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ARTICLE

Spatial heterogeneity study of early child marriages before and after implementation of prohibition of Child Marriage Act (2006) in India: Evidence from NFHS

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Abstract

Despite numerous laws, rights, and well-known health concerns, child marriage remains to be prevalent in developing countries such as India. This practice is fueled by a complex interaction of social and normative attitudes and values that are understated in national and even state-level assessments of child marriage drivers. This study aims to assess the spatial pattern and associated factors of early-marriage before and after Prohibition of Child Marriage Act in Indian districts among reproductive aged women. Univariate and Bivariate analysis, Multiple logistic regression, Moran's I Statistics and Regression analysis (OLS and Spatial Error/Lag Model) were carried out for the analysis of data in our study. The data came from the fourth round of the National Family Health Survey (2015-16).This study finds wide inter districts heterogeneity in levels of child marriage, one decade before and after prohibition of child marriage across India. The prevalence of child marriage has substantially declined (nearly 21%) after implementation of prohibition of child marriage act. Bivariate Moran's I value for rural was found to be highest 0.76 and 0.72 before and after implemented act respectively suggesting high spatial auto-correlation of early-marriages in the rural-districts of India. The findings of this study show that the prevalence of child marriage has substantially declined after implementation of child marriage act but this declining trend of child marriage has been accompanied by many factors apart from enforcement of laws against child marriage practice. Furthermore, future child marriage programs and policies should take into account improving economic status, enhancing female sovereignty and marital decision-making in the home, as well as the geographic, social, and normative aspects of the local community.

Keywords: Sexual and Reproductive Health and Rights, Child Marriage, Prohibition of Child Marriage Act, Spatial Heterogeneity, India

1. Introduction

UNICEF defined child marriage as marriage before 18 years of age and as per recent available stats, around 15 million married women aged 20-24 in India, got married before legal age of 18 years and this is the largest in number compared to any other nation (McDougal *et al.*, 2020; UNDESA Report, 2017; NFHS-4, 2015-16). Child marriage is a global phenomenon but mostly prevalent in south-asian countries and has decreased worldwide during the past 20 years (Raj *et al.*, 2010). Furthermore, India's demography is majorly defined by the marriage practices that prevail in various regions in various ways.

Marriage practices define fertility, maternal and child health and their mortality levels (Bhagat, 2016). The Right to Marriage is a fundamental right under Article 21 given to both the sex and child marriages or marriage before legal age (18 years for female and 21 years for male) violates the fundamental right (Act No. 6, 2007). As Child marriage is documented as a human-rights violation, it violates the basic right to health, nutrition, education, and it leads to abuse and exploitation for both genders (Pramila, 2013). But the impact on a female is more as she has to be a bride, further premature pregnancy and motherhood perhaps degrade her well-being (Pramila, 2013; Chari *et al.*, 2017). Child Marriage is mostly connected to poverty, lower education levels, and caste hierarchy (Pramila, 2013; Field *et al.*, 2008).

Child marriages limit girls' education, economic opportunities and affect the physical and psychological health (Nour, 2009). Child marriage or getting marry at early age is also associated with occurrence of sexually transmitted disease like HIV and increase the risk of complications at the time of pregnancy which further leads to infant and maternal mortality (Nour, 2009; UNICEF, 2017; Paul, 2020).The Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) affirms the women's right to education, health, employment, marriage and reproductive rights and questions the traditional and cultural factors which define gender roles and condemn forced marriages and relations (UN Entity for Gender Equality). Later on, the policymakers included these women-centric issues as one goal named Gender Equality out of 17 goals under Sustainable Development Goals (SDG Goal 5). Based on the recent data available one can infer that child marriages have been reduced from 47 percent in 2006 to 27 percent in 2016 (NFHS-4, 2015-16; NFHS-3, 2005-06). Yet the prevalence of child marriages hampers the pace of achieving the Sustainable Development Goal of Gender Equality (Goal 5) by 2030 (McDougal *et al.*, 2020; Efevbera *et al.* 2019; UNICEF, 2018). In British period, India has made many attempts to prevent the child marriage. In 1929, the Child Marriage Restraint act was implemented also known as Sarda Act which prohibited the marriage of girls before the age of 14 as legal age. Furthermore, Child Marriage Restraint Amendment Act enacted in 1976 in which the legal age of girls to marry increased from 14 to 18 and again this act was replaced by Child Marriage Prohibition act 2006 (Paul, 2020).

Females after getting married before the legal age are unable to plan or manage families, which leads to early pregnancy-related issues as well as high fertility. In the case of child marriages, the age difference between the bride and groom is ordinarily huge. Usually, bride is around 8 to 10 years younger than the groom; this age gap seizes her decision-making power as she subsequently does not have freedom to express herself (Abera, 2020). Therefore, not having freedom to express leads to impacts her sexual and reproductive rights (UNICEF, 2018; Abera, 2020).

Studies have shown that traditionally, the age of menarche also drives child marriages as families are ashamed of the presence of unmarried menstruating daughters in the family, hence early menarche results in early marriages (Jeneson and Thronton, 2003; Chari *et al.* , 2017; Roest, 2016). The income level of families also associated with child marriages. Negative income shocks to families delay the marriages whereas having abundant money entrenched the marriages (Saha, 2017; Corno *et al.*, 2020). Because dowry is a constraint in a marriage and the families who have improved access to money give dowry easily (Saha, 2017). Thus, the early age of menarche and not having budget constraints for marriage leads to an increase in child marriage. Age of girls depicts the verge of dowry, as young girls are more desirable for marriage then families need to pay a lower dowry (Chowdhury, 2010). Child marriages also varies with spatial distribution of any population. People who usually interact in the close geographical sphere with each other can become more alike subsequently influence each other's decision-making behaviors, this is termed as spatial dependence. On the other side, spatial heterogeneity is when different characteristics are the outcome of different geographical or spatial settings (Weeks, 2004). Spatial dependency considered as one of the important factors in child marriage. People with similar geographical areas and socio-demographic characteristics will usually have similar thoughts in terms of attitudes and behavior regarding marriage and typically follow similar norms (Weeks, 2005; McPherson *et al.*, 2001). Thus, a

comprehensive understanding of spatial homogeneity and heterogeneity is required to make interventions program for countering child marriages.

The study aims to analyses if the geographic regions with the lowest levels of female's education, rural as a place of residence, poor economic condition, and no-media exposure have also dealing with a higher risk of child marriage; whether there are any spatial outliers, and whether these relationships have changed significantly since the Prohibition of Child Marriage Act, 2006 was passed. This study aims to assess the spatial pattern and associated factors of early-marriages before and after Prohibition of Child Marriage Act in Indian districts among reproductive aged women.

2. Material and Methods

2.1 Data Source

Data were collected from the National Family Health Survey round four; 2015–16 is used in our analysis. NFHS-4 provides comprehensive information on men, women and their age at marriage, education, mass media and many socio-demographic characteristics for the states and districts of India. NFHS-4 represents a nationally representative sample of 601,509 households, 699,686 women and 103,525 men of age 15-49 years and 15-54 years respectively for India. The study variables were extracted from NFHS-4 women's file, where the district level information on age at marriage for 3, 32,289 women's were given. Out of 3,32,289 women's, 1,62,877 women married before 2006 and remaining 1,69,412 women married after 2006. Flow diagram also shows that before 2006 nearly half of the women (48%, N=78,189) married before reaching age 18 years whereas after 2006 the prevalence of child marriage reduced significantly and reaches to nearly one fourth (26.9%, N=45,532) of the overall married women (Figure 1). The outcome variable of interest is child marriage before and after Child Marriage Prohibition Act (2006). The others variables included in the study were aggregated at the district level and for spatial analysis converted variables with value in percentage were used in the analysis.

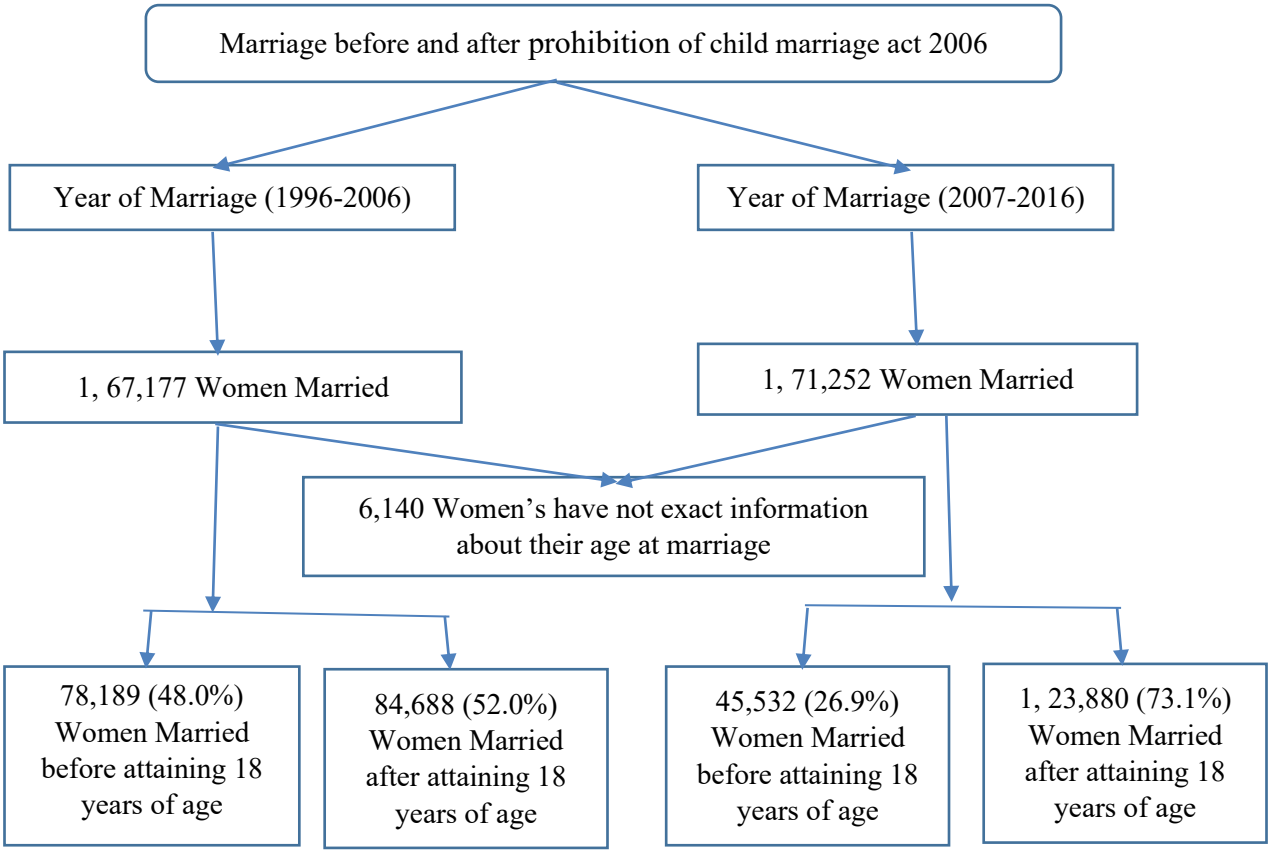


Figure 1. Flow diagram depicting the sample selection of early married women before and after Child Marriage Prohibition Act (2006).

2.2 Statistical Methods

Univariate and Bivariate analysis, Multiple logistic regression, Moran's I Statistics and Regression analysis (OLS and Spatial Error/Lag Model) were carried out for the analysis of data in our study. Descriptive statistics were performed to show the distribution of study participants. Bivariate Analysis were carried out to understand the nature of association between early marriage as a predictor and background characteristics as an outcome variable, the test of association was performed using Pearson's chi-square statistics. The sample weight was used to estimate the percentages. Furthermore, multiple logistic regression models were performed to assess the association of early marriage before and after prohibition of Child Marriage Act with socio-demographic variables.

Moran's I Statistics have been used to show the spatial dependence for the district level prevalence of early marriage before and after Prohibition of Child Marriage Act with the help of Moran's I value and Z-value for independent variables. Moran's I usually takes values in between -1 to +1, where positive values suggest the spatial clustering of the similar values and negative values indicate the clustering of different values. A zero value indicates a random spatial pattern with no spatial autocorrelation. Univariate LISA and bivariate LISA maps were utilized in this study to identify the spatial clusters. Univariate LISA map provided the geographical clustering of different variables used in this study while Bivariate LISA measured the correlation between the independent and the weighted average of the dependent variable in a particular location. Cluster map depicts the four major category of colour code namely,

1) *High-high clustering (Hot Spot)*: High prevalent location (district) surrounded by high prevalent neighbourhood district.
2) *Low-low clustering (Cold Spots)*: Low prevalent location (district) surrounded by low prevalent neighbourhood district.
3) *High-low clustering (Spatial outliers)*: High prevalent district surrounded by the low prevalent district.
4) *Low-high clustering (Spatial outlier)*: Low prevalent district surrounded by the high prevalent district.

Further, Ordinary Least Square and Spatial Error/ Lag Model regression analysis have also been used to show the adjusted coefficient of the correlates for early marriage before and after prohibition of Child Marriage Act in terms of coefficient, standard-error and p-value for district level meso-scale correlates for India. The basic difference between the two models is that the spatial lag model unlike spatial error model does not consider the spatial dependence in the error term. Diagnostics tests for spatial dependence were carried out, and the value of Lagrange Multiplier was found significant in both the models ($p < 0.0001$) and next we compared the Akaike Information criterion (AIC) value for both the models to know the best spatial fit. The model with lower AIC value were considered to be the best fit model.
For Univariate, bivariate and multiple logistic regression analysis STATA 16.0 were used. Further for visualize district level prevalence of early marriage and motherhood and for preparing the shape file Geographical Information System (ArcGIS version 10.4) software was used. Further to check the spatial dependence GeoDa version 1.20 was also used as a statistical tool.

2.3 Ethical Consideration

Because our research is based on previously collected survey data, in which any identifying information about a specific person has been deleted. Before taking part in the survey, all participants gave their informed consent, and all data was collected in a confidential manner. The Measure DHS International Program gave written permission to use the data, and the dataset was made public. As a result, no permission is required to utilise the dataset.

3. Results

3.1 Descriptive Statistics of samples by background characteristics

Table 1 shows the distribution of nationally representative samples before and after marriage prohibition act 2006, with background characteristics respectively.

Table 1. Distribution of samples by background characteristics

Characteristics	Before Marriage Restraint Act (1996-2005)		After Marriage Restraint Act (2007-2016)	
	N	Percentage	N	Percentage
Place of Residence				
Urban	57,930	34.7	57,165	33.4
Rural	109,247	65.4	114,087	66.6
Education				
No education	53,808	32.2	27,240	15.9
Primary	26,077	15.6	19,270	11.3
Secondary	72,576	43.4	94,414	55.1
Higher	14,716	8.8	30,328	17.7
Ethnicity				
SC	33,464	20.9	34,753	21.2
ST	15,193	9.5	16,595	10.1
Others	111,669	69.7	112,647	68.7
Religion				
Hindu	135,658	81.2	136,692	79.8
Muslim	21,639	12.9	24,951	14.6
Christian	4,118	2.5	3,832	2.2
Others	5,761	3.5	5,777	3.4
Wealth				
Poorest	32,529	19.5	28,724	16.8
Poorer	32,650	19.5	33,585	19.6
Middle	33,568	20.1	35,706	20.9
Richer	34,402	20.6	36,991	21.6
Richest	34,027	20.4	36,246	21.2
Mass Media				
No	34,635	20.7	29,167	17.0
Any	132,542	79.3	142,085	83.0
Regions				
East	31,815	19.0	33,076	19.3
West	14,202	8.5	13,991	8.2
North	33,855	20.3	34,840	20.3
South	22,596	13.5	21,079	12.3
Central	40,852	24.4	43,043	25.1
Northeast	23,857	14.3	25,223	14.7
Relation to husband prior to marriage				
No	144,117	86.2	145,189	84.8
Yes	23,060	13.8	26,063	15.2
Sex of household head				
Male	146,918	87.9	149,959	87.6
Female	20,259	12.1	21,293	12.4
Number of members in household				
1-4	62,042	37.1	59,304	34.6
5-8	86,123	51.5	83,458	48.7
>8	19,012	11.4	28,490	16.6
Age of household head				
<55 years	127,913	76.5	105,683	61.7
>=55 years	39,240	23.5	65,542	38.3
Total	**167,177**	**100.0**	**171,252**	**100.0**

Table 1 shows that for place of residence, there is slightly change in population i.e. 0.7 percent decrease in urban population while 1.2 percent increase in rural population after act was implemented. In education, there is decrease in no-education from 32.2 percent to 15.9 percent and improvement in secondary and higher education from 43.4% to 55.1% and 8.8% to 17.7% respectively in population before and after act. For religion, there is decrease in Hindu population by 1.4 percent while increase in Muslim population by 1.7 percent after act was implemented. Furthermore, there was decrease in poorest population from 19.5 percent to 16.8 percent while increase in middle, richer and richest population after act. There were increase in mass-media uses among population from 79.3 percent to 83.0 percent and also there was increase in relation to husband prior to marriage since 1996 from 13.8 percent to 15.2 percent in the sample. Additionally, household head of age greater than and equals to 55 years had also increase

remarkably from 23.5 percent to 38.3 percent after 2006.

3.2 Socio-demographic characteristics of Child Marriage

Socio-demographic characteristics of Child Marriage with background characteristics in India is depicted by table 2.

Table 2. Bivariate analysis showing the distribution of early marriage by background characteristics

Characteristics	Before Prohibition of Child Marriage Act (1996-2005)	Chi Square (P-value)	After Prohibition of Child Marriage Act (2007-2016)	Chi Square (P-value)
	Early Marriage (Yes): N (%)		Early Marriage (Yes): N (%)	
Place of Residence				
Urban	20617 [36.2]	0.000	9780 [17.3]	0.000
Rural	57573 [54.3]		35752 [31.7]	
Education				
No education	30733 [59.6]	0.000	9884 [37.1]	0.000
Primary	14937 [59.0]		7212 [38.1]	
Secondary	30708 [43.0]		27028 [28.9]	
Higher	1813 [12.4]		1407 [4.7]	
Ethnicity				
SC	17758 [54.5]	0.000	10285 [29.9]	0.000
ST	7749 [53.5]		5439 [33.5]	
Others	49827 [45.6]		27683 [24.8]	
Religion				
Hindu	64392 [48.7]	0.000	36722 [27.1]	0.000
Muslim	10709 [51.0]		7206 [29.3]	
Christian	1211 [30.3]		625 [16.5]	
Others	1877 [32.8]		979 [17.0]	
Wealth				
Poorest	19631 [62.3]	0.000	12267 [43.3]	0.000
Poorer	18642 [59.4]		12540 [37.9]	
Middle	17388 [53.5]		10359 [29.4]	
Richer	14233 [42.2]		7135 [19.4]	
Richest	8295 [24.6]		3230 [9.0]	
Mass Media				
No	20601 [61.4]	0.000	11449 [39.8]	0.000
Any	57588 [44.5]		34082 [24.2]	
Regions				
East	22251 [57.7]	0.000	15639 [39.0]	0.000
West	9813 [40.2]		6236 [25.2]	
North	9645 [42.6]		5264 [22.2]	
South	14369 [39.3]		7078 [19.4]	
Central	19908 [56.6]		9544 [25.2]	
Northeast	2203 [39.7]		1769 [27.7]	
Relation to husband prior to marriage				
No	66599 [47.4]	0.000	37585 [26.2]	0.000
Yes	11591 [52.0]		7947 [30.8]	
Sex of household head				
Male	68800 [48.0]	0.000	40002 [27.0]	0.000
Female	9389 [47.8]		5529 [26.3]	
Number of members in household				
1-4	25180 [41.7]	0.000	14477 [24.7]	0.000
5-8	43045 [51.3]		22703 [27.5]	
>8	9965 [53.6]		8351 [29.6]	
Age of household head				
<55 years	60638 [48.7]	0.000	31277 [30.0]	0.000
>=55 years	17544 [45.7]		14250 [21.9]	
Total	**78189 [48.0]**		**45532 [26.9]**	

Table 2 shows that there is significant decline in early-child marriage after implemented prohibition of child-marriage act-2006 i.e., from 48.0 % to 26.9 % but still early-marriage is happening around 27% in India. For place of residence, early marriage was high in rural population (54.3%) while in urban population estimate of early marriage was 36.2% before prohibition of child marriage acts, 2006. After act was implemented, it played significant role in reduction of early- marriage it comes to rural (31.7%)

and urban (17.3%) population. Increase in education is significantly associated with decrease in early-child marriage for instance, result shows that before prohibition of child marriage act (2006) child marriage ranges from 59.6% to 12.4% among no-education to highly educated women whereas, after act was implemented it comes 37.1% to 4.7% among no-education to highly educated respectively. Similarly, there is significant declines in all ethnical-group, early-child marriages among scheduled caste decreases from 54.5% to 29.9%, scheduled tribes 53.5% to 33.5% and others 45.6% to 24.8% after prohibition of child marriage restrain act, 2006. For religion, the early-child marriage before 2006 among Hindu (48.7%), Muslim (51.0%), Christian (30.3%) and others (32.8%). After 2006, Hindu (27.1%), Muslim (29.3%), Christian (16.5%) and others (17.0%) and for wealth, the early-child marriage before act was highly associated in poorest (62.3%), poorer (59.4%) and middle (53.5%) while richer and richest had comparably less associated i.e. (42.2%) and (24.6%) respectively. After act implemented, it decreased significantly among all wealth-quintile i.e. 43.3%, 37.9%, 29.4%, 19.4% and 9.0% respectively from poorest to richest quintile. Percentage of early-child marriage is low in mass-media exposure population in both before and after implementation of child marriage act. East and central regions had high association of early-child marriage before act i.e. 57.7% and 56.6 % respectively and after implemented act still east region is highly association of early-marriage i.e. 39.0% and in central region was 25.2% after act. There is significant decline in early-child marriage among household head age-group greater than 55 years i.e. only 23.8% as after act is implemented in India.

3.3 Adjusted and Crude Odds-Ratio of factors associated with early marriage before and after Prohibition of Child Marriage Act Using Multiple Logistic Regression

Table 3 depicts the crude and adjusted effects of early-child marriage before and after implementation of act using multiple logistic regression analysis. Secondary and higher educated women were having 5% (AOR: 0.95; CI: 0.92-0.99) and 78% (AOR: 0.22; CI: 0.20- 0.23) lower chances of marrying before their legal marriage age respectively after the act was implemented in compare to illiterate. In religion, the odds of early-marriage were less likely in Muslims, Christian and others as compared to Hindu before and after act in both crude and adjusted effect. The early marriage was negatively associated with wealth-quintile as their wealth improves the odds of having early child marriages decreases in both time zone. Furthermore, women having any mass media or female headed household or older household head were significantly contributing in reduction of child marriage in compare to their counter parts in both the cases before and after act implementation. Before act implemented, the COR and AOR of early-marriage were less associated in north-east (0.40and 0.51, p=0.00), south (0.44 and 0.58, p=0.00), north (0.50 and 0.70, p=0.00) and west (0.51 and 0.63, p=0.00) as compared to central region of India but after act implemented the odds of early marriage were observed to be high in the eastern, western and northern part of India as compared to central region of India. Additionally, irrespective of the act implementation it was found that women with prior relationship with their husband also lead to higher chances of child marriage.

Table 3. Multiple logistic regression analysis of factors associated with early marriage before and after Prohibition of Child Marriage Act

Characteristics	Before Prohibition of Child Marriage Act		After Prohibition of Child Marriage Act	
	COR (95% CI)	AOR (95% CI)	COR (95% CI)	AOR (95% CI)
Place of Residence				
Urban				
Rural	1.86*** [1.82,1.90]	1.05*** [1.02,1.08]	2.04*** [1.98,2.10]	1.06** [1.02,1.09]
Education				
No education				
Primary	0.94*** [0.91,0.97]	1.11*** [1.07,1.14]	0.97 [0.94,1.01]	1.13*** [1.09,1.18]
Secondary	0.50*** [0.49,0.52]	0.79*** [0.77,0.81]	0.63*** [0.61,0.65]	0.95** [0.92,0.99]
Higher	0.11*** [0.10,0.11]	0.23*** [0.21,0.24]	0.089*** [0.08,0.09]	0.22*** [0.20,0.23]
Ethnicity				
SC				
ST	0.70*** [0.67,0.72]	0.84*** [0.81,0.87]	0.86*** [0.83,0.89]	0.85*** [0.82,0.89]
Others	0.73*** [0.71,0.75]	0.88*** [0.86,0.91]	0.78*** [0.76,0.80]	0.99 [0.96,1.02]
Religion				
Hindu				
Muslim	0.96** [0.93,0.99]	0.92*** [0.89,0.96]	0.98 [0.95,1.01]	0.92*** [0.88,0.96]
Christian	0.43*** [0.41,0.45]	0.63*** [0.59,0.66]	0.53*** [0.50,0.56]	0.67*** [0.63,0.71]
Others	0.43*** [0.41,0.46]	0.58*** [0.55,0.61]	0.52*** [0.49,0.55]	0.66*** [0.62,0.70]
Wealth				
Poorest				
Poorer	0.82*** [0.80,0.84]	1.03 [0.99,1.06]	0.75*** [0.72,0.77]	0.84*** [0.81,0.87]
Middle	0.64*** [0.62,0.65]	0.92*** [0.88,0.95]	0.50*** [0.48,0.51]	0.62*** [0.60,0.65]
Richer	0.43*** [0.42,0.44]	0.70*** [0.67,0.73]	0.30*** [0.29,0.31]	0.43*** [0.41,0.45]
Richest	0.21*** [0.20,0.21]	0.42*** [0.40,0.44]	0.14*** [0.13,0.14]	0.26*** [0.24,0.27]
Mass Media				
No				
Any	0.51*** [0.50,0.52]	0.95*** [0.92,0.98]	0.46*** [0.45,0.47]	0.93*** [0.90,0.96]
Regions				
Central				
East	0.97 [0.95,1.00]	0.88*** [0.86,0.91]	1.66*** [1.61,1.71]	1.42*** [1.37,1.47]
West	0.51*** [0.49,0.53]	0.63*** [0.61,0.66]	0.98 [0.94,1.03]	1.28*** [1.22,1.34]
North	0.50*** [0.48,0.51]	0.70*** [0.68,0.73]	0.70*** [0.67,0.72]	1.14*** [1.10,1.19]
South	0.44*** [0.42,0.45]	0.58*** [0.56,0.61]	0.64*** [0.62,0.67]	0.95* [0.90,0.99]
Northeast	0.40*** [0.39,0.42]	0.51*** [0.48,0.53]	0.79*** [0.76,0.82]	0.93** [0.88,0.97]
Relation to husband prior to marriage				
No				
Yes	1.17*** [1.14,1.21]	1.24*** [1.20,1.28]	1.22*** [1.18,1.25]	1.25*** [1.21,1.30]
Sex of household head				
Male				
Female	0.93*** [0.91,0.96]	0.95** [0.92,0.99]	0.92*** [0.89,0.95]	0.94** [0.91,0.98]
Number of members in household				
1-4				
5-8	1.44*** [1.41,1.47]	1.25*** [1.22,1.28]	1.16*** [1.13,1.19]	1.37*** [1.33,1.41]
>8	1.67*** [1.61,1.73]	1.66*** [1.59,1.73]	1.28*** [1.24,1.33]	1.68*** [1.61,1.74]
Age of household head				
<55 years				
>=55 years	0.88*** [0.86,0.90]	0.90*** [0.87,0.92]	0.65*** [0.64,0.67]	0.67*** [0.66,0.69]

3.4 District level Prevalence of Early Marriage

Figure 2 indicates the percentage distribution of early marriage before (1996-2005) and after (2007-16) Prohibition of Child Marriage Act, 2006 in Indian districts.

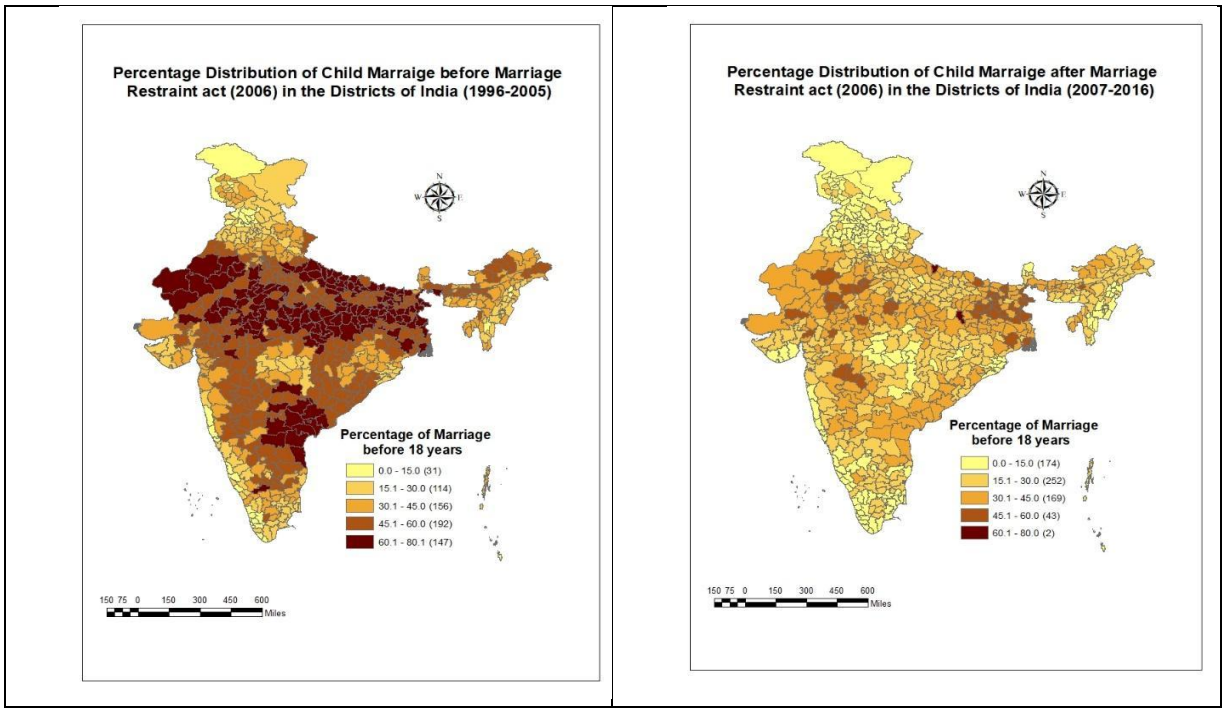


Figure 2. Spatial distribution of early marriage a decade before and after Prohibition of Child Marriage Act 2006 in Indian districts.

In the map of Figure 2, the percentage of marriages before 18 years categorized in five shades of colour. Darker the colour, higher the percentage of early-marriage among different district of India. During 1996-2005, the states like West Bengal, Rajasthan, Madhya-Pradesh, Uttar-Pradesh, Bihar and some parts of Andhra-Pradesh district had higher percentage of marriage before 18 years' ranges (60.1-80.1%) before act. Similarly, after implementation of prohibition of child- marriage act only two district have more than 60% of percentage of marriage before 18 years.

3.5 Univariate and Bivariate Moran's I Statistics

Table 4 indicates the univariate and bivariate Moran's I for the dependent and independent variables.

Table 4. Bivariate Moran's I Statistics showing the spatial dependence for the district level prevalence of early Marriage Before and After Prohibition of Child Marriage Act

District level Percentage of Meso scale Indicators/Variables	Before Prohibition of Child Marriage Act		After Prohibition of Child Marriage Act	
	Moran's I values	Z value	Moran's I values	Z value
Rural	0.76	30.08	0.72	28.74
No Education	0.68	28.74	0.56	24.57
SC	0.66	28.92	0.55	24.24
Hindu	0.74	30.43	0.69	28.10
Poorest	0.52	23.57	0.45	21.30
No Mass Media	0.57	25.26	0.50	22.45
Prior Relation to Husband	0.59	25.62	0.54	23.48
Female Household Head	0.68	28.45	0.62	26.07
1 to 4 Household Members	0.76	30.42	0.70	28.32
Household Head <55 Years	0.78	30.89	0.73	28.88

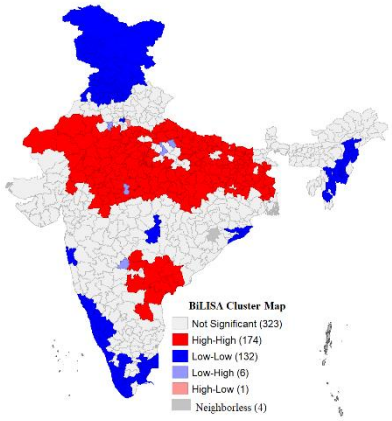
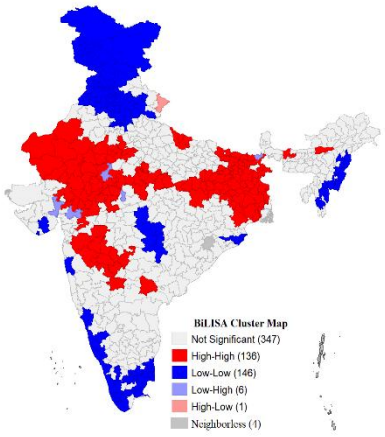
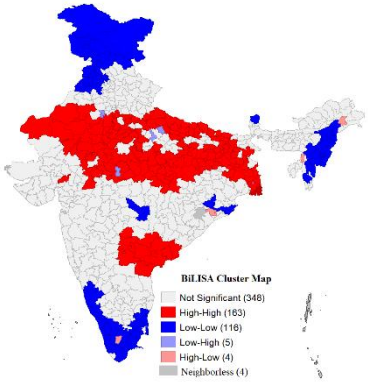
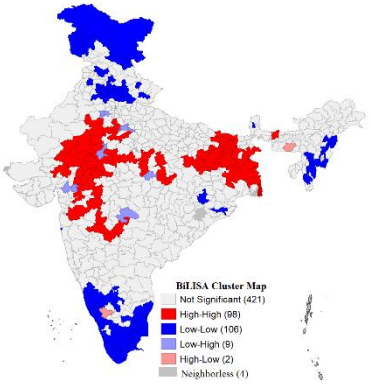
Table 4 shows the spatial dependence for the district level percentage of Meso scale Variables with

early-marriage before and after Prohibition of Child Marriage Act. Bivariate Moran's I value for rural was 0.76 and 0.72 before and after implemented act respectively which shows there is high spatial auto-correlation of early-marriages in the rural-districts of India. Similarly, for Hindu, there was 0.74 Moran's I values before act was implemented and it was decreased to 0.69 after act implemented. No mass-media, prior relation to Husband had Moran I value ranges from 0.50 and 0.54 respectively after the act was implemented. Female household head, 1-4 household members and household head less than 55 years had values around 0.70 for early-marriage which means there was still high spatial auto-correlation of early-marriage even after act was implemented.

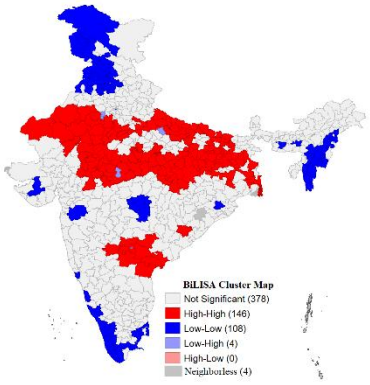
Similarly, from appendix table-1 indicates spatial dependence for the district using univariate Moran's I statistics before and after implementation of act, 2006. Moran's I value and Z-value for early-marriage ranges from (0.79, 31.09) and (0.73, 28.99) before and after act respectively which shows highly spatial auto-correlated. Similarly, for rural, Hindu, 1-4 household members and household head <55 years is more than 0.70 which mean it was highly spatial auto-correlated before act. After act implemented, value more than 0.70 only for rural and household head less than 55 years.

3.6 Bivariate LISA maps indicating the spatial distribution of different covariates of early marriage before and after child marriage prohibition act

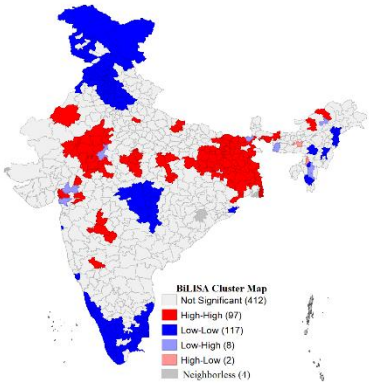
Figure 3 shows the bivariate LISA cluster maps indicating the spatial clustering and outliers of different independent variables across the districts of India, Before and After Prohibition of Child Marriage Act.

Before Prohibition of Child Marriage Act (1996-2005)	**After Prohibition of Child Marriage Act (2007-16)**
A1. Residence (Rural)	**A2. Residence (Rural)**
	
B1. Education (No Education)	**B2. Education (No Education)**
	

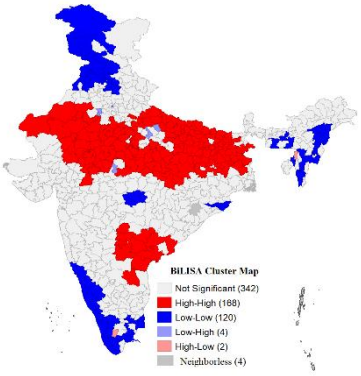
C1. Caste (SC)



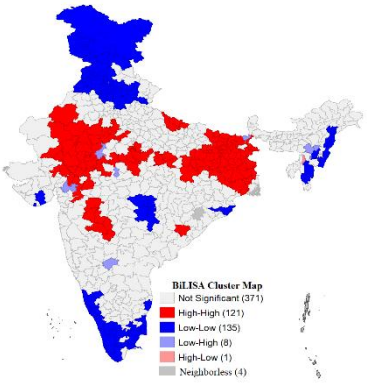
C2. Caste (SC)



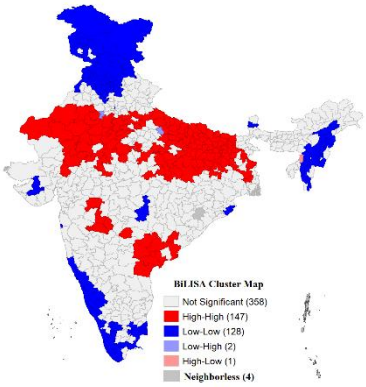
D1. Religion (Hindu)



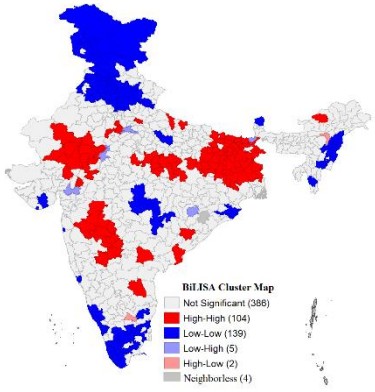
D2. Religion (Hindu)



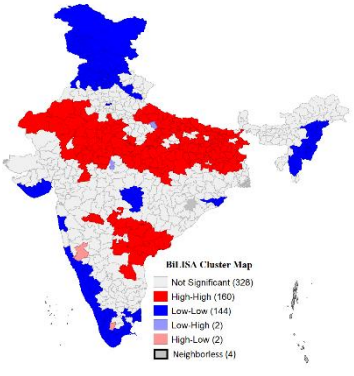
E1. Household Head (Female)



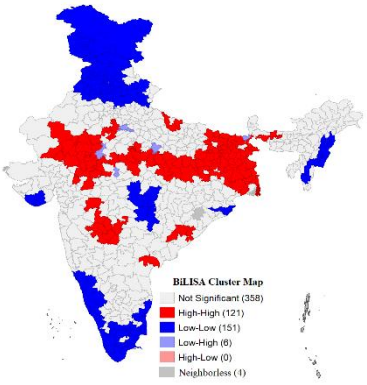
E2. Household Head (Female)



F1. No. of Household Members (1-4)



F2. No. of Household Members (1-4)



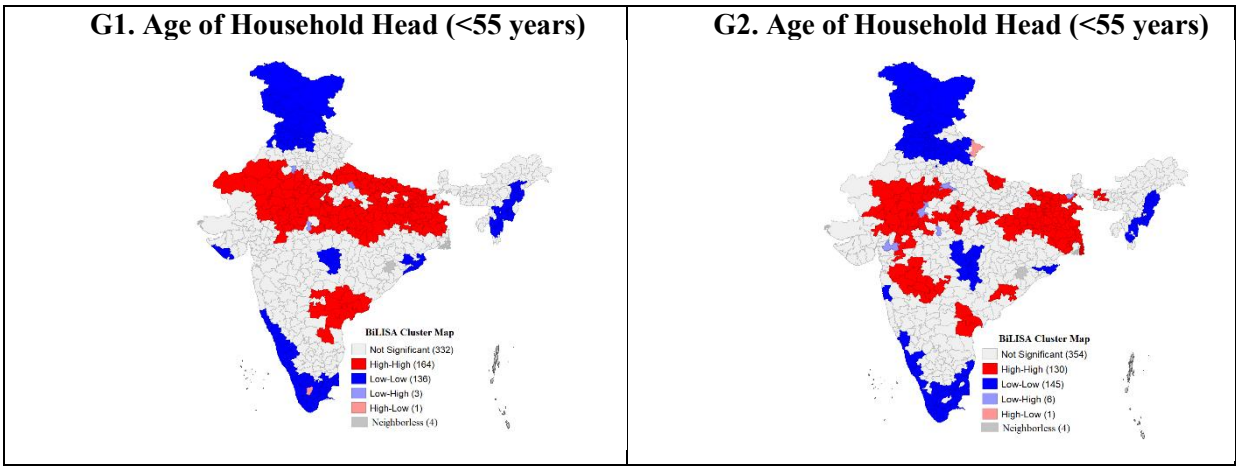


Figure 3. Bivariate LISA cluster maps showing the spatial clustering and outliers of different independent variables across the districts of India, Before and After Prohibition of Child Marriage Act.

In Figure 3, Map A1 indicates 174 hot-spot regions in rural area depicting high regional dependence of child marriage before the Child Marriage Act which includes regions of Uttar Pradesh, Bihar, Madhya Pradesh, West Bengal, Rajasthan, Andhra Pradesh, and Telangana. Map A2 shows 136 hot-spot regions indicating high regional dependence of child marriage after the Child Marriage Act which includes regions of Rajasthan, Madhya Pradesh, Jharkhand, Bihar, West Bengal and a few parts of Maharashtra and Telangana. Map B1 shows 163 hop-spot regions depicting high regional dependence of child marriage before the Child Marriage Act which includes regions of Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan, West Bengal, Andhra Pradesh, and Telangana. Map B2 indicates 98 hop-spot regions depicting high regional dependence of child marriage after the Child Marriage Act which includes a few parts of Rajasthan, Madhya Pradesh, Maharashtra, Bihar, Jharkhand, and West Bengal. Similar results were found in other figures (Map C1, C2, D1, D2, E1, E2, F1, F2, G1 and G2) which shows higher number of hotspots districts were accounted for early marriage before the act implementation and reduced significantly after act implementation.

3.7 Estimates of Ordinary Least Square and Spatial Error/Lag Model Regression Analysis

Further table 5, Ordinary Least Square regression analysis have also been used to show the adjusted coefficient of the correlates for early marriage before and after prohibition of Child Marriage Act in terms of coefficient, standard-error and p-value for district level meso-scale correlates for India. A positive coefficient indicates that as the value of the independent variable increases, the mean of the dependent variable also tends to increase. A negative coefficient suggests that as the independent variable increases, the dependent variable tends to decrease.

Table 5. Result of regression analysis (OLS) showing the adjusted coefficients of the correlates for early Marriage Before and After Prohibition of Child Marriage Act in India

District level meso scale correlates	Before Prohibition of Child Marriage Act		After Prohibition of Child Marriage Act	
	Coef. (SE)	P Value	Coef. (SE)	P Value
Rural	0.095 [0.01]	0.000	0.231 [0.015]	0.000
No Education	-0.003 [0.008]	0.690	-0.006 [0.006]	0.362
SC	0.002 [0.006]	0.778	0.009 [0.006]	0.128
Hindu	0.051 [0.009]	0.000	0.069 [0.011]	0.000
Poorest	0.004 [0.004]	0.317	-0.001 [0.004]	0.965
No Mass Media	0.001 [0.005]	0.783	-0.001 [0.005]	0.900
Prior Relation to Husband	0.015 [0.005]	0.004	0.020 [0.006]	0.001
Female Household Head	0.035 [0.007]	0.000	0.052 [0.008]	0.000
1 to 4 Household Members	0.034 [0.015]	0.022	0.085 [0.015]	0.000
Household Head <55 Years	0.755 [0.022]	0.000	0.492 [0.022]	0.000
R Square Value	0.9893		0.9838	
No of District	640		640	

Table 5 shows that early marriage was significantly associated among rural had coefficient value 0.095 and it increased to 0.231 after act was implemented. No education had negative coefficient and significant association with early marriages i.e. -0.003 before act and -0.006 after act but not significant. Hindu, prior relation to husband, female household head, and 1-4 household members had significant p-value and its coefficient value increased after prohibition of child marriage act, 2006 having R-square value 0.9893 and 0.9838 before and after prohibited act respectively.

Since the OLS confirmed spatial autocorrelation in its error term for the outcome variables (Table 6), we further estimated Spatial Error Model (SEM) and Spatial lag model (SLM). The underlying assumption of a spatial lag model is that the observations of the dependent variable are affected in the neighbourhood areas whereas the spatial error model is used to consider the effect of those variables which are not present in the regression model but have an effect on the outcome variable. Rural, Hindu, prior relation to husband, female household head, 1-4 household member and household head less than 55 years was significantly spatially associated with early marriage before and after act in districts of India. In lag model, rural and household head less than 55 years had significant higher coefficient value i.e. 0.092 and 0.741 respectively. In error model rural (0.234), Hindu (0.072), prior relation to husband (0.021), female household head (0.053)1-4 household member (0.081), and household head less than 55 years (0.486) respectively.

Table 6. Result of regression analysis (Spatial Error/Lag Model) showing the adjusted coefficients of the correlates for early Marriage Before and After Prohibition of Child Marriage Act in India

District level meso scale correlates	Before Prohibition of Child Marriage Act (Lag Model)		After Prohibition of Child Marriage Act (Error Model)	
	Coef. (SE)	P Value	Coef. (SE)	P Value
Rural	0.092 [0.011]	0.000	0.234 [0.015]	0.000
No Education	-0.003 [0.008]	0.695	-0.007 [0.006]	0.274
SC	0.001 [0.006]	0.911	0.007 [0.006]	0.194
Hindu	0.047 [0.009]	0.000	0.072 [0.011]	0.000
Poorest	0.004 [0.004]	0.328	0.002 [0.004]	0.541
No Mass Media	0.001 [0.005]	0.899	-0.002 [0.005]	0.728
Prior Relation to Husband	0.015 [0.005]	0.004	0.021 [0.006]	0.000
Female Household Head	0.035 [0.007]	0.000	0.053 [0.007]	0.000
1 to 4 Household Members	0.032 [0.015]	0.028	0.081 [0.015]	0.000
Household Head <55 Years	0.741 [0.022]	0.000	0.486 [0.021]	0.000
Lambda Value (Lag coefficient)	0.0337		0.211692	
AIC value	2566.76		2495.62	
Pseudo R Square	0.9896		0.9843	
No of District	640		640	

4. Discussion

Although India has progressed in postponing the age of marriage, child marriage continues to be practiced in many parts of the country. Our findings from the study indicate that child marriage is still occurring with 27% even after implication of child marriage act in 2006, 31.7% in rural area and 17.3% in urban area. Findings in our study suggested that education has major role in depleting child marriages in India, in both selected time zone highly educated women were having lowest prevalence of child marriage which was 12.4% and 4.7 before and after child marriage act 2006 respectively. Other literatures also suggested the same that, educational attainment of women has a significant negative association with child marriage, women with primary, secondary and higher education significantly have a lower chance of getting married before 18 years as compare to illiterate women (Hossain, 2016; Kamal *et al.*, 2015; Raj *et al.*, 2014). The possible reason can be the awareness which comes from the education which backlashes the stigma or norms related to child marriage practices (Nguyen *et al.*, 2019; Starmann *et al.*, 2018). Thus, the child marriage prevention programs mainly focus to increase the education level of girls which eventually increase her empowerment, autonomy and role in decision making (Jha *et al.*, 2016; Mehra *et al.*, 2018; RGSEAG – SABLA, 2010).

Child marriage has been shown to lead to host of negative health and social consequences, child

marriage is associated with many adverse effects as well (Paul, 2020; Hossain *et al.* 2022; Paul *et al.*, 2019). In our study it was also found that Child marriage depleted among schedule caste and schedule tribe after the implementation of child marriage act. Among religion Christian have lowest association with child marriage for both before and after implementation of child marriage act. Child marriage has been linked with a set of demographics, economic, spatial and social impacts which have been confirmed in various setting of this study. Studies shows that child brides are more likely to experience unintended pregnancy, high fertility and low percentage of contraceptive use. They have reduced access to universal health facilities and specifically mental health care (Paul and Chouhan, 2019; Elnakib *et al.*, 2022). They are often in a relationship characterized by large age differentials with their husband and as a result may have reduce bargaining power and decision making (Lal, 2018).

The economic status is significantly associated with child marriage in India. In this study it was found that Child marriage is highly associated with poorest, poorer and middle categories of wealth quintile whereas richer and richest has been comparably less associated i.e., the study has found that women of poorest category have higher chances of getting marriage at early compared with women from richer or richest category (Jain and Kurz, 2007; Paul, 2019). Many more studies, both in India and outside, back up this finding (Paul, 2020; Paul, 2019; Pau *et al.*, 2018; Gayawan and Adebayo, 2014). As marriage of girls before age 18 years is a fundamental violation of their human rights including their sexual and reproductive health. It is also a threat to the prosperity and stability of country, as per study it was found that poverty is one of the major factors underpinning child marriage (Raj, 2010; Kyari and Ayodele, 2014). According to a study conducted in Telangana's Warangal district, 50% of those who married before the age of 18 come from economically poor families, 60% have adopted the nuclear family system, 50% are illiterates, and 25% have studies below the eighth grade, and more than 90% of girls earn less than Rs 11000 per year (Lal, 2018).

It is also found that women living in rural areas have a higher prevalence of child marriage compared to women of urban area. Women in urban areas are more aware about the consequences of bearing child at early age since they are more educated and empowered than women in rural areas. Some studies conducted in Bangladesh also support this finding of the study (Hossain *et al.*, 2016; Kamal et al, 2015). The present study has also found the prevalence of child marriage is higher among Hindu women compared to Muslims and women from other religious groups since among Hindus it is believed that women should not kept with family after having menstruation therefore daughters are married off soon after the onset of puberty (Caldwell *et al.* , 1983).

Mass media is strongly associated with lower levels of child marriages. Mass media includes reading newspapers, having access to television, radio, and mobile phones. Having mobile phones strongly correlates with lower levels of child marriages (Raj, 2010). Having access to all these represents higher socioeconomic status which is again associated with lower levels of child marriages (Efevbera *et al.,* 2019). The National Family Health Survey says around three-fourth of the women who use mobile phones comes from the highest wealth quintile household and same is the case with newspaper access also (NFHS-4, 2015-16). In short, mass media connectivity has negative correlation with child marriages because the programmes or awareness campaigns by government spreads through these tools among communities. The use of mass media creates the pathway for messages to reach among the communities and amplifies the reach and impact of the programmes (Amin *et al.*, 2018; Gage, 2013).

From spatial analysis it is found that by considering place of residence at rural before the implementation of act there were 174 hot spots regions in India where the child marriage was in practice and these hotspots include regions of Uttar Pradesh, Bihar, Madhya Pradesh, west Bengal, Rajasthan, Andhra Pradesh and Telangana, after the implementation of act the hotspots reduced to 136 which includes region of Rajasthan, Madhya Pradesh, Jharkhand , Bihar, west Bengal and few cities of Maharashtra and Telangana, the major decrement of hotspots found in state of Uttar Pradesh, similar results has been found by taking other variables into consideration. As in Uttar Pradesh, the government has launched a programme at state level to combat the practice of child married and to increase awareness regarding consequences of child marriage which is A National Consultation on Prevention of Child Marriage that helped in formulating the Child Marriage Prohibition act. In many states improved access to educational attainment and employment prospects contributed in decline of child marriage, also many states-initiated programmes that enable people to break the boundaries and outreach all the social norms

helped in building skills and halt the practice of child marriage (Bhat, 2005). Findings from this study underline the need for understanding the spatial, cultural and social behavior for assessing the impact of the Child Marriage Prohibition Act 2006. Spatial heterogeneity is one of the major driving forces of child marriage. The socio-demographic factors of each district and the characteristics of neighbouring districts highlight the nature of child marriage or the age of marriage (Cislaghi *et al.*, 2020). People with same caste or community usually reside in neighbouring districts (Dheer *et al.*, 2015). And in India marriages used to occurs usually in the same caste or community (Kaur & Palriwala, 2018).

Child marriage is a complex phenomenon and to eliminate the child marriage practice several international Commitment, national acts and legislation have been organized in the past but it remains a common practice in India. Although over the past two decades India has perceived a substantial decline in the prevalence of child marriage however the absolute number of child marriage is still large in the country. According to the NFHS-4 (2015–2016), about 27 per cent of the women are married before 18 years and 7 percent of the women get married before 15 years (NFHS-4, 2015-16). There are many studies which have been done on the age at marriage of females in India (Caldwell *et al.*, 1983; Bloom & Reddy, 1986; Sivaram *et al.*, 1955). Some studies have been done to find the incidence of child marriage across various states, districts and regions of India and found that the prevalence of child marriage has decreased at a slower rate between 1992–1993 and 2005–2006, while child marriage has declined at a much faster rate between 2005–2006 and 2015–2016 (Pramila, 2013; Srinivasan & James, 2015). This is mainly due to the enforcement of the Prohibition of Child Marriage Act, 2006. First child marriage act was enacted in 1929 known as sarda act after that child marriage restraint act came into force in 1976 and the section 3 of this act states that male above 18 years married with a girl of age less than 18 years should be punished with imprisonment extended to 15 days or with a fine of 1000 rs or both, male above 21 years of age contracting child marriage shall be punished with imprisonment extended to three months including fine (Pramila, 2013). The punishment prescribed under this act was very minimal therefore child marriage prohibition act came into force in 2006. Under this act a man who is 18 year and age and married a girl of age less than 18 years then man can be punished with two years of imprisonment or with fine that may extend to one lakh rupees or with both, similar punishment will be enacted for the person who conduct child marriage or permits child marriage (Act No. 6, 2007). The strictness in the prohibition act causes the decline in child marriage in many states as well as in this country. However not only the law but, the upgrading in educational attainment, standard of living and enrichment in women empowerment have made significant progress in declining trends of child marriage practice, as it has been totally showed in this study.

This study has some limitations. Cross sectional data has been used for the analysis which is self-reported therefore there are chances of recall bias and social desirability bias, causality between child marriage and socio-economic characteristics of women cannot be accesses or determined from the findings of this study due to the cross-sectional data has been used for the analysis. The study has examined the socio-economic correlates of girl child marriage which include characteristics of the husband's family but the actual scenario should determine by women's native place since socio-economic characteristics of the husband's family may differ from women's native place parental family.

5. Conclusions

In India marriage is social process expressed in the form of rituals and symbols. It is one of the important social establishments and it is a means of establishing a family through which the society prolongs. The current study has examined the influence of enforcement of law on child marriages among girls. The findings of this study show that the prevalence of child marriage has substantially declined after implementation of child marriage act but this declining trend of child marriage has been accompanied by many factors apart from enforcement of laws against child marriage practice. This study shows strong association between female educational attainment and child marriage since women with higher educational attainment have higher job aspirations, which may lead to postponement of early marriages. Furthermore, improving the economic status of the household could be an effective means to eliminate the practice of child marriage recommends an improvement in access to secondary and higher education among young girls. As a result, it would enhance female sovereignty and marriage decision-making in the household therefore the chances of getting married during childhood become lower. Over

the time , the improvement in the act has been observed therefore the rate of child marriage has substantially declined during the past two decades hence the Prohibition of Child Marriage Act, 2006 is found to be effective in excretion of the practice of child marriage Besides, policymakers and programme administrators should pay special attention to communities who reside in rural part of India and to the group of population which are socially disadvantaged where most of the child marriages have taken place.

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Conflicts of Interest

The authors declare no conflict of interest.

Author's contribution

Conceptualization: BAHADUR, B.; SINGH, A.; GUPTA, J. **Data curation:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Formal analysis:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Funding acquisition:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Investigation:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Methodology:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Project administration:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Software:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Resources:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Supervision:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Validation:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Visualization:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Writing - original draft:** BAHADUR, B.; SINGH, A.; GUPTA, J. **Writing - review and editing:** BAHADUR, B.; SINGH, A.; GUPTA, J.

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