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Trend of child marriage in Bangladesh: A reflection on significant socioeconomic factors

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ABSTRACT

A complicating factor for child marriage in Bangladesh is age heaping or digital preference, where young girls misreport their age, claiming to be older or younger than they are. Analysis based on four nationally representative cross-sectional surveys over the last 10 years has shown that the age adjusted results are similar to the reported age results in terms of the direction of the associated socioeconomic factors; however, their effect sizes have changed. Data from 2004 to 2014 of the Bangladesh Demographic and Health Survey (BDHS) were used and cumulative link mixed models (CLMM) were fitted to ascertain the risk factors by adjusting cluster effects, where the outcome variable was categorized by women's age of marriage (ordinal in nature). Even after age adjustment, education of respondents and their partners, age of both the head of the house and their partner, and the geographic division showed a significant association in all surveys. Although the year wise effect showed significant improvement over the years in pooled data, the rate of improvement was not encouraging. Notable cluster (or community) level variations have been observed over the years, indicating that community specific factors such as regional culture and local environments should be considered during the intervention design.

1. Introduction

Bangladesh is known for its high prevalence of child marriage: over 52% of children are married before reaching 18 (Malhotra, Warner, McGonagle, & Lee-Rife, 2011; Lee-Rife, Malhotra, Warner, & Glinski, 2012; United Nations Children's Fund (UNICEF), 2016). However, Streatfield, Kamal, Ahsan, and Nahar (2015) showed that the marriage of children in Bangladesh might not occur as early as it appears because more than half of the female respondents in Bangladesh misreport their age during surveys, which creates an artificial inflation of the incidence of child marriage in Bangladesh. Using a survey in Matlab of 1766 women, they concluded that the average difference between actual and reported age is around 2 years (Streatfield et al., 2015). That leads to an important question: will the socioeconomic factors responsible for child marriage have a similar effect when the age is adjusted? We propose to address the question by analyzing the latest four nationwide Bangladesh Demographic and Health Surveys (BDHS) from 2004 to 2014. Furthermore, this study explores the improvement of the child marriage scenario in Bangladesh over the past 10 years. We reached two conclusions: a) although the prevalence of child marriage notably changed after adjusting the age, significant socioeconomic factors for the reported age and the adjusted age were mostly in the same direction; and b) there was limited improvement relating to child marriage over time, which was mostly a result of the level of education of both women and their husbands.

Age misstatement is a common phenomenon in surveys or census, particularly in developing countries in the subcontinent (Denic, Saadi, & Khatib, 2004; Mukhopadhyay & Majumdar, 2009). Age heaping or digital preference, the tendency to falsify one's age and state a lower digit than the actual age or preferring a number ending with 0 or 5, is a common form of such misstatements. (Pardeshi, 2010) and is closely associated with literacy and schooling (Tollnek & Baten, 2016). The validity of data from rural Bangladesh is compromised due to such misreporting (Callahan & Becker, 2012; Espeut & Becker, 2015). The low literacy rate in general, but more particularly for women, paves the way for age misstatements, negatively affecting the accuracy of public health studies (Mahmud, Shah, & Becker, 2012).

Several studies have been conducted on child marriage prevalence

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in Bangladesh, and the BDHS data sets were applied in most cases. Kamal, Hassan, Alam, and Ying (2015) analyzed six BDHS data sets to show that little improvement was observed over the course of a decade in Bangladesh. Education of women and their husbands (or partners), along with residence (urban or rural), faith and culture, norm and patriarchy and poverty (both economic and human poverty) are the known factors responsible for this social stigma (Barkat & Majid, 2003; Bhattacharyya, 2015; Hossain, Mahumud, & Saw, 2016; Kabir, Islam, Khan, & Roy, 2016; Kamal, 2010). Family formation at an early age does not allow women to receive better education and join the workforce; thus, the next generation falls victim to a similar situation, creating a socio-cultural norm (Zahangir, 2011). However, the situation is improving in Bangladesh where young girls are creating child marriage-free zones (UNICEF, 2016).

These studies on child marriage in Bangladesh showed a grim picture where girls are married off at an early age due to the disadvantaged socio-economic status of the households (Rahman, 2017). However, results from Streatfield et al. (2015) raise the issue that the effects of various socio-economic factors on child marriage could be overestimated, as the numbers of under-aged women during marriage may have been inflated due to age heaping. Thus, a change in the outcome scale could be possible if the bias was adjusted, and might affect the previous findings. Based on this hypothesis, the current study adjusted the age of marriage by 2 years and estimated the effect sizes for exploratory variables. This additional quantity changes the total proportion of females in child marriage categories (below 18 and over 18, detailed later), which would be expected to change the effect sizes and subsequent significance following statistical modeling. These hypotheses are based on the ecological approach to the study of the family (Andrews, Bubolz, & Paolucci, 1981); this theory posits that environmental resources/constraints (individual, family, community and societal), in other words, sociodemographic factors, can influence the family and its support systems (Holman, 2006; Liao, Lee, Roberts-Lewis, Hong, & Jiao, 2011).

This study contributes to the literature by confirming the previous results through the application of an age adjusted model by accumulating the effect of age heaping. More importantly, the considered data sets are clustered due to the survey design of the BDHS, which requires adjustment of the cluster effect to draw valid inferences observing cluster level variations in child marriage. In this study, the outcome of interest is ordinal in nature indicating the application of the ordinal logistic regression. Thus, we applied the cumulative link mixed model (CLMM) to fit the ordinal outcome, where survey clusters were considered to be random effects, to find the associated socioeconomic factors with child marriage over time. In addition, the latest survey of BDHS (2014) was included in the study. This study looks to contribute towards the assessment of Goal 5 of the Sustainable Development Goals (SDG): gender equality and women's empowerment, which is entwined with child marriage in developing countries such as Bangladesh (United Nations, 2017; United Nations Population Fund (UNFPA), 2017).

2. Material and methods

2.1. Ethical approval

This article does not contain any studies with human participants performed by any of the authors. The Bangladesh Demographic and Health Surveys were approved by the ICF Macro Institutional Review Board and the National Research Ethics Committee of the Bangladesh Medical Research Council (BMRC). Written consent relating to the survey was given by participants before interviews. All of the respondents were dis-identified before publishing the data. The secondary data sets analyzed during the current study are freely available upon request from the DHS website at http://dhsprogram.com/data/available-datasets.com. The website provides a list of countries and the link for Bangladesh displays the surveys conducted in Bangladesh. Searching 'Bangladesh DHS, 2011' in the DHS website will provide the survey data set.

2.2. Sampling and data description

Measure DHS+ is a platform where the data from developing countries are collected and analyzed periodically over an interval of a few years on the demographic and health characteristics of populations (Rutstein, Johnson, MEASURE, et al., 2004). Bangladesh Demographic and Health Surveys (BDHS) have been conducted in Bangladesh since 1993 in collaboration with DHS (Demographic and Health Survey) (DHS, 2016). These nationally representative cross-sectional surveys are also conducted in collaboration with the National Institute of Population Research and Training (NIPORT), ICF International, USA, and Mitra and Associates.

Two-stage stratified cluster sampling techniques were adapted for sampling purposes in these surveys (DHS, 2016). The sampling frame for the survey was a complete list of enumeration areas (EAs) from the recent census, which were either a village or a part of a village or a group of villages. In the first stage of the sampling, the EAs (clusters) were selected using the proportional to size (PPS) sampling method, where 600 clusters were selected in all BDHSs 2004, 2007, 2011, and 2014, respectively. In the second stage, an equal probability systematic sampling method was applied to draw on average 30 households from each cluster. Data were extracted from the BDHS of year 2004, 2007, 2011 and 2014 in this study. Only the data of females were considered and the temporary residents (de jure) were excluded in the sample. The selected sample size for each survey was over 10,000, detailed in Table 1.

The outcome variable was the respondent's marriage age, quantified by the difference between birth month and cohabitation month. It was categorized into 3 classes: married before 15 years of age, 15 to < 18 years, and 18 or over. 18 years is the legal age of marriage for women in Bangladesh (Mukti & Lutfunnahar, 2014). This outcome variable is ordinal in nature. The age of respondents was adjusted by adding 2 years to the reported age in the data set, as explained by Streatfield et al. (2015). The change in the outcome scales was evident; however, the proportion of child marriage (< 18 years) was still high (Table 1).

Table 1
Outcome scales of reported and adjusted age of marriage (women) for the four surveys.

Survey year	Age of marriage					
	Under 15		15– < 18		18 or more	
	Reported	Adjusted	Reported	Adjusted	Reported	Adjusted
BDHS 2004 (Sample = 10,548)	5822 (55.2%)	913 (8.7%)	3250 (30.8%)	6382 (60.5%)	1476 (14%)	3253 (30.8%)
BDHS 2007 (Sample = 10,088)	4526 (44.9%)	748 (7.4%)	3683 (36.5%)	5372 (53.3%)	1879 (18.6%)	3968 (39.3%)
BDHS 2011 (Sample = 16,518)	6615 (40%)	900 (5.4%)	6359 (38.5%)	8258 (50%)	3544 (21.5%)	7360 (44.6%)
BDHS 2014 (Sample = 16,719)	6083 (36.4%)	1025 (6.1%)	6745 (40.3%)	7669 (45.9%)	3891 (23.3%)	8025 (48%)

Table 2
CLMM fitted with BDHS 2004 to 2014 for ordinal-scaled reported age of marriage.

Variables	BDHS 2004	BDHS 2007	BDHS 2011	BDHS 2014
		Odds Ratio (95% Confidence Interval)		
Random effect (variance)	1.207	1.162	1.145	1.133
ICC	0.268	0.261	0.258	0.256
Residence (ref: Urban)				
Rural	0.924 (0.80, 1.07)	0.806 (0.71, 0.92)	0.959 (0.87, 1.06)	0.889 (0.81, 0.98) [b]
Division (ref: Barisal)				
Chittagong	1.587 (1.26, 1.99) [b]	1.485 (1.21, 1.83) [b]	1.843 (1.56, 2.17) [b]	1.633 (1.39, 1.92) [b]
Dhaka	0.996 (0.79, 1.24)	0.947 (0.77, 1.16)	1.227 (1.04, 1.44) [b]	1.209 (1.03, 1.42) [a]
Khulna	0.739 (0.58, 0.94) [b]	0.772 (0.62, 0.96) [b]	0.948 (0.80, 1.12)	0.758 (0.64, 0.89) [b]
Rajshahi	0.741 (0.59, 0.93) [b]	0.733 (0.59, 0.89) [b]	0.899 (0.78, 1.04)	0.741 (0.64, 0.86) [b]
Sylhet	2.427 (1.87, 3.16) [b]	2.851 (2.28, 3.57) [b]	3.642 (3.04, 4.36) [b]	3.179 (2.67, 3.78) [b]
Respondent's education (ref: No education)				
Primary	1.149 (1.03, 1.29) [a]	1.300 (1.16, 1.45) [b]	1.133 (1.04, 1.24) [b]	1.189 (1.08, 1.30) [b]
Secondary	2.449 (2.14, 2.79) [b]	2.345 (2.06, 2.67) [b]	2.151 (1.94, 2.38) [b]	1.877 (1.69, 2.08) [b]
Higher	19.056 (14.86, 24.44) [b]	16.287 (12.86, 20.62) [b]	12.781 (10.69, 15.29) [b]	10.991 (9.31, 12.98) [b]
Partner's education (ref: No education)				
Primary	1.224 (1.09, 1.38) [b]	0.994 (0.89, 1.12)	1.116 (1.02, 1.22) [a]	1.092 (1.00, 1.19) [a]
Secondary	1.324 (1.16, 1.51) [b]	1.309 (1.15, 1.49) [b]	1.236 (1.12, 1.37) [b]	1.274 (1.15, 1.41) [b]
Higher	1.724 (1.43, 2.08) [b]	1.701 (1.41, 2.05) [b]	1.785 (1.55, 2.06) [b]	1.846 (1.61, 2.12) [b]
Wealth index (ref: Poorest)				
Poorer	0.912 (0.79, 1.06)	1.069 (0.93, 1.24)	0.966 (0.87, 1.07)	1.018 (0.92, 1.13)
Middle	0.865 (0.74, 1.01)	1.045 (0.90, 1.21)	0.860 (0.77, 0.96) [b]	0.982 (0.88, 1.09)
Richer	0.987 (0.84, 1.16)	1.039 (0.89, 1.22)	0.904 (0.80, 1.02)	0.929 (0.82, 1.05)
Richest	0.964 (0.80, 1.16)	1.138 (0.95, 1.36)	1.003 (0.87, 1.16)	1.012 (0.88, 1.17)
Sex of house head (ref: Male)				
Female	0.967 (0.81, 1.16)	1.114 (0.95, 1.30)	0.886 (0.78, 1.01)	0.878 (0.78, 0.98) [a]
Age of house head (ref: Young)				
Adult	1.310 (1.00, 1.71) [a]	1.313 (1.00, 1.72) [a]	1.189 (0.97, 1.46)	1.184 (0.98, 1.43)
Old	1.855 (1.39, 2.47) [b]	1.856 (1.39, 2.48) [b]	1.639 (1.32, 2.04) [b]	1.680 (1.36, 2.07) [b]
Partner's age (ref: Young)				
Adult	1.261 (1.03, 1.55) [a]	0.736 (0.59, 0.92) [b]	1.041 (0.89, 1.21)	1.039 (0.89, 1.21)
Old	0.627 (0.47, 0.84)[b]	0.337 (0.25, 0.44) [b]	0.560 (0.45, 0.69) [b]	0.505 (0.41, 0.62) [b]
Partner's occupation (ref: Not working/ unemployed)				
Agriculture	1.078 (0.81, 1.44)	1.202 (0.88, 1.64)	0.940 (0.77, 1.14)	0.940 (0.67, 1.32)
Manual labor	1.215 (0.91, 1.63)	1.307 (0.96, 1.78)	1.031 (0.85, 1.25)	0.931 (0.66, 1.31)
Service	1.337 (1.00, 1.79) [a]	1.359 (0.99, 1.86)	1.063 (0.88, 1.29)	0.950 (0.68, 1.34)
Business	1.259 (0.94, 1.68)	1.281 (0.94, 1.75)	1.049 (0.86, 1.27)	0.862 (0.61, 1.21)
Others	1.129 (0.77, 1.65)	0.899 (0.59, 1.35)	1.086 (0.82, 1.43)	0.893 (0.61, 1.30)
Media exposure (ref: None)				
At least one	1.134 (1.02, 1.26) [a]	1.009 (0.93, 1.09)	0.977 (0.90, 1.06)	1.073 (0.99, 1.16)

[a] Level of significance at 5%.
[b] Level of significance at 1%.

2.3. Statistical analysis

Bivariate analysis was performed to explore the relationship between available variables and child marriage for both reported and adjusted age. A chi-square test provided the *p*-values determining the strength of the bivariate dependence (results are displayed in the supplementary file). The association was determined by fitting the random intercept ordinal data model, i.e. cumulative linear mixed model (CLMM) (Agresti, 2002). This model is an extension of the general ordinal logistic regression model, which enables the model to incorporate both the random effects and the fixed effects (Christensen, 2015; Christensen & Brockhoff, 2013). Due to sampling design, data are clustered in nature, indicating that individuals were correlated within clusters. Thus, it is important to adjust the cluster level variation in the model to draw more accurate statistical inferences. Random cluster effects characterize the dependency of individuals from the same cluster for clustered data. The CLMM provides the appropriate approach to adjust the cluster in the modeling correlated ordinal response to ensure the valid inferences as well as to determine the cluster level variation on outcome. This model is applied in public health studies (Adde et al., 2016; Bluemel et al., 2017; Raith et al., 2016). The CLMM model is an extension of the generalized linear mixed models (Raith et al., 2016), with an ordinal outcome (response) variable Y_i, which is the three categories of age of marriage in this study. This model is defined by,

$$logit(P(Y_i \leq j)) = \alpha_j - \beta_1 x_{i,1} - \beta_2 x_{i,2} - \ldots - \beta_n x_{i,n} - \mu_i b_m \quad (1)$$

where, $x_i = (x_1, \ldots, x_n)$ denotes the fixed effects (various socio-demographic factors) and b_m represents the random effect of clusters, which is assumed to follow normal distribution ($b_m \sim N(0, T_m^2)$). This model is referred to as a random-intercept model. All statistical analyses were conducted using *R* (version 3.4.0) and CLMM was fitted using *ordinal* package in *R* (R Core Team, 2018).

The exploratory variables that were fitted as the fixed effects were: place of residence ("Urban", "Rural"); administrative division ("Barisal", "Chittagong", "Dhaka", "Khulna", "Rajshahi", "Sylhet"); respondent's level of education ("No education", "Primary", "Secondary", "Higher"); partner's education; wealth index ("Poorest", "Poorer", "Middle", "Richer", "Richest"); sex of head of house ("Male", "Female"); age of head of house ("Young", "Adult", "Old"); partner's age; partner's occupation ("Not working/unemployed", "Agriculture", "Manual Labor", "Service", "Business", "Others"); and media exposure of respondents ("None", "at least one"). This study merged data from Rajshahi and Rangpur to Rajshahi as Rajshahi division was split into two divisions in BDHS 2011 and 2014. We categorized age variables: Young (under 25 years); Adult (in between 25 and 59 years); and Old (above 59 years). Media exposure was based on the respondent's affiliation with any mode of media, namely radio, newspaper or

television in the last month. The clusters from the data set were considered to be the random effect in the CLMM. Hence, the model was cluster adjusted, providing odds ratios of the fixed effects. Cluster level variation or unobserved heterogeneity within the cluster correlation were also observed using variance of random effect and intra-cluster correlation (ICC), respectively.

3. Results

Results of the analysis showed that about 86% of the sampled women were married before age 18 years (in 2004); however, this prevalence declined with an average rate of change of 4% per year and reached about 77% (in year 2014). After adjusting the age by 2 years, this prevalence changed from 69% (in year 2004) to 52% (in year 2014) (Table 1).

3.1. Bivariate analysis

According to bivariate analysis, all the covariates mentioned above had a significant association ($P - value < 0.001$) with child marriage except the sex of the head of the house. The results from the reported age and the adjusted age provided near similar results in terms of the direction of the effects. Considering the size of the tables, we added the bivariate tables in a supplementary file.

3.2. Year-wise analysis

Fitted models for both the reported age and the adjusted age displayed homogeneous results in terms of direction, although the effect size was slightly changed (Tables 2 and 3). Divisional residence, education of respondent and partner, age of head of the house and partner seemed to be the significant factors influencing child marriage in Bangladesh. However, the rural residence in 2014 was significant (1% level) for the reported age, which was not evident for the adjusted age. Similarly, media exposure in 2014 was important for the adjusted age, unlike the reported age.

In comparison with the Barisal division, Chittagong and Sylhet divisions showed significantly higher odds ratios against child marriage, displaying a considerably higher age (15+ or 18+) of marriage for women. However, the scenarios in Khulna and Rajshahi were worse in comparison with the Barisal division in both the reported and adjusted age of marriage. Early marriage was more common in these divisions compared to the reference category, Barisal. Education of respondent and her husband/partner showed consistent results in both Tables 2 and 3. The more educated they were, the higher the likelihood of not having a child marriage. In particular, women who are highly educated are very unlikely to be involved in a child marriage. Both the reported and the adjusted age showed higher risk of child marriage for not or less educated females and their husbands/partners. A contrasting result was found for the age of the head of the house and the age of the partner. Women with an older (age $>$ 59 years) head of the house are 1.5 times more likely to marry at age 18 or over compared to the young house head (age $<$ 25 years). However, if the partner was old, then there was a 20–70% lower chance of marriage at age 18 or above compared to the young partners, as explained in detail below. Both covariates showed similar results in the reported age and the adjusted age. Variance of random effect represents the cluster level unobserved heterogeneity in the child marriage adjusting various risk factors. These indicated that the variability in child marriage that was attributed to the clusters was notably high but decreasing across surveys (1.207 in 2004 to 1.133 in 2014). In addition, intra-cluster correlation (ICC) reflects the degree of correlation within a cluster. This correlation in the clustered data of child marriage was also high but marginally decreased over time (ICC: 0.268 in 2004 to 0.256 in 2014), which clearly supports the need to include a random effect for clustering in the model when analyzing the clustered child marriage data.

3.3. Compiled analysis

The data from BDHS 2004, 2007, 2011 and 2014 were merged into one pooled data set to further assess the covariates' combined effect. This combined data also allowed the quantification of the change in child marriage prevalence over the years. Table 4 demonstrates the similarity between the reported age and the adjusted age. All the significant covariates in the year-wise analysis were also significant here, alongside the residence and sex of the head of the house. Residents in rural areas have almost 10% higher chance of marrying earlier in comparison to urban dwellers. The women as heads of the house showed more intent to marry off their daughters earlier than the male heads. The odds ratios of year 2007, 2011 and 2014 have gradually increased in reference to 2004, and all were significant (1% level) in both age categories. Therefore, the gradual improvement of the child marriage status quo in Bangladesh is evident. Variance of random effect represents the cluster/community-level unobserved heterogeneity in child marriage after accounting for the different risk factors: therefore, they may be interpreted as net measures of child marriage for the cluster. Similar to year-wise stratified analysis, variance of random effects (1.162) in pooled data analysis showed a notable amount of cluster (or community) level variability in child marriage. Conversely, ICC 0.261 indicates a high dependency of individuals within the same cluster in the context of child marriage among women in Bangladesh.

4. Discussion

The results displayed two perspectives of child marriage in Bangladesh: a) even with age adjustments, the covariates remained analogously important, where the change in the child marriage scenario was significant in the last 10 years; and b) there was a discouragingly small improvement where the influencing factors over time remained unchanged. The significant factors were geographic division, education, age of the head of the house and partner, which were consistent over the four surveys as well as in the pooled data set. Interestingly, the wealth index, defined as the ownership of family properties, did not show any impact on the prevalence of child marriage, which is similar to the results found in Nepal (Maharjan, Karki, Shakya, & Aryal, 2012). It is important to note that the dowry tradition is more of a cultural trend and a swift income source for the bridegroom, where poverty plays a negligible role. However, this study was limited by the lack of data on the amount of dowry, if any, paid by the respondents (women) during their marriage.

The factors found to be significant in the CLMM are consistent with previous literature. Residents living in rural areas in Bangladesh consider marriage as a 'profit-making initiative' by marrying off their daughters in an early age, which is not necessarily the only economic way out for the metropolitan dwellers where more opportunities of income exist (Chowdhury, 2004; Kabeer, 2011). Furthermore, the act of dowry is more common in rural compared to urban areas (Chowdhury, 2010). Lack of both education and awareness of the consequences of early marriage encourage further child marriage; primary education does not provide sufficient protection against it (Bates, Maselko, & Schuler, 2007; Field & Ambrus, 2008; Nour, 2009; Raj, McDougal, Silverman, & Rusch, 2014). These create a never-ending cycle of custom, education and marriage, where the costs of education and delayed marriage for daughters are too high, with uncertain outcomes compared to the ready-made profit of low dowry marriage with one less mouth to feed in the family (Kabeer, 2011; Schuler, Bates, Islam, & Islam, 2006). Education of women assists them to attain a career path, which should reduce the prevalence of child marriage (Zahangir & Kamal, 2011). Similarly, a highly educated husband/partner is unlikely to participate in a child marriage (Kamal et al., 2015). Among the four surveys, only 0.3% (160 out of 53,845) of the married couples, where both were highly educated, participated in a child marriage.

From the perspective of Bangladesh, the age of the head of the house

Table 3
CLMM fitted with BDHS 2004 to 2014 for ordinal-scaled adjusted age of marriage.

Variables	BDHS 2004	BDHS 2007	BDHS 2011	BDHS 2014
		Odds ratio (95% confidence interval)		
Random effect (variance)	1.197	1.146	1.155	1.142
ICC	0.267	0.258	0.259	0.257
Residence (ref: Urban)				
Rural	0.929 (0.81, 1.07)	0.806 (0.70, 0.92)	1.012 (0.91, 1.13)	0.883 (0.79, 0.98)
Division (ref: Barisal)				
Chittagong	1.482 (1.18, 1.87) [b]	1.441 (1.17, 1.78) [b]	1.834 (1.54, 2.19) [b]	1.644 (1.38, 1.95) [b]
Dhaka	1.118 (0.89, 1.39)	0.882 (0.72, 1.08)	1.037 (0.87, 1.23)	1.182 (0.99, 1.39)
Khulna	0.759 (0.59, 0.96) [a]	0.745 (0.59, 0.93) [b]	0.836 (0.70, 0.99) [a]	0.786 (0.66, 0.93)
Rajshahi	0.829 (0.66, 1.03)	0.742 (0.60, 0.91) [b]	0.814 (0.69, 0.95) [b]	0.719 (0.62, 0.84) [b]
Sylhet	2.155 (1.65, 2.82) [b]	2.825 (2.25, 3.55) [b]	3.302 (2.73, 4.00) [b]	2.925 (2.43, 3.52) [b]
Respondent's education (ref: No education)				
Primary	1.108 (0.99, 1.24)	1.282 (1.14, 1.44) [b]	1.181 (1.08, 1.29) [b]	1.174 (1.07, 1.29) [b]
Secondary	2.256 (1.97, 2.59) [b]	2.340 (2.04, 2.68) [b]	2.144 (1.93, 2.39) [b]	1.976 (1.78, 2.19) [b]
Higher	19.660 (14.29, 27.04) [b]	16.446 (12.22, 22.13) [b]	16.88 (13.29, 21.44) [b]	13.105 (10.55, 16.28) [b]
Partner's education (ref: No education)				
Primary	1.186 (1.06, 1.33) [b]	1.067 (0.95, 1.19)	1.101 (1.00, 1.21) [a]	1.088 (0.99, 1.19)
Secondary	1.290 (1.13, 1.47) [b]	1.398 (1.22, 1.59) [b]	1.165 (1.05, 1.29) [b]	1.246 (1.12, 1.38) [b]
Higher	1.655 (1.35, 2.02) [b]	1.686 (1.38, 2.06) [b]	1.634 (1.39, 1.91) [b]	1.805 (1.55, 2.10) [b]
Wealth index (ref: Poorest)				
Poorer	1.007 (0.87, 1.16)	1.059 (0.91, 1.23)	0.957 (0.86, 1.07)	1.043 (0.94, 1.16)
Middle	0.973 (0.84, 1.13)	1.001 (0.86, 1.17)	0.859 (0.76, 0.97) [b]	0.952 (0.85, 1.07)
Richer	1.059 (0.90, 1.24)	0.923 (0.78, 1.09)	0.915 (0.81, 1.04)	0.899 (0.79, 1.02)
Richest	1.048 (0.87, 1.26)	1.053 (0.87, 1.27)	0.983 (0.84, 1.14)	0.914 (0.78, 1.07)
Sex of house head (ref: Male)				
Female	1.068 (0.89, 1.29)	0.951 (0.80, 1.12)	0.842 (0.73, 0.97) [b]	0.921 (0.81, 1.04)
Age of house head (ref: Young)				
Adult	1.074 (0.82, 1.39)	1.181 (0.89, 1.57)	1.186 (0.95, 1.47)	1.128 (0.92, 1.38)
Old	1.626 (1.22, 2.17) [b]	1.874 (1.37, 2.56) [b]	1.702 (1.35, 2.15) [b]	1.596 (1.27, 2.00) [b]
Partner's age (ref: Young)				
Adult	1.451 (1.17, 1.79) [b]	0.933 (0.73, 1.19)	1.014 (0.86, 1.19)	0.944 (0.79, 1.12)
Old	0.812 (0.61, 1.09)	0.375 (0.27, 0.52) [b]	0.529 (0.42, 0.67) [b]	0.416 (0.33, 0.52) [b]
Partner's occupation (ref: Not working/ unemployed)				
Agriculture	1.048 (0.78, 1.41)	1.116 (0.80, 1.55)	1.076 (0.87, 1.33)	0.950 (0.66, 1.38)
Manual labor	1.218 (0.91, 1.64)	1.212 (0.87, 1.68)	1.140 (0.92, 1.41)	0.999 (0.69, 1.45)
Service	1.316 (0.98, 1.77)	1.289 (0.93, 1.79)	1.164 (0.94, 1.44)	0.961 (0.66, 1.39)
Business	1.224 (0.91, 1.64)	1.191 (0.86, 1.65)	1.164 (0.94, 1.44)	0.881 (0.61, 1.28)
Others	1.261 (0.86, 1.86)	0.902 (0.59, 1.39)	1.327 (0.98, 1.79)	0.886 (0.59, 1.33)
Media exposure (ref: None)				
At least one	1.111 (0.99, 1.24)	0.975 (0.89, 1.07)	0.988 (0.91, 1.08)	1.118 (1.03, 1.22) [b]

[a] Level of significance at 5%.
[b] Level of significance at 1%

and the age of the partner showed contrasting, yet understandable results. Only 3.9% of the heads of the house were young, whereas 81.6% and 14.3% were adult (between 25 and 59 years) and old respectively. In the social context of Bangladesh, there are barely any single parent families. Hence, any family with a young (aged below 25 years) head of the house means the person himself is likely to have participated in child marriage and formed a family. On the other hand, the old heads of the house, who bear the finance of the family, allow the young to complete their education and thus there is a higher chance of avoiding child marriage. Many of the old heads of the house and their wives also participate in various awareness campaigns nowadays, which slows the rate of child marriage (Malhotra et al., 2011; Raynor, Wesson, & Keynes, 2006). However the partners, who were old might have participated more in child marriage themselves when they were young, compared to young people of today. The likely explanation is that the older people, defined as 59+ years, were married a minimum of 25–30 years before the survey when the social context inspired them to marry at an early age. The opportunity of having more offspring and the widespread practice of dowry made them and their wives easy victims of child marriage.

The changes in the child marriage scenario over the years were significant (Table 4), although the prevalence is still high, and the scenario has not changed as much as the contributors would have hoped. We considered each significant factor and attempted to determine possible intervention strategies for Bangladesh to consider while going forward. The prevalence of child marriage has decreased from 89% to 80% (73% to 55% for adjusted) in rural areas and 80% to 69% (61% to 45% for adjusted) in urban areas (Fig. 1 (a, b)). The apparent downturn seemed to be a positive sign; however, the absolute gap between rural and urban areas remained unchanged, around 10%, for the past 10 years in both reported and adjusted age. This gap may occur for several reasons. One reason is the lack of awareness about the legal age of marriage, i.e. a recent survey showed that awareness of the legal age of marriage among the rural and urban women was 45% and 55%, respectively (icddr,b and Plan International, 2013). Another reason for child marriage was financial insolvency, which was more than double in rural areas (16%) in contrast to urban areas (7%). Family pressure leading to the decision to marry could be another reason for child marriage where about 18.5% of the women from rural areas did not provide their consent before marriage, in comparison to 11% in urban areas (icddr,b and Plan International, 2013). The intervention policies should consider the process of reducing the gap between residents from the different areas, which is largely caused by the existing uneven literacy rates in rural and urban areas, particularly focusing on the parents, family and community members, and community leaders (Godha, Hotchkiss, & Gage, 2013).

The prevalence of child marriage among each category of education, except higher education, had reduced around 5–10% over the last

Table 4
CLMM fitted with pooled data of BDHS 2004 to 2014 for reported and adjusted age of marriage.

Variables	Reported age	Adjusted age
	Odds ratio (95% Confidence Interval)	
Random effect (variance)	1.162	1.164
ICC	0.261	0.261
Residence (ref: Urban)		
Rural	0.901 (0.85, 0.95) [b]	0.912 (0.86, 0.97) [b]
Division (ref: Barisal)		
Chittagong	1.651 (1.50, 1.81) [b]	1.613 (1.46, 1.78) [b]
Dhaka	1.111 (1.01, 1.22) [a]	1.059 (0.96, 1.16)
Khulna	0.811 (0.74, 0.89) [b]	0.786 (0.71, 0.87) [b]
Rajshahi	0.783 (0.72, 0.85) [b]	0.765 (0.69, 0.84) [b]
Sylhet	3.079 (2.78, 3.41) [b]	2.856 (2.57, 3.18) [b]
Respondent's education (ref: No education)		
Primary	1.197 (1.14, 1.26) [b]	1.189 (1.13, 1.25) [b]
Secondary	1.101 (1.05, 1.16) [b]	2.139 (2.02, 2.27) [b]
Higher	13.486 (12.22, 14.89) [b]	15.749 (13.84, 17.92) [b]
Partner's education (ref: No education)		
Primary	1.101 (1.05, 1.16) [b]	1.107 (1.05, 1.16) [b]
Secondary	1.269 (1.20, 1.34) [b]	1.251 (1.18, 1.33) [b]
Higher	1.786 (1.65, 1.93) [b]	1.702 (1.56, 1.86) [b]
Wealth index (ref: Poorest)		
Poorer	0.992 (0.93, 1.05)	1.017 (0.96, 1.08)
Middle	0.935 (0.88, 0.99) [a]	0.944 (0.88, 1.01)
Richer	0.959 (0.89, 1.03)	0.950 (0.89, 1.02)
Richest	1.043 (0.96, 1.13)	1.010 (0.93, 1.09)
Sex of house head (ref: Male)		
Female	0.929 (0.87, 0.99) [a]	0.921 (0.86, 0.99) [a]
Age of house head (ref: Young)		
Adult	1.214 (1.09, 1.36) [b]	1.13 (1.00, 1.27) [a]
Old	1.710 (1.51, 1.93) [b]	1.659 (1.46, 1.89) [b]
Partner's age (ref: Young)		
Adult	1.015 (0.93, 1.11)	1.051 (0.96, 1.16)
Old	0.508 (0.45, 0.58) [b]	1.659 (1.46, 1.89) [b]
Partner's occupation (ref: Not working/ unemployed)		
Agriculture	1.035 (0.91, 1.18)	1.052 (0.92, 1.21)
Manual labor	1.099 (0.96, 1.25)	1.133 (0.99, 1.30)
Service	1.143 (1.00, 1.30) [a]	1.158 (1.01, 1.33) [a]
Business	1.081 (0.95, 1.23)	1.095 (0.95, 1.26)
Others	1.026 (0.87, 1.21)	1.096 (0.92, 1.31)
Media exposure (ref: None)		
At least one	1.020 (0.98, 1.06)	1.023 (0.98, 1.07)
Year (ref: 2004)		
2007	1.406 (1.29, 1.53) [b]	1.288 (1.19, 1.39) [b]
2011	1.724 (1.60, 1.85) [b]	1.653 (1.53, 1.78) [b]
2014	1.922 (1.79, 2.07) [b]	1.782 (1.65, 1.92) [b]

[a] Level of significance at 5%.
[b] Level of significance at 1%.

10 years, which in aggregate might seem significant. However, the absolute difference between the other categories and higher education was 45–70% for both the reported and the adjusted age (Fig. 1 (c, d)). Raj et al. (2014) indicated that, as mentioned above, primary education is not a good protector for child marriage in Bangladesh. We agree with that, emphasizing that even secondary education might not be protective enough in the current context. The adjusted age showed a low prevalence (< 10%) of child marriage among the more highly educated women. However, it is important to note that girls who complete secondary education are more likely to come of age and thus reduce the risk of child marriage. In the current study sample, the proportion of women who completed secondary (or higher) education was 30.04%, 36.59&, 42.59% and 45.82% in the years 2004, 2007, 2011 and 2014 respectively showing the gradual increase in women's participation in education (El Arifeen et al., 2014; Heath & Mobarak, 2015). A similar scenario was observed in realtion to the partner's education. The prevalence of child marriage in all the categories, including the higher education level, had declined in a similar pattern; however, the gap between higher education and other levels was high as well. Thus, reducing the rate of child marriage will require higher education for the women as well as their partners. Interestingly, the decline in all the categories of both the respondent and the partner's education was similar in the surveys, demonstrating the persistence of the social stigma and how it contributes to all levels of education for both reported and adjusted cases.

Among the heads of the house, the young heads seemed to have participated more in child marriage; however, the difference among the age groups was not high. More than 80\% of the house heads (84% in urban and 80% in rural) were adult and 77% (reported) and 52% (adjusted) of them, as of 2014, were part of a child marriage (Fig. 2 (a, b)). Thus, any intervention polices should focus on the adults, in both rural and urban areas, to make them aware of the consequences of a child marriage. The association of the partner's age with child marriage gave an intuitive result, where old and young partners were more involved in child marriage. The prevalence of child marriage in adults had decreased around 10-15% over the years, which is highest among the age groups (Fig. 2 (c, d). Education, in the long run, will have an impact on these factors and should improve the status quo. Both Figures 1 and 2 displayed the lesser prevalence of child marriage in all sectors for adjusted age as expected; however, the socio-economic context remained homogeneous.

Moreover, over the years, cluster or community level variation was

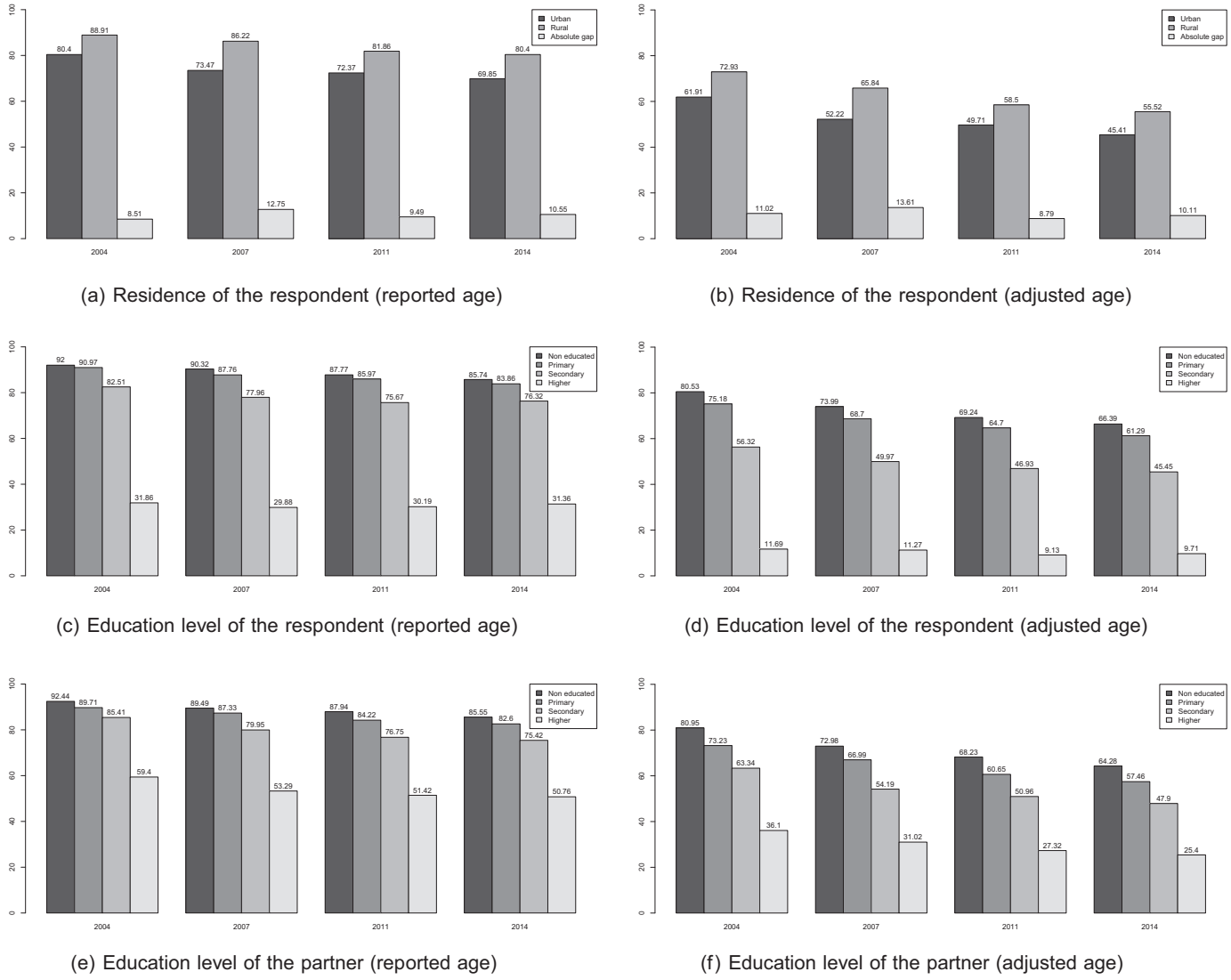

Fig. 1. Prevalence of child marriage (in %) in Bangladesh on the basis of the significant factors.

found to have a sizable effect on child marriage, which indicates the latent community specific factors that have noticeable contributions in explaining the total variability in the child marriage situation in Bangladesh. Bangladesh is culturally diverse, and economic and educational development vary across the various regions of the country. In addition, traditional and cultural beliefs might also encourage early marriage in remote areas. Policy makers have to consider these community specific variables including the cultural, environmental, social and behavioral facts while designing appropriate intervention.

Among these negatives, the overall scenario is slowly improving in Bangladesh. A reduction in child marriage for age under 15 was observed, from 55.2% (2004) to 36.4% (2014) for the reported age and from 8.7% to 6.1% for the adjusted age (Table 1). Such a reduction was also observed for 15 to 18 years of age and so was a simultaneous increase in marriage above 18. These changes could be attributed to the effort of multiple non-governmental organizations (NGOs), who strive to educate girls and their parents in rural Bangladesh (Biswas, Rahman, Kabir, & Raihan, 2017; DeJaeghere & Wiger, 2013; Naher, 2010). Furthermore, the government's initiative to launch incentivized educational packages such as 'food for education' have encouraged girls to attend school and thus delayed the marriage (Ahmed & Babu, 2007; Behrman, 2015; Buchmann, Glennerster, O'Neill, & Vargas-Garcia, 2017). Although these efforts are commendable, more work lie ahead to detect the most vulnerable households and reduce the percentage of child marriage in Bangladesh.

This study explored the trend of child marriage by considering all the available socio-economic parameters. Hence, the models were limited by individual covariates' effects, where interaction effects were not fitted. However, this study provided the significant socio-economic factors of Bangladesh, which can be further studied in depth to understand the underlying interaction among them. In some cases, there is a lack of information about issues such as women's consent during marriage and the amount of dowry during marriage. The age heaping of the husband was not reported either, as there was no prior study in Bangladesh in that regard. Interpretation of the study results must be undertaken with caution because broad age adjustments were used in the study, as it was not possible to determine the individuals who manipulated their ages from the data and their level of age heaping. Future studies with birth cohort data could empirically estimate the level of the biases and its subsequent effect on estimates of marriage age as well as factors such as dowry practices. Furthermore, the models interpret and identify the significant factors that influence child marriage in general; however, no causal effect had been analyzed. It is also important to note that this study was based on the empirical estimates from Streatfield et al. (2015), which has not yet been replicated nationally; this could induce some unintended bias in the results of this

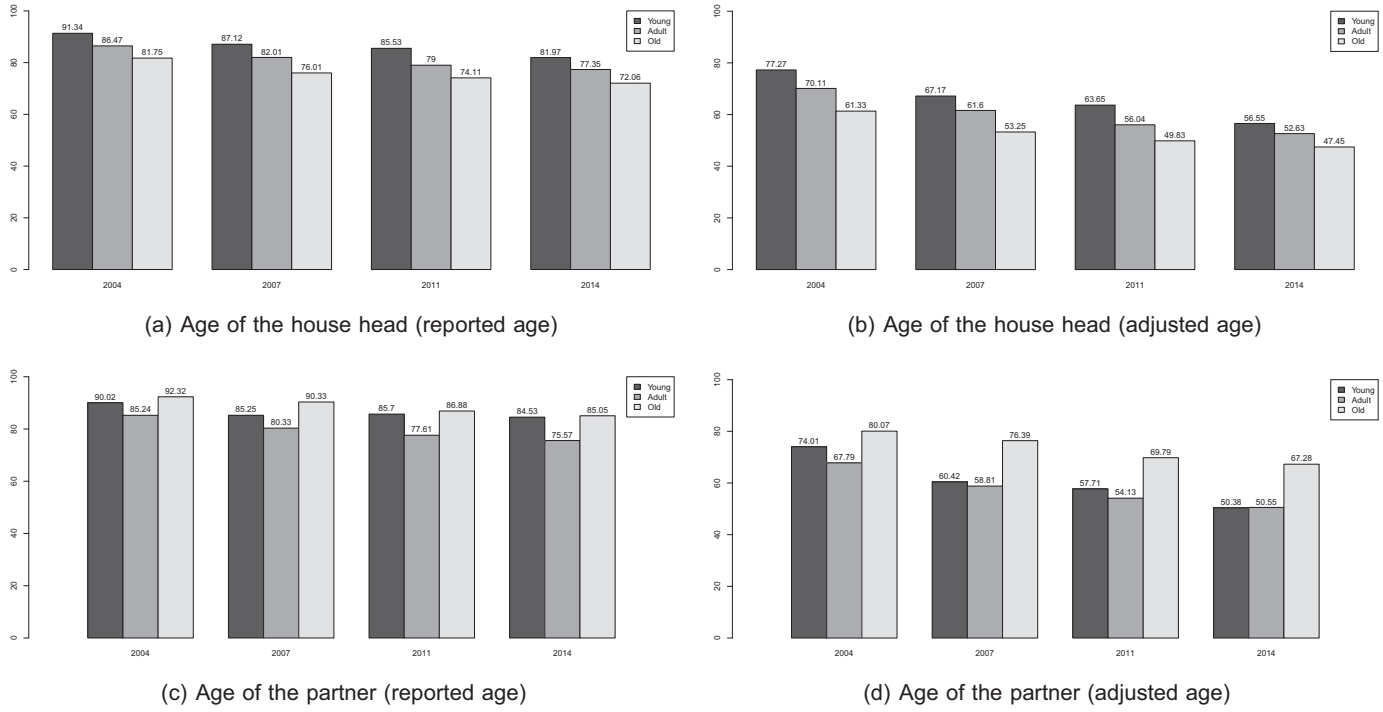

Fig. 2. Prevalence of child marriage (in %) in Bangladesh on the basis of the significant factors.

study (F¨oldv'ari, Van Leeuwen, & Van Leeuwen-Li, 2012; Murray et al., 2018).

5. Conclusions

This study aimed to understand the trend of child marriage in Bangladesh and ascertain whether the significant socioeconomic factors had changed over the years. Four nationwide surveys in the last 10 years were analyzed through the CLMM. We applied both reported age and adjusted age of marriage, considering the high misreporting of age in Bangladesh, to fit the models. Even with age adjustment, residence, education level of respondent and partner, age of the head of the house and partner were significant in all the surveys, where divisions and clusters were adjusted. The year wise effect showed significance in the pooled data, displaying a gradual improvement of the scenario. However, when we considered each factor, the rate of improvement did not provide an encouraging picture. We suggest that the gap in the prevalence of child marriage between rural and urban areas needs to be minimized. Primary and secondary education, for both the partners, do not seem to be sufficiently protective against child marriage compared to higher education. Focusing on the adults and senior citizens who, as heads of the house contribute more to child marriage, should considerably decrease this stigma. Furthermore, community level socio-cultural and behavioral facts have to be considered during the design of intervention studies due to community level variations in child marriage. Specific policies of intervention like sensitizing local community members and leaders on the issue of child marriage, strengthening the regulations such as registration systems to prevent the falsification of ages, and reinforcing national child protection systems through community-based mechanisms may help Bangladesh to limit the prevalence of child marriage.

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Contributor statement

RK Biswas compiled the data, synthesized the analysis plan, conducted statistical analysis, and drafted the manuscript. JR Khan conceptualized the study, finalized the statistical methods and edited the manuscript. The manuscript was critically reviewed and edited by E Kabir. All authors read and approved the final manuscript.

Conflict of interests

There was no conflict of interest among the authors. All authors read the final manuscript and approved it.

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