Quantifying the association of natal household wealth with women's early marriage in Nepal

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Abstract

Background. Women's early marriage (<18 years) is a critical global health issue affecting 650 million women worldwide. It is associated with a range of adverse maternal physical and mental health outcomes, including early childbearing, child undernutrition and morbidity. Poverty is widely asserted to be the key risk factor driving early marriage. However, most studies do not measure wealth in the natal household, but instead, use marital household wealth as a proxy for natal wealth. Further research is required to understand the key drivers of early marriage.

Methods. We investigated whether natal household poverty was associated with marrying early, independently of women's lower educational attainment and broader markers of household disadvantage. Data on natal household wealth (material asset score) for 2,432 women aged 18-39 years was used from the cluster-randomized Low Birth Weight South Asia Trial in lowland rural Nepal. Different early marriage definitions (<15, <16, <17 and <18 years) were used because most of our population marries below the conventional 18-year cut-off. Logistic mixed-effects models were fitted to estimate the probabilities, derived from adjusted Odds Ratios, of (a) marrying at different early ages for the full sample and for the uneducated women, and (b) being uneducated in the first place.

Results. Women married at median age 15 years (interquartile range 3), and only 18% married ≥18 years. Two-thirds of the women were entirely uneducated. We found that, rather than poverty, women's lower education was the primary factor associated with early marriage, regardless of how 'early' is defined. Neither poverty nor other markers of household disadvantage were associated with early marriage at any age in the uneducated women. However, poverty was associated with women being uneducated.

Conclusion. When assets are measured in the natal household in this population, there is no support for the conventional hypothesis that household poverty is associated with daughters' early marriage, but it is associated with not going to school. We propose that improving access to free education would both reduce early marriage and have broader benefits for maternal and child health and gender equality.

Introduction

53 **Introduction**
54 Women's early reproduction is detrimental to both maternal and child health (Finlay, Özaltin &
55 Canning, 2011; Fall et al., 2016). However, in many societies, strong cultural norms mean that
56 the vast majority of women marry before having children. In such societies, early marriage is
57 therefore the gateway to early childbearing. Since early marriage also has broader implications
58 for women's health, it is a crucial global health issue in its own right (Marphatia, Amable &
59 Reid, 2017).
60
61 Globally, 20% of women aged 20-24 years marry or enter into a formal union before 18 years of
62 age (UNICEF, 2021). Early marriage is associated with a range of penalties for women. These
63 include less education, under-nutrition, lower access to contraception and healthcare, early
64 childbearing, and higher morbidity and mortality during pregnancy and labor (Godha, Hotchkiss
65 & Gage, 2013; Raj & Boehmer, 2013; Ganchimeg et al., 2014; Raj et al., 2014; Delprato et al.,
66 2015; Goli, Rammohan & Singh, 2015; Marphatia et al., 2021a; Wells et al., 2021). These
67 disadvantages are likely to propagate adverse effects to the next generation (Bates, Maselko &
68 Schuler, 2007; Marphatia, Amable & Reid, 2017; Chari et al., 2017).
69
70 The United Nations (UN) defines 'child or early marriage' using a cut-off of <18 years (UN
71 General Assembly, 2014, 2018). However, among the Maithili-speaking Madhesi population in
72 Nepal, where our study is based, most women marry well below this threshold, around a median
73 age of 16.5 years (MOHP, New ERA & ICF International, 2017). In this population, it would
74 therefore be more informative to investigate the factors associated with marrying at different
75 early marriage ages.
76
77 In most studies using the <18 years cut-off to define early marriage, poverty in women's natal
78 household, where they are born and raised, is widely suggested to drive early marriage across the
79 global South, including in Nepal (ICRW, 2006; Chaudhuri, 2015; Hodgkinson, 2016). However,
80 most studies measure material assets (as an index of wealth) in the marital household only *after*
81 women have already married, and then use this information as a proxy for the natal household's
82 wealth *prior* to marriage (Raj et al., 2014; Delprato et al., 2015; Wodon et al., 2017; Scott et al.,
83 2021). This practice therefore relies on an assumption that women are likely to marry into
84 households of similar wealth as their natal homes. Wealth of natal and marital households might
85 indeed be correlated, but a severe shortage of data on natal wealth means that there is little
86 evidence for this assumption.
87
88 The wealth of the natal and marital households might therefore also be uncorrelated. For
89 example, some studies find that younger marriages (<15 years) may in part be driven by girls
90 wanting to marry into economically better-off marital households, as a way of escaping the
91 poverty of their natal home (Human Rights Watch, 2016). However, as wealth was measured in
92 neither the natal nor marital household in this qualitative study, it is unclear whether the aims of
93 these families were achieved. Moreover, some poorer families are able to educate their daughters
94 to secondary school level, and this is then leveraged to marry them into wealthier households
95 with more educated husbands (Fafchamps & Shilpi, 2011; Jackson, 2012; Boyden, 2013). We
96 argue, therefore, that using wealth of the marital household, where women end up after marriage,
97 to represent wealth of the natal household, where women came from prior to marriage, is
98 inappropriate when investigating the potential role of poverty in driving early marriage.

99
100   Attributing wealth to the correct household is crucial in this context, because it reflects not only
101   the family's socio-economic status but also its 'spatial niche'. This term refers to the physical
102   habitat or space within which a household is geographically located, and reflects proximity and
103   accessibility to a range of resources and people. Collectively, these characteristics are likely to
104   shape the natal household's intentions around the timing of their daughter's marriage.
105   Misinterpreting the source of the natal household's interests (by using marital household assets)
106   therefore means that we have an inadequate understanding of how both wealth and other related
107   factors may be associated with early marriage.
108
109   Using data on natal households from a cluster-randomized trial in lowland rural Nepal, we
110   investigate the independent associations of natal household poverty, as well as other socio-
111   economic factors, with different age groupings of early marriage. We also investigate the
112   contribution of education to early marriage, and whether broader socio-economic factors are
113   associated with women being uneducated in the first place.
114

115   **What do we know about poverty's association with early marriage?**
116   To date, most studies which investigate the link between wealth and age at marriage have
117   focused on women after they have married. Clearly, it is difficult to measure natal household
118   wealth after girls have already married and moved to their marital households. However, these
119   studies assume that marital household assets are a proxy for the natal household's assets (wealth)
120   without appropriate supporting evidence. Studies relating to Nepal vary in whether daughters
121   from the poorest (Guragain et al., 2017), or the wealthiest (Aryal, 2007) households have the
122   highest risk of marrying early. Other studies find an inconsistent relationship between wealth and
123   marriage age (Raj et al., 2014) or no relationship at all (Pandey, 2017).
124

125   Some studies have used household wealth data appropriately, but in two different ways. One
126   group of studies has described the proportion of women married <18 years stratified by marital
127   wealth quintiles without making an assumption that this also represents wealth in the natal
128   household. These studies consistently find that in impoverished regions of the world, including
129   Nepal, the poorest marital household quintile has the largest proportion of women married <18
130   years (ICRW, 2006; UNFPA, 2012; UNICEF & UNFPA, 2017; MacQuarrie & Juan, 2019).
131   Fewer studies have first measured wealth in the natal household itself, and then investigated if
132   this is associated with the likelihood of women marrying early (Muchomba, 2021). In India, one
133   study found that girls from poorer natal households were more likely to marry early (Singh &
134   Espinoza Revollo, 2016), whereas another study, which measured wealth at several time-points
135   from the daughter's birth through to adolescence, found no association between wealth and early
136   marriage (Marphatia et al., 2021b). For Nepal, we could only find one such study, which
137   produced a less consistent pattern, whereby it was not the poorest, but the second poorest
138   households whose daughters were married earliest (Bajracharaya and Amin 2012). Collectively,
139   these studies suggest that the relationship between poverty and early marriage is not as strong
140   when wealth is measured in natal households, and that using wealth in the marital household as a
141   proxy for wealth in the natal household may be inappropriate.
142

143   Many of the insights on how poverty may push girls into early marriage come from qualitative
144   literature, where household wealth is neither measured nor quantified. Nevertheless, such work

145 does offer valuable insights on subjective perspectives and decision-making around marriage.
146 Several studies from Nepal have identified a strong economic rationale for natal households to
147 marry daughters at a young age, related to material poverty: specifically in relation to the costs of
148 caring (food, clothes) for daughters and paying for their education (Verma, Sinha & Khanna, 2013;
149 Chaudhuri, 2015; Human Rights Watch, 2016; Samuels et al., 2017). The custom of dowry (illegal,
150 but typically still paid from the natal to marital household) is also likely to contribute to early
151 marriage. Dowry generally demands a substantial proportion of a household's income, and this is
152 greater for families with several daughters (Sah, 2012; Pesando & Abufhele, 2019). As dowry
153 tends to increase with age and education level, it may lower household investment in daughters
154 schooling and also incentivize early marriage (Sah, 2012; Hodgkinson, 2016; Human Rights
155 Watch, 2016; Karim, Greene & Picard, 2016).
156
157 Hence, in the poorest families, girls may be perceived as an economic burden and thus the earlier
158 they are married, the better the natal household's economic welfare (Hodgkinson, 2016;
159 Guragain et al., 2017). However, one study from Nepal reporting both attitudinal and
160 quantitative data found that the primary drivers of early marriage were family pressure, socio-
161 cultural norms, low education and food insecurity; income poverty was cited as a less important
162 factor (Maharjan et al., 2012).
163

Other markers of disadvantage and early marriage

165 Beyond low material assets, other markers of disadvantage may also be associated with early
166 marriage. For example, education is a key factor associated with marriage age, and studies
167 generally find that girls' lower educational attainment (years of schooling completed) increases
168 their risk of marrying early (Raj et al., 2014; Delprato et al., 2015; Sekine & Hodgkin, 2017;
169 Marphatia et al., 2020; Scott et al., 2021). The association between poverty and early marriage
170 may therefore vary by girls' education level, and poverty may also contribute to whether girls are
171 educated in the first place, because of the costs associated with schooling (e.g. fees, books,
172 uniforms, etc) (Verma, Sinha & Khanna, 2013; Chaudhuri, 2015; Samuels et al., 2017).
173

174 To understand the association between poverty and the timing of women's marriage, we also
175 need to consider other relevant socio-economic factors. In rural contexts, agrarian land-holding is
176 another relevant marker of household wealth (Fisher & Naidoo, 2016). Landlessness may
177 increase the risk of food insecurity, which in turn has been associated with both lower schooling
178 and earlier marriage (Moock & Leslie, 1986; UNICEF, 2014). Caste affiliation is also linked to
179 socio-economic status, with girls from disadvantaged castes generally completing less education
180 and also marrying <18 years (Stash & Hannum, 2001; Sah, 2018; Devkota, Eklund & Wagle,
181 2020). There is much less literature on the role of the natal household's geographic location in
182 relation to early marriage, but greater distance to school has been found to be a key constraint to
183 accessing education (Jamison & Lockheed, 1987; Ayral, 2014; Devkota & Upadhyay, 2015).
184 Thus, if schooling is not a viable option, marrying daughters early may alleviate household
185 financial pressures and food insecurity (Maharjan et al., 2012; Human Rights Watch, 2016;
186 Samuels et al., 2017).
187

188 Socio-cultural norms are also likely to shape both the timing of marriage and the amount of
189 education that girls are likely to complete. Bicchiere et al. (2014) define these normative social
190 preferences as 'moral rules' that govern decision-making relating to women's life options,

191 whether they refer to marriage, chastity, education, employment, etc. Failing to conform to these
192 norms may adversely affect a girl's marital options, and also her natal household's social
193 standing in the community (Caldwell, Reddy & Caldwell, 1983; Maertens, 2011, 2013).
194 However, such norms can also change over time. Several studies have suggested that secular
195 changes in attitudes and norms, coupled with widespread advocacy for minimum marriage age
196 legislation, improvements in household wealth, and increased girls' educational attainment, are
197 collectively likely to explain the overall decrease in early marriage over the past ~15 years across
198 South Asia (Raj, McDougal & Rusch, 2012; Allendorf & Thornton, 2015; MacQuarrie & Juan,
199 2019; Prakash et al., 2020; Scott et al., 2021).
200
201 **Study aim and hypotheses**
202 Our study aims to contribute new insights on the economic and social drivers of women's early
203 marriage and their lack of education in low-income settings. Using objective data on wealth and
204 broader markers of disadvantage measured in the natal household on 2,432 women aged 18-39
205 years from lowland rural Nepal, we investigate whether natal household poverty is associated
206 with marrying early. We define 'early marriage' using several different age groupings, because
207 most women in our population marry well below the 18-year threshold (universal minimum legal
208 age) conventionally used to define early marriage. This is crucial because if we only use the 18-
209 year threshold, we might miss identifying the factors associated with variability in age at
210 marriage as it is experienced in this early-marrying population.
211
212 Since two-thirds of our sample are entirely uneducated, we also investigate whether poverty is
213 associated with early marriage in uneducated women, and whether poverty is associated with
214 women being uneducated in the first place. The uneducated women are interesting to examine on
215 their own because for this group, variability in education cannot confound the association
216 between wealth and marriage age. Our models adjust for women's age, to capture potential
217 cohort effects and which may indicate secular changes in social norms over time. To ensure
218 observed associations between poverty and early marriage are not an artefact of related factors,
219 we include women's education level as another key exposure, and also broader markers of socio-
220 economic disadvantage measured in women's natal household: agrarian land-holding,
221 geographic location and caste affiliation.
222
223 We investigate four hypotheses:
224   (1) that natal household poverty is associated with marrying early, using different ages to
225   define this outcome: <15, <16, <17 and <18 years, in each case compared to marrying ≥18
226   years;
227   (2) that women's lower educational attainment, independent of natal household poverty and
228   broader markers of socio-economic disadvantage, is associated with early marriage: <15,
229   <16, <17 and <18 years, in each case compared to marrying ≥18 years;
230   (3) that amongst uneducated women, poverty, independent of broader markers of socio-
231   economic disadvantage, is associated with early marriage at different ages;
232   (4) that natal household poverty, independent of broader markers of socio-economic
233   disadvantage, is associated with women being uneducated.
234
Materials & Methods

236   Our study is based on data from the Low Birth Weight South Asia Trial (LBWSAT), which
237   assessed the impact of three pregnancy interventions on birth weight and infant growth (Saville
238   et al., 2018). This cluster-randomized control trial was conducted across 80 geographic clusters
239   in Dhanusha and Mahottari districts in Province 2 of the Terai region bordering Bihar state in
240   India. Married pregnant women were randomized to one of four intervention arms: Participatory
241   Learning and Action (PLA) behavior change intervention in Women's Groups, PLA with
242   unconditional cash transfers, PLA with a fortified blended food supplement, or a control group
243   accessing Government of Nepal health services. Questionnaires were administered orally to
244   25,090 married pregnant women aged 10-49 years in the home that they were residing in during
245   pregnancy (Saville et al., 2016).
246   Research ethics approval to conduct the trial was granted by the Nepal Health Research Council
247   (108/2012) and University College London (UCL) Research Ethics Committee (4198/001).
248   Village Development Committee secretaries consented for villages to participate in the trial.
249   Women gave written consent and guardians consented to the participation of married adolescents
250   <18 years of age. Further ethical approvals for secondary analyses of LBWSAT data for this
251   analysis were granted from the Nepal Health Research Council (292/2018), the Research Ethics
252   Committees at UCL (0326/015) and the University of Cambridge (1016).
253
254   Marriages in the Maithili-speaking Madhesi population of our study are generally arranged by
255   parents or close relatives, with girls having little say over the timing and choice of spouse
256   (Maharjan & Sah, 2012; Clarke, 2013). In 2016, the Maithili-speaking Madhesi women had the
257   lowest median age at marriage (16.5 years) nationwide (MOHP, New ERA & ICF International,
258   2017; Pandey, 2017), and were more likely to be uneducated (Marphatia et al., 2020). These
259   factors, and gendered socio-cultural norms restricting women's physical mobility outside of the
260   home, mean that women typically have low levels of agency and decision-making power (Gram
261   et al., 2017; Harris-Fry et al., 2018; Morrison et al., 2018). The main livelihood of this
262   population is subsistence farming (rice, wheat, pulses), with the majority of households
263   purchasing some food items from local markets, or 'bazaars' (Saville, Manandhar & Wells,
264   2020).
265
266   **Data**
267   ***Outcome variables***
268   For our first outcome variable, women's 'early marriage,' we use several different age groupings
269   since the majority of our sample (87%) married below the UN stipulated minimum age of 18
270   years. In Nepal, the legal minimum age at marriage is 20 years, and until recently, marriage at 18
271   years was possible with parental permission (His Majesty's Government of Nepal, 1963;
272   Government of Nepal, 2017). Since our trial was conducted prior to this change in legislation,
273   and as few women had married ≥20 years, we use the minimum marriage age cut-off of 18 years
274   as the reference group. To ensure comparability across these results, the same reference group,
275   marrying ≥18 years, is used irrespective of the age used to define early marriage. We examine
276   the factors associated with marrying <15 years (hence excluding women who married between
277   15-18 years), <16 years (hence excluding women who married between 16-18 years), <17 years
278   (hence excluding women who married between 17-18 years), and <18 years of age (includes the
279   full sample). In other words, each of the models above the <15 years has the lower group nested
280   within it, but excludes the higher group up to 18 years. **Figure 1** illustrates our approach.
281

282   **Figure 1 here**
283
284   Our second outcome variable, women 'being uneducated,' is coded as any formal education (≥1
285   year) vs no education (0 years). We use this cut-off because two-thirds of our sample have never
286   been to school.
287
288   ***Exposures***
289   Our primary exposure is the score of assets measured in the women's natal household. The natal
290   household asset score is categorized in quintiles, from 1 (poorest) to 5 (richest). This assessment
291   of assets is widely used by national representative surveys, including in our study context
292   (MOHP, New ERA & ICF International, 2017). These assets represent relatively stable markers
293   of wealth, relating to the structure of the home or ownership of consumer goods that require
294   significant financial outlay. They are assumed already to exist before a daughter marries.
295   However, in contrast to the 12-asset score that has been used in previous studies on this
296   population (Saville et al., 2016; MOHP, New ERA & ICF International, 2017; Sah, 2018), we
297   use an 8-asset score. We exclude goods such as color television, motorbike, and computer
298   because they could have been acquired after the daughter had married, especially if there was a
299   long time-gap between marriage and when the assets were measured. We also exclude agrarian
300   land-holding from the score, because we want to investigate whether its association with
301   women's early marriage and lack of education is independent to that of assets.
302
303   We therefore construct our score of assets from eight variables using principal component
304   analysis (Vyas and Kumaranayake 2006). The first principal component has positive factor
305   loadings for all eight variables and accounts for 36.7% of the variability, compared to 13.2% for
306   the second principal component. Thus we use the first principal component as the marker of natal
307   household wealth. The eight variables contributing the highest factor loadings to the first
308   principal component, listed in order of decreasing size (weight shown in parenthesis), are: wall
309   (0.457), roofing (0.442) and flooring (0.423) materials, toilet facilities (0.412), number of rooms
310   used for sleeping in the house (0.317), access to electricity (0.242), drinking water source (0.227)
311   and non-biomass cooking fuel use (0.188).
312
313   Our second key exposure is women's educational attainment. Education is coded according to
314   the Nepalese education system: none; primary (1-5 years); lower-secondary (6-8 years); or
315   secondary or higher (≥9 years) (Ministry of Education Nepal, 2016).
316
317   We also include broader markers of household socio-economic disadvantage. Agrarian land-
318   holding is coded as none, 0.01 to 0.5, 0.51 to 0.99 and ≥1 hectare. A household's spatial niche,
319   defined by its geographic location, is categorized by accessibility to large markets, known as
320   'bazaars,' using the normal form of transport, quantified in terms of time (<30 minutes; 30-59
321   minutes; 60-89 minutes; or ≥90 minutes). Large bazaars may be a proxy for access to broader
322   social connections, resources, larger health facilities and schools. Four groups describe caste
323   affiliation: disadvantaged castes are coded into two separate groups: Dalit and Muslim, middle
324   combines Janjati and various Madhesi castes, and advantaged combines Yadav and Brahmin. We
325   do not include religion as the disadvantaged caste variable already examines the Muslim faith
326   separately, and all other groups refer to the Hindu faith.
327

328 The women in our sample range from age 18 to age 39 years. Access to education and social
329 norms may have changed in the 20 years between the oldest and youngest generations. We
330 therefore control for women's age to capture the ways in which secular changes in societal
331 norms may impact marriage age and education patterns.
332
333 **Statistical methods**
334 We first test for bias in the characteristics of women with assets measured in their natal versus
335 marital households using chi-squared tests (categorical variables) and non-parametric k-sample
336 analysis of variance (Kruskal-Wallis test; continuous variables). We also test for differences in
337 individual assets by asset quintile level using chi-squared tests (categorical variables) and
338 ANOVA (reporting the mean and standard deviation, SD). Given the skewed distribution of
339 women's age, we report the median (and interquartile range, IQR) values in completed integer
340 years. A heat table examines the distribution of women by education level and natal household
341 wealth quintiles. We use SPSS 26 to conduct these analyses (IBM Corp., Armonk, NY). Using R
342 library tidyverse and ggplot2, we create boxplots to stratify the association of women's marriage
343 age with their education by natal household asset quintiles (Wickham, 2016; Wickham et al.,
344 2019).
345
346 We fit logistic mixed-effects models with a random effect on the intercept accounting for within-
347 cluster variability. If i denotes individuals nested within geographic clusters, the equation for a
348 general regression model of this form with p covariates, and random effects in the intercept (u_{i0})
349 and in one covariate (u_{i1}) is shown below. Logit is the log-odds function, defined as $\ln\left(\frac{\pi_i}{1-\pi_i}\right)$,
350 where π_i is the conditional probability that the binary outcome variable Y_i equals one divided by
351 the probability that it equals zero. β_0 is the intercept (constant term) and β_1 is the slope, or
352 coefficient estimate describing the relationship between the outcome and the predictor variable
353 X_1. The index j denotes variables, respectively, and the residual error term, ε_i is assumed to be
354 Normally distributed with mean 0 and variance σ^2, whilst the random effects are assumed to
355 follow a bivariate Normal distribution with mean (0,0) and variance-covariance matrix $\begin{pmatrix} \vartheta_0^2 & \tau_{01} \\ \tau_{01} & \vartheta_1^2 \end{pmatrix}$,
356 independently of ε.
357
358 Our logistic mixed-effects model, shown below differs from the usual fixed-effects model in that
359 it includes random effects accounting for unobserved heterogeneity due to the 80 geographic
360 clusters of the trial:
361

$$\text{logit} = \ln(odds) = \ln\left(\frac{\pi_i}{1-\pi_i}\right) = (\beta_0 + u_{i0}) + (\beta_1 + u_{i1})x_{i1} + \sum_{j=2}^{p} \beta_j x_{ij} + \varepsilon_i$$

363
364 Our models estimate the probabilities, derived from adjusted Odds Ratios (aORs) with 95%
365 Confidence Interval (CI) of women (a) marrying <15, <16 <17 or <18 years, and (b) being
366 uneducated. Models of the factors associated with being uneducated do not include marriage age
367 because it is not appropriate to use a factor which occurred at time B (marriage age) to predict
368 something earlier at time A (never starting school). All of the models control for women's age
369 (potential cohort effect), which, when included together with their age at marriage effectively

370 accounts for the time-gap between when they married and their current age (when they were
371 recruited into the trial). Since our interest is in understanding whether poverty (defined relative
372 to the richest quintile) is associated with early marriage, the reference group is set as the highest
373 category across variables, hence: richest asset quintile, secondary education, agrarian land-
374 holding of ≥1 hectare and advantaged caste. Living near to the biggest bazaar (<30 minutes) is
375 set as the reference group because we assume it is a proxy for better access to school and other
376 resources.
377
378 We evaluate goodness-of-fit using the Nakagawa-Schielzeth marginal R^2 which measures the
379 percentage of variance explained by the model's fixed effects (Nakagawa & Schielzeth, 2013).
380 Logistic mixed-effects models are fitted using the R library `lme4` (Bates et al., 2014).
381
382 We adjust for trial arm because women from natal households were more likely to enroll in the
383 cash and food interventions. However, since the trial recruited women who were already married
384 and currently pregnant, the intervention could not have influenced marriage age or education
385 (which typically is ended before/once women marry). Moreover, assets were measured before
386 the trial was conducted, so the cash supplementation arm could not have changed their value. As
387 the trial arm was not associated with our outcomes, we do not report the findings, although it is
388 still controlled for in our analyses.
389
390 We conduct a sensitivity analysis to examine if the association between poverty and our
391 outcomes change if we apply looser selection criteria, by including all of the women measured in
392 their natal household (*n*=3,379) regardless of their age. While this introduces the possibility of
393 distortion due to selection bias (as discussed above), it nevertheless allows us to test our
394 hypotheses with a much bigger sample of women.
395

396 ## Results
397 ### Sample selection
398 Married pregnant women were interviewed in the home in which they were residing at the time
399 of recruitment into the trial. Of the 25,090 women recruited into our study, we first exclude 408
400 women with multiple pregnancies during the trial to ensure they are not double counted in our
401 analysis. Second, of the remaining 24,682 women (raw data in **Data S1** contains this sample), we
402 exclude 3,968 women who had no data on the household in which assets were measured and a
403 further 17,335 women who were interviewed in their marital home. This leaves 3,379 women
404 whose assets and other characteristics were measured in their natal household.
405
406 Third, we exclude 947 women aged <18 years because they would not have had the chance of
407 marrying at older ages, nor adequate time to finish greater levels of education before marrying.
408 The relationship between wealth, education and marriage age is not likely to be distorted due to
409 the selection bias of recruiting only married pregnant women into our study. In the context of
410 our study, women are very unlikely to continue their education after marriage (Sekine &
411 Hodgkin, 2017). The vast majority of married women are also likely to have children, and it is
412 common in Nepal get pregnant in the first two years after marriage (MacQuarrie, 2016;
413 Marphatia et al., 2020). Our analysis therefore includes 2,432 women aged 18-39 years measured
414 in their natal households, representing 9.7% of the total 25,090 women recruited into the trial.
415

416 **Table S1** examines whether the characteristics of the women measured in their natal homes are
417 different to those measured in their marital homes. This enables us to identify potential bias in
418 our sample which may result in these two groups of women having a different relationship
419 between wealth and marriage age. A direct comparison between these women is not possible
420 because we do not know the socio-economic background of the natal households of the women
421 who were measured in their marital home.

422

423 In comparison to women who were measured in their marital home, those measured in their natal
424 homes are younger, have been married for less time, but at an older age. A greater proportion of
425 women measured in their natal households are from disadvantaged castes, residing further away
426 from big bazaars, and in the trial's cash and food supplementation arms. It is possible that the
427 trial may have incentivised women to return to their natal homes to access these incentives.
428 Women did not differ in their education level, age at first pregnancy, or household asset score.
429 Whilst these results show that women who went to their natal homes during pregnancy are
430 different than those who stayed in their marital homes, the differences are small. The women in
431 our sample still represent an important sub-group of women with rare data on the socio-
432 economic characteristics of their natal homes.

433
434

435 **Description of sample**
436 **Table 1** describes our sample of women aged 18-39 years. Women are of median age 21 years
437 (IQR 4) and have been married for a median of 5 years (IQR 5). Marriage is typically early
438 among women (median 15 years, IQR 3), and 18% married ≥18 years. Two-thirds of the women
439 are uneducated, 39% are from natal households without agrarian land and disadvantaged castes
440 respectively, and 29% live far from large bazaars.

441
442   **Table 1 here**
443

444 The heat table shows the overall number of women by their education level and natal household
445 wealth quintiles (**Table 2**). Green shaded areas indicate low numbers and red shaded numbers
446 the highest numbers. Within the whole sample, uneducated women are most likely to come from
447 poorer natal households, and the more educated women are more likely to come from richer
448 households. However, since two-thirds of our sample is uneducated, there is substantial
449 variability by wealth that is independent of education.

450
451   **Table 2 here**
452

453 **Figure 2** illustrates the association of women's marriage age with their education level, stratified
454 by natal household asset quintiles. Overall, within each wealth group, women with more
455 education marry later. The level of education associated with delayed marriage differs slightly
456 across wealth groups. Interestingly, even in the poorest and poor wealth groups, the median age
457 at marriage is two years later among women with ≥6 years of education than among those with
458 no or less education.

459
460   **Figure 2 here**
461
462 **Hypothesis 1**

463   Hypothesis 1 investigates the association of the natal household asset score with the odds of
464   early marriage, using each of the four age-definitions of early marriage. Across Models 1-4 in
465   **Table 3**, there is no evidence of a cohort effect, which may be explained by the relatively narrow
466   age range of our sample. Relative to the richest asset quintile, women from all other asset
467   quintiles have an elevated risk of early marriage, regardless of the age threshold used to define
468   'early'. However, there is little consistent gradient between the coefficients of the poorest four
469   asset groups, indicating that the main difference in marriage age is between the richest and the
470   rest (this is confirmed by analyses using other asset groups as reference (not shown)). The
471   variance in marriage age explained by the four models is very low: 5.0%, 3.2%, 2.8% and 2.1%.
472   These results do not support our first hypothesis, that natal household poverty is associated with
473   the likelihood of marrying at different early ages.
474
475   **Table 3 here**
476
477   **Hypothesis 2**
478   Hypothesis 2 investigates the association of broader socio-economic factors with the likelihood
479   of marrying early as defined by the four different age thresholds. With the exception of Model 4,
480   age is not a significant factor associated with early marriage, indicating the absence of a cohort
481   effect (**Table 4)**. Model 4 shows that older women are less likely to marry <18 years than ≥18
482   years, which is perhaps surprising: we expected that further in the past (older women) prevailing
483   socio-cultural norms might have more strongly favoured earlier marriage. This cohort effect only
484   emerges when education is controlled for in the analysis, which suggests that it is connected to
485   difference in the availability of, and attitudes towards, education over time. It is also possible that
486   this cohort effect emerges because in the past, high levels of education were rarer, and therefore
487   more tightly associated with delayed marriage compared to more recent times, when education is
488   more widely available to the younger women in our sample.
489
490   Across Models 1-4 in **Table 4**, the asset score is no longer associated with early marriage when
491   women's education is included. The effect of lower wealth appears therefore to be channelled
492   through women's education, which is a better predictor of early marriage in this population.
493   There is a clear education gradient in the likelihood of marrying early, however 'early' is
494   defined. Relative to secondary education, all other education levels have an elevated risk of early
495   marriage, with uneducated women having a substantially greater risk. The magnitude of effect of
496   education also decreases with each additional year used to define early marriage, suggesting that
497   education tends to increase with age, but assets do not. Neither land, caste nor geographic
498   location are associated with any of the marriage age models when women's education is
499   controlled.
500
501   Compared to **Table 3**, these models are almost three times better at explaining the variance
502   across the four marriage age groups: 23.5%, 16.4%, 13.1% and 10.6%. These results support our
503   second hypothesis, that women's lower educational attainment, independent of natal household
504   poverty and broader markers of socio-economic disadvantage, is associated with early marriage,
505   whatever the age threshold used to define 'early'.
506
507   **Table 4 here**
508

Hypothesis 3

Hypothesis 3 investigates whether amongst the uneducated women (n=1,610), poverty, independent of broader markers of socio-economic disadvantage, is associated with early marriage at different ages. Results show no cohort effect, nor any association with wealth (**Table 5** Models 1-4), suggesting that the uneducated women who marry early are not systematically more or less wealthy compared to those marrying ≥18 years. There is also no association between broader socio-economic factors and early marriage, whatever age threshold is used to define early marriage (**Table 6** Models 1-4).

Tables 5 & 6 here

In **Table 5**, models explain 6.2%, 5.4%, 5.0% and 5.0% of the variance in women marrying <15, <16, <17 years and <18 years respectively. In **Table 6**, models explain slightly more of the variance in early marriage across the age groups 7.1%, 6.6%, 5.8% and 6.0%. In comparison to models in **Table 4** for women with all educational levels, those in Table 6 explain less variance. The total absence of women's education in these models is likely to explain this difference. These results do not support our third hypothesis, that among uneducated women, poverty, independent of broader markers of socio-economic disadvantage, is associated with early marriage at different ages.

Hypothesis 4

Hypothesis 4 investigates whether poverty, independent of broader socio-economic factors, is associated with women being uneducated. Across the two models in **Table 7**, older women are more likely to be uneducated, reflecting the increase in the availability and acceptability of education for girls over the 20-year period during which our sample was maturing. Model 1 shows a clear wealth gradient in the likelihood of being uneducated. Relative to the richest quintile, all other asset quintiles have an elevated risk of being uneducated, with the poorest quintile having a substantially greater risk. Model 2 finds a similar pattern after inclusion of broader socio-economic factors. In comparison to Model 1, the magnitude of effect of the first wealth quintile is weaker, that of the mid quintile only slightly weaker, and unchanged in the two richest quintiles. Relative to higher agrarian land-holding, both none and some land-holding are associated with being uneducated. Relative to the advantaged caste, the two disadvantaged castes are associated with being uneducated, with the risk substantially greater for the Muslim caste. Relative to living near a big bazaar, living 30-59 minutes away, but not further distances, is marginally associated with being uneducated.

Model 1 explains 21.0% of the variance in women's education, which is lower than Model 2, which explains 36.3% of the variance. These results support our fourth hypothesis, that poverty, independent of broader socio-economic factors, is associated with women being uneducated.

Table 7 here

Supplementary analysis

A potential reason why poverty may not be associated with women's early marriage, irrespective of the age used to define early marriage, could be that the individual assets owned by households do not actually differ between the wealth quintiles. **Table S2** shows, however, that there is

555 substantial variability across the eight individual assets used to produce our composite asset
556 score using PCA. We also include land-holding in this analysis because it is another marker of
557 wealth in our primarily agrarian population. These individual assets and land ownership matter
558 for daily life and indicate the household's purchasing power. Our results show that asset
559 ownership does indeed differ by wealth levels, nevertheless our analyses described above show
560 that wealth in itself is not associated with women's early marriage in this population.
561
562 Given the selection bias in our study of recruiting young, already married and pregnant women,
563 we have restricted the analyses described above to women aged ≥18 years only. With the
564 exception of the association of age, our results are nonetheless similar if we include the full
565 sample of women aged 12-39 years (*n*=3,379) (**Tables S3-S7)**. The significance of the age
566 variable in these models is a product of the selection effects (as discussed above), and not a
567 cohort effect.
568
569 ## Discussion
570 Our study aims to contribute robust evidence on the association between natal household wealth
571 and early marriage. Our results show that if we measure assets in the natal household, we do not
572 support the conventional hypothesis that household poverty is associated with women's early
573 marriage. In our population, relative to the richest households, all other asset level households
574 have an elevated risk of marrying early, and the poorest households do not stand out. Additional
575 analysis shows substantial variability in individual assets and land-holding by asset quintiles, but
576 that wealth in itself is not directly associated with women's early marriage. Our results are
577 somewhat similar to the only other study from Nepal which measured natal household wealth
578 and also did not find the poorest households married daughters the earliest; rather, daughters
579 from the second poorest households were more likely to marry early (Bajracharya & Amin,
580 2012). In contrast, studies from India have either found that poorer households are most likely to
581 marry their daughters early (Singh & Espinoza Revollo, 2016), or that wealth of the natal
582 household is not associated with early marriage (Marphatia et al., 2021b). Overall, these
583 inconsistent results suggest that we still have a poor understanding of how wealth may shape the
584 timing of women's marriage.
585
586 We also found that women's education displaces wealth as a predictor of early marriage,
587 whatever age is used to define early marriage. Relative to secondary-schooled women, women in
588 all other education categories have a higher risk of marrying early. However, there is also a clear
589 gradient, with uneducated women showing the greatest likelihood of early marriage. The
590 association of high wealth with reduced risk of early marriage therefore works through
591 education, and more generally it is women's education level that is directly related to their
592 marriage age. This finding supports the well-established association between women's lower
593 education and their early marriage (Raj et al., 2014; Delprato et al., 2015; Sekine & Hodgkin,
594 2017; Marphatia et al., 2020; Scott et al., 2021).
595
596 Nonetheless, we found that even in combination, household wealth and women's educational
597 attainment still explain a low proportion of the variance in the likelihood of early marriage
598 models, suggesting that other factors largely drive marriage decisions in this population. Among
599 uneducated women, neither poverty nor broader markers of household disadvantage are
600 associated with early marriage, however 'early' is defined. Since there was no association of

601   household wealth with early marriage among uneducated women, we suggest that socio-cultural
602   norms that are unconnected with education may be the primary driver of early marriage. For
603   example, if girls are not in school, their primary role in society may be that of a daughter, wife
604   and mother. However, the differences in the age of marriage within uneducated women may also
605   relate to other factors unmeasured by our study.
606
607   Where poverty appears to really matter is for the level of education achieved by women,
608   potentially because of the costs associated with schooling, as reported in other studies (Verma,
609   Sinha & Khanna, 2013; Chaudhuri, 2015; Samuels et al., 2017). We found that independent of
610   poverty, both landless and lower agrarian land-holding families are less likely to send their
611   daughters to school. The lack of land may reflect chronic food insecurity, whereas households
612   with some land may prefer daughters to contribute to family income through working on the
613   farm, rather than attending school. Whereas landlessness and the related food insecurity have
614   been associated with both lower schooling and early marriage of girls (Moock & Leslie, 1986;
615   UNICEF, 2014), our study found that it predicted less schooling, but not early marriage.
616   However, as with wealth, the association of lower agrarian land-holding and early marriage may
617   work through education, in that if girls are not in school, marrying them early may decrease
618   household food and financial burdens (Maharjan et al., 2012; Human Rights Watch, 2016;
619   Samuels et al., 2017).
620
621   Like other studies, we also find that disadvantaged castes, especially of the Muslim faith, tend to
622   have lower education (Stash & Hannum, 2001; Sah, 2018; Devkota, Eklund & Wagle, 2020), but
623   this factor was not associated with early marriage. Caste affiliation may be a maker of overall
624   status in society, and therefore act as another marker of access to resources and life
625   opportunities. We find no evidence of the natal household's proximity to big bazaars mattering
626   for early marriage, and there is also no clear relationship between distance from bazaar and lack
627   of education.
628
629   **Implications**
630   Our results have implications for research, policy and practice. First, there is an urgent need for
631   informative objective data measuring wealth in women's natal households, ideally before they
632   marry, and also in women's marital households, ideally at the time of their marriage. This
633   approach would provide much needed evidence on whether natal household poverty is indeed
634   associated with the likelihood of early marriage and whether women marry into households of
635   similar wealth levels.
636
637   These data-related issues, and in particular the inadequate understanding of the association of
638   wealth and marriage age, may partly explain the inconsistent results of interventions targeting
639   poverty as the main driver of early marriage. A recent systematic review found conditional cash
640   transfers (CCTs) to keep girls in school were more effective in delaying marriage than those
641   directly targeting delayed marriage or poverty (Malhotra & Elnakib, 2021). In Bangladesh, CCTs
642   supported girls to stay in school for longer, but delayed marriage for only the youngest girls
643   (aged 12-14 years) living in the poorest district (Amin, 2007). In India, another intervention gave
644   CCTs to parents if their daughters had reached the age of 18 years unmarried. Compared to a
645   control group, the girls who participated in this intervention stayed in school up to grade eight,
646   and were in fact more likely to marry just after the 18 year cut-off stipulated by the intervention

647 (Nanda et al., 2015). In both interventions, the cash transfers was primarily used by parents to
648 pay the higher cost of dowries demanded by marital households for older, more educated girls
649 (Amin, 2007; Nanda et al., 2015).
650
651 Second, we need to better understand the different factors increasing the risk of marrying at
652 different ages, for women of different education levels. Reducing the costs of schooling (e.g.
653 fees, learning materials, offering scholarships) and improving the quality of education may help
654 girls to stay in school for longer and also delay marriage, thereby achieving several of the
655 Sustainable Development Goals (Muchomba, 2021). Further research is needed to understand
656 whether the expansion of free state provision of secondary education would have a sustained
657 impact on delaying marriage. However, any school-based efforts will miss the girls who never
658 went to school in the first place or have already dropped out and married.
659
660 Third, there needs to be a collective shift in societal gendered norms and the value attributed to
661 girls and women in society (Maertens, 2013; Bicchieri, Jiang & Lindemans, 2014; Marphatia,
662 Amable & Reid, 2017). Changing norms is difficult and slow, as shown by social interventions
663 that did not succeed in delaying marriage age in India (Prakash et al., 2019; Ramanaik et al.,
664 2020). Moreover, in populations where women marry very early, it may initially be more
665 realistic to delay marriage by one year at a time. In our study, this would mean first delaying
666 marriage from 15 to 16 years, and then from 16 to 17 years. 'Nudging' populations towards a
667 slightly later marriage age for women may therefore lead to more substantial secular changes
668 over time. Whilst this may sit uncomfortably with the human rights constituencies advocating for
669 the 18-year minimum marriage age, ignoring these practiced norms may render us even further
670 from the common goal of delaying marriage overall (Schaffnit, Urassa & Lawson, 2019).
671 Delaying marriage, even by one year, will inevitably delay the age at first child bearing. Early
672 marriage must therefore be seen as a critical concern for public health (Marphatia, Amable &
673 Reid, 2017).
674
675 **Limitations**
676 Our study has some limitations. With cross-sectional data, we can only investigate associations
677 and not causality. Although we include education in early marriage models, like other studies,
678 we do not know the direction of this association. We did not have data on the amount of dowry
679 paid by women's natal household, nor whether it accelerated the timing of their marriage. Our
680 study involved only married pregnant women and we found that women measured in their natal
681 homes during pregnancy differed from those who remain in their marital homes. However, these
682 differences were small. As we do not have matching data on pregnant women in their marital
683 homes we cannot explore the other ways in which they may differ. In our population, women are
684 also very unlikely to continue their education after marriage, and the vast majority of married
685 women are likely to have children, and it is common in Nepal get pregnant in the first two years
686 after marriage. Our asset score was measured in the natal household after, and not at, marriage.
687 To address this, our asset score excluded items which could have been purchased after marriage.
688 Despite these limitations, our study benefited from a large sample size and the unique data on
689 several different socio-economic variables as well as women's education. The associations
690 between poverty, education and marriage age, and poverty and lack of education identified in our
691 study are likely to be widely applicable, especially to similar Madhesi populations living around
692 the bordering regions of India and Nepal.

693

Conclusion

694
695 Our study is unique in having objective data on assets and broader markers of disadvantage
696 measured in women's natal household. These data enable us to conduct robust and appropriate
697 investigations of the association of natal household wealth with early marriage, using different
698 age thresholds to define 'early'. We also investigate the association of education with the
699 likelihood of early marriage, and whether poverty is associated with early marriage in
700 uneducated women who comprise two-thirds of our sample. Finally, we investigate whether
701 poverty is associated with the likelihood of women having no formal education. Whilst we do
702 not find that natal household poverty predicted early marriage in rural lowland Nepal, further
703 research is required in other populations to establish whether this association is apparent more
704 generally.

705
706

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707
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711 (MIRA, Nepal) staff for data collection, and the UCL Institute for Global Health
712 team for their support (see Saville et al., 2018 for details).

713

Data availability statement

714
715 Raw data are available for the purposes of replicating the results in this paper (**Data S1**). Contact
716 Dr Naomi Saville at n.saville@ucl.ac.uk for further information.

717
718

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Figure 1

Early marriage groups used in analysis

Our first outcome variable, women's 'early marriage,' uses four different age groupings, described as Scenarios A, B, C and D in the Figure. To ensure comparability across these results, the same reference group, marrying at the minimum age cut-off of ≥18 years, is used irrespective of the age used to define early marriage. Each of the scenarios above the <15 years has the lower group nested within it, but excludes the higher group up to 18 years.

Scenario A: we predict being married <15y, compared to those ≥18y

Scenario B: we predict being married <16y, compared to those ≥18y

Scenario C: we predict being married <17y, compared to those ≥18y

Scenario D: we predict being married <18y, compared to those ≥18y

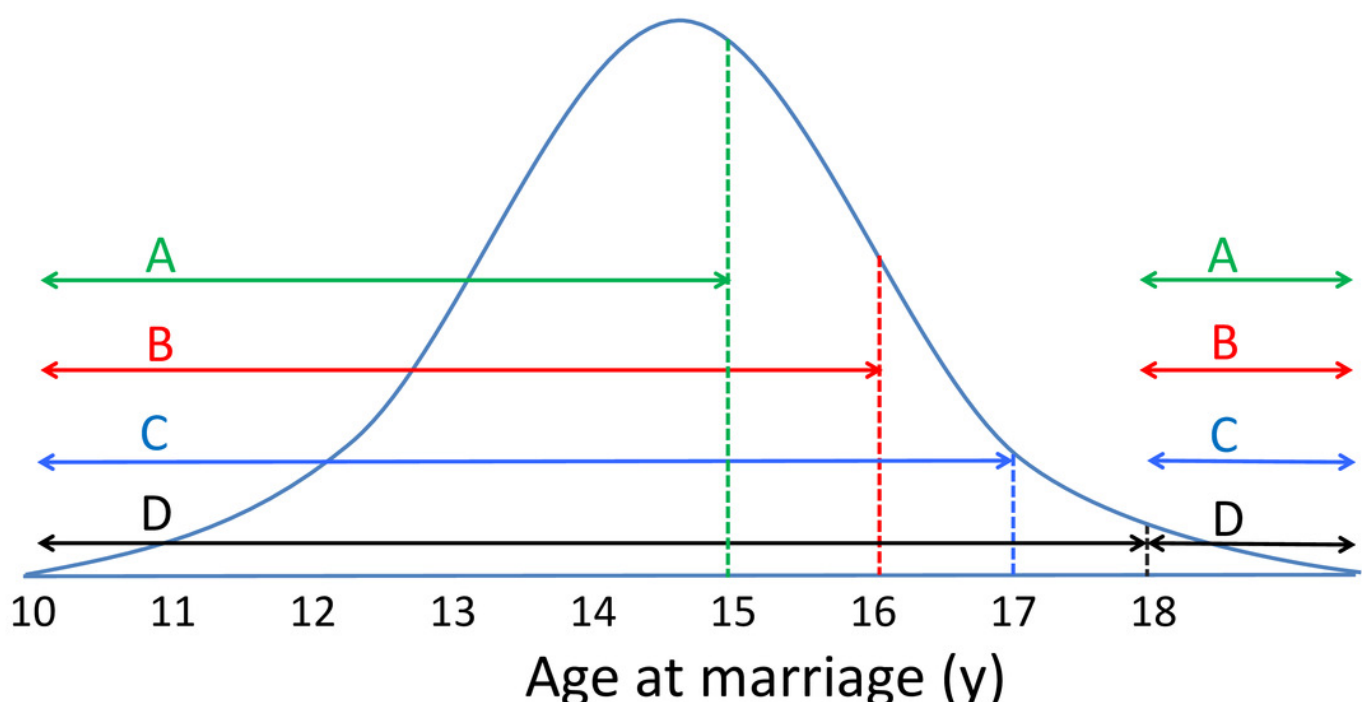
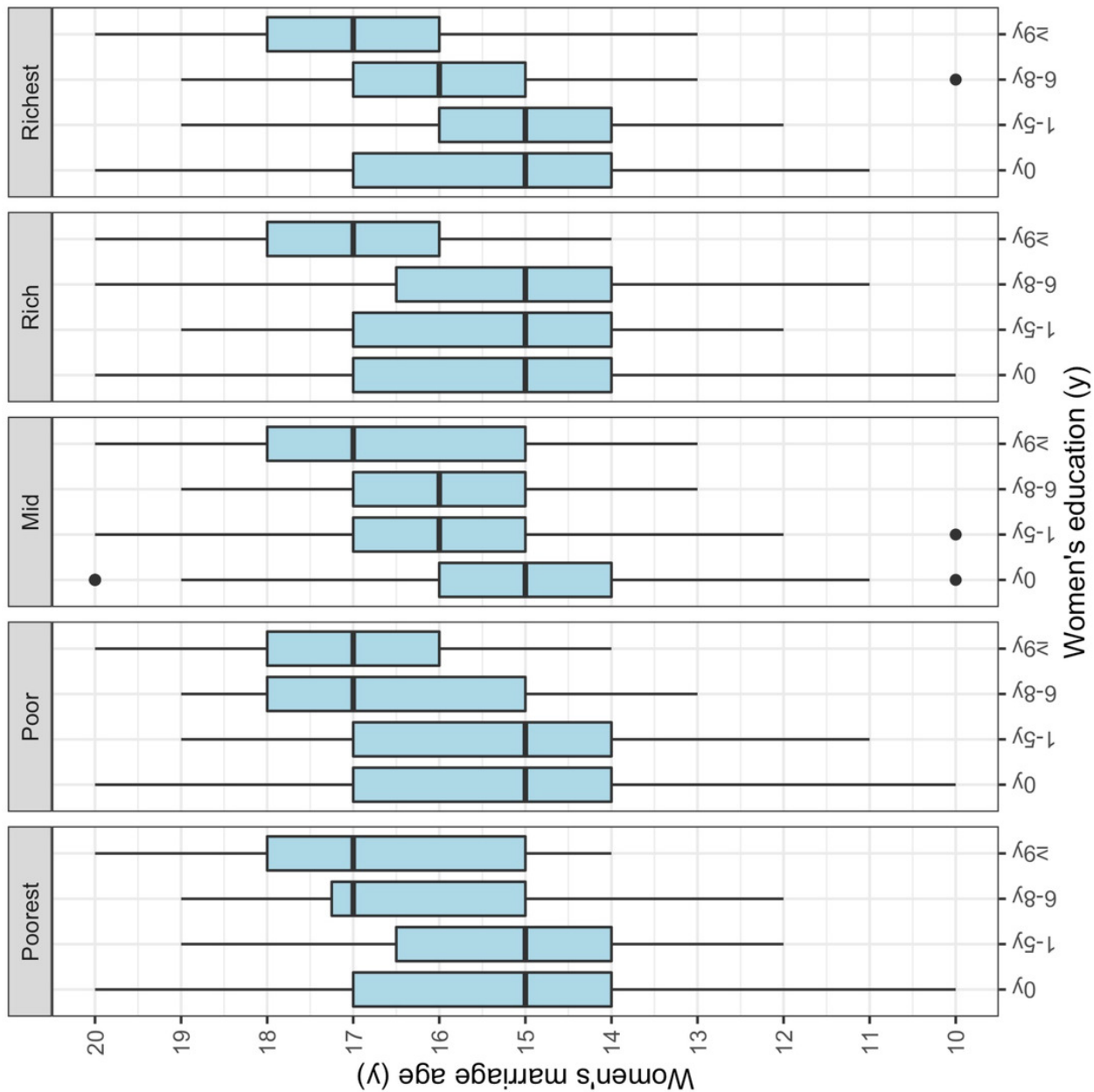



Figure 2

Association of women's marriage age and their education level stratified by natal household asset score

This figure uses the raw data to stratify the association of women's marriage age with women's education by natal household asset quintiles.

Description of sample

	Traits measured in women's natal household (*n*=2,432)	
	Median	**IQR**
Women's age (y)	21	4
Women's age at marriage (y)	15	3
Time since marriage (y)	5	5
	Frequency	**%**
Trial intervention arm		
Control	429	17.6
Women's Group	446	18.3
Women's Group with cash transfer	793	32.6
Women's Group with food supplement	764	31.4
Women's age at marriage (y)		
<15 years	666	27.4
15 years	574	23.6
16 years	356	14.6
17 years	408	16.8
≥18 years	428	17.6
Women's education level (y)		
None	1,610	66.2
Primary (1-5 years)	244	10.0
Lower-secondary (6-8 years)	196	8.1
Secondary or higher (≥9 years)	382	15.7
Natal household asset score (quintiles)		
1: poorest	525	21.6
2: 2nd poorest	484	19.9
3: middle	528	21.7
4: 2nd richest	465	19.1
5: richest	430	17.7
Natal household agrarian land-holding		
None	951	39.1
0.01 to 0.5 hectares	750	30.8
0.51 to 0.99 hectares	344	14.1
≥1 hectare	387	15.9
Natal household access to big bazaar		
<30 minutes	798	32.8
30-59 minutes	934	38.4
60-89 minutes	472	19.4
≥90 minutes	228	9.4
Natal household caste affiliation		
Disadvantaged: Dalit	494	20.3
Disadvantaged: Muslim	468	19.2
Middle: Janjati, Terai castes	927	38.1
Advantaged: Yadav, Brahmin	543	22.3

1 **Table 1.** Description of sample

2 IQR, interquartile range.

Heat map of women's educational attainment by natal household wealth

The heat table shows the overall number of women by their education level and natal household wealth quintiles. Green shaded areas indicate low numbers and red shaded numbers the highest numbers.

1 **Table 2.** Heat map of women's educational attainment by natal household wealth

	Natal household asset quintiles					
Women's education (y)	Poorest	2nd Poorest	Mid-level	2nd Richest	Richest	Total row
None	464	351	356	255	184	1,610
Primary (1-5 years)	27	50	61	56	50	244
Lower-secondary (6-8 years)	20	38	41	59	38	196
Secondary/higher (≥9 years)	14	45	70	95	158	382
Total column	525	484	528	465	430	2,432

Hypothesis 1: Associations of natal household asset score with marrying early

1   **Table 3.** Hypothesis 1: Associations of natal household asset score with women's early marriage

	Model 1: Marrying <15 years $n=1,094$[1] $R^2 =0.050$		Model 2: Marrying <16 years $n=1,668$[2] $R^2 = 0.032$		Model 3: Marrying <17 years $n=2,024$[3] $R^2 = 0.028$		Model 4: Marrying <18 years $n=2,432$[4] $R^2 = 0.021$	
	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value
Women's age (y)	1.02 (0.97, 1.06)	0.485	1.01 (0.97, 1.05)	0.556	0.99 (0.96, 1.03)	0.646	0.98 (0.95, 1.01)	0.178
Asset score								
Poorest	2.98 (1.90, 4.67)	<0.001	2.44 (1.67, 3.58)	<0.001	2.26 (1.58, 3.24)	<0.011	1.93 (1.37 2.72)	<0.001
2nd poorest	2.39 (1.53, 3.71)	<0.001	1.68 (1.16, 2.44)	0.007	1.57 (1.11, 2.23)	0.002	1.41 (1.01, 1.97)	0.043
Mid	2.12 (1.35, 3.31)	0.001	1.83 (1.26, 2.66)	0.001	1.74 (1.23, 2.47)	0.001	1.52 (1.09, 2.12)	0.013
2nd richest	2.34 (1.49, 3.69)	<0.001	1.93 (1.31, 2.83)	0.001	1.90 (1.32, 2.73)	<0.001	1.72 (1.22, 2.43)	0.002
Richest (ref)	1.00		1.00		1.00		1.00	
Intercept	0.52 (0.16, 1.72)	0.286	1.46 (0.53, 3.97)	0.462	3.11 (1.23, 7.86)	0.017	6.00 (2.54, 14.15)	<0.001

2   Models include fixed and random effects estimates for geographic clusters and control for trial arm. As associations of trial arm with early marriage across the
3   age groupings were not statistically significant, they are not reported in Tables. aOR, adjusted Odds Ratio. CI, 95% Confidence Interval. [1]$n=428$ married ≥18y vs
4    $n=666$ married <15y. [2]$n=428$ married ≥18y vs $n=1,240$ married <16y. [3]$n=428$ married ≥18y vs $n=1,596$ married <17y. [4]$n=428$ married ≥18y vs $n=2,004$ married
5   <18y.

Hypothesis 2: Broader socio-economic factors associated with women marrying early

1 **Table 4.** Hypothesis 2: Broader socio-economic factors associated with women's early marriage

	Model 1: Marrying <15 years $n=1,094$[1] $R^2=0.235$		Model 2: Marrying <16 years $n=1,668$[2] $R^2=0.164$		Model 3: Marrying <17 years $n=2,024$[3] $R^2=0.131$		Model 4: Marrying <18 years $n=2,432$[4] $R^2=0.106$	
	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value
Women's age (y)	0.99 (0.94, 1.04)	0.670	0.98 (0.94, 1.02)	0.401	0.96 (0.93, 1.00)	0.047	0.95 (0.91, 0.98)	0.003
Asset score								
Poorest	1.04 (0.58, 1.85)	0.902	0.90 (0.55, 1.44)	0.651	0.98 (0.63, 1.53)	0.933	0.92 (0.60, 1.39)	0.675
2nd poorest	1.02 (0.59, 1.74)	0.949	0.74 (0.47, 1.15)	0.184	0.82 (0.55, 1.23)	0.338	0.79 (0.54, 1.16)	0.233
Mid	0.95 (0.56, 1.63)	0.863	0.91 (0.59, 1.40)	0.658	1.01 (0.68, 1.50)	0.948	0.94 (0.65, 1.37)	0.763
2nd richest	1.61 (0.94, 2.75)	0.083	1.30 (0.84, 2.02)	0.233	1.48 (1.00, 2.21)	0.051	1.31 (0.90, 1.89)	0.157
Richest (ref)	1.00		1.00		1.00		1.00	
Women's education								
None	18.43 (10.60, 32.03)	<0.001	11.50 (7.66, 17.28)	<0.001	8.00 (5.59, 11.47)	<0.001	5.65 (4.07, 7.84)	<0.001
Primary (1-5y)	11.72 (6.06, 22.68)	<0.001	7.21 (4.30, 12.08)	<0.001	5.07 (3.18, 8.08)	<0.001	3.81 (2.46, 5.89)	<0.001
Lower-secondary (6-8y)	5.23 (2.56, 10.66)	<0.001	4.56 (2.64, 7.88)	<0.001	3.96 (2.43, 6.45)	<0.001	3.43 (2.18, 5.41)	<0.001
Secondary/higher (≥9) (ref)	1.00		1.00		1.00		1.00	
Agrarian land								
None	1.05 (0.61, 1.79)	0.866	1.06 (0.68, 1.65)	0.793	0.95 (0.63, 1.43)	0.819	0.98 (0.67, 1.44)	0.927
0.01 to 0.5 hectares	1.36 (0.81, 2.26)	0.242	1.42 (0.93, 2.15)	0.104	1.26 (0.85, 1.85)	0.246	1.32 (0.92, 1.89)	0.136
0.51 to 0.99 hectares	0.96 (0.55, 1.69)	0.895	1.08 (0.68, 1.70)	0.746	1.09 (0.72, 1.65)	0.688	1.09 (0.74, 1.60)	0.671
≥1 hectare (ref)	1.00		1.00		1.00		1.00	
Access to big bazaar								
<30 min (ref)	1.00		1.00		1.00		1.00	
30-59 minutes	1.09 (0.71, 1.68)	0.682	1.15 (0.80, 1.64)	0.443	1.03 (0.74, 1.44)	0.841	1.09 (0.80, 1.48)	0.605
60-89 minutes	1.11 (0.66, 1.87)	0.702	1.17 (0.76, 1.80)	0.471	1.01 (0.68, 1.51)	0.954	1.01 (0.70, 1.46)	0.967
≥90 minutes	1.32 (0.69, 2.53)	0.409	1.14 (0.65, 2.01)	0.650	0.90 (0.53, 1.52)	0.687	1.03 (0.63, 1.68)	0.912
Caste								
Disadvantaged: Dalit	0.98 (0.56, 1.71)	0.931	1.13 (0.71, 1.78)	0.616	1.19 (0.78, 1.83)	0.425	1.20 (0.80, 1.79)	0.376
Disadvantaged: Muslim	1.01 (0.59, 1.71)	0.984	0.99 (0.63, 1.55)	0.956	1.01 (0.67, 1.55)	0.946	1.03 (0.69, 1.54)	0.883
Middle: Janjati, Terai castes	0.99 (0.63, 1.54)	0.953	1.13 (0.78, 1.62)	0.517	1.13 (0.81, 1.58)	0.467	1.09 (0.80, 1.49)	0.576
Advantaged: Yadav, Brahmin (ref)	1.00		1.00		1.00		1.00	
Intercept	0.14 (0.03, 0.59)	0.007	0.55 (0.17, 1.77)	0.316	1.63 (0.57, 4.72)	0.363	4.01 (1.53, 10.52)	0.005

2   Models include fixed and random effects estimates for geographic clusters and control for trial arm. aOR, adjusted Odds Ratio. CI, 95% Confidence Interval.

3   [1]n=428 married ≥18y vs n=666 married <15y. [2]n=428 married ≥18y vs n=1,240 married <16y. [3]n=428 married ≥18y vs n=1,596 married <17y. [4]n=428 married

4   ≥18y vs n=2,004 married <18y.

Hypothesis 3: Associations of natal household asset score and marrying early in uneducated women

1 **Table 5.** Hypothesis 3: Associations of natal household asset score and early marriage in uneducated women

	Model 1: Marrying <15 years $n=736^1$ $R^2=0.062$		Model 2: Marrying <16 years $n=1,156^2$ $R^2=0.054$		Model 3: Marrying <17 years $n=1,376^3$ $R^2=0.050$		Model 4: Marrying <18 years $n=1,610^4$ $R^2=0.050$	
	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value
Women's age (y)	1.00 (0.94, 1.06)	0.951	1.00 (0.95, 1.05)	0.923	0.98 (0.94, 1.03)	0.474	0.98 (0.93, 1.02)	0.316
Asset score								
Poorest	0.89 (0.46, 1.72)	0.733	0.87 (0.48, 1.57)	0.634	0.91 (0.52, 1.61)	0.756	0.82 (0.48, 1.41)	0.470
2nd poorest	0.83 (0.43, 1.62)	0.590	0.69 (0.37, 1.27)	0.231	0.70 (0.39, 1.25)	0.228	0.67 (0.38, 1.16)	0.155
Mid	0.87 (0.44, 1.71)	0.679	0.83 (0.45, 1.54)	0.560	0.83 (0.46, 1.50)	0.544	0.75 (0.43, 1.32)	0.319
2nd richest	1.71 (0.80, 3.65)	0.168	1.53 (0.76, 3.11)	0.235	1.48 (0.75, 2.93)	0.258	1.48 (0.77, 2.84)	0.241
Richest (ref)	1.00		1.00		1.00		1.00	
Intercept	3.28 (0.70, 15.41)	0.133	7.14 (1.74, 29.26)	0.006	12.28 (3.27, 46.17)	<0.001	17.30 (4.98, 60.07)	<0.001

2 Models include fixed and random effects estimates for geographic clusters and control for trial arm. aOR, adjusted Odds Ratio. CI, 95% Confidence Interval.
3 [1]$n=206$ married ≥18y vs $n=530$ married <15y. [2]$n=206$ married ≥18y vs $n=950$ married <16y. [3]$n=206$ married ≥18y vs $n=1,170$ married <17y. [4]$n=206$ married
4 ≥18y vs $n=1,404$ married <18y.

Hypothesis 3: Broader socio-economic factors associated with women marrying early in uneducated women

1 **Table 6.** Hypothesis 3: Broader socio-economic factors associated with early marriage in uneducated women

	Model 1: Marrying <15 years $n=736^1$ $R^2=0.071$		Model 2: Marrying <16 years $n=1{,}156^2$ $R^2=0.066$		Model 3: Marrying <17 years $n=1{,}376^3$ $R^2=0.058$		Model 4: Marrying <18 years $n=1{,}610^4$ $R^2=0.060$	
	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value	aOR (95% CI)	*p*-value
Women's age (y)	1.00 (0.95, 1.06)	0.959	1.00 (0.95, 1.05)	0.995	0.98 (0.94, 1.03)	0.482	0.98 (0.93, 1.02)	0.338
Asset score								
Poorest	0.75 (0.36, 1.57)	0.449	0.78 (0.40, 1.49)	0.446	0.86 (0.46, 1.61)	0.639	0.78 (0.43, 1.40)	0.400
2nd poorest	0.74 (0.37, 1.50)	0.402	0.63 (0.33, 1.20)	0.163	0.65 (0.35, 1.20)	0.172	0.62 (0.35, 1.12)	0.115
Mid	0.79 (0.39, 1.59)	0.503	0.77 (0.41, 1.46)	0.432	0.79 (0.43, 1.45)	0.439	0.72 (0.40, 1.28)	0.260
2nd richest	1.56 (0.72, 3.38)	0.262	1.45 (0.71, 2.96)	0.311	1.41 (0.71, 2.82)	0.325	1.43 (0.74, 2.77)	0.287
Richest (ref)	1.00		1.00		1.00		1.00	
Agrarian land								
None	1.41 (0.72, 2.78)	0.315	1.24 (0.69, 2.25)	0.476	1.16 (0.65, 2.06)	0.609	1.26 (0.73, 2.18)	0.402
0.01 to 0.5 hectares	1.59 (0.81, 3.11)	0.179	1.48 (0.82, 2.68)	0.196	1.46 (0.82, 2.59)	0.200	1.67 (0.97, 2.89)	0.066
0.51 to 0.99 hectares	1.21 (0.55, 2.67)	0.634	1.18 (0.58, 2.39)	0.646	1.18 (0.60, 2.31)	0.638	1.32 (0.69, 2.53)	0.395
≥1 hectare (ref)	1.00		1.00		1.00		1.00	
Access to big bazaar								
<30 min (ref)	1.00		1.00		1.00		1.00	
30-59 minutes	0.94 (0.56, 1.57)	0.810	0.91 (0.57, 1.44)	0.687	0.89 (0.57, 1.38)	0.597	0.92 (0.61, 1.41)	0.715
60-89 minutes	1.10 (0.58, 2.09)	0.777	1.35 (0.76, 2.43)	0.308	1.19 (0.68, 2.07)	0.536	1.18 (0.70, 2.00)	0.536
≥90 minutes	1.47 (0.67, 3.22)	0.331	1.29 (0.61, 2.70)	0.506	1.09 (0.54, 2.20)	0.803	1.10 (0.56, 2.14)	0.790
Caste								
Disadvantaged: Dalit	1.09 (0.54, 2.20)	0.800	1.03 (0.56, 1.89)	0.933	1.01 (0.56, 1.82)	0.973	1.07 (0.61, 1.88)	0.813
Disadvantaged: Muslim	0.96 (0.50, 1.82)	0.890	0.85 (0.48, 1.51)	0.576	0.87 (0.50, 1.50)	0.610	0.88 (0.52, 1.49)	0.642
Middle: Janjati, Terai castes	0.96 (0.53, 1.74)	0.904	1.00 (0.59, 1.69)	0.996	1.00 (0.60, 1.66)	0.996	0.96 (0.59, 1.56)	0.865
Advantaged: Yadav, Brahmin (ref)	1.00		1.00		1.00		1.00	
Intercept	2.27 (0.40, 12.91)	0.354	5.62 (1.16, 27.28)	0.032	10.94 (2.48, 48.26)	0.002	13.49 (3.31, 55.02)	<0.001

2 Models include fixed and random effects estimates for geographic clusters and control for trial arm. aOR, Adjusted Odds Ratio. CI, 95% Confidence Interval.

3 $^1n=206$ married ≥18y vs $n=530$ married <15y. $^2n=206$ married ≥18y vs $n=950$ married <16y. $^3n=206$ married ≥18y vs $n=1{,}170$ married <17y. $^4n=206$ married

4 ≥18y vs $n=1{,}404$ married <18y.

Hypothesis 4: Broader socio-economic factors associated with women being uneducated

1 **Table 7.** Hypothesis 4: Broader socio-economic factors associated with women being
2 uneducated

	Model 1: Natal household asset score $n=2,432^{1}$ $R^{2}=0.210$		Model 2: Broader socio-economic factors $n=2,432^{1}$ $R^{2}=0.363$	
	OR (95% CI)	*p*-value	aOR (95% CI)	*p*-value
Women's age (y)	1.16 (1.12, 1.20)	<0.001	1.18 (1.14, 1.23)	<0.001
Asset score	1.00		1.00	
Poorest	11.84 (8.36, 16.77)	<0.001	8.79 (5.97, 12.95)	<0.001
2nd poorest	4.01 (2.97, 5.40)	<0.001	3.60 (2.59, 5.01)	<0.001
Mid	3.18 (2.39, 4.23)	<0.001	3.16 (2.31, 4.34)	<0.001
2nd richest	1.68 (1.27, 2.22)	<0.001	1.68 (1.23, 2.28)	<0.001
Richest (ref)			1.00	
Agrarian land				
None			2.99 (2.15, 4.18)	<0.001
0.01 to 0.5 hectares			1.79 (1.33, 2.42)	<0.001
0.51 to 0.99 hectares			1.17 (0.84, 1.63)	0.351
≥1 hectare (ref)			1.00	
Access to big bazaar				
<30 min (ref)			1.00	
30-59 minutes			1.18 (0.90, 1.55)	0.220
60-89 minutes			1.16 (0.83, 1.60)	0.387
≥90 minutes			1.62 (1.05, 2.51)	0.031
Caste				
Disadvantaged: Dalit			1.66 (1.18, 2.35)	0.004
Disadvantaged: Muslim			7.12 (4.83, 10.49)	<0.001
Middle: Janjati, Terai castes			0.99 (0.76, 1.29)	0.927
Advantaged: Yadav, Brahmin (ref)			1.00	
Intercept	0.04 (0.02, 0.09)	<0.001	0.01 (0.00, 0.02)	<0.001

3 Models include fixed and random effects estimates for geographic clusters and control for trial arm. aOR, Adjusted
4 Odds Ratio. CI, 95% Confidence Interval. $^{1}n=822$ educated (≥1y schooling) vs $n=1,610$ uneducated.