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Mir Azad Kalam  
*Narasinha Dutt College, Howrah, India*

Santosh Kumar Sharma  
*International Institute of Population Sciences*

Saswata Ghosh  
*Institute of Development Studies Kolkata (IDSK)*

Subho Roy  
*University of Calcutta*

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**Change in the Prevalence and Determinants of Consanguineous Marriages in India  
between National Family and Health Surveys (NFHS) 1 (1992–1993) and 4 (2015–2016)**

Mir Azad Kalam,<sup>1\*</sup> Santosh Kumar Sharma,<sup>2</sup> Saswata Ghosh,<sup>3</sup> and Subho Roy<sup>4</sup>

<sup>1</sup>Narasinha Dutt College, Howrah, India.

<sup>2</sup>International Institute of Population Sciences, Mumbai, India.

<sup>3</sup>Institute of Development Studies Kolkata (IDSK), Kolkata, India.

<sup>4</sup>Department of Anthropology, University of Calcutta, Kolkata, India.

\*Correspondence to: Mir Azad Kalam, Narasinha Dutt College, 129 Belilious Road, West Bengal, Howrah 711101, India. E-mail: imirazad@gmail.com.

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**Abstract**

The aim of the present study was to determine the changing prevalence of consanguineous marriage in India between two national-level surveys. The primary hypothesis was whether region of residence and religious affiliation continue to play a significant role in determining consanguineous marriage even after controlling other potentially significant confounding variables. Data from the 81,781 and 85,851 ever-married women during the survey periods 1992-1993 (NFHS-1) and 2015-2016 (NFHS-4) respectively were used in the analysis. We used multinomial as well as binary logistic regression analyses to examine the determinants

of consanguineous marriage types, and, paternal and maternal first-cousin marriages respectively. In both the analyses a systematic model building procedure were adopted. Altogether four models were estimated. In the final model (model 4) of both the analyses, all the background characteristics of the respondents (region of residence, religious affiliation, socio-demographic, household wealth) and years of survey were included. Results show that although the overall prevalence of consanguineous marriage in India declined significantly (16%); but it was not uniform across the background characteristics of the respondents. North Indian region (154%) shows a significant increase in consanguineous marriage, whereas eastern (31%), central (2.3%), north-eastern (40%) and southern (8%) regions of India show a significant decline in consanguineous marriage. Hindus (16%) and Muslims (29%) both show significant decline in consanguineous marriage. Muslims of eastern (48%), central (29%), western (31%), and southern (27%) regions and the Hindus of western region (37%) show significant decline in consanguineous marriage. Relative risk ratios (RRRs) estimated by using multinomial logistic regression models suggest those living in southern region shows 9.55 ( $p < 0.001$ ), 5.96 ( $p < 0.001$ ), and 38.16 ( $p < 0.001$ ) times more likelihood in the prevalence of first-cousin, second-cousin and uncle-niece marriages respectively compared to the northern region after controlling all other confounding variables. Muslims also show 3.76 ( $p < 0.001$ ) and 2.91 ( $p < 0.001$ ) times more likelihood in first-cousin and second-cousin marriages respectively compared to Hindus. Adjusted odds ratios (AORs) estimated by using binary logistic regression models suggest those living in southern and north-eastern region were 1.25 ( $p < 0.001$ ) and 1.36 ( $p < 0.05$ ) times more likely to marry maternal first cousin respectively compared to the northern region. The AOR estimates also show that Muslims were 1.11 ( $p < 0.01$ ) times more likely to marry maternal first cousin compared to Hindus. We conclude from this study that despite significant development in the socio-economic condition of India during the post-globalisation era (beginning from 1992-1993), region of

residence and religious affiliation continued to play significant role till the recent past in determining consanguineous marriage, as hypothesized in the study.

The global prevalence of consanguineous marriage at the beginning of this decade was around 10%, recording a high prevalence in the Arab and Middle East Muslim countries and low in West Europe, North America, Australia and Russia (Bittles and Black 2010; Tadmouri et al. 2009). First-cousin marriage still contributes to most of the consanguineous marriage types (Bittles 2012; Islam 2018).

Worldwide, studies reveal a change in the prevalence of consanguineous marriage across time period, but the pattern is not uniform (Hamamy et al. 2005; Islam 2018). For example, Sharkia et al. (2008) observed around 43% decline in the prevalence of first-cousin marriage among the Israeli Arab population during the two survey periods 1980-1985 and 2000-2004. On the other hand, the prevalence of first-cousin marriage increased by 14% during the period 1995-2000 in Oman (Islam 2012). Similar trend has also been observed in Jordan during the period 1990-2012 (Islam 2018). Studies also show that the prevalence of consanguineous marriage has increased from parental generation (39.0%) to offspring generation (50.5%) (Al-Ghazali et al.1997).

A changing pattern in consanguinity has also been observed in many Indian studies. For example, the prevalence of consanguineous marriage declined around 25% during the last three decades of the last century (1970-2000) (Allendorf and Pandian 2016). Regional differences in the prevalence and changing pattern of consanguineous marriages are widely observed across India. For example, the report of the National Family Health Survey 1992-93 shows that consanguineous marriages constitute 16% of all marriages, with a wide range of difference between northern and southern regions of the country (Banerjee and Roy 2002). On the basis of a national level data, Sharma et al. (2020) also observed north-south regional and religious disparity in the prevalence of consanguineous marriage. Some small-scale studies also revealed a declining trend in consanguineous marriage (Kalam et al.2016; Krisnamoorthy and Audinarayana 2001). For example, Kalam et al. (2016) observed that the

prevalence of consanguineous marriage among the *Darbhanga Khotta* Muslim population of Malda district of West Bengal has reduced to half during the last seven decades.

Religious belief is found to be another important factor in the prevalence of consanguineous marriage (Bittles 2012). Like other Muslim populations of West and South Asian countries, consanguineous marriage is widely practised by the Muslims of India (Bittles and Hussain 2000; Bittles 2012; Sharma et al. 2020; Tadmouri et al. 2009). In Islam, consanguineous marriage, especially first-cousin marriage, is a preferred form of marriage (Armstrong 1991; Bittles 2012); but there are scholars who do not agree to this view (Akrami and Osati 2007; Hussain and Bittles 1998). Uncle–niece and aunt-nephew marriages are proscribed in the *Quran* and regarded as forbidden (*haram*)(Sura-Al-Nisa Ch: 4, V: 20-22). However, there are studies that report uncle-niece marriage within Indian Muslim communities in western and northern regions (Basu and Roy 1972; Malhotra et al. 1977) and in southern region (with low prevalence) (Ali 1968; Bittles et al. 1993; Roychoudhury 1980; Sanghvi 1966). In contrast, the practice of uncle-niece marriage is culturally endorsed among the Hindu communities living in the southern region of India (Krishnamoorthy and Audinarayana 2001; Padmadas and Nair 2002; Sharma et al. 2020).

Socio demographic and economic factors remain significant determinants in the prevalence of consanguineous marriage over the years. For example, ages at marriage, education, occupation, place of residence as well as economic status are found to be the significant determinants for consanguineous marriage (Denic et al.2012; Hussain and Bittles 1998; Islam 2018;Jurdi and Saxena 2003; Kelmemi et al.2015; Modell and Darr 2002; Shenk et al. 2016). Women who are working, having higher level of education, living in urban areas and economically well off are less likely to practice consanguineous marriages (Denic et al. 2012; Hussain and Bittles 1998; Islam 2018; Kelmemi et al. 2015; Modell and Darr 2002). The prevalence of this marriage type is high among couples from older age cohorts compared

to those from the younger age cohorts (Bittles 2012; Padmadas and Nair 2002; Sharma et al. 2020). Based on Indian national level data, Sharma et al. (2020) observed that highly educated women, living in urban areas, and economically more affluent were less likely to practice first-cousin marriages.

In the last few decades, because of the effect of globalisation, India has witnessed a substantial change in socio-demographic development (MOSPI 2017), in terms of women's participation in work force, literacy rate, and in the expansion of urban base (Chatterjee and Ramu 2018). Such socio-demographic transformation perhaps emancipated the women of this country and has widened the liberty to choose their life partners either blood related or not related. But, the question remains, whether the regional and religious differences or socio-demographic changes play a crucial role in determining the prevalence of consanguineous marriage.

In Indian context, there has been hardly any study that examined the changing pattern in consanguineous marriage at a macro-level, especially considering two different time periods. Thus, the objectives of the study were to investigate the change in prevalence and determinants of consanguineous marriages in India between two National Family and Health Surveys (NFHS) 1(1992-1993) and 4(2015-2016). Our primary hypothesis was region of residence and religious affiliation continue to play very important role in determining consanguineous marriage even after controlling other potentially significant confounders.

## **Materials and Methods**

Data for this study were obtained from the first and fourth cross-sectional rounds of NFHS, which were carried out during 1992-1993 and 2015-2016 respectively. NFHS does not carry out cohort surveys and thus respondents are different in each survey. The first round of NFHS was carried out by the International Institute for Population Sciences (IIPS), Mumbai,

whereas the fourth round was conducted by the IIPS and International Classification of Functioning, Disability and Health (ICF). NFHS is an Indian variant of Demographic and Health Survey (DHS), which collects and disseminate information on fertility, mortality, family planning, and important aspects of reproductive health, nutrition and healthcare based on a nationally representative household surveys for 90 countries (IIPS and ICF 2017). The dataset is available in the public domain subject to a prescribed registration and approval process. Requisite permission in accessing and usage of dataset was obtained from the DHS Program archive ([www.dhsprogram.com](http://www.dhsprogram.com)). Although four rounds of NFHS were carried out in India, but data on consanguinity were available only in the first and the fourth rounds.

During 1992-93, NFHS collected information from 88,562 households and interviewed 89,777 ever-married women (in the age group 13-49) in all the states in India. However, union territories were excluded from the survey. Total 81,781 women were selected for the current analyses after excluding 6,424 women who were not the usual residents of the households, and 1,537 women who reported more than one marriage. During 2015-16, NFHS collected information from 601,509 households and interviewed 699,686 women belong to the age group 15-49 at the district level in all the states and union territories in India. As per the state module, the sample size for women was 122,351. We have used state module in case of the fourth round of NFHS for two reasons- (a)for its comparability with the first round and (b)for incorporating questions on occupation of respondent and her partner, and educational attainment of partner only in the state module. Total 85,851 ever married women were selected for analyses in this round after excluding 30,045 women who were never married, 3,444 women who were not the usual residents of the households and 1,448 women who reported more than one marriage. 1,563 women who belong to the union territories of India were also excluded from the analyses to maintain comparability.



Although there were second and third rounds of the surveys, only the first and fourth rounds included two questions pertaining to consanguineous marriages. First, whether, the respondent was biologically related to her husband before marriage and second, if answered in the affirmative, the exact nature of the relationship. In the latter question, the respondents are supposed to report whether their husbands to be an uncle, equivalent in their progeny to a coefficient of inbreeding of  $F=0.125$ , a paternal or maternal first-cousin ( $F=0.0625$ ), a second-cousin ( $F=0.0156$ ), or 'not related' ( $F$  unspecified).

In the first round of NFHS, total 10,948 respondents reported consanguineous marriage in response to the first question, the number decreased to 7,572 (7,647 weighted cases) when more rigorous second stage definition was used, after excluding the 3,376 cases of 'not related' category, which was not defined precisely in terms of the level of genetic relatedness of the marriage partners. In the fourth round, total 10,509 respondents reported of consanguineous marriage in response to the first question, the number reduced to 6,792 (6,742 weighted cases) after employing the second stage definition excluding the 3,717 cases of 'not related' category because they were not defined precisely in terms of the level of genetic relatedness of the marriage partners. In the present study, the response to the second question was considered to be more accurate in defining the consanguinity and hence used in the analyses. Sample weights for individuals as provided by both the rounds of NFHS were used in the entire analyses, which rules out any bias regarding regional representation in the prevalence of consanguineous marriages.

In order to assess the changing prevalence and determinants of consanguineous marriages in India, first bivariate analyses were performed to understand the regional variation in the prevalence of consanguinity and type of consanguineous marriages. The proportionality tests have been employed to see whether the increases or decreases in the prevalence of consanguineous marriage across states are statistically significant.

We also estimated the prevalence of types of consanguineous marriage by respondent's background characteristics for both the rounds of survey. The background characteristics included in the study are age at marriage (in years) (below 18, 18-24, 25 and above), education of the respondents and of their husbands (no education, primary, secondary, higher), respondents' occupation (not working/don't know, blue collar/white collar) and that of their husbands (not working/don't know, blue collar, white collar), religion (Hindu, Muslim, others), caste (scheduled caste, scheduled tribe, other backward caste, others), wealth quintiles (poorest, poorer, middle, richer, richest), place of residence (urban, rural), and region of residence (north, east, central, north-east, west, south). The study has used the Chi-Square statistical test to understand the association between background characteristics and consanguinity prevalence.

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where,  $O_i$  is the observed count and  $E_i$  is the expected count under the corresponding null hypothesis. Additionally, proportionality tests have also been used to understand changes of significance of different characteristics in two survey rounds.

To determine the factors associated with type of consanguineous marriages, multinomial logistic regression model was used in pooled cross-sectional data of two points of time. This allowed us to assess the independent effect of time (that is, year of survey) in determining the prevalence of consanguineous marriage. Additionally, to understand the changing direction of association of the factors between two surveys, the same model was employed in cross-sectional data of two separate points of time and the results were presented in Appendices (Table A2 and Table A3). Multinomial logistic regression is an expansion of logistic regression in which one equation was set up for each logit relative to the reference outcome. Consanguineous marriages consist of four categories as marriage with first-cousin (paternal and maternal), second-cousin, uncle/niece, and others/not-related. For a dependent

variable with four categories, this requires the estimation of three equations, one for each category relative to the reference category (not-related), to describe the relationship between the dependent and the independent variables. These equations would be

$$\ln \left[ \frac{P(Y_i=2)/X_i}{P(Y_i=1)/X_i} \right] = \alpha_2 + \beta_1^2 X_{i1} \dots \beta_k^2 X_{ik} \quad (1)$$

$$\ln \left[ \frac{P(Y_i=3)/X_i}{P(Y_i=1)/X_i} \right] = \alpha_3 + \beta_1^3 X_{i1} \dots \beta_k^3 X_{ik} \quad (2)$$

$$\ln \left[ \frac{P(Y_i=4)/X_i}{P(Y_i=1)/X_i} \right] = \alpha_4 + \beta_1^4 X_{i1} \dots \beta_k^4 X_{ik} \quad (3)$$

Where,  $\alpha_2$ ,  $\alpha_3$  and  $\alpha_4$  are the intercepts for the category paternal first-cousin, maternal first-cousin, second-cousin, uncle and  $\beta_k^2$ ,  $\beta_k^3$ , and  $\beta_k^4$  are the slope coefficient of the  $X_i$  variables for respective category of the dependent variable.

Apart from multinomial logistic regression, we also used binary logistic regression to determine the factors associated with the first-cousin (paternal and maternal) marriage. In this analysis, the response variable first-cousin was recoded as '0' if the marriage was with paternal first-cousin, and 1 if the marriage was with maternal first-cousin.

$$\log_e [P(Y_i=1 | X_i) / 1 - P(Y_i=1 | X_i)] = \log_e [\pi / 1 - \pi] = \alpha + \beta_1 X_{i1} \dots \beta_k X_{ik} \quad (4)$$

Where,  $Y_i$  is the binary response variable and  $X_i$  is the set of explanatory variables such as, socio-demographic characteristics as mentioned in case of multinomial model, and  $\beta_1$ ,  $\beta_2$ , ...,  $\beta_k$  are the coefficient of the  $X_i$  variables.

In both the multivariate regression analyses (multinomial logistic regression as well as binary logistic regression) a systematic model building procedure was adopted and altogether four models were estimated. Model 1 included only the region of residence of the respondent (north, east, central, north-east, and west, south). This allowed us to test whether there is a significant regional difference in the likelihood of consanguineous marriage types. Model 2 included religious affiliation of the respondent in addition to the region of residence. This allowed us to find out differences in the likelihood of consanguineous marriage types associated with the region of residence and religious affiliation of the respondent. Model 3

introduced other socio-demographic and economic variables such as, age at marriage of the respondents, educational attainments of the respondents and their husbands, occupation of the respondents and their husbands, place of residence, caste affiliation, and household wealth, in addition to region of residence and religious affiliation of the respondents. Model 4, our final model, included years of survey (1992-93, 2015-16) variable in addition to the variables of Model 3 to understand independent effect of time on consanguineous marriage types after controlling other potentially confounding variables.

Estimating the models in this way allowed the testing of the significance of association of region of resident of the respondents with types of consanguineous marriage (for multinomial model) or marriage with only first-cousin (for binary model), and, significance of association of region of residence and religious affiliation with types of consanguineous marriages, after controlling for a wide range of other confounding factors. Moreover, it allowed the identification of factors that reduced the significance of variable of interest in each model.

Data were analysed using Stata 15.0 version software. Appropriate sampling weights were used to analyse the data as mentioned earlier.

## **Results**

The overall prevalence of consanguineous marriage declined around 16%, from 9.4% to 7.9% between 1992-1993 and 2015-2016 (Table 1). The trend is not similar in all the regions and the states of India. The rate of consanguineous marriage in the north Indian region has significantly increased by 153%. Among the states of the northern region of India, Haryana has registered the highest increase in consanguineous marriage (311%), followed by Rajasthan (123%), Jammu and Kashmir (103%), Punjab (78%), and Delhi (48%). The Central India also shows a significant increase (2.3%) in the prevalence of consanguineous

marriage. The state of Madhya Pradesh/Chhattisgarh in the central region of the country shows significant increase (32%) in the prevalence of consanguineous marriages. A reverse trend was observed in the eastern part of the country, a significant decline by 31% in consanguineous marriage. Among the states of the eastern region of India, Bihar/Jharkhand (38%) and West Bengal (45%) showed a significant decline in consanguineous marriage. Similar to the East India, the north-eastern region also showed a significant decline (40%) in consanguineous marriage. Among the states of this region, Arunachal Pradesh (50%), Assam (69%), and Tripura (81%) showed a significant decline in consanguineous marriage. The western region of India also showed a significant decline (34%) in consanguineous marriage. Among the states of the western region, Goa (36%) and Maharashtra (43%) showed a significant decline in consanguineous marriage, while the state of Gujarat of this region registered a significant increase (12%) in consanguineous marriage. Of all the regions of the country, the southern region showed the highest prevalence of consanguineous marriage in both the survey periods, though declined by 8% between 1992-93 and 2005-2016. Among the states of this region, the highest decline in consanguineous marriage was observed in Kerala (49%), followed by Andhra Pradesh/Telangana (19%) and Karnataka (8%).

Figure 1 depicts the types of consanguineous marriage in two survey periods according to region of residence. It was observed that the south region (27% for 1992-1993 and 25% for 2015-2016) shows the highest and north-east (2% for 1992-1993 and 1% for 2015-2016) shows the lowest prevalence of all types of consanguineous marriage.

A significant decline of consanguineous marriage has also been observed in both Hindu (16%) and Muslim (29%) populations of this country between the two survey periods, but disproportionately (Table 2). A similar decline has also been observed for Indian populations of different religious beliefs (29%). Figure 2 shows the percentage of consanguineous marriage according to the religious belief in the two survey periods. It

revealed that Muslims show the highest percentage of consanguineous marriage in both the survey periods.

We also compared the prevalence of consanguineous marriage between Hindu and Muslim populations of India according to regions and states between the two survey periods (Table 3). It is important to note that in the eastern region; only Muslims showed a significant decline (48%) in consanguineous marriage and that for the state of Bihar/Jharkhand, the decline (51%) was significant. Similarly, in the central region, only Muslims showed a significant decline (29%) in consanguineous marriage and that for the state of Uttar Pradesh/Uttarakhand the decline (37%) was significant. In the western region, both Hindus (37%) and Muslims (31%) showed a significant decline in consanguineous marriage. Both the Hindus (46%) and Muslims (30%) of Maharashtra and only the Muslims (37%) of Gujarat in this region showed a significant decline in the prevalence of consanguineous marriage. The Muslims (27%) of the southern region showed significant decline in the prevalence of consanguineous marriage. When compared for the states of this region, the prevalence in consanguineous marriage declined significantly among the Hindus living in Andhra Pradesh/Telangana (17%) and Tamil Nadu (22%) compared to the Muslims and other religious communities.

We further explored the changes in the prevalence of consanguineous marriage types between the two survey periods according to several background characteristics (Table 4). It has been observed that although the prevalence of consanguineous marriage declined for those who got married before attaining 18 years of age, the prevalence increased with higher marital ages, particularly for first-cousin marriage. It is interesting to observe that for both women and men, the prevalence of such marriage, particularly first-cousin marriage, has increased over the time for those who have attained 11 or more years of education.

The same table also reveals that the prevalence of consanguineous marriage has declined across respondents' occupational types, notably among those engaged in blue-collar occupation (from 12.6% to 8.4%) between 1992-1993 and 2015-16. A reduction of 32% and 52% in the prevalence of first-cousin and uncle-niece marriages respectively was found among those respondents with blue-collar job between the two survey periods. Similarly, among the men, the prevalence of first-cousin and uncle-niece marriage has declined 23% and 54% who were either not-working or engaged in blue-collar activities between 1992-93 and 2015-2016. Overall, the prevalence of consanguineous marriage remained similar among urban respondents, but it declined among their rural counterparts (20%) during the two survey periods. Among urban respondents, the prevalence of first-cousin marriage has increased by somewhat 7%, while it declined by 19% among their rural counterparts between the survey periods.

It has been observed that the prevalence of consanguineous marriage declined across caste groups between the two survey periods. Schedule tribe populations showed the lowest percentage of first-cousin, second-cousin, and uncle-niece marriages in both the survey periods. It is interesting to observe that the prevalence of consanguineous marriage have declined substantially among the poorest(50%) sections of the society between the two survey periods, but the trend remained similar for respondents belonging to middle wealth quintile. On the other hand, the richer section of the society showed an increased prevalence (8%) in consanguineous marriage between the two survey periods. Further, it has been observed that first-cousin marriage was the highest for the respondents of poorest quintile during 1992-1993 compared to the respondents in rest of the wealth quintiles. The trend is just reversed during 2015-2016; a decline by 46 % in the prevalence of first-cousin marriage was observed between the two survey periods among the respondents of poorest quintile.

However, such bivariate relationships may or may not hold once the whole range of factors is controlled in the multivariate framework.

### ***Results of Multinomial Logistic Regression Analysis of Consanguineous Marriage Types***

Table 5 represents the relative risk ratios (RRR) for different types of consanguineous marriages, which were estimated using 'not related' marriage types as reference category. As mentioned earlier, a systemic model building procedure (partial to final) was adopted to understand the effects of different background characteristics, particularly region and religion, on types of consanguineous marriage. The final model (Model 4) includes all the background characteristics including years of surveys.

After controlling a range of background characteristics in Model 4, it was observed that the respondents belonging to the southern region showed the highest odds in the prevalence of first-cousin (RRR=9.55, 95% CI=8.89, 10.26), second-cousin (RRR=5.96, 95% CI=4.94, 7.19) and uncle-niece (RRR=38.16, 95% CI=25.86, 56.3) marriages compared to the northern region. Respondents who belonged to the western region were also found to have moderately higher odds in the prevalence of first-cousin (RRR =4.02, 95% CI=3.71, 4.63), and uncle-niece (RRR =3.14, 95% CI=1.93, 5.12) marriages compared to the northern region. Respondents who belonged to the eastern region were significantly more likely to marry their first-cousin (RRR =1.54, 95% CI=1.42, 1.66), and uncles (RRR =2.14, 95% CI=1.55, 3.75) than their northern counterparts. The respondents of the central region were significantly more likely to marry their first-cousin (RRR =1.27, 95% CI=1.17, 1.38) but, significantly less likely to marry their second-cousin (RRR =0.52, 95% CI=0.40, 0.69) compared to the northern region. Respondents who belonged to the north-eastern region were significantly less likely to marry their first (RRR =0.44, 95% CI=0.38, 0.5) and the second-cousins (RRR =0.34, 95% CI=0.22, 0.52) compared to the northern region. Such associations



were also observed in the partial models in varying degree (Model 1 to Model 3).

Respondents who belonged to the central region were significantly more likely to marry their uncles compared to the same reference category in Model 1 and Model 2. However, the association became insignificant after the inclusion of socio-demographic and economic characteristics in Model 3 and year of survey in Model 4.

From Model 4, it can be ascertained that Muslims were significantly more likely to marry first-cousins (RRR =3.76, 95% CI=3.57, 3.96), and second-cousins (RRR =2.91, 95% CI =2.49, 3.4) compared to Hindus in Model 4. It was found in Model 2 that Muslim respondents were significantly less likely to marry their uncles (RRR=0.77, 95% CI=0.60, 1.0), but such association becomes insignificant after the inclusion of socio-demographic variables in Model 3 and year of survey variable in Model 4. Other religious groups were significantly less likely to marry their cousins (RRR =0.80, 95% CI=0.73, 0.88 for first-cousins; RRR =0.79, 95% CI=0.60, 1.04 for second-cousins; and RRR =0.61, 95% CI=0.44, 0.85 for uncle-niece marriages) compared to Hindus (Model 4).

Other socio-demographic and economic factors of the respondents such as, age at marriage, education of the respondents and that of their husbands, occupation, caste, and wealth quintile were significantly associated with different types of consanguineous marriage. In Model 4 respondents who married between 18-24 years of age were significantly less likely to marry first-cousins (RRR =0.77, 95% CI=0.74, 0.8), second-cousins (RRR =0.86, 95% CI=0.75, 0.99), and uncles (RRR =0.73, 95% CI=0.62, 0.85) compared to the respondents who married below 18 years of age. Similarly, respondents who married after 25 years of age were significantly less likely to marry first-cousins (RRR =0.53, 95% CI=0.48, 0.59), second-cousins (RRR =0.70, 95% CI=0.51, 0.96), and uncles (RRR =0.38, 95% CI=0.25, 0.58) compared to the respondents who married below 18 years of age. Results were consistent with Model 3, only the degree of association varied.

Education of the respondents showed a significant association with consanguineous marriage. In the complete model (Model 4), respondents who have attained a higher level of education were less likely to marry their first-cousin (RRR =0.79, 95% CI=0.74, 0.84 for respondents with education level 1-5, RRR =0.80, 95% CI=0.76, 0.85 for those with education level 6-10, and RRR =0.73, 95% CI=0.67, 0.80 for respondents with education level 11 and above) compared to the non-educated respondents. No significant association was found with respondents' education and second-cousin marriage. Similarly, respondents with higher level of education were less likely to marry their uncles (RRR =0.81, 95% CI=0.65, 1.0 for respondents with education level 1-5, and RRR =0.77, 95% CI=0.62, 0.95 for respondents with education level 6-10) compared to non-educated respondents. Husbands with education level 1-5 (RRR =0.95, 95% CI=0.89, 1.0) and education level 6-10 (RRR =0.94, 95% CI=0.89, 1.0) were significantly less likely to marry their first-cousin; but with education level 11 and above (RRR =1.08, 95% CI=1.00, 1.17) were significantly more likely to marry their first-cousin compared to non educated counterparts. Husbands with higher educational attainment were significantly more likely to marry their second-cousins (RRR =1.28, 95% CI=1.06, 1.54 for husbands with education level 1-5, and RRR =1.29, 95% CI=1.08, 1.54 for those with education level 6-10) compared to the non educated respondents. Husbands with education level 11 and above were significantly more likely to marry niece (RRR =1.27, 95% CI=0.97, 1.66) compared to non-educated husbands. Similar association was observed in the partial model (Model 3), with varying degree. Respondents engaged in the blue-collar job were significantly more likely to marry their first-cousins (RRR =1.13, 95% CI=1.07, 1.19) compared to their non-working counterparts, while respondents engaged in the white-collar job were significantly more likely to marry their second-cousin (RRR =1.31, 95% CI=1.10, 1.57) compared to non-working respondents. Although, the respondents in white-collar jobs were significantly more likely to marry uncles

compared to the same reference category in Model 3, yet such association became insignificant after the inclusion of year of survey in Model 4. Husbands' occupation and place of residence were not significantly associated with the prevalence of consanguineous marriages in Model 3 and Model 4 independently.

Compared to the schedule caste group, the respondents of other caste groups (non-SC/ST) were significantly less likely to marry first-cousin (RRR=0.81, 95% CI=0.76, 0.86), and uncles (RRR =0.73, 95% CI=0.61, 0.87) (Model 4). Respondents belonging to schedule tribe group showed no significant association in the prevalence of consanguineous marriage types compared to schedule caste group. The results were consistent in both Model 3 and Model 4, with varying degrees of association. Wealth quintile was found to be one of the important factors in determining consanguineous marriages. From Model 4, it was observed that respondents from poorer wealth quintile were significantly more likely to marry first-cousin (RRR=1.11, 95% CI=1.04, 1.19) compared to the respondents from poorest wealth quintile. The degree of association of marrying the second-cousin significantly decreased with increase in wealth quintile (RRR =0.78, 95% CI=0.64, 0.95 for the poorer, RRR =0.73, 95% CI=0.61, 0.88 for the middle class, RRR =0.61, 95% CI=0.50, 0.74 for the richer group, and RRR=0.54, 95% CI=0.44, 0.67 for the richest group) compared to the same reference category. Similarly, the likelihood of marrying uncles declined with rise in wealth quintile (RRR =0.66, 95% CI=0.53, 0.81 for the middle quintile, RRR =0.64, 95% CI=0.51, 0.79 for the richer quintile, and RRR =0.49, 95% CI=0.38, 0.62 for the richest quintile) compared to the same reference group. In Model 3, it has been observed that the respondents from poorer quintile were significantly less likely to marry uncles compared to the respondents of poorest quintile, but the degree of association become insignificant after the inclusion of year of survey in Model 4.

Year of survey independently have significant association with the prevalence of consanguineous marriage types even after controlling all other potentially confounding variables in Model 4. It has been observed that the respondents in the survey period 2015-2016 were significantly more likely to marry first-cousin (RRR =1.07, 95% CI=1.03, 1.12), and less likely to marry second-cousin (RRR =0.89, 95% CI=0.77, 1.02) and uncles (RRR =0.81, 95% CI=0.69, 0.95) compared to the survey period 1992-1993.

The Appendix tables (Table A2 and A3) depict the relative risk ratios (RRRs) of consanguineous marriage types of the two survey periods independently obtained by using multinomial logistic regressions. It was observed that the trend in the likelihood of first-cousin marriage in the central, western and southern regions were higher for both the survey periods; but the RRR values have declined for the period 2015-2016. The RRR values for first-cousin marriage for the period 2015-2016 were in reverse direction for eastern and north-eastern regions compared to 1992-1993 period. For the second-cousin marriage in the eastern region and for the second-cousin as well as uncle-niece marriage in the central region, RRR values showed a reverse trend, when compared between the two survey periods. However, no such differences in the association between religion and consanguineous marriage were observed in both the survey periods, except for the second-cousin marriage for 'other' religion. Although the level of educational attainment among respondents and that of their husbands had significant association with consanguineous marriage types in 1992-1993, such relationships do not exist during 2015-2016, barring few of the independent variables. The association of respondents' occupation and first-cousin marriage was in a reverse direction, when compared between the two survey periods. The RRR values show a reverse direction in the association between consanguineous marriage and husbands' engagement in white-collar jobs, when compared between the two survey periods. It may be observed that the place of residence was significantly associated with first-cousin marriage in the survey

period 1992-1993 and for uncle-niece marriage in the survey period 2015-2016. The schedule tribe group shows no significant association with all the consanguineous marriage types in 1992-1993, but significantly associated for first-cousin marriage 2015-2016. The wealth quintile was significantly associated with all the consanguineous marriage types in 1992-1993, but only for first-cousin marriage 2015-2016.

### ***Results of Binary Logistic Regression Results of Consanguineous Marriage (Paternal and Maternal First-Cousin)***

We used binary logistic regression model to find out the odds of maternal first-cousin marriage after controlling region, religion, socio-demographic, wealth quintile variables, and year of the survey by considering paternal first-cousin marriage as base category. Adjusted odds ratios (AOR) are reported in Table 6. After controlling all the confounding variables in Model 4, it was observed that respondents from the north-eastern region and southern regions of this country were significantly more likely to marry their maternal first-cousin (AOR=1.36, 95% CI=0.99, 1.85 for north-east and AOR=1.25, 95% CI=1.07, 1.45 for the southern region) compared to the northern region. The association between southern region and maternal first-cousin marriage in unadjusted Model 1 and between north-east regions and maternal first-cousin marriage in unadjusted Model 3 were not significant compared to the same reference category. The respondents from western region were significantly less likely to marry their maternal first-cousin (AOR=0.86, 95% CI=0.73, 1.02) than those of the northern region in Model 4. The likelihood was consistent in unadjusted models (Model 1, Model 2, and Model 3), only degrees of association vary.

Religion is another important factor which determines likelihood of paternal and maternal first-cousin marriages. In Model 4, it was observed that Muslims were significantly

more likely to marry maternal first-cousins (AOR=1.11, 95% CI=1.0, 1.22) compared to Hindus. The results were consistent in preceding unadjusted models (Model 2, Model 3).

In Model 4, respondents who married within 18-24 years of age were significantly more likely to marry maternal first-cousins (AOR=1.08, 95% CI=0.99,1.17) compared to those who married before 18 years of age. Model 3 of our analysis showed that the respondents who married after 25 years of age were significantly more likely to marry maternal first-cousin (AOR=1.24, 95% CI=1.01,1.51); but this variable did not remain significant after the inclusion of year of survey in Model 4.

Respondents with 1-5 years, and 11 or more years of education were significantly less likely to marry maternal first-cousin (AOR=0.90, 95% CI=0.81, 1.01 for those with 1-5 years of education, and AOR=0.87, 95% CI=0.74, 1.03 for those with 11 or more years of schooling) compared to the respondents with no education. The association was insignificant in unadjusted in the partial model (Model 3), where year of survey variable was not included. Husbands with 11 or more years of education were also significantly less likely to marry their maternal first-cousin (AOR=0.87, 95% CI=0.76, 1.0) compared to their non-educated counterparts in both Model 3 and Model 4. Respondents' occupation and place of residence were not associated in determining odds of maternal first-cousin marriage in both Model 3 and Model 4. On the other hand, husbands who were in white-collar job in unadjusted model (Model 3) were significantly less likely to marry maternal first-cousins (AOR=0.90, 95% CI=0.83, 0.98) compared to the husbands who were either not working or engaged in blue-collar activities. However, the occupation of the husbands did not remain significantly associated with maternal first-cousin marriage in the complete model (Model 4).

Respondents belonging to schedule tribe group were significantly more likely to marry maternal first-cousin (AOR=1.19, 95% CI=1.02, 1.39) compared to those from the schedule caste group (Model 4). The result was found to be consistent with Model 3.

From Model 4, it can be ascertained that respondents from the richer and the richest quintile were significantly more likely to marry maternal first-cousins (AOR=1.13, 95% CI=1.0, 1.28 for richer quintile, and AOR=1.18, 95% CI=1.04, 1.35 for the richest quintile) compared to the respondents from the poorest quintile. Similar results were found in Model 3, with a varying degree of association. Year of surveys also have significant influence in determining odds of maternal first-cousin marriage. Respondents surveyed in 2015-2016 were significantly more likely to marry maternal first-cousins (AOR=1.19, 95% CI=1.09, 1.29) compared to their counterparts in the survey period 1992-1993 (Model 4).

## **Discussion**

Based on the nationally representative data collected in a gap of more than two decades, from the beginning of post-globalisation era [between NFHS (1992–1993) and NFHS (2015-2016)], we found changes in the prevalence in consanguineous marriage and in its determinants. For example, our study confirms a significant decline (16%) in consanguineous marriage. It seems that a drop in the prevalence of first-cousin marriage contributes in the overall decline in consanguinity.

The declining trend in consanguineous marriage is not similar across all the regions of the country. The eastern, north-eastern and western regions of India show a significant decline in the prevalence of consanguineous marriages, unlike the other regions of the country. North-east India shows the lowest prevalence of consanguineous marriage as found in other studies (Allendorf and Pandian 2016; Banerjee and Roy 2002; Sharma et al. 2020). Several studies argued that the trend in consanguinity among the Hindus of south India at different marriage cohorts might be due to the increased rate of dowry in case of marital alliance with not related couples (Allendorf and Pandian 2016; Banerjee and Roy 2002; Caldwell et al.1983; Krishnamoorthy and Audinarayana 2001;Padmadas and Nair 2002).Our

study also confirms that the prevalence of consanguineous marriage is the highest in the southern region of the country, except for the state of Kerala. Conversely, in the north, marrying a blood relative is customarily not admissible (Allendorf and Pandian 2016), barring the state of Jammu and Kashmir, which is numerically dominated by Muslim populations (COI 2011).

Several studies show Muslims has the highest prevalence of consanguineous marriage (Al-Gazali et al. 1997; Assaf and Khawaja 2009; Bener and Hussain 2006; Hamamy et al. 2011), since some believe it to be the prescribed form of marriage in Islam. Among Muslims, cousin marriage could possibly be described as an example provided by the *sunnah* (practical activity) of the Prophet (Bittles 2012). It is believed that among six wives of the Prophet, two of the wives were biological relatives. He also married his daughter Fatima to his paternal first-cousin, Ali (Armstrong 1991). Variations are, however, seen in the levels of consanguineous unions contracted in different branches of Islam and between specific communities. These variations reinforce the influence of local and regional customs in establishing marital alliance. Although Hindu dominated in terms of number (80%), the country of India is also the land of the second largest Muslim population in the world, constituting 14% of India's population and 10% of the total Muslim population of the world (PRC 2015). The study of consanguineous marriages in India is certainly very complicated given the diversity of the population, and it is exacerbated by the strongly divergent attitudes towards consanguineous marriage in majority of Hindu population (Kumari et al. 2019). Consanguineous marriage is very common among the Indian Muslims and varies regionally (Bittles and Hussain 2000). For example, we found that Muslims of western India shows the highest prevalence of consanguineous marriage compared to Muslims of the southern region. The trend is reverse for Hindus, when western and southern regions are compared. Iyer (2002) argued that it is typical for the Hindu women in south India to marry their maternal



uncles as matter of cultural trait, unlike the Muslims. However, the prevalence of consanguineous marriage significantly declines among both Hindus and Muslims in western region of the country. In the western region, Maharashtra, Gujarat, and Goa are the three economically developed states and often regarded as business hub of the country (Bhuyan 2018; The Hindu Businessline 2013). The western states are spending their resources more efficiently on education and the development of the social sector (Bhuyan 2018).

Comparatively, higher progress in the social sector in the western states perhaps affects the prevalence of consanguineous marriage. Imbibing western culture and developing awareness of the risk of consanguineous marriage could be some plausible reasons for the decline in consanguineous marriage across age cohorts (Bittles et al.1993; Kalam et al. 2016).

The recent survey period 2015-2016 (NFHS-4) of our study shows higher prevalence of maternal first-cousin marriage. The north-east and the southern part of India have a favoured prevalence of maternal first-cousin marriage, whereas the western region shows less favour in maternal first-cousin. Muslims show a higher favour in the prevalence of maternal first-cousin marriage. The determinant for the type of first-cousin marriage is also a culturally defined phenomenon. For example, marrying maternal or paternal first-cousin is an important phenomenon in many Arabian countries as well as in India. The Arab Muslim communities of the Middle East (Korotayev 2000; Murphy and Kasdan 1959), the Kurds of Western Asia (Barth 1954), and the Israeli Jewish community (Goldberg 1967) prefer paternal first-cousin marriage. It is believed that after the conversion of Arabian community into Islam, reform of the laws of inheritance was introduced according to the *Quran*. Daughters were entitled to inherit half of the amount received by sons, and wives received a determinate share from their husbands (Bittles and Hamamy 2010). A dower (*mahr*) also is specified as part of the marriage arrangement, with the goods transferred to the bride at marriage. In this situation, it could be preferred that a woman's share of her family wealth would be retained within the

family by marrying paternal cousin (Bittles 2012). Kalam (2019) (unpublished field data) in a study on the Indian *Darbhanga Khotta* Muslim community observed that women feel confident and comfortable in fixing marital alliance for their daughters, especially with their sisters' sons.

Our study shows more likelihood of marrying maternal first-cousins among the schedule tribes. In a small-scale study among the *Gond* population (scheduled tribe) of Andhra Pradesh, Pingle and Haimondorf (1987) observed a strong preference for the maternal first-cousin as found in our study. Similarly, in the north-east India, among the *Garos* and the *Khasis* scheduled tribes of the state of Meghalaya, marrying father's sister's son (FSSo) is preferred (Sarkar 1988).

Several studies argued that higher educational level of women, age at marriage and living standard might reduce the prevalence in consanguineous marriage (Islam 2018; Jurdi and Saxena 2003; Kelmemei et al. 2015; Shenk et al. 2016). It is true that the background characteristics of the respondents of our study showed a wide disparity in socio-demographic development in India between two survey periods (Appendix Table A1). Our study revealed that respondents who got married at later age, are highly educated, and economically affluent were less likely to practice consanguineous marriage.

Goode (1963) was of the opinion that consanguinity will decrease with modernization, increase in social development, especially with the increase in female education and work force participation. Studies show that an increase in social status of women, measured in terms of increase in educational attainment, participation in work force and supplement in household income provides liberty to decide on age at marriage and to choose life partners (Dyson and More 1983; Givens and Hirschman 1994; Rao et al. 1972). Rao et al. (1972) found that women living in urban areas and men belonging to high-status occupations were less likely to have consanguineous marriages than their counterparts in a

district in Tamil Nadu, South India, similar to Goode's (1963) proposition. In the last few decades of the post globalization era, India has achieved considerable progress in socio-demographic aspects including wealth quintile (Mishra and Joe 2020; MOSPI 2017). Our study also reports a decrease in percentage of respondents who married below 18 years of age, increase in educational attainments and economic affluence between the two successive survey periods (Appendix Table A1). And many of these variables remained significant determinants (however, with low odds) for consanguineous marriage in both the survey periods (Appendix Table A2 and Table A3).

It appears from the above discussion that the value of odds ratio remained consistently high across in all the models for region and religion, after controlling socio-demographic variables. A close scrutiny of the trends in the results (RRR) suggests that north-south regional dichotomy in culture and religion largely determines consanguineous marriage consistently between the two survey periods rather than socio-demographic conditions in India. Furthermore, the trends in the results (AOR models) suggest cultural differences among north-east, south, and western regions of the country and Islamic domination in the prevalence of maternal first-cousin marriage. The results also suggest that husbands' occupation and their place of residence are found to be insignificant in the consanguineous marriage between two survey periods. At the moment we do not have any explanation why the likelihood of first-cousin marriage increased in the later survey period. Perhaps this could be taken up for future research.

We conclude from this study that region of residence and religious affiliation continue to play very important role in determining consanguineous marriage even after controlling other potentially significant confounders, as hypothesized primarily.

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**Table 1. Variation in the Prevalence of Consanguineous Marriage by Region and State of India, 1992–2016 (excluding UTs)**

State and region	NFHS 1 (1992-93)			NFHS 4 (2015-16)		
	Consanguinity, % (F≥0.0156)	No. of consanguineous marriages	Total ever married women	Consanguinity, % (F≥0.0156)	No. of consanguineous marriages	Total ever married women
<b>North India***</b>	<b>2.42</b>	<b>453</b>	<b>18733</b>	<b>6.11</b>	<b>1031</b>	<b>16869</b>
Delhi**	4.00	129	3,263	5.90	35	590
Haryana***	0.90	23	2,556	3.70	93	2524
Himachal Pradesh	0.70	18	2,701	0.50	11	2143
Jammu and Kashmir***	7.80	197	2,542	15.80	717	4547
Punjab***	0.90	24	2,821	1.60	35	2215
Rajasthan***	1.30	62	4,850	2.90	140	4850
<b>East India***</b>	<b>5.22</b>	<b>686</b>	<b>13147</b>	<b>3.61</b>	<b>556</b>	<b>15412</b>
Bihar/Jharkhand***	5.30	274	5,203	3.30	303	9294
Odisha	5.50	219	3,998	5.00	194	3897
West Bengal***	4.90	193	3,946	2.70	59	2221
<b>Central India*</b>	<b>6.20</b>	<b>964</b>	<b>15551</b>	<b>6.34</b>	<b>1394</b>	<b>21996</b>
Madhya Pradesh/ Chhattisgarh**	4.10	229	5,541	5.40	537	9972
Uttar Pradesh/Uttarakhand	7.40	735	10,010	7.10	857	12024
<b>North-east***</b>	<b>1.90</b>	<b>168</b>	<b>8808</b>	<b>1.15</b>	<b>128</b>	<b>11141</b>
Arunachal Pradesh**	4.00	34	844	2.00	31	1615
Assam***	1.60	46	2,801	0.50	18	3497
Manipur	2.00	18	920	1.60	23	1398
Meghalaya	2.80	30	1,089	1.80	18	975
Mizoram	0.30	3	990	0.90	11	1238
Nagaland	1.30	15	1,137	1.50	16	1039
Sikkim	NA	NA	NA	1.30	8	627
Tripura**	2.10	22	1,028	0.40	3	752
Western***	12.66	1300	10265	8.38	719	8582

Goa***	10.60	320	3,030	6.80	41	602
Gujarat***	4.90	169	3,471	5.50	245	4469
Maharashtra***	21.50	811	3,764	12.30	433	3511
South***	26.67	4075	15279	24.59	2914	11853
Andhra Pradesh/Telangana***	31.50	1,217	3,861	25.50	571	2237
Karnataka***	29.90	1,193	3,995	27.50	868	3157
Kerala***	7.70	297	3,873	3.90	69	1795
Tamil Nadu***	38.50	1,368	3,550	30.10	1406	4664
Total (weighted)***	9.40	7,647	81,781	7.90	6,742	85,851

\*\*\*p<0.001; \*\*p<0.01; \*p<0.05

**Table 2. Prevalence of Consanguineous Marriages by Religion in India, 1992–2016**

Religion	% (no. of consanguineous marriages)	Total ever married women	% (no. of consanguineous marriages)	Total ever married women
	NFHS 1 (1992-93)		NFHS 4 (2015-16)	
Hindu***	8.42	63,732	7.07	64,940
	(5,364)		(4,593)	
Muslim***	21.98	8,570	15.72	11,971
	(1,883)		(1,882)	
Others***	4.22	9,479	2.99	8940
	(400)		(267)	
Total	9.35	81,781	7.85	85,851
	(7,647)		(6,742)	

\*\*\*p<0.001; \*\*p<0.01; \*p<0.05

**Table 3. Variation in the Prevalence of Consanguineous Marriage by Region and State of India****According to Religion, 1992–2016 (excluding UTs)**

	H 92-93	H 15-16	M 92-93	M 15-16	O 92-93	O 15-16
North India	1.00	2.14	23.05	19.98	1.24	1.94
Delhi	2.10	3.00	18.81	19.20	4.80	0.00
Haryana	0.86	2.65	1.47	14.37	1.31	3.03
Himachal Pradesh	0.62	0.52	5.73	2.28	0.00	0.00
Jammu and Kashmir	1.10	5.08	40.33	21.33	2.82	4.29
Punjab	1.12	1.05	2.86	9.71	0.64	1.61
Rajasthan	0.56	1.83	13.75	15.29	0.00	2.58
East India	2.72	2.45	21.95**	11.44	2.43	2.44
Bihar/Jharkhand	1.03	1.50	27.69***	13.45	0.71	1.02
Odisha	5.30	4.82	13.78	8.91	8.42	7.60
West Bengal	1.79	1.36	16.80	6.60	0.00	2.92
Central India	3.33	4.64	27.32**	19.31	4.65	4.16
Madhya Pradesh/ Chhattisgarh	3.28	4.44	19.74	24.55	4.16	4.37
Uttar Pradesh/Uttarakhand	3.36	4.84	28.68***	18.12	5.13	3.69
North-east	0.78	0.46	4.75	1.90	2.31	1.55
Arunachal Pradesh	1.71	0.75	0.00	3.57	5.33	2.34
Assam	0.72	0.27	3.76	0.98	2.33	0.76
Manipur	0.52	0.92	13.21	7.71	2.78	0.93
Meghalaya	0.00	0.22	4.00	0.00	2.98	2.27
Mizoram	0.00	0.00	0.00	0.00	0.31	0.94
Nagaland	0.00	0.00	0.00	3.09	1.40	1.55
Sikkim	NA	1.59	NA	0.00	NA	1.02
Tripura	0.89	0.00	9.88	5.95	11.76	0.00

Western	10.83**	6.81	32.94	22.90**	9.44	9.03
Goa	11.85	7.37	18.59	6.45	5.91	4.90
Gujarat	1.80	4.16	36.36	22.78**	1.75	6.20
Maharashtra	19.85***	10.69	35.47	24.81*	17.51	10.72
South	29.43	27.06	19.42	14.16*	11.08	12.09
Andhra Pradesh/Telangana	31.47**	26.10	29.54	21.12	37.06	24.51
Karnataka	30.53	29.29	27.19	19.82	20.80	11.82
Kerala	8.84	4.40	9.43	3.65	2.12	2.29
Tamil Nadu	40.19***	31.31	33.18	22.43	19.81	16.65
Total	8.42**	7.07	21.98	15.72***	4.22	2.99

\*\*\*p<0.001; \*\*p<0.01; \*p<0.05

**Table 4. Consanguineous Marriages (%) by Background Characteristics in India, 1992–2016**

**(excluding UTs)**

Background characteristics	First-cousin					First-cousin				
	(Paternal and maternal)	Second -cousin	Uncle /niece	Not related	Consanguinity, % (F≥0.0156)	(Paternal and maternal)	Second -cousin	Uncle /niece	Not related	Consanguinity, % (F≥0.0156)
	NFHS 1 (1992-93)					NFHS 4 (2015-16)				
Age at marriage	Pearson chi2(6) = 500.613; p = 0.000					Pearson chi2(6) = 85.827; p = 0.000				
Below 18	9.4	0.9	0.8	88.9	11.1	7.7	0.6	0.4	91.3	8.7
18-24	5.7	0.7	0.5	93.1	6.9	6.7	0.6	0.4	92.3	7.7
25 and above	3.2	0.3	0.2	96.3	3.7	5.0	0.7	0.2	94.1	5.9
Respondents' education	Pearson chi2(9) = 257.366; p = 0.000					Pearson chi2(9) = 15.800; p = 0.071				
No education	8.7	0.7	0.71	89.8	10.2	7.0	0.6	0.37	92.0	8.0
1-5	7.7	1.0	0.75	90.6	9.4	6.7	0.6	0.27	92.4	7.6
6-10	7.0	0.8	0.55	91.6	8.4	7.2	0.6	0.39	91.8	8.2
11 and above	3.6	0.6	0.32	95.5	4.5	6.5	0.6	0.48	92.4	7.6
Husbands' education	Pearson chi2(9) = 329.435; p = 0.000					Pearson chi2(9) = 49.329; p = 0.000				
No education	9.3	0.7	0.8	89.2	10.9	7.7	0.5	0.4	91.3	8.7
1-5	9.2	1.1	0.8	88.9	11.1	7.4	0.6	0.4	91.6	8.4
6-10	6.9	0.8	0.5	91.9	8.1	6.7	0.7	0.4	92.2	7.8
11 and above	5.6	0.5	0.5	93.4	6.6	6.3	0.5	0.4	92.8	7.2
Respondents' occupation	Pearson chi2(6) = 363.877; p = 0.000					Pearson chi2(6) = 20.967; p = 0.002				
Not working/don't know	6.9	0.7	0.48	91.9	8.1	6.8	0.6	0.4	92.3	7.7
Blue collar	10.8	0.8	1.05	87.3	12.6	7.3	0.6	0.5	91.6	8.4
White collar	7.8	1.0	0.92	90.3	9.7	7.3	0.8	0.4	91.5	8.5
Husbands' occupation	Pearson chi2(3) = 111.092; p = 0.000					Pearson chi2(3) = 16.6431; p = 0.001				

Not working/Blue collar	8.8	0.7	0.86	89.6	10.4	6.7	0.6	0.4	92.3	7.7
White collar	7.2	0.8	0.51	91.5	8.5	7.4	0.7	0.4	91.5	8.5
Place of residence	Pearson chi2(3) = 14.520; p = 0.002					Pearson chi2(3) = 59.163; p = 0.000				
Urban	7.4	0.8	0.6	91.2	8.9	7.9	0.7	0.4	91.0	9.0
Rural	8.0	0.7	0.7	90.6	9.4	6.5	0.6	0.4	92.5	7.5
Caste groups	Pearson chi2(6) = 205.897; p = 0.000					Pearson chi2(6) = 166.228; p = 0.000				
SC	8.3	0.8	1.1	89.8	10.2	7.0	0.5	0.5	92.0	8.1
ST	5.2	0.3	0.3	94.3	5.7	4.6	0.4	0.3	94.7	5.3
Others	8.2	0.9	0.6	90.3	9.7	7.4	0.6	0.4	91.6	8.4
Wealth Quintile	Pearson chi2(12) = 139.177; p = 0.000					Pearson chi2(12) = 283.540; p = 0.000				
Poorest	8.4	1.1	0.97	89.5	10.5	4.5	0.5	0.3	94.7	5.3
Poorer	8.0	0.9	0.83	90.3	9.7	6.9	0.5	0.4	92.2	7.8
Middle	8.2	0.9	0.75	90.1	9.9	8.5	0.7	0.4	90.4	9.6
Richer	7.3	0.6	0.55	91.5	8.5	8.0	0.7	0.5	90.8	9.2
Richest	7.5	0.5	0.31	91.7	8.3	6.4	0.6	0.4	92.7	7.4
Total (Unweighted)	7.8	0.8	0.7	90.7	9.3	6.9	0.6	0.4	92.1	7.9

Note: Figures in the parenthesis indicates df (degrees of freedom)



**Table 5. Multinomial Logistic Regression Results of Consanguineous Marriage According to Background Characteristics in India, 1992–2016**

	Background characteristics	First-cousin (Paternal and maternal) RRR (CI)	Second-cousin RRR (CI)	Uncle/niece RRR (CI)
Model 1	Region			
	North®			
	East	1.48***(1.38,1.6)	0.89(0.73,1.09)	2.70***(1.77,4.11)
	Central	1.22***(1.13,1.32)	0.47***(0.36,0.6)	1.76***(1.11,2.79)
	North-East	0.35***(0.3,0.4)	0.23***(0.16,0.35)	1.14(0.65,2.02)
	Western	3.09***(2.87,3.33)	0.85(0.66,1.1)	2.76***(1.73,4.43)
	South	7.62***(7.16,8.12)	4.69***(4,5.51)	36.38***(25.22,52.48)
	Constant	0.04***(0.04,0.04)	0.01***(0.01,0.01)	0.001***(0.001,0.002)
Model 2	Region			
	North®			
	East	1.48***(1.38,1.6)	0.89(0.73,1.09)	2.53***(1.66,3.85)
	Central	1.25***(1.16,1.35)	0.48***(0.37,0.62)	1.66***(1.05,2.64)
	North-East	0.40***(0.35,0.46)	0.26***(0.18,0.39)	1.40(0.79,2.49)
	Western	3.42***(3.18,3.68)	0.94(0.73,1.2)	2.69***(1.68,4.31)
	South	8.18***(7.67,8.73)	5.01***(4.26,5.88)	35.05***(24.29,50.58)
	Religion			
	Hindu®			
	Muslims	3.40***(3.25,3.57)	3.15***(2.75,3.6)	0.77***(0.6,1)
Others	0.71***(0.65,0.77)	0.75***(0.58,0.98)	0.50***(0.36,0.7)	
Constant	0.03***(0.03,0.03)	0.01***(0.004,0.01)	0.001***(0.001,0.0013)	
Model 3	Region			
	North®			
	East	1.55***(1.43,1.68)	1.015(0.81,1.27)	2.30***(1.48,3.58)
	Central	1.27***(1.17,1.39)	0.52***(0.39,0.68)	1.42(0.88,2.3)
	North-East	0.43***(0.38,0.5)	0.34***(0.22,0.52)	1.52(0.84,2.76)

Western	4.01***(3.7,4.35)	1.15(0.88,1.5)	3.13***(1.92,5.1)
South	9.51***(8.85,10.21)	6.00***(4.98,7.24)	38.47***(26.08,56.76)
Religion			
Hindu®			
Muslims	3.78***(3.59,3.98)	2.89***(2.47,3.37)	0.93(0.71,1.22)
Others	0.79***(0.73,0.87)	0.80(0.62,1.05)	0.65***(0.45,0.87)
Age at marriage			
Below 18®			
18-24	0.78***(0.75,0.81)	0.85**(0.74,0.97)	0.70***(0.6,0.82)
25 and above	0.54***(0.48,0.6)	0.68**(0.5,0.93)	0.36***(0.23,0.55)
Respondent's education			
No education®			
1-5	0.79***(0.74,0.84)	1.002(0.84,1.2)	0.79**(0.64,0.98)
6-10	0.82***(0.77,0.87)	0.88(0.74,1.05)	0.74***(0.6,0.91)
11 and above	0.75***(0.69,0.82)	0.95(0.73,1.24)	0.81(0.6,1.11)
Husbands education			
No education®			
1-5	0.95*(0.89,1.01)	1.28***(1.06,1.54)	0.97(0.79,1.18)
6-10	0.95*(0.9,1.01)	1.28***(1.07,1.53)	0.89(0.73,1.08)
11 and above	1.089**(1.01,1.17)	0.99(0.77,1.27)	1.26*(0.97,1.64)
Respondent's occupation			
Not working/don't know®			
Blue collar	1.13***(1.07,1.19)	1.07(0.91,1.26)	1.08(0.91,1.29)
White collar	1.01(0.95,1.08)	1.32***(1.11,1.58)	1.19*(0.97,1.47)
Husband occupation			
Not working/Blue collar®			
White collar	0.97(0.93,1.02)	1.11(0.97,1.27)	0.97(0.83,1.14)
Place of residence			
Urban ®			
Rural	1.02(0.97,1.07)	0.93(0.81,1.07)	1.05(0.89,1.25)

	Caste			
	SC®			
	ST	1.06(0.98,1.15)	0.98(0.74,1.28)	0.85(0.64,1.14)
	Others	0.80***(0.76,0.85)	0.96(0.81,1.15)	0.76***(0.64,0.91)
	Wealth Quintile			
	Poorest®			
	Poorer	1.11***(1.04,1.19)	0.77***(0.64,0.94)	0.83*(0.67,1.03)
	Middle	1.04(0.97,1.11)	0.72***(0.6,0.87)	0.638***(0.52,0.79)
	Richer	0.96(0.9,1.03)	0.60***(0.49,0.73)	0.62***(0.5,0.77)
	Richest	0.98(0.91,1.05)	0.54***(0.44,0.66)	0.48***(0.37,0.61)
	Constant	0.04***(0.03,0.04)	0.01***(0.004,0.01)	0.002***(0.001,0.003)
	Region			
	North®			
	East	1.53***(1.42,1.66)	1.04(0.83,1.3)	2.41***(1.55,3.75)
	Central	1.27***(1.17,1.38)	0.52***(0.4,0.69)	1.45(0.9,2.35)
	North-East	0.43***(0.38,0.5)	0.34***(0.22,0.52)	1.55(0.85,2.81)
	Western	4.02***(3.71,4.36)	1.15(0.88,1.5)	3.14***(1.93,5.12)
	South	9.55***(8.89,10.26)	5.96***(4.94,7.19)	38.16***(25.86,56.3)
	Religion			
	Hindu®			
Model 4	Muslims	3.76***(3.57,3.96)	2.91***(2.49,3.4)	0.94(0.72,1.23)
	Others	0.80***(0.73,0.88)	0.79*(0.6,1.04)	0.61***(0.44,0.85)
	Age at marriage			
	Below 18®			
	18-24	0.77***(0.74,0.81)	0.86**(0.75,0.99)	0.73***(0.62,0.85)
	25 and above	0.53***(0.48,0.59)	0.70**(0.51,0.96)	0.38***(0.25,0.58)
	Respondent's education			
	No education®			
	1-5	0.79***(0.74,0.84)	1.01(0.84,1.21)	0.81*(0.65,1)
	6-10	0.80***(0.76,0.85)	0.90(0.75,1.08)	0.77**(0.62,0.95)

11 and above	0.73***(0.67,0.8)	0.99(0.76,1.29)	0.87(0.64,1.2)
Husbands education			
No education®			
1-5	0.945*(0.89,1)	1.28***(1.06,1.54)	0.97(0.79,1.19)
6-10	0.94**(0.89,1)	1.29***(1.08,1.54)	0.90(0.74,1.1)
11 and above	1.08**(1.001,1.17)	0.99(0.78,1.28)	1.27*(0.97,1.66)
Respondent's occupation			
Not working/don't know®			
Blue collar	1.13***(1.07,1.19)	1.08(0.91,1.27)	1.08(0.91,1.29)
White collar	1.02(0.95,1.09)	1.31***(1.1,1.57)	1.17(0.96,1.45)
Husband occupation			
Not working/Blue collar®			
White collar	0.99(0.95,1.04)	1.07(0.92,1.23)	0.91(0.77,1.08)
Place of residence			
Urban ®			
Rural	1.02(0.98,1.08)	0.93(0.81,1.07)	1.04(0.88,1.23)
Caste			
SC®			
ST	1.06(0.98,1.15)	0.98(0.75,1.28)	0.85(0.64,1.14)
Others	0.81***(0.76,0.86)	0.94(0.79,1.12)	0.73***(0.61,0.87)
Wealth Quintile			
Poorest®			
Poorer	1.11***(1.04,1.19)	0.78**(0.64,0.95)	0.85(0.69,1.05)
Middle	1.04(0.97,1.11)	0.73***(0.61,0.88)	0.66***(0.53,0.81)
Richer	0.964(0.9,1.03)	0.61***(0.5,0.74)	0.63***(0.51,0.79)
Richest	0.982(0.92,1.05)	0.54***(0.44,0.67)	0.49***(0.38,0.62)
Year			
1992-93®			
2015-16	1.07***(1.03,1.12)	0.88*(0.77,1.02)	0.81***(0.69,0.95)
Constant	0.04***(0.03,0.04)	0.01***(0.004,0.01)	0.002***(0.001,0.004)

RRR= Relative risk ratio; CI = Confidence interval; \*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$ ; base category = others/not related

**Table 6. Binary Logistic Regression Results of Consanguineous Marriage (Paternal and Maternal First-Cousin) According to Background Characteristics in India, 1992–2016**

	Model 1	Model 2	Model 3	Model 4
	AOR(CI)	AOR(CI)	AOR(CI)	AOR(CI)
<b>Region</b>				
<b>North®</b>				
East	0.90(0.78,1.03)	0.92(0.79,1.06)	0.95(0.82,1.12)	0.95(0.81,1.11)
Central	0.97(0.83,1.13)	0.99(0.85,1.16)	1.05(0.89,1.25)	1.09(0.92,1.3)
North-East	1.31**(1,1.72)	1.32*(0.99,1.76)	1.29(0.95,1.75)	1.35*(0.99,1.85)
Western	0.76***(0.66,0.88)	0.79***(0.68,0.92)	0.83**(0.7,0.97)	0.86*(0.73,1.02)
South	1.09(0.97,1.23)	1.15**(1.01,1.32)	1.20**(1.04,1.4)	1.25***(1.07,1.45)
<b>Religion</b>				
<b>Hindu®</b>				
Muslims		1.09*(0.99,1.19)	1.11**(1.01,1.23)	1.11**(1,1.22)
Others		1.07(0.89,1.28)	0.99(0.83,1.2)	1.01(0.84,1.22)
<b>Age at marriage</b>				
<b>Below 18®</b>				
18-24			1.106**(1.02,1.2)	1.08*(0.99,1.17)
25 and above			1.24**(1.01,1.51)	1.17(0.96,1.44)
<b>Respondents' education</b>				
<b>No education®</b>				
1-5			0.92(0.82,1.03)	0.90*(0.81,1.01)
6-10			1.04(0.94,1.16)	0.99(0.89,1.11)
11 and above			0.93(0.8,1.09)	0.87*(0.74,1.03)
<b>Husbands' education</b>				
<b>No education®</b>				

1-5			0.96(0.86,1.07)	0.95(0.85,1.06)
6-10			0.97(0.87,1.07)	0.95(0.86,1.06)
11 and above			0.88*(0.77,1.01)	0.87*(0.76,1)
Respondents' occupation				
Not working/don't know®				
Blue collar			0.99(0.9,1.09)	0.99(0.9,1.09)
White collar			0.98(0.87,1.11)	0.99(0.88,1.12)
Husbands' occupation				
Not working/Blue collar®				
White collar			0.90**(0.83,0.98)	0.94(0.87,1.03)
Place of residence				
Urban ®				
Rural			0.94(0.86,1.03)	0.95(0.87,1.04)
Caste				
SC®				
ST			1.19**(1.03,1.39)	1.19**(1.02,1.39)
Others			0.96(0.87,1.07)	0.99(0.89,1.1)
Wealth Quintile				
Poorest®				
Poorer			1.03(0.91,1.17)	1.02(0.9,1.15)
Middle			1.10(0.98,1.25)	1.09(0.96,1.23)
Richer			1.14**(1,1.29)	1.13*(1,1.28)
Richest			1.17**(1.03,1.33)	1.18**(1.04,1.35)
Year				
1992-93®				
2015-16				1.18***(1.09,1.29)
Constant	0.94(0.84,1.05)	0.89*(0.78,1.01)	0.86(0.69,1.07)	0.77**(0.62,0.96)

log likelihood	-8522.94	-8521.24	-8235.20	-8227.83
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AOR= Adjusted odds ratio; CI = Confidence interval; \*\*\*p<0.001; \*\*p<0.01; \*p<0.05; base category = paternal first-cousin



**Supplementary Table S1. Background Characteristics of Respondents in NFHS-1 (1992–1993) and NFHS-4 (2015–2016)**

Background characteristics	NFHS-1 (1992-93)		NFHS-4 (2015-16)		Pr( Z  <  z )
	Proportions	Number	Proportions	Number	
<b>Age at marriage</b>					
Below 18	66.5	54,360	40.0	34,280	0.000
18-24	31.6	25,825	52.2	44,821	0.000
25 and above	1.9	1,554	7.8	6,714	0.000
<b>Respondents' education</b>					
No education	62.0	50,719	32.6	27,995	0.000
1-5	13.7	11,238	14.1	12,114	0.377
6-10	17.8	14,593	34.3	29,400	0.000
11 and above	6.4	5,231	19.0	16,342	0.000
<b>Husbands' education</b>					
No education	34.9	28,550	19.9	17,041	0.000
1-5	17.9	14,629	14.9	12,787	0.000
6-10	31.3	25,587	39.9	34,282	0.000
11 and above	15.9	13,015	25.3	21,740	0.000
<b>Respondents' occupation</b>					
Not working/don't know	66.5	54,358	68.7	59,015	0.000
Blue collar	21.0	17,134	22.9	19,677	0.000
White collar	12.6	10,289	8.3	7,159	0.000
<b>Husbands' occupation</b>					
Not working/Blue collar	44.5	36,377	67.2	57,727	0.000
White collar	55.5	45,404	32.8	28,124	0.000
<b>Place of residence</b>					
Urban	26.6	21,782	35.0	30,073	0.000

Rural	73.4	59,999	65.0	55,778	0.000
Religion					
Hindu	82.1	67,116	81.2	69,732	0.000
Muslims	11.8	9,681	13.4	11,530	0.001
Others	6.1	4,984	5.4	4,589	0.142
Caste					
SC	12.1	9,926	20.1	16,424	0.000
ST	8.9	7,306	9.6	7,830	0.138
Others	78.9	64,549	70.4	57,642	0.000
Wealth Quintile					
Poorest	19.4	15,899	16.7	14,316	0.000
Poorer	20.9	17,090	19.0	16,321	0.000
Middle	20.7	16,934	20.9	17,920	0.646
Richer	20.4	16,662	21.4	18,404	0.021
Richest	18.6	15,196	22.0	18,890	0.000
Region					
North	12.2	9,961	12.4	10,652	0.662
East	22.1	18,074	20.9	17,897	0.006
Central	23.9	19,539	21.7	18,585	0.000
North-East	3.9	3,216	3.4	2,922	0.298
Western	14.7	11,984	16.6	14,219	0.000
South	23.2	19,007	25.1	21,576	0.000
Total	100.0	81,781	100.0	85,851	

**Supplementary Table S2. Multinomial Logistic Regression Results of Consanguinity According to Background Characteristics in India, 1992–1993**

Background characteristics	First-cousin (Paternal and maternal) RRR (CI)	Second-cousin RRR (CI)	Uncle/niece RRR (CI)
<b>Region</b>			
North®			
East	2.13***(1.86,2.45)	1.02(0.71,1.46)	2.49**(1.21,5.15)
Central	2.52***(2.22,2.88)	0.56***(0.38,0.84)	0.66(0.26,1.64)
North-East	0.89(0.73,1.10)	0.43***(0.23,0.8)	2.58**(1.1,6.09)
Western	8.13***(7.17,9.22)	1.24(0.84,1.84)	4.14***(1.96,8.74)
South	15.44***(13.73,17.37)	8.74***(6.71,11.38)	66.66***(36.46,121.89)
<b>Religion</b>			
Hindu®			
Muslims	3.69***(3.43,3.97)	2.62***(2.12,3.22)	0.73(0.5,1.07)
Others	0.877**(0.78,0.99)	0.61**(0.41,0.9)	0.67*(0.44,1.01)
<b>Age at marriage</b>			
Below 18®			
18-24	0.72***(0.67,0.77)	0.86(0.72,1.04)	0.72***(0.58,0.89)
25 and above	0.39***(0.31,0.5)	0.34***(0.16,0.7)	0.30***(0.13,0.68)
<b>Respondent's education</b>			
No education®			
1-5	0.71***(0.66,0.78)	0.89(0.71,1.13)	0.78*(0.6,1.02)
6-10	0.67***(0.61,0.73)	0.74**(0.58,0.95)	0.56***(0.42,0.76)
11 and above	0.46***(0.38,0.54)	0.81(0.52,1.25)	0.34***(0.19,0.59)
<b>Husbands education</b>			
No education®			
1-5	0.902***(0.83,0.98)	1.276**(1.02,1.6)	0.10(0.79,1.27)

6-10	0.98(0.91,1.06)	1.21*(0.96,1.53)	0.89(0.69,1.16)
11 and above	1.217***(1.09,1.36)	0.968(0.68,1.37)	1.703***(1.2,2.42)
Respondent's occupation			
Not working/don't know®			
Blue collar	1.21***(1.12,1.31)	1.08(0.85,1.37)	0.951(0.75,1.2)
White collar	0.99(0.91,1.08)	1.23*(0.99,1.54)	1.24*(0.97,1.59)
Husband occupation			
Not working/Blue collar®			
White collar	0.91***(0.85,0.97)	1.08(0.89,1.32)	0.71***(0.57,0.88)
Place of residence			
Urban ®			
Rural	0.92**(0.86,0.99)	0.89(0.73,1.08)	0.84(0.67,1.06)
Caste			
SC®			
ST	0.95(0.84,1.08)	0.69(0.43,1.09)	0.75(0.5,1.14)
Others	0.77***(0.71,0.84)	0.90(0.7,1.15)	0.66***(0.52,0.83)
Wealth Quintile			
Poorest®			
Poorer	0.95(0.87,1.05)	0.78**(0.61,1)	0.88(0.68,1.14)
Middle	0.83***(0.76,0.9)	0.63***(0.5,0.8)	0.63***(0.48,0.81)
Richer	0.82***(0.75,0.9)	0.51***(0.4,0.66)	0.55***(0.42,0.72)
Richest	0.88***(0.8,0.96)	0.47***(0.36,0.61)	0.37***(0.27,0.51)
Constant	0.03***(0.03,0.04)	0.01***(0,0.01)	0.003***(0,0.01)

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RRR= Relative risk ratio; CI = Confidence interval; \*\*\*p<0.001; \*\*p<0.01; \*p<0.05; base category = others/not related

**Supplementary Table S3. Multinomial Logistic Regression Results of Consanguinity According to Background Characteristics in India, 2015–2016**

Background characteristics	First-cousin (Paternal and maternal) RRR (CI)	Second-cousin RRR (CI)	Uncle/niece RRR (CI)
<b>Region</b>			
<b>North®</b>			
East	0.62***(0.55,0.71)	0.53***(0.36,0.79)	2.17**(1.18,3.97)
Central	1.19***(1.07,1.31)	1.05(0.78,1.41)	2.23***(1.26,3.9)
North-East	0.21***(0.17,0.26)	0.25***(0.14,0.45)	0.98(0.42,2.29)
Western	2.06***(1.84,2.31)	1.11(0.76,1.61)	2.56***(1.33,4.91)
South	6.53***(5.94,7.19)	3.38***(2.54,4.51)	18.51***(10.99,31.17)
<b>Religion</b>			
<b>Hindu®</b>			
Muslims	3.74***(3.47,4.03)	3.03***(2.39,3.85)	1.24(0.84,1.83)
Others	0.79***(0.69,0.92)	1.11(0.75,1.64)	0.53**(0.3,0.97)
<b>Age at marriage</b>			
<b>Below 18®</b>			
18-24	0.83***(0.78,0.89)	0.91(0.74,1.12)	0.78**(0.61,1.01)
25 and above	0.60***(0.53,0.68)	0.93(0.65,1.33)	0.46***(0.27,0.77)
<b>Respondent's education</b>			
<b>No education®</b>			
1-5	0.95(0.86,1.04)	1.163(0.87,1.56)	0.759(0.51,1.14)
6-10	1.03(0.95,1.12)	1.08(0.83,1.42)	1.026(0.74,1.42)
11 and above	0.99(0.88,1.11)	1.15(0.8,1.65)	1.39(0.91,2.12)
<b>Husbands education</b>			
<b>No education®</b>			

1-5	1.02(0.92,1.12)	1.19(0.85,1.66)	0.87(0.59,1.29)
6-10	0.91**(0.84,1.01)	1.35**(1.01,1.81)	0.87(0.62,1.22)
11 and above	1.01(0.90,1.12)	0.97(0.67,1.42)	0.87(0.57,1.34)
Respondent's occupation			
Not working/don't know®			
Blue collar	1.02(0.95,1.10)	1.07(0.84,1.35)	1.23(0.94,1.61)
White collar	1.12**(1.01,1.25)	1.41**(1.03,1.93)	0.91(0.6,1.39)
Husband occupation			
Not working/Blue collar®			
White collar	1.16***(1.09,1.24)	1.07(0.86,1.33)	1.29*(0.99,1.68)
Place of residence			
Urban ®			
Rural	1.03(0.96,1.11)	0.95(0.76,1.19)	1.34**(1.01,1.78)
Caste			
SC®			
ST	1.15***(1.03,1.28)	1.18(0.83,1.66)	0.98(0.65,1.48)
Others	0.85***(0.79,0.92)	0.94(0.73,1.22)	0.76**(0.58,1)
Wealth Quintile			
Poorest®			
Poorer	1.24***(1.12,1.38)	0.87(0.62,1.23)	1.09(0.72,1.63)
Middle	1.18***(1.06,1.31)	1.05(0.75,1.47)	1.01(0.66,1.55)
Richer	0.96(0.85,1.08)	0.92(0.63,1.33)	1.17(0.74,1.84)
Richest	0.81***(0.71,0.93)	0.76(0.5,1.16)	1.01(0.59,1.72)
Constant	0.04***(0.04,0.05)	0.004***(0,0.01)	0.001***(0,0)

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RRR= Relative risk ratio; CI = Confidence interval; \*\*\*p<0.001; \*\*p<0.01; \*p<0.05; base category =

others/not related

## **Figure Captions**

**Figure 1.** Types of consanguineous marriages by regions of India, 1992–2016.

**Figure 2.** Prevalence of consanguineous marriages by religion in India, 1992–2016.

Figure 1.

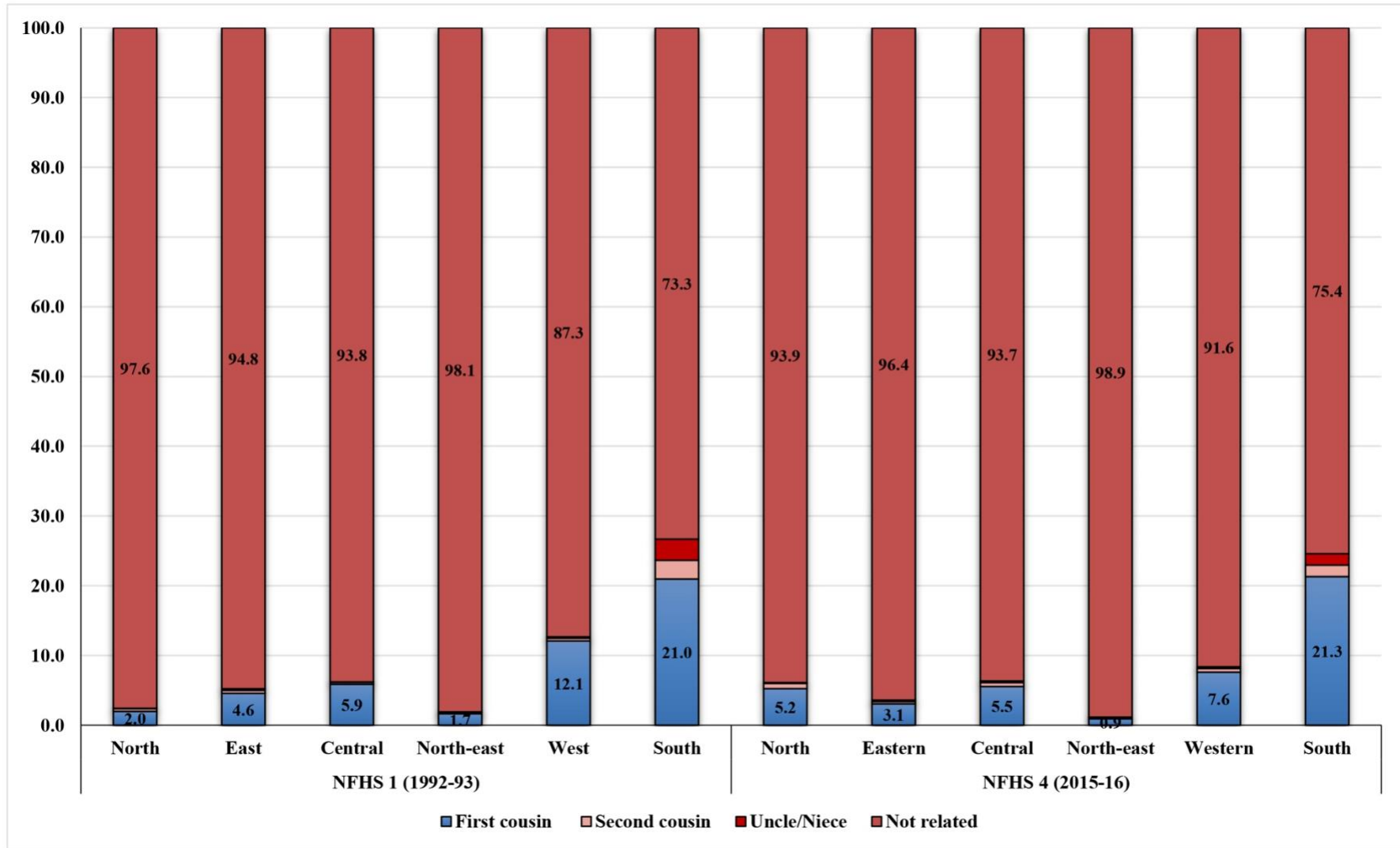




Figure 2.

