Childlessness and its association with fertility in India: A Spatio Temporal Analysis

Abstract

Infertility or childlessness is an issue of global concern. Though childlessness has been an essential feature of the population of the developed world but the situation is altogether different in developing country like India. Childlessness has increased remarkable in India (WHO, 1995). Thus using data from Census of India 2001 and 2011, this paper tries to make a spatial analysis of childlessness at district level in India and its association with fertility. The result indicates that for the last two decades (2001 and 2011) there is a high-high association of childlessness in the southern states and low-low association in the districts of the north-western and northern states. Both the spatial error model and fixed effect model indicates that there is an inverse relation of childlessness and TFR. Thus a spatial analysis of childlessness and its relation with fertility throws some light on the much unexplored area in India context.

Key Words: *Childlessness, Infertility, Spatial analysis, spatial error model, fixed effect model*

Background

Infertility or childlessness is an issue of global concern. Though used identically there is a marked difference between the two. Childlessness is the failure of a couple to have a live birth, whereas infertility is the failure to conceive. WHO (1991) defines infertility as failure to conceive despite two years of cohabitation and exposure to pregnancy. If the couple has never conceived despite cohabitation and exposure to pregnancy (not contracepting) for a period of two years, it is called primary infertility; primary infertility is also referred to as primary sterility. If a couple fails to conceive following a previous pregnancy, despite cohabitation and exposure to pregnancy (in the absence of contraception, breastfeeding or postpartum amenorrhea) for a period of two years, it is secondary infertility; this is also known as secondary sterility. But infertility and childlessness as a whole imply that couples do not have a child.

Infertility affects 50-80 million couples during their reproductive life (WHO, 1991). Childlessness has been an essential feature of the population of the developed world right from the beginning of 19th century. Great Depression marked the peak of childlessness in USA. A study made in the United States concludes that roughly 20% women born in early and mid-1950s remained childless, while half of the white women were childless at the age of 25 (Morgan, 1991). Another study revealed that ever married white women who were 45 to 49 years old in 1950, 19.5 percent reported being childless. Most of the studies have pointed out that infertility or childlessness may be attributed to the voluntary causes. This largely puts forward a secular phenomenon of decline in importance of parenthood. Willkie (1981)

explained that these phenomena were largely noticed by the higher educated women, interested in pursuing a career.

The situation is altogether different in developing country like India. Motherhood is a blessing and one who cannot procreate is considered as a curse to the society. Stigmatization and discrimination are often associated with childless men and women (Runganga et. al. 2001). Women are the one who is always blamed and bear the major burden of infertility. This burden may include blame for reproductive failure, which is followed by a list of emotional and mental distress resulting in anxiety, depression, frustration, griefand fear, marital distress leading to abandonment, divorce, or polygamy.(Greil 1997). Yet there has been an increase in childlessness over time.

As per DLHS 3 survey around 8.8% of currently married women in reproductive age group had infertility problems in India. At the national level, around 6% women have primary infertility whereas 2% have secondary infertility. The WHO estimates the overall prevalence of primary infertility in India to be between 3.9 to 16.8 percent (WHO, 1995). Based on the census reports of India for 2001, 1991 and 1981 researchers show that infertility in India has increased since 1981. The marital infertility rate has gone up from 11 to 16 percent. The incidences of infertility are increasing day by day. It may be due to many reasons, as HIV/STD, stress, the way of living, job pressure, postponing parenthood, obesity etc. The phenomenon of ‘voluntary infertility' evident in the western world has reached the country. Women nowadays are educated, independent, career-minded, and defer marriage or childbearing till they can afford all the good things in life. This results in late marriage. With age, the fecundability reduces, as a result, these women remain childless.

It is also evident that in the past decade's world has experienced a major decline in fertility. During the past half-century, the TFR declined from 5 children per women to 2.5 children per woman from 1950 to 2010. The decline in TFR for the developed world has a long history and dates back to as early as the 1900s (Kohler, 2005). But for the developing world, the process is relatively new. In Asia, Japan was the first country to experience the decline in TFR followed by Singapore, Taiwan, and Korea. Even by the 1970s, many countries in Asia still belonged to the high fertility group (Silva 2008). Some of the districts in India is yet to reach replacement level fertility. The factors for such a rapid change has been a concern of research among many social scientist and demographers. India was the first country to launch the family planning programme for reducing population growth in 1952 (Kulkarni and Rani 1995; Gubhaju 2006; Bhat 2002; Haub 2011). But, hardly any change was found in fertility level in the 1960s, (Kulkarni 2011). But, the Sample Registration Survey (SRS) results showed a decline in the

crude birth rate from 36.6 in 1972 to 33.3 in 1978. Preston and Bhat (1984) argued that a large share of this decline probably occurred in southern states (Kerala and Tamil Nadu). Thus from the very beginning, there has been a huge state differential in the fertility trends in India. Thus past research studies have shown that there has been an increase in childlessness over time and a decline in total fertility rate in India.

Need for the Study

India is a country, where pronatalist norm leads to a higher fertility and the infertile couples especially the women is regarded as a curse to the society. According to Meade (1979), along with lack of industrialization, low educational standard, limited mass communication, cultural factors such as universal and early marriage and childlessness as a social disgrace are important factors affecting population explosion in India. Though the cause of infertility and or childlessness cannot be attributed only to factors pertinent for women, yet it is the women who are looked down upon. The International Conference on Population and Development (ICPD) Programme of Action states that reproductive health services should include the prevention and appropriate treatment of infertility (United Nations, 1994), there is an inadequate focus on infertility in India's reproductive health programme. Traditionally, childless women in India experience stigma and isolation. A women's identity if often threatened when she cannot have a child. This creates anxiety and is a cause of lower self-esteem and a sense of powerlessness. Childlessness not only impacts society in terms of the stigmas associated with it but plays a dominant role in determining the future needs of various services housing, education, healthcare, demand for various consumer goods etc. (Kreyenfeld, 2017). Childlessness cannot be differentiated from fertility. It may be correct to say that the fertility levels of any population are very much influenced by the levels of childlessness (both voluntary and involuntary) in the population and it plays an important role in determining both levels and differentials of fertility. The evidence in the past has suggested that the decline in impaired fertility leads to an increase in the total fertility rate (Larsen 1996). However, in the recent years, infertility has received considerable international attention (Bonnar et al. 1984; Belsey 1978;Leridon 1979) but its worldwide extent has never been systematically described.

There is a dearth of studies in India exploring the dynamics of childlessness and its relation to fertility. Demographers and social scientist mostly focus on the trends and levels of fertility as it is considered an essential component of demography. While TFR is still above replacement level for most of the states and districts, studies mainly focus on the factors affecting fertility and means of limiting the fertility.

In some of the regions, infertility is found to be widespread and its prevalence reaching such proportions that it can well be considered as a public health problem affecting the lives of the whole society (WHO 1991). Thus it is important to make a detailed study of this much-unexplored area. Unfortunately, available studies are mostly at the state level and fail to provide a proper explanation of why there are certain pockets of high infertility. A district-level analysis of childlessness and its relation with fertility is essential to explain the factors affecting childlessness. There is a need to explore this unexplored phenomenon. Hence, this study makes an attempt to answer these questions by drawing upon evidence from available sources at district level for the last two decades i.e. 2001 and 2011.

Data and Methods

The entire analysis has been done using data from Census of India 2001 and 2011. Census is conducted throughout the country by the Registrar General and Census Commissioner of India under the Ministry of Home Affairs, Government of India. The 2001 and 2011 census data was gathered from 29 states and 6 union territories of India divided into 593 and 640 districts respectively. District Level Household Survey (DLHS 1) conducted in 1998-99 by International Institute for Population Sciences, Mumbai has also been used for the analysis. The DLHS provides district wise information on maternal and child health, family planning, reproductive health.

Outcome Variable

The outcome variable used in the analysis is childlessness. Childlessness is defined in a number of ways (Mascarenhas et al.,2012; Rutstein and Shah, 2004; WHO, 2006; WHO-ICMART, 2009). It can be distinguished on the basis of voluntary and involuntary (biological) causes. Since this paper does not try to distinguish between voluntary and involuntary causes, childlessness has been calculated as the percentage of women childless at the age group 45-49 years (Singh et.al., 2017).

Predictor Variables

The predictor variables chosen for the analysis includes the total fertility rate, percentage of urban population, percentage of Muslim population, percentage of SC-ST population, percentage of literate females, percentage of population belonging to the poorest and richest wealth quintiles. The predictors have been calculated using the Census of India 2001 and 2011 data. District level estimates of TFR has been calculated using total number of births in the preceding year and the total number of women in the 5-year age groups. The calculated TFR has been matched with SRS. The wealth index have been calculated using micro level housing

data on a sample basis provided by Census 2011 for the first time (ORGI, 2011). These data include information on household ownership, household type, electricity availability, types of wall, types of floor, roof type, water availability, type of bathroom and latrine use, drainage and sewerage, type of fuel use, availability of different modes of communication and different modes of entertainment. These have been used to estimate a wealth index at the national level by means of principal components analysis (PCA). The index was subsequently coded into five quintiles – poorest (bottom 20% of households), poorer, middle, richer and richest (top 20% of households). Since the analysis has been done using both 2001 and 2011 census, for 2001 census DLHS 1 data has been used to calculate the wealth index.

Methodology

The paper is mainly based on spatial analysis of the pattern of childlessness in India over the last two decades. So in order to accomplish this descriptive maps had been generated using ArcGIS which were exported to Geoda for spatial analysis, First-order contiguity matrix has been used as weight for analysis purpose.

Moran's *I*, univariate and bivariate Local Indicators of Spatial Association (LISA) has been estimated. Moran's *I* is the Pearson coefficient measure of spatial autocorrelation (Moran, 1950) which measures the degree to which data points are similar or dissimilar to their spatial neighbours. Negative values indicate negative spatial autocorrelation and a positive value indicates a positive spatial autocorrelation. Positive autocorrelation indicates that points with similar characteristics are closely distributed in space, whereas negative spatial autocorrelation indicates that closely associated points are more dissimilar. Values of *I* range from −1 (indicating perfect dispersion) to +1 (perfect correlation). A zero value indicates a random spatial pattern. Univariate LISA measures the correlation of neighbourhood values around a specific spatial location. It determines the extent of spatial clustering present in the data. Bivariate LISA measures the local correlation between a variable and the weighted average of another variable in the neighbourhood.

Spatial error model available in Geoda has also been done to examine the relationship between dependent and the independent variables (Anselin, 2005). This model evaluates clustering of an outcome variable that is not explained by the independent variables. Spatial clustering is explained with reference to the clustering of the error terms. The spatial error model can be mathematically expressed as

$$\boldsymbol{y = Xb + u}$$

with, $\boldsymbol{u = m.\ W.\ u. + e}$

where, *u* is the model prediction error; *e* are the residues (spatially uncorrelated); *m* is the spatial auto regressive parameter; and *W* is the spatial weights matrix.

Fixed effect OLS regression has also been done. The two year decadal data has been compiled together and then after making the data panel the regression has been done. In panel data where longitudinal observations exist for the same subject, fixed effects represent the subject-specific means. In panel data analysis the term fixed effects estimator (also known as the within estimator) is used to refer to an estimator for the coefficients in the regression model including those fixed effects (one time-invariant intercept for each subject). This accounts for the controlling the unobserved heterogeneity in dependent variable over time and space. The equation for the model is

$$\mathbf{Yit = \beta 1 Xit + \alpha i + uit}$$

Where

– αi (i=1….n) is the unknown intercept for each entity (n entity-specific intercepts).

– Yit is the dependent variable (DV) where i = entity and t = time.

– Xit represents one independent variable (IV),

– β1 is the coefficient for that IV,

– uit is the error term

This part of the analysis has been done using STATA 13 software.

Results

Prevalence of childlessness in India

The present analysis has been done for two census years 2001 and 2011. It is seen that the percentage of women childless at the end of reproductive period i.e. age group 45-49 years has increased from 6.11 to 6.74. Higher percentage of childlessness is found in the north-eastern states and the southern states, while lower percentage is observed in the northern states. In 2001 Tamil Nadu had the highest percentage of childless women (10.85) followed by Meghalaya (10.56), while Haryana had the lowest percentage of childless women (2.37). In 2011, Goa had the highest percentage of childless women (10.13), with an increase of about 4.5% between the two decades. The total fertility rate (TFR) decreased from 2.52 to 2.17 over the two decades. It is seen that the areas of high childlessness exhibits low TFR. Southern states have low TFR, while the northern states had higher TFR.

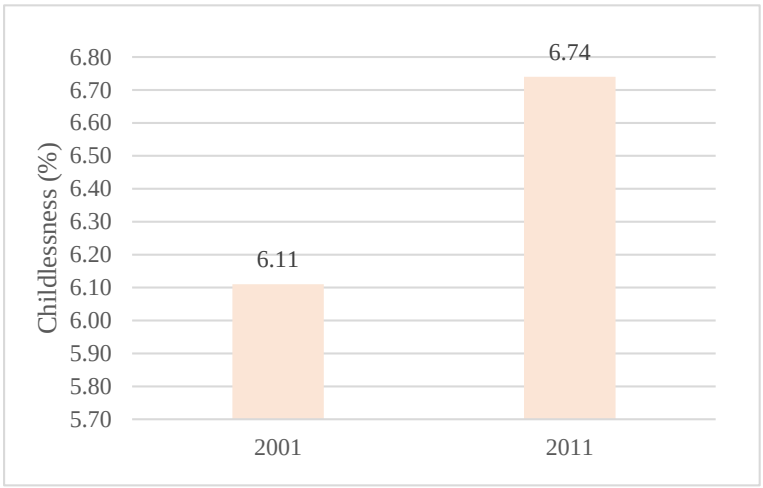


Fig 1: Percentage of childless women, India

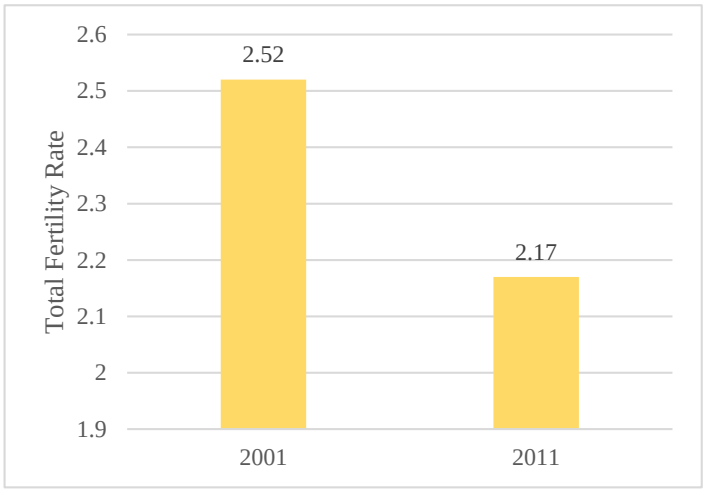


Fig 2: Total fertility Rate, India

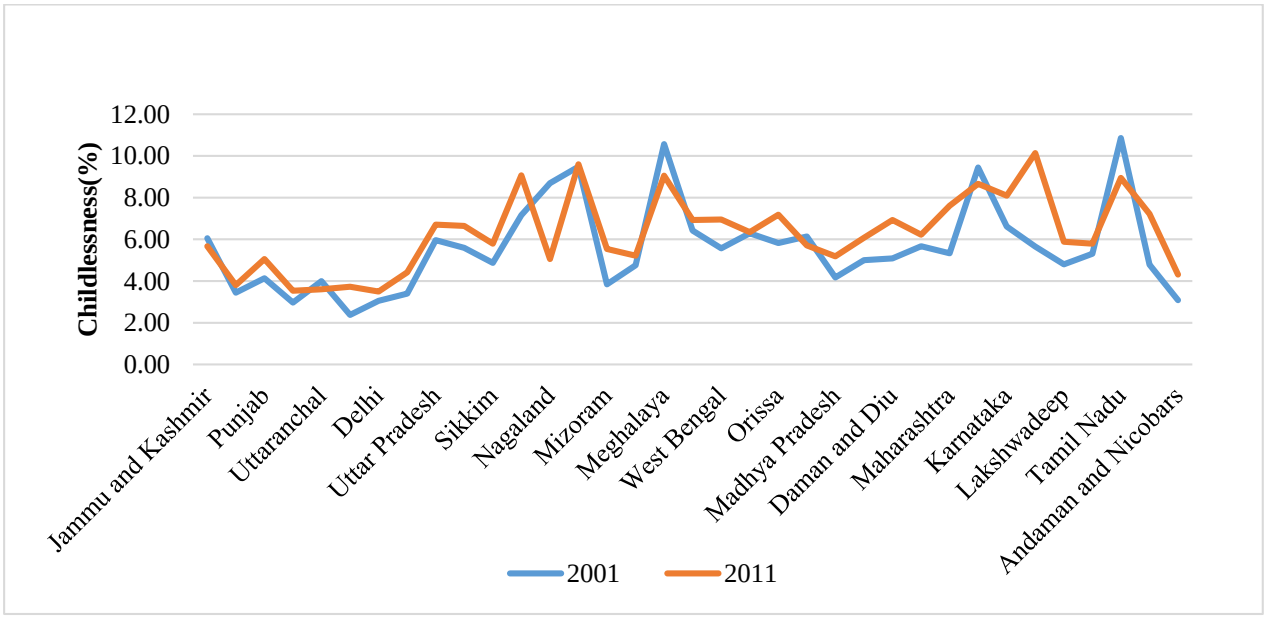


Fig 3: Trend in childlessness in Indian States and Union Territories

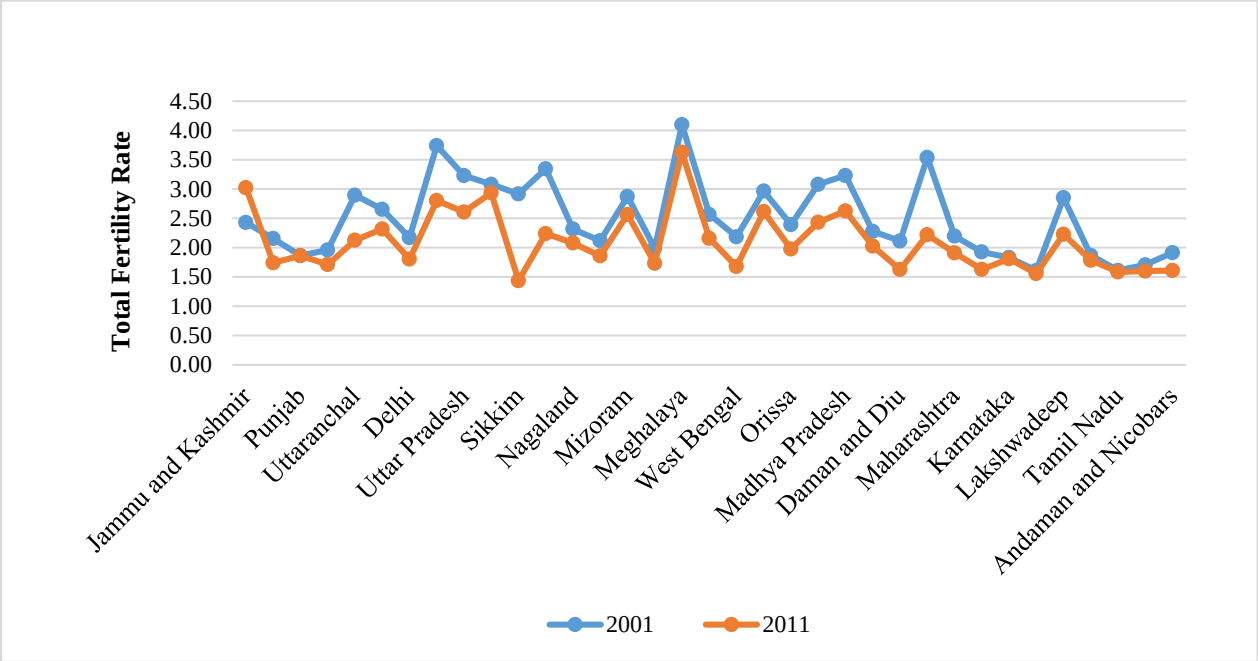
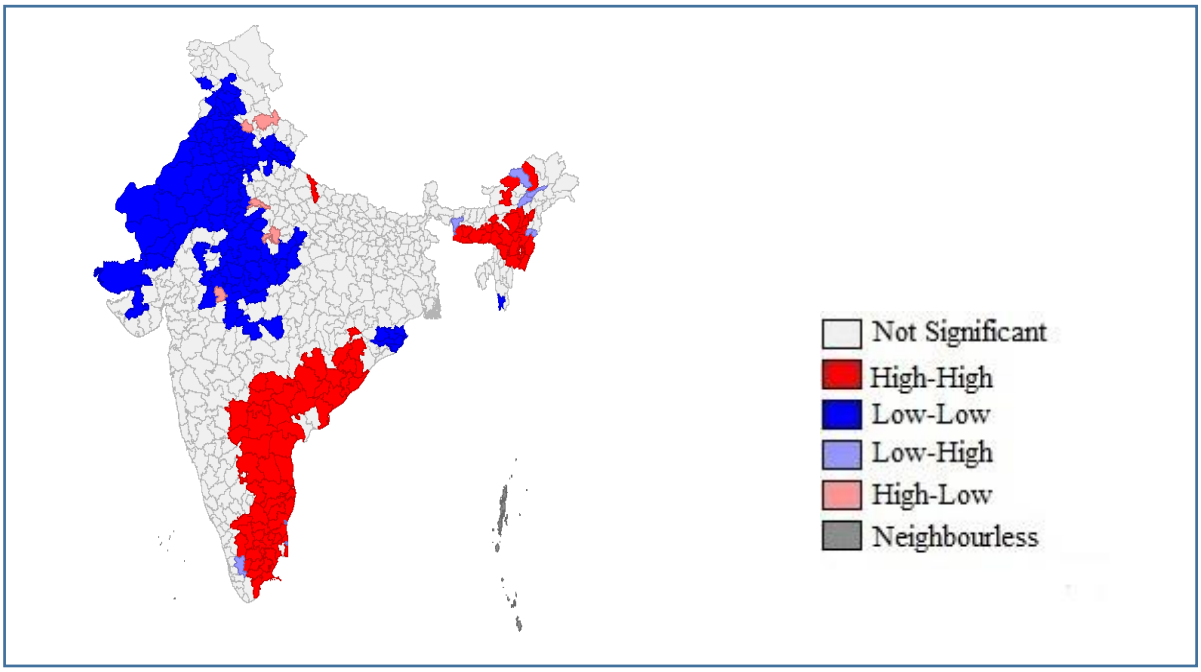


Fig 4: Trend in TFR across Indian States and Union Territories

Spatial Autocorrelation and LISA Maps

Using the district level data spatial analysis has been done and LISA maps generated. The cluster map shows locations that have significant local Moran's *I* values classified by the type of spatial correlation. The dark red colour indicates high-high association, the dark blue indicates low-low association, the light red colour indicates a high-low association and the light blue indicates a low-high association. For example, high-high childlessness means that districts with above-average percentage of childless women share boundaries with neighbouring districts that have above-average percentage of childless women (fig 5 and 6). On the other hand, high-low means that districts with above-average childless women are surrounded by districts with below average values. High-high are also referred to as hot spots and low-low as cold spots (Iwasawa et al., 2009; Sridharan et al., 2011).

Fig 5: Univariate LISA Map showing clustering of childlessness in Indian districts, 2001



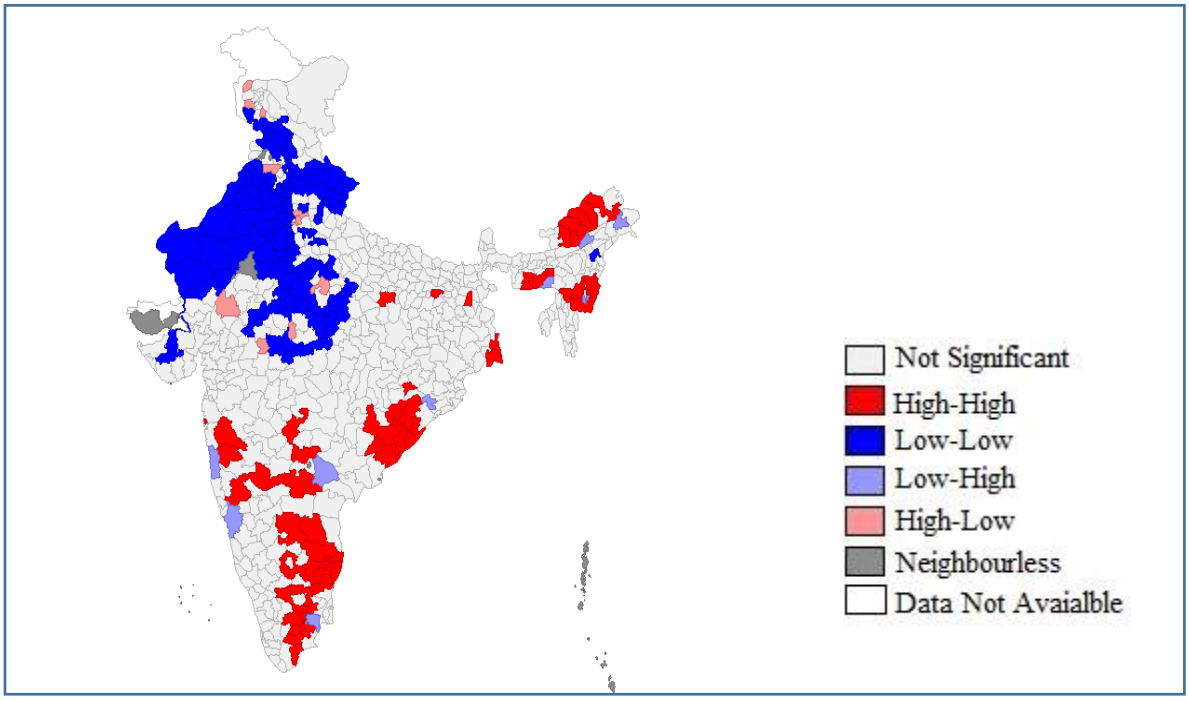


Fig 6: Univariate LISA Map showing clustering of childlessness in Indian districts, 2011

The cluster maps show a high-high association of childlessness in districts of the southern states and a low-low clustering in the districts of the north-western states. Several districts in north-eastern India also show clustering of high childlessness, while low childlessness is clustered in northern and central districts as well. As is indicated in fig 7 the Moran value also shows a high

spatial auto correlation among the districts. The Moran value has declined from 0.633 to 0.472 from 2001 to 2011.

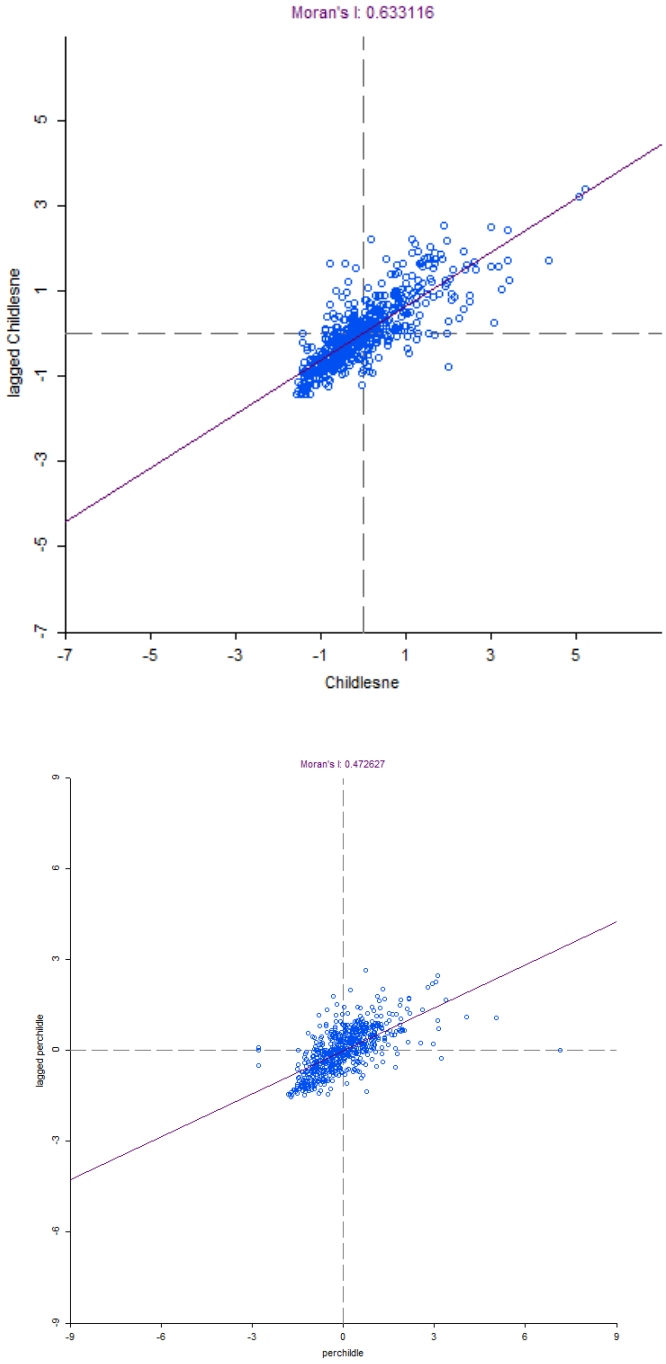


Fig 7: Moran I values for Childlessness

Bi-variate LISA map showing spatial autocorrelation between the dependent variable that is childlessness with TFR has also been plotted and Moran's I value has been generated for the same. It is seen in figure 8 that in 2001, a high low spatial association of childlessness and TFR exits in the southern districts while a low-high association in the western central and few districts of Uttar Pradesh. A high-high association exists in few districts of Uttar Pradesh, Bihar and the north-eastern states, while a low-low association exists in few districts of the northern states. The Moran I value of -0.21 indicates that there is an inverse spatial relationship between childlessness and TFR, which is truly represented in the LISA map. Similarly for 2011, as is shown in figure 9 that childlessness has an inverse relation with TFR. A high-low correlations is located mainly in southern India. A few eastern districts also exhibit such correlations. In comparison, high childlessness are significantly correlated with low TFR in western and central districts. There are a few outliers as well. As in case of 2001, in 2011 the Moran's I value of -0.11 indicates that there is an inverse spatial relationship between childlessness and TFR.

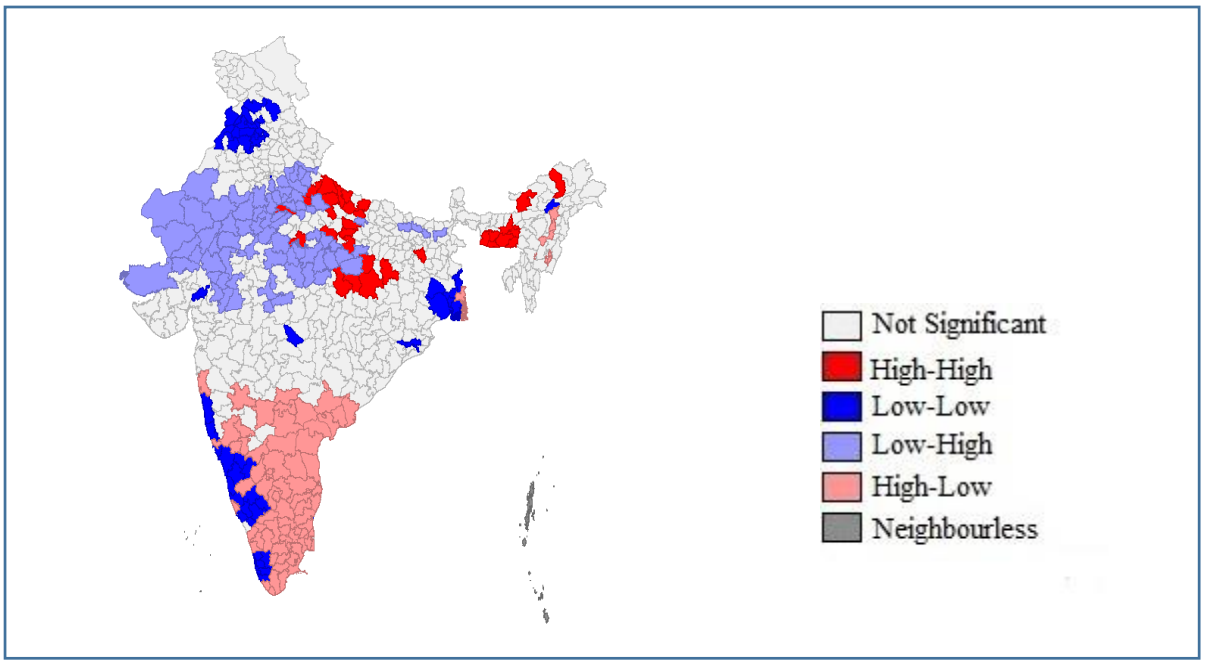


Fig 8: Bi-variate LISA map showing correlation between childlessness and TFR in Indian districts 2001

OLS Regression Models

In order to see whether a value observed in one location depends on the values observed at neighbouring locations i.e. spatial dependence, spatial error model has been used which is presented in table 1. The models show spatial clustering while examining association between LBW and independent variables. After checking for multi-collinearity the results has been presented. Model 1 includes spatial error model for 2001 and model 2 includes the results for

2011. The lambda value is significant for both the model and the value indicates high spatial dependence.

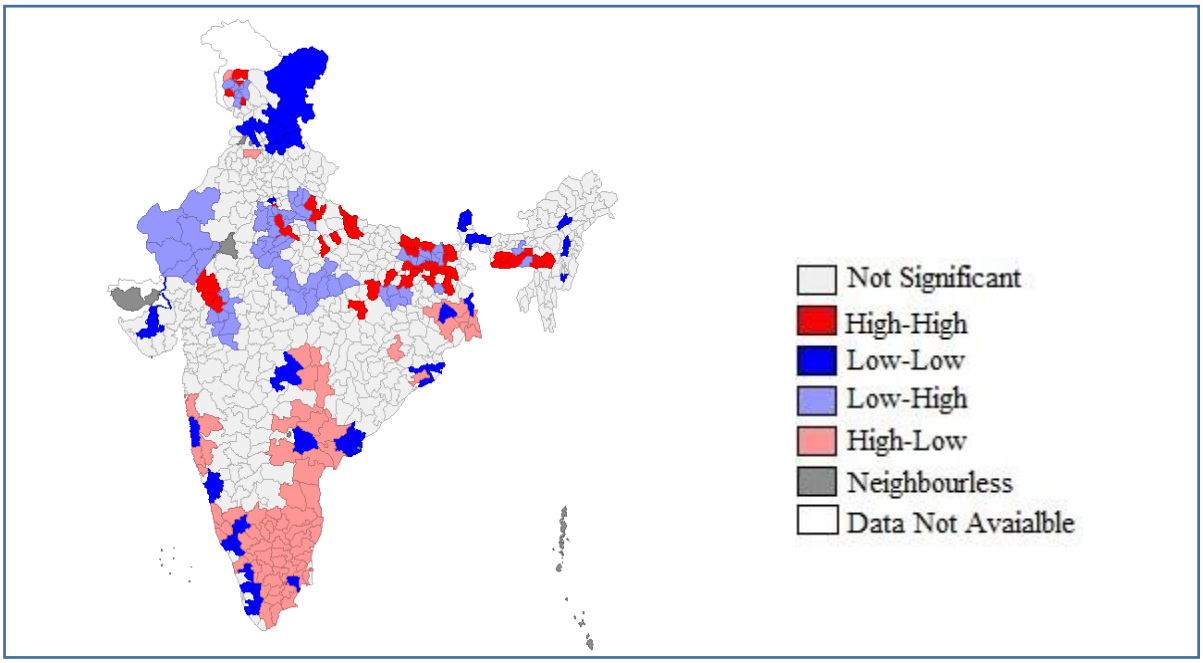


Fig 9: Bi-variate LISA map showing correlation between childlessness and TFR in Indian districts 2011

Table 1: Results of regression model for childlessness, Indian districts

Variables	**Model 1**	**Model 2**	**Model 3**
TFR	-1.2513**	-0.01357**	-0.7308**
Percentage Urban	0.0150**	0.0349**	0.0262**
Percentage Muslim	-0.0012	0.0164**	0.0311**
SC/ST	0.0236**	0.03415**	0.0251**
Female Literacy	-0.0455**	-0.0060**	-0.0192**
Poorest	-0.0137	-0.0026	-0.0028
Richest	-0.0148*	0.0151	-0.0008
Year (Dummy/Panel)			0.2679***
Spatial Autocorrelation	0.792**	0.693**	
R Square/ Psuedo R Square	0.663	0.491	0.590
Number of observation	593	640	1233

Note: ** p<0.05 *<0.10; Model 1 includes Spatial Error Model for 2001; Model 2 includes Spatial Error Model for 2011 and model 3 includes Fixed Effect Regression (OLS) based on panel data created for both census years

It is seen that there exists a negative relation with TFR i.e. with an increase in TFR there is a decline in childlessness. Childlessness has a positive association with percentage of urban population and the SC/ST population. While it has a negative association with the female literacy i.e. with increase in literacy there is a decline in childlessness. The third model includes

the regression results after keeping the districts fixed. After fixing for the unobserved heterogeneity in terms of different values of childlessness and independent variable the result are similar with the other two models and indicates a negative relation between childlessness and TFR.

Conclusion

In Indian context childlessness is an issue that has not been of much concern among the researcher. The univariate and bivariate LISA maps gives a clear picture of the spatial clustering of the variables. Univariate LISA maps shows the areas (districts in this case) where childlessness is high. The bi-variate maps have tried to check the association between childlessness and TFR. It could be concluded that with an increase in childlessness there is a decrease in TFR and vice-versa (Singh et.al, 2017). Analysis of childlessness among married women aged 40-44 and 45-49 years based on the 2001 Census also depicts high rates of childlessness along the southern and eastern coasts (Ram, 2006). The data from the 1981 Indian Census also suggest a similar pattern among married women aged 40-44 and 45-49 years. A study by Agrawal et al. (2012) suggests a high prevalence of childlessness in all the southern states. Unisa (1999) also finds high levels in Andhra Pradesh. Using data from the National Family Health Survey 2005-2006, Ganguly and Unisa (2010) found that prevalence is highest in the southern states. The significant lambda value in both the models indicate relationship between childlessness and independent variables at the macro-level (districts) may be misleading if spatial clustering is ignored.

Though childlessness is high in the southern states and there exists a north-south distinction, yet, the epidemiology of childlessness in India has rarely been explored. Through this paper, the spatial pattern and trend of childlessness have been explored for two time periods (census year 2001 and 2011). The paper has also tried to establish a relation between childlessness and fertility in India. Here the analysis restricts to zero parity children and does not classify into voluntary and involuntary childlessness. Childlessness is an issue of concern and has many factors associated with it. In Indian context a childless women is considered as a curse to the society. With development childlessness has been increasing, but whether it is because of biological factors or involuntary causes has to be checked. A focus is also needed for the outliers that is regions where there is high-high association of childlessness and TFR and low-low association of the same. Such outliers are mostly observed in the state of Uttar Pradesh, Bihar (high-high) and Punjab, Himachal Pradesh (low-low). Focus should be on the states

which indicates a high childlessness and high fertility. With limited study in spatial pattern of childlessness and its association with TFR, this study would shed some light in the area which needs some concern.

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