Trends and factors associated with child marriage in four Asian countries [version 1; peer review: 1 approved, 1 approved with reservations]

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Abstract

Background: Child marriage, defined as marriage before the age of 18, is a human rights violation and is associated with numerous adverse health, social, and economic outcomes. As such, the phenomena of child marriage garners substantial programmatic and policy action. However, a better understanding of specifically how child marriage is or is not changing is needed.

Methods: This study analyzes trends in the age structure of child marriage with cumulative incidence functions using data from Demographic and Health Surveys in four Asian countries. It further uses equiplots and chi-square tests of independence to identify specific patterns of and trends in inequalities of child marriage across three socio-economic factors: education, wealth, and residence.

Results: We find significant decreases in child marriage in all four countries since the 1990s. The rate of change has been unevenly paced, with rapid increases in age at marriage followed by periods of little observable change. Child marriage generally falls first during the youngest ages, followed by decreases in marriage later in adolescence. Marriage remains an adolescent experience for the majority of women in Bangladesh and Nepal. Child marriage is most common in Bangladesh and least common in Indonesia, while India has experienced the largest declines in child marriage. There is no discernible trend toward non-marriage, but rather a trend toward delayed marriage only. We find widespread education-, wealth-, and residence-based inequalities, with child marriage concentrated among more disadvantaged groups. Inequalities based on education are wider than either those based on wealth or residence. Inequalities have mostly lessened over the previous decade, except in Nepal. A pattern of mass deprivation is observed with regard to education, while wealth-based inequalities follow a queuing pattern.

Conclusions: These inequality patterns suggest delayed marriage be broadly promoted, alongside targeted interventions directed to the
most disadvantaged groups.

**Keywords**
child marriage, trends, inequalities, Bangladesh, India, Indonesia, Nepal

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Introduction
Child marriage, also referred to as early marriage, is defined as any legal or customary union involving a boy or girl before the age of 18. The practice disproportionately impacts the lives of girls more than boys (Parsons et al., 2015). According to Girls Not Brides, 1 in 5 girls are married by their 18th birthday, and approximately 67%–76% of child marriages take place in Africa. Next to Africa, child marriage is also prevalent in Asia, where approximately 46 percent of women aged 20–24 in South Asia reported getting married before the age of 18 (World Health Organization, 2016).

Previous studies show the associations between child marriage and poor health outcomes in Asia. For example, one study examined the associations between child marriage and reproductive health and fertility outcomes, including terminated pregnancy and inadequate use of maternal health services in Bangladesh, India, Nepal, and Pakistan. Those who married during early adolescence and childhood were more likely to experience negative outcomes, compared with women who married during their middle adolescence (Godha et al., 2013). Child marriage is associated with poor reproductive, maternal, child health, and economic outcomes. Previous studies have shown that the practice is associated with stillbirth, miscarriages, and pregnancy termination incidents (Kamal & Hassan, 2015). In the same vein, research in India found an association between child marriage and women’s increased risk of no contraceptive use prior to first childbirth, multiple unwanted pregnancies, and sterilization (Raj et al., 2009). Child marriage is associated with a host of other social factors in addition to poor health outcomes. While there are short-term transactions like dowry, girls who marry before the age of 18 are less likely to obtain an education, which has shown to reduce the likelihood of experiencing poverty with more education. In countries that experience urbanization and industrialization, as well as accelerated rates of social change, including in countries like India and Indonesia, child marriage rates are high with little reductions (Nagi, 1993).

In addition to child marriage’s link to poor health and mortality outcomes, the practice is widely recognized as a violation of human rights. According to Human Rights Watch, marrying off daughters early in countries like Bangladesh can deepen their poverty. Given this, several countries passed laws to change the legal age of marriage to 18 years. However, enforcement of laws setting the legal age of marriage as well as those requiring marriages to be registered have been weak (Nour, 2009), and therefore inadequate in curbing the practice.

The prevalence of child marriage among the countries that are analyzed in our research study is as follows: Bangladesh, 59%; India, 27%; India, 14%; and Nepal, 40% (UNICEF, 2018). In addition to country-specific laws and legislation to address the issue of child marriage, a key Sustainable Development Goal (SDG) target that countries have committed to pertains to the elimination of child marriage by 2030 (United Nations, 2016). This SDG target contributes towards Goal 5, calling for the advancement of gender equality (5.3.1 Proportion of women aged 20–24 years who were married or in a union before age 15 and before age 18). Consequently, delaying marriage beyond the adolescent years is often promoted as a means to improve gender equity (see SDGs), and to reduce the likelihood of “too early” pregnancies, which comes with associated risks of maternal and infant morbidity (Chandra-Mouli et al., 2013). Amid changing social norms and interventions intended to reduce child marriage, it behooves us to better understand trends in the age distribution of marriage and changing patterns in factors associated with child marriage.

Therefore, this study examines trends in child marriage and socioeconomic factors associated with marriage over the past three decades in four Asian countries: Bangladesh, India, Indonesia, and Nepal. Specifically, we examine the trends in the age structure of marriage over time. We further analyze whether child marriage is changing similarly for all population sub-groups, or differentially for women in different educational, wealth, and residence categories. We identify specific patterns of inequality in child marriage and time trends in those inequalities. Our research questions are as follows:

• To what extent has child marriage decreased since the early 1990s?

• As child marriage declined over time, has the age distribution of marriage changed?

• Which socioeconomic factors continue to be associated with child marriage?

• Is child marriage a generalized phenomenon across social groups or has it become increasingly concentrated? If so, among which groups?

Methods
Data
We use data from a total of 21 Demographic and Health Surveys (DHS) in four countries. These surveys are: Bangladesh 1993-94, 1996-97, 1999-2000, 2004, 2007, 2011, 2014; India 1998-99, 2005-06, 2015-16; Indonesia 1991, 1994, 1997, 2002-03, 2007, 2012; and Nepal 1996, 2001, 2006, 2011, and 2016. DHS surveys are nationally representative household surveys with data on a wide range of topics, including age of marriage and fertility outcomes, comparing women who married before the age of 18 to those who married later. Data are representative at the national level, urban/rural residence level, and typically at least one sub-national level in each country.

The DHS surveys in this study range in total sample size from about 8,400 to 700,000 women. The largest sample sizes are found among the India surveys. Response rates of eligible women range from 92%–98%. This study focuses its analyses on young women age 15–29 or specific age groups within this range. The average analytic sample size approaches 32,000 women age 15–29. Sample details are shown in Table 1.

Typically, DHS surveys interview all de facto women age 15–49 in sampled households. However, only ever-married women are eligible for interview in certain surveys. DHS surveys
employ multistage, clustered sampling. Details of the sampling strategy can be found in survey final reports for each survey (Badan Pusat Statistik-Statistics Indonesia - BPS & ORC Macro, 2003; CBS et al., 1991; CBS et al., 1995; CBS et al., 1998; Family Health Division of the Department of Health Services of the Ministry of Health/Nepal et al., 2002; Ministry of Health and Population et al., 2012; Ministry of Health and Population et al., 2007; IIPS & ICF, 2017; IIPS & Macro International, 2007; IIPS & ORC Macro, 2000; Ministry of Health - MOH/Nepal et al., 2017; Mitra et al., 1997; Mitra et al., 1994; NIPORT et al., 2016; NIPORT et al., 2013; NIPORT et al., 2009; NIPORT et al., 2001; NIPORT et al., 2005; Pradhana et al., 1997; Statistics Indonesia - Badan Pusat Statistik - BPS & Macro International, 2008; Statistics Indonesia - Badan Pusat Statistik - BPS et al., 2013).

All analyses are conducted in Stata 15 (StataCorp, 2017) and are weighted to account for sampling probability and non-response and use the `svy` suite of commands to account for the complex sampling design. Samples of ever-married women are adjusted using the all-woman factors (awfactt, awfactu, awfacte, and awfactw) to account for this sampling restriction and to produce unbiased estimates of marriage age.

### Analytical strategy

This study consists of two related analyses. The first is a trends analysis and the second examines inequalities in marriage age over time. In the trends analysis, we use data from all 21 surveys to examine trends from the early 1990s through the most recent survey between 2012 (Indonesia) and 2016 (India and Nepal).

We use survival analysis methods to estimate the cumulative incidence function of age of marriage among women during age 15–24. Unlike medians, survival analysis facilitates the use of data from all women throughout the age spectrum, regardless

### Table 1. Survey sample sizes.

| Survey/Year     | Eligible respondents | Eligible woman response rate | Sample size |   |
|-----------------|----------------------|------------------------------|-------------|---|
|                 |                      |                              | Age 15–19   | Age 20–24 | Age 25–29 | Age 15–29 |
| **Bangladesh**  |                      |                              |             |           |           |           |
| Bangladesh 2014 | Ever Married Women   | 96.4                         | 2,023       | 3,161     | 3,343     | 8,527     |
| Bangladesh 2011 | Ever Married Women   | 95.8                         | 1,911       | 3,456     | 3,387     | 8,754     |
| Bangladesh 2007 | Ever Married Women   | 97.8                         | 1,348       | 2,174     | 1,935     | 5,457     |
| Bangladesh 2004 | Ever Married Women   | 98.4                         | 3,293       | 2,595     | 2,100     | 7,988     |
| Bangladesh 1999-00 | Ever Married Women | 96.2                          | 3,006       | 2,345     | 2,101     | 7,452     |
| Bangladesh 1996-97 | Ever Married Women | 96.8                          | 2,533       | 2,075     | 1,989     | 6,597     |
| Bangladesh 1993-94 | Ever Married Women | 96.5                          | 2,562       | 2,329     | 2,038     | 6,929     |
| **India**       |                      |                              |             |           |           |           |
| India 2015-16   | All Women            | 94.3                         | 124,878     | 122,955   | 115,076   | 362,909   |
| India 2005-06   | All Women            | 92.4                         | 23,955      | 22,807    | 20,653    | 67,415    |
| India 1998-99   | Ever Married Women   | 93.0                         | 20,130      | 20,401    | 19,420    | 59,951    |
| **Indonesia**   |                      |                              |             |           |           |           |
| Indonesia 2012  | All Women            | 95.0                         | 7,207       | 6,589     | 7,160     | 20,956    |
| Indonesia 2007  | Ever Married Women   | 95.1                         | 914         | 4,156     | 6,170     | 11,240    |
| Indonesia 2002-03 | Ever Married Women | 97.3                          | 924         | 3,892     | 5,528     | 10,344    |
| Indonesia 1997  | Ever Married Women   | 97.1                         | 5,896       | 6,286     | 6,555     | 18,737    |
| Indonesia 1994  | Ever Married Women   | 96.9                         | 6,082       | 6,235     | 6,443     | 18,760    |
| Indonesia 1991  | Ever Married Women   | 96.7                         | 4,777       | 5,200     | 5,503     | 15,480    |
| **Nepal**       |                      |                              |             |           |           |           |
| Nepal 2016      | All Women            | 96.8                         | 2,622       | 2,306     | 2,094     | 7,022     |
| Nepal 2011      | All Women            | 97.6                         | 2,790       | 2,281     | 2,129     | 7,200     |
| Nepal 2006      | All Women            | 98.0                         | 2,437       | 2,042     | 1,770     | 6,249     |
| Nepal 2001      | Ever Married Women   | 97.8                         | 916         | 1,651     | 1,646     | 4,213     |
| Nepal 1996      | Ever Married Women   | 97.9                         | 2,179       | 1,913     | 1,668     | 5,760     |
of right censoring due to young age or whether marriage is a rare event at young ages. These survival curves illustrate shifts in the age structure of child and early marriage. Tarone-Ware tests of equality are used to detect statistically significant changes between surveys (Cleves et al., 2010; Tarone & Ware, 1977).

The second analysis examines socio-economic factors associated with marriage by age 15 and by age 18 among women aged 20–29 at the time of the survey. For this analysis, we use the most recent DHS survey in each country and the DHS survey that is approximately 10 years prior to identify whether the factors associated with child marriage have shifted over the preceding decade. Chi-square tests of independence are used to assess any association between marriage age and socio-economic factors at both time points. Namely, we analyze child marriage in relation to wealth, education, and rural/urban residence.

We further analyze whether the phenomenon of child marriage is equitably distributed across these socio-economic factors. We examine whether child marriage has become more concentrated in certain population subgroups over time or if it has converged at a common level among all subgroups over time. That is, we analyze whether child marriage has become more or less inequitable over the preceding decade. We employ equiplots in Stata to present the results of this analysis (International Center for Equity in Health, 2014). We identify the pattern of inequality, if any exists, as (1) a mass deprivation pattern if child marriage is prevalent in all population subgroups but the most advantaged; (2) a queuing pattern if child marriage increases with each category of disadvantage; or (3) a marginalization pattern if child marriage is concentrated only among the most disadvantaged subpopulations and rarer in all other, more advantaged subgroups (WHO, 2013). A pattern of universal coverage would indicate low levels of child marriage among all population subgroups, with no observed inequalities among them.

Measures
Our outcome of interest is age at first marriage. For the remainder of this study, the term “marriage” is used to refer to first marriage and refers equally to formal unions and the more informal condition of “living with someone as if married”. The DHS invests significant effort to ensure that dates of key events, including marriage, are accurately reported through multiple data checks and procedures for reconciling discrepant reports and imputing missing information (Croft et al., 2018; ICF International, 2012; Pullum, 2006). Like most dates, date of marriage is recorded in DHS recode datasets in century month codes (CMC), which is the number of months since January 1900. Age at first marriage is calculated as the difference between the CMC of marriage and CMC of date of birth. For the trends analysis using survival curves, age at first marriage is expressed as a continuous variable in months.

For the analysis of socio-economic factors associated with AFM, our outcome is operationalized as two dichotomous variables: marriage by age 15 and marriage by age 18. We present the proportion married by each of these ages because we are interested in all child marriage (< age 18) and especially in the youngest child marriage (< age 15), which carries with it even increased biological risks and social vulnerabilities.

The socio-economic factors in this study are: women’s education, household wealth, and residence.

Women’s education at the time of the survey is categorized into no education, primary, secondary, and higher education.

Household wealth is a measure of relative wealth. A household wealth index is calculated based on ownership of a range of assets and housing materials. Wealth quintiles are then calculated based on the distribution of the index across the de jure population. The construction of both the household wealth index and quintiles, now standard in DHS surveys, is described in detail elsewhere (Rutstein & Johnson, 2004).

Residence captures whether the respondent resides in a rural or an urban area at the time of the survey, based on a priori classification of primary sampling units selected for the survey. In Nepal, a change in classification criteria between 2011 and 2016 resulted in the designation of areas as urban municipalities that had previously been defined as rural areas, resulting in an overall increase from 58 municipalities in 2011 to 263 municipalities by 2016. As a result of the changed definition, rural/urban residence cannot be directly compared between the Nepal DHS 2016 and 2011 or earlier surveys.

In studying inequalities, rural women, women in the poorer wealth quintiles, and women with no or primary education are considered to be relatively disadvantaged. These are denoted by yellow/orange shades with more advantaged groups indicated by dark teal shades in the equiplots.

Ethical review
DHS survey protocols undergo ethical review in the United States with ICF’s institutional review board. The Bangladesh and Nepal surveys underwent a second human subjects review with the Bangladesh Medical Research Council (BMRC) and the Nepal Health Research Council (NHRC), respectively. The Indonesia Ministry of Health has determined that the Indonesia surveys did not require a second ethical review. Prior to release, all survey data are anonymized and, where geographic coordinates of primary sampling units are collected, these coordinates are offset by up to 2 km in urban areas and 5-10 km in rural areas to prevent identification (Burgert et al., 2013).

Results
Trends in the Age Structure of Marriage
Figure 1–Figure 4 display the cumulative incidence functions showing trends over time in the age structure of marriage up to age 25. Solid lines indicate significant change from the preceding survey while dashed lines indicate any observed change since the preceding survey is not statistically significant. These figures
Figure 1. Cumulative incidence functions of age at marriage among women age 15–25, Bangladesh.

Figure 2. Cumulative incidence functions of age at marriage among women age 15–25, India.

indicate a consistent trend toward later marriage over time in all four countries. Notably, however, the pace of this trend toward later marriage has not been steady. Rather, the change is unevenly paced. Sizeable leaps in age at marriage are followed by periods of little change, and vice versa.

Generally, reductions in child marriage first occur among marriage at the youngest ages, followed by decreases in marriage later in adolescence. The shape of the age curve of marriage is reminiscent of a logistic curve, with marriage levels remaining nearly flat and close to zero before age 15, followed by a rapidly increasing slope in the core adolescent years (15–20), before plateauing again as age 25 is approached. While most of the earliest age curves of marriage in the 1990’s indicate convex curvature during the adolescent years, by the most recent surveys, most curves indicate concave curvature in this age span.
Overall, there is little reduction in the proportion marrying by the older ages of the observed age spectrum. This suggests there is no discernible trend toward non-marriage, but rather a trend toward delayed marriage in the study countries. The proportion marrying by age 25 remains at about 88%–90% in Bangladesh and Nepal, and 80% in Indonesia and India.

*Trends in the age structure of marriage in Bangladesh.* In Bangladesh, seven DHS surveys have been conducted at regular 3-4-year intervals over the past 2 decades. These surveys indicate progression toward later marriage (i.e. less child marriage) over successive surveys (p=0.000), albeit at an inconsistent pace of change (Figure 1). Delays in age at marriage follows...
an alternating pattern through time: There was no significant change in the age structure of marriage between 1993-94 and 1996-97 (p=0.110). However, this was followed by a significant delay in marriage by 1999-2000 (p=0.000), no significant change between then and 2004 (p=0.259), followed by a significant delay between 2004 and 2007 (p=0.006), once more no significant change between 2007 and 2011 (p=0.068). Finally, 2014 shows a significant delay in marriage compared to the preceding survey in 2011 (p=0.001).

Bangladesh shows the highest levels of child marriage and some of the very earliest marriage among the countries studied, particularly in the 1993-94 and 1996-97 surveys. However, the overall levels of marriage during the observation age period are not appreciably higher than those found in the other study countries. The proportion of women age 15–24 marrying as adolescents (age <20) has changed very little, remaining between 75%–78%. In contrast, the proportion of women marrying by age 15 has fallen by half, from about 41% in 1993-94 to 20% in 2011.

Among the surveys with a significant change in the age structure of marriage since the preceding surveys, the 1999-2000 shows the biggest changes being a decrease in marriage at the youngest ages. The 2007 survey shows the biggest changes again at the youngest ages and extending into mid-adolescence. The 2014 survey shows the largest declines to those marrying in mid-adolescence.

**Trends in the age structure of marriage in India.** India has had three surveys over the past 17 years, conducted at irregular and longer intervals than is typical for DHS surveys. There is significant change between all surveys in the age structure of marriage (p=0.000), as shown in Figure 2. Between the NFHS-2 in 1998-99 and NFHS-3 2005-06 surveys, the decline in marriage occurred at all ages and the two curves are nearly parallel. Between 2005-06 and 2015-16, there are large declines in marriage at all adolescent ages, but relative declines are largest at younger ages. The proportion marrying by age 15 fell by two thirds and the curve has become concave below age 18. Meanwhile, the largest absolute differences between surveys occur among older adolescents, with the proportion who married by age 18 fell from over 20 percentage points between 1998-99 and 2015-16.

India shows the sharpest declines in child marriage of the study countries. By 2015-16, marriage is no longer an adolescent experience for the majority of women. The proportion of women age 15–24 who married by age 20 fell from 64% in 1998-99 to 45%. Compared to Bangladesh and Nepal, India also indicates less marriage at older ages. Nearly two in 10 women remain unmarried at age 25 in 2015-16.

**Trends in the age structure of marriage in Indonesia.** Of the six Indonesia surveys in this study, the first three were conducted at 3-year intervals and the next three at 5 year intervals. Overall, the cumulative declines in early marriage over the successive surveys between 1991 and 2012 are highly significant (p=0.000). However, changes between some pairs of surveys are not significant (Figure 3).

In contrast to the other study countries, there is substantially less child marriage overall and much less very early marriage in Indonesia, especially. Just 2% of the analytic sample marry by age 15 in 2012, down from 8% in 1991. There are also slightly higher rates of non-marriage, with two in 10 women having not married by age 25.

There has been statistically significant, albeit modest, change in the age structure of marriage between 1991 and 1994 (p=0.005). The two age curves have a similar shape, but differences emerge in mid- and late adolescent years. There was no significant change between the 1994 and 1997 surveys (p=0.579), but this was followed by significant change in the 5 years between the 1997 and 2002-03 surveys (p=0.000). The shift we see is that the earliest marriages occur at slightly older ages in 2002-03, along with declines in the proportion marrying throughout the adolescent years and early 20s.

The shifts in the age curves of marriage toward delayed marriage between 2002-03 and 2007 were significant while those between 2007 and 2012 were not significant, though these results are borderline (p=0.0448 and p=0.0577, respectively). Overall the proportion of women age 15–24 marrying as adolescents (age <20) declined from just over 50% in 1991 to 37% in 2012. The proportion marrying by age 18 halved over this time period, with the biggest declines (5 percentage points) occurring between 1997 and 2003-03.

**Trends in the age structure of marriage in Nepal.** Five surveys have been conducted in Nepal at regular 5-year intervals over the past 20 years. Each successive survey indicates a shift in the age structure toward later marriage that is statistically significant, except between the Nepal DHS 2011 and Nepal DHS 2016 surveys (see Figure 4). The small observed decline in child marriage between 2011 and 2016 is not significant. The shape of the curve has shifted over this time period from a notable convex curvature during adolescence (age 15–20) in 1996, indicating a concentration of marriages at these ages, to a more linear shape during these ages in 2016.

The shift in the age pattern of marriage between the earliest surveys (1996 and 2001) indicates a sizable decline in marriage during the early adolescent ages (age 12–15) and less change during the older adolescent years (age >15). This shift toward less very early child marriage continues between the 2001 and 2006 surveys, though it is now accompanied by less marriage in the mid- and later adolescent years as well. Between 2006 and 2011, changes in the age structure of marriage is mostly accounted for by fewer women marrying during late adolescence and early 20’s; declines in marriage during very early adolescent years are slight. Overall, the proportion marrying by age 15 has more than halved between 1996 and 2016. The proportion marrying later in adolescence has fallen dramatically as well, from 75% marrying by age 20 in 1996 to about 55% in 2016.
Patterns and trends in inequality of child marriage

To examine socioeconomic factors associated with child marriage and trends in the inequality of child marriage across sub-populations, we move from the entire age curve and examine levels of marriage at two age points: the percent of women (age 20–29) who have married by age 15; and the percent married by age 18; and present these figures in equiplots. Figure 5 shows these indicators by educational categories. Figure 6 shows the same by household wealth quintile and Figure 7 by urban/rural residence.

Associations of child marriage with socioeconomic characteristics. Both indicators of child marriage are universally associated with education and with household wealth and residence in three of four study countries at both time points (p≤0.001). Marriage by age 15 is associated with residence and wealth in Nepal 2016 (p≤0.001) but not in 2006. Stated otherwise, the prevalence of child marriage is inequitably distributed among educational, residential, and wealth population sub-groups. In each study country, child marriage is more prevalent among more disadvantaged groups. For example, the percentage of women age 20–29 who were married by age 15 is 41% among women with no education, compared to just 2% among those with higher education in Bangladesh 2014 (Figure 5). In Nepal 2016, the percentage who married by age 18 among the poorest women is more than double that among the richest wealth quintile (51% versus 23%) (Figure 6).

Trends in educational inequalities in child marriage. Overall, the percentage of women age 20–29 who married by age 15 declined over the previous decade from 43% to 26%--a 17-point decrease--in Bangladesh, from 16% to 8% in India, from 12% to 9% in Nepal, and from 6% to 4% in Indonesia. The largest declines in overall percentage of women age 20–29 married by age 18 occurred in India, where child marriage fell from 48% to 30%, an 18-point decline, over one decade. This is followed by Nepal, where child marriage decreased from 55.5% to 42%, Bangladesh from 74% to 63.5%, and Indonesia from 26.5% to 19%. However, these declines were not equally experienced by all population sub-groups.

Marriage by age 15 was already rare among women with higher education and this has not risen (Figure 5). Over time, the percentage who married by age 15 has decreased among women in all other educational categories in Bangladesh, India, and Indonesia, narrowing inequalities in those countries. In Nepal, there is no evidence of decreasing inequalities by education. In all study countries but Bangladesh, marriage by age 15 has fallen to less than 20% among the least educated women. Although the prevalence of marriage by age 15 among women with no education is higher in Bangladesh in 2014 (41%) than elsewhere, this is a decrease of more than 20 percentage points over the preceding decade. Bangladesh nonetheless exhibits a mass deprivation pattern and the greatest inequality by education, in which child marriage is prevalent in all educational subgroups but the most advantaged. The other countries exhibit a bifurcated pattern in the most recent survey in which child marriage is similarly high among women with no education and with primary education and similarly low among women with secondary and with higher education. Indonesia indicates the smallest inequalities in marriage before 15 by education.

Figure 5 similarly shows that while the prevalence of marriage by age 18 has changed little among more educationally
advantaged women, declines are more substantial among those with the most disadvantage, causing education-based inequalities to have decreased over the preceding decade. India shows some of the most substantial decreases, with marriage by age 18 falling by 21 percentage points among women with no education and 13 points among women with primary education over the decade. Bangladesh also saw sizable decreases among poorly educated women, as it did with marriage by age 15. Nonetheless, a mass deprivation pattern of inequality is observed in Bangladesh in this indicator too. In the other three countries, the inequality pattern is a blend of a queuing pattern and a mass deprivation pattern: child marriage increases with increasing disadvantage, while women with no education and primary education are similar to one another. Overall, education-based inequalities in marriage by age 18 are greatest in Bangladesh and Nepal and smallest in Indonesia.
Trends in wealth inequalities in child marriage. Figure 6 similarly shows that marriage by age 15 has declined over the decade among most wealth quintiles. In Bangladesh, India, and Indonesia, these declines among more disadvantaged women (poorest and poorer wealth quintiles) have outpaced those among more advantaged women, such that wealth-based inequalities in marriage by age 15 have narrowed. In these countries, the pattern of inequality in the earliest child marriages has begun to change from one of a queuing pattern, in which prevalence increases steadily as quintiles become poorer, towards a universal pattern of lower prevalence, though statistically significant inequalities remain for now.

In Bangladesh, women in all wealth quintiles have experienced a decrease in marriage by age 18, at similar rates. As such, there is no observable decline in the degree of wealth-based inequalities in child marriage as there is with marriage by age 15. Bangladesh continues to demonstrate a queuing pattern, with a difference of 37 points in the prevalence of marriage by age 18 among women in the poorest and the richest quintiles. In India and Indonesia, which also indicate queuing patterns, the overall degree of wealth-based inequality has decreased, as declines in child marriage among disadvantaged groups have outpaced those among advantaged groups.

Although wealth-based inequalities were smaller in Nepal a decade ago than elsewhere, these inequalities have not narrowed over time. This is because, in contrast to the other study countries, declines in marriage by age 15 and by age 18 were driven by further declines among richer women, for whom child marriage was already less prevalent. Thus, inequalities by wealth have increased between 2006 and 2016 here. Nepal has shifted from exhibiting a queuing pattern of inequality to a mass deprivation pattern, in which prevalence of child marriage is similarly high in all disadvantaged groups and relatively low only among the richest quintile. In both child marriage indicators, wealth-based inequalities are greatest in Bangladesh and smallest in Indonesia.

Trends in residential inequalities in child marriage. Marriage by age 15 and by age 18 has declined among both urban and rural women in all three countries for which we can assess trends: Bangladesh, India, and Indonesia. Because declines in marriage by age 15 were larger among rural populations, the degree of inequality narrowed over the preceding decade in these countries. In India and Indonesia, but not in Bangladesh, the degree of residential inequality in marriage by age 18 also has declined.

Nonetheless, residence-based inequalities in both child marriage indicators are observed in all four study countries at the time of the most recent survey. Nepal shows slightly greater residence-based inequality, with 17 points separating the prevalence of marriage by age 18 among rural and urban populations. This difference ranges from 14–16 points elsewhere.

Discussion and conclusion

This study analyzed trends in the age structure of child marriage in four Asian countries. It further analyzed both specific patterns of and trends in the inequality of child marriage according to three socio-economic factors—education, wealth, and residence. We find significant and substantial decreases in child marriage in all four countries between the earliest and most recent surveys. The rate of change has been unevenly paced between intervening surveys. The first reductions in child marriage to occur are due to declines in marriage at the youngest ages. Over time, this change is followed by decreases in marriage later in adolescence.

We find widespread education-, wealth-, and residence-based inequalities in child marriage. In each study country, child marriage is more prevalent among more disadvantaged groups. Inequalities have mostly lessened over the previous decade, except in Nepal where education-based and wealth-based inequalities in child marriage have increased or remained the same over time.

The results of this study suggest directions to build on recent achievements to promote child wellbeing and gender equality through accelerated reductions in child marriage. This study’s results suggest intervention strategies targeting the middle to late adolescent years, when the majority of child marriages occur. Such efforts need to be accompanied by initiatives to eliminate marriage in the early adolescent ages in Bangladesh and among least educated populations elsewhere. Marriage by age 15 still approaches 20% among women age 20–29 with those who have primary education only or no education. Similarly, progress toward SDG 5.3 to eliminate the harmful practice of child, early, and forced marriages could be stymied without a continued focus on the needs of rural, poor, and under-educated population sub-groups. A focus on these sub-groups could both hasten reductions in child marriage and enhance equity in health and social outcomes, particularly needed in Bangladesh and Nepal.

This study finds that India has experienced the most rapid declines in child marriage of the study countries. Child marriage remains most common in Bangladesh and least common in Indonesia. Despite marked reductions in child marriage, this study finds that marriage is still an adolescent experience for the majority of women in Bangladesh and Nepal and for substantial proportions (37%–45%) of women in Indonesia and India. These findings echo those of other research on the burden of child marriage and reinforces child marriage as an adolescent sexual and reproductive health priority (MacQuarrie et al., 2017; Mathur et al., 2003; WHO, 2011; WHO, 2017; Wodon et al., 2017).

With the cumulative incidence of marriage by age 25 remaining relatively static, this study finds no discernible trend toward non-marriage, but rather a trend toward delayed marriage only. This finding differs from studies in other parts of Asia that have noted paired trends of delayed marriage and non-marriage (Jones, 2010; Jones, 2007).

Although we find that inequalities in child marriage have largely declined over time, these inequalities persist in all study coun-

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1Due to a change in the classification system of “rural” and “urban” designations between surveys, no conclusions can be drawn about the trends of child marriage by residence in Nepal. Rural-urban comparisons within the Nepal 2006 and the Nepal 2016 surveys remain valid.
tries. Inequalities based on education are wider than either those based on wealth or residence. Female education and its relationship with child marriage is a much researched topic (e.g., Amin & Al-Bassusi 2004; Bhatti & Jeffery, 2012; Blossfeld & De Rose, 1992; Delprato et al., 2015; Field & Ambrus, 2008; Glick et al., 2015; Ikamari, 2005; Jejeebhoy, 1995; Lloyd & Mensch, 2008; MacQuarrie, 2016; Mensch et al., 1998). Regardless of the causal direction between child marriage and school drop-out, there is widespread consensus that marriage and pursuing education are largely competing states and, therefore, promoting education and delayed marriage are twin goals (Girls Not Brides, 2018; MacQuarrie et al., 2016; McCleary-Sills et al., 2015; Warner et al., 2012). This study’s findings add to those of others in suggesting the need to reach poorly educated communities with interventions to avoid child marriage and increase educational opportunities.

Bangladesh, with the greatest amount of child marriage, experiences the greatest inequalities and Indonesia the least. This finding is suggestive of a positive relationship between the degree of inequality and the magnitude of child marriage. A pattern of mass deprivation, in which child marriage is prevalent in all but the most highly educated group, is observed with regard to education, while wealth-based inequalities follow a queuing pattern, in which child marriage increases with each category of wealth disadvantage. Results suggest a possible trajectory toward a universal pattern in which the earliest child marriages (< age 15) are nearly eliminated in all wealth groups in Bangladesh, India, and Indonesia. The combination of the mass deprivation and the queuing patterns observed suggest that a combination of whole-population, universal approaches and targeted interventions is warranted to eliminate inequalities while reducing child marriage (WHO, 2013; WHO, 2015).

This study set out to examine trends in the age structure and socio-economic inequalities in child marriage. We found a predictable pattern to changes in the age structure of child marriage: reductions in the earliest child marriages occur before reductions in marriages in the core adolescent years (age 15–20). Delayed marriage is not accompanied by increasing non-marriage. Amidst declining child marriage, we found persistent inequalities between richer and poorer, educated and less educated, and urban and rural women. Inequalities in child marriage narrowed in three of four countries, but increased in Nepal. The patterns of inequality detected in this study indicate widespread, broad initiatives to reduce child marriage for all, accompanied by specially targeted interventions directed to the most disadvantaged population sub-groups.

Data availability
The DHS Program prepares and makes available DHS survey data in the form of standard recode files in a range of file formats for use with several statistical software packages. All data used in this study are publicly available and free of charge upon registration at https://www.dhsprogram.com/Data/. A guide for how to apply for dataset access is available at: https://dhsprogram.com/data/Access-Instructions.cfm.

Specifically, this study used the following women’s (IR) standard recode files in Stata for Bangladesh: BDIR72FL.dta, BDIR61FL.dta, BDIR51FL.dta, BDIR4JFL.dta, BDIR41FL.dta, BDIR3AFL.dta, and BDIR31FL.dta. For India, the files used are: IAIR74FL.dta, IAIR52FL.DTA, and IAIR42FL.dta. The Indonesia files used are: IDR63FL.dta, IDR51.dta, IDR42FL.dta, IDR3AFL.dta, IDR31FL.dta, and IDR21FL.dta. For Nepal, the study used: NPIR7HFL.dta, NPIR60FL.dta, NPIR51FL.dta, NPIR41FL.dta, and NPIR31FL.dta. Analysis of ever-married samples obtained data on the age-specific distribution of unmarried women from the following all-person (PR) standard recode files: BDPR72FL.dta, BDPR61FL.dta, BDPR51FL.dta, BDPR4JFL.dta, BDPR41FL.dta, BDPR3AFL.dta, BDIR31FL.dta, IDPR52.dta, IDPR42FL.dta, IDPR3AFL.dta, IDPR31FL.dta, IDPR21FL.dta, NPPR41FL.dta, and NPPR31FL.dta.

Grant information
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**Publisher Full Text**
This article uses an innovative quantitative method to explain why child marriage is or is not changing in the South Asian and Southeast Asian region.

The authors look at four countries – Bangladesh, Nepal and Pakistan in South Asia and Indonesia in Southeast Asia and show that trends in prevalence of child marriage tend to fall first during the youngest ages. Based on their statistical method, the authors find that child marriage is highly correlated with being disadvantaged socially and economically. As such, the authors conclude that initiatives promoting the abandonment of child marriage should target directly the most disadvantaged groups.

While the method is innovative, the conclusions are nothing new. The literature thus far has extensively shown that child marriage is highly correlated with education level, SES, and residence, which is inextricably linked with being socially disadvantaged.

More specifically:

1. Does the work clearly and accurately present and cite the current literature?
   The authors should cite more recent research that has been conducted in both regions (South Asia and Southeast Asia). These include recent situational analysis reports from UNICEF, World Vision, WHO among others, such as:
   - IPU and WHO (2016). Child, early and forced marriage legislation in 37 Asia-Pacific countries.
   - Menz, S. (2016). Statelessness and child marriage as intersectional phenomena: instability, inequality, and the role of the international community.
   - Roest, J. (2016). Child marriage and early child-bearing in India: Risk factors and policy implications.
   - Wodon, Q., Male, C., Nayihouba, A. et al. (2017). Economic impacts of child marriage: global synthesis report.
Yeung J., Desai S., and G. Jones. (2016). Families in Southeast and South Asia.

2. Are the conclusions drawn adequately supported by the results?
The conclusions of the paper does support the results adequately. However, it would be important to provide more contextual analysis of each selected country. Child marriage is indeed highly correlated with structural inequality but it would be good to have a discussion on the kind of inequalities that are discussed and how these contribute to higher rates of child marriage. For example, we know that there are communities who, under the same socioeconomically disadvantaged conditions, do not recourse to child marriage. So what is different? What role does ethnicity play in rates of child marriage? Also, the selected countries, we know that conflict, such as in Bangladesh, Nepal and India has exacerbated child marriage. Bangladesh is highly vulnerable to natural disasters which, also has an impact on child marriage.

3. Relatedly, the paper does not provide a context nor a justification for why they selected the specific countries (Bangladesh, India, Nepal, Indonesia). Indonesia, for example, is very different from the three South Asia countries. So why was Indonesia included?

4. This brings me to another related comment on the need to specify what the authors refer to when they speak of “Asian” countries. Most of the selected countries are from South Asia whose drivers are very different from, say, the Asia Pacific region. In addition, some of the discussion about drivers is too general and does not reflect the nuances in the region. If the paper focuses on 3 South Asian countries exclusively, then the authors need to refer to South Asia and one country in Southeast Asia so the reader distinguishes the two regions because each presents very different contexts related to child marriage.

5. In the following sentence, “Consequently, delaying marriage beyond the adolescent years is often promoted as a means to improve gender equity (see SDGs), and to reduce the likelihood of “too early” pregnancies, which comes with associated risks of maternal and infant morbidity (Chandra-Mouli et al., 2013)”. This sentence assumes that child marriage leads to early pregnancy in which case, delaying marriage would reduce early pregnancy. But in South East Asia, such as in Thailand or Vietnam, we know that it is actually pregnancy that leads to early marriage. So the authors need to specify which type of child marriage they are referring to: forced marriage? Or early marriage in which the brides and the groom do have a say in whom to marry? In fact, increasingly, the literature shows that there are several types of child marriage which have very different implications programmatically. So it would be important for the authors to clearly state which type of union they are presenting.

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**Is the work clearly and accurately presented and does it cite the current literature?**
Partly

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
I cannot comment. A qualified statistician is required.

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Partly

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Senior Research Officer working on sexual reproductive health of adolescents, child marriage, female genital mutilations, social norms and gender analysis.

**I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.**

Reviewer Report 05 June 2019

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**Alka Barua**
Independent expert, Ahmedabad, Gujarat, India

While the paper deals with a very important issue in the subcontinent and presents detailed analysis of the available data, there are some minor suggestions for improving clarity.
For example:
- 2nd para on page 3, the second last sentence lacks clarity and needs re-phrasing
- The 1st sentence in the 4th para on page 3 has an error - India is mentioned twice
- Please provide reference for definition of marriage - 4th para page 14
- 9th para on page 14 - There is a possibility of re-classification of municipalities in India too - in the relevant period.

**Is the work clearly and accurately presented and does it cite the current literature?**
Yes

**Is the study design appropriate and is the work technically sound?**
Yes

**Are sufficient details of methods and analysis provided to allow replication by others?**
Yes

**If applicable, is the statistical analysis and its interpretation appropriate?**
Yes

**Are all the source data underlying the results available to ensure full reproducibility?**
Yes

**Are the conclusions drawn adequately supported by the results?**
Yes

*Competing Interests*: No competing interests were disclosed.

*Reviewer Expertise*: Adolescent health, Reproductive health

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.