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## School socioeconomic composition and adolescent sexual initiation in Malawi

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### Abstract

While numerous studies have documented the determinants of sexual behavior among adolescents in less developed countries, relatively little is known about the influence of social contexts such as school and neighborhood. Using two waves of data from a school-based longitudinal survey conducted in Malawi from 2011 to 2013, this study advances our understanding of the relationship between school-level socioeconomic contexts and adolescents' sexual activity. The results from two-level multinomial logistic regression models suggest that high socioeconomic composition of the student body in school decreases the odds of initiating sexual activity, independently of other important features of schools as well as individual-level characteristics. This study also finds that the association between school socioeconomic composition and sexual activity is statistically significant only among males, but not females, suggesting that school's socioeconomic contexts may be more relevant to male adolescents' initiation of sexual activity.

### Introduction

In sub-Saharan Africa, adolescent sexual activity is known to be closely associated with negative consequences such as unintended pregnancies and sexually transmitted infections (STIs) including HIV, as well as poor educational attainment and achievement (Biddlecom et al. 2008; DiClemente, Salazar, and Crosby 2007; Lloyd 2007; Pettifor et al. 2004). While numerous studies have documented the determinants of sexual behavior among sub-Saharan African adolescents, the possible effects of a broader social context, including school and neighborhood environments have been largely ignored. As school enrolment and grade attainment have substantially increased in sub-Saharan Africa during the last few decades, a growing number of adolescents in these regions are at risk of initiating sexual intercourse while enrolled in school (Biddlecom et al. 2007, 2008). School environment is one of the most important ecological contexts where adolescents learn values and norms that can influence their attitudes and behaviors, through channels such as the formal curriculum, school resources, and interaction with many important social entities including teachers, friends, and friends' parents (Barrett et al. 2007; Cherng, Calarco, and Kao 2012; Coleman et al. 1966).

Despite the significance of a school setting in shaping adolescents' norms and behaviors and some empirical evidence on the relationship between school context and adolescent sexual behavior in developed countries (Bearman and Brückner 2001; Furstenberg et al. 1987; Kirby 2002; Richards-Shubik 2012; Teitler and Weiss 2000), a lack of appropriate data in less developed countries has hampered the examination of the relationship between school context and adolescent outcomes. As an increasing number of adolescents in sub-Saharan Africa remain enrolled in school throughout their adolescence, it becomes more critical to assess the effects of school contexts on adolescent sexual behavior to better develop school-based policies and programs to promote adolescents' sexual and reproductive health (Lloyd 2007). In this study, I use two waves of data from a large-scale school-based longitudinal survey in Malawi to examine whether school contexts shape adolescents' sexual activity. Among various characteristics of schools, I focus on socioeconomic composition of the student body, a factor widely acknowledged to create a normative and cultural environment that promotes or undermines adolescents' attitudes towards learning and sexual and reproductive behaviors (Coleman et al. 1966; Diez Roux 2004; Legewie and DiPrete 2012; Raudenbush and Willms 1995; Teitler and Weiss 2000). In addition, as previous empirical work suggests that the influence of social groups and environments may differ by the gender of the adolescent, I explore whether the effects of school socioeconomic composition on sexual activity differ by gender.

### **Schooling and adolescent sex in sub-Saharan Africa**

As secondary school enrolment in sub-Saharan African countries have increased from 23.4% in 1993 to 41.2% in 2012 (World Bank 2014), more adolescents in these countries spend their adolescence in school environment. School attendance is often believed to delay the timing of first sexual intercourse, increase the likelihood of engaging in safer sex, and reduce the chance of contracting HIV, especially for girls (Behrman 2015; Biddlecom et al. 2008; Jukes, Simmons, and Bundy 2008; Lloyd 2005, 2007). In the sub-Saharan African countries hardest hit by HIV/AIDS, governments encourage schools not only to integrate HIV/AIDS and sex education programs into the formal curriculum, but to assign a certain portion of the school budget for these trainings (Lloyd 2007; Munthali, Chimbiri, and Zulu 2004). Students may also benefit from a growing number of school-based HIV/AIDS/STIs prevention programs run by international development agencies. These concentrated efforts may heighten students' awareness of the danger of early premarital sex and unprotected sexual behaviors. Furthermore, students tend to be more willing than non-students to avoid early sexual activity because of the possible consequences of sexual activity—STIs including HIV/AIDS and unintended pregnancy, which could negatively affect their academic progress (Lloyd 2007). The cost of early and unprotected sexual activity might be even greater in a school culture where returning to school after the birth of a child is neither easy nor welcomed (Grant and Hallman 2008; Munthali et al. 2004).

### **School socioeconomic composition and adolescent sexual behavior**

Even though schooling, in general, seems to be protective of early initiation of sexual intercourse, there is often quite substantial between-school variation in contextual and environmental factors that could lead to distinct likelihoods of sexual activity among adolescents across schools (Coleman et al. 1966; Raudenbush and Willms 1995). That is, a

school's specific characteristics may increase or decrease adolescents' probability of engaging in sexual activity. Among diverse dimensions of school-level disparities, much of the previous literature mostly in developed countries views socioeconomic composition of the student body as an important contextual factor that might affect adolescent outcomes (Coleman et al. 1966; Legewie and DiPrete 2012; Mayer 1991; Teitler and Weiss 2000). This literature suggests that school socioeconomic composition informs peer norms and culture, shaping adolescents' attitudes and behavior. More specifically, theory and empirical evidence suggest that there are a number of different explanations for the underlying mechanisms by which socioeconomic composition of the student body could affect adolescent sexual activity.

According to the institutional resource model (Jencks and Mayer 1990; Leventhal and Brooks-Gunn 2000), greater school resources may lead to improved quality of learning through better trained teachers, more support from parents, and other factors related to school financing, thus enhancing the protective effects of school attendance and involvement on students' sexual behavior. For example, socioeconomically advantaged parents may contribute to creating a better atmosphere for studying by financially supporting schools (i.e., making donations or paying school fees on time) or putting more pressure on headmasters and teachers responsible for curriculum quality and school learning climates. As a result, better school quality in these schools may lead to a lower level of school dissatisfaction and grade repetition (Brossard, Coury, and Mambo 2010; Samdal et al. 1998; UNESCO 2012; Woolley, Kol, and Bowen 2008). There is mounting evidence that school dissatisfaction or detachment is positively associated with sexual behavior among adolescents (Halpern et al. 2000; Kirby 2002; Lévy-Garboua, Lohéac, and Fayolle 2006; Takakura, Wake, and Kobayashi 2010).

Relatedly, it is well documented, especially in the educational literature, that students attending schools with a more advantaged student body benefit from a learning-oriented environment that is created from highly motivated and capable students from high socioeconomic backgrounds (Coleman et al. 1966; Jencks and Mayer 1990; Legewie and DiPrete 2012). This learning-oriented peer culture has also been known to enhance students' educational aspirations as well as educational attainment (Jencks and Mayer 1990; Lee and Burkam 2002). Given that the normative environment of a school influences academic outcomes, it may also affect other adolescent behaviors as well. For example, in sub-Saharan African settings, more socioeconomically advantaged schools may have a normative environment that discourages early sexual activity, childbearing, and marriage because these factors may have been seen as major obstacles to educational attainment.

Focusing more on the roles of nonparental adults, the collective socialization model suggests that students' behaviors and activities in socioeconomically advantaged schools may be better supervised and monitored by peers' parents and adults in the school or community (Jencks and Mayer 1990; Leventhal and Brooks-Gunn 2000). Schools with low socioeconomic status often lack social networks among parents and an effective monitoring/supervision system, thereby leading to increased risk of students' involvement in problem behaviors (Sampson, Raudenbush, and Earls 1997). Moreover, the collective socialization model implies that students attending schools without socioeconomic enrichment of a

school's student body tend to be less motivated to study and less optimistic about their future (e.g., no steady employment and earning, family instability, and etc.) due to a paucity of adult role models (Wilson 1987).

While no studies in sub-Saharan Africa have explicitly examined the relationship between school socioeconomic contexts and adolescent sexual outcomes, two studies have investigated whether school contexts are important to adolescents' sexual behaviors. Those studies emphasize the importance of classmates' age composition as a social environment that may shape adolescent's sexual behavior (Lam, Marteleto, and Ranchhod 2013; Marteleto, Lam, and Ranchhod 2008). Marteleto and colleagues (2008) find that in urban South Africa students who had higher grade attainment for their age were more likely to have sex, suggesting that high rates of grade repetition may create a risky environment where adolescents are influenced by the behavior of older peers. Using the same data, Lam and colleagues (2013) find that cumulative exposure to classmates who are at least two years older is associated with girls' likelihood of engaging in sexual activity.

### **Role of gender in school context**

In rural Kenya, Mensch and colleagues (2001) find that among a wide range of school quality characteristics, only the percentage of female students who report that they feel being treated equally is associated with lower likelihood of engaging in premarital sex among girls, while none of the school characteristics is associated with boys' sexual activity. The authors suggest that boys tend to engage in sexual activity largely independent of school factors while girls' sexual activity may be more responsive school environments. In contrast, while there is little empirical evidence on gender differences in the relationship between school socioeconomic composition and sexual behavior, recent research from industrialized countries suggests that male students are more sensitive to the effect of school socioeconomic composition on academic achievement (Legewie and DiPrete 2012). The authors argue that boys gain more than girls from a learning-oriented environment since academic competition is facilitated as an important aspect of masculine identity for males, while girls' peer groups tend to encourage attachment to teachers and school, often independent of school context. Assuming that there is a link between strengthened academic aspirations and sexual and reproductive behaviors, it can be argued that school socioeconomic composition may influence males' likelihood of sexual initiation more strongly than females.

Given gender differences in friendship formation and social interactions in schools, we can also expect that the effect of school socioeconomic composition on sexual debut might vary by gender. Girls tend to maintain more intense friendships exclusively with a few close friends while boys interact less intimately but with wider groups of peers (Crosnoe 2000; Maccoby 1990). Girls' friendships tend to be based on greater similarity in attitudes and behaviors while boys typically emphasize shared activities (Crosnoe 2000). These gender differences contribute to different life-course trajectories for male and female adolescents (Giordano, Longmore, and Manning 2006; Starrels and Holm 2000; Warr 2002). In light of these differences, it can be argued that boys may be more responsive to the norms and characteristics of a larger and less intimate group of peers such as schoolmates, whereas

girls may be more influenced by smaller peer groups (Leventhal and Brooks-Gunn 2000). Thus, I hypothesize that the relationship between school socioeconomic status and sexual activity is more pronounced among males than females.

## Data and Methods

### Data

Malawi is a small landlocked country in sub-Saharan Africa. Basic education in Malawi consists of eight years of primary education (Standard 1 through 8) and four years of secondary education (Form 1 through 4). Unlike the universal primary education policy adopted in 1994, secondary school admission is determined based on performance on the Primary School Leaving Certificate Examination (PSLCE). The passing rates for PSLCE in 2011 are 75% for male students and 62% for female students. According to the Ministry of Education (2013), as of 2012, there were approximately 4.19 million children enrolled in primary schools and 260,000 children in secondary schools. Among 1,015 secondary schools in the country, 60% are Community Day Secondary Schools (CDSS) and only 10% are Conventional Secondary Schools (CSS). The remaining schools are either religious institutions or private schools. The disparities between CDSSs and CSSs in terms of physical and human resources are distinctively large because CSSs are supported directly by the government while CDSSs are run by communities (Brossard et al. 2010; Hoop 2011). Thus, students attending CSSs considerably benefit from both quality of teaching (e.g., education level of teachers) and basic physical resources including availability of libraries, toilets, electricity, and books. In contrast, private schools tend not to be categorized as a homogenous group in Malawi because the size and quality of private schools in Malawi considerably vary (Hoop 2011).

This study uses two waves of data collected in 2011 through 2013 as a part of HIV/AIDS prevention program for Malawian adolescents, supported by Daeyang Luke Hospital in Malawi, the Korea International Cooperation Agency (KOICA) and Africa Future Foundation in Korea. The target population of the baseline survey was all students from Form 1 to Form 3 (equivalent to grade 9 and 11 in the U.S. education system) who were initially enrolled in thirty-three public secondary schools (either CDSS or CSS) in major traditional authorities (TA) within Lilongwe District: Chimutu, Chitukula, Kalumba, and Tsabango in 2011<sup>1</sup>. These four TAs cover a large part of Lilongwe District<sup>2</sup>. These regions were chosen as target areas for the program because they are the catchment area of Daeyang Luke Hospital.

The wave 1 survey consists of two sets of questionnaires: 1) an in-class self-report survey and 2) a private interview with HIV Voluntary Counselling and Testing (VCT). In the first part, students completed the questionnaires about basic demographics, household assets, health, labor market participation, school performance, time/risk preference, HIV-related knowledge and behaviors, attitudes towards HIV/AIDS, and friend networks. After the in-

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<sup>1</sup>The survey excludes the private secondary schools because the quality and characteristics of private secondary schools significantly varies depending on funders.

<sup>2</sup>These four TAs belong to one of three educational districts—Lilongwe City, Lilongwe Rural East, and Lilongwe Rural West.

class survey, each student was interviewed about sexual experiences by a same-sex enumerator in a confidential manner. At baseline between October 2011 and March 2012, 7,971 secondary school students (approximately 80% of initially enrolled students) participated the baseline survey.

The wave 2 survey, conducted in 2013, includes 5,431 students who were successfully followed up, leading to almost 70% follow-up rate. The remaining 2,540 students were lost between two waves. In order to reduce sample attrition bias, 15% of 2,540 lost students (or 381 students) were randomly sampled for home survey. Out of these randomly sampled 381 students, 71.1% (or 271 students) were successfully tracked and interviewed<sup>3</sup>. Therefore, at wave 2, 5,702 students completed the school or home survey, and the “effective survey rate” reached 90.8%<sup>4</sup>. In the analyses, the sample was weighted to account for the different likelihood of follow-up through the school and home surveys (Baird et al. 2014; Baird, Hamory, and Miguel 2008).

The major strengths of the data lies in the fact that sample size is large (almost 30% of students who were enrolled in CDSSs or CSSs in the Lilongwe district<sup>5</sup>), and that the data is a virtual census of students in each school, so that the measures of schools’ characteristics will contain less error, compared to the data representing a sample of the population of students within schools. Among those who participated the wave 1 survey, twenty-five respondents (including seven with missing values) whose marital status was not “Never married” at the time of survey were excluded because sexual activity for those who have ever cohabited or married or are currently married is universally accepted and expected. After additionally dropping 30 students who had any missing values on individual-level controls, the final analytic sample is 7,916 students (3,950 male students and 3,966 female students) in 33 schools.

The restriction of the analysis in this paper to students who were enrolled in public secondary schools produces a very select group of adolescents especially for Malawi, where the net secondary enrollment rate was only 31.2% in 2013<sup>6</sup>. However, in the context of the rapid school expansion that most sub-Saharan African countries have been experiencing (UNESCO 2015a, 2015b), understanding how school contexts influence adolescent educational and sexual outcomes may be critical for developing policies and programs to effectively integrate more disadvantaged students into the existing educational system. In addition, given relatively large variation in school characteristics and quality, even among this select group of adolescents, the school effect on adolescent outcomes should differ across schools.

<sup>3</sup>Based on the home-visit survey (N=271), the main reasons for loss-to-follow-up at wave 2 survey were due to transfer (44.8%), absence (29.9%), dropout (14.3%), and others (e.g., no submission of parental consent, refusal to participate the survey, and so on) (11%). Approximately 24% of those who dropped out of school reported pregnancy as a major reason for dropout while only 0.1% reported marriage as a major reason.

<sup>4</sup>The effective survey rate (ESR) is a function of the regular follow-up rate (RFR) and home-visit follow-up rate (HFR) as follows:  $ESR = RFR + (1-RFR) * HFR$ . Overall, ESR is 90.8% ( $68.1\% + 31.9\% * 71.1\%$ ) (Baird et al. 2014).

<sup>5</sup>The total number of students enrolled in CDSSs or CSSs in these districts were about 30,426 in 95 schools (Department of Education Planning 2013).

<sup>6</sup>Net enrollment rate taken from the online World Bank Education Statistics Database, accessed on May 16, 2015.

## Dependent variable

The primary focus of this analysis is to examine whether the timing of students' transition to first sex is associated with their school's socioeconomic composition. In each wave, students were asked at which age they had sexual intercourse for the very first time. Based on the responses to this question in both waves, the dependent variable was created with multiple categories to reflect the longitudinal nature of data<sup>7</sup>: (1) had no sex by wave 2 (reference category), (2) initiate sex between two waves, (3) already had sex by wave 1, and (4) lost-to-follow-up at wave 2<sup>8</sup>.

## Key independent variables

School socioeconomic composition, as the main explanatory variable, is measured by a combined index reflecting socioeconomic composition of students attending the same school: (a) the percentage of students with top 10% asset-based wealth index of household<sup>9</sup>, (b) the percentage of students whose father or mother completed secondary school or more, and (c) the percentage of students whose father belonged to the occupation category of "professional/managerial" or "government officer"<sup>10</sup>. Because of the high correlations among these variables, I use principal components analysis to create school socioeconomic composition index. In addition to the composite measure of school socioeconomic composition, I also examine whether each constituent measure has any noticeable differences in the relationship with student's sexual debut. In each model, the corresponding level-1 socioeconomic characteristic that was used to create school-level measure was group-mean centered to distinguish the estimated effect of school-level socioeconomic characteristic from the individual-level effect (Raudenbush and Bryk 2002).

To examine the extent to which the measure of school socioeconomic composition reliably capture a school-level construct, I assessed the econometric properties of school socioeconomic composition scales using three-level multilevel models (Mujahid et al. 2007; Raudenbush and Sampson 1999). In the model, level 1 corresponds to the three survey questions that measure socioeconomic status within individuals. Level 2 corresponds to persons nested within schools and finally level 3 corresponds to schools. Variance components were estimated for each level, and then using these estimates, I calculated the intra-class (intra-school) correlation coefficient (ICC) and the reliability of the school-level measure. The ICC was calculated as the ratio of the variance between schools divided by the sum of between- and within-school variances. The ICC, ranging from 0 to 1, will be high

<sup>7</sup>I used new Stata generalized structural equation modeling command *gsem*, which allows to model a multinomial logistic regression model with random effects. Additionally, I confirmed that the results of this study are not sensitive to using another Stata command *gllamm*.

<sup>8</sup>364 respondents (or 4.5%) who produced inconsistent information about their sexual activity (i.e., reported sexual activity at wave 1, but no sex at wave 2) were coded (3) already had sex by wave 1. 555 respondents (or 7%) who reported sexual activity at wave 1 and were lost to follow up at wave 2 were coded (4) lost-to-follow-up at wave 2. However, coding them (3) already had sex by wave 1 did not affect the results of the study (results not shown).

<sup>9</sup>I tested the robustness of the findings in the paper by using different levels of wealth index as a cut-off (top 10%, 20%, 25%, and 30%), and found that the results are very consistent (results not shown).

<sup>10</sup>The choices for father's occupation given to students were as follows: *No job, Farmer Laborer, Clerical and sales, Professional/managerial, Government officer, and Others*. I chose *Professional/managerial* and *Government officer* as relatively prestigious jobs in Malawi that are closely related to social status. In addition, these occupations are salaried employment which tend to provide access to a stable sources of income and networks of social relations. Although these occupations might be correlated with other socioeconomic status including income/asset and educational attainment, father's occupational status might better and more directly capture social status than income/asset and educational attainment.

when there is greater agreement between respondents within a school. The school level reliability, on the other hand, is a function of the ICC and the number of individuals in each school (Mujahid et al. 2007). The reliability, ranging from 0 to 1, will be high when the variance across schools is large, or 2) the sample size within schools is large. In addition, this measure also depends on the number of scale items. The interpretation of this measure is similar to a Cronbach's alpha in psychometrics scale analysis (Mohnen et al. 2011). The ecometric properties of the scales measured by the ICC and reliability were good, 0.423 for the ICC and 0.973 for reliability, suggesting that the measure of school socioeconomic composition is adequately capturing school attributes, and thus, the mean of the three scores used in the paper is a reasonable estimate for the true school-level socioeconomic status.

### Other control variables

A set of control variables at the individual- and school-level was chosen on the basis of relevant prior empirical studies. All models include the following individual-level control variables: gender, age, ethnicity, self-reported math performance, top 10% asset-based wealth index, parent's completion of secondary education, father's high occupational status, and parental survival (both parents, mother only, father only, and no parents). I use asset-based wealth index of household as a measure of socioeconomic status not necessarily because data on household income or expenditures are absent, but because wealth seems to better capture long-term socioeconomic position of a household (Bärnighausen et al. 2007). Following Filmer and Pritchett's method, I construct asset-based wealth index (Filmer and Pritchett 2001; McKenzie 2005) which includes source of drinking water (pipe water, borehole, well, surface water, and bottled water), types of toilet facilities (flush toilet, improved toilet, traditional pit toilet, and no facility/bush/field), household durable assets, and the number of rooms in the home. Information on livestock ownership is not used because the respondents in this study are from both rural and urban areas. Livestock ownership may be a good indicator for wealth only in rural area, but not in urban areas.

In order to control for school-level characteristics that may confound the association between school socioeconomic composition and sexual debut, the following school-level variables are included: average class size, rurality, and type of schools (i.e., CSS vs. CDSS). While not perfect, these school-level variables could control for school-level confounding factors such as quality of teaching and access to basic physical resources. I also include specific features of schools that may affect sexual debut to examine whether school socioeconomic composition has an effect on sexual debut, independently of those characteristics of schools (Diez Roux 2004; Raudenbush and Willms 1995). The following set of school-level aggregate measures were included: % students satisfied with school<sup>11</sup>, % students who have ever repeated grade during secondary school, and mean study after school<sup>12</sup>.

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<sup>11</sup>School satisfaction is measured based on student's response to the question "How satisfied are you with your school in general?" The response is a five-point scale ranging from "Very dissatisfied" to "Very satisfied." To create the percentage of students who are satisfied with school, this variable is dichotomized into "Very dissatisfied/Dissatisfied/So-so" (0) and "Satisfied/Very Satisfied" (1).  
<sup>12</sup>Study after school is measured based on student's response to the question "Do you study after class? (either at home or school)" The response is a six-point scale ranging from "No, not at all" to "Four times or more a week."



## Analysis

In this research, multilevel modelling with hierarchical structure is employed to predict students' sexual behaviors. Multilevel modelling approach is based on the assumption that each school is responsible for a part of the variation in students' sexual activity and that ignoring the nested structure of the data might lead to misattributing the effects of student-level characteristics (Raudenbush and Bryk 2002). I use two-level multinomial logistic regression models to explore how school-level socioeconomic composition relates to adolescents' sexual initiation between the two waves. In the final tables, I only present the result comparing those who remained sexually inexperienced by wave 2 (reference category) to those who initiated sex between wave 1 and 2<sup>13</sup>. When using a longitudinal data, multinomial logistic regression is especially beneficial for reducing bias potentially resulting from non-random loss to follow-up. In addition, this joint model may benefit from obtaining smaller standard errors than the separate-fitting models, although the efficiency loss for a stratified model is minimal when using the most frequent category of the outcome is set as the reference group (Agresti 2002). For example, since the primary comparison of our interest is between (1) had no sex by wave 2 (reference category) and (2) initiate sex between two waves, and the category of "had no sex by wave 2" is the most frequent<sup>14</sup>, fitting independent binary regression models comparing these two categories is expected to produce similar results<sup>15</sup>.

## Findings

### Descriptive Statistics

Table 1 presents weighted descriptive statistics for all variables included in the multilevel modeling analysis at both the individual and school level. Descriptive statistics are presented for the students who are included in the final analytic sample. The total number of students included in this study is 7,916, with 3,950 male students and 3,966 female students. While 16% of the respondents already had sex by wave 1, about half of them remain sexually inactive by wave 2. Between wave 1 and wave 2, approximately 11% of male students reported sexual debut; only 8% of female students initiated sexual intercourse. Half of the sample have at least one parent who has ever completed secondary education, and 26% of the students have father who is employed in professional or managerial occupations or serves as a government officer. For 24% of the sample students, at least one parent has died. 14% of the students in the sample attend schools located in rural area.

It seems that there is substantial variation across schools in various school-level characteristics. The percentage of the students who have ever repeated a grade ranges from 4% to 22%, and the percentage of the students satisfied with school ranges from 7% to 61%. Average score for studying after school is 4.9, meaning that students, on average, study two or three times a week after school. More importantly, there are significant variations between schools in their aggregate socioeconomic characteristics: between 0% and 31% of

<sup>13</sup>The results for the remaining pairs of comparisons (i.e., (1) had no sex by wave 2 (reference category) vs. (3) already had sex by wave 1 and (1) had no sex by wave 2 (reference category) vs. (4) lost-to-follow-up at wave 2) are included in the Appendix.

<sup>14</sup>The weighted sample shows that 51% of the students remain sexually inactive by Wave 2.

<sup>15</sup>As a robustness check, I fitted the independent binary regression model (i.e., two-level logistic and probit model) to confirm that the results including the magnitude of the effect and statistical significance are considerably similar (results not shown).

students in a school were in the top 10% of the wealth index, between 13% and 72% of parents had completed secondary education, and between 7% and 46% of fathers had high occupational status.

Table 2 reports the relative risk ratios and standard errors obtained from two-level multinomial logistic regression with random intercepts, where the effect of school socioeconomic composition on sexual debut is examined. Model 1 shows that without controlling for individual- and school-level characteristics, higher school socioeconomic composition is very strongly associated with decreased odds of initiating sexual activity between waves. In Model 2 where a set of individual-level factors is included, attending schools with higher socioeconomic composition is still very strongly associated with the odds of sexual debut, although the association is considerably reduced. As expected, gender and age are strongly associated with the odds of sexual debut. In addition, higher self-reported math performance decreases the odds of initiating sexual intercourse.

After controlling for a set of structural characteristics of school, the association between school socioeconomic composition and sexual initiation remains statistically significant at the 99% level (Model 3). Adding three additional school-level characteristics that are believed to influence students' sexual activity reduces the strength of the association between school socioeconomic composition and sexual debut, while the association is still marginally statistically significant ( $p=0.082$ ) (Model 4). These findings suggest that school socioeconomic composition seems to be associated with adolescents' sexual initiation, independently of other important school-level characteristics as well as individual-level characteristics. Among the school-level characteristics, higher school satisfaction among students decreases the odds of initiating sexual intercourse. To interpret the effects of school socioeconomic composition and sexual debut and test possible nonlinear effects, Model 5 presents the result from the analysis using terciles of the school socioeconomic composition index. Compared to students attending the most disadvantaged schools (i.e., bottom tercile), the odds of initiating sexual intercourse between waves for those who attend schools in the top and middle tercile of school socioeconomic composition is reduced by an estimated 30% ( $30\% = 100\% * (0.696 - 1)$ ) and 24%, respectively<sup>16</sup>, suggesting that the effect of school socioeconomic composition appear to be nonlinear.

Table 3 presents the results from the separate models for male (Models 1–4) and female students (Models 5–8). Models 1 and 5 show that without any control variables, school socioeconomic composition is associated with the odds of initiating sexual activity, for both males and females. Similar to the pooled sample, even after controlling for a set of individual-level variables, the association is still statistically significant for both gender (Models 2 and 6). Male students from families with top 10% wealth index are less likely to have sex, while for female students, high self-reported math performance decreases the odds of sexual debut. Interestingly, female students whose mother was dead are less likely to have sex than students with both biological parents alive.

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<sup>16</sup>Attending the middle tercile schools is marginally associated with a reduced odds of initiating sexual activity ( $p = 0.102$ ).

Once the first set of school-level variables is added, the association between school socioeconomic status and initiating sexual activity between waves still remains statistically significant for both gender (Models 3 and 7). For males, the inclusion of three additional school-level characteristics slightly increases the standard errors and slightly decreases the magnitude of the odds ratio (Model 4). In female samples, however, with very slight change in standard errors, the substantial decrease in the magnitude of the odds ratio of school socioeconomic leads to statistical insignificance (Model 8). These findings suggest that attending schools with higher socioeconomic composition decreases the odds of initiating sexual activity only among male adolescents<sup>17</sup>. While aggregated school satisfaction decreases the odds of sexual debut only among males, the percentage of students who have repeated a grade is only associated with females' odds of initiating sexual intercourse.

Table 4 presents the results from the models by constituent socioeconomic measure and also by gender<sup>18</sup>. The result shows that in the pooled sample, the percentage of students who belong to the top 10% wealth index is most strongly associated with the odds of transition to first sex (Model 1)<sup>19</sup>. On the other hand, the percentage of students whose parents have at least secondary school education is associated with the odds of sexual debut at the 90% level ( $p=0.090$ ), while no statistically significant association is found for the percentage of students whose father has high occupational status (Models 2–3). The exactly same patterns are found in the male samples (Models 4–6). The results show that a one standard deviation increase (i.e., 8 percentage point) in the percentage of top 10% wealth index decreases the odds of sexual initiation by an estimated 29% while a one standard deviation increase (i.e., 18 percentage point) is associated with an increase in the odds of initiating sexual intercourse by an estimated 21%. However, similar to the results from the model using the composite measure of school socioeconomic composition (Table 3), among female adolescents, no constituent school socioeconomic measures are found to be associated with the odds of initiating sexual activity (Models 7–9). These findings suggest that high family economic status at the school level appear to be more salient to delay of first sexual

<sup>17</sup>In linear models, it is common and appropriate to fit an interactive model to examine whether some effects may differ by heterogeneous groups such as gender and race. To do so, the interaction term of the variable of one's interest and group indicator is obtained and tested to determine whether or not the coefficient of interaction term is statistically significant. However, in non-linear models, the sign and significance of the coefficient estimates of interaction terms are an inappropriate source for inferences about the true sign and significance of the interaction effect (Ai and Norton 2003; Greene 2010; Karaca-Mandic, Norton, and Dowd 2012). For example, even if the interaction terms are significant in nonlinear models, the sign, size, and statistical significance of the coefficient on the interaction effect can vary across observations, and those variations can sometimes be substantially large because the magnitude of the interaction effect depends on other covariates in the model. Thus, it is necessary to compute the cross derivative in order to obtain the correct magnitudes and standard errors of the interaction effect for each observation (Ai and Norton 2003). Since using this approach does not provide a simple and straightforward answer to whether there is statistically significant gender differences or not, I rather rely on separate sample estimation to obtain the valid estimates of school socioeconomic composition and its statistical significance for each gender.

<sup>18</sup>I used group-mean centering (or centering within cluster (CWC)) to determine whether there is a differential association exists between a socioeconomic measure and the dependent variable at the two levels (i.e., individual- and school-level). In order to determine the statistical significance on the differential association, it is necessary to test whether the coefficients of socioeconomic status at the different levels are statistically different from each another. In doing so, following Enders and Tofighi (2007), I examined whether school-level socioeconomic status measure is statistically significant when centered at the grand mean (CGM). Because the differences in the statistical significance of the contextual SES variables between under CGM and CWC are negligible (results not shown), I relied on the statistical significance of school-level socioeconomic measure under CWC to determine whether the coefficient of school-level socioeconomic measure is statistically significantly different from that of individual-level socioeconomic status.

<sup>19</sup>I tested the robustness of the findings by using different levels of wealth index as a cut-off (top 20%, 25%, and 30%), and found that as the cut-off increases, the effect of attending schools with students from wealthier families becomes weaker. And the decrease in the effect was more dramatic between top 10% and 20% than top 20% and 30% (results not shown).

intercourse than other aspects of school socioeconomic status such as parental education and father's occupational status, especially among male adolescents.

## Discussion and Conclusions

As access to education has significantly expanded in less developed countries in the past few decades, more adolescents in these countries spend a large portion of their adolescence in school. Despite the importance of schools as a social context that influences students' attitudes and behaviors, little is known about how school environments shape adolescents' sexual behavior in less developed countries. Drawing on two waves of data from a school-based longitudinal survey in Malawi, this study deepens our understanding of the role of school socioeconomic context in influencing adolescents' premarital sexual activity.

This study has two main findings. First, attending high socioeconomic status schools is associated with a reduced odds of engaging in early premarital sexual activity among Malawian adolescents. In particular, it is important to note that despite the modest correlations between school socioeconomic composition measure and three specific features of schools that are believed to influence adolescents' sexual behavior, an independent association between school socioeconomic composition and sexual initiation has been identified (Diez Roux 2004; Raudenbush and Willms 1995). These findings provide empirical support for the hypothesis that school-level socioeconomic contexts are important for early premarital sexual activity among adolescents, independent of other important characteristics of schools as well as individual-level factors. Among three constituent measures of school socioeconomic composition, the percentage of students from the wealthiest 10% families is found to be the most strongly associated with sexual debut for both the pooled and male samples. These findings suggest that with regard to sexual activity, students (especially males) may be more responsive to schoolmates' material resources than cultural resources, while the opposite seems to be true for educational outcomes (see, for example, Cherng et al. 2012).

Second, this study provides some suggestive evidence on gender differences in responding to school contexts. The results from separate models for male and female students suggest that school socioeconomic composition is associated with sexual debut only for male students when controlling for a complete set of individual- and school-level characteristics. For females, the magnitude of the effect of school socioeconomic composition is substantially reduced when three specific characteristics of schools are accounted for, suggesting that school socioeconomic contexts may be less related to sexual debut for females than males. The results are in line with the work of Legewie and DiPrete (2012), who argue that male students are more sensitive to socioeconomic composition of the student body. Interestingly, however, these findings seem to be inconsistent with some of the previous studies in sub-Saharan Africa which have demonstrated that male student's sexual behavior tends not to be influenced by various aspects of school environments, including the level of gender equality and the age composition of students (Lam et al. 2013; Mensch et al. 2001). One possible explanation for these mixed findings is that male and female students may be differently responsive to different school characteristics and environments. For example, in this paper, congruent with the past research (Lam et al.

2013), the percentage of students who have ever repeated a grade during secondary school (resulting in greater exposure to older peers for younger students) is very strongly associated with the odds of transition to first sex only among female students, whereas students' school satisfaction and the academic atmosphere of schools are associated with only male students' sexual initiation. However, the interpretation of the results from gender-stratified models should be interpreted cautiously, considering that in less developed countries including Malawi, girls are more likely to underreport premarital sexual activity due to social norms and school policies against adolescent sexual activity and pregnancy (Grant 2012; Mensch, Hewett, and Erulkar 2003; Soler-Hampejsek et al. 2013; Wight et al. 2006). This underreporting of sexual experience by female students may lead to an underestimation of the association between school socioeconomic composition and sexual debut.

This study has several limitations that need to be acknowledged. Selection bias is often considered a critical barrier in school effects studies as well as neighborhood effects studies because it is likely that people select a place to live and a school for their children to attend (Oakes 2004; Sampson, Morenoff, and Gannon-Rowley 2002). Specifically, school assignment in Malawi is not random. Although the system of selecting students for these schools varies across different school types, the selection process for public secondary schools, which are of primary interest in this analysis, is relatively straightforward. Simply speaking, the top performing students on the national placement exam are selected into Conventional Secondary School (CSS) and then, Community Day Secondary School (CDSS) select students from their own localities. In the public educational system, students hardly ever choose a school, although it is possible in theory for students to select a school at the same level of their originally assigned schools or below. After enrolment, it is very difficult to transfer to another school because a transfer can be made only when a school has a slot to fill. Hence, it can be concluded that students' academic performance and residential locations of their family or relatives mostly determine school selection among adolescents in Malawi. It may be hard to address this selection issue without random school assignment. In this study, I attempted to account for selection issue by controlling for several individual-level characteristics that are believed to be correlated with sexual debut and school socioeconomic composition, although by including many of these variables more assumptions (e.g., linearity and homoskedasticity) are needed with sparse data (Diez Roux 2004; Oakes 2004). However, it is still possible that unobservable or unmeasured factors are correlated with the choice of school and neighborhood, thus confounding the effect of the school on sexual debut.

In addition, although I tried to control for school-level characteristics that may confound the association between school socioeconomic composition and sexual debut, the estimated coefficient of school socioeconomic composition may be biased if important school-level variables are omitted from the analytical models. One might argue that peers' sexual experience (i.e., the percentage of sexually experienced students) is a more natural school-level measure that might be associated with adolescent sexual activity. Although, in principal, using the lagged measure of school peers' sexual activity might not suffer from "reflection problem" (i.e., endogeneity of group- and individual-level decisions) (Manski 1993), the lagged behavior among peers can simply be a proxy measure of contemporaneous behaviors when the lagged and contemporaneous peer measures are highly correlated and

the lag length is mis-specified (for example, it may be hard to know the appropriate lag length) (Manski 1995, 2000). Another related problem is that because more students in low socioeconomic status schools had already experienced sexual debut by wave 1, the percentage of sexually experienced students by wave 1 and school socioeconomic composition are highly correlated ( $\rho = -0.78$ ), thus making it impossible to distinguish effects of the two school-level factors. Because separating them is beyond the scope of this paper, and the primary focus of this study is to examine the effect of school socioeconomic composition, peers' sexual experience was not included in the final estimation model.

It is also possible that school effects may be confounded by neighborhood effects because in many settings school and neighborhood environments are closely related. Due to empirical difficulties and data unavailability, only a few studies in developed countries have attempted to understand how these two different contexts separately and jointly affect adolescent outcomes. Although the existing literature suggests that the magnitude of neighborhood effects is relatively smaller for nonacademic outcomes such as transition to first sexual intercourse than educational outcomes (Jargowsky and Komi 2009; Owens 2010; Raudenbush 1993; Teitler and Weiss 2000), the influence of schools may be overestimated when neighborhood effects are at work.

In addition, since this study targets students attending public secondary schools in the Lilongwe district, the generalizability of the findings from the study should be limited accordingly. As the public educational system in many sub-Saharan African countries fails to absorb an increasing number of graduates from primary schools and more private secondary schools rapidly emerge, examining the effects of private secondary schools may be critical. The effects of school socioeconomic composition among private secondary schools might be different from public secondary schools.

In both developed and developing countries, early premarital sexual activity places adolescents at heightened risk of STIs and unintended pregnancies, which in turn often result in low educational attainment, poor health, and low socioeconomic status later in life. With the rapid expansion of education in sub-Saharan Africa, school contexts have gained more attention as an important social context where adolescent culture and norms are produced and learned through peer influence. As adolescents delay marriage and stay in school longer than before, they tend to initiate sexual activity while in school. Though numerous individual- and family-level risk factors have been found to be associated with sexual initiation in less developed countries, the role of school-level factors has been neglected. This study suggests that a school's socioeconomic context plays an important role in shaping adolescents' sexual activity, independently of other characteristics of schools that are known to influence sexual behavior. Further research is required to understand the mechanisms through which school socioeconomic composition influences adolescents' transition to first sex and involvement in unsafe sexual behaviors. More specifically, it would be interesting to explore how school socioeconomic composition is connected to school normative environments about adolescent sexual behavior and educational attainment. In addition, it may be important to understand what roles smaller peer groups such as close friendships within a school can play in the relationship between adolescent sexual behaviors and school-level factors.

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## Appendix

**Table A1**

Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves (ref: (1) had no sex by wave 2), 2011–2013

	(1)		(2)		(3)		(4)		(5)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
School socioeconomic composition	0.762***	0.879**	0.852***	0.867**	0.852***	0.907	0.855***	0.944		
Bottom tercile (ref.)										
Top tercile									0.590***	0.700*
Middle tercile									0.542***	0.674*
<i>Individual-level</i>										
Female			0.341***	0.746***	0.339***	0.746***	0.344***	0.743***	0.343***	0.742***
Age			1.594***	1.164***	1.589***	1.166***	1.596***	1.163***	1.597***	1.160***
Chewas (ref.)										
Tumbuka			0.923	1.223	0.922	1.226	0.918	1.229	0.909	1.250*
Yao			1.236	1.254	1.215	1.259	1.211	1.263	1.211	1.285
Ngoni			1.193	0.955	1.172	0.962	1.167	0.966	1.167	0.979
Others			1.147	1.018	1.132	1.025	1.126	1.030	1.121	1.047
Math performance			0.892*	0.915*	0.901	0.910**	0.903	0.911**	0.901	0.909**
Top 10% wealth index			0.919	1.358*	0.947	1.350	0.953	1.347	0.936	1.362*
Parent's secondary education completed			1.019	1.163*	1.003	1.169**	1.009	1.165**	1.006	1.178**
Father's high occupational status			0.983	1.043	0.984	1.042	0.984	1.042	0.980	1.048
Both parents (ref.)										
Mother only			0.872	1.047	0.870	1.051	0.872	1.047	0.874	1.051

	(1)		(2)		(3)		(4)		(5)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
Father only			1.304	1.211	1.300	1.210	1.307	1.210	1.307	1.212
No parents			1.404	1.366*	1.408	1.371*	1.407	1.375*	1.406	1.389*
<i>School-level</i>										
Average class size					0.998	0.996	0.998	0.995	1.000	0.996
Rurality					0.835	1.284	0.788	1.280	0.777	1.157
Conventional					0.718	0.764	0.783	0.945	0.756	0.923
Secondary School										
% Have ever repeated							1.001	1.017	0.998	1.011
% Satisfied with school							0.993	0.989	0.993	0.990
Mean study after school							0.805	0.667	0.649	0.583
Constant	0.297***	0.486***	0.000***	0.053***	0.000***	0.073***	0.001***	0.599	0.004***	1.484
N (Schools)	33	33	33	33	33	33	33	33	33	33
N (Students)	7916	7916	7916	7916	7916	7916	7916	7916	7916	7916

\* p < 0.05,  
 \*\* p < 0.01  
 \*\*\* p < 0.001

**Table A2**

Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves (ref: (1) had no sex by wave 2), males, 2011–2013

	(1)		(2)		(3)		(4)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
School socioeconomic composition	0.716***	0.815**	0.799***	0.805**	0.766***	0.825*	0.786***	0.895
<i>Individual-level</i>								
Age			1.544***	1.191***	1.542***	1.193***	1.543***	1.187***
Chewas (ref.)								
Tumbuka			1.088	1.255	1.090	1.262	1.084	1.261
Yao			1.627*	1.705**	1.591*	1.712**	1.582*	1.725**
Ngoni			1.036	1.014	1.001	1.029	0.995	1.033
Others			1.363	1.202	1.328	1.218	1.319	1.228
Math performance			0.950	0.934	0.967	0.925	0.967	0.928
Top 10% wealth index			0.854	1.317	0.895	1.298	0.902	1.281
Parent's secondary education completed			1.155	1.363**	1.129	1.375**	1.134	1.364**
Father's high occupational status			0.822	0.865	0.818	0.864	0.819	0.865

	(1)		(2)		(3)		(4)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
Both parents (ref.)								
Mother only			0.779	0.919	0.772	0.923	0.772	0.905
Father only			1.688	1.246	1.683	1.241	1.693*	1.233
No parents			2.101***	1.472*	2.131***	1.484*	2.127***	1.501*
<i>School-level</i>								
Average class size					1.000	0.997	0.998	0.993
Rurality					0.642	1.260	0.574*	1.174
Conventional					0.475***	0.549	0.749	1.098
Secondary School								
% Have ever repeated							0.991	1.013
% Satisfied with school							0.984*	0.977*
Mean study after school							0.604	0.370*
Constant	0.524***	0.582***	0.000***	0.031***	0.000***	0.041***	0.008	9.678
N (Schools)	33	33	33	33	33	33	33	33
N (Students)	3950	3950	3950	3950	3950	3950	3950	3950

\* p &lt; 0.05,

\*\* p &lt; 0.01

\*\*\* p &lt; 0.001

**Table A3**

Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves (ref: (1) had no sex by wave 2), females, 2011–2013

	(1)		(2)		(3)		(4)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
School socioeconomic composition	0.843**	0.941	0.945	0.932	0.987	0.947	0.978	0.973
<i>Individual-level</i>								
Age			1.766***	1.132***	1.774***	1.132***	1.791***	1.130***
Chewas (ref.)								
Tumbuka			0.676	1.155	0.682	1.154	0.680	1.155
Yao			0.654	0.933	0.664	0.935	0.663	0.940
Ngoni			1.525*	0.880	1.547*	0.886	1.549*	0.888

	(1)		(2)		(3)		(4)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
Others			0.924	0.878	0.937	0.883	0.932	0.885
Math performance			0.788*	0.913	0.781**	0.912*	0.787*	0.913*
Top 10% wealth index			1.110	1.402*	1.105	1.399*	1.106	1.396*
Parent's secondary education completed			0.839	1.016	0.846	1.018	0.855	1.020
Father's high occupational status			1.181	1.212*	1.174	1.211*	1.166	1.204*
Both parents (ref.)								
Mother only			1.008	1.134	1.005	1.138	1.005	1.141
Father only			0.635	1.223	0.640	1.223	0.622	1.221
No parents			0.414*	1.331	0.414*	1.333	0.414*	1.329
<i>School-level</i>								
Average class size					0.997	0.996	0.999	0.996
Rurality					1.469	1.209	1.517	1.335
Conventional					0.803	0.727	0.687	0.700
Secondary School								
% Have ever repeated							1.009	1.022
% Satisfied with school							1.011	1.004
Mean study after school							1.204	1.199
Constant	0.134***	0.414***	0.000***	0.068***	0.000***	0.092***	0.000***	0.027
N (Schools)	33	33	33	33	33	33	33	33
N (Students)	3966	3966	3966	3966	3966	3966	3966	3966

\* p < 0.05,  
 \*\* p < 0.01  
 \*\*\* p < 0.001

**Table A4**

Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves (ref: (1) had no sex by wave 2), by constituent socioeconomic measure of school, 2011–2013

	(1)	(2)	(3)
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
% Top 10% wealth index	0.965***	0.994	
% Parent's secondary school completed		0.987**	0.996

	(1)		(2)		(3)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
% Father's high occupational status					0.980*	0.991
<i>Individual-level</i>						
Female	0.343***	0.743***	0.344***	0.743***	0.344***	0.743***
Age	1.595***	1.164***	1.597***	1.162***	1.598***	1.162***
Chewas (ref.)						
Tumbuka	0.928	1.218	0.909	1.232	0.900	1.238
Yao	1.214	1.255	1.206	1.266	1.191	1.273
Ngoni	1.170	0.961	1.162	0.967	1.152	0.971
Others	1.131	1.024	1.121	1.032	1.108	1.036
Math performance	0.902	0.911**	0.904	0.910**	0.903	0.910**
Top 10% wealth index (CWC)	0.968	1.336				
Parent's secondary education completed (CWC)			1.009	1.167**		
Father's high occupational status (CWC)					0.982	1.045
Top 10% wealth index			0.942	1.351	0.935	1.355
Parent's secondary education completed	1.007	1.162**			0.999	1.171**
Father's high occupational status	0.981	1.040	0.981	1.044		
Both parents (ref.)						
Mother only	0.874	1.045	0.872	1.048	0.868	1.050
Father only	1.308	1.209	1.302	1.211	1.307	1.211
No parents	1.416	1.371*	1.406	1.377*	1.391	1.381*
<i>School-level</i>						
Average class size	0.996	0.994	0.999	0.995	0.999	0.995
Rurality	0.830	1.354	0.773	1.258	0.875	1.305
Conventional	0.840	0.951	0.763	0.931	0.750	0.929
Secondary School						
% Have ever repeated	1.004	1.020	1.003	1.017	1.003	1.017
% Satisfied with school	0.993	0.990	0.993	0.990	0.993	0.989
Mean study after school	0.784	0.665	0.724	0.634	0.875	0.696
Constant	0.002***	0.654	0.003***	0.959	0.001***	0.615
N (Schools)	33	33	33	33	33	33
N (Students)	7916	7916	7916	7916	7916	7916

\* p &lt; 0.05,

\*\* p &lt; 0.01

\*\*\*  
p < 0.001

**Table A5**

Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves (ref: (1) had no sex by wave 2), by constituent socioeconomic measure of school and by gender, 2011–2013

	(1)	(2)	(3)	(4)	(5)	(6)
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
% Top 10% wealth index	0.950***	0.986			0.990	1.000
% Parent's secondary school completed		0.980***	0.991			0.999
% Father's high occupational status				0.968**	0.985	
<i>Individual-level</i>						
<i>Female</i>						
Age	1.543***	1.189***	1.545***	1.185***	1.546***	1.187***
Chewas (ref.)						
Tumbuka	1.092	1.241	1.070	1.275	1.062	1.269
Yao	1.573*	1.706**	1.575*	1.741**	1.559*	1.732**
Ngoni	0.992	1.025	0.989	1.041	0.983	1.038
Others	1.324	1.214	1.310	1.239	1.297	1.235
Math performance	0.967	0.929	0.969	0.927	0.968	0.927
Top 10% wealth index (CWC)	0.912	1.263				1.131
Parent's secondary education completed (CWC)			1.136	1.372**		
Father's high occupational status (CWC)					0.819	0.865
Top 10% wealth index			0.888	1.292	0.883	1.286
Parent's secondary education completed	1.127	1.356**			1.124	1.369**
Father's high occupational status	0.811	0.863	0.816	0.868		1.177
<i>Both parents (ref.)</i>						
Mother only	0.772	0.902	0.770	0.907	0.769	0.907
Father only	1.693*	1.230	1.686	1.234	1.692	1.232
No parents	2.147***	1.497*	2.120***	1.505*	2.092***	1.501*
<i>School-level</i>						
Average class size	0.994	0.992	1.000	0.995	0.999	0.994
Rurality	0.630*	1.299	0.533*	1.065	0.683	1.291
Conventional	0.861	1.151	0.740	1.107	0.707	1.082
<i>Secondary School</i>						
% Have ever repeated	0.996	1.018	0.992	1.011	0.995	1.015
% Satisfied with school	0.984*	0.977*	0.984*	0.977*	0.984*	0.977*
Mean study after school	0.577	0.364*	0.508	0.334*	0.674	0.383

	(1)		(2)		(3)		(4)		(5)		(6)	
	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2	(1) had no sex by wave 2 vs. (3) already had sex by wave 1	(1) had no sex by wave 2 vs. (4) lost-to-follow-up at wave 2
Constant	0.021	12.498	0.050	28.637	0.009	10.863	0.000***	0.029	0.000***	0.030	0.000***	0.024*
N (Schools)	33	33	33	33	33	33	33	33	33	33	33	33
N (Students)	3950	3950	3950	3950	3950	3950	3966	3966	3966	3966	3966	3966

\* p < 0.05,  
 \*\* p < 0.01  
 \*\*\* p < 0.001



Table 1

Descriptive statistics (weighted sample), unmarried Malawian secondary school students, 2011–2013

	Total Mean	Min	Max	Males Mean	Females Mean
<i>Dependent variable</i>					
Had no sex by wave 2	0.51	0.00	1.00	0.42	0.59
Initiate sex between two waves	0.10	0.00	1.00	0.11	0.08
Already had sex by wave 1	0.16	0.00	1.00	0.23	0.08
Lost-to-follow-up at wave 2	0.24	0.00	1.00	0.24	0.24
<i>Individual-level</i>					
Age	16.21	11.00	29.00	16.70	15.71
Ethnicity					
Chewa	0.51	0.00	1.00	0.53	0.49
Tumbuka	0.09	0.00	1.00	0.08	0.09
Yao	0.07	0.00	1.00	0.07	0.07
Ngoni	0.18	0.00	1.00	0.18	0.18
Others	0.15	0.00	1.00	0.14	0.16
Math performance	2.83	1.00	5.00	3.01	2.65
Top 10% wealth index	0.10	0.00	1.00	0.10	0.10
Parent's secondary education completed	0.50	0.00	1.00	0.47	0.52
Father's high occupational status	0.26	0.00	1.00	0.24	0.27
<i>Household composition</i>					
Both parents	0.76	0.00	1.00	0.75	0.77
Mother only	0.14	0.00	1.00	0.13	0.14
Father only	0.05	0.00	1.00	0.06	0.04
No parents	0.05	0.00	1.00	0.06	0.05
<i>School-level</i>					
Average class size	70.97	29.00	111.50	69.85	72.12
Rurality	0.14	0.00	1.00	0.14	0.13
Conventional Secondary School	0.16	0.00	1.00	0.18	0.15
% Have ever repeated	10.30	3.74	21.84	10.16	10.43
% Satisfied with school	23.24	6.80	60.92	23.38	23.09

	<b>Total Mean</b>	<b>Min</b>	<b>Max</b>	<b>Males Mean</b>	<b>Females Mean</b>
Mean study after school	4.87	4.28	5.47	4.87	4.87
School socioeconomic composition	-0.04	-2.94	2.80	-0.10	0.01
% Top 10% wealth index	9.93	0.00	31.03	9.83	10.03
% Parent's secondary school completed	49.64	12.87	72.46	48.88	50.42
% Father's high occupational status	25.35	6.85	46.38	25.00	25.70
Observations	7916			3950	3966

Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves, 2011–2013

Table 2

	(1) Total	(2) Total	(3) Total	(4) Total	(5) Total
School socioeconomic composition	0.806***	0.870***	0.864**	0.910	
Bottom tercile (ref.)					
Top tercile					0.696*
Middle tercile					0.757
<i>Individual-level</i>					
Female	0.603***	0.605***	0.599***	0.599***	0.599***
Age	1.284***	1.281***	1.275***	1.276***	1.276***
Chewas (ref.)					
Tumbuka	1.267	1.262	1.266	1.241	1.241
Yao	0.972	0.971	0.977	0.956	0.956
Ngoni	1.214	1.207	1.214	1.190	1.190
Others	1.205	1.195	1.205	1.180	1.180
Math performance	0.844*	0.846*	0.846*	0.846*	0.848*
Top 10% wealth index	0.696	0.690	0.688	0.685	0.685
Parent's secondary education completed	0.875	0.877	0.872	0.864	0.864
Father's high occupational status	0.769	0.770	0.770	0.767	0.767
Both parents (ref.)					
Mother only	0.949	0.947	0.944	0.937	0.937
Father only	0.761	0.762	0.760	0.763	0.763
No parents	0.696	0.696	0.698	0.692	0.692
<i>School-level</i>					
Average class size		0.996	0.995	0.995	0.995
Rurality		0.878	0.911	0.919	0.919
Conventional Secondary School		0.910	1.141	1.135	1.135
% Have ever repeated			1.026	1.025	1.025
% Satisfied with school			0.990*	0.991*	0.991*

	(1) Total	(2) Total	(3) Total	(4) Total	(5) Total
Mean study after school				0.674	0.590
Constant	0.189***	0.008***	0.011***	0.082	0.181
N (Schools)	33	33	33	33	33
N (Students)	7916	7916	7916	7916	7916
Log-likelihood	-11151.19	-10490.46	-10477.01	-10468.00	-10466.48

\* p < 0.05,

\*\* p < 0.01

\*\*\* p < 0.0001

**Table 3**  
Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves, by gender, 2011–2013

	(1) Male	(2) Male	(3) Male	(4) Male	(5) Female	(6) Female	(7) Female	(8) Female
School socioeconomic composition	0.825***	0.882*	0.843*	0.861*	0.762***	0.830**	0.817**	0.909
<i>Individual-level</i>								
Age	1.218***	1.216***	1.216***	1.216***		1.408***	1.406***	1.371***
Chewas (ref.)								
Tumbuka	1.715	1.708	1.708	1.705		0.815	0.808	0.818
Yao	0.599	0.603	0.603	0.598		1.398	1.382	1.428
Ngoni	1.099	1.101	1.101	1.089		1.339	1.339	1.351
Others	1.855*	1.851*	1.851*	1.823*		0.626	0.624	0.638
Math performance	0.905	0.906	0.906	0.907		0.773*	0.779*	0.770*
Top 10% wealth index	0.596*	0.592*	0.592*	0.593*		0.898	0.890	0.895
Parent's secondary education completed	0.959	0.960	0.960	0.960		0.835	0.835	0.826
Father's high occupational status	0.597	0.603	0.603	0.605		0.965	0.963	0.949
Both parents (ref.)								
Mother only	0.928	0.933	0.933	0.929		0.951	0.963	0.956
Father only	1.154	1.171	1.171	1.183		0.245*	0.242*	0.249*
No parents	0.827	0.833	0.833	0.841		0.590	0.594	0.594
<i>School-level</i>								
Average class size			1.000	0.998			0.992	0.992
Rurality			0.755	0.634			0.992	1.288
Conventional Secondary School			0.749	1.253			0.640*	0.784
% Have ever repeated				0.988				1.059**
% Satisfied with school				0.986*				0.998
Mean study after school				0.440				1.089
Constant	0.262***	0.014***	0.016***	1.526	0.134***	0.001***	0.002***	0.001*
N (Schools)	33	33	33	33	33	33	33	33

	(1) Male	(2) Male	(3) Male	(4) Male	(5) Female	(6) Female	(7) Female	(8) Female
N (Students)	3950	3950	3950	3950	3966	3966	3966	3966
Log-likelihood	-5958.03	-5687.45	-5666.63	-5653.91	-4906.24	-4690.14	-4685.31	-4674.18

\*  $p < 0.05$ ,

\*\*  $p < 0.01$

\*\*\*  $p < 0.0001$

**Table 4**

Relative risk ratios from two-level multinomial logistic regression models of school socioeconomic composition on sexual initiation between two waves, by constituent socioeconomic measure of school and by gender, 2011–2013

	(1) Total	(2) Total	(3) Total	(4) Male	(5) Male	(6) Male	(7) Female	(8) Female	(9) Female
% Top 10% wealth index	0.974**		0.958***				0.984		
% Parent's secondary school completed		0.991			0.987			0.991	
% Father's high occupational status			0.986			0.981			0.980
<i>Individual-level</i>									
Female	0.598***	0.599***	0.599***						
Age	1.274***	1.276***	1.276***	1.212***	1.217***	1.219***	1.375***	1.371***	1.371***
Chewas (ref.)									
Tumbuka	1.282	1.257	1.253	1.761	1.681	1.672	0.808	0.816	0.817
Yao	0.987	0.972	0.969	0.611	0.592	0.589	1.408	1.426	1.429
Ngoni	1.223	1.208	1.206	1.111	1.078	1.074	1.335	1.351	1.350
Others	1.216	1.199	1.195	1.871*	1.802*	1.795*	0.629	0.639	0.639
Math performance	0.845*	0.846*	0.846*	0.905	0.908	0.908	0.769*	0.771*	0.770*
Top 10% wealth index (CWC)	0.697		0.608*				0.894		
Parent's secondary education completed (CWC)		0.870			0.955			0.827	
Father's high occupational status (CWC)			0.768			0.600			0.953
Top 10% wealth index		0.685	0.683	0.588*	0.586*	0.586*	0.888	0.890	0.890
Parent's secondary education completed	0.876		0.868	0.970		0.953	0.817		0.826
Father's high occupational status	0.771	0.768		0.607	0.602		0.944	0.945	
Both parents (ref.)									
Mother only	0.946	0.943	0.942	0.934	0.926	0.926	0.950	0.959	0.955
Father only	0.762	0.759	0.759	1.188	1.178	1.177	0.250*	0.249*	0.249*
No parents	0.702	0.696	0.695	0.856	0.836	0.833	0.588	0.596	0.594
<i>School-level</i>									
Average class size	0.993*	0.996	0.995	0.995	0.999	0.998	0.991	0.993	0.992
Rurality	0.932	0.912	0.981	0.639	0.620	0.751	1.385	1.315	1.269
Conventional Secondary School	1.187	1.119	1.113	1.414	1.247	1.214	0.824	0.792	0.734

	(1) Total	(2) Total	(3) Total	(4) Male	(5) Male	(6) Male	(7) Female	(8) Female	(9) Female
% Have ever repeated	1.027	1.027	1.027	0.989	0.990	0.993	1.063***	1.062**	1.054**
% Satisfied with school	0.991*	0.990	0.990	0.986*	0.985*	0.985	0.997	0.998	0.998
Mean study after school	0.668	0.628	0.702	0.425*	0.392*	0.454	1.049	1.013	1.240
Constant	0.116	0.154	0.085	3.186	4.477	1.646	0.002*	0.002*	0.001*
N (Schools)	33	33	33	33	33	33	33	33	33
N (Students)	7916	7916	7916	3950	3950	3950	3966	3966	3966
Log-likelihood	-10464.80	-10469.40	-10470.99	-5650.97	-5655.29	-5656.97	-4674.47	-4674.25	-4673.34

CWC = centering within cluster

\* p < 0.05,

\*\* p < 0.01

\*\*\* p < 0.001