Lucky Late Bloomers? Consequences of Delayed Marriage for Women in Rural Western Kenya*

Joan Hamory Hicks[1]
University of Oklahoma

Daniel L. Hicks
University of Oklahoma

June 2019

Abstract:

We examine the impact of delayed marriage on outcomes for women in rural western Kenya, a setting in which the overwhelming majority of women are married by mid-to-late adolescence. The timing of physical maturation in girls has been shown to influence marriage timing in a quasi-random manner, and we find that each additional year that menarche is delayed is associated with an increase of roughly 0.3 years in age at first marriage. Using age of menarche as an instrument for marital age, we show that delayed marriage substantially increases female educational attainment and academic test scores, and improves health along a subset of dimensions. At the same time, delayed marriage appears to have little effect on outcomes associated with female bargaining power, including marriage market, child health, and household decision-making outcomes, as well female attitudes toward gender roles and children. We interpret these findings within our rural Kenyan setting.

JEL Classification: J12, J16, I25, I15, O12
Keywords: Marriage, gender, education, female empowerment

---

*Acknowledgements: The authors acknowledge helpful discussions with Joaquín Artés, Jennifer Graves, and Kevin Grier, as well as participants of the 2013 Pacific Conference for Development Economics and the 2015 Royal Economic Society Conference. J.H. Hicks gratefully recognizes support from the Eunice Kennedy Shriver National Institute of Child Health & Human Development (National Institutes of Health Grant Number R01HD044475). The content of this article is solely the responsibility of the authors, and does not necessarily represent the official views of the Eunice Kennedy Shriver National Institute of Child Health & Human Development or the U.S. National Institutes of Health. All errors are our own.

[1] Corresponding author: Department of Economics, Cate 1 Room 158, 308 Cate Center Drive, Norman, Oklahoma 73072; 510-502-8623; jhamoryhicks@ou.edu

I. Introduction

Early marriage continues to be a common practice in the developing world. A 2012 report published by the United Nations Population Fund (UNFPA) compiles information from numerous large-scale household surveys collected during 2000-2010, and finds that one-third of women aged 20-24 living low-income countries report being married by the age of 18.[2] Yet, prevalence varies greatly by region, with the highest incidence in South Asia (46%), West and Central Africa (41%), and East and South Africa (34%).

Early marriage has been associated with worse outcomes for women, including lower educational attainment, earlier age at first birth, higher total fertility, lower utilization of maternal healthcare, poor health outcomes for both women and their children, lower status within the household, higher experience of intra-partner violence, and lower participation in market work (see, for example, Jensen and Thornton, 2003; Kidman, 2016; UNFPA, 2012; and Yount et al., 2018). However, identifying a causal relationship between early marriage and adult outcomes is challenging due to the presence of other (difficult to observe) omitted factors which likely affect both marriage timing and adult outcomes, such as parent socio-economic status or gender norms.

Recent work has sought to rigorously identify the causal impacts of early marriage for women. Field and Ambrus (2008) pioneer the use of a novel instrument for early marriage in Bangladesh, a context where child marriage is pervasive.[3] Because menarche represents a constraint on marriage prospects in that context, the timing (age) of menarche provides an exogenous source of variation by creating a lower bound on the age of entry into the marriage market. Using this

[2] The report utilizes survey data from numerous Demographic and Health Surveys (DHS), Multiple Indicator Cluster surveys, and others (UNFPA, 2012).

[3] Results from the 2014 Bangladesh DHS suggest that 34% of women aged 20-49 were married by the age of 15, 71% by age 18, and 96% by age 25 (ICF 2015).

innovative instrumental variables (IV) strategy, the authors find that delaying marriage improves women's educational attainment and prenatal investments in Bangladesh.

Subsequent work has utilized this same IV strategy to examine the impacts of early marriage on a wider range of outcomes, and in other contexts. Asadullah and Wahhaj (2018) exploit differences in age of menarche between sisters to estimate the impact of early marriage on gendered attitudes and intra-household resource allocation in Bangladesh, and find that early marriage worsens both sets of outcomes. Sekhri and Debnath (2014) explore the intergenerational impact of early marriage for women in India, another high-prevalence country for early marriage, and find that delayed marriage increases children's reading and arithmetic skills.[4,5] Chari et al. (2017) also examine early marriage in India, and find that delayed marriage improves the health and educational outcomes of the brides' children.

Economic analyses of the impacts of early marriage in sub-Saharan Africa remain scarce despite widespread prevalence in portions of the region. Sunder (2018) studies Uganda, a context with marriage timing similar to India, and finds that early marriage reduces educational attainment, literacy, labor force participation, and contraceptive use of women, and negatively impacts the health outcomes of their children there.[6]

We seek to extend the literature for sub-Saharan Africa, and to study the impacts of delayed marriage in an environment where marriage occurs slightly later in adolescence. In particular, we

[4] Marriage timing in India, while still during adolescence, is somewhat later than in Bangladesh. Results from the 2015-16 Indian DHS suggest that 12% of women aged 20-49 were married by the age of 15, 37% were married by age 18, and 83% by age 25 (ICF 2015).

[5] Related work, such as that of Delprato et al. (2015) and (2017), use a set of instruments to estimate the impacts of early marriage on schooling outcomes for the women and her children across several countries in sub-Saharan Africa and South West Asia.

[6] Rates of early marriage in Uganda are par with India, so ages of marriage are somewhat later than in Bangladesh. According to the 2016 Ugandan DHS, 12% of women aged 20-49 were married by the age of 15, 40% by age 18, and 86% by age 25 (ICF 2015).

study the causal impact of early marriage in rural western Kenya. According to the 2014 Demographic and Health Survey, only 7% of Kenyan women aged 20-49 report being married by the age of 15, but this number increases rapidly to 27% by age 18, and 79% by the end of adolescence (age 25). We focus on women primarily living in rural western Kenya, where rates of early marriage are even higher than the national average; the median age of first marriage among women aged 25-29 in our study area is 18.4, compared to a national average of 20.2 (ICF, 2015).

To overcome endogeneity concerns, we follow Field and Ambrus (2008) and use timing of menarche as an instrumental variable (IV) for timing of marriage. We explore the impact of early marriage on a wide range of adult outcomes among Kenyan women, focusing on outcomes that may be impacted through female bargaining power in the household (educational, marriage market, and health, sexual and reproductive health, and household decision-making outcomes). We also explore the impacts of early marriage on adult female attitudes toward gender roles and children.

We show that delayed marriage causally influences educational outcomes in this rural Kenyan context, following the earlier literature for other places where early marriage is common. In particular, each additional year of delay in age at first marriage for women in this region increases educational attainment by 0.78 years. We find evidence that delayed marriage improves academic test scores. We also find that a subset of dimensions of adult health are impacted by delayed marriage.

Despite the substantial impacts we identify on educational and some health outcomes, we document limited evidence of impact on a broad range of other outcomes associated with female bargaining power in the household, such as marriage market, child health, and household decision-making outcomes, as well female attitudes toward gender roles and children. These results highlight an important avenue for future analysis, examining the reasons why additional educational attainment for women in this context is not translating into broader behavioral and attitudinal shifts as well.

Our analysis makes several contributions to the existing literature. First, this paper serves as a demonstration of external validity for the findings of Field and Ambrus (2008), extended to a country in East Africa also characterized by adolescent marriage. In the context of quasi-experimental research methods, validation research is not especially common, particularly for studies which examine social institutions (see Glazerman, Levy, and Myers, 2002 for an overview). Specifically, our findings suggest that the results for the Bangladeshi case, where early adolescent marriage is more prevalent, extend to Kenya, a region characterized by later (although still early compared to more highly developed economies) marriage and by a different set of ethnic and religious customs. The strength of our observed association between marriage and education indicates that the Field and Ambrus findings are likely to generalize more broadly within the developing world.

However, our work is not just a straightforward replication of the earlier study in Bangladesh. We focus on a wider range of outcomes – outcomes which may be impacted by marriage timing through a bargaining power mechanism – in particular to understand whether the improvements in educational outcomes as a result of delayed marriage are accompanied by other improvements in the status of young females. Our findings suggest that policies which restrict adolescent marriage or incentivize later marriage for women are also likely to yield improvements in educational outcomes and potentially in perceptions of health and wellbeing. At the same time, our results provide no clear proof to suggest that policy makers can count on these advances from delayed marriage to immediately translate into gains in other gendered areas, such as better marriage market outcomes for women, or less gendered attitudes.

This paper proceeds as follows. Section II discusses the study context and examines the existing literature. Section III describes the data and presents summary statistics. Section IV

discusses the empirical strategy. Section V explores the impact of early marriage on a range of socio-economic outcomes among Kenyan youth. Section VI concludes.

II. Gender, Marriage, and Fertility in Rural Western Kenya

Our primary study area is Busia County, a densely-settled farming region in rural western Kenya bordering Lake Victoria. The administrative divisions in southern Busia County are home to a relatively ethnically homogenous population – individuals in our sample are primarily Luhya (89 percent; the area is also home to smaller numbers of Luo, 7 percent, and Teso, 3 percent). In this region, economic and social roles differ markedly by gender. Patrilocal exogamy is prevalent, and women have weak land rights. As in many parts of the developing world, women tend to marry (either formally or informally) at a young age.[7] Men traditionally pay a bride price, so while women often marry shortly after leaving school (or leave school prematurely in order to marry), men typically work for several years between school and marriage, in part to accumulate resources to marry.

We focus on a survey of individuals who at the time of data collection were primarily in their mid-twenties (mean age 26.6). Women in our study area in this age group are substantially more likely to be married than their male counterparts (70 percent versus 56 percent). Furthermore, there is a large gender gap in age at first marriage. On average 13 percent (1 percent) of women (men) are married before age 18 and 47 percent (16 percent) are married by age 21. The average male spouse in our sample is 5 years older than his female partner, and approximately 97 percent of unions in our data entail a positive age difference between male and female spouses. Figure 1 plots the distribution of age of first marriage among married women in our sample.

[7] Informal marriages are common in this region, in part because marriage under the age of 18 is illegal, and in part because acquisition of the marriage certificate is a costly endeavor.

As might be expected in a poor agrarian society, total fertility in rural western Kenya is high and is characterized by gender disparities in the timing of fertility over the life-cycle (Central Bureau of Statistics, 2004). Despite our sample's relative youth, the gender gap is already evident. Females in our sample have had more pregnancies than partners of male respondents (2.0 versus 1.4). Since we focus on a group of individuals who have just begun to reach peak child-bearing years, total fertility in our sample is lower than the regional average, which exceeds 5.

III. Data

We employ data from the Kenya Life Panel Survey (KLPS), an unusual longitudinal survey of rural Kenyan youth which has gathered information on a wide range of outcomes (including education, health, labor market, migration, marriage, fertility, and social attitudes) in three rounds of data collection between 2003 and 2014. Respondents of this panel data collection effort were involved in one of two school-based development programs which took place between 1998 and 2002. The Primary School Deworming Project (PSDP) provided deworming treatment to all eligible children in 75 primary schools in southern Busia County during 1998-2002, and the Girls' Scholarship Program (GSP) awarded merit-based scholarships to qualifying grade 6 girls in a separate set of primary schools in Busia County in 2001-2002.[8] Thus, KLPS respondents compose a representative subset of individuals who were enrolled in primary school in southern Busia County in 1998 or 2001.[9]

[8] Both of these programs used randomized methods to study program impacts. For more information on the PSDP, see Miguel and Kremer (2004) and Miguel and Kremer (2014). For more information on the GSP, see Kremer, Miguel, and Thornton (2009).

[9] Note that some KLPS respondents were also enrolled in a third, more recent program, known as the Vocational Training Voucher Program (VTVP). For more on this program, see Hicks *et al.* (2015).

The 1998 Kenya DHS reports that 85 percent of 8 to 18 year olds in western Kenya were enrolled in school at that time, indicating that our school-based sample is broadly representative of children in the region. Nevertheless, because we focus on a population of individuals who were enrolled in school, it is likely that we may be missing the poorest of the poor in the region, and perhaps some of the earliest marriages (girls who had already dropped out of school to marry). We discuss how this affects our analysis in the results section.

We utilize data collected during the third round of the KLPS (KLPS-3), which was conducted during 2011-2014. Attrition rates in the KLPS are quite low, especially for panel data collection efforts in less developed countries, and the effective tracking rate for KLPS-3 was 87 percent.[10] In our analysis, we focus on female KLPS-3 respondents who experienced menarche between the ages of 11 and 19 (88 percent of women interviewed[11]), for whom we have all necessary survey information, and who have ever been married (70 percent of women interviewed). This sample comprises 2,686 women who range in age from 19 to 36 at the time of KLPS-3 data collection.[12]

Summary statistics for a range of key individual, household, marriage and fertility outcomes are presented in Table 1 for our sample of respondents. The average age of KLPS women at the time of Round 3 interview was 27. The majority of these individuals (76 percent) come from the PSDP follow-up, which reflects the relative size of the follow-up subsample for that program in comparison to the GSP follow-up subsample. Roughly 50 percent of interviewees were in the PSDP treatment group – meaning they were enrolled in a school that received deworming treatment within

[10] See Baird, Hicks, and Miguel (2008) for a description of the KLPS tracking strategy, and for an explanation of the effective tracking rate.
[11] The remaining women are either outliers in or are missing data on age of menarche.
[12] As we explain below, our results also hold when we instead focus on the sample of women who have ever either been married or pregnant (80.4 percent of the full sample).

the first two years of that program. Only 12 percent were part of the GSP treatment group, meaning they were enrolled in schools that were eligible to receive a scholarship. One quarter of interviewed women were additionally enrolled in the more recent Vocational Training Voucher Program (VTVP), and 12 percent actually received a voucher to attend a vocational training institution. Controls for all of these subsamples are included in the analysis presented in Section V.

The second panel of Table 1 focuses on parental and family characteristics of these KLPS women. The average father of a young woman in our sample attained nearly 8 years of schooling. In contrast, mothers of young women in our sample generally dropped out of primary school well before completion, attaining only 5.6 years of schooling. Information on father's education is missing for 16 percent of individuals, and information on mother's education is missing for 10 percent of individuals. Consistent with family size in this region, the average young woman interviewed in KLPS-3 has more than 5 siblings.

The bottom panel of Table 1 summarizes marriage and fertility characteristics of these women. Seventy percent of KLPS-3 female interviewees were married at the time of data collection, and 80 percent had ever been pregnant. Among those in our sample of married women, 98 percent had been pregnant at some point, and the average age of marriage and first pregnancy was 20.

IV. Empirical Strategy - Menarche as an Instrumental Variable

Earlier physical maturation in women has been associated with earlier marriage and fertility timing in previous studies (Field and Ambrus, 2008; Gorry, 2012). The use of menarche as an instrument for age of marriage rests on several assumptions.

First, age of menarche needs to be correlated with age of marriage. Accounts of marriage practices among the Luhya and Luo, the two main ethnic groups in our study region, suggest that marriage prior to menarche is extremely uncommon in western Kenya (Clark, Kabiru, and Mathur,

2010). In fact, 99 percent of women in our study area report menarche before marriage. In this regard, timing of menarche still clearly represents a firm lower bound on marriage, and an important influence on the date of entry into the marriage market in our setting.

Figure 2 plots age of marriage as a function of menarcheal age for our sample of women in Busia, Kenya. As can be seen, later menarche is strongly associated with later marriage. This can also be seen in Figure 3, which plots the distribution of age of marriage after dividing the sample into girls who undergo menarche between ages 11 and 14 and girls who undergo menarche between ages 15 and 19.[13] Table 2 presents the results of first stage regressions, which indicate a strong, positive relationship between age of menarche and age at first marriage. Each additional year that menarche is delayed is associated with 0.28 years later marriage, and this relationship is robust to the inclusion of a measure of earlier life health status (Column 2, height-for-age z-score at KLPS Round 1 interview, which we discuss in more detail below).

That said, the context of our results differ from those of Field and Ambrus (2008) because in the case of Bangladesh, girls are frequently subject to arranged marriages and are often married as close as possible to the exact timing of menarche in order to preserve the bride's virginity. The authors find that over 70 percent of first marriages occur within 2 years of menarche. In our sample, 36 percent of women marry within 5 years and 62 percent within 10 years of menarche. Because marriage timing is not tied quite as closely with timing of menarche in our Kenyan sample, we cannot rule out that our findings are a lower bound on the impacts of delayed marriage. In particular, our results should be interpreted as the causal impact of delaying marriage where a greater fraction of our sample is delaying marriage from 15 to 16, or 17 to 18 years of age, as opposed to the

[13] While adolescent marriage is technically restricted in Kenya, the law in place at the time of the onset of puberty in our sample is vague. Section 14 of the Child Act of 2001 states that "No person shall subject a child to female circumcision, early marriage or other cultural rites, customs or traditional practices that are likely to negatively affect the child's life, health, social welfare, dignity or physical or psychological development" (National Council for Law Reporting, 2010).

larger proportions of the sample in Bangladesh moving from 12 to 13 or 13 to 14 years old. If the impacts of a year delay in marriage are even larger for the earliest marriages in our sample, then our estimates will be more conservative – providing what is essentially a lower bound on the true gains to a year of delay in marriage.

A second assumption of this instrumental variables strategy is that the timing of menarche is exogenous, so that common unobservable factors do not influence both the timing of physical maturation and later life outcomes. Researchers have argued that in wealthy nations, variation in the timing of menarche is primarily attributable to genetic differences and not environmental factors (Parent et al., 2003; Gorry, 2012). In low income countries, while economic and environmental factors have been linked to changes in the age of menarche, most of this evidence is correlative in nature. Among the most robust impacts have been seen from extreme malnutrition, including for instance, *in utero* and early life nutrition shocks which lead to stunting in preschool aged children - which has been correlated with significant increases in age at menarche (see for example; A. Ali et al., 2011; Belachew et al., 2011; Simondon et al., 1998).

The general consensus among researchers is that the timing of menarche is quasi-random with shocks to health and nutrition and genetic factors influencing but not entirely determining outcomes. A check on the association between adolescent height (a measure of cumulative health, which we operationalize as the height-for-age z-score measured at KLPS Round 1 data collection) and age of menarche in the KLPS sample suggests that nutrition is not a primary concern in our setting, as the data reveals a weakly positive but not statistically significant coefficient (0.078, s.e. 0.049, not shown). Together, this suggests that menarche can be used as an instrument for age of marriage in this context.

To alleviate any remaining influences of omitted variables correlated with menarche, we proxy for resource availability *in utero* and during early childhood, and ability to smooth shocks to

health and nutrition, by using information on parent education. Furthermore, we follow the practice of Field and Ambrus (2008) and limit the analysis to individuals who report age of menarche within a specified band, owing to the association between environmental factors and chronic medical conditions with very early or very late menarche outcomes. Specifically, we restrict the sample to individuals who report age of menarche between 11 and 19, which encompasses 95 percent of all respondents who are not missing information on age of menarche.[14]

Another key assumption of our analysis is that age of menarche does not affect the outcomes of interest directly, but only through age of marriage. One concern is that menstruation may directly affect school attendance of girls in this region. Anecdotal evidence suggests that women in developing countries commonly lack access to sanitary products or sufficient toilet facilities and thus may have worse school attendance when menstruating. Recent rigorous research provides mixed evidence on this issue. Oster and Thorton (2011), studying Nepal, show that while menstruation does reduce school attendance, the effect is extraordinarily small – on the order of less than one day per year in a 180 day school year. Exploiting a randomized evaluation, they find that improved access to modern sanitary products has no significant impact on girl's school attendance. Alternatively, studying a nationwide school latrine construction program in India, Adukia (2017) finds that girls who have started puberty are more likely to enroll in school when sex-specific facilities are provided to them. Recent systematic reviews on this topic are inconclusive. One review of the evidence on the impacts of education and resource provision interventions for menstrual management on educational outcomes includes little in the way of evidence from randomized trials,

[14] Field and Ambrus (2008) restrict their analysis to those reporting age of menarche between 11 and 16, which they report covers 90 percent of the sample. Recent research has documented variation in the timing of menarche across countries and over time possibly owning to nutrition, stress, climactic and environmental conditions including weather and altitude, and exposure to endocrine disruptors (Parent et al., 2003).

and reports no statistically significant findings related to educational impacts (Hennegan and Montgomery, 2016).[15]

An additional concern is that age of menarche could affect fertility outcomes. We confirm all of our findings using an additional measure, which we call "age at family formation", defined as being the minimum of age at which an individual first becomes pregnant or age at first marriage. As before for age at marriage, later onset of menarche is strongly associated with delays in the age of first family formation and the primary set of findings we obtain from the IV analysis are largely unchanged when using this alternative measure (results not shown).

A final concern is that the information we use on menarcheal age is based on interviewee recollection and thus subject to recall error. Menarche is a significant life event, and most research suggests that recall data on this topic is accurate. Nevertheless, as a check we compare our estimates with those from other research. A number of studies have examined the timing of menarche specifically among African populations, finding that mean age of menarche typically ranges from 12 and 16, with most studies of rural populations documenting mean ages of 14 or 15.[16] In Mumias and Asembo, two small towns in western Kenya located near the primary study area, Leenstra et al. (2005) document median menarcheal age ranging from 14.6 to 15.1. This is consistent with the results from our survey for Busia (approximate mean and median age of 15).

Formally, we undertake a 2SLS regression of the following form:

$$Age\_Marriage_i = \alpha_1 + \varphi(Age\_Menarche)_i + X'_{1i}\delta_1 + \omega_i \qquad (1)$$

[15] Another recent systematic review focusing on the impact of sex-specific facilities finds none that study educational outcomes (Birdthistle et al., 2011).

[16] For a general overview see (Padez, 2003). Recent country specific studies include: Sudan (A. Ali *et al.*, 2011), Nigeria (Adebara and Munir'deen, 2013), Ethiopia (Zegeye, Megabiaw, and Mulu, 2009), Gambia (Prentice *et al.*, 2010), Senegal (Simondon, *et al.,* 1998) and Kenya (Leenstra *et al.,* 2005).

$$Y_i = \alpha_2 + \beta(Age\_\hat{Marriage})_i + X'_{2i}\delta_2 + v_i \quad (2)$$

where *i* indexes individuals. *Age_Marriage* is an individual's age at first marriage, and *Age_Menarche* is age at menarche. $\boldsymbol{X}_i$ represents a vector of individual-level controls, including age at survey, father's education, mother's education, and number of siblings, and a set of KLPS baseline survey grade indicators. These grade indicators serve as cohort fixed effects in our analysis. Since there is a reasonable amount of missing data on parent education (16 percent of the sample is missing information on father education, and 10 percent on mother education), missing parent education data is replaced with mean values, and we include indicators of missing data in the control set. We additionally include indicators for months since KLPS-3 surveying began, as well as indicators for being included in the PSDP sample, for being randomly assigned to treatment in the PSDP or GSP programs, for being included in the VTVP, and for being randomly assigned to receive a VTVP voucher. Standard errors are clustered by KLPS baseline primary school, since the respondents were drawn from a school-based sample. Survey weights are applied to all regressions, in order to ensure that our results are generalizable to individuals who attended primary school in Busia County. For ease of exposition, we present results of linear regressions in what follows – however, results are substantively the same when we use probit models for binary outcomes.

As discussed before, Table 2 presents the first stage estimates obtained from equation (1). Column (1) employs our primary control set, while column (2) additionally includes a measure of adolescent health – height for age using KLPS-1 z-scores.[17] Both strategies reveal a highly significant and positive relationship between the timing of physical maturation and age of marriage. The

[17] Note that only a subset of individuals interviewed in KLPS Round 3 were also interviewed in KLPS Round 1, which accounts for the reduced sample size in Table 2, column 2 as compared to column 1. The height z-score is calculated by standardizing (mean 0, standard deviation 1) within each age among females interviewed in round 1.

coefficient estimates suggest that each additional year of delay in menarche is associated with a delay in age of marriage on the order of 0.28 years.

V. Results

The second stage results from our instrumental variables strategy are presented in Tables 3 through 6.[18] In addition to the conventional presentation of regression coefficients, standard errors, and stars to indicate standard levels of statistical significance, we also account for testing multiple outcomes by presenting the false discovery rate (FDR) adjusted q-values (in square brackets) which limit the expected proportion of rejections within a set of hypotheses that are Type I errors (Benjamini, Krieger, and Yekutieli, 2006; Anderson, 2008).[19]

Table 3 focuses on educational outcomes, with educational attainment outcomes in Panel A and exam outcomes in Panel B. In our rural Kenyan context, girls typically leave school when they get married, and so age of marriage is likely to have a direct impact on educational outcomes. Indeed, results presented in Table 3, Panel A suggest that each additional year of delay in marriage is associated with an increase in educational attainment of 0.78 years (column 1).[20] The remaining columns of Panel A include binary outcome variables, and these coefficients can be interpreted as percentage point increases in the likelihood of completion or attendance respectively. Moving

[18] Appendix Tables A1 through A4 present these same regressions, but also including an earlier life height measure (KLPS-1 height-for-age z-score, available for those in our sample who were also interviewed in KLPS Round 1). This height measure was standardized within our regression sample. The inclusion of this control cuts the sample dramatically, so we elect to present results without the control as the main tables and present those with the control as appendix tables as a robustness check in order to account for a measure of early life health. The regressions controlling for height overwhelming confirm the results presented in the main tables.

[19] FDR adjusted q-values are calculated within each family of outcomes, as defined by the set of outcomes included in a given table.

[20] This result is substantially higher than what was found by Field and Ambrose (2008) in their study of Bangladesh (where each additional year that marriage is delayed increased highest grade attached by 0.24 years). Recall that our sample is one of women who were enrolled in primary school (in grades 2-7) at the baseline of data collection in the late 1990s and early 2000s. It is possible that our findings somewhat larger because we focus on a school-based sample.

across the columns of the table, we can see that each year of delayed marriage is associated with a higher probability of completing primary school (column 2; 18.4 percentage points), attending secondary school (9.7 percentage points), completing secondary school (6.4 percentage points), and attending college (6.4 percentage points). All of these results are statistically significant at high levels of confidence, even after adjusting for multiple inference.[21]

Panel B explores indicators of academic performance, to explore whether these increases in attainment are associated with any learning outcomes. Columns 1 and 2 study impacts on reading and math tests that were administered to KLPS respondents at the time of survey interview.[22] The reading test is an English language exam including numerous "silly sentences"; the subject is requested to indicate which sentences are true (make sense) and which are false ("silly"). This tests vocabulary and reading comprehension. The math exam tests addition, subtraction, multiplication, and division, as well as more advance problems including addition and subtraction of fractions. Importantly, we see gains in both sets of test scores as a result of delayed marriage; each year of delayed marriage is associated with a 0.16 standard deviations gain in reading test scores (column 1), and a 0.18 standard deviations gain in math test scores (column 2), a highly significant finding that is robust to FDR adjustment (though only the math test score gain in statistically significant when we additionally control for KLPS-1 height z-score in Appendix Table A1).

Next, we study two key examinations in the Kenyan educational system - the Kenyan Certificate of Primary Education (KCPE) and Kenyan Certificate of Secondary Education (KCSE). Both exams are administered by the Ministry of Education, Science, and Technology, and results are

[21] All of these results except for attending college or university are robust to additionally controlling for KLPS-1 height-for-age z-score. Results are similar when we estimate ivprobit regressions in lieu of linear ones.
[22] For this analysis, scores are standardized within the sample of focus for this analysis.

used for admission into secondary school or to college and university level education, respectively.[23] Panel B, columns (3) and (5) examine the probability that girls sit for the KCPE and KCSE. Here we observe strong effects of delayed marriage the probability of sitting for each exam. For example, the estimates in column (3) suggest that each additional year in age at first marriage is associated with a 18.8 percentage point increase in the likelihood of taking the KCPE test. The KCSE results are slightly smaller, but consistent with those for the primary school exams - delayed marriage and fertility yield improved educational outcomes for these women.[24] That said, there is limited evidence that females with delayed marriage are actually more likely to pass the secondary school entrance exam. Yet, these educational findings are consistent with those of Field and Ambrus (2008) who document that delayed marriage is associated with increased educational attainment and higher literacy rates for women.

Tables 4, 5, and 6 extend this analysis of the impacts of early marriage beyond educational outcomes; in particular, we focus on outcomes which we believe could be impacted through a household bargaining mechanism. Table 4 focuses on marriage market outcomes, Table 5 focuses on own health and nutrition, fertility and sexual and reproductive health, and child health. Table 6 focuses on female attitudes toward gender roles and towards children.

The results presented in Table 4 suggest that, surprisingly, delayed marriage does not have much of an effect across a range of marriage market outcomes. We find no (or only very weak) statistically significant evidence that delayed marriage affects whether the women lives with her husband's family, the difference in age between herself and her spouse, the difference in education level between herself and her spouse, whether she felt ready to marry at the time of marriage,

[23] See Ozier (2018) for a comprehensive discussion of the KCPE and KCSE.
[24] Both entrance exam results are also robust to additionally controlling for KLPS-1 height-for-age z-score, using the sample of individuals who were interviewed in both rounds.

whether she received a brideprice or the amount of that brideprice, whether her marriage was informal (i.e., not performed by a government, religious, or traditional officiant), or whether she was part of a polygamous relationship.

Table 5 focuses on own health, sexual and reproductive health, and child health outcomes. Panel A examine impacts on health and nutrition outcomes of the adult female. Although we do not detect any improvement in objective measures of current health (hemoglobin level or body weight), results suggest substantial improvements in an indicator of (very) good self-reported health and an index of symptoms and diseases reported in the four weeks preceding the interview (including a wide range of symptoms and illnesses, from fever, persistent cough, and lethargy, to yellow fever, cholera and diabetes).[25]

Although results presented in panel B do suggest a substantial decrease in fertility (likely a mechanical delay, since many women in this context do not get pregnant until after they are married), there is only weak evidence that delayed marriage reduces desired fertility, and no evidence to suggest that delayed marriage is associated with better child health outcomes (columns 3 and 4).

Table 6 explores the impacts of delayed marriage on female attitudes toward gender and children, and once again finds limited evidence of an effect. Surprisingly, there is no detected relationship between delayed marriage and progressive gender attitudes, including questions such as whether women should have equal rights with men, physical violence is never justified, and men should help out around the house if their wives work. If anything, most point estimates seem to move in a direction of less progressive attitudes as a result of delayed marriage, and results in Panel A, column (4) suggest weak evidence that women who marry later think that family decisions should be made by men. The findings in Panel B studying attitudes related to education and children

[25] The results for self-reported symptoms and illnesses are robust to additionally controlling for KLPS-1 height-for-age z-score, using the sample of individuals who were interviewed in both rounds.

suggest slightly more progressive attitudes, but once again these are generally not statistically significant.

Together across Tables 3 through 6, our results suggest that later marriage causally increases female educational attainment and improves some dimensions of academic test scores as well as yields gains in self-reported health. Surprisingly, we find little evidence of an impact of delayed marriage across a range of other outcomes related to female bargaining power in the household in our rural Kenyan setting.

As a caveat for the interpretation of these findings, it is worth highlighting that our sample is selected in two ways as discussed in Section II. First, at the time of data collection, 30 percent of female KLPS-3 respondents were not yet married. These individuals have different characteristics along many dimensions and the estimated impact of age of marriage, if they do choose to marry, may be different for this group of individuals. Second, our sample is based on individuals who attended primary school at least through grade 2. It is possible that, the poorest of the poor in the region may have already dropped out of school prior to the study, and this group may have had some of the earliest marriages and different marital outcomes. The results we identify thus represent the impact of age of marriage among the population studied, and are not perfectly representative of the entire population in the region.

VI. Conclusion

Our analysis makes several contributions to the literature on early marriage in low-income countries. First, this paper serves as a demonstration of external validity for the findings of Field and Ambrus (2008), extended to a country in East Africa also characterized by adolescent marriage. Specifically, our findings suggest that the results for the Bangladeshi case, where early adolescent

marriage is more prevalent, extend to Kenya, a region characterized by marriage later in adolescence on average and by a different set of ethnic and religious customs.

However, our work is also novel in that it extends the literature in multiple ways. We focus on a wider range of outcomes – outcomes which may be impacted by marriage timing through a bargaining power mechanism – in particular to understand whether the improvements in educational outcomes as a result of delayed marriage are accompanied by other improvements in the status of young females. We show that delayed marriage not only increases educational attainment and academic test scores, but it also appears to improve self-reported health outcomes. At the same time, we find no clear relationship between age at first marriage and a wide range of other adult outcomes related to bargaining power within the household, such as marriage market outcomes, child health, and attitudes toward gender roles and children.

These results are informative for policy. In the case of Kenya, legal changes are already occurring which could reduce the prevalence of early marriage. The government recently enacted a law of banning marriage for those under age 18 (National Council for Law Reporting, 2014), although enforcement is questionable as many marriages in Kenya—like much of the developing world—are informal (UNICEF, 2005). Our results suggest that policies and social changes which successfully restrict adolescent marriage and incentivize later marriage for women could yield improvements in these educational and health outcomes, but they are not likely to prove a panacea for closing the gender gap more broadly. To the extent that the gains for delaying marriage at later stages of adolescence is smaller than for earlier stages, the results we present for Kenya may reflect a lower bound on the potential gains in other settings with very early marriage.

Finally, the results of this study suggest that existing trends in which age of marriage is increasing in many parts of the developing world are likely to reinforce progress towards closing the gender gap in education, which may spark a virtuous cycle. Our analysis suggests that even in

societies where arranged marriage is uncommon and age of marriage is not extremely low in a comparative sense, there may still be gains from a reduction in adolescent marriage.

References

Ali, A.A.A., D.A. Rayis, M. Mamoun, and I. Adam (2011). "Age at menarche and menstrual cycle pattern among schoolgirls in Kassala in eastern Sudan." *Journal of Public Health and Epidemiology,* 3(3): 111-114.

Adebara, I.O., and M.A. Ijaiya (2013). "Relationship of Biosocial Factors and Hemoglobin Genotype with Age of Menarche among School Girls in Ilorin, Nigeria." *Nepal Journal of Obstetrics and Gynaecology,* 7(1): 19-24.

Adukia, A. (2017). "Sanitation and Education." *American Economic Journal: Applied Economics* 9(2): 23-59. DOI: 10.1257/app.20150083.

Anderson, M.L. (2008). "Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedaian, Perry Preschool, and Early Training Projects." *Journal of the American Statistical Association,* 103: 1481-1495.

Asadullah, M.N. and Z. Wahhaj. (2018). "Early Marriage, Social Networks and the Transmission of Norms." *Economica.* doi:10.1111/ecca.12291

Baird, S., J.H. Hicks, and E. Miguel (2008). "Tracking, Attrition and Data Quality in the Kenyan Life Panel Survey Round 1 (KLPS-1)," *Working Paper C08-151, Center for International and Development Economics Research*, University of California at Berkeley.

Baum, C.F., M.E. Schaffer, and S. Stillman. (2007). "Enhanced routines for instrumental variables/GMM estimation and testing." *Boston College Economics Working Paper No.* 667.

Belachew, T., C. Hadley, D. Lindstrom, Y. Getachew, L. Duchateau, and P. Kolsteren (2011). "Food insecurity and age at menarche among adolescent girls in Jimma Zone Southwest Ethiopia: a longitudinal study." *Reproductive Biology and Endocrinology* 9(1): 125-132.

Benjamini, Y., A. Krieger, and D. Yekutieli (2006). "Adaptive Linear Step-Up Procedures That Control the False Discovery Rate." *Biometrika* 93: 491-507.

Birdthistle, I., K. Dickson, M. Freeman, and L. Javidi (2011). "What impact does the provision of separate toilets for girls at schools have on their primary and secondary school enrolment, attendance, and completion? A systematic review of the evidence." London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Central Bureau of Statistics (2004). "Kenya, Ministry of Health (MOH), and ORC Macro." *Kenya Demographic and Health Survey*, 2003. Calverton, MD: CBS, MOH, and ORC Macro.

Chari, A.V., R. Heath, A. Maertens, and F. Fatima. (2017). "The causal effect of maternal age at marriage on child wellbeing: Evidence from India." *Journal of Development Economics*, 127:42-55.

Chari, A.V., A. Maertens, and S. Srinivasan (2016). "Male Earnings Inequality and Female Marital Outcomes: Evidence from India." In: *Development, Institutions and Markets*. Oxford University Press.

Clark, S., C. Kabiru, and R. Mathur (2010). "Relationship Transitions among Youth in Urban Kenya" *Journal of Marriage and Family*, 72:73-88.

Delprato, M., K. Akyeampong, and M. dunne. (2017). "Intergenerational Education Effects of Early Marriage in Sub-Saharan Africa". *World Development* 91: 173-192.

Field, E., and A. Ambrus. (2008). "Early marriage, age of menarche, and female schooling attainment in Bangladesh." *Journal of Political Economy,* 116(5): 881-930.

Gorry, D.H. (2012). "The Effect of Menarche on Education: Explaining Black-White Differences." Unpublished Manuscript, Utah State University.

Glazerman, S., D. Levy, and D. Myers. (2002). "Nonexperimental Replications of Social Experiments: A Systematic Review." Mathematica Policy Research, Inc. Discussion Paper #8813-300.

Hennegan, J. and P. Montgomery (2016). "Do Menstrual Hygiene Management Interventions Improve Education and Psychosocial Outcomes for Women and Girls in Low and Middle Income Countries? A Systematic Review." *PLOS ONE* 11(2): e0146985. doi:10.1371/journal.pone.0146985.

Hicks, J.H., M. Kremer, I. Mbiti, and E. Miguel (2015). "Vocational Education in Kenya – A Randomized Evaluation." Unpublished Manuscript, University of California, Berkeley's Center for Effective Global Action.

ICF (2015). *The DHS Program STATcompiler.* Funded by USAID. http://www.statcompiler.com. Accessed May 30 2019.

Jensen, R., and R. Thornton (2003). "Early Female Marriage in the Developing World." In *Gender, Development and Marriage*, edited by Caroline Sweetman. Oxford: Oxfam GB.

Kidman, R. (2016). "Child marriage and intimate partner violence: a comparative study of 34 countries," *International Journal of Epidemiology,* 46(2): 662-675.

Kremer, M., E. Miguel, and R. Thornton (2009). "Incentives to Learn" *Review of Economics and Statistics*, 91(3): 437-456.

Leenstra, T., L.T. Petersen, S.K. Kariuki, A.J. Oloo, P.A. Kager, F.O. Ter Kuile. (2005) "Prevalence and severity of malnutrition and age at menarche; crosssectional studies in adolescent schoolgirls in western Kenya." *European Journal of Clinical Nutrition*, 59: 41-48.

Mensch, B.S., M.J. Grant, and A.K. Blanc. (2006). "The Changing Context of Sexual Initiation in sub-Saharan Africa." *Population and Development Review* 32(4): 699-727.

Miguel, E. and M. Kremer (2004). "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities." *Econometrica*, 72(1): 159-217.

Miguel, E., and Kremer, M. (2014). "Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities, Guide to Replication of Miguel and Kremer (2004)," *Center for Effective Global Action Working Paper Series* 39.

National Council for Law Reporting (2010). The Children Act (2001). Laws of Kenya: Chapter 141: The Children Act. [Act No. 8 of 2001, L.N. 23/2002, Act No. 8 of 2010, Act No. 12 of 2012.] Revised Edition 2010 (2007).

National Council for Law Reporting (2014). The Marriage Act (2014). The Marriage Act. *Kenya Gazette Supplement, Acts* 2014

Oster, E., and R. Thornton (2011). "Menstruation, sanitary products, and school attendance: Evidence from a randomized evaluation." *American Economic Journal: Applied Economics* 3(1): 91-100.

Ozier, O. (2018). "The impact of secondary schooling in Kenya: a regression discontinuity analysis" *Journal of Human Resources*, 53(1): 157-188.

Padez, C. (2003). "Age at Menarche of Schoolgirls in Maputo, Mozambique," *Annals of Human Biology,* 30: 487–495.

Parent, A. S., G. Teilmann, A. Juul, N. E. Skakkebaek, J. Toppari, and J. P. Bourguignon (2003). "The Timing of Normal Puberty and the Age Limits of Sexual Precocity Variations Around the World, Secular Trends and Changes After Migration," *Endocrine Reviews*, 24(5): 668–693.

Prentice, S., A.J. Fulford, M.A.J. Landing, G.R. Goldberg, and A. Prentice (2010). "Evidence for a downward secular trend in age of menarche in a rural Gambian population." *Annals of human biology* 37(5): 717-721.

Sekhri, S. and S. Debnath. (2014). "Intergenerational Consequwences of Early Age Marriages of Girls: Effect on Children's Human Capital." *The Journal of Development Studies* 50(12): 1670-1686.

Simondon, K. B., F. Simondon, I. Simon, A. Diallo, E. Benefice, P. Traissac, P. and B. Maire. (1998). "Preschool stunting, age at menarche and adolescent height: a longitudinal study in rural Senegal." *European Journal of Clinical Nutrition* 52: 412–418.

Stock, J. H., and M. Yogo. (2005). "Testing for Weak Instruments in Linear IV Regression." In *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, ed. D.W. Andrews and J. H. Stock, 80–108. Cambridge University Press.

Sunder, N. (2018). "Marriage Age, Social Status and Intergenerational Effects in Uganda." Unpublished working paper.

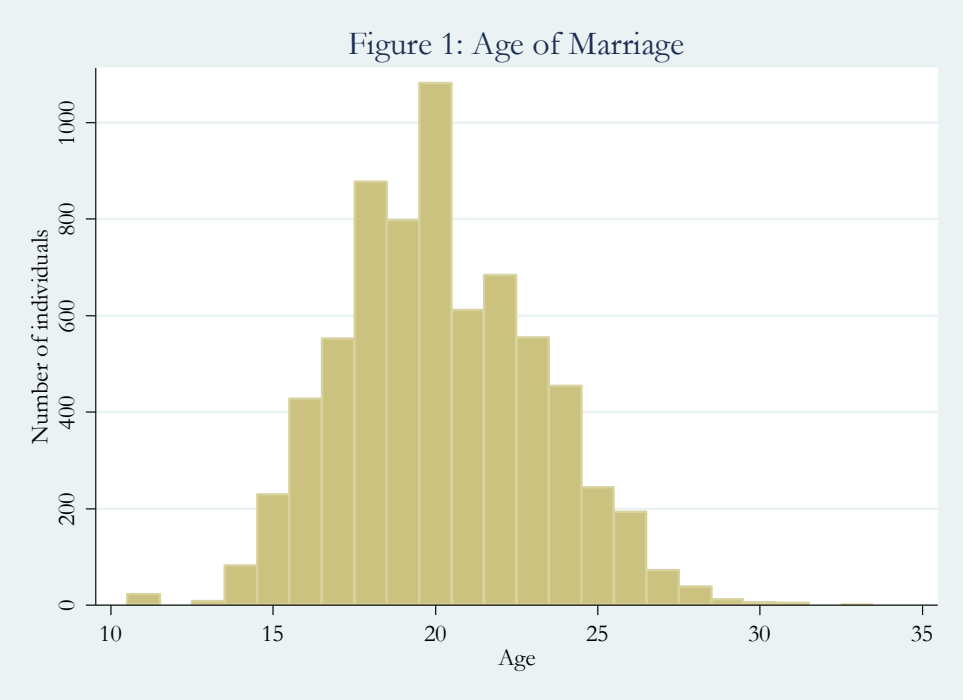
United Nations Children's Fund (UNICEF) (2005). "Early Marriage: A harmful traditional practice, A statistical exploration". UNICEF: New York.

United Nations Population Fund (UNFPA) (2012). "Marrying Too Young: End Child Marriage." New York: United Nations Population Fund.

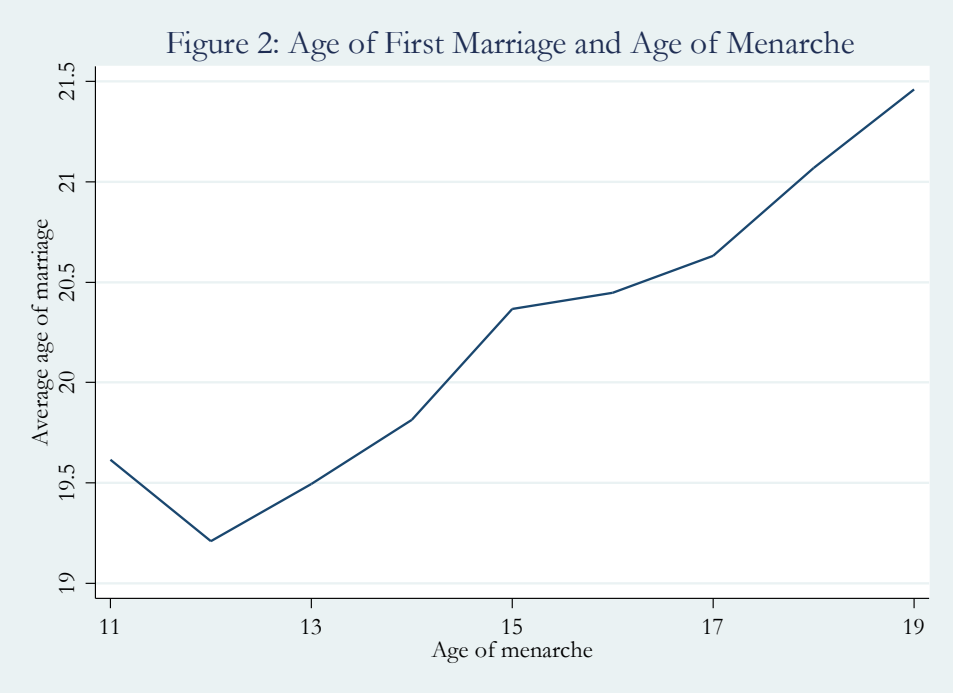
Westoff, C.F. (2003). "Trends in marriage and early childbearing in developing countries." DHS Comparative Reports No. 5, Calverton, Maryland: ORC Macro.

Yount, K.M., A.A. Crandall, Y.F. Cheong. (2018). "Women's Age at First Marriage and Long-Term Economic Empowerment in Egypt" *World Development*. 102: 124-134.

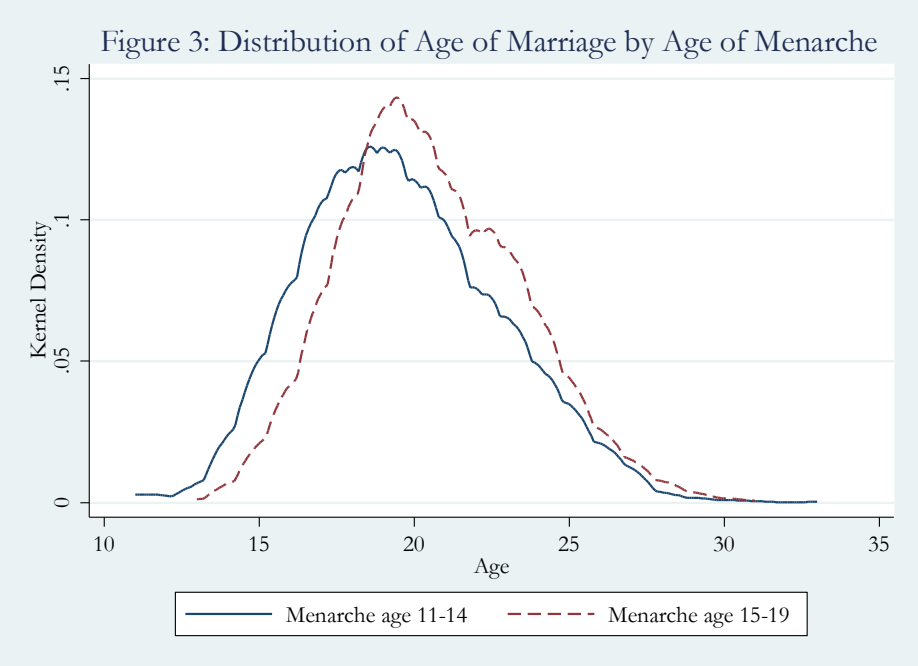
Zegeye, D.T., B. Megabiaw, and A. Mulu. (2009). "Age at menarche and the menstrual pattern of secondary school adolescents in northwest Ethiopia." *BMC women's health* 9(1): 29.



Notes: The sample used in this figure includes all females surveyed in KLPS Round 3 who have information on age of first marriage.



Notes: The sample used in this figure includes all females survyeed in KLPS Round 3 who experienced menarche between the ages of 11 and 19, and have information on age of first marriage.



Notes: The sample used in this figure includes all females survyeed in KLPS Round 3 who experienced menarche between the ages of 11 and 19, and have information on age of first marriage.

Table 1: Summary Statistics

	Obs	Mean	Std Dev
Individual Characteristics			
Age of menarche (years)	2,686	14.75	(1.83)
Height at KLPS-1 survey (cm)[1]	1,878	161.09	(6.77)
Indicator for part of PSDP sample	2,686	0.76	(0.43)
Indicator for part of PSDP treatment group	2,686	0.51	(0.50)
Indicator for part of GSP treatment group	2,686	0.12	(0.32)
Indicator for part of Vocational Training sample	2,686	0.25	(0.43)
Indicator for part of Vocational Training Voucher treatment group	2,686	0.12	(0.32)
Primary school grade (cohort) in 1998	2,686	3.98	(1.70)
Age at KLPS-3 survey (years)	2,686	26.64	(2.50)
Household Characteristics			
Father's education (years)[2]	2,307	7.81	(3.93)
Indicator for father's education missing	2,686	0.16	(0.37)
Mother's education (years)[2]	2,449	5.59	(3.61)
Indicator for mother's education missing	2,686	0.10	(0.30)
Number of siblings	2,686	5.57	(2.88)
Marriage and Fertility Outcomes			
Age of first marriage, among those who have been married (years)	2,686	20.12	(3.02)
Indicator for ever pregnant	2,686	0.98	(0.15)
Age of first pregnancy, among those who have been pregnant (years)	2,686	19.88	(2.71)

Notes: The sample described here includes all females surveyed in KLPS Round 3 who experienced menarche between the ages of 11 and 19, have information on age of first marriage, and have non-missing information on regression controls (described in the main text as well as the notes below Table 2). [1]Height at KLPS-1 survey was only measured among those also interviewed during KLPS Round 1, and hence the sample size is smaller. [2]The sample size on parent education measures is slightly smaller due to missing data.

Table 2: Age of Menarche as an Instrument

	Age at first marriage	
	(1)	(2)
Age of menarche	0.280***	0.291***
	(0.048)	(0.046)
Years of schooling completed by father	0.052*	0.062**
	(0.027)	(0.031)
Years of schooling completed by mother	0.033	0.020
	(0.025)	(0.027)
Number of siblings	0.011	0.027
	(0.027)	(0.030)
Height for age z-score, KLPS-1		0.015
		(0.088)
Number of Observations	2,686	1,862
R2	0.083	0.087

Notes: The sample presented here includes all females surveyed in KLPS Round 3 who experienced menarche between the ages of 11 and 19, who have information on age at first marriage, and for whom information on all regression controls exists. Covariates not shown include indicators for participation in the PSDP and VTVP; indicators for assigment to the treatment group for the PSDP, GSP, and VTVP; indicators for primary school grade at KLPS baseline in 1998 (cohort indicators); age at KLPS-3 survey; indicators for missing information on father and mother education; and indicators for number of months since KLPS-3 data collection began. Missing information on parent education is replaced with mean values. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by baseline primary school, are in parenthesis. *** P-value<0.01, ** P-value<0.05, * P-value<0.1.

Table 3: IV Regressions for Education Outcomes

Panel A: Attainment	Years of education attained[1]	Indic for completed primary	Indic for attended secondary	Indic for completed secondary	Indic for attended college or university
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	0.778***	0.184***	0.097***	0.064***	0.023*
	(0.138)	(0.035)	(0.020)	(0.016)	(0.013)
	[0.001]	[0.001]	[0.001]	[0.001]	[0.016]
Number of observations	2,657	2,657	2,657	2,657	2,657
Kleibergen-Paap F-Statistic^	33.5[§]	33.5[§]	33.5[§]	33.5[§]	33.5[§]
Mean (std dev) of depvar	8.216	0.599	0.263	0.147	0.065
	(2.365)	(0.490)	(0.440)	(0.354)	(0.247)

Panel B: Exam Outcomes	Reading test score (standardized)[2]	Math test score (standardized)[2]	Indic for took secondary school entrance exam	Indic for passed secondary school entrance exam[3]	Indic for took post-secondary entrance exam
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	0.158**	0.343***	0.188***	0.144	0.057***
	(0.062)	(0.075)	(0.031)	(0.121)	(0.017)
	[0.005]	[0.001]	[0.001]	[0.050]	[0.001]
Number of observations	2,508	2,536	2,686	1,599	2,686
Kleibergen-Paap F-Statistic^	27.8[§]	27.7[§]	33.2[§]	3.6	33.2[§]
Mean (std dev) of depvar	-0.062	-0.095	0.545	0.635	0.141
	(1.008)	(1.006)	(0.498)	(0.482)	(0.348)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use [§] to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Years of education measures only academic education, and thus does not include vocational training. [2]Reading and math test scores are standardized within the regression sample, and are only available among those who agreed to take the test during the KLPS3 survey interview. [3]Passed secondary school entrance exam is measured only among those who took the exam, which accounts for the smaller sample size.

Table 4: IV Regressions for Marital Outcomes

Panel A	Indic for patrilocal exogamy	Age of spouse at marriage	Own age at marriage - spouse age at marriage	Education level of spouse (years)	Own yrs education - spouse yrs education
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	-0.005	0.470	0.530*	0.081	-0.081
	(0.012)	(0.298)	(0.298)	(0.273)	(0.273)
	[1.000]	[0.608]	[0.608]	[1.000]	[1.000]
Number of observations	2,664	2,606	2,606	2,612	2,612
Kleibergen-Paap F-Statistic^	32.9§	29.3§	29.3§	13.8	13.8
Mean (std dev) of depvar	0.058	25.21	-5.07	8.88	-0.66
	(0.234)	(5.33)	(4.99)	(3.35)	(3.03)

Panel B	Indic for felt ready to marry at marriage	Indic for brideprice was paid	Value of brideprice (Ksh)[1]	Indic for marriage is informal	Indic for has a cowife
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	0.025	-0.041*	209.983	0.025	-0.009
	(0.024)	(0.021)	(2,186.070)	(0.026)	(0.022)
	[0.857]	[0.608]	[1.000]	[0.857]	[1.000]
Number of observations	2,681	2,684	585	2,686	2,660
Kleibergen-Paap F-Statistic^	33.2§	33.3§	12.3	33.2§	34.6§
Mean (std dev) of depvar	0.351	0.240	32,053	0.623	0.222
	(0.477)	(0.427)	(24,173)	(0.485)	(0.416)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel, all of which relate to first marriage. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. The regressions for education level of spouse and "Own yrs education - spouse yrs education" additionally control for own education. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use § to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Brideprice is measured only among those who receieved a brideprice, which accounts for the smaller sample size.

Table 5: IV Regressions for Health and Fertility Outcomes

Panel A: Own Health	Indic for self-reported health (very) good	Hemoglobin Level	Body weight	Fraction of 22 symptoms and illness reported[1]	Number of meals eaten yesterday
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	0.049**	-0.069	-0.022	-0.022***	0.031
	(0.020)	(0.137)	(0.434)	(0.006)	(0.041)
	[0.025]	[0.448]	[0.623]	[0.001]	[0.350]
Number of observations	2,686	2,495	2,588	2,686	2,686
Kleibergen-Paap F-Statistic^	33.2§	26.0§	31.6§	33.2§	33.2§
Mean (std dev) of dependent variable	0.64	12.10	59.81	0.135	2.30
	(0.48)	(1.94)	(9.16)	(0.109)	(0.69)

Panel B: Fertility and Child Health	Number of pregnancies	Number of children born alive	Indic for 1st child had health symptom in past 7 days[2]	Indic for 1st child has good health (self-report)	Total number of children desired[3]
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	-0.338***	-0.332***	-0.044	-0.004	-0.224*
	(0.055)	(0.053)	(0.029)	(0.021)	(0.121)
	[0.001]	[0.001]	[0.149]	[0.623]	[0.085]
Number of observations	2,686	2,686	2,526	2,536	2,638
Kleibergen-Paap F-Statistic^	33.2§	33.2§	33.6§	34.0§	36.1§
Mean (std dev) of dependent variable	2.672	2.476	0.653	0.758	3.50
	(1.303)	(1.269)	(0.476)	(0.429)	(1.88)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use § to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Symptoms and illnesses included in the index are: fever, persistent cough, always feeling tired, stomach pain, worms, blood in stool, rapid weight loss, frequent diarrhea, skin rash/irritation, open sores/boils, difficulty swallowing, serious wound or injury, malaria, typhoid, tuberculosis, sores or ulcers on the genitals, cholera, yellow fever, asthma / breathlessness at night, frequest and excessive urination, constant thirst / increased drinking of fluids, and diabetes. [2]Symptoms included in this indicator are: fever/malaria, vomiting, cough, and diarrhea. [3]Responses of "as many as possible" were replaced with the max value among other responses.

Table 6: IV Regressions for Attitudes Toward Gender and Children

Panel A: Attitidues Toward Gender	Indic for agree that women should have equal rights[1]	Indic for agree that no one should use physical violence[2]	Indic for agree that husband should do chores if wife works[3]	Indic for agree that family decisions should be made by men[4]	Indic for agree that women can be mechanics[5]
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	-0.012	-0.002	0.012	0.050**	0.010
	(0.013)	(0.023)	(0.021)	(0.022)	(0.020)
	[1.000]	[1.000]	[1.000]	[0.131]	[1.000]
Number of observations	3,148	2,686	2,686	2,685	2,686
Kleibergen-Paap F-Statistic^	97.2[§]	33.2[§]	33.2[§]	33.3[§]	33.2[§]
Mean (std dev) of dependent variable	0.904	0.815	0.775	0.266	0.784
	(0.294)	(0.388)	(0.418)	(0.442)	(0.411)

Panel B: Attitudes Toward Children, Decisionmaking Power	Index of decisionmaking related to children[6]	Indic for agree that education helps oneself to earn money	Indic for would allow daughter to marry before finishing primary school	Indic for would refuse if child offered job while in primary school	Highest level of education desired for children[7]
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	-0.020	0.013	-0.001	0.091***	0.093
	(0.041)	(0.015)	(0.009)	(0.027)	(0.069)
	[1.000]	[1.000]	[1.000]	[0.007]	[0.889]
Number of observations	2,513	2,686	2,686	2,686	2,685
Kleibergen-Paap F-Statistic^	34.1[§]	33.2[§]	27.0[§]	33.2[§]	33.0[§]
Mean (std dev) of dependent variable	1.641	0.932	0.043	0.568	5.524
	(0.748)	(0.252)	(0.202)	(0.495)	(0.878)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use [§] to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Indicator for agrees (very strongly) with "in our country, women should have equal rights and receive the same treatment as men do" rather than "women have always been subject to traditional laws and customs, and should remain so". [2]Indicator for agrees (very strongly) with "no one has the right to use physical violence against anyone else" rather than "a married man has the right to beat his wife if she misbehaves". [3]Indicator for (strongly) agrees with "if the wife is working outside the home, then the husband should help her with household chores". [4]Indicator for (strongly) agrees with "the important devisions in the family should be made by the men of the family". [5]Indicator for (strongly) agrees with "it is okay for a woman to be a mechanic". [6]Index is constructed as the sum of decisionmaking power for 3 individual items, where 1=total power, 0.5=power shared with someone else, and 0=no power. The items are what do to if a child falls sick, how children should be disciplined, and whether to have another child. [7]Scale ranges from 1-7, and includes some primary, complete primary, some secondary, complete secondary, college, university, and a degree higher than university.

Table A1: IV Regressions for Education Outcomes, with KLPS-1 Height Control

Panel A: Attainment	Years of education attained[1]	Indic for completed primary	Indic for attended secondary	Indic for completed secondary	Indic for attended college or university
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	0.513***	0.138***	0.075***	0.042***	0.002
	(0.113)	(0.031)	(0.023)	(0.015)	(0.010)
	[0.001]	[0.001]	[0.002]	[0.004]	[0.212]
Number of observations	1,861	1,861	1,861	1,861	1,861
Kleibergen-Paap F-Statistic^	38.7§	38.7§	38.7§	38.7§	38.7§
Mean (std dev) of dependent variable	8.427	0.643	0.291	0.170	0.069
	(2.357)	(0.479)	(0.454)	(0.376)	(0.253)

Panel B: Exam Outcomes	Reading test score (standardized)[2]	Math test score (standardized)[2]	Indic for took secondary school entrance exam	Indic for passed secondary school entrance exam[3]	Indic for took post-secondary entrance exam
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	(0.017)	0.223***	0.144***	0.100	0.036**
	(0.053)	(0.063)	(0.026)	(0.066)	(0.015)
	[0.201]	[0.001]	[0.001]	[0.051]	[0.009]
Number of observations	1,750	1,766	1,862	1,186	1,862
Kleibergen-Paap F-Statistic^	31.8§	34.0§	38.5§	9.6	38.5§
Mean (std dev) of dependent variable	0.001	-0.009	0.591	0.675	0.161
	(0.998)	(1.003)	(0.492)	(0.468)	(0.368)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. Regressions also control for KLPS Round 1 height z-score. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use § to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Years of education measures only academic education, and thus does not include vocational training. [2]Reading and math test scores are standardized within the regression sample, and are only available among those who agreed to take the test during the KLPS3 survey interview. [3]Passed secondary school entrance exam is measured only among those who took the exam, which accounts for the smaller sample size.

Table A2: IV Regressions for Marital Outcomes, with KLPS-1 Height Control

Panel A	Indic for patrilocal exogamy	Age of spouse at marriage	Own age at marriage - spouse age at marriage	Education level of spouse (years)	Own yrs education - spouse yrs education
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	0.008	0.375	0.625***	-0.071	0.071
	(0.014)	(0.238)	(0.238)	(0.264)	(0.264)
	[0.551]	[0.423]	[0.096]	[0.630]	[0.630]
Number of observations	1,848	1,813	1,813	1,829	1,829
Kleibergen-Paap F-Statistic^	38.4§	36.0§	36.0§	21.8	21.8
Mean (std dev) of dependent variable	0.061	25.18	-4.89	9.11	-0.68
	(0.239)	(5.05)	(4.70)	(3.29)	(3.01)

Panel B	Indic for felt ready to marry at marriage	Indic for brideprice was paid	Value of brideprice (Ksh)[1]	Indic for marriage is informal	Indic for has a cowife
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	0.032	-0.035	-2,470	0.039	-0.029
	(0.027)	0.022	2,698	(0.027)	(0.021)
	[0.493]	[0.423]	[0.493]	[0.423]	[0.423]
Number of observations	1,857	1,861	394	1,862	1,843
Kleibergen-Paap F-Statistic^	38.0§	38.6§	12.6	38.5§	41.0§
Mean (std dev) of dependent variable	0.360	0.229	33,226	0.624	0.218
	(0.480)	(0.420)	(24,385)	(0.485)	(0.413)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel, all of which relate to first marriage. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. Regressions also control for KLPS Round 1 height z-score. Regressions for education level of spouse and "Own yrs education - spouse yrs education" additionally control for own education. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use § to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Brideprice is measured only among those who receieved a brideprice, which accounts for the smaller sample size.

Table A3: IV Regressions for Fertility and Health Outcomes, with KLPS-1 Height Control

Panel A: Own Health	Indic for self-reported health (very) good	Hemoglobin Level	Body weight	Fraction of 22 symptoms of illness reported[1]	Number of meals eaten yesterday
	(1)	(2)	(3)	(4)	(5)
Age at Marriage or Family Formation	0.005	-0.219	0.064	-0.016**	0.017
	(0.027)	(0.154)	(0.565)	(0.007)	(0.049)
	[0.376]	[0.180]	[0.376]	[0.059]	[0.372]
Number of observations	1,862	1,734	1,794	1,862	1,862
Kleibergen-Paap F-Statistic^	38.5§	32.9§	33.7§	38.5§	38.5§
Mean (std dev) of dependent variable	0.66	12.04	59.76	0.133	2.28
	(0.47)	(1.95)	(9.13)	(0.105)	(0.67)

Panel B: Fertility and Child Health	Number of pregnancies	Number of children born alive	Indic for 1st child had health symptom in past 7 days[2]	Indic for 1st child has good health (self-report)	Total number of children desired[3]
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	-0.351***	-0.348***	-0.052*	-0.034	-0.295*
	(0.055)	(0.059)	(0.031)	(0.025)	(0.157)
	[0.001]	[0.001]	[0.161]	[0.180]	[0.118]
Number of observations	1,862	1,862	1,736	1,743	1,831
Kleibergen-Paap F-Statistic^	38.5§	38.5§	39.3§	40.7§	42.4§
Mean (std dev) of dependent variable	2.61	2.40	0.676	0.756	3.52
	(1.32)	(1.27)	(0.468)	(0.430)	(2.08)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. Regressions also control for KLPS Round 1 height z-score. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use § to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Symptoms and illnesses included in the index are: fever, persistent cough, always feeling tired, stomach pain, worms, blood in stool, rapid weight loss, frequent diarrhea, skin rash/irritation, open sores/boils, difficulty swallowing, serious wound or injury, malaria, typhoid, tuberculosis, sores or ulcers on the genitals, cholera, yellow fever, asthma / breathlessness at night, frequest and excessive urination, constant thirst / increased drinking of fluids, and diabetes. [2]Symptoms included in this indicator are: fever/malaria, vomiting, cough, and diarrhea. [3]Responses of "as many as possible" were replaced with the max value among other responses.

Table A4: IV Regressions for Attitudes Toward Gender and Children, with KLPS-1 Height Control

Panel A: Attitidues Toward Gender	Indic for agree that women should have equal rights[1]	Indic for agree that no one should use physical violence[2]	Indic for agree that husband should do chores if wife works[3]	Indic for agree that family decisions should be made by men[4]	Indic for agree that women can be mechanics[5]
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	-0.008	-0.032	-0.006	0.022	-0.001
	(0.017)	(0.026)	(0.021)	(0.024)	(0.022)
	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
Number of observations	1,862	1,862	1,862	1,861	1,862
Kleibergen-Paap F-Statistic^	38.5§	38.5§	38.5§	38.8§	38.5§
Mean (std dev) of dependent variable	0.898	0.817	0.781	0.267	0.805
	(0.303)	(0.387)	(0.414)	(0.443)	(0.396)

Panel B: Attitudes Toward Children, Decisionmaking Power	Index of decisionmaking related to children[6]	Indic for agree that education helps oneself to earn money	Indic for would allow daughter to marry before finishing primary school	Indic for would refuse if child offered job while in primary school	Highest level of education desired for children[7]
	(1)	(2)	(3)	(4)	(5)
Age at Marriage	-0.033	-0.015	-0.001	0.071**	0.054
	(0.045)	(0.020)	(0.008)	(0.029)	(0.069)
	[1.000]	[1.000]	[1.000]	[0.176]	[1.000]
Number of observations	1,729	1,862	1,862	1,862	1,861
Kleibergen-Paap F-Statistic^	38.7§	38.5§	38.5§	38.5§	39.1§
Mean (std dev) of dependent variable	1.627	0.941	0.038	0.599	5.527
	(0.741)	(0.236)	(0.191)	(0.490)	(0.869)

Notes: Regression results presented are from the second stage of 2SLS regressions, where the instrumented variable is age of marriage. Dependent variables are listed across the top of each panel. See the notes under Table 2 for a description of the sample and a list of covariates included in the regressions. Regressions also control for KLPS Round 1 height z-score. Sample size varies slightly across columns due to missing data in the outcome measure, unless otherwise noted below. Regressions are weighted to maintain initial population proportions. Robust standard errors, clustered by KLPS baseline primary school grade, are in parenthesis. False discovery rate adjusted q-values are in brackets. *** P-value<0.01, ** P-value<0.05, * P-value<0.1. ^Because there are no critical values associated with the Kleibergen-Paap statistic, we follow the suggestion in Baum et al. (2007) and apply Stock and Yogo (2005) critical values. We use § to indicate that the Kleibergen-Paap statistic exceeds the Stock and Yogo critical value at 10% maximal IV size. [1]Indicator for agrees (very strongly) with "in our country, women should have equal rights and receive the same treatment as men do" rather than "women have always been subject to traditional laws and customs, and should remain so". [2]Indicator for agrees (very strongly) with "no one has the right to use physical violence against anyone else" rather than "a married man has the right to beat his wife if she misbehaves". [3]Indicator for (strongly) agrees with "if the wife is working outside the home, then the husband should help her with household chores". [4]Indicator for (strongly) agrees with "the important devisions in the family should be made by the men of the family". [5]Indicator for (strongly) agrees with "it is okay for a woman to be a mechanic". [6]Index is constructed as the sum of decisionmaking power for 3 individual items, where 1=total power, 0.5=power shared with someone else, and 0=no power. The items are what do to if a child falls sick, how children should be disciplined, and whether to have another child. [7]Scale ranges from 1-7, and includes some primary, complete primary, some secondary, complete secondary, college, university, and a degree higher than university.