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Household and community socioeconomic and environmental determinant of child morbidity in India: A multilevel analysis of pooled data from three Demographic and Health Survey

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Abstract

Child morbidity is a leading cause of mortality among children in developing countries more specifically in India. While researchers have devoted considerable attention to the important of individual level factors on child health, less is known about household, community and environmental factors affecting child health. Thus, this paper examines the household, community socioeconomic and environmental determinants of child morbidity (diarrhoea, fever and Acute respiratory infection (ARI)) in India. The present study utilizes data from India Demographic and Health Survey called National Family Health Survey conducted in 1992-92, 1998-99 and 2005-06. The study uses pooled multilevel logistic regression model to estimate the net effect of both household and community factors and their relative importance of individual risk factors over time. The prevalence of diarrhoea, fever and ARI were increased during 1992-93 to 1998-99, however it decline from 1998-99 to 2005-06. The finding demonstrate that child's sex and age, size of birth, duration of breastfeeding, mothers age at child birth, caste, religion, improved household (water, toilet , cooking fuel and type of house) are significant determinants of child morbidity. There is also strong evidence of the impact of community level factors on child morbidity. Overall, the results of this study suggest that the challenge to reduce the prevalence of child morbidity goes beyond the individual factors, and requires to understanding of contextual factors.

Introduction

More than 10 million children under the age five die every year (UNICEF, 2004). Diarrhoea and respiratory infection abetted by undernutrition, account for more than two-fifth of all deaths among children under five (Black, Morris, & Bryce, 2003). High infant and childhood mortality rates obviously induce low life expectancy in many developing countries and have severe negative impact on future development. Although several factors are responsible for the survival of children under age five. Studies reveal that some childhood disease that often results in mortality can be explained by well known health hazards within the child's household environment (Rutstein, 2000). Indeed, environmental health hazards are threats to the health of millions of people in the setting where they live (Bank, 2000). A variety of health hazard, including poor air quality, poor building standards, and contamination of water and food are present in the household environment. Studies have shown that sanitation, water supply and hygiene are generally poor in developing countries; more than 1 billion live without adequate shelter, about 1.4 billion people lack of access to safe

drinking water, and over 2.9 billion have no access to adequate sanitation (Rutstein, 2000) (WHO, 2005) (WHO, 2009).

Thus, investigation of proximate determinants that influences the risk of child morbidity is highly important. Previous studies on child disease have focused mainly on various socioeconomic and demographic factors that are available in the data set. However, most of the studies have neglected the aspects of household environment and community factors where children are living. The present study aims to explore what measures will further reduce the prevalence of child morbidity in India. Using pooled data from National Family Health Survey (NFHS) which was conducted in the period of 1992-93 to 2005-06, we investigate the risk factors of child morbidity over the past decades to highlight areas in which effective policy intervention could further reduce the prevalence of child morbidity.

Data and Methods

Data Source: The present study utilizes data from the publicly available three rounds of Demographic and Health Survey (DHS) known as National Family Health Survey (NFHS) in India. We pooled the data for children less than five years of age from all the three rounds of NFHS. The first round of National Family Health Survey known as NFHS-1 was conducted during period 1992-93, NFHS-2 was conducted in 1998-99 and NFHS-3 was conducted in 2005-06. These surveys were designed to provide estimates on various aspects of demographic behaviour, including mortality and health. They were done in collaboration with the International Institute for Population Sciences (IIPS), Mumbai, India, ORC Macro, Calverton, Maryland, USA, and the East-west Center, Honolulu, Hawaii, USA. IIPS coordinated these surveys and collaborated with number of Field Organizations for survey implementation. We will base our analysis on the information from weighted samples of married women age 15 to 49. In each survey, response rates among women interviewed were quite high (96.1% in NFHS-1, 95.5% in NFHS-2, and 94.5% in NFHS-3). These surveys were based on a stratified random sampling procedure. The primary stratification variable was place of residence, which allowed urban and rural samples to be drawn within each state. With minor exceptions in a few urban areas and slums, a uniform sample design was adopted in all states. The households were selected with equal probably from the household list in each enumeration area using systematic sampling and all eligible women in each household were interviewed (IIPS & Macro, National Family Health Survey (NFHS-1), 1992-93) (IIPS & Macro, National Family Health Survey (NFHS-2), 1998-99) (IIPS & Macro, National Family Health Survey (NFHS-3), 2006-06).

Outcomes variables: We examine the three types of child morbidity in our paper. These are diarrhoea; fever and Acute Respiratory Infection (ARI).The prevalence of these morbidities were estimated by asking a series of question to their mothers. For instance:

1. Diarrhoea- NFHS asked mothers of children born during the five year preceding the survey a series of question about the episodes of diarrhoea suffered by children in the two weeks before the survey.
2. Fever- asked mothers of children under five with fever during the two weeks preceding the survey.

3. Acute Respiratory Infection (ARI) - the prevalence of ARI was estimated by asking mothers whether their children under age five years had been ill with cough accompanied by short, rapid breathing which was chest related in the two weeks preceding the survey.

Independent variables: The description of the variable used in the analysis is given in appendix table.

Analytical Strategy: First we calculate descriptive statistics. We presented the proportion of children born during three years preceding the survey for each category in the explanatory variables. To explore the factors that may have contributed to increase/decrease in the prevalence of child morbidity during 1992-93 to 2005-06, we examine the association between child morbidity in individual children, family level socio economic and community socio economic characteristics. Since the hierarchical structure of the data presents children (level 1), as nested within family (level 2), who are in turn nested within communities (level 3) (Boco, 2010). The multilevel modelling strategy accommodates the hierarchical nature of the data and corrects the estimates standard errors to allow for clustering of observations within units (Goldstein, 2003). The three level random effects model with logit link function can be expressed as follows

$$\ln \frac{p_{ijk}}{1-p_{ijk}} = \alpha + x_{ijk}\beta + w_{jk}\gamma + z_k\eta + u_{jk} + v_k$$

Where $\ln \frac{p_{ijk}}{1-p_{ijk}}$ is the logit in which p_{ijk} is the probability that the i^{th} individual in the j^{th} family belonging to k^{th} community reported sickness. $x_{ijk}\beta$, w_{jk} and z_k are vectors of individual, family and community level characteristics; α is constant, while β , γ , and η are vectors of estimated parameter coefficients; u_{jk} and v_k are unexplained residual term at the family and community level respectively. The study used penalised quasi-likelihood (PQL) approximate estimation procedure, which has been found to be the least biased in case of binary response (Rasbash, Charlton, Browne, Healy, & Cameron, 2009) (Singh & Parsuraman, 2014).

Results

Unobserved Heterogeneity at family and community levels in diarrhoea, fever and ARI

The first step in multilevel model analysis was to consider if our data set justified the decision to assess random effects at family and community level. The results of multilevel random intercept null model (without any explanatory variables) are shown in table 1. There was significant amount of variation in the prevalence of diarrhoea, fever and ARI across family and community level. The results based on variance partition coefficient (VPC) values, almost 22 percent and 7 percent of the total variance in the prevalence of diarrhoea, almost 15 percent and 7 percent of the total variance in the prevalence of fever, and almost 36 percent and 13 percent of the total variance in the prevalence of ARI were attributable to the difference across family and community level respectively. The largest variation at family and community level was observed in ARI, while lowest in

fever. The larger magnitude of family VPC than community VPC suggests that family may be more important determinants of child morbidity than community.

Table 1: Parameter coefficients of pooled multilevel model for diarrhoea, fever and ARI among children under three years of age preceding the survey-empty model, without covariates

	Diarrhoea	Fever	ARI
Random Effect			
Family random variance	0.625(0.044)	0.284(0.030)	1.167(0.042)
Community (PSU) random variance	0.285(0.018)	0.282(0.014)	0.650(0.026)
Family VPC (%)	21.67	14.68	35.58
Community (PSU) VPC (%)	6.79	7.31	12.73

Individual, family and community level factors on the risk of diarrhoea, fever and ARI

Table 2 presents the adjusted odd ratios and 95 percent confidence intervals of predictor's variables on the risk of diarrhoea, fever and ARI for India. At the individual levels, the results show the older children have significantly higher risk of diarrhoea, fever and ARI as compared to younger ages (less than 6 months) of children. The results show a systematically significantly less to suffer from child morbidity. The combination of higher birth order and shorter birth interval increases the risk of morbidity. Four or higher birth order preceded by an interval of less than twenty four months were more likely to get diarrhoea and fever but it was significantly less likely for ARI than first birth order. The size of the child at birth was significantly linked with child morbidity. For instance, the average or larger than average size of the child at birth was significantly less likely to get infected with diarrhoea, fever and ARI in comparison with children with smaller size at birth. The children, who were breasted for prolonged time, were significantly higher risk of diarrhoea, fever and ARI. Like, children age seven and above were more likely (significant for 13-18 months and 19 months and above) in comparison to 0-6 months of breastfeeding. Mothers older age at birth reduce the odds of the children suffering from diarrhoea, fever and ARI compared to younger women and the results were statistically significant. The results reveal a contrary relationship between maternal and paternal education and child morbidity- the more schooling a mother and father have, the more likely her child is to get diarrhoea, fever and ARI. Children of mothers who attained no education (illiterate) were lower risk of child morbidity. The results were statistically significant for primary and secondary educated mothers. Children belonged to higher socially house were lower chance of diarrhoea, fever and ARI.

The sources of drinking water and toilet facility have profound implication of the health outcomes of children. Improved source of drinking water and toilet facility were less likely to be contaminated and lower chance of diarrhoea, fever and ARI, while other sources such as shared/public tap and no toilet and share toilet facility were more likely to carry disease causing agents. The availability of pucca house and using of electricity/lpg/biogas and coal/charcoal/kerosene were significantly lower risk of diarrhoea, fever and ARI as compared to kacha house and use of biomass. Most of the studies, however, have failed to account for many important variables, including household-level and community-level heterogeneity. The results were mixed

concerning the association between rural residences. It was observed that the risk of diarrhoea is less prevalent in rural area, while the risk was higher in rural area for fever and ARI. Moreover, the results were insignificant for diarrhoea, fever and ARI. The results suggested that community-level poverty was associated with higher risk of diarrhoea among children, whereas it was not associated with the increased risk of fever and ARI. The results also showed that, even after controlling for household-level and community-level factors, the influence of community level maternal education was robust for diarrhoea and the risk of diarrhoea among children was less for high community level maternal education as compared to low community level maternal education. The odds of having fever and ARI were higher among children where community level maternal education is high. The findings reveal that, the ethnic composition within community affect child morbidity. It was observed that not homogeneous ethnic community were higher risk of diarrhoea, fever and ARI among children but the result was statistically significant only for ARI. Similarly, non homogeneous religious community were significantly more likely to get diarrhoea, fever and ARI.

Table 2: Results of pooled multilevel logistic regression for diarrhoea, fever and ARI among children under three years of age preceding the survey, NFHS (1992-2006), India

Characteristics	Diarrhoea		Fever		ARI	
	Odds Ratio	95 % CI	Odds Ratio	95 % CI	Odds Ratio	95 % CI
Age						
<6 **(R)**						
6-11	1.774***	(1.630, 1.930)	2.056***	(1.905, 2.220)	1.672***	(1.528, 1.830)
12-23	1.296***	(1.182, 1.421)	1.747***	(1.612, 1.893)	1.343***	(1.237, 1.458)
24-35	0.824***	(0.750, 0.905)	1.309***	(1.208, 1.418)	1.041	(0.959, 1.130)
Sex						
Male**(R)**						
Female	0.918***	(0.884, 0.952)	0.883***	(0.856, 0.912)	0.857***	(0.829, 0.886)
Size of child at birth						
smaller than average**(R)**						
average	0.746***	(0.713, 0.780)	0.745***	(0.717, 0.775)	0.872***	(0.825, 0.921)
larger than average	0.834***	(0.784, 0.886)	0.766***	(0.727, 0.808)	0.758***	(0.727, 0.790)
Birth order and preceding birth interval						
first order**(R)**						
2-3 & < 24 months	0.929*	(0.869, 0.993)	0.876***	(0.828, 0.928)	0.851***	(0.801, 0.905)
2-3 & 24+ months	0.959*	(0.913, 1.007)	0.969	(0.930, 1.010)	0.928***	(0.889, 0.969)
4+ & < 24 months	1.009	(0.924, 1.102)	1.010	(0.938, 1.088)	0.866***	(0.799, 0.938)
4+ & 24+ months	0.983	(0.929, 1.041)	0.970	(0.923, 1.020)	0.884***	(0.840, 0.930)
Duration of breastfeeding						

0-6 months[(R)]						
7-12 months	1.016	(0.943, 1.095)	1.037	(0.972, 1.106)	1.006	(0.939, 1.077)
13-18 months	1.123**	(1.030, 1.224)	1.178***	(1.096, 1.267)	1.091*	(1.009, 1.180)
19 and above	1.114*	(1.024, 1.212)	1.188***	(1.107, 1.275)	1.122**	(1.041, 1.209)
Mothers age at child's birth						
less than 20 years[(R)]						
20-29 years	0.942***	(0.902, 0.983)	0.967*	(0.931, 1.003)	0.908***	(0.874, 0.945)
30 and above	0.879***	(0.819, 943)	0.927*	(0.874, 0.983)	0.906**	(0.849, 0.966)
Mothers education						
No education[(R)]						
Primary	1.129**	(1.064, 1.197)	1.153***	(1.095, 1.213)	1.158***	(1.099, 1.221)
Secondary	1.135***	(1.071, 1.204)	1.116***	(1.061, 1.175)	1.115***	(1.056, 1.178)
Higher	0.955	(0.868, 1.051)	1.006	(0.927, 1.092)	1.094*	(1.002, 1.195)
Fathers education						
No education[(R)]						
Primary	1.013	(0.953, 1.077)	1.058*	(1.005, 1.113)	1.062*	(1.005, 1.122)
Secondary	1.108**	(1.029, 1.194)	1.018	(0.973, 1.065)	1.009	(0.961, 1.060)
Higher	0.948*	(0.896, 1.004)	0.963	(0.904, 1.025)	0.911**	(0.852, 0.974)
Caste						
scheduled caste[(R)]						
scheduled tribe	1.079*	(1.000, 1.165)	0.946	(0.885, 1.012)	0.890**	(0.828, 0.957)
other	0.949*	(0.899, 1.003)	0.937**	(0.894, 0.982)	0.979	(0.931, 1.030)
Religion						
Hindu [(R)]						
Muslim	1.102**	(1.037, 1.171)	1.362***	(1.294, 1.433)	1.116***	(1.057, 1.179)
Others	1.108**	(1.029, 1.194)	1.066*	(1.001, 1.135)	1.010	(0.945, 1.080)
Type of house						
Kacha[(R)]						
Semi-pucca	1.081***	(1.033, 1.131)	1.008	(0.969, 1.048)	0.977	(0.938, 1.018)
Pucca	0.948*	(0.896, 1.004)	0.969	(0.922,1.017)	0.929**	(0.881, 0.979)
Fuel cooking						
Biomass[(R)]						
electricity/lpg/biogas	0.983	(0.911, 1.061)	0.909**	(0.852, 0.970)	0.911*	(0.847, 0.980)
coal/charcoal/kerosene	0.972	(0.897, 1.054)	0.946	(0.884, 1.014)	1.008	(0.938, 1.084)
Source of drinking water						
shared hand pump/well/others [(R)]						
own tap	0.919*	(0.860, 0.983)	0.918**	(0.865, 0.973)	0.898***	(0.845, 0.954)

public/sared tap	1.104***	(1.041, 1.171)	1.073**	(1.019, 1.129)	1.000	(0.952, 1.050)
own hand pump/well	0.947*	(0.897, 1.001)	0.991	(0.947, 1.037)	0.944*	(0.893, 0.997)
Source of toilet						
own flush/pit toilet[(R)]						
no toilet facility	1.094**	(1.030, 1.163)	1.099***	(1.044, 1.156)	1.113***	(1.054, 1.176)
share flush/toilet toilet/others	1.112*	(1.022, 1.210)	1.040	(0.969, 1.116)	1.123**	(1.044, 1.207)
Place of residence						
Urban[(R)]						
Rural	0.993	(0.933, 1.057)	1.021	(0.967, 1.079)	1.035	(0.976, 1.097)
Community level socioeconomic status						
Low[(R)]						
High	1.012	(0.945, 1.084)	0.954	(0.900, 1.012)	0.977	(0.916, 1.043)
Proportion of women aged 15-19 in the community with secondary or higher education						
Low[(R)]						
High	0.980	(0.913, 1.052)	1.046	(0.986, 1.109)	1.053	(0.984, 1.128)
Community Size						
Low[(R)]						
High	1.018	(0.964, 1.076)	0.976	(0.931, 1.023)	0.957	(0.908, 1.009)
Community level ethnic homogeneity						
Totally homogenous [(R)]						
Not homogenous	1.011	(0.940, 1.087)	1.006	(0.947, 1.069)	1.101**	(1.028, 1.179)
Community level religious homogeneity						
Totally homogenous[(R)]						
Not homogenous	1.037	(0.976, 1.102)	1.099***	(1.044, 1.156)	1.158***	(1.092, 1.229)
Region						
South[(R)]						
North	1.496***	(1.392, 1.609)	0.982	(0.922, 1.046)	1.103**	(1.032, 1.179)
Central	1.415***	(1.308, 1.530)	1.070*	(1.001, 1.144)	1.340***	(1.249, 1.438)
East	1.354***	(1.252, 1.464)	1.411***	(1.322, 1.505)	1.513***	(1.413, 1.620)
Northeast	1.088*	(0.992, 1.193)	1.204***	(1.118, 1.298)	1.718***	(1.585, 1.861)
West	1.392***	(1.280, 1.515)	1.164***	(1.085, 1.249)	1.363***	(1.263, 1.472)
Survey year						
1992-93[(R)]						
1998-99	1.763***	(1.620, 1.918)	1.445***	(1.344, 1.554)	2.121***	(1.965, 2.290)
2005-06	1.031	(0.974, 1.092)	0.705***	(0.672, 0.741)	0.219***	(0.205, 0.234)
Random-effect parameters						
Family level random variance	0.543	(0.459, 0.627)	0.202	(0.147, 0.257)	0.632	(0.593, 0.671)

Community level random variance	0.244	(0.213, 0.275)	0.196	(0.172, 0.219)	0.215	(0.188, 0.242)

Discussion and Conclusions

The results of this study confirm the presence of unobserved heterogeneity between families and community level. We examine the household and community level socioeconomic and environmental factors associated with child morbidity (diarrhoea, fever and ARI) among children under three years old in India and assess the changes in the effects of those factors between 1992-93 to 2005-06. The prevalence of diarrhoea, fever and ARI increased during 1992-93 to 1998-99 and later decline during 1998-99 to 2005-06. This study also confirm the results of the other studies which have documented that the age, sex of the child, size of the child at birth, birth order and preceding birth interval, in combination, and duration of breastfeeding are strongly associated with the risk of child morbidity. This study concluded that children whose age is between 6-23 months were at high risk of developing diarrhoea, fever and ARI. The results are consistent with the finding of the study which was conducted in Thailand (Wilund & Panza, 2009). Prolonged breastfeeding are associated with high risk of diarrhoea, fever and ARI. This association is more prominent in children who are breastfeed for seven months and above and the result is consistent with other studies (Lamberti, Walker, Noiman, Victora, & Black, 2011) (Mulder-Sibanda & Sibanda-Mulder, 1999). Our study confirms and highlights the importance of breastfeeding for the prevention of childhood disease. Among infant 0-6 months of age, these findings support the recommendation for exclusive breastfeeding during first six months of life as key child survival intervention. Low birth weight is predominately risk factors of child morbidity; these children are at higher risk of diarrhoea, fever and ARI. Undernutrition amongst women is one of the prime reasons behind low birth weight children. In this context, it can be suggested that health department should ensure proper implementation of ICDS scheme and advise specific strategies to improve antenatal care and diet for pregnant women (Singh & Singh, 2014).

The study revealed that mother's characteristics like early mothers age at birth, higher mother education are the risk factors for children suffering from diarrhoea, fever and ARI. This paper finding is contrast to the finding of previous study where existing studies concluded that the increasing mother education is more protective (or less risk increasing) for children, higher education helping them to provide their children more hygienic living environments, implement health-promoting behaviours, and obtain greater access to health care (Hatt & Waters, 2005). Adolescents mothers are more likely to give birth to preterm and low birth weight children compared with older peers. This is mainly associated with lower education, poor maternal nutritional (lower BMI), reinforcing the point that adolescents are unready for childbirth (Azad, 2009). Because of early marriage, these adolescents women are bearing children at a young age which is itself is at risk factors of premature birth and low-birth-weight of child. Thus early marriage of a family leads to their children suffering from childhood morbidity.

The results indicate significantly large residual community level effects moderately large family level effects on the risk of child morbidity, even after controlling for a range of child-level, family-level and community-level. The study found higher prevalence of child morbidity at community level as compared to family-level. This result suggests that communities are a major determinant of the risk of child morbidity in India. The physiological characteristics of children place them at risk of child morbidity due to unhygienic household environment. This study found that the use of improved water and sanitation are lowering the prevalence of diarrhoea, fever and ARI among children, while other sources, such as surface water and shared tap, are more likely to carry disease causing agents. The finding from this study corroborates other studies on the relationship between household source of drinking water, toilet facility and child morbidity (Jinadu, Olusi, Agun, & Fabiya, 1991) (Chakrabarti, 2012) (Sastry, 1996). This study shows that ethnic concentration and religious concentration within community is predictive of child morbidity risk. Because of higher diversity in ethnic and religious in India, the effect of ethnic and religious composition are complex and sometimes difficult to understand. The results of this study indicate that children who live in communities where relatively many are members of the same ethnic and religious groups are lower risk of child morbidity. This finding is consistent with the finding of previous studies (Kravdal, 2004) (Glei & Goldman, 2000). Overall, the results of this study suggest that the challenge to reduce the prevalence of child morbidity goes beyond addressing individual level, and requires a better understanding of contextual factors. In the light of the finding from this study, intervention aim at improving on care seeking for managing child morbidity should equally consider the influence of individual, family and community in which these children resides.

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Appendix Table 1: Description of variables used in the analysis (variable names and definitions)

Names	Description
Individual level variables	
Age of child in months	Categorised as (1= 0 to 5 months; 2= 6 to 11 months; 3=12 to 23 months and 4=24 to 35 months).
Sex of the child	Whether the child is male or female (1=Male and 2=Female).
Size of child at birth	Size of child is categorised as (1=smaller than average; 2=Average and 3=larger than average).
Birth order and preceding birth interval	Birth order and preceding birth interval were combined in one variable and is classified as follows: 1=first birth; 2=birth order 2-3 & shorter birth interval (<24 months); 3=birth order 2-3 & long birth interval (24 and above); 4=birth order 4+ with shorter birth interval (<24 months) and 5=birth order 4+ with longer birth interval (24 and above).
Duration of breastfeeding	Categorised as (1=0-6 months; 2=7-12 months; 3=13-18 months; 4=19 and above).
Family level variables	
Mothers age at child's birth	Respondent age at child birth (1= less than 20 years; 2=20-29 years; 3=30 and above).
Mothers education	Categorical variable indicating highest education level that respondent completed (1= no education; 2=Primary; 3=Secondary; 4=higher).
Fathers education	Categorical variable indicating highest education level that respondent partner completed (1= no education; 2=Primary; 3=Secondary; 4=higher).
Caste	Categorised as (1=Schedule caste); 2=Schedule tribes; 3=Other).
Religion	Religion categorised as (1=Hindu; 2=Muslim; 3=Others).
Type of house	Categorised as (1=Kacha; 2=Semi-pucca; 3=Pucca).
Fuel cooking	Fuel cooking categorised as (1=Biomass; 2=electricity/lpg/biogas; 3=coal/charcoal/kerosene).
Source of drinking water	Source of drinking water categorised as (1=shared hand/pump/well/others; 2=own tap; 3=public/shared tap; 4=own hand pump/well).
Source of toilet	Source of toilet categorised as (1=own flush/pit latrin; 2=no toilet facility; 3=shared flush/toilet/others).
Community level variables	
Place of residence	Whether the cluster is urban/rural community categorised as (1=Urban; 2=Rural).

Community level socioeconomic status	Proportion of household poor (two lowest wealth quintiles) in the community
Proportion of women aged 15-19 in the community with secondary or higher education	Dichotomous variables indicating whether the proportion of women aged 15-49 in the community with secondary or higher education is high or low (cut-off at mean proportion).
Community Size	The proportion of
Community level ethnic homogeneity	Measure based on the concept of the index of Ethno-linguistic fractionalization (ELF). Ethno-linguistic fractionalization is the probability that two people randomly drawn from the population are from distinct ethnic groups. This index is calculated as $ELF=1-\Sigma_i$ (proportion of ethno-linguistic $group_i$ in the population)^2. Theoretically, for each primary sampling unit, the scale goes from 0 (totally homogeneous) to 1 (completely diversity).
Community level religious homogeneity	Same as the description of Community level ethnic homogeneity
Region	Region categorised as (1=South; 2=North; 3= Central; 4=East; 5=Northeast; 6=West).