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Papers

Young Mothers of Uttar Pradesh: Exploring Teenage Pregnancy Prevalence and It's Correlates

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Abstract
Teenage pregnancy remains a major public health concern in India, reflecting deep-rooted socio-economic and gender disparities. This study analyses the spatial and temporal trends of teenage pregnancy with a focus on Uttar Pradesh (UP), comparing NFHS-4 (2015–16) and NFHS-5 (2019–21) data. Findings reveal a marginal national decline but persistent high prevalence in UP, with distinct inter-district variations. A district-level socio-economic composite score was constructed for 71 districts (Census of India, 2011) using seven normalized indicators i.e., child marriage, ruralness, agricultural dependence, female literacy, anaemia prevalence, contraceptive use, and SC/ST population through min–max scaling and rational weightage in SPSS. Correlation analysis showed a strong negative association between socio-economic scores and teenage pregnancy prevalence, shows statistically significant under t-test validation. Districts were grouped into high, Medium-high, Medium-low, and low socio-economic categories using mean ± 0.5 SD thresholds, with variations visualized through boxplots and whisker charts. Kruskal–Wallis H-test confirmed significant regional disparities, while choropleth mapping identified persistent hotspots in eastern and southern UP. Overall, lower socio-economic status, poor literacy, and high child marriage prevalence correspond to higher teenage pregnancy rates, emphasizing the need for targeted regional interventions.

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INTRODUCTION

Teenage pregnancy, defined as pregnancy in girls aged 10 to 19 years, is a critical public health and social issue globally (WHO, 2020; UNICEF, 2021). In India, it largely results from early and forced marriage rather than premarital sexual activity, especially in rural and socio-economically disadvantaged populations (Silverman; Raj, 2007; Sanjay Rode, 2011). Adolescent pregnancies increase risks of maternal and neonatal complications, school dropout, and perpetuation of poverty and gender inequality (Ganchimeg *et al*., 2014; Nair *et al*., 2012). Nationally, women aged 15–19 have begun childbearing considered teenage pregnancy (IIPS, 2022), but in Uttar Pradesh (UP), rates are even higher in some region whicle lower in others depicting the spatial differences, which is driven by early marriage, low female literacy, limited reproductive health access, and entrenched cultural norms (IIPS; ICF, 2022; Sahoo *et al*., 2023; Rani; Bonu, 2009). Determinants include socio-economic status, education, family environment, cultural norms, access to health services, and early marriage (Chaudhary; Kumari, 2018; WHO, 2020). Theoretical frameworks such as ecological systems theory (Bronfenbrenner, 1979), social learning theory (Bandura, 1977), and the theory of planned behaviour (Ajzen, 1991) highlight the interplay of individual, social, and structural factors. This study examines trends, district-wise variations, socio-economic correlates, and zonal patterns of teenage pregnancy in UP to inform evidence-based interventions and policy planning.

LITERATURE REVIEW

Teenage pregnancy has been conceptualized differently by global health agencies and scholars, reflecting medical, social, legal, and cultural dimensions. The World Health Organization (2020) and UNICEF (2021) define it as any pregnancy in girls aged 10–19 years, emphasizing heightened maternal risks including anaemia, obstetric complications, and neonatal mortality as well as serious social consequences such as school dropout and restricted socio-economic mobility. In India, scholars connect teenage pregnancy strongly with early marriage rather than premarital relationships. Silverman and Raj (2007) argue that adolescent pregnancy typically follows forced or early marriage, while Rode (2011), drawing on evidence from Uttar Pradesh, includes any conception before age 20 and highlights the concentration of teenage motherhood among rural, socio-economically marginalized, and lower-caste communities. Nair *et al*. (2012) identify teenage pregnancy as the result of intersecting structural constraints such as limited education, gender inequality, and restricted agency. More recently, the UDAYA study (Population Council, 2020) defines adolescent motherhood as any first or repeat pregnancy among married girls aged 15–19 years, noting that most such pregnancies occur with minimal reproductive autonomy. Choudhary *et al*. (2017) add that pregnancies in this age group occur before full physical and emotional maturity, reinforcing health and psychosocial vulnerabilities.

The conceptual framework of this study draws upon established definitions and interpretations from a wide range of scholarly literature to ensure theoretical clarity and comprehensiveness. However, the empirical operationalization of key variables and indicators is primarily grounded in data from the National Family Health Survey, which serves as the core database for analysis that is 15 - 19 years. NFHS provides standardized, nationally representative, and methodologically consistent information on fertility, health, and demographic behavior, making it particularly suitable for empirical investigation. Thus, while multiple scholarly perspectives inform the conceptual understanding, the measurement and analysis are anchored in NFHS data to maintain consistency, reliability, and comparability across the study.

Although the global standard age range for defining teenage pregnancy is 10–19 years, scholars contend that biological and emotional maturity do not always align with chronological age (Choudhary *et al*., 2017). In India, pregnancies below age 18 contradict legal norms set by the Prohibition of Child Marriage Act, yet large-scale datasets like UDAYA (Population Council, 2020) show persistent pregnancies among girls aged 15–17, especially in Uttar Pradesh and Bihar. Rode (2011) therefore argues for an expanded definition up to age 20 to capture both biological risk and socio-cultural context. Findings from NFHS-5 (IIPS, 2022) report that 6.8% of adolescent girls (15 to19) nationally have begun childbearing. In Uttar Pradesh, the prevalence is higher, ranging between 9 to12%, driven by early marriage, poverty, restricted access to sexual and reproductive health services, and entrenched patriarchal norms (Sahoo *et al*., 2023; Rani; Bonu, 2009). Studies consistently show higher

adolescent pregnancy rates among rural residents, lower-income households, and disadvantaged caste groups (Jejeebhoy, 2005). Limited contraceptive knowledge, low media exposure, and lack of adolescent-friendly health services further exacerbate early childbearing (Priyadharshani *et al*., 2024).

Community perceptions heavily shape how teenage pregnancy is understood and addressed. In many rural parts of Uttar Pradesh, early childbearing is normalized as part of early marriage (Jejeebhoy, 2005), whereas urban and better-educated communities view it as a barrier to education, employment, and upward mobility (NFHS-5, 2022; Population Council, 2020). Qualitative studies highlight that adolescent girls experiencing early pregnancy often face shame, limited mobility, and social isolation (Chaudhary; Kumari, 2018). Health professionals treat adolescent pregnancy as a significant public-health concern requiring improved sexuality education, contraceptive counselling, and adolescent-centric service delivery (WHO, 2020). Spatial analyses reveal district-level clustering of early marriage and teenage pregnancy within Uttar Pradesh (Singh *et al*., 2024), showing that averages conceal significant local heterogeneity.

Teenage pregnancy in India is shaped by interconnected socio-economic, cultural, educational, and familial factors. Poverty restricts access to schooling and healthcare, contributing to early marriage and pregnancy (Rani, Bonu, 2009; Jejeebhoy, Santhya, 2011). Multiple NFHS-based analyses show that education is the strongest protective factor girls with secondary or higher schooling delay marriage and childbearing (IIPS, ICF, 2022). Lack of comprehensive sexuality education leads to misinformation and low contraceptive use (Population Council, 2020). Gender norms emphasizing early fertility and low decision-making power reduce girls' autonomy (Sahoo *et al*., 2023). Family structures also matter: unsupportive or unstable home environments increase risk, while supportive families help delay sexual debut and pregnancy (Chaudhary, Kumari, 2018). Recent longitudinal analyses from Uttar Pradesh and Bihar show that early marriage and motherhood significantly reduce young women's empowerment and access to economic opportunities). Additionally, clinical studies note higher rates of anaemia, low birth weight, and neonatal complications among adolescent mothers (Saikia, Singh, 2016).

Overall, teenage pregnancy in Uttar Pradesh emerges as a multidimensional issue embedded in socio-economic disadvantage, gender norms, legal gaps, and inadequate healthcare systems. While national prevalence is declining, inequalities remain pronounced, especially among the poorest and least educated girls (Kumari *et al*., 2025). Effective intervention requires a culturally sensitive, rights-based, and gender-transformative approach centering adolescent autonomy, improving school retention, strengthening enforcement against child marriage, expanding sexuality education, and scaling up adolescent-friendly reproductive health services. The existing literature therefore provides strong justification for in-depth, Uttar Pradesh–specific analysis of teenage pregnancy prevalence, spatial variations, and socio-demographic correlates.

STUDY AREA

Uttar Pradesh (UP), India's most populous state, covers 243,290 sq. km and lies between 23°52′ to 31°28′ N latitude and 77°03′ to 84°39′ E longitude. The state shares its northern boundary with Nepal, while being bordered by Uttarakhand and Himachal Pradesh to the northwest, Haryana, Delhi, and Rajasthan to the west, Madhya Pradesh to the south, Chhattisgarh and Jharkhand to the southeast and Bihar to the east. Administratively, UP comprises 75 districts, forming diverse cultural and ecological regions. Its physiography includes the fertile Gangetic Plain, the marshy yet productive Terai region in the north, the rocky Vindhyan Plateau in the south, and the Shivalik foothills in the northwest. The state experiences a subtropical monsoon climate, characterized by very hot summers (up to 45°C), cold winters (below 5°C) and annual rainfall ranging from 800 to 1200 mm.

According to the Census of India (2011), Uttar Pradesh had a population of 199.8 million, with recent estimates exceeding 240 million, making it demographically larger than many countries. Despite its agricultural strength and dense settlement patterns, UP faces substantial socio-economic challenges including widespread rural poverty, low female literacy, early marriage norms, and unequal access to healthcare. These structural and demographic disparities, coupled with geographic and climatic variations, contribute to significant inter-district differences in teenage pregnancy. Consequently, Uttar Pradesh offers a critical context for analysing the spatial distribution and socio-economic determinants of early childbearing, enabling evidence-based planning and targeted policy interventions.

OBJECTIVES

To understand the trend of teenage pregnancy prevalence in India, with a special focus on Uttar Pradesh, in order to provide a comparative perspective between national and state-level patterns.

To analyse the changes in teenage pregnancy prevalence across districts of Uttar Pradesh between NFHS-4 and NFHS-5.

To examine the relationship between socio-economic conditions of districts and teenage pregnancy prevalence.

To construct zonation of districts based on socio-demography factors and compare these zones with teenage pregnancy prevalence to identify spatial variations and regional patterns across Uttar Pradesh.

RESEARCH METHODOLOGY

The methodology is designed to address all four research objectives. The first two objectives, focusing on temporal and spatial variations in teenage pregnancy through trend and temporal change analysis. The third and fourth objectives, which examine socio-economic determinants and spatial disparities, were addressed through composite index construction, correlation, and spatial zonation techniques.

Data Sources

This study utilized secondary data from three rounds of National Family Health Survey NFHS-3 2005-06, (2007), NFHS-4 2015–16, (2017) and NFHS-5 2019–21, (2022 and Census of India (2011) for district-level socio-demographic indicators. As the district is the unit of analysis for this paper. All computations, correlations, and spatial visualizations were performed at the district level for Uttar Pradesh, enabling regional comparisons and identification of socio-economic patterns influencing teenage pregnancy.

Spatio–Temporal Analysis of Teenage Pregnancy

To understand both spatial and temporal variation, teenage pregnancy prevalence rates from NFHS-4 and NFHS-5 were compared at national, state (Uttar Pradesh), and district levels.

Trend Analysis

The overall trend of teenage pregnancy between the three NFHS rounds was assessed using descriptive statistics and bar graph.

Temporal Change Calculation

District-level percentage change was calculated to quantify improvement or deterioration between NFHS-4 and NFHS-5.

$$\Delta = \text{NFHS 4} - \text{NFHS 5}$$

Classification of Change

Changes in teenage pregnancy across districts were classified into four categories based on percentage change: Large Improvement (>3% decrease), Small Improvement (0.5–3% decrease), No Significant Change (–0.5% to +0.5%), and Deterioration/Needs Improvement (<–0.5% or increase). Districts were then spatially mapped in ArcGIS (2013) to visualize the spatial heterogeneity of trends across Uttar Pradesh.

Analysis of Socio-Economic Determinants of Teenage Pregnancy

This objective examines how socio-economic conditions influence teenage pregnancy prevalence across districts.

Selection of Indicators

Seven socio-economic indicators were identified based on theoretical relevance inspired by literature review and data availability (Table 1).

Table 1 – Dependent and Independent Variables in District-Level Socio-Economic Analysis

S.No	Indicator	Description
Dependent Variable		
1	Teenage Pregnancy	Percentage of women aged 15-19 who have already had a live birth or are pregnant with their first child
Independent Variable		
1	Ruralness	Percentage of population living in rural areas
2	Agriculture workers	Percentage of population engaged in agriculture (cultivators and agricultural labourers)
3	SC/ST Population	Percentage of Scheduled Castes and Scheduled Tribes population
4	Female literacy	Literacy rate
5	Anaemia	Percentage of anaemic women aged 15-19
6	Child Marriage	Percentage of women aged 20-24 married before 18
7	Contraceptive Use	Percentage of currently married women using any contraceptive method

Source: Census of India (2011).

Data Processing and Normalization

District-level data were compiled and cleaned in Microsoft Excel (2003) to ensure consistency and completeness. Missing or inconsistent values were verified against original sources. To enable comparability across indicators with differing units, all variables were normalized using Min–Max scaling.

$$X' = \frac{X - X_{min}}{X_{max} - X_{min}}$$

where $X'$is the normalized value scaled between 0 and 1.

Weight Derivation

Each indicator was assigned a relative weight based on its correlation strength with the dependent variable (teenage pregnancy rate) using Pearson's correlation coefficient (r):

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum(X_i - \bar{X})^2 \sum(Y_i - \bar{Y})^2}}$$

Absolute correlation values were normalized so that the sum of all weights equals 100:

$$w_i = \frac{| r_i |}{\sum | r_i |} \times 100$$

This ensured that variables with stronger associations received proportionally higher weights. (Table 3) further Statistical computation was conducted using SPSS.

The study adopts a correlation-based weighting approach for index construction, wherein weights are derived from the strength of association between individual indicators and the composite phenomenon. This method is supported in the literature on composite indices, where correlation analysis is used to examine interrelationships among variables and to derive objective weights based on their informational contribution (Greco *et al.*, 2019; Ray, 2008). Correlation-based weighting helps reduce subjectivity in weight assignment and ensures that indicators with stronger empirical relevance exert greater influence on the index. Such data-driven approaches are widely recommended for enhancing robustness and validity in composite indicator construction.

Composite Socio-Economic Index

A district-level socio-economic development score was calculated as a weighted aggregation of the normalized indicators:

$$SEDS = \sum(w_i \times X_i')$$

This composite score reflects the overall socio-economic condition of each district, serving as a continuous variable for correlation and spatial analysis.

Correlation Analysis

The association between teenage pregnancy prevalence and the socio-economic development score was examined using Pearson's correlation analysis in Python. The significance of r was tested using the t-statistic:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}, df = n-2$$

Where:

r = Pearson correlation coefficient
n = number of observations (districts)
df = degrees of freedom = $n - 2$

Two-tailed p-values were obtained from the t-distribution; correlations with $p \leq 0.05$ were considered statistically significant. *Scatter plots* were used to visualize trends and directions of association.

Zonation and Classification

Districts were categorized into four socio-economic zones: High development, Medium-high, Medium-low, Low development based on the mean ± 0.5 standard deviation of the composite score. This classification enabled comparative analysis of teenage pregnancy prevalence across socio-economic strata.

Table 2 – Classification of districts by Standard Deviation score

SD-based classification	
Zones	Range
High development	>μ + 0.5 σ
Medium- High	μ to μ + 0.5σ
Medium- Low	μ to μ - 0.5 σ
Low development	< μ - 0.5σ

Source: The authors (2025).

Statistical Testing for Group Differences

Since data were not normally distributed, the Kruskal–Wallis H test, a non-parametric alternative to one-way ANOVA, was used to test for significant differences in teenage pregnancy rates among zones:

$$H = \frac{12}{N(N+1)}\sum_{i=1}^{k}\frac{R_i^2}{n_i} - 3(N+1)$$

Where:

N= total number of observations,
R_i= sum of ranks in group i, and
n_i= number of observations in group i.
A higher H value indicates greater inter-group differences and vice versa. Statistical tests were implemented using Python.

Spatial Analysis and Visualization

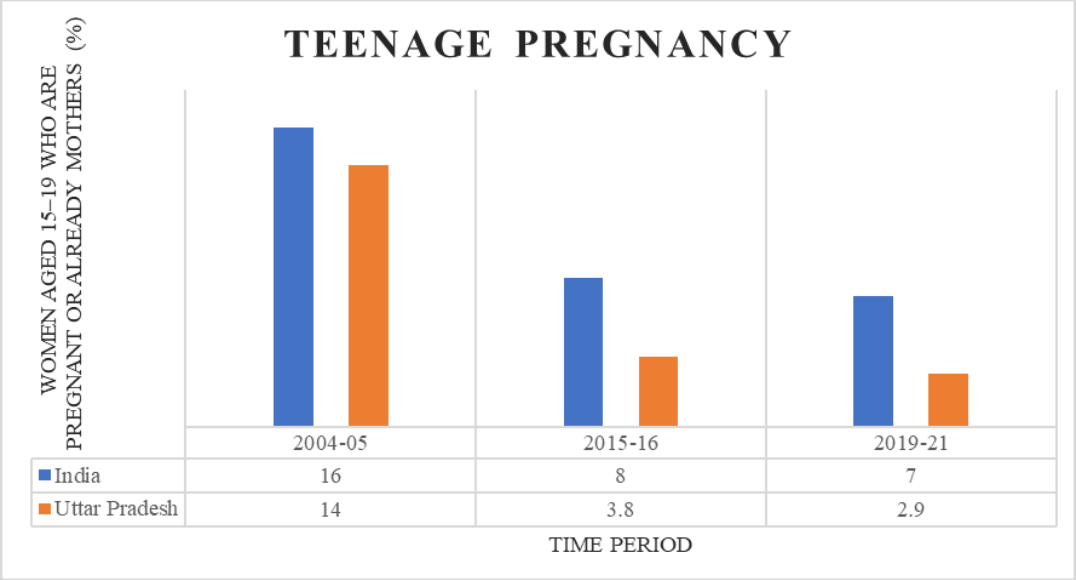
District-wise choropleth and bivariate maps were generated using ArcGIS to illustrate the spatial pattern of teenage pregnancy relative to socio-economic conditions. Boxplots and whisker plots were also used to visualize distribution, outliers, and regional disparities.

RESULTS AND DISCUSSIONS

Trend of Teenage Pregnancy Prevalence in India and Uttar Pradesh

Analysis of the National Family Health Survey (NFHS) data over three rounds indicates a declining trend in teenage pregnancy prevalence at both national and state levels. At the national level, the prevalence decreased from 16% in NFHS-3 to 8% in NFHS-4 and further to 7% in NFHS-5, demonstrating a substantial reduction over time. In Uttar Pradesh, the prevalence remained consistently lower than the national average in each survey round, with 14% in NFHS-3, 3.8% in NFHS-4, and 2.9% in NFHS-5. This suggests that interventions and socio-economic changes in the state may have contributed to a sharper decline in teenage pregnancies relative to the national trend. (Figure 1).

Figure 1 – Trend of Teenage pregnancy prevalence rate in India and Uttar Pradesh

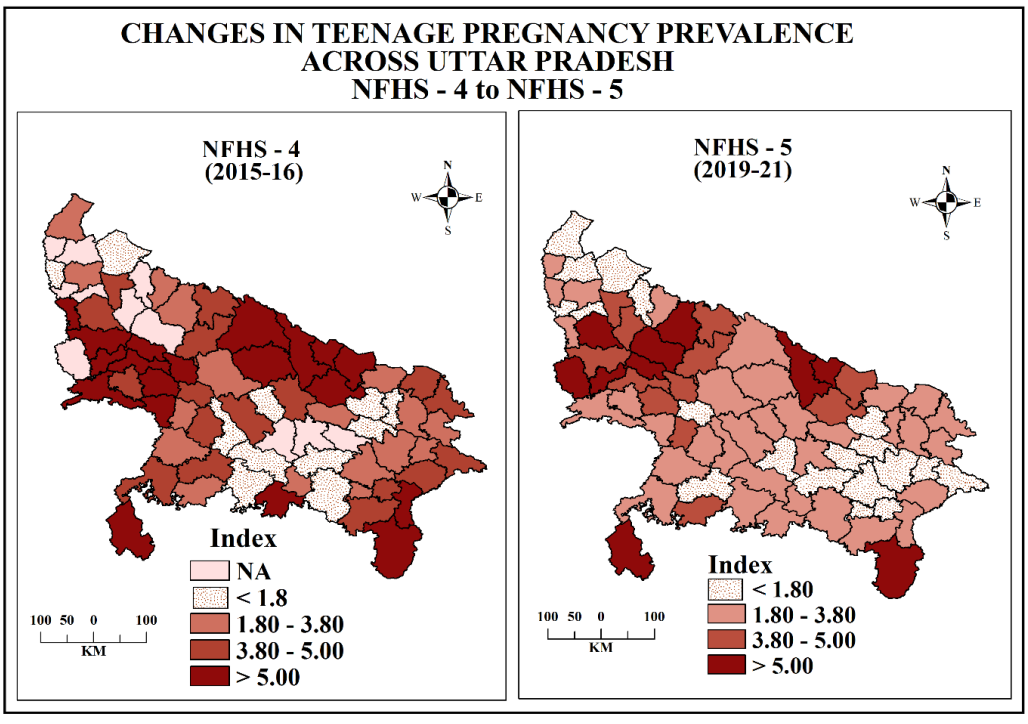


Source: Computed from for NFHS-3 (2007), NFHS-4 (2017), NFHS-5 (2022).

Despite the overall declining trend, spatial variation persists across districts of Uttar Pradesh. Certain districts continue to exhibit higher prevalence rates, indicating that reductions are not uniform across the state. The spatial variation in teenage pregnancy across Uttar Pradesh reflects differences in socio-economic development, education, and access to healthcare. Districts with low literacy, high poverty, and limited female employment show higher prevalence. Cultural norms supporting early marriage and unequal program implementation further contribute to disparities, indicating uneven progress and the need for targeted district-level interventions.

Compare Spatial Distribution and Changes in Teenage Pregnancy Across Districts in Uttar Pradesh Between NFHS-4 (2015–16) and NFHS-5 (2019–21)

Figure 2 – District level Spatial map showing teenage pregnancy prevalence in NFHS-4 and NFHS-5



Source: The authors (2025).

Spatial Dynamics of Teenage Pregnancy in Uttar Pradesh

Spatial analysis of NFHS-4 (2015–16) and NFHS-5 (2019–21) data shows that teenage pregnancy in Uttar Pradesh exhibits clear ecological clustering, forming identifiable hotspots and coldspots across different physiographic regions.

In NFHS-4, high-prevalence hotspots of adolescent fertility were concentrated in three main belts. The first was the Terai region (such as Lakhimpur Kheri, Bahraich, Shravasti, Balrampur, Gonda, Sitapur), The second region is the semi-arid region of western Uttar Pradesh, consisting of the districts Aligarh, Kasganj, Hathras, Etah, Agra, Gautam Buddha Nagar, Etawah, and Mainpuri. Lastly, the forested and hilly southeastern zone (Sonbhadra and Chandauli). These regions, marked by low literacy, widespread poverty, limited healthcare access, and entrenched early marriage norms, represented the core vulnerable zones of adolescent fertility.

By NFHS-5, these hotspots showed a spatial contraction, with reduced intensity and fragmentation of high-prevalence areas. This improvement reflects the impact of national and state programs such as *Rashtriya Kishor Swasthya Karyakram (RKSK)*, *Mission Parivar Vikas*, and *Beti Bachao Beti Padhao* along with district-level actions to promote girls' education, delay marriage, and expand adolescent health services. The Terai, arid and semi-arid, and forested belts, though still relatively higher than the state average, now show substantial progress due to enhanced outreach and awareness. Overall, teenage pregnancy in Uttar Pradesh is shifting from a widespread challenge to a localized issue, confined to a few residual vulnerable pockets. This pattern highlights the success of region-specific interventions and the growing convergence in adolescent health outcomes across ecological zones.

Comparison of NFHS-4 and NFHS-5 reveals a geographical reorganization of teenage pregnancy patterns, with the rise of distinct low-prevalence coldspots and contraction of former hotspots.

Areas along the Purvanchal–Awadh transitional belt including *Jaunpur,* and *Ambedkar Nagar, Basti, Pratapgarh, Sulatanpur etc* —have evolved from transitional zones in NFHS-4 into a stable low-prevalence cluster in NFHS-5. This Purvanchal–Awadh transitional belt reflects improvements in female literacy, reproductive health awareness, and delayed marriage practices, aided by strong community engagement and policy outreach. Similarly, the northwestern region (*Saharanpur, Muzzfarnagar, Bijnaur, Muradabad and nearby distrcis*) has transformed from small isolated low-prevalence pockets into a well-established coldspot cluster. This shift is associated with urbanization, better health infrastructure, and stronger gender empowerment initiatives.

Collectively, these changes demonstrate a spatial contraction of teenage pregnancy prevalence in Uttar Pradesh, where low-risk zones are expanding and stabilizing, and high-risk zones are shrinking. The pattern underscores the effectiveness of sustained adolescent health interventions and the diffusion of positive social and behavioural change across regions.

District-Level Analysis of Change in Teenage Pregnancy Prevalence in Uttar Pradesh

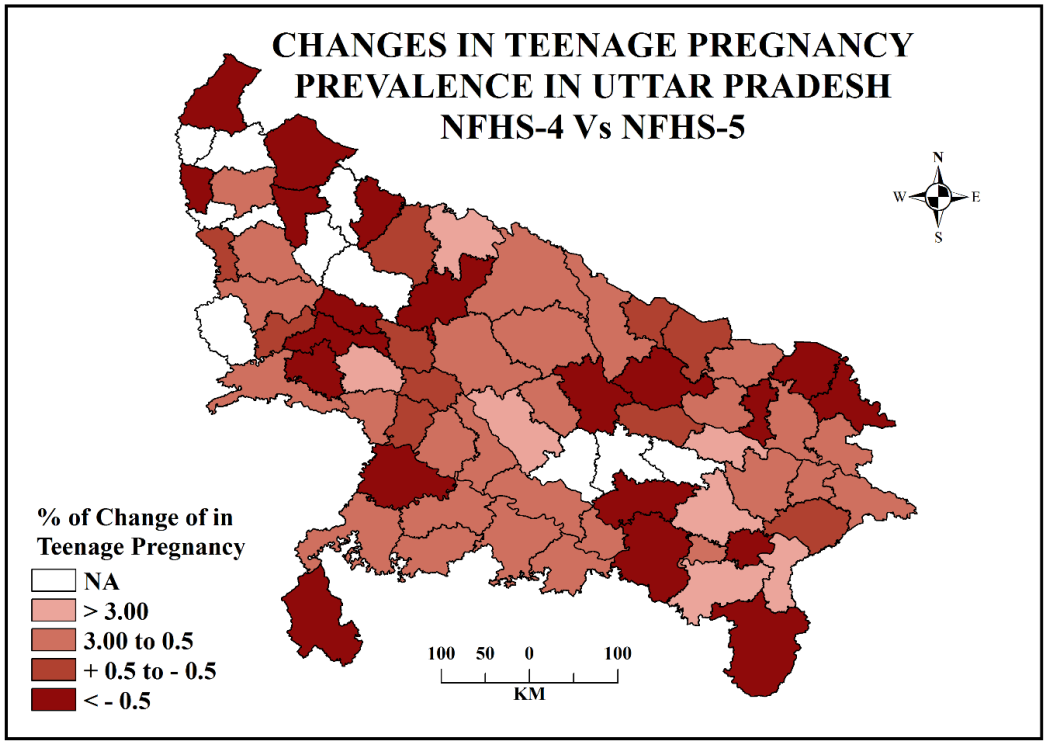
The present analysis examines inter-district variations in the prevalence of teenage pregnancy across Uttar Pradesh by comparing data from NFHS-4 (2015–16) and NFHS-5 (2019–21). The change in prevalence was calculated using the formula Δ = (NFHS-4 value – NFHS-5 value), where a positive difference denotes improvement (a reduction in prevalence) and a negative difference indicates deterioration (an increase in prevalence). While NFHS-5 provides data for all 75 districts, NFHS-4 lacks comparable data for 11 districts—Amethi, Badaun, Ghaziabad, Hapur, Mathura, Moradabad, Muzaffarnagar, Sambhal, Shamli, Sultanpur, and Rae Bareli. Accordingly, this analysis includes 64 districts with data Available at for both periods. District-level analysis was limited to Available at data, as some districts were affected by boundary reorganization between survey rounds or had missing data, with reasons documented in the NFHS reports.

To facilitate interpretation, districts were categorized as follows: (i) Improvement – positive difference greater than +0.5 percentage points; (ii) No significant change – difference between −0.5 and +0.5; and (iii) Decline in performance – negative difference less than −0.5. This classification enables a systematic understanding of temporal changes in teenage pregnancy prevalence and their spatial distribution across the state.

District-wise analysis shows that approximately two-thirds of the analyzed districts experienced improvement, indicating a broad decline in teenage pregnancy across much of Uttar Pradesh. The most notable

improvements were recorded in Etah (+4.9), Chitrakoot (+4.7), Varanasi (+4.1), Sitapur (+3.9), Chandauli (+3.7), Gautam Buddha Nagar (+3.7), Kannauj (+3.2), Hamirpur (+3.1), and Etawah (+3.0), suggesting significant progress in adolescent reproductive health. These gains may be attributed to intensified public health outreach, improved female educational participation, and the expansion of initiatives such as the *Rashtriya Kishor Swasthya Karyakram* (RKSK) and *Mission Parivar Vikas*. In contrast, districts such as Bareilly (−2.8), Auraiya (−2.8), Fatehpur (−2.0), Kanpur Nagar (−2.0), Banda (−1.9), Lucknow (−1.3), and Rampur (−1.3) recorded declines, possibly reflecting persistent socio-economic vulnerabilities, early marriage practices, and limited access to adolescent-friendly health services, especially in urban and peri-urban settings. Districts including Hardoi, Firozabad, Basti, Jyotiba Phule Nagar, Mahrajganj, Shahjahanpur, Siddharthnagar, Gorakhpur, Mahoba, and Meerut exhibited negligible changes, indicating stabilization or limited progress over time (Figure 3).

Figure 3 – District-level map showing change (either increase or decrease) over time



Source: The authors (2025).

The spatial pattern of these changes, when mapped across Uttar Pradesh, exhibits distinct regional clustering. A strong *improvement belt* emerges in eastern and central Uttar Pradesh, encompassing *Varanasi, Chandauli, Ballia, Mau, Mirzapur, Ghazipur, and Jaunpur*. This region has historically benefited from focused reproductive health interventions, improved school retention rates among adolescent girls, and the gradual empowerment of women through self-help groups and community health programs. Similarly, central districts such as *Etah, Kannauj,* and *Etawah* reflect successful rural health mobilization and outreach efforts. In contrast, western and south-central Uttar Pradesh—including *Ghaziabad, Bulandshahr, Baghpat, Kanpur Nagar, Fatehpur,* and *Banda*—form a cluster of declining performance, which may be attributed to persistent gender disparities, migration-linked service gaps, and urbanization pressures that limit access to adolescent health services. The northern and north-eastern districts, including *Gorakhpur, Basti, and Siddharthnagar*, show minimal change, possibly due to a combination of stable but slow-moving social indicators and limited programmatic expansion.

Overall, this spatial mosaic underscores the uneven pace of progress across Uttar Pradesh, shaped by the state's demographic diversity, socio-cultural heterogeneity, and differential health infrastructure development. Regions with strong institutional networks, NGO participation, and higher female literacy have shown consistent improvement, whereas areas characterized by poverty, early marriage, and

gender inequality continue to lag. These findings highlight the importance of geographically targeted interventions to ensure equitable adolescent reproductive health outcomes across all districts of the state.

Relationship Between Socio-Economic Conditions and Teenage Pregnancy

A Pearson's correlation analysis (two-tailed) was conducted using district-level data (n = 64) to examine the strength and direction of associations between teenage pregnancy and seven socio-economic and health indicators. The relative weights of these indicators were derived from their absolute correlation coefficients, normalized so that their total equaled 100. Table 3 summarizes the correlation coefficients and corresponding weights. All reported relationships were statistically significant at $p <$ 0.05.

Table 3 – Bivariate Correlation of Key Socio-Economic Indicators with Teenage Pregnancy and Their Relative Weightages

No.	Indicator	Correlation with Teenage Pregnancy (r)	p-value	Weightage (%)
1	Ruralness	0.0626	0.618	5
2	Agricultural Dependency	0.3351**	0.0044	15
3	SC/ST Population	–0.0347	0.777	5
4	Literacy	–0.4942***	0.00002	25
5	Anaemia	0.2221	0.067	10
6	Contraceptive Prevalence Rate (CPR)	0.0356	0.769	5
7	Child Marriage	0.6551***	<0.001	35
	Total			100

Note: Correlation coefficients are Pearson's r values computed using district-level data. Weightages are based on the relative magnitude of the correlation coefficients.

Source: The authors (2025).

Asterisks indicate levels of statistical significance: p < 0.05 (*), p < 0.01 (**), p < 0.001(***).

While Table 3 summarizes the direct correlations between teenage pregnancy and each indicator, the full correlation matrix (Table 4) provides additional insights into the interrelationships among explanatory variables, highlighting potential mediation effects particularly between literacy, child marriage, and agricultural employment.

As shown, child marriage exhibited the strongest positive association with teenage pregnancy (r = 0.655), followed by literacy (r = −0.494) and Agricultural dependency (r = 0.335). Anaemia showed a moderate positive relationship (r = 0.222), whereas ruralness, SC/ST population proportion, and CPR exhibited weak or negligible correlations.

The correlation structure suggests that social determinants particularly early marriage and female education play the most direct role in shaping adolescent fertility outcomes, while other factors such as rurality and caste composition may influence teenage pregnancy indirectly through socio-economic and cultural pathways. The inclusion of the full correlation matrix (Supplementary table) provides further evidence of inter-variable linkages, with strong correlations observed between literacy and child marriage, indicating potential mediating relationships among these variables.

Table 4 – Correlation Matrix

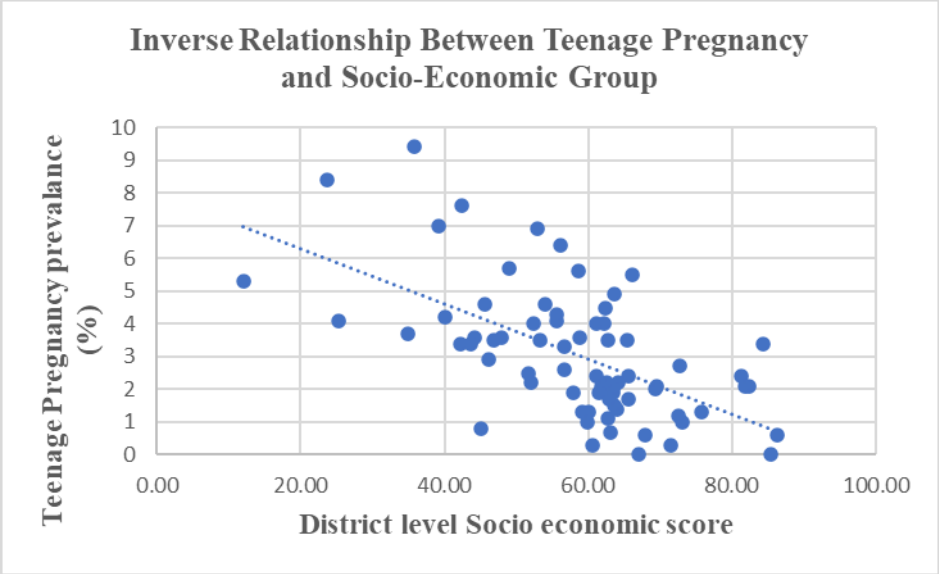
Correlation Matrix								
	Teenage pregnancy	Ruraliness	Agricultural Dependency	SC/ST population	Literacy	Anaemia	CPR *	Child marriage
Teenage pregnancy	1.000	0.063	0.335	-0.035	-0.494	0.222	0.036	0.655
Ruraliness	0.063	1.000	0.812	0.256	-0.480	-0.205	-0.426	0.320
Agricultural Dependency	0.335	0.812	1.000	0.253	-0.590	-0.010	-0.293	0.501
SC/ST population	-0.035	0.256	0.253	1.000	0.128	-0.133	-0.233	0.033
Literacy	-0.494	-0.480	-0.590	0.128	1.000	-0.032	0.270	-0.581
Anaemia	0.222	-0.205	-0.010	-0.133	-0.032	1.000	0.082	-0.026
CPR	0.036	-0.426	-0.293	-0.233	0.270	0.082	1.000	-0.244
Child marriage	0.655	0.320	0.501	0.033	-0.581	-0.026	-0.244	1.000

Note: CPR indicates Contraceptive Prevalence Rate

Source: The authors (2025).

These findings justify the use of weighted indicators in constructing the district level socio economic scores as they capture the relative importance of key socio-economic predictors of teenage pregnancy.

Figure 4 – Scatter plot showing the inverse relationship between teen pregnancy rate and socio-economic group



Note: The downward trend line indicates a significant negative correlation ($r = -0.598$, $p < 0.001$), suggesting that higher socio-economic development is associated with lower teenage pregnancy prevalence.

Source: The authors (2025).

Zonation of Districts Based on Socio-Economic Conditions and Comparison with Teenage Pregnancy

To examine the relationship between socio-economic development and teenage pregnancy, the 71 districts of Uttar Pradesh were classified into four development zones namely, High, Medium-High, Medium-Low, and Low based on their District level composite socio-economic scores derived from Census of India data (2011) and NFHS data (shown in figure 5). This zonation allows for systematic comparison of teenage pregnancy prevalence across districts with varying levels of development.

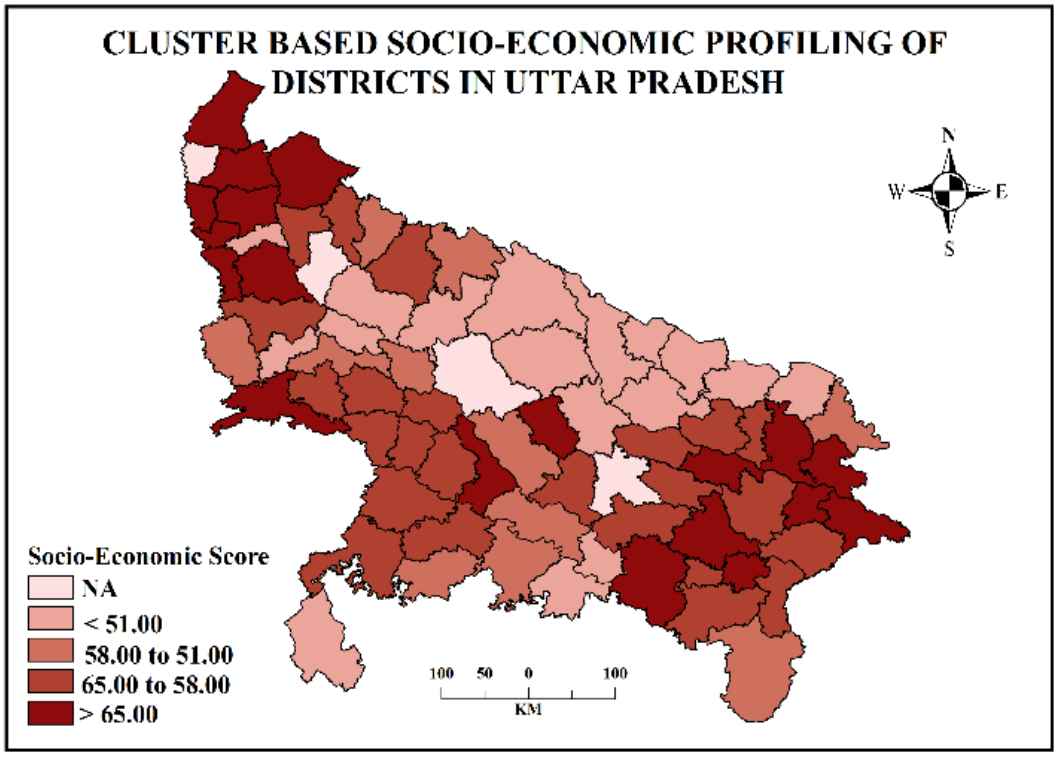
Table 5 – Distribution of Districts and Teenage Pregnancy Statistics Across Development Zones

Zone	No. of districts	Range of District score	Mean Teen Pregnancy	SD	CV (%)	minimum	maximum
High development	19	>65	1.74	1.310	75.113	0	5.5
Medium-High	24	65—58	2.44	1.389	56.908	0.3	5.6
Medium- Low	11	58—51	3.85	1.499	38.869	1.9	6.9
Low development	17	<51	4.77	2.142	44.859	0.8	9.4

Source: The authors (2025).

Analysis of Table 5 revealed a clear inverse relationship with development level. The mean teenage pregnancy rate increased progressively from High development districts (1.74) to Medium-High (2.44), Medium-Low (3.85), and Low development districts (4.77). This trend indicates that districts with lower socio-economic development experience higher teenage pregnancy rates, likely due to limited access to girls education, reduced reproductive health awareness, and persistent early marriage practices and rural agricultural background.

Figure 5 – Socio-Economic Development Zonation of Districts in Uttar Pradesh



Source: The authors (2025).

The variability of teenage pregnancy within each development zone was assessed using standard deviation (SD) and coefficient of variation (CV). SD ranged from 1.31 in High development districts to 2.14 in Low development districts, while CV varied from 38.9% in Medium-Low to 75.1% in High development districts. The relatively higher CV in the High development group suggests greater relative heterogeneity, likely due to a few districts with slightly elevated teenage pregnancy rates despite overall high development. Outliers in the Low development group, with a maximum teenage pregnancy rate of 9.4, indicate localized socio-cultural or health-related challenges.

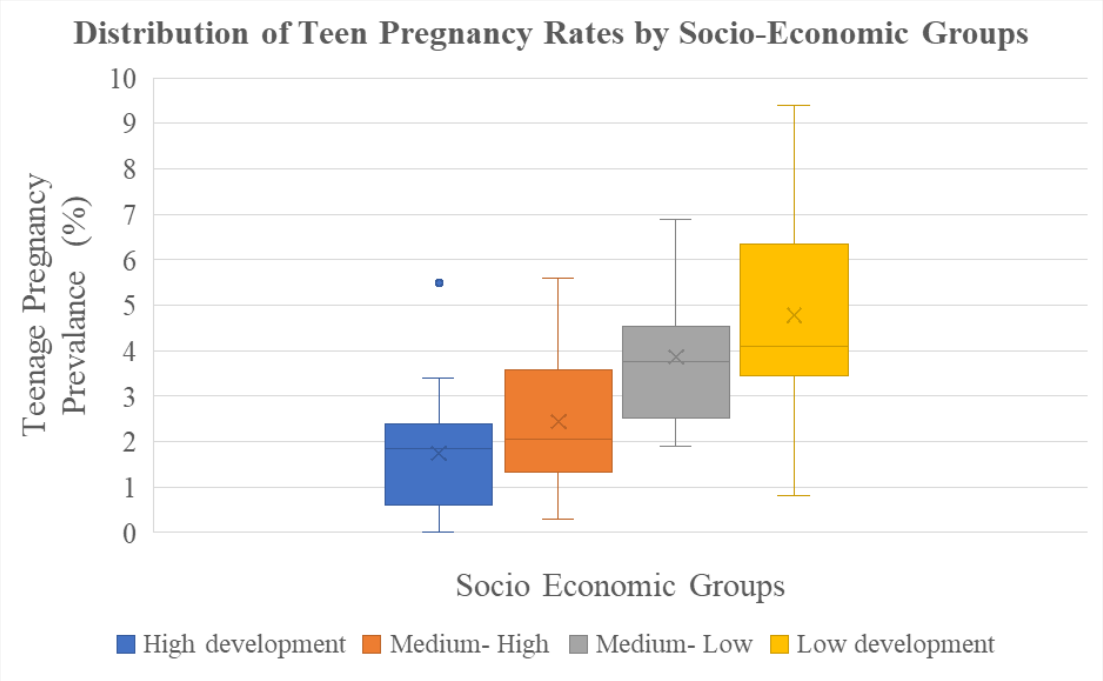
To test the statistical significance of differences in teenage pregnancy across the four development zones, a Kruskal-Wallis H test was performed. The analysis yielded H = 64.39 with a p-value of 6.76×10^{-14} (Table 6) indicating highly significant differences between groups. Pairwise comparisons using Dunn's post hoc test confirmed that High development districts consistently exhibit lower teenage pregnancy rates than other zones and vice versa while Medium-Low and Low development districts have similarly elevated rates. This analysis is visually depicted by Boxplot graph shown in figure 6.

Table 6 – Kruskal-Wallis H Test and Dunn's Post Hoc Pairwise Comparisons

Kruskal–Wallis Test				
H value	64.39			
p value	6.76×10^{-14}			
Dunn test (Pairwise comparison)				
	High development	Medium- High	Medium- Low	Low development
High development	1.00E+00	6.75×10^{-3}	5.46×10^{-7}	2.84×10^{-13}
Medium- High	6.75×10^{-3}	1.00E+00	4.17×10^{-2}	6.38×10^{-6}
Medium- Low	5.46×10^{-7}	4.17×10^{-2}	1.00E+00	5.03×10^{-1}
Low development	2.84×10^{-13}	6.38×10^{-6}	5.03×10^{-1}	1.00E+00

Source: The authors (2025).

Figure 6 – Boxplot Comparing Teenage Pregnancy Prevalence Across Development Zones



Source: The authors (2025).

These findings highlight the strong association between socio-economic development and teenage pregnancy. High development districts benefit from greater educational opportunities, higher contraceptive awareness, and better healthcare access, contributing to lower adolescent fertility. In contrast, Low and Medium-Low development districts face challenges such as persistent child marriage, lower female literacy, higher anaemia prevalence, and limited health infrastructure. Social and cultural norms, particularly among marginalized SC/ST communities, further exacerbate early childbearing. Improving education, delaying marriage, expanding reproductive health awareness, and addressing rural poverty are essential steps toward reducing teenage pregnancy in less developed districts.

LIMITATIONS

Using the prevalence of teenage pregnancy (% of girls aged 15–19 who are currently pregnant or already mothers) provides a useful snapshot of adolescent fertility but has several limitations. Unlike the Adolescent Fertility Rate (AFR), which measures annual births per 1,000 girls, prevalence is a point-in-time measure and may miss pregnancies that result in births later or end in miscarriage or abortion, thus underestimating total adolescent pregnancies. Additionally, small sample sizes at the district level can reduce reliability and exaggerate fluctuations, especially in less populated areas. Therefore, while prevalence can highlight regional disparities and trends over time, it should not be interpreted as a direct measure of fertility.

This study is constrained by the use of datasets with differing temporal reference periods, namely the National Family Health Survey and the Census of India. Despite aligning the nearest Available at years, minor temporal mismatches may persist, particularly in rapidly changing regions. Additionally, the sample-based nature of NFHS and the decadal frequency of Census data may affect the precision of comparisons. However, these limitations are unlikely to significantly alter the broader spatial patterns observed.

CONCLUSION AND SUGGESTIONS

The trend analysis indicates an overall declining pattern in teenage pregnancy across Uttar Pradesh; however, comparative district-level analysis identifies persistent core vulnerable zones corresponding to three ecological regions: the Terai belt, the semi-arid zone, and the forested and hilly southeastern districts. These hotspots have contracted over time, while low-risk areas have expanded. Change maps reveal heterogeneous performance, with some districts demonstrating notable improvements, while others show stagnation or negative trends. Correlation and composite socio-economic analyses indicate a strong inverse relationship between district-level socio-economic development and teenage pregnancy, highlighting the protective role of higher literacy, reduced child marriage, and better health access. District zonation further confirms that higher socio-economic scores correspond with lower teenage pregnancy rates, though intra-regional variability persists. Non-parametric analyses, including the Kruskal-Wallis test and Dunn's pairwise comparisons, validate these differences statistically, emphasizing that socio-economic disparities and local ecological contexts jointly shape adolescent reproductive health outcomes. The accompanying figures and maps visually convey these patterns, illustrating spatial clustering, trends over time, and the relative vulnerability of districts, making complex inter-district comparisons more accessible and interpretable.

To address these disparities, targeted interventions are essential. Policies should focus on delaying child marriage, enhancing female literacy, and expanding adolescent reproductive health education, particularly in high-risk zones. Community-based health navigators, incentive programs for school retention and delayed marriage, nutritional support, and telehealth services can improve access and awareness in remote areas. District-level monitoring dashboards can track progress and guide adaptive policy responses. Integrating socio-economic, educational, and health strategies in a context-specific manner is key to reducing teenage pregnancy and promoting adolescent well-being across Uttar Pradesh.

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Nitin Kumar Mishra: Conceptualization, Methodology, Supervision, Writing – Review & Editing. Alok Nishad: Conceptualization, Methodology, Formal Analysis, Data Curation, Visualization, Writing – Original Draft.

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