.9)	14.92	15.36	13.52
Mild (10.0-11.9)	41.38	41.80	40.37
Not Anaemic (>12.0)	42.49	41.68	45.19
Women BMI (kg/m2)***			
Underweight/thin (<18.5)	28.48	28	21.25
Normal (18.5--24.9)	62.24	62.01	62.50
Overweight/Obese (≥25.0)	9.28	9.99	16.25
RHI***			
poor	65.24	51.93	20.61
Average	21.43	27.62	38.22
High	13.33	20.44	41.17
Total (%)	100	100	100

Source: Author's calculation based on NFHS-5 dataset.
Note: Pearson's chi-square (χ^2) test was used to examine the association between variables.
*Significance levels: *p < 0.10; **p < 0.05; ***p < 0.01.*

About 65.24 percent of women married before age 15 years were in the poor reproductive health. In comparison, only 20.61 percent of women married at 18 years or above. Similarly, 13.33 percent of women married by the age of 14 year, as compared to 41.17 percent of women married by the age of 18 years, belong to the high reproductive health quintile.

These find suggest that women who married at an early age not only start early childbearing but are also more likely to report pregnancy complications, unwanted pregnancies, and to be underweight and have iron-deficiency anaemia.

Tables 2 Prevalence of Poor Reproductive Health Outcome Among Currently Married Women (Aged 15–30) Who Were Married at an Early Age Compared to Those Married as Adults, by Demographic Characteristics in India

	Age at Marriage		
Demographic characteristics	≤14 Year (%)	15-17 Year (%)	≥18 Year (%)
Place of residence***			
Urban	16.43	20.13	25.22
Rural	83.57	79.87	74.78
Education of women***			
Illiterate	37.83	23.34	14.32
Primary	23.35	17.83	12.78
Secondary	37.29	55.29	63.4
Higher	1.53	3.54	9.49
Household Wealth***			
Poor	60.58	49.59	37.62
Non Poor	39.42	50.42	62.39
Work last 12 months***			
Not-working	58.40	62.33	67.12
Working	41.60	37.67	32.88
Household structure***			
nuclear	38.46	42.31	45.87
Non-nuclear	61.54	57.69	54.13
Type of caste ***			
Schedule caste	24.65	21.62	19.49
Schedule tribe	20.01	19.01	19.61
Other backward classes	39.85	41.82	39.74
General	13.98	16.69	20.52
Religion***			
Hindu	78.76	79.31	73.99
Muslim & other	21.24	20.69	26.01

Source: Calculated by the authors using NFHS-5 data.
Note: Pearson's chi-square (χ^2) test used to assess differences between groups.
*Significance levels: *p < 0.10; **p < 0.05; ***p < 0.01.*

Table 2 presents the prevalence of poor reproductive health outcome among currently married women (aged 15–30) who were married at an early age as compared to adults by demographic characteristics in India. In addition, the demographic characteristics of women, such as place of residence, religion, caste, education, and household wealth status, are important variables to influence the poor reproductive health Outcome among those mothers who were married at an early age as compared to adults in India. In this analysis, the percentage of poor reproductive health among women in early marriage say ≤14 years & 15-17 year is disproportionately higher than that of women in adult marriage (say ≥18 years) among various demographic characteristics such as illiteracy (say 37.83 percent in ≤14 years & 23.34 percent in 15-17 years), rural residence (say 83.57 percent in ≤14 years & 79.87 percent in 15-17 years). for the scheduled caste category (say 24.65 percent in ≤14 years & 21.62 percent in 15-17 years), currently working (say 41.60 percent in ≤14 years & 37.67 percent in 15-17 years), poor households wealth (say 60.58 percent in ≤14 years & 49.59 percent in 15-17 years), and non-nuclear family (say 61.54 percent in ≤14 years & 57.69 percent in 15-17 years), Therefore, women who were married at an early age (say ≤14 years & 15-17 years) have more prevalent poor reproductive health outcome among mother as compared to women who were married at an adult age (say ≥18 years) among various demographic characteristics in India.

Table 3 presents using the odds ratio of logistic regression models to show the impact of women in early marriage, say less than 14 years, 15–17 years, on the reproductive health of mothers in India. In the first model, it has been observed that women married less than 14 years (say 36.488 point) have higher odds of poor reproductive health outcome as compared to women married above 18 years in India. It represents that women in early marriage say ≤14 years & 15-17 years have significantly increased the likelihood of occurrence of poor reproductive health outcome among mothers. One of the reasons, women who were married at an early age (say ≤14 years) were associated with a high risk of early childbearing of mother and a short birth interval as compared to women who were married at an adult age, which leads to pregnancy-related complications, miscarriage, stillbirth, and pre-mature birth during delivery of the adolescent mother because their bodies are not ready for reproductive purposes (Godha et al., 2011; Cameron et al., 2022; Paul et al., 2019), which leads to poor reproductive health outcome among mother. Therefore, this analysis highlights that women in early marriage (say, less than 14 years) have higher chances of poor reproductive health outcome among mothers as compared to women in adult marriage (≥ 18 years) in India. In case of 15-17 year age group, women in early marriage have higher chances (say 13.83 point) of poor reproductive health outcome among mothers as compared to women in adult marriage in India. One of the reasons, women who were married at an early age (say 15–17 years) have higher risk of inadequate nutritional food during the pregnancy period and suffered from various infection diseases, poor mental health, and malnutrition problems as compared to women who were married at an adult age, which is directly related to

reproductive health problems for adolescent mothers (Cameron et al., 2022; Irani & Roudsari, 2019; Santhya et al., 2017). Therefore, women in early marriage (say, 15–17 years) have higher chances of poor reproductive health outcome among mothers as compared to women in adult marriage (≥ 18 years) in India.

Table 3 Probit Model Showing the Association Between Early Marriage and Poor Reproductive Health Outcome Among Currently Married Women Aged 15–30 Years in India

Dependent Variables:	1St Model		2nd Model		3rd Model	
Poor reproductive health	Odd ratio	SE	Odd ratio	SE	Odd ratio	SE
Early marriage (≤14 years)	36.48***	0.90	33.68***	1.12	7.31***	1.79
Early marriage (15-17 years)	13.83***	0.21	11.92***	0.28	3.91***	0.58
Adult marriage(≥18 years)	Refer (1.00)		Refer(1.00)		Refer (1.00)	
Wealth of House (ref. Poor wealth)						
Middle wealth			1.15***	0.03	0.93	0.17
Rich wealth			1.09***	0.03	0.75*	0.13
Early marriage(≤14 year) with wealth of house (ref. Poor wealth)						
Marriage ≤14 years with middle wealth			.82***	0.08	0.43	0.23
Marriage ≤14 years with rich wealth			.74***	0.10	1.27	0.63
Early marriage (15-17 year) with wealth of house (ref. Poor wealth)						
Marriage 15-17 years with middle wealth			.92***	0.05	1.13	0.27
Marriage 15-17 years with rich wealth			.85***	0.05	1.14	0.26
woman's current age					1.15***	0.02
Year of schooling					0.98**	0.01
Menstruated in last 6 months					1.29**	0.17
Currently working					1.47***	0.14
Antenatal care received					0.10***	0.01
Women underweight					0.01***	0.01
Health check from Anganwadi					0.66***	0.07
Modern contraceptive use					1.64***	0.16
Living children morethan2					1.27**	0.15
Spousal age gap					1.65**	0.27
Nuclear family (ref joint)					1.47***	0.13
_cons	0.02***	0.01	0.02***	0.00	0.00***	0.00
Observation	388,780		388,780		15,544	

*Source: Calculated from NFHS-5 data. *, **, and *** refer to 10%, 5%, and 1% levels of significance, respectively. Figures in parentheses denote robust standard errors. OR – Odds Ratio.*

The analysis is adjusted for: woman's current age, years of schooling, menstruation in the last 6 months, currently working, antenatal care received, women underweight, health check-up from Anganwadi center, modern contraceptive use, number of living children (more than two), spousal age gap, and nuclear family structure.

In the second model, household wealth is added as a predictor variable along with early marriage. It has been observed that women in early marriages say less than 14 years (33.68 point) and 15-17 years (11.92 point) have more experience to reproductive health problems, even after controlling for household wealth. Additionally, household wealth itself had a significant negative impact on experiencing poor reproductive health of mothers. Moreover, women in early marriage (say ≤14 years) with middle and richer wealth quintiles were 0.82 points and 0.74 points, respectively, less likely to experience poor reproductive health outcome than women from poor wealth quintiles. Similarly, women in early marriage (say 15–17 years) with middle and richer wealth quintiles were 0.92 points and 0.85 points, respectively, less likely to experience poor reproductive health outcome than women from poor wealth quintiles. In the third model, women's socio-economic variables are added with early marriage to show the impact of early marriage on the poor reproductive health outcome among mothers. After controlling for socio-economic variables, it has been observed that women in early marriage say ≤14 years (7.31 point) and 15-17 year (3.91 point) have more experience to poor reproductive health outcome among mother. The slight reduction of the odd ratio of women in early marriage in the third model indicates that other socio-economic variables are also important estimators for the occurrence of poor reproductive health outcome among mothers. This analysis include early marriage with socio-economic variables like the woman's age, year of schooling, current working status, antenatal care received, living children more than two in the household, etc., as significant predicators for experiencing poor reproductive health outcome among mothers. Moreover, the year of schooling has a significant impact on the occurrence of poor reproductive health outcome among mothers. As a result, women with more years of schooling are 0.98 points less likely to occurrence of poor reproductive health outcome among mothers. In addition, household with living children more than two, say 1.27 points more likely to experience poor reproductive health outcome among mothers. Moreover, women who are currently working are more experience with poor reproductive health by 1.47 points than women who are not working. Women who health checks from Anganwadi and nuclear families are less likely to experience poor reproductive health outcome among mothers.

Discussion

The analysis revealed that women who marry at a younger age, particularly below 14 years and 15-17 years, are at a much higher risk of experiencing poor reproductive health outcomes among mothers compared to those who marry at an adult age. This finding underscores the complex factors contributing to these outcomes. Early childbearing and short birth intervals can lead to various pregnancy-related complications, including preterm births and miscarriages. Factors such as unsafe sexual practices, inadequate nutrition during pregnancy, limited access to healthcare services, and socio-economic disparities further exacerbate these challenges. Even after controlling for household wealth and socio-economic variables such as education level and

working status, early marriage remains a significant predictor for poor reproductive health outcomes among mothers. This suggests that addressing early marriage practices requires holistic interventions that go beyond solely economic or educational aspects. The implications of these findings emphasize the urgent need for targeted interventions aimed at addressing early marriage practices in India while also improving access to comprehensive sexual and reproductive healthcare services for young women. These interventions should be designed with an understanding of broader societal issues such as poverty alleviation efforts and educational opportunities for girls. This study reinforces the importance of considering comprehensive socio-economic factors when designing interventions aimed at mitigating challenges faced by young brides within these communities. By addressing early marriage practices alongside broader socio-economic issues through targeted intervention programs, there is potential to significantly improve overall reproductive health outcomes among mothers in India.

Conclusion

The analysis reveals a concerning association between early marriage and poor reproductive health outcome among currently married women aged 15-30 in India. Women who were married at an early age, particularly ≤14 years and 15-17 years, are more likely to experience adverse reproductive health outcomes such as pregnancy complications, unwanted pregnancies, being underweight, and having iron-deficiency anemia compared to those married at an adult age (≥18 years). This underscores the urgent need for targeted policies and interventions aimed at delaying the age of first marriage to improve maternal and child health outcomes in India. Additionally, addressing broader determinants like education and socioeconomic status that contribute to poor reproductive health outcome among women marrying early is crucial for achieving positive advancements in this area. Overall, these findings emphasize the necessity for prioritizing efforts that delay early marriage as part of comprehensive strategies geared towards enhancing maternal and child health in the country.

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Appendix A Description of Variables Used in the Analysis

Outcomevariables	Description	Coding of variables
Y_{i1}	Poor reproductive health	◆ 1 if yes, 0 otherwise
Regressor variables	Description	Coding of variables
x_1	married less than 14 years	◆1 if women married <14 years, 0 otherwise
x_2	married 15-17 years	◆1 if women married 15-17 years, 0 otherwise
Control variables	Description	Coding of variables
x_w	Household Wealth	◆ categorical variable say poor, middle & rich
x_k	Early marriage (<14 year) with wealth of house	◆ categorical variable say poor, middle & rich
X_m	Early marriage (15-17 year) with wealth of house	◆ categorical variable say poor, middle & rich
X_3	Women age	◆ Continuous variables with women age 15-30 years,
X_4	year of schooling	◆ Continuous variables with single years (0-20 years)
X_5	Menstruated last 6 months	◆ 1 if yes, 0 otherwise
X_6	Currently working	◆1 if yes, 0 otherwise
X_7	Antenatal care received	◆1 if yes, 0 otherwise
X_8	women underweight	◆ 1 if yes, 0 otherwise
X_9	Benefit from anganwadi	◆1 if yes, 0 otherwise
X_{10}	Modern contraceptive use	◆1 if yes, 0 otherwise
X11	Living children morethan2	♦1 if yes, 0 otherwise
X12	Spousal age gap	◆ Continuous variables
X13	Nuclear family	◆1 if household members <=4, 0 otherwise

Source: Extracted by individual level of NFHS-5 data.

Appendix B Reliability Statistics (Cronbach's Alpha) for Items Used to Construct the Reproductive Health Index (RHI) Among Currently Married Women Aged 15–30 in India

Item	Obs (Sign)	Average Inter-item covariance	Alpha
Women anemia	106609 (+)	0.011	0.501
Women gave birth below 18 year of age	106609 (+)	0.008	0.331
Pregnancy complication	106609 (+)	0.003	0.177
Wanted last child	106609 (+)	0.002	0.304
Women underweight	106609 (-)	0.010	0.471
Miscarriage	106609 (+)	0.010	0.491
Stillbirth	106609 (+)	0.011	0.404
Abortion	106609 (+)	0.010	0.499
Test scale (overall) Number of items in the scale: 8		0.009	0.518
Scale reliability coefficien (Cronbach's alpha: 0.518			

Source: *Author's calculation based on NFHS-5 dataset.*
Note: (+/−) signs indicate hypothesized direction of association with poor reproductive health.
Abbreviations: BMI – Body Mass Index; RHI – Reproductive Health Index; SD – Standard Deviation.