



RURAL RESIDENCE, SOCIOECONOMIC STATUS, AND ADVERSE OUTCOMES IN TEENAGE PREGNANCIES: A HOSPITAL-BASED OBSERVATIONAL STUDY FROM RURAL SOUTH INDIA

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ABSTRACT

Rural residence and low socioeconomic status (SES) are powerful social determinants of poor maternal and perinatal health. Their specific contribution to adverse outcomes in teenage pregnancies in South India remains under-quantified. This study examines rural-urban and SES-based disparities in anemia, preterm labor, and low birth weight (LBW) among teenage mothers at a tertiary hospital in rural South India. **Methods:** A hospital-based observational study analyzed 100 consecutive teenage pregnancies (maternal age 15–19 years) identified among 1,263 deliveries (incidence 8.3%) at a tertiary care facility in rural South India (January–December 2023). Residence (rural/urban) and SES (modified Kuppuswamy scale) were the primary exposure variables. Anaemia, preterm labor, and LBW were the primary outcomes. Associations were evaluated using chi-square tests ($p < 0.05$). **Results:** Rural residence (64%) and low SES (64%) predominated. Rural mothers had higher rates of anemia (62.5% vs. 44.4%; $p = 0.08$), preterm labor (31.3% vs. 16.7%; $p = 0.10$), and LBW (32.8% vs. 19.4%; $p = 0.15$) compared with urban mothers; differences were clinically meaningful though not statistically significant, reflecting limited power at this sample size. Low SES was significantly associated with higher anemia prevalence (68.8% vs. 33.3%; $p = 0.001$) and elevated, though non-significant, rates of preterm labor (31.3% vs. 16.7%; $p = 0.10$) and LBW (35.9% vs. 13.9%; $p = 0.01$). Younger age (15–17 years) conferred additional preterm risk (30.7% vs. 13.5%; $p = 0.04$). **Conclusions:** Low SES is a statistically significant determinant of anemia and LBW in teenage pregnancies, while rural residence shows clinically important but statistically non-significant trends at this sample size. Larger studies are needed to confirm rural-urban differences. Targeted rural and socioeconomic interventions—including enhanced antenatal care, food security programs, and supplementation adherence—are urgently required.

KEYWORDS : Teenage Pregnancy, Rural Health, Socioeconomic Status, Social Determinants, Perinatal Outcomes, South India

INTRODUCTION

Teenage pregnancy disproportionately burdens rural and socioeconomically disadvantaged populations in low- and middle-income countries, including India (1,2). The National Family Health Survey-5 (NFHS-5, 2019–21) confirms higher rates of teenage childbearing and adverse perinatal indicators in rural compared with urban areas across India, with particularly pronounced disparities in states with persistent developmental gaps (3).

Rural environments in India are characterized by structural challenges—limited access to antenatal care, poor road connectivity, food insecurity, sanitation deficits, higher infection burden, and constrained health-seeking behavior—that are established social and environmental determinants of maternal and child health (4,5). Low SES further compounds these risks through reduced nutritional intake, delayed or absent antenatal care attendance, and greater exposure to communicable diseases. In adolescents, these social stressors interact with biological immaturity to amplify the risk of anemia, preterm birth, and low birth weight (LBW) (6,7).

Indian-specific evidence demonstrates that rural teenage mothers face substantially higher rates of anemia than their urban counterparts, attributable to monotonous iron-poor diets, low supplementation adherence, and limited laboratory infrastructure for early diagnosis (8,9). Similarly, socioeconomic gradients in LBW and preterm delivery have been

documented across hospital-based cohorts in South Asia, consistent with pathways involving chronic undernutrition and restricted healthcare utilization (10).

This study examines rural-urban and SES-based disparities in adverse maternal and perinatal outcomes among teenage mothers at a tertiary hospital in rural South India. By identifying the magnitude of these disparities and the pathways through which they operate, the study provides a framework for designing targeted community-level interventions.

MATERIALS AND METHODS

Study Design and Setting

A hospital-based observational study was conducted at a tertiary maternity hospital serving predominantly rural populations in South India.

Study Population and Period

Teenage pregnant mothers (aged 15–19 years) delivering at the study facility between January 2023 and December 2023 were included. Singleton pregnancies within this age group with complete hospital records were eligible for inclusion. Multiple pregnancies, mothers outside the 15–19-year age range, and records with critical missing data were excluded.

Sample Size and Sampling

The study is a descriptive observational analysis of all eligible consecutive teenage deliveries during the study period. For

estimating anemia prevalence as the primary outcome ($p = 0.40$ from prior hospital-based studies in the region, $d = 0.10$, $Z = 1.96$, 95% confidence level), the minimum required sample size was approximately 93 cases. Accounting for a 10% non-response/record-incompleteness rate, the target was set at 100 teenage mothers. Consecutive sampling was employed until this target was achieved. A total of 100 teenage pregnancies were accrued from 1,263 consecutive deliveries (incidence 8.3%), consistent with the hospital's estimated annual teenage delivery burden of 10–15% of approximately 3,500 deliveries per year.

Primary Exposure Variables

Residence: Classified as rural or urban based on reported home address and census classification at the time of admission.

Socioeconomic Status (SES): Assessed using the modified Kuppuswamy socioeconomic scale, dichotomized as low SES versus middle/high SES for bivariate analysis.

Outcome Definitions

Anemia: Diagnosed based on WHO criteria (hemoglobin < 11 g/dL during pregnancy) supplemented by clinical pallor on examination.

Low Birth Weight (LBW): Birth weight $< 2,500$ g per WHO definition.

Preterm Labor/Delivery: Clinical diagnosis of preterm labor or delivery at < 37 completed weeks of gestation.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS v.20. Descriptive statistics summarized frequencies and percentages. Bivariate associations between residence, SES, and key outcomes were assessed using Pearson chi-square tests; $p < 0.05$ was considered statistically significant. Given the modest sample size, all associations are presented with exact p-values to enable assessment of both statistical significance and effect magnitude. Clinically meaningful differences that did not reach statistical significance are explicitly identified as such, with underpowering noted as a probable explanation.

Ethical Clearance

Ethical clearance was obtained from the Institutional Ethics Committee (IEC). Patient confidentiality was maintained throughout; all data were de-identified prior to analysis.

RESULTS

Socio-Demographic Profile

Of the 100 teenage mothers, 26 (26%) were aged 15–17 years and 74 (74%) were aged 18–19 years. Rural residence predominated (64 rural, 36 urban). Low SES was recorded in 64% of cases by modified Kuppuswamy classification. Educational attainment was distributed as follows: 22% illiterate, 38% with primary education, and 40% with secondary or higher education.

Rural-Urban Disparities in Adverse Outcomes

Rural mothers demonstrated higher rates of anemia, preterm labor, and LBW compared with urban mothers across all three outcomes (Table 1). Differences were clinically substantial — particularly for anemia (62.5% vs. 44.4%) and LBW (32.8% vs. 19.4%) — but did not reach conventional statistical significance, most plausibly reflecting limited statistical power at this sample size ($n = 64$ rural, $n = 36$ urban) rather than an absence of true effect. These findings should be interpreted as hypothesis-generating, warranting confirmation in larger studies.

Table 1: Association of Residence with Key Adverse Outcomes (n=100)

Residence	Anemia n (%)	Preterm Labor n (%)	LBW n (%)	Total n
Rural (n=64)	40 (62.5%)	20 (31.3%)	21 (32.8%)	64
Urban (n=36)	16 (44.4%)	6 (16.7%)	7 (19.4%)	36
Total	56 (56.0%)	26 (26.0%)	28 (28.0%)	100
p-value	0.08	0.10	0.15	—

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Chi-square test. Non-significant differences are noted; limited statistical power at this sample size is the probable explanation for failure to reach $p < 0.05$ despite clinically meaningful effect sizes.

SES Disparities in Adverse Outcomes

Low SES was significantly associated with anemia prevalence (68.8% vs. 33.3%; $p = 0.001$) and LBW (35.9% vs. 13.9%; $p = 0.01$), representing the study's most robust findings. The association with preterm labor did not reach statistical significance (31.3% vs. 16.7%; $p = 0.10$), though the direction and magnitude are consistent with a real effect (Table 2).

Table 2: Association of Socioeconomic Status with Key Adverse Outcomes (n=100)

SES Category	Anemia n (%)	Preterm Labor n (%)	LBW n (%)	Total n
Low SES (n=64)	44 (68.8%)	20 (31.3%)	23 (35.9%)	64
Middle/High SES (n=36)	12 (33.3%)	6 (16.7%)	5 (13.9%)	36
Total	56 (56.0%)	26 (26.0%)	28 (28.0%)	100
p-value	0.001*	0.10	0.01*	—

Chi-square test. *Statistically significant ($p < 0.05$). SES = socioeconomic status assessed by modified Kuppuswamy scale.

Age-Related Risk

Younger maternal age (15–17 years) was independently associated with higher preterm delivery rates compared to older teenagers aged 18–19 years (30.7% vs. 13.5%; $p = 0.04$), confirming that biological immaturity contributes additional obstetric risk beyond the effects of residence and SES.

DISCUSSION

This study demonstrates that low SES is a statistically significant determinant of anemia ($p = 0.001$) and LBW ($p = 0.01$) in teenage pregnancies in rural South India, with effect sizes of substantial public health importance. Rural residence showed clinically meaningful but statistically non-significant trends across all three outcomes — a finding most parsimoniously explained by insufficient power at the current sample size rather than an absence of true association, and one that warrants prospective examination in larger multi-centric cohorts.

The SES-anemia association (68.8% in low-SES vs. 33.3% in middle/high-SES mothers) is consistent with established pathways: low-SES adolescent girls in rural India consume monotonous diets with low bioavailable iron, have reduced adherence to iron-folate supplementation under schemes such as Anemia Mukh Bharat, and are more likely to present late or not at all for antenatal care (8,9). The SES-LBW association (35.9% vs. 13.9%; $p = 0.01$) reflects the downstream nutritional and obstetric consequences of these same constraints, mediated through intrauterine growth restriction and preterm delivery (6,7).

Rural residence, while not reaching statistical significance as a predictor in this sample, plausibly operates through partially overlapping but distinct mechanisms: limited physical access to antenatal facilities, poor road connectivity, dependence on agricultural labor, higher infectious disease burden, and inadequate sanitation — all of which have been documented as determinants of adverse perinatal outcomes in rural Indian populations (4,5,10). The rural-urban differences observed here (anemia: 62.5% vs. 44.4%; LBW: 32.8% vs. 19.4%) are large enough to be clinically significant

and warrant confirmation rather than dismissal on grounds of non-significance alone.

The additional preterm risk conferred by younger maternal age (15–17 years; $p = 0.04$) is consistent with evidence that uterine and cervical immaturity in early adolescence elevates preterm labor risk independently of nutritional or socioeconomic status, underscoring the importance of delayed marriage and first birth as a policy priority (1,2).

Taken together, these findings affirm that rural residence and low SES act as layered social determinants that amplify the inherent biological vulnerability of teenage pregnancy. While South India performs relatively better on aggregate maternal health indicators compared with northern states, rural pockets within the region sustain preventable and concentrated burdens that require targeted intervention.

Strengths and Limitations

Strengths of this study include consecutive sampling minimizing selection bias, direct linkage to clinical outcome data, and explicit reporting of p-values for all associations — including non-significant findings — to allow transparent interpretation. The study is limited by its single-center observational design, which restricts generalizability. The modest sample size ($n=64$ rural, $n=36$ urban) was underpowered to detect moderate rural-urban effect sizes with conventional significance. Multivariable regression to adjust for confounders such as age, education, and gravidity was not feasible at this sample size. Residence and SES are proxies for underlying environmental and social mechanisms; direct measurement of sanitation access, dietary intake, or infection burden was not performed. These limitations reinforce the call for larger prospective studies rather than undermining the study's descriptive contribution.

CONCLUSIONS AND RECOMMENDATIONS

Low socioeconomic status is a statistically significant and clinically important determinant of anemia and LBW in teenage pregnancies in rural South India. Rural residence shows consistent, clinically meaningful trends across all adverse outcomes, with non-significance at this sample size most likely reflecting insufficient power rather than true absence of effect. These findings identify actionable targets for public health intervention.

Priority recommendations include: (1) strengthened and digitally monitored implementation of Anemia Mukh Bharat among rural and low-SES adolescent girls, with community health worker follow-up for supplementation adherence; (2) integration of nutritional counseling and dietary diversification into routine antenatal care contacts; (3) expanded rural antenatal care outreach to reduce access barriers including transportation and awareness; (4) school-based nutrition and reproductive health programs targeting adolescent girls prior to pregnancy; and (5) delayed marriage and girls' education initiatives to reduce early teenage childbearing. Larger multi-centric prospective studies incorporating geospatial residence data, biomarker profiles, and multivariable modeling will further quantify and disentangle the contributions of rural environment and SES to adverse perinatal outcomes in teenage pregnancies.

Declarations

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Conflicts of Interest: None declared.

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