

Structural vulnerabilities and adolescent pregnancy outcomes: a cross-sectional study from a tribal community in Jharkhand, India

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ABSTRACT

Background. Adolescent pregnancy remains a major public health challenge among tribal populations, where social, educational, and healthcare-related disadvantages frequently coexist and contribute to adverse maternal and neonatal outcomes. This study examined the sociodemographic profile, vulnerability factors, maternal and fetal outcomes, and the impact of cumulative vulnerability among pregnant tribal adolescents in Jharkhand.

Methods. A cross-sectional, hospital-based descriptive study was conducted among 197 pregnant adolescents aged 13–19 years belonging to Scheduled Tribes in Jharkhand, recruited through purposive sampling at the point of hospital admission for delivery between December 2023 and November 2025. Data were collected through structured interviews during hospital admission for delivery, supplemented by available hospital records. Sociodemographic characteristics, established risk factors including family dysfunction and educational barriers, maternal complications, and neonatal outcomes were assessed. An exploratory study-specific composite vulnerability score was developed using seven predefined vulnerability indicators and categorized as <4 or ≥4. Associations between vulnerability score and maternal-fetal outcomes were evaluated using unadjusted bivariate analysis.

Results. Most participants were aged 13–15 years (83.8%), illiterate (79.7%), primigravida (87.8%), and had received no antenatal care (73.6%). Poor socioeconomic conditions and lack of sexual and reproductive health information were reported by all participants, while school dropout (81.7%), sexual pressure from peers (71.6%), and family addiction history (38.6%) were also common. Maternal complications included anaemia (65.5%) and pregnancy-induced hypertension (32.5%). Low birth weight (63.5%) was the most frequent neonatal complication, followed by feeding difficulty (20.3%), prematurity (13.2%), and intrauterine fetal demise (4.1%). More than two-thirds of participants (71.1%) had a composite vulnerability score ≥4. Higher vulnerability scores were significantly associated with anaemia ($p<0.001$), pregnancy-induced hypertension ($p=0.004$), low birth weight ($p<0.001$), and prematurity ($p=0.016$).

Conclusion. This study reveals a marked clustering of poverty, illiteracy, family disruption, and healthcare exclusion among pregnant tribal adolescents accessing institutional delivery in this region of Jharkhand, and an association between the cumulative burden of these vulnerabilities and adverse maternal and neonatal outcomes.

Key words: syndemic framework, institutional delivery, maternal outcomes, low birth weight, fetal outcome.

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Adolescent pregnancy remains a pressing global concern, particularly in low- and middle-income countries, where it significantly contributes to maternal and perinatal morbidity and mortality, with an estimated 21 million pregnancies occurring annually among adolescents aged 15–19 years in these regions as of 2019; approximately 50% of which were unintended and resulted in an estimated 12 million births.¹ In India, national estimates from the sixth round of the National Family Health Survey (NFHS-6, 2023–24) place the prevalence of teenage childbearing among women aged 15–19 years at 6.7%, essentially unchanged from the 6.8% recorded in NFHS-5 (2019–21),^{2,3} despite national programs such as Rashtriya Kishor Swasthya Karyakram (RKSK) and the Reproductive, Maternal, Neonatal, Child and Adolescent Health (RMNCH+A) strategy.^{4,5} Encouragingly, NFHS-6 shows a decline in child marriage before age 18 among women aged 20–24 years, from 23.3% (NFHS-5) to 20.1% (NFHS-6); however, disaggregated tribal and Jharkhand-specific estimates from this round were not yet available at the time of writing.^{2,3} Adolescent girls, especially those from tribal communities, remain on the fringes of the healthcare system.

India's legal framework nominally protects adolescents from early marriage and sexual exploitation through the Prohibition of Child Marriage Act, 2006, which sets the minimum legal age of marriage at 18 years for women, and the Protection of Children from Sexual Offences (POCSO) Act, 2012, which criminalizes sexual activity with any person under 18 years irrespective of consent. Enforcement of both statutes remains inconsistent in tribal and rural areas, where early marriage continues to be normalized by community practice.⁶ Recent Indian reviews and multilevel analyses confirm that Scheduled Tribe status is independently associated with higher odds of adolescent pregnancy nationally and that illiteracy, domestic violence, and limited media exposure remain key determinants.⁷ Comparative work from tribal and non-tribal communities

elsewhere in eastern India has similarly documented markedly lower antenatal care utilization among tribal teenage mothers than their non-tribal counterparts.⁸

Jharkhand, with one of the highest tribal populations in India, exhibits a disproportionate burden of early marriage, school dropout, and adolescent childbirth.⁹ Tribal adolescents face entrenched structural vulnerabilities including poverty, illiteracy, substance abuse in the family, and disrupted family systems. These intersecting disadvantages not only increase their susceptibility to early pregnancy but also predispose them to poor maternal and neonatal outcomes.

The phenomenon of adolescent pregnancy in tribal regions must be seen through a syndemic lens, where multiple social and biological adversities cluster and interact synergistically to amplify risk.¹⁰ Traditional biomedical models fail to capture the deeper socioeconomic and cultural mechanisms driving early reproduction. This study investigates adolescent pregnancy in a tribal community of Jharkhand, focusing on the clustering of family-level and structural vulnerability factors, missed preventive health opportunities, and resultant maternal-foetal outcomes among adolescents who accessed institutional delivery services.

Methods

Study design and population

This cross-sectional, hospital-based descriptive study was conducted among adolescent pregnant girls belonging to tribal communities in Jharkhand over a period of 24 months, from December 2023 to November 2025. Participants were recruited at the point of hospital admission for delivery at government or affiliated tribal health centers in collaboration with peripheral health centers and outreach clinics serving tribal populations in rural Jharkhand. Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of Tata Main Hospital, Jamshedpur.

Study participants

The study included pregnant adolescents aged 13–19 years who identified as members of Scheduled Tribes and were admitted for delivery at government or affiliated tribal health centers. A total of 197 adolescent girls were enrolled through purposive sampling. This non-probability sampling approach enabled focused recruitment of pregnant tribal adolescents accessing institutional delivery services, a vulnerable and hard-to-reach population with low healthcare utilization rates. However, this sampling strategy and facility-based recruitment introduce important limitations to representativeness: participants were limited to those who accessed institutional care at the time of delivery, and the sample therefore excludes adolescents who delivered at home, who were unable to access institutional care at all, and whose pregnancies ended before delivery (through miscarriage, induced abortion, or undetected loss).

Participants were excluded if they (i) refused informed consent / assent, (ii) had serious medical comorbidities such as diabetes, epilepsy, or congenital heart disease, or (iii) were unable to participate due to cognitive or communication impairments. Adolescents with these comorbidities were excluded because each is independently and strongly associated with adverse pregnancy outcomes; their inclusion would have confounded the interpretation of associations between social vulnerability and the maternal / fetal outcomes that were the primary focus of this study.

Participants received no monetary compensation for their participation. However, as part of routine hospital care, all participants received standard postpartum supplies and newborn care kits provided by the government health program.

Study procedure

Eligible participants were approached during hospital admission for delivery. After obtaining informed written consent from participants

and/or guardians (for minors), a structured interview was conducted using a predesigned and pretested proforma. The proforma was developed based on variables reported in the existing literature on tribal adolescent pregnancy risk factors, reviewed internally by departmental faculty, and pretested on a small pilot sample of tribal adolescents (not included in the final analysis) to check comprehensibility; it was administered orally in the local tribal language by trained field investigators. No formally validated psychometric instrument was used to assess sensitive constructs such as dating violence or peer sexual pressure, which we note as a limitation. The questionnaire captured sociodemographic data (age, education, gravida, antenatal care received), maternal complications (e.g., anaemia, pregnancy-induced hypertension, puerperal infection), and neonatal outcomes (e.g., low birth weight, intrauterine fetal death, feeding difficulty, prematurity).

In addition, a set of predefined risk factors was assessed based on existing literature, including:

- Family factors: single mother, single-parent family, suicide or criminal record in family, history of addiction
- Social and psychological factors: sexual pressure from peers, dating violence, lack of spiritual life
- Educational and informational barriers: school dropout, lack of sexual/reproductive health information

Operational definitions

Illiteracy was defined as inability to read and write a simple sentence in any language, based on self-report and, where available, cross-checked against school records. School dropout was defined as discontinuation of formal schooling before completion of the terminal grade appropriate to the participant's age, for any reason. Socioeconomic status (SES) was assessed using the Modified Kuppuswamy scale and poor SES was defined as belonging to

the lower or upper-lower socioeconomic strata. Lack of prior sexual and reproductive health information was assessed via a single question asking whether the participant had ever received information on reproductive health, contraception, or pregnancy from any source (school, health worker, family, or media) before the index pregnancy; a negative response was scored as present. Sexual pressure from peers and dating violence were assessed through direct interview questions without a validated instrument, as noted above. Specifically, sexual pressure from peers was defined as a participant reporting, in response to a direct interview question, that she had ever felt urged, coerced, or pressured by a peer (a friend or acquaintance close in age) to enter into a romantic or sexual relationship or to engage in sexual activity; any positive response, regardless of the specific circumstances described, was scored as present. Dating violence was defined as a participant reporting, in response to a direct interview question, that she had ever experienced physical, sexual, or emotional violence (including hitting, threats, forced sexual activity, or intimidation) from a romantic partner; any such reported experience was scored as present. As these were single, non-validated items rather than standardized scales, they capture the presence or absence of a self-reported experience rather than its severity, frequency, or context, which we note as an additional limitation. Family-level variables (addiction, suicide, criminal record) referred to first-degree relatives residing in the same household (parents and siblings) unless otherwise specified by the participant, and the recall period for these variables was lifetime/ever. Anaemia, pregnancy-induced hypertension, puerperal infection, prematurity (birth before 37 completed weeks of gestation), and low birth weight (birth weight <2.5 kg) were defined using standard WHO/national clinical criteria and were confirmed from hospital records rather than relying solely on self-report.

All data were collected by trained field investigators fluent in local tribal languages to ensure comfort and comprehension for

participants. To minimize interviewer bias, all field investigators underwent standardized training on neutral questioning techniques and avoiding leading questions. A structured interview protocol was used consistently across all participants. To reduce recall bias, data on pregnancy complications and risk factors were collected during hospital admission (within 24-48 hours of delivery) when events were recent, and were corroborated with available medical records where possible. Data were anonymized and double-entered for quality assurance.

Data analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Descriptive statistics were calculated for all variables. Categorical variables were expressed as frequencies and percentages.

To quantify the cumulative burden of structural and psychosocial vulnerabilities, a composite vulnerability score was developed for each participant; this score has not been externally validated. Based on factors identified from existing literature and observed to be highly prevalent in the study population, one point was assigned for the presence of each of the following characteristics: illiteracy, school dropout, absence of antenatal care, history of addiction in the family, single-parent family, sexual pressure from peers, and history of dating violence. Equal weighting of these seven items was adopted as a simple, transparent approach in the absence of prior data that would permit empirical or theoretically derived weighting. We also note that illiteracy and school dropout, while conceptually distinct in our population may partially overlap and could result in some double-counting of a single underlying disadvantage.

The resulting score ranged from 0 to 7, with higher scores indicating greater cumulative vulnerability. This composite vulnerability score was calculated for each participant by summing the presence of seven predefined vulnerability factors, yielding a score ranging from 0 to 7.

The frequency distribution of vulnerability scores was described, and participants were subsequently categorized into low-vulnerability (<4) and high-vulnerability (≥ 4) groups using a cut-off selected a priori to approximate the median of the observed distribution and to yield a clinically interpretable “high-vulnerability” group; this cut-off has not been externally validated and should be interpreted as exploratory.

Associations between vulnerability score category and maternal outcomes (anaemia, pregnancy-induced hypertension, and puerperal infection) as well as fetal outcomes (low birth weight, feeding difficulty, premature birth, and intrauterine fetal demise) were assessed using the Chi-square test. Fisher’s exact test was applied when the expected cell count in any contingency table was less than five. A two-tailed p-value <0.05 was considered statistically significant. These analyses are unadjusted bivariate comparisons; multivariable analysis to adjust for potential confounders (e.g., maternal age, parity, gestational age, antenatal care utilization, and nutritional status) was not performed in the present study, and reported associations should therefore not be interpreted as independent or causal effects (see Limitations). Recruitment occurred across a network of peripheral health

centers and outreach clinics rather than a single site; clustering by recruitment centre was not formally accounted for in the analysis.

Results

Out of the 197 adolescent pregnancies studied from tribal populations in Jharkhand, the majority of participants were aged 13–15 years (83.8%), and illiterate (79.7%). Most were primigravida (87.8%) and had no antenatal care (73.6%). 21.3% of the deliveries were conducted through caesarean section (Table I).

Among risk factors, 100% reported a lack of sexual and reproductive health information and poor socio-economic conditions. A significant proportion had a history of school dropout (81.7%), experienced sexual pressure from peers (71.6%), and had a history of addiction in the family (38.6%) (Table II).

Regarding maternal complications, anaemia was the most common (n=129, 65.5%), followed by pregnancy-induced hypertension (n=64, 32.5%). Puerperal infection was recorded in four cases (2%). In terms of fetal outcomes, low birth weight (LBW) was observed in 125 cases (63.5%), followed by feeding difficulty (n=40, 20.3%), premature birth (n=26, 13.2%), and intrauterine fetal demise (n=8, 4.1%).

Table I. Sociodemographic and obstetric profile of the study participants (N = 197).

Variable	Category	Frequency	Percentage
Age	13–15 years	165	83.8
	16–19 years	32	16.2
Education	Illiterate	157	79.7
	Literate	40	20.3
Gravida	Primigravida	173	87.8
	Multigravida	24	12.2
Antenatal care (ANC) visits	None	145	73.6
	<2 visits	40	20.3
	>2 visits	12	6.1
Mode of delivery	Normal vaginal delivery	155	78.7
	Caesarean delivery	42	21.3

Table II. Distribution of established risk factors for adolescent pregnancy among the study participants (N=197).

Risk factor	Frequency	Percentage
Single mothers	32	16.2
Mother as single parent	52	26.4
Sexual pressure from peers	141	71.6
Lack of sexual and reproductive info	197	100.0
Criminal record in family	32	16.2
Suicide in family	28	14.2
School dropout	161	81.7
Poor socio-economic conditions	197	100.0
Addiction history in family	76	38.6
Siblings sexually active	24	12.2
Lack of spiritual life	20	10.2
History of dating violence	36	18.3

The distribution of the composite vulnerability score demonstrated a substantial clustering of risk factors among study participants. More than two-thirds of the adolescents (71.1%) had a vulnerability score of ≥ 4 , indicating the co-occurrence of multiple social, educational, and familial risk factors. The most common scores were 4 (31.0%) and 5 (23.4%), while only 9.6% of participants had scores below 3. No participant had a vulnerability score of zero (Table III).

Adolescents with a vulnerability score ≥ 4 experienced significantly higher rates of adverse maternal and fetal outcomes compared with those scoring <4 . Anaemia was significantly more prevalent among participants with higher vulnerability scores (77.1% vs. 36.8%, $p<0.001$),

Table III. Composite vulnerability score of the study participants (N=197).

Vulnerability score	Frequency	Percentage
0	0	0.0
1	4	2.0
2	15	7.6
3	38	19.3
4	61	31.0
5	46	23.4
6	24	12.2
7	9	4.6

as was pregnancy-induced hypertension (38.6% vs. 17.5%, $p=0.004$). Similarly, low birth weight was observed in three-fourths of adolescents with vulnerability scores ≥ 4 compared with one-third of those with lower scores (75.7% vs. 33.3%,

Table IV. Association of composite vulnerability score with maternal and fetal outcomes.

Characteristics	Vulnerability score ≥ 4 (N=140)	Vulnerability score <4 (N=57)	p-value#
Maternal complications			
Anemia	108 (77.1)	21 (36.8)	$<0.001^*$
Pregnancy-induced hypertension	54 (38.6)	10 (17.5)	0.004^*
Puerperal infection	4 (2.9)	0 (0.0)	0.326
Fetal complications			
Low birth weight (LBW)	106 (75.7)	19 (33.3)	$<0.001^*$
Feeding difficulty	29 (20.7)	11 (19.3)	0.823
Premature birth	22 (15.7)	4 (7.0)	0.016^*
Intrauterine death (IUD)	6 (4.3)	2 (3.5)	1.000

Values are presented as n (%); # p value was calculated using chi-square test or Fisher Exact test; * $p<0.05$ was considered to be statistically significant.

$p < 0.001$). Premature birth was also significantly more common in the high-vulnerability group (15.7% vs. 7.0%, $p = 0.016$) (Table IV).

Discussion

This study highlights the substantial structural vulnerabilities faced by pregnant adolescents in tribal Jharkhand. Most participants were aged 13–15 years (83.8%), indicating pregnancies occurring during early adolescence, a period of ongoing physical, cognitive, and emotional development.^{11,12} Illiteracy was highly prevalent (79.7%), reflecting persistent educational disadvantages in tribal communities. Educational deprivation is particularly important because literacy has been consistently associated with delayed childbearing, improved reproductive health knowledge, and better maternal outcomes.^{13,14} Similar patterns have been reported among tribal populations in Rajasthan and other regions of India, although the predominance of very early adolescent pregnancies observed in our study appears particularly pronounced.¹⁵⁻¹⁷ A recent narrative review of teenage pregnancy among tribal populations in India similarly identifies limited awareness, early/child marriage, and lack of parental or spousal support as recurring themes across settings.⁶

The majority of participants were primigravida (87.8%) and had received no antenatal care (73.6%), indicating major gaps in preventive healthcare access. Despite the availability of national maternal health programmes, antenatal care utilization in this cohort was considerably lower than national estimates among tribal populations.² According to the National Family Health Survey-5, even among tribal populations nationally, antenatal care coverage is typically above 60%.² This disparity suggests that the specific geographic and cultural contexts of Jharkhand's tribal communities create additional barriers to healthcare access beyond those experienced by tribal populations elsewhere in India. Although

most deliveries occurred vaginally, over one-fifth were conducted by caesarean section, suggesting that access to institutional obstetric care was available for at least a proportion of participants.

The universal presence of poor socioeconomic conditions and lack of sexual and reproductive health information underscores the deeply entrenched nature of disadvantage in this population. School dropout (81.7%), sexual pressure from peers (71.6%), family addiction (38.6%), single-parent households (26.4%), and dating violence (18.3%) were also common. These findings are consistent with ecological models of adolescent pregnancy that emphasize the interaction of family, social, and community-level determinants in shaping reproductive outcomes.^{10,18-24} Together, these factors reflect a broader context of social vulnerability that extends beyond individual reproductive behaviour, although we did not formally test for interaction between these factors and cannot determine whether they act synergistically or merely co-occur.

The burden of maternal and neonatal morbidity observed in this study was considerable. Anaemia was the most common maternal complication, affecting 65.5% of participants, substantially exceeding estimates reported among Indian adolescent girls and reflecting the combined effects of nutritional deprivation, early pregnancy, and limited antenatal care.²⁵⁻²⁷ Pregnancy-induced hypertension was observed in nearly one-third of participants (32.5%), a prevalence considerably higher than that reported in most adolescent pregnancy cohorts.²⁸ Among neonatal outcomes, low birth weight was recorded in 63.5% of newborns, far exceeding national averages and highlighting the adverse intrauterine environment associated with maternal undernutrition and poor healthcare access.²⁹ Feeding difficulties, prematurity, and intrauterine fetal demise further underscored the high-risk nature of pregnancies in this population. We emphasize that, because outcome ascertainment in this study was largely

restricted to the 24–48-hour period around delivery, with no structured follow-up after discharge, these figures likely underestimate the true burden of puerperal infection, feeding difficulties, and neonatal complications that manifest later in the postpartum or neonatal period. Collectively, these findings indicate that adolescent pregnancy in tribal communities is associated with significant social vulnerability and a substantial burden of adverse maternal and neonatal outcomes.

A contribution of this study was the development of an exploratory, study-specific composite vulnerability score to quantify the cumulative burden of educational, familial, healthcare-related, and psychosocial disadvantages. More than 70% of participants had a vulnerability score of ≥ 4 , indicating that multiple vulnerabilities frequently coexisted within the same individual. This finding demonstrates a clustering of social vulnerabilities in this population: our analysis summed binary indicators and examined their combined association with outcomes but did not formally test for statistical interaction or synergy between individual vulnerabilities, nor between the co-occurring health conditions themselves. Rigorous testing of the syndemic hypothesis in this population would require dedicated interaction analyses which we recommend for future research.

The co-occurrence of family disruption, single-parent households, and addiction within families in this cohort suggests that adolescent pregnancies often occur within broader contexts of persistent social disadvantage within the family unit. This pattern helps explain why interventions that focus narrowly on individual behaviour change, without addressing family- and community-level determinants, may have limited effectiveness in populations facing such concentrated disadvantage. Breaking cycles of disadvantage is likely to require interventions that extend beyond reproductive health services to include educational support, social protection, nutrition, and community-based empowerment

initiatives, alongside stronger enforcement of the Prohibition of Child Marriage Act, 2006, and child-protection provisions under the POCSO Act, 2012, given that a substantial proportion of participants in this cohort became pregnant below the legal age of marriage and consent. The findings also highlight the limitations of health programmes that focus primarily on service delivery without addressing underlying social determinants. Effective strategies should combine school-retention initiatives, adolescent-friendly reproductive health services, nutrition support, community-based reproductive health education, and social protection measures.

This study has several limitations. First, the cross-sectional design precludes establishing temporal or causal relationships between vulnerability factors and adverse pregnancy outcomes. Second, purposive sampling and hospital-based recruitment may have introduced selection bias, and findings may not be generalizable to all tribal communities in India. Third, some psychosocial variables were assessed using non-validated, study-specific questions and were self-reported, and may be subject to recall or social desirability bias; family-level variables used a lifetime recall period, which may introduce further reporting variability. Fourth, the composite vulnerability score was developed specifically for this study using equally weighted, dichotomized indicators and has not been externally validated; some component variables (illiteracy and school dropout) may conceptually overlap. Fifth, outcome ascertainment was largely restricted to the 24–48-hour period around delivery with no structured post-discharge follow-up, likely underestimating outcomes such as puerperal infection and later-presenting neonatal complications. Sixth, the reported associations between vulnerability score and outcomes are unadjusted; we could not account for potential confounders such as maternal age, parity, gestational age, antenatal care, and nutritional status, nor for clustering by recruitment centre, and these associations

should not be interpreted as independent or causal effects. Moreover, this study did not include a comparison group of non-adolescent (adult) pregnant women from the same tribal population; consequently, we cannot determine whether the sociodemographic and obstetric profile, or the observed maternal complications, are specific to adolescent pregnancy or instead reflect broader characteristics shared by pregnant women in this population regardless of age. Future studies incorporating an adult pregnant comparison group are needed to disentangle age-specific risk from population-level disadvantage. Nevertheless, the study provides valuable descriptive insights into the co-occurrence of structural disadvantage and adverse maternal and neonatal outcomes among a highly marginalized and underrepresented population, and identifies clear directions for future research.

Conclusion

The present study reveals that adolescent pregnancy in tribal communities accessing institutional delivery in Jharkhand occurs within a complex network of educational, familial, socioeconomic, and healthcare-related vulnerabilities. The high prevalence of cumulative vulnerability and its unadjusted association with anaemia, pregnancy-induced hypertension, low birth weight, and prematurity are consistent with a clustering of social disadvantages linked to adverse maternal and neonatal outcomes in this population. These findings underscore the need for comprehensive, culturally appropriate interventions that simultaneously address education, healthcare access, nutrition, social protection, and family-level determinants, alongside adequately powered, adjusted, and longitudinal studies to confirm and extend these findings.

Ethical approval

This study was approved by the Institutional Ethics Committee of Tata Main Hospital, Jamshedpur under reference no. TMH/IEC/NOV/10/2023 dated 29.11.2023.

Author contribution

The authors confirm contribution to the paper as follows: Study conception and design: ID, AK, TP; data collection: ID; analysis and interpretation of results: AK, TP; draft manuscript preparation: ID, AK, TP. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that there is no conflict of interest.

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