Spatial heterogeneity and major correlates of Unmet Need of family planning among young married women aged 15-24 in India: An Exploratory Study

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Abstract
For young women aged 15 to 24, unintended pregnancies remain very common, reflecting lower contraceptive use. Given the socio-cultural and traditional beliefs and practices, the unmet need for family planning is a crucial indicator for tracking the progress in contraceptive prevalence, ensuring young women’s reproductive and sexual rights. This article aims to analyze spatial heterogeneity in the unmet need for family planning among young women age 15 to 24 and their mesoscale correlates. Using data from the recent round of Indian DHS (2015–2016), commonly known as the National Family Health Survey (NFHS), this study identifies the significant correlates of unmet need of contraception among young married women in India. The statistical methods range from multinomial logistic regression, spatial autocorrelation in terms of Moran’s I statistics, to spatial auto regression, to understand the spatial dependence and clustering in the unmet need across India’s districts. The contraceptive prevalence rate among young married women age 15 to 24 in India was 24%, while almost the same proportion of them (23%) had an unmet need for contraception. Current age, education, religion, poverty, number of children, media exposure, awareness about family planning, and birth occurred in the last 3 years were significant predictors of unmet need. The univariate Moran’s I for unmet need was 0.50, suggesting strong spatial heterogeneity in India. The auto regression models become much more influential after including the spatial weights in the model, where illiteracy, unawareness, poverty, and rural residence were statistically significant predictors of unmet need of family planning among young married women in India. Findings of the study providing complex cultural ecologies of contraceptive use dynamics may give vital inputs in designing gender-sensitive interventions that can create a suitable support system and enabling environment for increasing use of contraception and reducing the unmet need of family planning.

Keywords
unmet need, contraception, adolescents, spatial heterogeneity, India

Background and Rationale
Family planning (FP) has always been a matter of public health concern in India, targeting to reduce the fertility rate to 2.1% by 2025. However, a higher prevalence of unmet need of FP in India has focused more on female sterilization than delaying births, although delaying births is more relevant for young women, who are in the process of building a family. According to the National Family Health Survey (NFHS), unmet need for family planning refers to fecund women who are not using contraception but who wish to postpone the next birth (spacing) or stop childbearing altogether (limiting). Specifically, women are considered to have an unmet need for spacing if they are at risk of becoming pregnant, not using contraception, and either does not want to become pregnant within the next two years or are unsure if or when they want to become pregnant. It also includes pregnant women with a mistimed pregnancy or in postpartum amenorrhoeic for up to two years following a mistimed birth and not using contraception. (International Institute for Population Sciences [IIPS] & ICF, 2017). On the contrary, women are considered to have an unmet need for limiting if they are at the risk of becoming pregnant, not using contraception, and want no (more) children or pregnant with an unwanted pregnancy or in postpartum amenorrhoeic for up to two years following an unwanted birth and not using contraception. It should be clear that the women classified as infecund do not have unmet need as these women have no risk of getting pregnant. Unmet need for family planning is

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the sum of unmet need for spacing plus the unmet need for limiting. (IIPS & ICF, 2017) Over time, many adolescents and young women would enter into their span of the reproductive phase. Their reproductive choice and behaviour will shape the future structure and size of the population. Therefore, fulfilling the contraceptive needs of these younger cohorts will be critical for the success of the family planning programs in India. It would also contribute to promoting people’s health and well-being, such as reducing infant mortality by increasing birth intervals and reducing the number of high-risk births. (DeGraff & de Silva, 2018).

A high rate of unmet need for modern contraceptives might lead to increased rates of unwanted pregnancies and induced abortions, which would be a severe concern to adolescents and young women in India (Motlaq et al., 2013). Furthermore, it is noticeable that stagnation in the contraceptive prevalence rate in India (54%) and higher unmet need of contraception among women (13%) over the last one decade envisages significant obstacle in the successful implementation of the FP programs.

The estimates of unmet need stand relatively high in Asian countries like India, where the highest estimates are found in Pakistan, followed by Cambodia, Nepal, and Vietnam (Westoff, 2006). For women of age 15 to 24, unintended pregnancies remain very common amid their peak of reproductive life, reflecting low contraceptive use. As per the latest report of NFHS-4, “the highest percentage of unmet need for contraception is found in the age group 15-19 (22.2%) and 20-24 (22.3%).” While the knowledge of contraception in this age group is above 92%, the use of any contraceptive method remains as low as 14.9% and 28.9% in 15 to 19 and 20 to 24 age groups, respectively (IIPS & ICF, 2017).

Unmet need is a crucial indicator for judging the desired success of the FP programs in any country. Therefore, it was included as an indicator to the Millennium Development Goals (MDGs), again in 2012 at the London Summit on Family Planning (Cleland et al., 2014) and now in the Sustainable Development Goals (SDGs). The unmet need, as explained earlier, is a concept inclusive of many dimensions and hence serves a wide variety of purposes: to estimate the number of women with unmet need worldwide as a rationale for increased investment in family planning programs; to evaluate national family planning programs and find out the gap between the apprehensions regarding population growth and the inability of women and couples to achieve their reproductive goals. (Bradley & Casterline, 2014)

**Literature Review**

**High contraception rates and high unmet need**

A higher prevalence of contraception does not account for low or reduced unmet need, which has been discussed in many studies. One such study based on Sri Lanka suggests that even though the contraceptive prevalence is high in Sri Lanka, the incidence of unmet need remains relatively high (DeGraff & de Silva, 1991). Another study has elucidated the similar fact that although “there is a high awareness of the various contraception methods, there persists a knowledge-use gap in the practice of the more practical modern contraceptive methods” (Iloghalu et al., 2018). However, studies have also found that the overall proportion of unmet needs falls slightly as contraceptive use has increased (Ross & Winfrey, 2018). Nonuse of contraceptives among women with unmet need revealed that significant reasons for “non-use of contraception in many developing countries include infrequent sexual activity and concerns regarding the side effects and health risks associated with contraceptive methods” (Sedgh & Hussain, 2014).

**Lag in terms of knowledge and accessibility**

Plenty of literature reveals that the issue of unmet needs is essential for adolescent and young women as “they have lower use of contraception, poorer knowledge of FP, and less access to information and services than adult women” (Kennedy et al., 2011). Community-based cross-sectional studies highlight that currently married women age 15 to 19 and 20 to 24 have a higher unmet need for contraception than never-married women and older women (Pack et al., 2018; Shifa, 2014). A study based in the backdrop of developing countries presented that women with unmet needs lack the necessary knowledge of methods of contraception and high costs of using a contraceptive, which block the implementation of preferences; also women with unmet need are fearful than others of the effects on health using contraceptives (Casterline et al., 1997).

**Inefficiency from the supply side**

Unmet need is caused due to inefficient delivery from the supply side. A study based in Vietnam revealed, “significant barriers to enlarged contraceptive use and the fact that the reduction of unmet need rests on the supply side” (Ross & Pham, 1997). Another study by Cleland discusses that the “lack of access to services is the root cause of unmet need. The most basic and commonly understood aspect of access is physical proximity to contraceptive supplies” (Cleland et al., 2014). Bongaarts (2019) revealed through a remarkable work that “the recent growth in investments in FP programs is primarily based on the existence of an unmet need for contraception and the assumption that such investments reduce the unmet need.” Nonetheless, while “a decline in unmet need at the aggregate probably reflects improvements in a country’s service delivery program, an increase or a lack of reduction does not necessarily imply program failure” (Jain, 1999).

Studies over the years have revealed that adolescents “appear to have lower use and higher unmet need for contraception, poorer knowledge of FP, and less access to
information and services than older women” (Kennedy et al., 2011). The spatial distribution of unmet need for FP is not random in any country; the magnitude and severity of unmet need vary among the geographical zones (Alaba et al., 2015). Most of the studies in India or outside have focused on the levels and trends of unmet needs, mainly on the country level. However, the state- and district-level variation and its spatial pattern have always been less explored. The lifestyle of communities, their cultural ecologies, and access to health facilities vary significantly across different countries. This means that the extent of unmet need and its correlations also differ considerably across different spaces (Shifa, 2014). The districts in India differ culturally and geographically, hence depicting enormous heterogeneity (Sharma et al., 2020). The geographical location significantly influences predictors affecting unmet need as accessibility, availability, and means of transport directly or indirectly affect the unmet need of contraception among adolescents.

The Objective of the Study

Given the above-explained importance of spatial heterogeneity, covering cultural ecologies influencing attitude, perception, and behaviors to contraceptive use or unmet need of contraception among young married women, our objective is to identify predictors of unmet need of FP in India. Analyzing the complex cultural ecologies of health, particularly fertility-related beliefs and gender norms, and how they interact with the FP decisions of young women age 15 to 24; this study explores the predictors of unmet need among married young women age 15 to 24 in India, and identify spatial covariates as a proxy of cultural ecologies of unmet need of contraception.

Data and Methods

The data used in the study have been availed from the NFHS-4 conducted in 2015–2016. All four rounds of NFHS surveys were conducted under the Ministry of Health and Family Welfare (MoHFW) supervision, Government of India. A total of 28,586 primary sampling units (PSUs) were selected, in which 28,522 clusters were finalized for data collection—the NFHS-4 works on a two-stage stratified sampling design. For the selection of PSUs, the 2011 census was utilized. In rural areas, PSUs were villages, while census enumeration blocks (CEBs) were used for urban areas. A total of 601,509 households were successfully interviewed with a 98% response rate. The woman’s questionnaire collected information from all eligible women age 15 to 49, who were asked questions on varied topics like background characteristics, reproduction, FP, maternal and child health, breastfeeding, and nutrition, marriage, and sexual activity, fertility preferences, husband’s background, and woman’s work and other health issues. The analysis is limited to the currently married female adolescent and young women age 15 to 24, and the final sample size is 94,034 (IIPS & ICF, 2017).

Outcome Variable

In addition to the unmet need, defined in the introduction section, and women who reported the use of contraception during the survey, those women who neither use any contraceptive nor want to limit or postpone birth were treated as having no demand for contraception (Islam et al., 2016). The outcome variable was the demand for contraception, which was classified into two categories for the bivariate analysis—the unmet need for contraception and demand satisfied. For multinomial logistic regression, the same variable was classified into three categories: the unmet need for contraception, demand satisfied/met need (reference category), and no demand for contraception. For the spatial analysis, only the category unmet need has been taken into consideration.

Predictor Variables

A set of predictors was identified based on prior literature and data availability in the contemporary setting (DeGraff & de Silva, 1991; Islam et al., 2016; Nketiah-Amponsah et al., 2015; Pal et al., 2018). The final list of predictors included age, education, residence, religion, wealth, region, children ever born, marital duration, media exposure, birth in the last 3 years, and heard about FP and health insurance.

Statistical Analyses

The study starts with a descriptive analysis of outcomes and predictors. The bivariate analysis provided the percentage distribution of unmet need for contraception and demand satisfied among women age 15 to 24 according to relevant characteristics. The level of significance was based on the chi-square tests. In the next step, as the outcome variable was in three categories, multinomial logistic regression has been used based on important predictors for the study. The reference category was taken as the met need for contraception.

Finally, spatial analysis of unmet need has been conducted with the help of software like ArcGIS and GeoDa. Univariate and Bivariate Moran’s I statistics, bivariate local indicators of spatial analysis (LISA) cluster, and significance maps with a set of regression models have been used for spatial analysis of unmet need (Khan et al., 2018; Pal et al., 2018; Rahman, 2012). Moran’s I statistics tell us that whether a phenomenon is clustered spatially or not. The formula to compute the Moran’s I statistic is as follows (Anselin, 1995):

Univariate Moran’s I = \frac{1}{n} \cdot \frac{\sum_{i} \sum_{j} W_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i} (x_i - \bar{x})^2}
where \( x \) is the variable of interest and \( \overline{X} \) is the mean of \( x \); \( n \) is the number of spatial units; \( W_{ij} \) is the standardized weight matrix between observation \( i \) and \( j \) with zeroes on the diagonal; and \( S_o \) is the aggregate of all spatial weights, that is, \( S_o = \sum \sum W_{ij} \).

Similarly, the bivariate Moran’s I statistic is expressed as follows:

\[
\text{Bivariate Moran’s } I = \frac{n}{S_o} \times \frac{\sum \sum W_{ij} (x_i - \overline{x})(y_j - \overline{y})}{\sum (y_i - \overline{y})^2}
\]

where \( x \) and \( y \) are the variables of interest; \( \overline{x} \) is the mean of \( x \); \( \overline{y} \) is the mean of \( y \); \( n \) is the number of spatial units; \( W_{ij} \) is the standardized weight matrix between observation \( i \) and \( j \) with zeroes on the diagonal; and \( S_o \) is the aggregate of all spatial weights, that is, \( S_o = \sum \sum W_{ij} \).

Bivariate LISA maps have been made to identify the spatial autocorrelation among unmet need and other study predictors. Bivariate LISA maps assess the correlation between independent and dependent variables geographically. The value of Moran’s I usually range from −1 to +1, where positive values depict the spatial clustering of similar values, and negative values indicate the grouping of dissimilar values. A zero value indicates a random spatial pattern with no spatial autocorrelation. Univariate LISA measures the correlation of neighborhood values around a specific geographical location (Anselin, 1995). The LISA cluster map is a type of choropleth map depicting spatial correlation with a significant local Moran statistic which can be classified as: dark red for high–high clustering, dark blue stands for low–low, light blue for low–high and light red stands for high–low. The high–high and low–low suggest clustering of similar values, whereas high–low and low–high locations indicate the negative association of the values. On the contrary, the significance map is a unique choropleth map showing those locations in different shades of green depending on the significance level. The significance levels are shown as \( p < .05, p < .01, p < .001, \) and \( p < .0001 \).

A set of regression models have been used to estimate significant correlates of unmet needs and to identify the best-fit model for analyzing unmet needs spatially. The ordinary least square (OLS) model was run to check the association between the independent and dependent variables and the outcome variable. The basic equation of linear regression (OLS) can be defined as:

\[ Y = \alpha + \beta X + \varepsilon \]

where \( Y \) is the dependent variable, \( x \) is the vector of explanatory variables, \( \alpha \) is the model intercept, and \( \beta \) is the corresponding coefficient vector (Khan et al., 2018).

We used spatial lag and error models after finding that Moran’s I for unmet need was statistically significant. The spatial lag model (SLM) suggests that the units to be analyzed are spatially dependent on each other and lagging to each other in the nearby spatial locations.

On the contrary, the spatial error model (SEM) considers the contribution of omitted variables that are not included in the model but can have a significant effect on the analysis.

Akaike Information Criterion (AIC) values were examined and compared between spatial lag and error models to choose the best-fit model. It was found that the AIC values were lowest in the SEM, and hence, then the SEM was considered as the best-fit model for the analysis.

## Results

### Demand for contraception by sociodemographic profiles

It is apparent from Table 1 that the total unmet need and demand satisfied among young married women in India were 23.3% and 27.9%, respectively. A higher prevalence of unmet need was found among the 15 to 19 age group adolescents than among the older women. In contrast, more young women in the age group 20 to 24 reported their demand satisfied. A higher unmet need was reported in the rural areas (22.3%), whereas higher demand was satisfied (32.9%) was reported among the urban dwellers. The highest unmet need was found among the Hindu religion; the demand satisfied was highest among the other category. The prevalence of unmet need was significantly associated with the wealth quintiles. The richest were found to have the lowest prevalence of unmet need (21.5%) and the highest preponderance of demand satisfied (32.9%) and vice-versa among the poorest lot. Respondents belonging to the central part of the country showed a higher prevalence of unmet need (23.8%) followed by East (22.9%) and West (22.7%) regions. Unmet need was found to be highest when a woman reported having one or more children (24.3%–27.0%). The adolescents who have been in the marital union for less than 5 years had the highest preponderance of unmet need (22.7%). The highest demand was satisfied among those in the marriage union for more than 10 years (56.7%). Women having exposure to media had less preponderance of unmet need (21.5%) than those not exposed (24.4%); vice-versa in case of demand satisfied. The highest number of unmet needs among women having three births in the last 3 years were (37.5%) than those with zero births (14.5%). Unmet need was less among those with zero births (14.5%). Unmet need was found among the Hindu religion; the demand satisfied was highest among the other category. 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Table 1. Percentage Distribution of Demand for Contraception Among Currently Married Females Aged 15 to 24 by Selected Background Characteristics, India, NFHS, 2015–2016.

| Characteristics       | Unmet need | Demand satisfied | p value | Sample      |
|-----------------------|------------|------------------|---------|-------------|
| Age                   |            |                  |         |             |
| 15–19                 | 22.21      | 17.23            | .000    | 17,606 (18.72) |
| 20–24                 | 22.06      | 33.03            | .000    | 76,427 (81.28)  |
| Educational status    |            |                  |         |             |
| Illiterate            | 21.72      | 25.41            | .000    | 16,654 (17.71)  |
| Literate              | 22.16      | 31.08            | .000    | 77,379 (82.29)  |
| Place of residence    |            |                  |         |             |
| Urban                 | 21.47      | 32.93            | .000    | 24,364 (25.91)  |
| Rural                 | 22.30      | 29.08            |         | 69,669 (74.09)  |
| Religion              |            |                  |         |             |
| Hindu                 | 22.23      | 29.81            | .000    | 75,802 (80.61)  |
| Muslim                | 19.63      | 30.77            | .001    | 1,356 (1.44)    |
| Others                | 21.62      | 31.25            | .000    | 16,874 (17.95)  |
| Wealth                |            |                  |         |             |
| Poorest               | 24.01      | 24.19            | .000    | 19,522 (20.76)  |
| Poorer                | 21.98      | 30.08            | .000    | 22,420 (23.84)  |
| Middle                | 20.90      | 31.32            | .000    | 21,377 (22.73)  |
| Richer                | 21.95      | 32.65            | .000    | 18,524 (19.70)  |
| Richest               | 21.50      | 32.95            | .000    | 12,188 (12.96)  |
| Region                |            |                  |         |             |
| North                 | 20.69      | 31.79            | .000    | 11,665 (12.41)  |
| Central               | 23.81      | 24.85            | .000    | 22,020 (23.42)  |
| East                  | 22.91      | 33.52            | .000    | 26,407 (28.08)  |
| North East            | 19.5       | 44.59            | .000    | 3,263 (3.47)    |
| West                  | 22.71      | 29.96            | .000    | 12,901 (13.72)  |
| South                 | 19.65      | 27.74            | .000    | 17,775 (18.90)  |
| Children ever born    |            |                  |         |             |
| 0                     | 14.54      | 13.15            | .000    | 32,508 (34.57)  |
| 1                     | 26.96      | 31.43            | .000    | 36,944 (39.29)  |
| 2                     | 24.27      | 50.35            | .000    | 20,328 (21.62)  |
| 3 and above           | 26.42      | 49.79            | .000    | 4,252 (4.52)    |
| Marital duration, years |          |                  |         |             |
| Less than 5           | 22.70      | 21.94            | .000    | 66,414 (70.63)  |
| 5–9                   | 20.84      | 48.92            | .000    | 25,097 (26.69)  |
| More than 10          | 18.32      | 56.70            | .000    | 2,521 (2.68)    |
| Media exposure        |            |                  |         |             |
| No                    | 24.39      | 22.48            | .000    | 19,785 (21.04)  |
| Yes                   | 21.47      | 32.1             |         | 74,248 (78.96)  |
| Birth in last 3 years |            |                  |         |             |
| Zero                  | 14.49      | 24.65            | .000    | 41,810 (44.46)  |
| One                   | 28.19      | 34.21            | .000    | 44,392 (47.21)  |
| Two                   | 27.63      | 35.39            | .000    | 7,831 (8.33)    |
| Heard about family planning |      |                  |         |             |
| No                    | 23.55      | 26.88            | .000    | 35,683 (37.95)  |
| Yes                   | 21.19      | 32.04            | .000    | 58,350 (62.05)  |
| Health insurance      |            |                  |         |             |
| No                    | 22.87      | 29.22            | .000    | 80,369 (85.47)  |
| Yes                   | 17.48      | 35.14            | .000    | 13,664 (14.53)  |
| Total                 | 22.09      | 30.08            |         | 94,034        |

Note. p-values are based on chi-square tests. NFHS = National Family Health Survey.
Table 2. Results of Multinomial Logistic Regression Depicting Relative Risk With 95% CI for Demand for Contraception Among Currently Married Females Aged 15 to 24 in India, NFHS, 2015–2016.

| Predictors                        | Unmet need RRR (95% CI) | No demand RRR (95% CI) |
|-----------------------------------|-------------------------|------------------------|
| **Age**                           |                         |                        |
| 15–19®                           | 1.00                    | 1.00                   |
| 20–24                            | 0.75* (0.7, 0.79)       | 1.00 (0.95, 1.05)      |
| **Educational status**            |                         |                        |
| Illiterate®                       | 1.00                    | 1.00                   |
| Literate                          | 0.95* (0.9, 1)          | 0.74* (0.7, 0.78)      |
| **Place of residence**            |                         |                        |
| Urban®                            | 1.00                    | 1.00                   |
| Rural                             | 1.01 (0.96, 1.06)       | 1.05* (1, 1.1)         |
| **Religion**                      |                         |                        |
| Hindu®                            | 1.00                    | 1.00                   |
| Muslim                            | 2.16* (1.94, 2.39)      | 2.66* (2.42, 2.93)     |
| Others                            | 0.99 (0.95, 1.05)       | 1.13* (1.08, 1.18)     |
| **Wealth**                        |                         |                        |
| Poorest®                          | 1.00                    | 1.00                   |
| Poorer                            | 0.89* (0.84, 0.94)      | 0.83* (0.78, 0.87)     |
| Middle                            | 0.84* (0.79, 0.89)      | 0.72* (0.68, 0.76)     |
| Richer                            | 0.83* (0.77, 0.89)      | 0.62* (0.58, 0.66)     |
| Richest                           | 0.70* (0.65, 0.76)      | 0.49* (0.46, 0.53)     |
| **Region**                        |                         |                        |
| North®                            | 1.00                    | 1.00                   |
| Central                           | 1.37* (1.29, 1.45)      | 1.24* (1.18, 1.3)      |
| East                              | 1.40* (1.31, 1.49)      | 1.04 (0.99, 1.1)       |
| North East                        | 0.87* (0.81, 0.95)      | 0.58* (0.54, 0.62)     |
| West                              | 1.47* (1.36, 1.59)      | 1.35* (1.25, 1.45)     |
| South                             | 1.47* (1.37, 1.59)      | 1.7* (1.59, 1.82)      |
| **Children ever born**            |                         |                        |
| 0®                                | 1.00                    | 1.00                   |
| 1                                 | 0.46* (0.43, 0.5)       | 0.17* (0.16, 0.18)     |
| 2                                 | 0.32* (0.29, 0.35)      | 0.07* (0.06, 0.07)     |
| 3 and above                       | 0.35* (0.31, 0.4)       | 0.06* (0.05, 0.07)     |
| **Marital duration, years**       |                         |                        |
| Less than 5®                      | 1.00                    | 1.00                   |
| 5–9                               | 0.61* (0.58, 0.65)      | 0.69* (0.65, 0.72)     |
| More than 10                      | 0.48* (0.43, 0.55)      | 0.43* (0.38, 0.48)     |
| **Media**                         |                         |                        |
| No®                               | 1.00                    | 1.00                   |
| Yes                               | 0.78* (0.74, 0.83)      | 0.75* (0.71, 0.79)     |
| **Birth in last 3 years**         |                         |                        |
| 0®                                | 1.00                    | 1.00                   |
| 1                                 | 2.14* (2.01, 2.28)      | 1.6* (1.51, 1.69)      |
| 2 and above                       | 2.49* (2.28, 2.73)      | 2.66* (2.45, 2.89)     |
| **Heard about family planning**   |                         |                        |
| No®                               | 1.00                    | 1.00                   |
| Yes                               | 0.81* (0.78, 0.85)      | 0.84* (0.81, 0.88)     |
| **Health insurance**              |                         |                        |
| No®                               | 1.00                    | 1.00                   |
| Yes                               | 0.74* (0.7, 0.79)       | 0.89* (0.85, 0.94)     |

Note. NFHS = National Family Health Survey; RRR = relative risk ratio; ®= reference category. *p < .05.
exposure, heard about FP, health insurance coverage and birth in the last 3 years preceding the survey, were significant predictors of unmet need for contraception relative to the met need for contraception. In contrast, education and place of residence did not come up as significant for the analysis.

The likelihood of having an unmet need for contraception was decreased among young married women in the age group 20 to 24 (relative risk [RR] [95% CI]: 0.75 [0.70–0.79]) than those in the 15 to 19 age group. Muslim adolescents have a higher likelihood of having unmet needs compared to their Hindu counterparts (RR [95% CI]: 2.16 [1.94–2.39]). Adolescents belonging to the richest wealth quintile have the lowest likelihood of having an unmet need for contraception relative to the met need for contraception (RR [95% CI]: 0.70 [0.65–0.76]). Women living in the eastern (RR [95% CI]: 1.40 [1.31–1.49]) and southern (RR [95% CI]: 1.47 [1.37–1.59]) regions were more likely to have an unmet need for contraception compared to the northern region. Women belonging to the northeastern region (RR [95% CI]: 0.87 [0.81–0.95]), on the contrary, were less likely to have an unmet need for contraception in comparison to the north. The women who have more than one child were less likely to have an unmet need for contraception than those having no children. Women who have been in the marital duration for more than 10 years have a lower likelihood (RR [95% CI]: 0.48 [0.43–0.55]) of having unmet needs relative to the met need for contraception. The media acted significantly as the women who were exposed to media have lower likelihood (RR [95% CI]: 0.78 [0.74–0.83]) of having unmet needs than those not exposed. The likelihood of having unmet need was increased (RR [95% CI]: 2.49 [2.28–2.73]) with two and above births in the last 3 years. The likelihood of having an unmet need for contraception was decreased among adolescents who have heard about FP (RR [95% CI]: 0.81 [0.78–0.85]) than those who had not heard about FP. Women who were covered through health insurance were less likely (RR [95% CI]: 0.74 [0.7–0.79]) to have an unmet need for contraception relative to the met need for contraception.

All the predictors were significant except age, which lost its significance here for no demand for contraception. The results depict that literate women were more prone to have no demand for contraception (RR [95% CI]: 0.74 [0.7–0.78]) than illiterate ones. Women belonging to rural areas were more likely (RR [95% CI]: 1.05 [1–1.1]) to have no demand for contraception than their urban counterparts. Muslim adolescents were most likely to have no demand for contraception (RR [95% CI]: 2.66 [2.42–2.93]) than the Hindu ones. Women hailing from the richest wealth section were least likely to have no demand for contraception than the poorest women (RR [95% CI]: 0.49 [0.46–0.53]). Women from the northeastern region were least likely to have no demand for contraception (RR [95% CI]: 0.58 [0.54–0.62]), whereas the highest likelihood (RR [95% CI]: 1.35 [1.25–1.45]) was found in the western region compared to the northern region.

Women who had three or more living children had the lowest likelihood of having no demand for contraception (RR [95% CI]: 0.06 [0.05–0.07]) than those who had no child. Women who have been in the marital duration for more than 10 years (RR [95% CI]: 0.43 [0.38–0.48]) and those exposed to media (RR [95% CI]: 0.75 [0.71–0.79]) were least likely to have no demand for contraception than their respective counterparts. In the last 3 years, women having two and above births had the highest likelihood of having no demand for contraception relative to the met need for contraception (RR [95% CI]: 2.66 [2.45–2.89]). Women who heard about FP (RR [95% CI]: 0.84 [0.81–0.88]) and who have health insurance (RR [95% CI]: 0.89 [0.85–0.94]) were least likely to have no demand for contraception relative to the met need.

Spatial pattern and clustering of unmet need for contraception among young females aged 15 to 24

The spatial analysis begins with understanding the pattern in which unmet need is spread across Indian districts. Figure 1 shows the spatial distribution of unmet need for contraception among young married women across districts of India. For this, a technique based on graduated colors has been prepared through ArcGIS in which the districts are categorized into three categories: low, medium, and high. The different shades of color represent the spatial difference in unmet need. The lightest shade of the map stands for the lowest
prevalence, while the darkest stands for the highest prevalence. Two hundred fourteen districts showed the prevalence of high unmet need (range: 27.4%–55.9%), whereas 213 districts portray medium prevalence (range: 18.7%–27.4%) and 214 districts as low prevalence (range: 0.0%–18.7%). These maps depict the spatial heterogeneity and show the extent of geographical disparity in the prevalence of unmet need among adolescents across districts of India. A significant chunk of the prevalence can be seen in Gujarat, Uttar Pradesh, Bihar, Nagaland, Kerala, Manipur, Arunachal Pradesh, and Tamil Nadu.

Table 3 depicts the values of Univariate and Bivariate Moran’s I statistics for unmet need for FP and its major correlates in India. The univariate Moran’s I value for unmet need was 0.50, which depicts its high spatial autocorrelation across India’s districts as proxies of cultural ecologies across the country. Among the predictors, Muslim, poorest wealth category, other backward castes (OBC), no media exposure, and illiteracy showed the highest and statistically significant values depicting their spatial autocorrelation with unmet need for FP across districts. It was found that the spatial autocorrelation of the poorest wealth category (0.72) and Muslim (0.70) was the highest, followed by OBC (0.68), no media (0.68), and illiterates (0.64). Finally, the spatial autocorrelation of no living children and the unmet need was 0.09. On the contrary, no children ever born and wanting another child showed comparatively low spatial autocorrelation.

Table 4 presents the results from OLS, SLM, and SEM, depicting the association between the variables taken in the study. OLS and spatial regression models (SAR) results describe the effect of the predictors on the outcome variable. Poorest wealth category, Muslim women, not heard about FP, women with no children ever born, and women belonging to OBC were the factors that showed significant association throughout the models in the study. Based on the AIC values, the SEM was found to be the best model for all the predictors as the AIC value was lowest in this model. The AIC value for SEM was 4,300.98, and the error lag value ($\lambda$) was 0.67 ($p$ value < .001), while the value for adjusted $R^2$ was .50.

In the OLS model, the factors like not heard about FP, no children ever born, and caste category OBC were significantly and spatially associated with unmet need. A 10-point increase in women who never heard about FP was associated with a 1.8 and a 1.3-point increase in unmet need across districts in OLS and SLM models, respectively. Similarly, if women with no children ever born increased with 10 points, the unmet need will increase by 1.6 and 1.0-point in OLS and SLM models, respectively. A 10-point increase in women belonging to other backward castes would mean a 1.1-point increase in unmet need for the OLS model. Finally, if the women with two and above births increase by 10 points, the unmet need will increase by 1.3 points across districts, as per the SLM model. With respect to SEM, the coefficient was largest for never heard about FP (0.14, [0.000]) followed by age 15 to 19 (0.12, [0.025]) and media exposure (−0.12, [0.000]). The value of the coefficient in SEM for not heard about FP confirmed that a 10-point increase in the proportion of women who have not heard about FP was associated with a 1.4-point increase in unmet need. Similarly, a 10-point increase in adolescents aged 15 to 19 was associated with a 1.2 increase in unmet needs across India’s districts. Similarly, a 10-point increase in women who are exposed to media was associated with a 1.2-point decrease in unmet needs across districts of India.

### Bivariate LISA Maps

Moran’s I statistics indicate significant spatial dependence of the independence and outcome variables across India’s districts. Figure 2 consists of bivariate LISA and significance
maps, which show the clustering of unmet needs with its covariates across 640 districts in India. Map 1 shows the Bivariate LISA cluster map, which depicted that around 57 districts constituted the hotspots (high proportion of illiterate adolescents and high unmet need). In comparison, 90 districts form the cold spots (low proportion of illiterate adolescents and low unmet need). The hotspots districts belonged mainly to Gujarat, Uttar Pradesh, Bihar, and Arunachal Pradesh. In Map 2, it was found that almost 72 districts were the hotspots concerning rural residence (high proportion of women living in rural areas and high unmet need), and 63 districts made up to the cold spots (low percentage of women living in rural areas and low unmet need). Here the significant hotspots were found to be located in Uttar Pradesh, Bihar, Arunachal Pradesh, Nagaland, and Gujarat.

Similarly, Maps 3 and 4 showed the hotspots and cold spots for women belonging to Muslim women and the poorest wealth category. Map 5 showed high clustering in 75 districts (high proportion of women who have not heard about FP and high unmet need), while 96 districts showed low clustering. The districts about high clustering were mostly from Gujarat, U.P, Bihar, and a few from northeastern states. Map 6 identifies high grouping (high proportion of women with no children ever born and high unmet need) concentrated in 67 districts, whereas 82 districts showed low clustering. The hotspots districts majorly belonged to the states of Gujarat, U.P, Bihar, and Kerala. Map 7 showed 55 hotspots for age 15 to 19 (high proportion of adolescents in the age group 15 to 19 and high unmet need) in the states of U.P., Bihar, followed by northeastern states and Gujarat while 80 districts showed the cold spots. Map 8 suggested that 74 districts formed the hotspots (high proportion of adolescent women wanting another child and high unmet need), whereas 68 districts came up as cold spots. The states identified were Gujarat, U.P., Bihar, and Kerala.

Similarly, Map 9 depicted 81 hotspots (high proportion of adolescent women belonging to OBC and high unmet need) in Gujarat, up, Bihar, Kerala, and Tamil Nadu; while 74 cold spots were found. Finally, the hotspots (64) and cold spots (106) were identified (a high proportion of adolescents having no exposure to media and high unmet need). The states identified were Gujarat, U.P., Bihar, and few northeastern states.

**Discussion and Conclusion**

The study explored the critical predictors of unmet need for contraception among currently married adolescents and young women using the data from NFHS-4. The study unveils that unmet needs still exist as an important problem among adolescents in India. It has severe implications for their sexual life as well as their reproductive intentions. An extensive spatial analysis was done to capture the spatial heterogeneity and analyze the clustering pattern across India’s districts. The study revealed the greatest decrease in the likelihood of having unmet need was seen among women aged 20 to 24, resided in urban areas, belonged to the wealthiest wealth category, have more than two children, married for more than 10 years, who were exposed to media, who have heard about FP method and had health insurance.

Similarly, the greatest increase in the likelihood of unmet need was observed among women of the 15 to 19 age group,
Figure 2. Bivariate LISA cluster and significance Maps showing the spatial clustering and outliers of unmet need among currently married female adolescents in India, 2015–2016. Map (1) Cluster and significance map of unmet need and illiterate adolescents. Map (2) unmet need and rural residence. Map (3) unmet need and religion (Muslim). Map (4) unmet need and poorest wealth index. Map (5) unmet need and not heard about FP. Map (6) unmet need and no children ever born. Map (7) unmet need and age 15 to 19. Map (8) unmet need and women wanting another child. Map (9) unmet need and Other Backward Castes (OBC). Map (10) unmet need and no media exposure.

Note: LISA = Local Indicators of Spatial Analysis; FP = Family planning.
who were Muslim, who belonged to the poorest wealth category, who had no children ever born, who were not exposed to media, had not heard about FP and not had health insurance. A significant regional variation has been found, which showed that the northeastern region had the least likelihood of having unmet need and demand satisfied. In contrast, the west, south, and eastern regions had the highest probability of the same.

The study findings show that the unmet need was higher among the 15 to 19 age group adolescents. This is consistent with the previous study, which stated that the unmet need for contraception was common among the ascents (Pack et al., 2018). Contrary to this, some studies reveal that older women were more likely to have unmet needs, probably due to confidence gained with previous experiences of pregnancy and childbirth (Bamgboye & Ajayi, 2016). The educational status also emerged as an important predictor of unmet need among women. Prior studies had also emphasized that the likelihood of unmet need decreased when the women were educated. It was found that with the increase in the number of children, the possibility of unmet need decreased among women. The likelihood of having unmet need was reduced if the women had heard about FP in the last few months. This finding complies with other studies which conclude that FP workers’ giving FP methods or discussion of FP with health workers contributed the most to reducing the unmet need for contraception (Islam et al., 2016; Kennedy et al., 2011).

From the spatial analysis, the following noteworthy findings emerge from the study. First, the research shows that spatial patterns of unmet needs are diverse across the districts of India. The study further finds that sociodemographic factors like no media exposure, not heard about FP, age 15 to 19 were contributing a significant increase in unmet need across the districts of India. Second, the spatial dependence was highest for the factors like not heard about FP, OBC, no media exposure, poorest wealth category, and Muslim adolescents. Third, the values of Moran’s’ I statistics suggest a spatial clustering in the districts belonging majorly to Gujarat, Uttar Pradesh, Bihar, Arunachal Pradesh, and a few northeastern states. Uttar Pradesh has high demands for services concerning unmet need as its surrounding states like Bihar, Jharkhand, Orissa, Chhattisgarh, and most of the northeastern states as per few studies (Ansary). Based on prior literature, the substantially high unmet need could be attributed to the FP program’s poor performance in Bihar. It has failed to provide people with enough choices and a range of contraceptives for spacing (Pal et al., 2018).

Among the southern states, hotspots were found in Kerala and Tamil Nadu. Many studies on South India have revealed that ignorance regarding the availability of services for FP was higher in the unmet need group than contraceptive users in the respective study area (Rini & Vijayakumar, 2017). The usage of temporary methods remains low, possibly due to social stigma, cultural disbeliefs, lack of knowledge, and concern about side effects (Prasad et al., 2016). The significant hotspots were found in Gujarat, Uttar Pradesh, Bihar, while the significant cold spots were observed in Telangana, Andhra Pradesh, Punjab, and Haryana.

In a nutshell, through its district-level spatial analysis, this study shows considerable regional disparities concerning unmet need for FP among young Indian women aged 15 to 24. It reveals that the unmet need for contraception among currently married adolescents and young women (23%) is way higher than the national average (13%). A higher unmet need for contraception portrays the FP providers’ inefficiency and displays the need to formulate effective FP policies, primarily focusing on the higher risk groups identified in the study (Nyarko et al., 2019). A large variety of permanent and temporary methods should be provided to choose the contraceptive methods depending on her needs. The study indicates regional disparities due to which some states and districts appear in a disadvantaged position. The spatial clustering (hotspots) is found higher where there is no media exposure, where women have not heard about FP, where illiteracy prevails. The underlying spatial heterogeneity shows the inefficient reach of the public health planners to these hotspots districts. The health care sector and other nongovernmental stakeholders should prominently focus on the areas with high clustering of unmet need among currently married females. These hotspots and areas with high clustering need to be intervened with more resource allocation, depending on the specific needs of the particular area and its population.

**Recommendation**

The results of this study have merit in its ability to generate context-specific evidence crucial for designing better interventions, which will enable young couples to successfully navigate complex socio-cultural norms and make right FP decisions that protect their well-being by ensuring reproductive and sexual rights.

**Limitations**

The article has some limitations as well. First, findings are based on a cross-sectional data set, and hence it is not feasible to establish causal linkages between predictors and response variables. Second, it included only young married women aged 15 to 24, it may not be generalized for the entire cohort of young women age 15 to 24.

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References
Alaba, O. O., Olaomi, J. O., & Olubusoye, O. E. (2015). Spatial pattern and determinants of unmet need of family planning in Nigeria. South African Family Practice, 57(5), 306–312.
Anscary, R. Pattern of unmet need for family planning in Uttar Pradesh (INDIA). https://paa2013.princeton.edu/papers/132891
Anselin, L. (1995). Local indicators of spatial analysis—LISA. Geographical Analysis, 27(2), 93–115.
Bamgboye, E. A., & Ajayi, I. (2016). Unmet needs for family planning among women in Nigeria changing patterns of unmet needs for family planning among women of reproductive age in Nigeria. African Journal of Reproductive Health, 20(3), 127–135.
Bongaarts, J. (2019). The impact of family planning programs on unmet need and demand for contraception. Studies in Family Planning, 45(2), 247–62.
Bradley, S. E. K., & Casterline, J. B. (2014). Understanding unmet need: History, theory, and measurement. Studies in Family Planning, 45(2), 123–150.
Casterline, J. B., Perez, A. E., & Biddlecom, A. E. (1997). Factors underlying unmet need for family planning in the Philippines. Studies in Family Planning, 28(3), Article 173.
Cleland, J., Harbison, S., & Shah, I. H. (2014). Unmet need for contraception: Issues and challenges. Studies in Family Planning, 45(2), 105–122.
DeGraff, D. S., & de Silva, V. (1991). Unmet need for contraception in Sri Lanka. International Family Planning Perspectives, 17(4), Article 123.
DeGraff, D. S., & de Silva, V. (2018). A new perspective on the definition and measurement of unmet need for contraception. International Family Planning Perspectives, 22(4), 140–147.
Iloghalu, I., Ibeh, C., Modebe, I., Ezeama, N., Azuike, E., & Obi, K. (2018). Predictors of unmet need for contraception among urban and rural women in Anambra State, Nigeria: A mixed method survey. International Journal of TROPICAL DISEASE & Health, 29(4), 1–20.
International Institute for Population Sciences, & ICF. (2017). National Family Health Survey (NFHS-4), 2015-16: India.
Islam, A. Z., Mostofa, M. G., & Islam, M. A. (2016). Factors affecting unmet need for contraception among currently married fecund young women in Bangladesh. European Journal of Contraception and Reproductive Health Care, 21(6), 443–448.
Jain, A. (1999). Should eliminating unmet need for contraception continue to be a program priority? Source: International Family Planning Perspectives, 25, 39–43.
Kennedy, E., Gray, N., Azzopardi, P., & Creati, M. (2011). Adolescent fertility and family planning in East Asia and the Pacific: A review of DHS reports. Reproductive Health, 8(1), 1–11.
Khan, J., Shil, A., & Prakash, R. (2018). Exploring the spatial heterogeneity in different doses of vaccination coverage in India. PLOS ONE, 13(11), Article e0207209.
Motaq, M. E., Esfami, M., Yazdanpanah, M., & Nakhaee, N. (2013). Contraceptive use and unmet need for family planning in Iran. International Journal of Gynecology and Obstetrics, 121(2), 157–161.
Nketiah-Amponsah, E., Arthur, E., & Aaron, A. (2015). Correlates of contraceptive use among Ghanaian women of reproductive age (15-49 years). African Journal of Reproductive Health, 16(3), 155–170.
Nyarko, S. H., Sparks, C. S., & Bitew, F. (2019). Spatio-temporal variations in unmet need for family planning in Ghana: 2003–2014. Genus, 75(1), Article 22.
Pack, A. P., McCarragher, D. R., Chen, M., Okigbo, C. C., Albert, L. M., & Wambugu, S. (2018). Factors associated with unmet need for modern contraception in post-conflict Liberia. African Journal of Reproductive Health, 18(2), 58–67.
Pal, A., Yadav, J., & Singh, S. K. J. (2018). Factors associated with unmet need of family planning in Bihar, India: A spatial and multilevel analysis. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, 7(9), Article 3638.
Prasad, R. V., Venkatachalam, J., & Singh, Z. (2016). Unmet needs of family planning among women: A cross-sectional study in a rural area of Kanchipuram district, Tamil Nadu, South India. Journal of Obstetrics and Gynecology of India, 66(1), 488–493.
Rahman, M. (2012). Women’s autonomy and unintended pregnancy among currently pregnant women in Bangladesh. Maternal and Child Health Journal, 16(6), 1206–1214.
Rini, R., & Vijayakumar, B. (2017). Unmet need for family planning in South India. International Journal of Biomedical and Advance Research, 8(3), 82–86.
Ross, J. A., & Pham, S. B. (1997). Unmet need for contraception in Vietnam: Who needs what and when. Social Biology, 44(1–2), 111–123.
Ross, J. A., & Winfrey, W. L. (2018). Unmet need for contraception in the developing world and the former Soviet Union: An updated estimate. International Family Planning Perspectives, 28(3), 138–143.
Sedgh, G., & Hussain, R. (2014). Reasons for contraceptive nonuse among women having unmet need for contraception in developing countries. Studies in Family Planning, 45(2), 151–169.
Sharma, H., Singh, S. K., & Srivastava, S. (2020). Socio-economic inequality and spatial heterogeneity in anaemia among children in India: Evidence from NFHS-4 (2015–16). Clinical Epidemiology and Global Health, 8(4), 1158–1171.
Shifa, G. T. (2014). High unmet need for family planning and factors. Global Journal of Medical Research Interdisciplinary, 14(4), 21–32.
Westoff, C. F. (2006). New estimates of unmet need and the demand for family planning (DHS Comparative Reports No. 14). Macro International.