Early Marriage of Women and Education of Children in Sub-Saharan Africa: Cases of Mali and Nigeria.

Jean Claude Saha,[†] Josiane Saleu Feumeni[‡] & Koné Madaidé Kadidiata[§]

Abstract

We analyzed the impact of early marriage of women on children's education in Mali and Nigeria using data from the 2018 Demographic and Health Surveys. We employed instrumental variables, Binary Probit, and multiple linear regression models to conduct our analysis. Our findings reveal several key insights. Firstly, early marriage of women reduces the number of years of schooling for children in Mali and in Nigeria. Secondly, early marriage of women diminishes the likelihood of children completing primary school in Mali and Nigeria. This latter discovery is the most crucial contribution of our research, as no previous study has explored this relationship. Additionally, we confirmed the mother's education as a pathway through which this negative impact on children's number of years of schooling is transmitted, but we have not confirmed it as a channel for influencing school completion. As policy implications for the amelioration of children's education in these countries, we recommend that their governments work for an increase in the age at first marriage of girls, through an improvement in their education and a delay in their first sexual intercourse.

Key words: Early marriage; Women; Education; Children; Mali; Nigeria

JEL Classification Codes: I29, I39; O12, O15, O55

[†] Associate Professor of Economics, Faculty of Economics and Management, University of Yaounde II, Cameroon. E-Mail : sahajclaude@yahoo.fr. Corresponding Author

[‡] Lecturer in Economics, Faculty of Economics and Management, University of Yaounde II, Cameroon. E-Mail : saleujosiane@yahoo.com

[§] Ph. D student in Economics, Faculty of Economics and Management, University of Yaounde II, Cameroon. E-Mail: madaidekadidiatakone@gmail.com

1. Introduction

Early marriage of girls is a major concern in West and Central Africa, where 37% of girls are married before the age of 18 and 12% before the age of 15. In these sub-regions, the United Nations Children's Fund (UNICEF, 2022) reported about 60 million child brides, with 23.6 million in Nigeria, 7.1 million in DR Congo, 4.8 million in Niger, 2.8 million in Burkina Faso, 2.8 million in Mali, 2.6 million in Cameroon, 2.3 million in Côte d'Ivoire, 2.2 million in Ghana, 2.1 million in Chad, 1.7 million in Guinea, 1.5 million in Senegal, and 1.1 million in Benin. In this article, we focus on the specific cases of Mali and Nigeria.[1]

According to the Demographic and Health Survey conducted in Mali in 2018 (DHSM-2018), 18% of women aged 25 to 49 were already in a union before the age of 15, 53% before the age of 18, and more than 90% before the age of 25, with 17.8 years as the median age. In 2022, 55% of girls got married before the age of 18, 15% before the age of 15 in Mali (UN, 2022). The poverty of parents[2] is one of the several factors explaining these early marriages of girls. In Nigeria, 23.6 million girls got married before the age of 18, with 10.3 million before the age of 15 (UNICEF, 2022); and according to Nigeria's EDS 2018 (DHSN-2018), the age at first union is earlier in the northern states than in the southern states (15.8 years on average in the Northwest, 23.6 years in the Southeast). According to the MICS-2018 survey, the ratio of marriages before 18 among women aged 20 to 49 varies by regions, by areas of residence, and by crop (Dixon, 1971; Adebambo, 2010).

In terms of education in Mali, 51% of boys and 61% of girls aged 6 and above have no education; only 4% of men and women have completed primary education; 1% of girls and 3% of boys have reached higher education, 55.6% of children aged 6 to 9 are not educated, 43.8% do not complete primary education; in the 10-14 and 15-19 age groups, 40.9% and 41.2% respectively have no education, only 7.3% and 6.7% complete primary education (DHSM-2018). Globally, the school attendance rate is 51% at primary school and 30% at secondary school. In 2022, the Modular Household Survey (EMOP-2022) reveals that 94.6% of children under 5 have never been to school; between 5 and 9 years, 52.6% of children in rural areas and 38.7% in urban areas never went to school; the primary school enrollment is estimated at 54.2% in rural areas, 24.4% and 31.8% in the Kidal and Menaka regions respectively, the secondary school enrollment ratio is 58.8% in the Gao region, 20.2% in the Mopti region, 10.2% in the Kidal region and 5.2% in Menaka, almost zero in the Taoudenite region (EMOP, 2022). In Nigeria, only 61% of children aged 6 to 11 regularly attend primary school; 47% of girls aged 12 to 18 regularly attend secondary education, compared to 52% of boys; the primary school enrollment ratio is 72% in urban areas

[1] These countries have signed the treaties of the United Nations and the Organization of African Unity (OAU) on the rights of women and children, which establish the minimum age of marriage for girls at 18. However, in Mali, Law No. 2011-087 of December 30, 2011, sets the minimum age of marriage at 16 for girls and 18 for boys, with 15-year-old girls allowed to marry with parental consent. In the Federal Republic of Nigeria, only 29 out of the 36 states have established the minimum age of marriage for girls at 18.

[2] Parents often arrange marriages for teenage girls to settle debts or provide the family with a basic income, as highlighted in the evocative title of a Human Rights Watch report (2013) titled "This Old Man Can Feed Us, You Will Marry Him: Child and Forced Marriage in South Sudan." Other contributing factors include ignorance of the law, lack of formal enforcement mechanisms, customary and religious laws prohibiting premarital sexual intercourse, and parents arranging child marriages at a young age.

and 53% in rural areas, 65% and 37% respectively at the secondary level[3]; considering socio-economic status, the secondary school attendance rate is 15% in the poorest quintile and 70% in the richest quintile (DHSN-2018); inequality is unequally distributed across the national territory[4] (UNICEF, 2013).

The phenomenon of child marriage has important consequences on the life of the bride, including generational[5] and intergenerational effects. In this article, we will focus on one specific intergenerational consequence: the impact on the education of children born to early married women in Mali and Nigeria. Our main research question is: What is the effect of early marriage on mothers' children's education in Mali and Nigeria? The two specific research questions are: 1) How does early marriage affect the schooling of children in Mali and Nigeria? 2) What impact does early marriage have on the likelihood of children completing primary school in Mali and Nigeria? Two research hypotheses are associated with these questions. H1: Early marriage negatively impacts children's education. H2: Early marriage decreases the likelihood of children completing primary education.

We answer these specific questions in the general framework of the domestic economics developed by Mincer (1965) and Lancaster (1966), particularly in that of the economics of marriage founded by Becker (1973, 1974) and developed by Weiss (1997) and Ikamari (2005), with insights from the field of education economics of Schultz (1961, 1962), Becker (1962, 1964), and Cohn (1980). In the existing empirical literature, the cases of Sub-Saharan African (SSA) countries, in which early marriage is widespread, have not yet been sufficiently analyzed, and our specific objectives have not yet been realized for these countries. Our research aims at testing two specific hypotheses never tested in SSA countries—see the previous paragraph.

The remainder of this article is organized as follows. Section 2 presents a literature review. Section 3 describes the methodology, whereas section 4 presents and discusses empirical results. Section 5 provides a conclusion.

[3] The Nigerian education system includes primary, secondary, and tertiary levels. A child typically begins primary school at the age of 6, then moves on to secondary school at age 12 after obtaining the First School Leaving Certificate and passing the Common Entrance exam. Secondary education is divided into two cycles, each lasting 3 years, and culminates in the attainment of the Senior Secondary School Certificate. Higher education typically spans 4 years, giving rise to the system's designation as 6-3-3-4.

[4] In this country, 10.5 million children were out of school in 2021 due to insecurity, and 18.5 million in 2022. Girls are more affected than boys, according to UNICEF (2022). This exposes children to violence, child marriage, early pregnancy, and child labor.

[5] Early marriage of girls hinders their education (Timin and Dosse, 2020; Bayisenge, 2010; Lloyd et al., 2008; Longwe et al., 2012; Adekola et al., 2016; Malhotra, 2017) and exposes them to various forms of violence. It also accelerates population growth and increases poverty (World Bank, 2022).

2. Review of the literature

2.1 Review of the theoretical literature

How can we explain the phenomenon of early marriage among women and what potential impact does it have on the education of their children? The theoretical answers can be found within the framework of domestic economy, pioneered by Mincer (1965) and Lancaster (1966), particularly in the economics of marriage established by Becker (1973, 1974)[6] and further developed by Weiss (1997)[7] and Ikamari (2005). Additionally, insights can be gained from the field of education economics, as outlined by Schultz (1961, 1962), Becker (1962, 1964), and Cohn (1980).

Becker (1974) distinguishes between early marriage and subsequent marriage. He argues that marriage occurs at an early age if one desires a high number of children, expects a high income, and has low education. Wahhaj (2015) offers a theoretical explanation of the persistence of early marriage: since the main qualities of a potential wife are imperfectly observed, their age remains the only signal. Assuming that good quality wives are not readily available on the marriage market, men are encouraged to marry young women. Girls, in order to avoid a bad reputation, are encouraged to accept the first proposal. Therefore, the marriage market equilibrium tends to be reached at a young age for girls.

The consequences of early marriage on women's education and that of their children have also been theorized by neoclassical economists. Considering education expenditure as an investment in human capital that has internal and external effects, Schultz (1961, 1962) and Becker (1962, 1964) developed the theory of human capital formation. This theory forms the basis of the economic analysis of education, which Cohn (1980) defines as the study of the allocation of resources to different types of training. Since parents are the ones who invest in their children's education, early marriage, which negatively impacts mothers' education, can be seen as a potential indirect barrier to children’s education.

This theoretical literature presents the early marriage of girls as a stable equilibrium of the market of marriage, the consequence of which is the low education of mothers and the low education of their children. This equilibrium is stable because of the main characteristics of the demand and the supply. But this literature doesn’t indicate a solution to the problem. How can we reduce the phenomenon of early marriage among girls, which has important intra- and intergenerational negative consequences? Our work tries to answer this important question.

2.2. Review of the empirical literature

Several studies have specifically analyzed the effects of early marriage of women. Sekhri and Debnath (2014) conducted a study in India, analyzing a sample of 41,554 households from 25 states and territories of the Union of India. They found that a one-year increase in the age of a

[6] According to him, marriage is a voluntary commitment made by either the individuals getting married or their parents. One chooses to marry when they believe their well-being will be greater with marriage than without it, assuming they find the ideal partner in the competitive marriage market. In the context of the economics of marriage, the advantages of marriage stem from the combination of production and consumption, as well as the division of labor, which enables economies of scale to develop.

[7] Weiss (1997) views marriage as a partnership aimed at achieving joint consumption and production, with the most well-known joint production being the raising and education of children. In addition to individual benefits, Ikamari (2005) argues that marriage, by uniting two families, also brings social benefits.

mother's marriage increases the probability that her children can handle complex arithmetic and reading problems by 3.5 points, and decreases by 0.8 points the probability of not understanding anything at school. Chari *et al.* (2017) also used the same data and found that early maternal marriage leads to a decrease in investments in the education and health of her children. They discovered that a one-year delay in a mother's marriage increases the probability of children attending school by 3.1% and improves their reading and mathematical performance by 2.3% and 3%, respectively.

Delprato *et al* (2017) analyzed Demographic and Health Survey (DHS) data from 25 sub-Saharan African countries in 2000 and 2002 and found that early maternal marriage contributes to inequality in child education. When a mother marries early, her daughters are 6-11% more likely to never attend school, 1.6-1.7% more likely to be late in school, and 3.3-5.1% less likely to complete primary school; her sons are 5.2-8.8% more likely to never attend school, 1-1.9% more likely to be late in school, and 2.3-5.5% less likely to complete primary school. Field and Ambrus (2008) confirmed this negative effect of early marriage on child education in rural Bangladesh. Based on the 1996 and 2001 DHSs, they found that each additional year of marriage postponement is associated with an additional 0.22 years of schooling and 5.6% more literacy. These findings were further supported by Hicks and Hicks (2019) in Kenya.

To identify the transmission channel of this negative effect, Sekhri and Debnath (2014) and Delprato *et al*, (2017) examined the empirical significance of a mother's education and empowerment. Sekhri and Debnath (2014) confirmed the presence of the mother's education channel but did not confirm the mother's autonomy channel. Delprato *et al*, (2017) confirmed the mother's education channel, and fount the presence of a poor birth planning channel and a lack of prenatal and child care channel.

From this empirical literature, it emerges that the cases of Sub-Saharan African countries in which early marriage is a widespread phenomenon have not been sufficiently analyzed and that our specific objectives have not yet been realized for these countries. Our research aims at testing on two African countries two hypothesis which have not yet been tested.

3. Materials and methods

3.1. Variables and sources of data

We have five quantitative variables: number of years of schooling (NAS), age at first marriage (MA), age at first sexual intercourse (AS), and household size (MT); and nine qualitative variables: place of residence, religion, socioeconomic status, sex of head of household, sex of child, occupation of father, education of father, education of mother, and school completion. In the case of Mali, the DHSM-2018 database provides information on education, family, and marital characteristics of households. It allows for the assessment of individuals aged 6 and older (school attendance, literacy, education, completion of primary and secondary education) and offers information on the marital status of women aged 15 to 49. By linking the characteristics of children to those of their parents in this database, we obtained a sample of 11,426 children and 6,642 women for the study. For Nigeria, we obtained a sample of 41,676 children and 24,844 women from the DHSN-2018 database after performing the same operation.

3.2. Methodology for assessing the effect of early marriage of women on child schooling

In order to avoid potential bias from endogeneity in the 'age at first marriage of women' variable (Chari *et al*., 2017; Delprato, Akyeampong and Dunne, 2017; Field and Ambrus, 2008), we conducted a Wu-test Durbin Hausman. The results of this test confirmed endogeneity in Mali but not in Nigeria. As a result, we utilized an instrumental variable model for Mali and a multiple regression model for Nigeria.

Our instrumental variable model consists of a two-equation system. The first equation relates 'age at first marriage' to 'age at first sexual intercourse' (instrumental variable) of women, while the second equation relates the 'number of years of schooling' for children to the 'age at first marriage' of mothers, controlling for child, household, and community characteristics. The model for Mali is the system of equations as shown below:

$$\left\{\begin{array}{l} AM_j = \alpha_0 + \alpha_1 AS_j + \alpha_2 TM_{ij} + \alpha_3 MR_{ij} + \alpha_4 RE_j + \alpha_5 SSE_j + \alpha_6 SCM_{ij} + \alpha_7 SE_{ij} + \alpha_8 OM_j + \alpha_9 OP_j + \alpha_{10} EM_j + \alpha_{11} EP_j + \mu_j \\ NAS_{ij} = \beta_0 + \beta_1 AM_j + \beta_2 TM_{ij} + \beta_3 MR_{ij} + \beta_4 RE_j + \beta_5 SSE_j + \beta_6 SCM_{ij} + \beta_7 SE_{ij} + \beta_8 OM_j + \beta_9 OP_j + \beta_{10} EM_j + \beta_{11} EP_j + \mu_{ij} \end{array}\right\}$$

With i for children (i=1, 2,.., 11,426) and j for parents (mother or father) (j=1, 2,.., 6,642), ij for the child i of parent j .

Where the variables are defined as follows:

AM= the age at first marriage; TM= the size of the household; MR= the milieu of residence: OM= the occupational status of the mother; OP= the occupational status of the father; EM= the education of the mother; EP= the education of the father; NAS= the number of years of schooling; SE= the sex of the child; SSE= the socio-economic status of the household; SCM= the sex of the head of household; RE= the religion of the mother.

The multiple regression model for Nigeria is the equation 3 that follows:

$$NAS_{ij} = \beta_0 + \beta_1 AM_j + \beta_2 TM_{ij} + \beta_3 MR_{ij} + \beta_4 RE_j + \beta_5 SSE_j + \beta_6 SCM_{ij} + \beta_7 SE_{ij} + \beta_8 OP_j + \beta_9 EM_j + \beta_{10} EP_j + \mu_{ij}$$

With i for children (i=1, 2,…., 41,676) and j for women (j=1, 2,…,,24,844). For example: SCM_{ij} designates the sex of the head of household of child i of mother j, MR_{ij} designates the place of residence of child i whose mother is j. It is important to remember that the definition of variables has been provided in the previous section. It is also important to remember that we have only one equation for Nigeria because the test has not confirmed the presence of endogeneity.

3.2. Methodology for estimating the effect of early marriage of women on the completion of primary education by their children

The endogenous variable, 'school completion', is a binary qualitative variable that takes the value of 1 if the child has completed primary school and 0 if not. The main exogenous variable is the 'age at first marriage' of the mothers. Following Greene (2003), we adopt the binary Probit model below. In this model, P_{ij} represents the probability that a child i of mother j has completed the primary school cycle, i ranging from 1 to N, with N=11,426 for Mali and N=41,676 for Nigeria, j ranging from 1 to 6,642 for Mali and from 1 to 24,844 for Nigeria.

For Mali we have the equation 4 that follows:

$$P_{ij} = \beta_0 + \beta_1 AM_j + \beta_2 TM_{ij} + \beta_3 MR_{ij} + \beta_4 RE_j + \beta_5 SSE_j + \beta_6 SCM_{ij} + \beta_7 SE_{ij} + \beta_8 OM_j + \beta_9 OP_j + \beta_{10} EM_j + \beta_{11} EP_j + \mu_{ij}$$

For Nigeria we have the equation 5 that follows:

$$P_{ij} = \beta_0 + \beta_1 AM_j + \beta_2 TM_{ij} + \beta_3 MR_{ij} + \beta_4 RE_j + \beta_5 SSE_j + \beta_6 SCM_{ij} + \beta_7 SE_{ij} + \beta_8 OP_j + \beta_9 EM_j + \beta_{10} EP_j + \mu_{ij}$$

The models are similar, except that the variable 'mother's occupation' (OM) is omitted for Nigeria because it creates a collinearity problem.

4. Estimation of the models and results

4.1. Early marriage of women and schooling of their children

4.1.1. Results of the descriptive analysis

In Mali, our sample includes 11,426 children, of which 60.08% had mothers who were married early, and 51.69% of them were out of school at the time of the survey. More detailed information can be found in the Annex (Figure 1). The sample also consists of 6,642 women, with 6,610 of them being married and 3,838 married at an early age. A detailed description can be found in the appendix. The table below 1 displays the correlations between variables.

Table 1: Matrix of correlations between variables-Mali

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
(1) NAS	1												
(2) AM	0.047	1											
(3) As	0.067	0.471	1										
(4) TM	0.047	-0.066	-0.035	1									
(5) Place of résidence	-0.23	-0.118	-0.071	0.026	1								
(6) Religion	0.02	0.02	0.068	-0.008	-0.11	1							
(7) Socio-eco. status	-0.283	-0.038	-0.046	-0.01	0.407	-0.111	1						
(8) Sex head household	-0.014	-0.022	-0.049	-0.24	0	-0.013	-0.029	1					
(9) Child's sex	-0.016	0.006	0.001	-0.009	-0.02	-0.011	-0.029	-0.002	1				
(10)Mother's occupation	0.092	-0.064	-0.036	0.108	0.022	-0.025	-0.032	0.013	-0.007	1			
(11) Father's occupation	0.036	-0.036	-0.007	0.077	0.022	0.005	-0.031	-0.049	0.006	0.197	1		
(12) Mother's education	0.207	0.094	0.052	-0.056	-0.261	0.034	-0.263	-0.006	0.006	0.027	0.061	1	
(13) Father's education	0.222	0.105	0.07	-0.017	-0.221	0.014	-0.22	-0.068	0.008	0.048	0.057	0.397	1

Source: Computed by the authors, based on the DHSM-2018 database

Table 1 shows that the age at first marriage of women (AM), household size (TM), mother's religion, occupation, and education of parents are positively correlated with the number of years of schooling of children (NAS). Similarly, having a mother who is not Muslim, both parents educated and employed, positively correlates with the number of years of schooling for children. The other variables in the study have a negative correlation with the NAS.

The data also reveals a positive correlation between the age at first marriage and the instrumental variable (age at first sexual intercourse of women). In Nigeria, the sample consists of 41,676 children, 34.67% of whom were in school during the survey. Figure 4 (see Annex) shows that children's schooling is influenced by the age at first marriage of mothers. The sample also includes 24,844 women, 23,992 of whom are married, with 12,084 marrying at an early age. The education of these women in relation to their age at first marriage is described in Figure 5 (see Annex). Descriptive statistics of quantitative variables, distribution of qualitative variables, and cross-statistics of qualitative variables with the school situation of children are presented in the appendix. Correlation coefficients are presented in the table 2 below.

Table 2: Matrix of correlations between variables-Nigeria

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
(1) NAS	1										
(2) Age 1st marriage	0.167	1									
(3) Household size	-0.079	-0.240	1								
(4) Place of residence	-0.234	-0.204	0.101	1							
(5) Religion	0.100	0.141	-0.143	-0.082	1						
(6) Socio-eco. status	-0.367	-0.282	0.124	0.474	-0.083	1					
(7) Sex head household	0.126	0.133	-0.261	-0.095	0.090	-0.103	1				
(8) Sex of child	-0.011	0.008	-0.009	-0.011	0.005	-0.016	0.011	1			
(9) Father's occupation	0.034	0.036	-0.034	-0.013	0.017	-0.041	0.014	0.010	1		
(10)Mother's education	0.349	0.341	-0.332	-0.321	0.205	-0.498	0.175	0.010	0.058	1	
(11) Father's education	0.362	0.271	-0.212	-0.284	0.194	-0.485	0.113	0.010	0.082	0.601	1

Source: Computed by the authors, based on the DHSM-2018 database

Table 2 shows that women's age at first marriage, their religion, the sex of the head of the household, the occupation of the father, and the education of both the father and mother are positively correlated with the schooling of the children. On the other hand, the size of the household, the zone of residence, socio-economic status, and the sex of the child are negatively correlated.

4.2. Results of econometric analysis

The model for Mali (system 1) is estimated using the two-stage least squares technique (2SLS). Standard OLS models assume that errors in the dependent variable are uncorrelated with the independent variable(s). When this is not the case, linear regression using ordinary least squares (OLS) no longer provides optimal model estimates. Two-stage least-squares regression uses instrumental variables that are uncorrelated with the error terms to compute estimated values of the problematic predictor(s) (the first stage), and then uses those computed values to estimate a linear regression model of the dependent variable (the second stage). Since the computed values are based on variables that are uncorrelated with the errors, the results of the two-stage model are optimal.

In our case, in the first stage, the relationship between the age at first marriage and the age at first sexual intercourse (instrumental variable) of women, that is the first equation of the system1, is estimated using the OLS technique. The results presented in table 3 show that the age at first sexual intercourse positively influences the age at first marriage. More precisely, a one-year increase in age at first sexual intercourse is associated with a 0.721-year increase in age at first marriage.

Table 3: OLS Estimates-Age at first marriage and age at first sexual intercourse of women in Mali

	Coefficients	Standard error	p-value	Confid. interval	
Age 1rst sexual intercourse	0.7021***	0.0131	0.0001	0.6770	0.7271
Size of Household	-0.0452***	0.0902	0.0004	-0.0651	-0.0261
Milieu of residence					
Rural	-0.6590***	0.8601	0.0000	-0.8270	-0.4910
Religion					
Muslim	-0.3518**	0.1488	0.0194	-0.6431	-0.0581
Socio-eco status					
Poor	0.2471***	0.0758	0.0010	0.0990	0.3963
Sex head household					
Female	-0.1918*	0.1109	0.0862	-0.4073	0.0271
Sex of the child					
Female	0.0217	0.0658	0.7423	-0.1080	0.1522
Mother's occupation					
Occupied	-0.3268***	0.0718	0.0001	-0.4641	-0.1913
Father's occupation					
Occupied	-0.3192***	0.1088	0.0030	-0.5330	-0.1050
Mother's education					
Educated	0.3891***	0.0962	0.0000	0.2031	0.5783
Father's education					
Educated	0.5118***	0.0933	0.0000	0.3310	0.6933
Constant	7.4869***	0.2949	0.0000	6.9090	8.0640
Average endogeneous variable	17.409	Observations	11,170		
R-squarred	0.237	Prob>F		0.000	
F-test	314.561	SD errors		4.002	

Note: *** p<.01, ** p<.05, * p<.1

Source: Estimated by the authors, on STATA, based on the MDHS-2018 database

The relationship between children's schooling and the age at first marriage of mothers for Mali (equation 2 of the system 1) is estimated using OLS. The results, shown in the table 4, indicate that the age at first marriage of women has a positive influence on the NAS of their children. Specifically, a one-year increase in the mother's age at first marriage leads to a 0.065 year increase in the NAS of children. This finding is consistent with the results of Sekhri and Debnath (2014) and Chari *et al*. (2017) in the context of India[8].

[8] Using the instrumental variable method, Sekhri and Debnath (2014) found that a one-year delay in the mother's marriage increases the probability of a child being enrolled in public school by 4.6 percentage points and in private school by 7.8 percentage points. Similarly, the results of Chari et al. (2017) indicate that a one-year delay in the mother's marriage would increase the likelihood of a child's schooling by 3.1%.

Table 4: OLS Estimates-Children's schooling and the age at first marriage of mothers in Mali

	Coefficients	Standard error	p-value	Confidence interval	
Age 1rst marriage	0.0654***	0.0130	0.0001	0.0388	0.0882
Size of household	0.0401***	0.0071	0.0004	0.0271	0.0542
Place of residence					
Rural	-0.6309***	0.0617	0.0003	-0.7530	-0.5088
Religion					
Muslim	-0.1923**	0.1067	0.0731	-0.4019	0.0177
Socio-eco status					
Poor	-1.0488***	0.0550	0.0003	-1.1550	-0.9421
Sex head household					
Female	0.0370	0.0801	0.6450	-0.1190	0.1930
Sex child					
Female	-0.1357***	0.0476	0.0041	-0.2302	-0.0432
Mother's occupation					
Occupied	0.4403***	0.0503	0.0001	0.3412	0.5388
Father's occupation					
Occupied	0.0418	0.0781	0.5880	-0.1112	0.1960
Mother's education					
Educated	0.5226***	0.0688	0.0003	0.3871	0.6590
Father's education					
Educated	0.7766***	0.0666	0.0001	0.6451	0.9078
Constant	1.1388***	0.2880	0.0001	0.5740	1.7050
Avec *** p<.01, ** p<.05, * p<.1					

Source: Our estimation, using STATA, based on the DHSM-2018 database

When considering control variables, it was found that the sex of the head of household and the father's occupation were not significant. However, the size of the household, the environment of residence, the child's sex, religion, the mother's socio-economic status, the mother's occupation, and the parents' education were found to be significant. The environment of residence, the child's sex, and the household's socio-economic status had a negative impact, while the mother's occupation, the parents' education, and the size of the household had a positive impact[9]. This model using instrumental variables successfully corrected for endogeneity bias.[10]

[9] The fact that a child lives in a rural area, is female, and has a lower social status decreases his NAS by 0.63, 0.14, and 1.04 years, respectively. Additionally, having a mother of Muslim religion decreases the child's NAS by 0.19 years. On the other hand, a child having both parents educated increases his NAS by 0.52 and 0.78 years, respectively. The mother's occupation also increases the NAS of the children by 0.44 years. Furthermore, a one-year increase in the (TM) also increases the child's NAS by 0.4 years. This positive effect on children's education contradicts the literature, but it can be explained by the fact that in African households, more adult members contribute to household consumption and education expenditure, in addition to the head of the household. This additional support helps facilitate investments in the education of the youngest members.

[10] To verify, we estimated a multiple OLS regression model and compared the results to those obtained using 2SLS. The results (Table 7, Appendix) underestimate the effect of women's age at first marriage on their children's NAS SIN, as well as that of the control variables, confirming the existence of an endogeneity bias that the use of 2SLS has corrected.

For Nigeria, the results of Ordinary Least Squares (OLS) estimation (see table 5 below) show that the age at first marriage of women positively affects the Number of Years of Schooling (NAS) of their children. More specifically, a one-year delay in the first marriage of women leads to a 0.01 year increase in the NAS of their children. Our first research hypothesis (H1) is validated in the case of Nigeria: early marriage of women negatively influences the schooling of their children. This result is consistent with those found by Sekhri and Debnath (2014) and Chari et al. (2017) cited above.

Table 5: OLS estimation of the model for Nigeria (equation 3)

	Coefficients	Standard error	p-value	Confidence interval	
Age at 1st marriage	0.0091***	0.0042	0.0101	0.0021	0.0171
Size of Household	0.0521***	0.0041	0.0002	0.0432	0.0603
Place of residence					
Rural	-0.3481***	0.0372	0.0003	-0.4211	-0.2753
Religion					
Muslim	0.2431***	0.0621	0.0001	0.1211	0.3651
Socio-eco. status					
Poor	-1.3671***	0.0402	0.0001	-1.4460	-1.2880
Sex head of household					
Female	0.4303***	0.0710	0.0003	0.2911	0.5690
Sex of the child					
Female	-0.1361***	0.0311	0.0002	-0.1971	-0.0752
Father's occupation					
Occupied	0.0822	0.0791	0.3004	-0.0731	0.2360
Mother's education					
Educated	0.9381***	0.0432	0.0002	0.8541	1.0221
Father's education					
Educated	1.214***	0.0411	0.0005	1.1331	1.2941
Constant	2.303***	0.119	0.0004	2.071	2.535

Avec *** p<.01, ** p<.05, * p<.1

Source: Our estimations, using STATA, based on the DHSN-2018 database

Our research hypothesis, H1, has been accepted: early marriage of women negatively impacts the schooling of their children in both Mali and Nigeria. However, what are the transmission channels of this negative influence? To address this question, we have concentrated on testing the women's education transmission channel[11]. To answer this question, we compare the regression coefficient of our model without "women's education" as a control variable to that obtained with it included

[11] Empirical literature indicates that Sekhri and Debnath (2014) and Delprato et al. (2017) have empirically confirmed the existence of a 'mother's education' channel and rejected that of a 'mother's empowerment' channel. Additionally, Delprato et al. (2017) highlighted the existence of a 'poor birth planning' channel and a 'lack of prenatal and child care' channel. However, due to the absence of data, we are unable to evaluate the existence of the 'mother's empowerment', 'poor birth planning', and 'lack of prenatal and child care' channels.

(table 6). If the difference is significant, we can conclude that women's education is a transmission channel.

Table 6: Evaluation of women's education transmission channel in the two countries

	Estimation without 'Mother's education' as control variable					
	MALI			NIGERIA		
	coefficient	Standard error	P-value	coefficient	Standard error	P-value
Age at 1st marriage	0.032***	0.006	0.000	0.125***	0.0041	0.000
	Estimation with 'Mother's education' as control variable					
Age at 1st marriage	0.019***	0.006	0.000	0.041***	0.0043	0.000
Mother's education	1.423***	0.064	0.000	2.305***	0.0344	0.000

Source: The authors' estimates using Stata, on the DHSM-2018 and DHSN-2018 databases

The table demonstrates that when women's education is taken into account, the estimated coefficient for age at first marriage significantly decreases. In Mali, it goes from 0.032 to 0.019, and in Nigeria, it goes from 0.125 to 0.041. This suggests that women's education plays a crucial role in transmitting the impact of early marriage on women to the education of their children in both Mali and Nigeria.

4.3. Early marriage of women and child's completion of primary school

4.3.1. Results of descriptive analysis

The sample from Mali consists of 5,133 children who began primary school. Of these, 90.69% did not complete it, and 38.52% have mothers who married early. Among the 478 children who did finish primary school, 42.89% have mothers who married later in life (see Figure 6 in the Annex). The table below displays the breakdown of school completion rates based on other qualitative variables.

Table 7: Primary School Completion Rates by Qualitative Variables in Mali Model

Variables	Primary school completed	Primary school not completed
Place of residence		
Urban	10.86%	89.14%
Rural	8.61%	91.39%
Religion		
Muslim	9.07%	90.93%
Christian	17.27%	82.73%
Other religion	9.76%	90.24%
Socio-economic status		
Poor	8.56%	91.44%
Middle	8.33%	91.67%
Rich	10.09%	89.91%
Sex head of household		
Male	9.43%	90.57%
Female	8.58%	91.42%
Sex of the child		
Male	9.88%	90.12%
Female	8.66%	91.34%
Mother's occupation		
No occupation	8.68%	91.32%
Occupation	9.64%	91.34%
Father's occupation		
No occupation	6.83%	93.17%
Occupation	9.63%	90.37%
Mother's education		
Non educated	9.38%	90.62%
Educated	9.12%	90.88%
Father's education		
Non educated	8.86%	91.14%
Educated	10.75%	89.25%

Source: Computed by the authors, based on the DHSM-2018 database

The sample from Nigeria consists of 20,107 children who enrolled in primary school, with 87.29% of them not completing their education. Additionally, 54.71% of the children have mothers who were married at a young age. Among those who did finish the school cycle, 47.87% have mothers who married later in life (see Figure 6 in the Annex). The model includes two quantitative variables (AM and TM) and ten qualitative variables. The table below displays the breakdown of school completion based on the qualitative variables.

Table 8: Cross-tabulation of primary school completion with qualitative variables of the Nigeria-model

Variables	Primary school completed	Primary school not completed
Place of residence		
Urban	13.22%	86.78%
Rural	12.35%	87.65%
Religion		
Muslim	13.39%	86.61%
Christian	12.63%	87.37%
Other religion	14.12%	85.88%
Socio-eco status		
Poor	12.49%	87.51%
Middle	11.89%	88.11%
Rich	13.44%	86.56%
Sex head household		
Male	12.44%	87.56%
Female	15.13%	84.86%
Sex of the child		
Male	12.93%	87.07%
Female	12.45%	87.55%
Father's occupation		
No occupation	15.70%	84.30%
Occupation	12.38%	87.62%
Mother's education		
No education	12.23%	87.71%
Education	13.02%	86.98%
Father's education		
No education	11.91%	88.09%
Education	12.74%	87.26%

Source: Computed by the authors, based on the DHSN-2018 database

4.3.2. Results of econometric analyses

For Mali, the results of estimating the binary Probit model using the maximum likelihood technique are presented in the table 9 below.

Table 9: Binary Probit model estimation using the maximum likelihood technique for Mali

	Coefficients	Standard Error	p-value	Confidence int.	
Age at 1st marriage	0.0130**	0.0061	0.0341	0.0011	0.0250
Size of household	0.0200***	0.0071	0.0021	0.0071	0.0332
Place of residence					
Rural	-0.1290**	0.0605	0.0322	-0.2460	-0.0112
Religion					
Muslim	-0.2932***	0.1024	0.0044	-0.4920	-0.0931
Socio-eco status					
Poor	-0.0273	0.0632	0.6630	-0.1504	0.0953
Sex head household					
Female	0.0424	0.0813	0.6104	-0.1181	0.2010
Sex of the child					
Female	-0.0712	0.0504	0.1524	-0.1691	0.0260
Mothers' occupation					
Occupation	0.0340	0.0543	0.5312	-0.0720	.1391
Fathers' occupation					
Occupation	0.1503	0.0921	0.1031	-0.0302	0.3310
Mothers' education					
Educated	-0.0923	0.0644	0.1490	-0.2171	0.0331
Fathers' education					
Education	0.0981	0.0602	0.1051	-0.0210	.2161
Constant	-1.4780***	0.1912	0.0000	-1.8520	-1.1041

*** p<0.01, ** p<0.05, * p<0.1

According to these results, early marriage among women has a negative impact on their children's likelihood of completing primary school. Specifically, a one-year delay in a mother's first marriage would increase the probability of her children completing primary school by 1.3%. This finding is novel in the literature, as previous studies have not explored this relationship. Among the other explanatory variables, only TM, place of residence, and religion are significant[12]. A one-unit increase in TM results in a 2% higher probability of children completing primary school[13]. Living in a rural area and having a Muslim mother decrease the probability of completing primary school by 12.9% and 29.3%, respectively.

For Nigeria, the results of the same model estimation using the same technique are shown in the table below. According to these results, a one-year delay in women's first marriage increases the probability of their children completing primary school by 0.06%. Therefore, our research hypothesis is accepted: in Nigeria, early marriage of women negatively influences the completion

[12] All other control variables are non-significant. This leads us to postulate that other control variables related to the characteristics of the school and the follow-up of children by the school could play a role.

[13] This result appears to contradict the existing literature that suggests household size negatively impacts children's education. However, it is understandable in the African context, where older household members contribute to household consumption and education spending, thereby promoting the education of the youngest members.

of primary school by their children. This result is a new addition to the literature, providing value to this paper, similar to the case of Mali. Only two control variables are significant[14]: the size of the household (TM) and the occupation of the father (Op). The seemingly paradoxical positive influence of TM can be explained in the African context (see explanation above).

Table 10: Binary Probit model estimation using the maximum likelihood technique - Nigeria

	Coefficients	Standard Error	p-value	Confidence int.	
Age at 1st marriage	0.0060**	0.0031	0.0210	0.0010	0.0111
Size household	0.0141***	0.0033	0.0002	0.0081	0.0202
Place of residence					
Rural	-0.0362	0.0264	0.1721	-0.0871	0.0161
Religion					
Muslim	0.0160	0.0410	0.6970	-0.0652	0.0972
Socio-eco status					
Poor	0.0306	0.0291	0.2912	-0.0262	0.0873
Sex head household					
Female	0.0750	0.0492	0.1260	-0.0212	0.1704
Sex of the child					
Female	-0.0205	0.0231	0.3881	-0.0661	0.0262
Fathers' occupation					
Occupation	-0.1520**	0.0610	0.0121	-0.2711	-0.0330
Mothers' education					
Educated	0.0281	0.0301	0.3530	-0.0312	0.0872
Fathers' education					
Educated	0.0441	0.0305	0.1501	-0.0160	0.1041
Constant	-1.2651***	0.0890	0.0000	-1.4390	-1.0905

*** p<0.01, ** p<0.05, * p<0.1

Therefore, we conclude that the H2 research hypothesis is validated: in Mali as well as in Nigeria, women's early marriage reduces the chances of their children completing primary school. Does this negative effect also affect the mother's education? To answer this question, we re-estimate our model without the mother's education as a control variable. The new coefficient of the mother's age at first marriage is compared to the one obtained with mother's education. A difference would indicate the existence of a mother's education channel. The results of the estimation of this reduced model are compared to the baseline results in the table below.

[14] All other control explanatory variables are non-significant. An attempt to explain this lack of significance has already been outlined above.

Table 11: Verification of mother's education as a transmission channel

	Estimation of the model without mother's education					
	MALI			NIGERIA		
	coefficient	Standard error	P-value	coefficient	Standard error	P-value
Age at 1st marriage	0.014**	0.006	0.021	0.005**	0.002	0.036
	Estimation of the model with mother's education					
	MALI			NIGERIA		
	coefficient	Standard error	P-value	coefficient	Standard error	P-value
Age at 1st marriage	0.0014**	0.006	0.019	0.004*	0.002	0.086
Mother's education	-0.031	0.057	0.589	0.023	0.024	0.337

Source: Authors' estimations, using Stata, on NDHS-2018 and MDHS-2018 databases

According to these results, the coefficient of mother's education is not significant in Mali and Nigeria. Therefore, we conclude that in these countries, a mother's education is not a transmission channel for the negative effect of her early marriage on her children's chances of completing primary school.

5. Conclusion

As for many countries, we have just demonstrated that early marriage of women negatively influences the education of their children in Mali and Nigeria. Specifically, early marriage of mothers reduces the number of years of schooling for their children and decreases their chances of completing primary school. In Mali, a one-year increase in the age at first marriage of women leads to a 0.065-year increase in the number of years of schooling for their children and a 1.3% increase in the probability of their children completing primary school. In Nigeria, a one-year delay in women's first marriage results in a 0.01-year increase in their children's number of years of schooling and a 0.06% increase in the probability of their children completing primary school. The existence of women's education channel of transmission of this negative influence on children's years of schooling is confirmed in both countries, but it is not confirmed as transmission channel of the influence on the completion of primary education.

As policy implications for the amelioration of childreen's education in these countries, we recommend that their governments work for the delay of the first marriage (the increase in the age at first marriage) of the girl child. This increase in the age at first marriage of a girl child can be obtained through an improvement in their education and, to a certain extent, through a delay in their first sexual intercourse. These governments should then invest and sensitize the population for more education for girls as well as for the delay of their first sexual intercourse. These actions are able to stop what seems to be a vicious circle from poor education of girls to poor education of their future children through early sexual intercourse and early marriage of these girls. However, this result may have suffered from a religious bias. Indeed, the two countries are predominantly Muslim countries. More than half of the Nigeria's population and about 95% of the Malian population are Muslim, and Muslim religion has been found to be an aggravating factor. So for

further research, it will be interesting to investigate Sub-Sahara African Christian-dominant countries. Also, due to the absence of data, we have not been able to evaluate the 'mother's empowerment', the 'poor birth planning', and the 'lack of prenatal and child care' channels. In further research, it will be interesting to evaluate these channels in the context of SSA countries.

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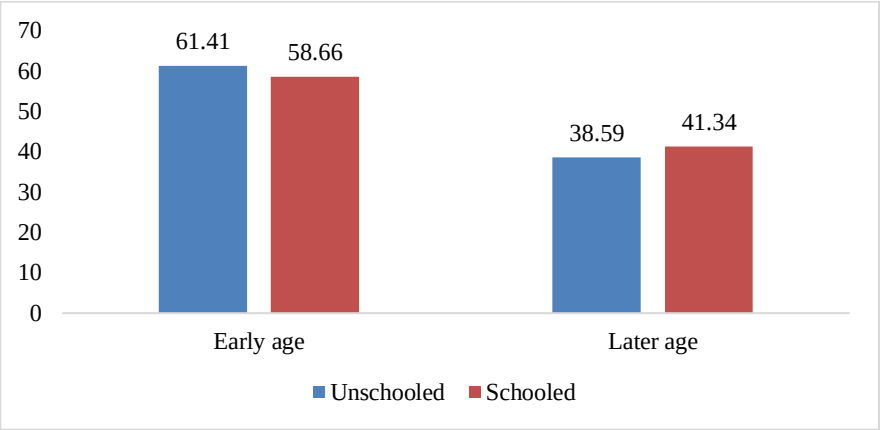
ANNEXES

Description of the samples

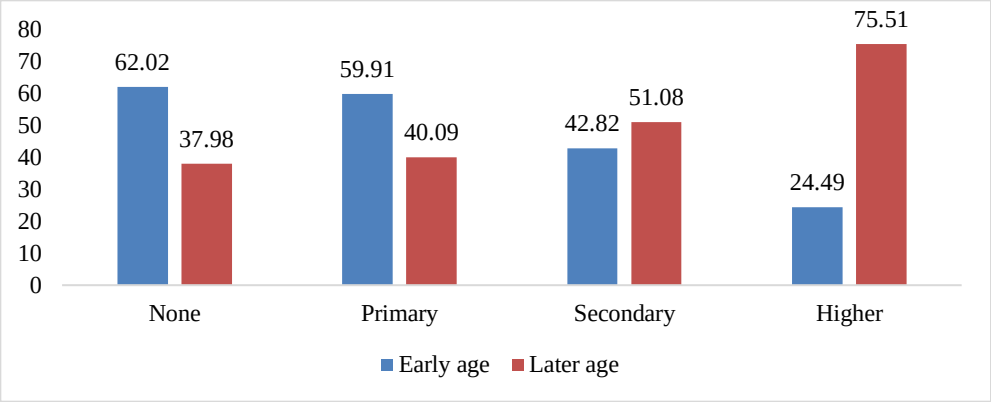
For objective 1

Figure 1: School enrolment by age at first marriage of mothers in Mali



Source: Authors, using data from MDHS-2018

Figure 2: Women's education by age at first marriage



Source: Authors, using data from MDHS-2018

Table 1 : Descriptive statistics for quantitative variables-Mali

Variables	Observations	Mean	Standard deviation	Min.	Max.
Numbers of years of (NAS)	11426	2.016	2.69	0	16
Age of first marriage (AM)	11431	17.437	4.017	10	42
Age at first sexual relations (AS)	11431	16.164	2.623	8	30
Household size (TM)	11431	8.07	3.501	2	45

Table 2: Descriptive statistics for categorical variables-Mali

Variables	Numbers	Proportions
Residence		
Urban	2 950	25.81%
Rural	8 480	74.19%
Religion		
Muslim	10 834	94.78%
Other religion	597	5.22%
Socioeconomic status		
Poor	4 588	40.14%
Middle	2 294	20.07%
Rich	4 549	39.80%
Sex of head of household		
Male	9 976	87.27%
Female	1 455	12.73%
Child sex		
Boy	6 022	52.68%
Girl	5 409	47.32%
Mother's occupation		
None occupation	4 402	38.51%
Occupation	7 029	61.49%
Father's occupation		
None occupation	1 214	10.87%
Occupation	9 956	89.13%
Mother's education		
None education	9 350	81.80%
Education	2 081	18.20%
Father's education		
None education	8 982	80.41%
Education	2 188	19.59%

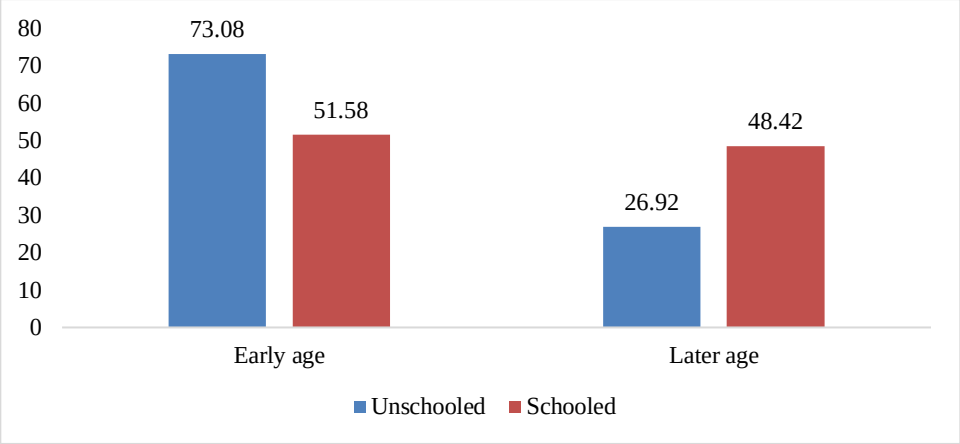
Source: Authors, using data from MDHSM-2014

Table 3: Cross-analysis of the explained variable with the explanatory variables-Mali

Variables	Enrolled (Years of schooling > 0)	Not in school (Years of schooling = 0)
Residence		
Urban	67.74%	32.26%
Rural	41.55%	58.45%
Religion		
Muslim	48.58%	51.42%
Christian	60.64%	39.36%
Other religion	31.03%	68.97%
Socio-eco status		
Poor	29.07%	70.93%
Middle	44.40%	55.60%
Rich	69.69%	30.31%
Sex head household		
Male	48.45%	51.55%
Female	47.35%	52.65%
Sex child		
Boy	48.81%	51.19%
Girl	47.75%	52.25%
Mother's occupation		
None occupation	42.29%	57.71%
Occupation	52.09%	47.91%
Father's occupation		
None occupation	42.42%	57.58%
Occupation	49.14%	50.86%
Mother's education		
None éducation	42.55%	57.45%
Education	74.20%	25.80%
Father's education		
Aucune éducation	42.44%	57.56%
Education	72.90%	27.10%

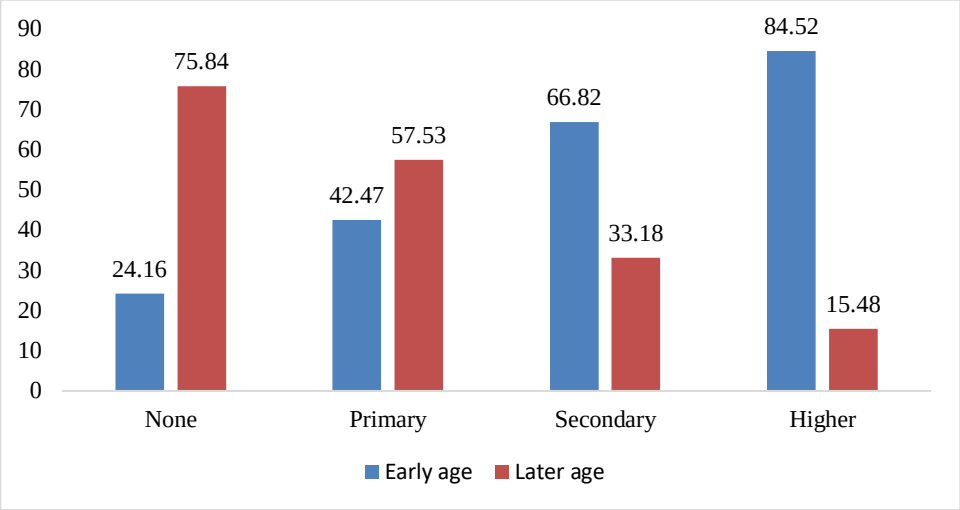
Source: Authors, using data from MDHS-2018

Figure 4: Schooling status of Nigerian children by age at mother's first marriage in Nigeria



Source: Authors, using data from NDHS-2018

Figure 5: Women's level of education in relation to their age at first marriage in Nigeria



Source: Authors, using data from NDHS-2018