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Abstract

Introduction: Among people who have ever attended school, higher educational attainment appears to be associated with higher prevalence of HIV. This study assesses the association between education and HIV status in Malawi, among individuals with some education, after adjusting for various background characteristics.

Methods: We used nationally representative data from the 2010 Malawi Demographic and Health Survey (MDHS). A weighted total of 5,092 women age 15-49 and 5,460 men age 15-54 who were tested for HIV and ever had sex were included in the analysis. Multiple logistic regressions were used to explore the association between HIV status and educational attainment, as well as other factors.

Results: Among women with a secondary education, compared with women with a primary education, the unadjusted odds ratio of testing HIV-positive was 1.6. Men with a secondary education had 1.1 higher odds of testing HIV-positive compared with men with a primary education. Among women with a tertiary education, compared with women with a primary education, the odds ratio was 1.5, and among men it was 1.7. The association of HIV prevalence with education, however, was no longer significant in the models controlling for variables related to high-risk behaviors, access to health care services, and partner and demographic characteristics. Adjusted models showed significantly increased odds of HIV associated with a higher lifetime number of partners, marriage status, comprehensive knowledge of HIV/AIDS among men but not women, older age, urban residence, residence in the Southern Region of Malawi, higher wealth status, higher occupation rank, and among women but not men.

Conclusion: Education was not found to be associated with being HIV-positive, but lifetime number of sexual partners, age, residence, and wealth status may be important factors associated with HIV seropositivity. Except for lifetime number of sexual partners and marital history, the other factors that are most likely to be associated with HIV seropositivity reflect survival rates related to knowledge and access to care. Individuals with higher education may live longer with HIV infection than individuals with lower educational attainment, resulting in higher HIV prevalence among the educated, even if their infection rates are not as high. Our findings perhaps suggest a need for better education on HIV/AIDS and better health practices, while further supporting avoidance of risky behavior.

Key words: Educational attainment, HIV, Malawi

1. Introduction

HIV Epidemiology in Malawi

Malawi is among the countries worst affected by the HIV pandemic. In Malawi, the number of people living with HIV and AIDS (PLHIV) was estimated to be over one million in 2014, which includes 930,000 people age 15 and older, and 130,000 children under age 14 (UNAIDS 2016). Sixty percent of seropositive adults are women. In 2014, the prevalence of HIV was estimated at 10%, and the number of new cases was estimated at 34,000 per year, including 26,000 new infections among people age 15 and older, and 7,400 new infections among children under age 15 (National AIDS Commission 2015).

After the first case of HIV was diagnosed in 1981, the number of people affected rose until peaking in 1999. From then, both the incidence and prevalence of HIV in Malawi have been declining, largely due to reduction in risky behavior (Bello et al. 2011). Slowing of the incidence of HIV resulted in a reduction of HIV prevalence, as smaller proportions of the population were newly infected. Another determinant of prevalence of HIV in Malawi is longer survival of HIV patients. Since 2004, Malawi scaled up Antiretroviral Therapy (ART), which has influenced the trajectory of the HIV epidemic by reducing mortality, morbidity, and transmission (Government of Malawi 2015). In addition, seropositive individuals have greater access to improved care through prophylaxis treatment of infection, improved management, and nutritional support. Between 2010 and 2015, ART services averted an estimated 30,000-35,000 deaths each year (UNAIDS 2016). Although there has been reduction in incidence over time, more patients now survive for longer, and HIV remains an important disease with a high burden on the Malawian society.

The 2010 Malawi Demographic and Health Survey (DHS) shows that prevalence of HIV varies substantially with gender, age, urban-rural residence, geographic area, and socioeconomic status. Among adults age 15-49, women have higher HIV prevalence than men (13% compared with 8%). Gender and age seem to interact, with the age distribution of HIV prevalence varying between women and men. Adolescent and young women in Malawi have four times higher HIV prevalence than men in the same age groups (National Statistical Office (NSO) and ICF Macro 2011). This difference has also been observed elsewhere. For example, in South Africa in 2014 adolescent and young women had eight times higher risk than men in the same age groups (Dellar, Dlamini, and Karim 2015). Factors considered to determine this pattern, both in Malawi and South Africa, include but are not limited to intergenerational sex, social vulnerability, and biological vulnerability of young women. In Malawi, however, men are affected more in older ages, over age 35, and also the cumulative lifetime number of sex partners is correlated strongly with HIV prevalence among men. Other factors presumed to affect HIV prevalence among men include

increasing income with age, which enables men to pay for transactional sex and to have multiple concurrent sexual relationships.

Distribution of prevalence of HIV in Malawi also varies by residence and region of the country. HIV prevalence is twice as high in urban areas (17%) compared with rural areas (9%). Among the three regions of Malawi, HIV prevalence is highest in the Southern Region, at 14.5%, double that in the Northern Region and Central Region. Within these broad geographical regions, variations also exist by district, sub-district, proximity to main roads, and socio-demographic groups (National Statistical Office (NSO) and ICF Macro 2011).

Association of HIV Prevalence and Educational Attainment

Educational status is well recognised as a positive determinant of health. The World Health Organization (WHO) lists education as one of the key determinants of health and explains that higher education levels are linked with better health outcomes (World Health Organization 2016). A recent review of the Sustainable Development Goals (SDGs) showed that education leverages health outcomes (Vladimirova and Le Blanc 2015).

Recent Demographic and Health Surveys (DHS) in Malawi show that HIV prevalence in Malawi varies by educational attainment but with a bimodal distribution—that is, prevalence is highest among those with no education, while among those who ever attended school, HIV prevalence increases with the level of education attained (National Statistical Office (NSO) and ICF Macro 2011; (National Statistical Office (NSO) [Malawi] and ORC Macro 2005). This observation has also been made in other countries (Hargreaves and Glynn 2002; Smith et al. 1999; Fortson 2008).

Factors affecting HIV prevalence among those who are educated may be different from those among individuals without education. These factors therefore need to be investigated separately. In this study, we examined factors associated with educational attainment and HIV prevalence only among those who ever attended school, because of the potential to influence policy for targeted interventions in schools. Our study conceptualizes that attainment of higher education is associated with either an increase in risky behaviors or an increase in survival rates. More risky behavior probably is due to better access to disposable income, increased travel, and increased time away from home that may increase the lifetime number of sexual partners. Survival could also be related to education in that higher educational attainment promotes better access to and use of health care services (National Statistical Office (NSO) and ICF Macro 2011).

Study Rationale

An increasing burden of HIV with increasing educational level works against the goals of investing in education. The substantial investment required by the country to educate Malawians, especially

at the tertiary level, may not yield the expected returns to education because of the dangers posed by HIV/AIDS. Therefore, we need prevention measures that protect the school-going young population from primary HIV infection. Schools and academic institutions provide a logical venue for interventions targeting this high-risk population. In Malawi, however, academic institutions and schools lack a strong public health policy to back school-based HIV prevention interventions, such as condom promotion and distribution. Such interventions are widely considered in Malawi to promote sexuality among children, in a society with cultural and religious values that only accept sex after marriage, and therefore are rarely implemented. As intervention is clearly needed, and as schools are a conducive environment for targeted protection of young adolescents, youths, and young adults who are attaining an education, it is critical that other solutions be explored. Further examination of factors influencing HIV infection and survival may help to explain the paradoxical association of educational attainment and HIV prevalence, among those who have received any schooling, and therefore to better understand which interventions may be most effective in reaching Malawians who have attended school.

One of the paradigm shifts in the National HIV Prevention Strategy 2015-2020 in Malawi is a focus on targeted interventions, in contrast to blanket coverage. Our study is complementary to this prevention strategy, as it examines prevalence of HIV among a specific population. Through the National HIV Prevention Strategy 2015-2020, Malawi seeks to complement the global effort that integrates treatment and prevention—"90-90-90: The Ambitious Treatment Target to Help End the AIDS Epidemic" (UNAIDS 2014). This study aims to provide evidence toward targeted solutions that will have local and global impact on reducing prevalence of HIV.

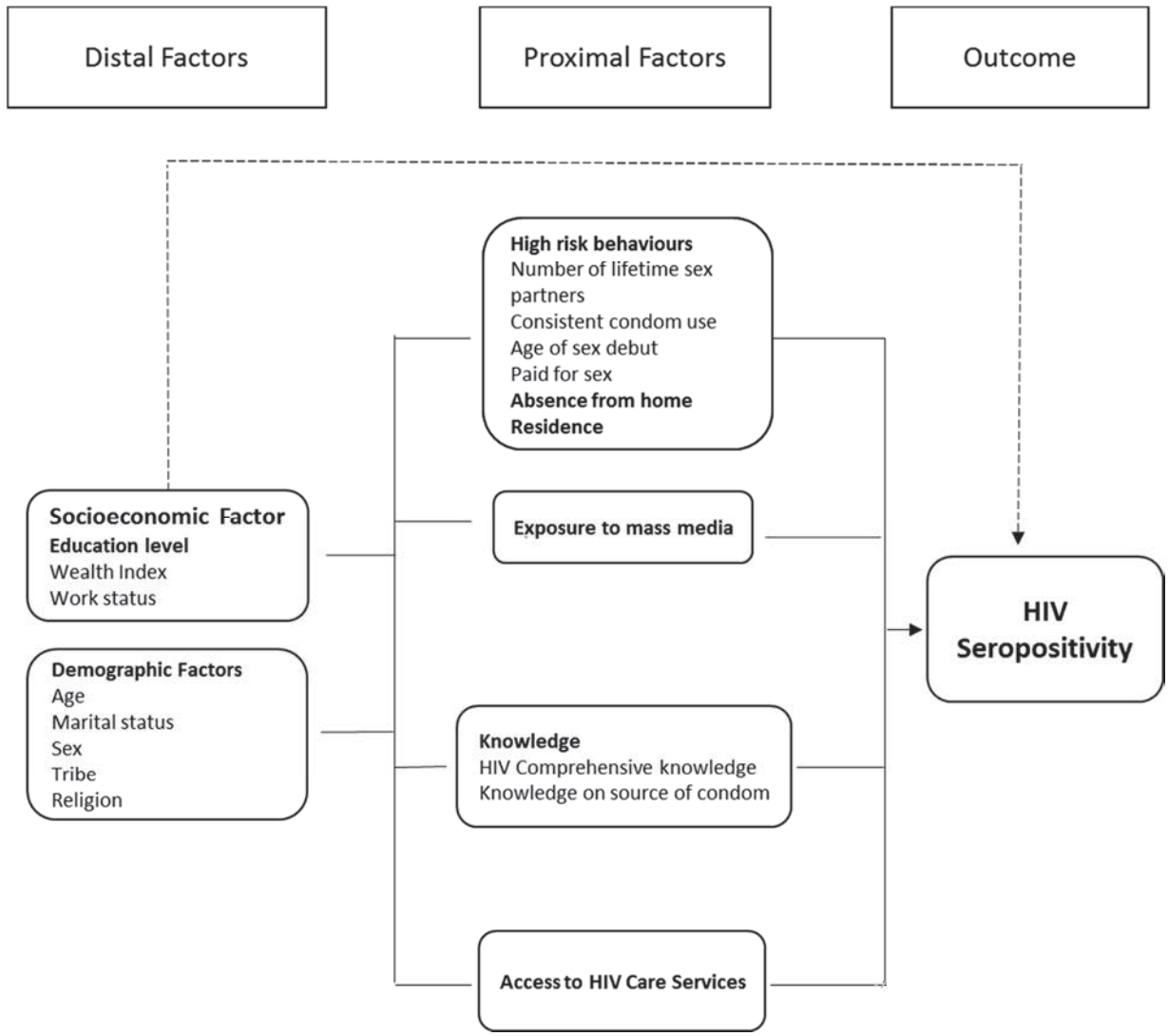
Conceptual Framework

Based on the literature regarding risk factors for HIV infection, we created a conceptual framework to guide our analysis (Figure 1). The conceptual framework has two levels of associated factors that determine prevalence of HIV among educated individuals: distal and proximal factors. Distal factors are the underlying or contextual factors that influence proximal factors. In addition to educational attainment, other distal factors include socioeconomic status (measured using the DHS wealth index), work status, and demographic characteristics such as age, sex, marital status, tribe, and religion.

Higher educational status is associated with higher income in Malawi (Castel, Phiri, and Stampini 2010). Those with higher education are more likely to have the means to pay for sex and to have a greater lifetime number of sexual partners. Similarly, higher wealth, working status, and older age may increase exposure to a higher lifetime number of partners. Women are biologically vulnerable to HIV infection, and younger age puts them at higher risk of intergenerational sex, which is an independent risk factor (Dellar, Dlamini, and Karim 2015; Tenkorang 2014). Religion

and tribe may influence age at sexual debut and risk of multiple sexual partners. Some tribes in Malawi are known to have values that promote risky sexual behavior through cultural rituals (Peters, Kambewa, and Walker 2010). However, educational attainment may improve individuals' assertiveness to refuse participation in high-risk behaviors. In addition, more highly educated seropositive individuals may be more likely to seek care and to have access to treatment such as ART compared with those with less education. Although HIV care is although offered free in Malawi, it has cost implications mainly related to transportation (Pinto et al. 2013). Therefore, individuals with higher education may live longer with HIV infection than those with lower educational attainment. This may result in higher HIV prevalence rates among the educated, even if their infection rates are not as high.

Figure 1. Association between HIV status and educational level: A conceptual framework

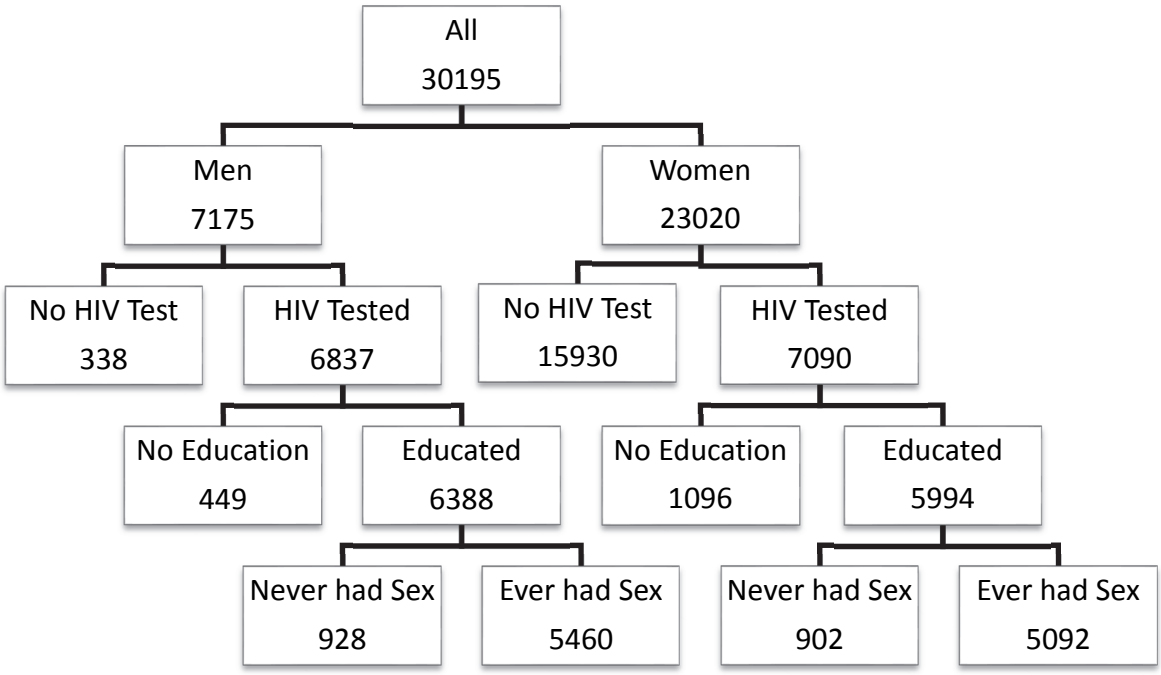


2. Methods

2.1. Data

We used nationally representative data from the 2010 Malawi Demographic and Health Survey (MDHS). The 2010 MDHS used a two-stage clustering sample design and selected 849 clusters with a total of 27,345 households. A subsample of one-third of the households was selected for HIV testing among eligible women age 15-49 and eligible men age 15-54. Only those tested for HIV during the survey were selected in the first stage of our study sample selection. Our study primarily aims to provide information that will support targeted interventions in schools, and hence the analysis focused on people who ever attended school and excluded those who never attended school. In addition, we focused on women and men who were ever exposed to sexual activities, because sexual transmission is the primary source of HIV infection in Malawi; hence only women and men who attended school and ever had sex were included in the study sample. Figure 2 shows the derivation of the analysis sample.

Figure 2. Derivation of the analysis sample



2.2. Key Variables

For our analysis the outcome variable was HIV serostatus. The independent variables included eight distal factors: educational attainment, wealth index, work status, age, marital status, sex, tribe, and religion; and included nine proximal factors: lifetime number of sex partners, consistent condom use, age of sexual debut, paying for sex, exposure to media, HIV/AIDS comprehensive knowledge, knowledge on source of condom, access to services, and staying away from home. We analysed educational attainment as a categorical variable but explored its performance when modelled as a continuous variable.

All of our measures were simple binary or categorical variables defined as response categories in the DHS questionnaire, except for the variable on comprehensive knowledge on HIV/AIDS. This variable is a binary (yes/no) variable defined as knowing that using a condom consistently during sexual intercourse and having just one uninfected faithful partner can reduce the chance of getting the AIDS virus, knowing that a healthy-looking person can have the AIDS virus, and rejecting the two most common misconceptions in Malawi about AIDS transmission or prevention (i.e. knowing correctly that mosquitoes do not transmit HIV and that one cannot get HIV through witchcraft) (National Statistical Office (NSO) and ICF Macro 2011).

A variable on access to ART services was generated at the DHS cluster level using data from the Malawi Service Provision Assessment 2013-14 database(Ministry of Health (MoH) [Malawi] and ICF International 2014). GPS data from both DHS and SPA surveys were used to identify facilities with ART services within a 10-km buffer for rural clusters, and a 5-km buffer for urban clusters. Levels of access to ART services were defined as low if there was no facility with ART services within the respective buffer, medium if there was one facility with ART services, and high if there were two or more facilities with ART services within the buffer.

2.3. Statistical Analysis

We conducted the analysis in several steps. First, we explored the outcome and explanatory variables through descriptive analyses. We studied the variables in the different domains of our conceptual framework, namely socioeconomic and demographic characteristics, high-risk sexual behavior, knowledge of HIV, access to media, access to ART services, and urban-rural residence. We ran bivariate analyses of HIV serostatus with educational attainment as well as other factors, stratifying by sex. Finally, we ran multiple logistic regression analyses that had HIV serostatus as the outcome and educational attainment as the main predictor variable, controlling for age, age at sex debut, wealth index, access to ART services, religion, ethnicity, mass media exposure, consistent condom use, comprehensive HIV knowledge, and access to ART services. The

collinearity among the selected variables in the conceptual framework was checked before conducting the regressions.

STATA 14 was used in data management and analysis. Sample weight was applied to correct for non-response and sampling disproportionalities, and the analysis accounted for the effect of complex survey design. Odds ratios and their corresponding 95% confidence intervals were reported to determine independent association of the variables with HIV prevalence. Statistical significance level was set at $p<0.05$.

3. Results

3.1. Sample Description

A weighted sample of 5,092 women and 5,460 men who attended at least one year of schooling and ever had sex were included in the analysis. Table 1 summarizes background characteristics of women and men in the sample. The majority of respondents among women (77%) and men (67%) had attained only primary school education, were rural residents (79% of women and 78% of men), and were married at the time of the survey (76% of women and 67% men). About a third of the population were youth under age 25. Access to ART services was good—77% of women and 78% of men resided near two or more facilities that provided ART services.

Table 1. Percent distribution of women and men included in the analysis, by background characteristics

	Women		Men	
Background characteristics	**Number**	**%**	**Number**	**%**
Education				
Primary	3,937	77.3	3,637	66.6
Secondary	1,038	20.4	1,636	30.0
Tertiary	117	2.3	186	3.4
Age				
15-19	672	13.2	922	16.9
20-24	1,193	23.4	991	18.2
25-29	1,273	25.0	973	17.8
30-34	752	14.8	816	14.9
35-39	562	11.0	652	11.9
40-44	352	6.9	447	8.2
45-49	288	5.7	371	6.8
50-54	n/a	n/a	287	5.3
Marital status				
Never married	450	8.8	1,624	29.7
Currently married	3,882	76.2	3,628	66.5
Formerly married	760	14.9	207	3.8
Residence				
Rural	4,023	79.0	4,281	78.4
Urban	1,069	21.0	1,179	21.6
Region				
Northern	651	12.8	602	11.0
Central	2,101	41.3	2,454	45.0
Southern	2,340	45.9	2,403	44.0
Wealth quintile				
Poorest	763	15.0	699	12.8
Poorer	954	18.7	1.051	19.3
Middle	998	19.6	1,122	20.6
Richer	1,022	20.1	1,154	21.1
Richest	1,355	26.6	1,433	26.2
Access to ART services				
Low	230	4.6	245	4.6
Medium	894	18.0	955	17.9
High	3,851	77.4	4,146	77.6
Total	5,092	100.0	5460	100.0

3.2. HIV Prevalence and Differentials by Educational Attainment and Other Background Characteristics

HIV prevalence among women was 15 % compared with 9% among men. Figure 3 shows an increase in HIV prevalence with increased educational attainment, among both women and men.

Figure 3. HIV prevalence by educational attainment among women and men, MDHS 2010

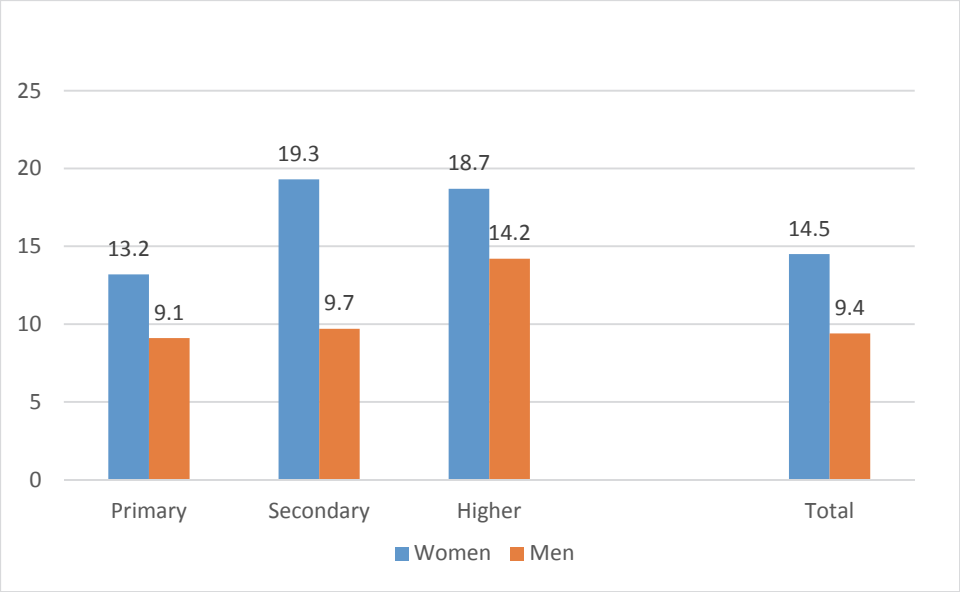


Table 2 shows HIV status by other background characteristics. HIV seropositivity is higher with increased education, age, and wealth status, higher among the employed compared with the unemployed, among rural compared with urban residents, in the Southern Region, and almost double among the formerly married compared with the married or never-married.

Table 2. Percentage of women and men who were HIV-positive, by background characteristics, Malawi 2010

	Women			Men		
Characteristic	**%**	**95% CI**	**N**	**%**	**95% CI**	**N**
Education						
Primary	13.2	[11.9,14.6]	3,937	9.1	[7.8,10.5]	3,637
Secondary	19.3	[15.8,23.4]	1,038	9.7	[7.9,11.8]	1,636
Tertiary	18.7	[11.4,29.2]	117	14.2	[9.4,20.9]	186
Age						
15-19	6.3	[4.2,9.2]	672	0.8	[0.4,1.7]	922
20-24	6.4	[4.8,8.4]	1,193	3.2	[2.0,5.3]	991
25-29	13.6	[11.3,16.4]	1,273	6.9	[5.0,9.6]	973
30-34	22.2	[18.6,26.3]	752	11.1	[8.5,14.5]	816
35-39	25.5	[21.0,30.5]	562	18	[14.0,22.8]	652
40-44	23.5	[18.6,29.4]	352	22.3	[17.3,28.4]	447
45-49	19.4	[14.6,25.4]	288	14.9	[11.1,19.7]	371
50-54	N/A	N/A	N/A	15.4	[10.4,22.1]	287
Residence						
Urban	26.3	[22.1,30.8]	1,069	15.1	[11.9,18.8]	1,179
Rural	11.4	[10.3,12.7]	4,023	7.9	[6.9,9.0]	4,281
Region						
Northern	9.3	[7.2,12.0]	651	6.5	[4.7,9.0]	602
Central	9.9	[7.9,12.4]	2,101	7.3	[5.7,9.3]	2,454
Southern	20.2	[18.1,22.4]	2,340	12.3	[10.7,14.3]	2,403
Religion						
Christian	14.3	[12.9,15.9]	4,467	9.5	[8.3,10.9]	4,638
Muslim	16.7	[13.2,21.0]	573	8.9	[6.4,12.1]	617
No/Other religion	8.8	[2.9,23.5]	52	8.5	[3.8,18.0]	205
Ethnicity						
Chewa	9.8	[8.0,12.0]	1,688	5.5	[4.1,7.3]	1,783
Tumbuka	11.2	[8.1,15.2]	505	5.9	[3.8,9.0]	466
Lomwe	22.8	[19.5,26.4]	883	14.5	[11.7,17.9]	1,035
Yao	19	[14.9,24.1]	602	12.3	[9.3,16.0]	670
Ngoni	14.8	[11.5,18.7]	677	8.8	[6.1,12.5]	715
Wealth index						
Poorest	8.5	[6.4,11.2]	763	5.8	[4.0,8.2]	699
Poorer	10.1	[8.2,12.5]	954	7.2	[5.4,9.6]	1,051
Middle	11.9	[9.8,14.4]	998	8.5	[6.6,10.9]	1,122
Richer	14.5	[11.8,17.6]	1,022	9.7	[7.5,12.4]	1,154
Richest	23	[19.6,26.8]	1,357	13.3	[10.8,16.3]	1,433
Marital status						
Never married	7.7	[5.2,11.3]	450	2.3	[1.5,3.5]	1,624
Currently married	11.7	[10.3,13.4]	3,882	11.9	[10.4,13.6]	3,628
Formerly married	32.8	[28.8,37.1]	760	22.1	[16.0,29.7]	207
Occupation						
Not employed	10.8	[8.3,14.0]	1,219	3.1	[1.7,5.6]	427
Unskilled/Manual	11	[9.5,12.6]	2,368	7.8	[6.7,9.1]	2,931
Clerical/Skilled	23.3	[20.5,26.4]	1,397	12.6	[10.6,14.8]	1,883
Technical/Managerial	21.3	[13.4,32.1]	108	16.6	[10.5,25.3]	218

3.3. Logistic Regression Analysis of Factors Associated with HIV Serostatus

Results of unadjusted logistic regressions

Table 3 presents the unadjusted logistic regression results looking at factors associated with HIV serostatus among educated women and men.

Table 3. Unadjusted logistic regression analysis of factors associated with HIV prevalence among educated Malawian women and men, MDHS 2010

	Women		Men	
Variables	**OR**	**95% CI**	**OR**	**95% CI**
Education				
Primary	1.0	-	1.0	-
Secondary	1.6***	1.2 - 2.0	1.1	0.8 - 1.4
Tertiary	1.5	0.8 - 2.7	1.7*	1.0 - 2.7
Age				
15-19	1.0	-	1.0	-
20-24	1.0	0.6 - 1.7	3.9**	1.5 - 10.0
25-29	2.4***	1.5 - 3.7	8.8***	3.8 - 20.6
30-34	4.3***	2.7 - 6.7	14.7***	6.5 - 33.1
35-39	5.1***	3.1 - 8.4	26.9***	11.6 - 62.3
40-44	4.6***	2.8 - 7.7	35.5***	15.0 - 84.1
45-49	3.6***	2.2 - 5.9	22.0***	9.2 - 52.4
50-54	n/a	n/a	23.3***	9.5 - 56.8
Residence				
Urban	1.0	-	1.0	-
Rural	0.4***	0.3 - 0.5	0.5***	0.4 - 0.7
Region				
Northern	1.0	-	1.0	-
Central	1.1	0.7 - 1.6	1.1	0.7 - 1.7
Southern	2.5***	1.8 - 3.3	2.0***	1.4 - 3.0
Religion				
Catholic	1.0	-	1.0	-
Muslim	1.2	0.9 - 1.6	0.9	0.6 - 1.3
No/Other religion	0.6	0.2 - 1.9	0.9	0.4 - 2.1
Ethnicity				
Chewa	1.0	-	1.0	-
Tumbuka	1.2	0.8 - 1.7	1.1	0.6 - 1.9
Lomwe	2.7***	2.1 - 3.6	2.9***	1.9 - 4.5
Yao	2.2***	1.5 - 3.1	2.4***	1.6 - 3.8
Ngoni	1.6*	1.1 - 2.3	1.7*	1.1 - 2.5
Other	1.5*	1.1 - 2.0	2.3***	1.5 - 3.6
Occupation				
Not employed	1.0	-	1.0	-
Unskilled/Manual	1.0	0.7 - 1.4	2.7**	1.4 - 5.0
Clerical/Skilled	2.5***	1.8 - 3.4	4.5***	2.4 - 8.6
Technical/Managerial	2.2*	1.2 - 4.2	6.2***	2.7 - 14.4

Continues

Table 3—*Continued*

	Women		Men	
Variables	**OR**	**95% CI**	**OR**	**95% CI**
Wealth quintile				
Poorest	1.0	-	1.0	-
Poorer	1.2	0.8 - 1.8	1.3	0.8 - 2.0
Middle	1.5*	1.0 - 2.1	1.5	0.9 - 2.4
Richer	1.8**	1.2 - 2.7	1.7*	1.1 - 2.8
Richest	3.2***	2.2 - 4.6	2.5***	1.6 - 3.9
Marital status				
Never married	1.0	-	1.0	-
Currently married	1.6*	1.0 - 2.5	5.6***	3.6 - 8.8
Formerly married	5.9***	3.7 - 9.4	11.9***	6.6 - 21.4
Travel away from home in past 12 months				
Did not travel away	1.0	-	1.0	-
Away for more than one month in last 12 months	1.2	0.9 - 1.7	0.9	0.6 - 1.3
HIV knowledge				
Comprehensive knowledge score	1.4**	1.2 - 1.8	1.6***	1.2 - 2.0
Know source for male condoms	1.0	-	1.0	-
Don't know source for male condoms	0.7	0.5 - 1.0	0.6	0.3 - 1.1
Know source for female condoms	1.0	-	1.0	-
Don't know source for female condoms	0.7**	0.6 - 0.9	0.9	0.7 - 1.1
Access to ART services within the buffer				
No access to ART services	1.0	-	1.0	-
Access to one facility with ART	2.2**	1.4 - 3.5	1.3	0.7 - 2.4
Access to two or more facilities with ART	2.5***	1.6 - 3.9	1.4	0.8 - 2.4
Access to radio (media)				
Less than once a week	1.0	-	1.0	-
At least once a week	1.1	0.8 - 1.4	1.0	0.7 - 1.3
Lifetime number of partners				
One partner	1.0	-	1.0	-
Two partners	2.7***	2.0 - 3.5	3.2***	1.9 - 5.2
Three partners	6.2***	4.5 - 8.5	5.2***	3.1 - 8.7
Four or more partners	12.5***	8.6 - 18.0	7.5***	4.7 - 12.2
Consistent condom use in past 12 months				
No	1.0	-	1.0	-
Yes	1.5	0.8 - 2.7	0.9	0.5 - 1.8
Age at sexual debut				
<14	1.0	-	1.0	-
14-18	0.9	0.6 - 1.2	1.5	0.9 - 2.4
19-24	0.7	0.5 - 1.1	1.3	0.8 - 2.2
>=25	1.1	0.7 - 1.7	1.4	0.8 - 2.6
Weighted number	5,092		5,460	

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

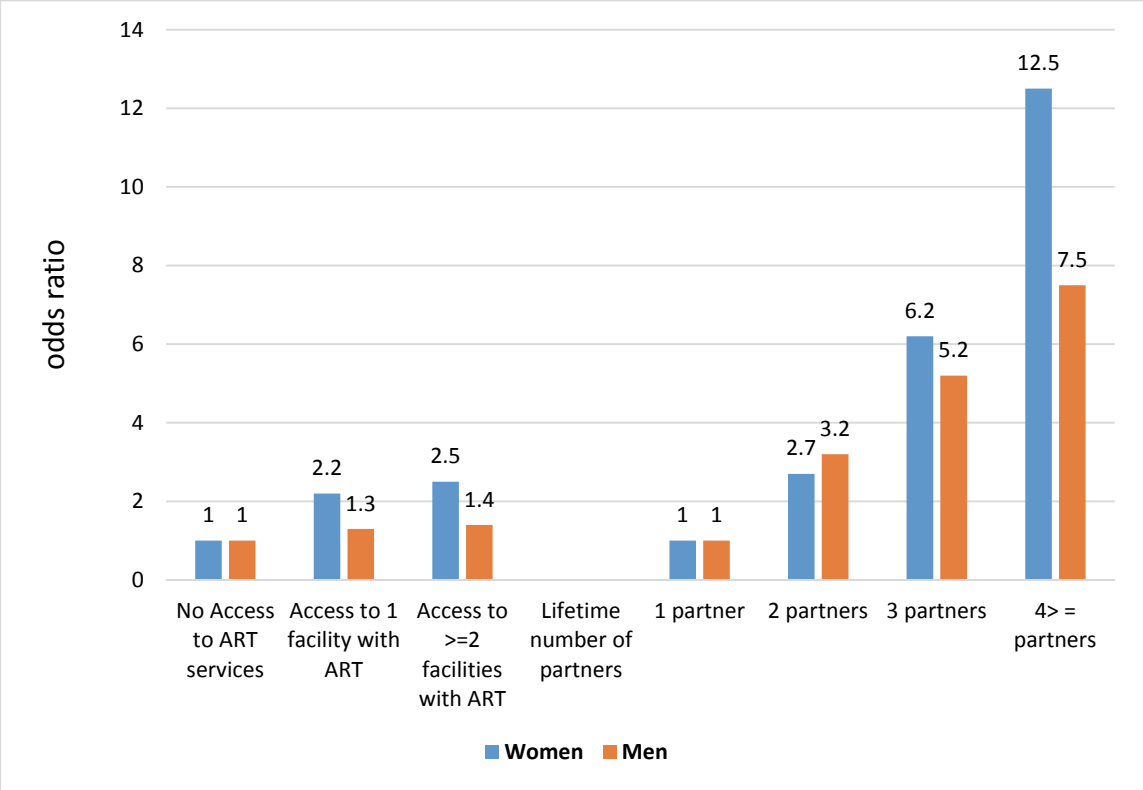
The unadjusted odd ratio of testing HIV positive among women with secondary compared with primary education was 1.6 (95 % CI 1.2-2.0) and among men the odds ratio was 1.1 (95 % CI 0.8-1.4) comparing the same groups. Comparing tertiary education with primary education, the odds

ratio was 1.5 (95 % CI 0.8-2.7) among women and 1.7 (95 % CI 1.0-2.7) among men. The odds comparing secondary education with primary education among women were significant, as were the odds comparing tertiary education with primary education among men. The odds of testing HIV-positive significantly increased with increasing age among both women and men, with a large magnitude of difference among men. There were no significant differences observed for religion, consistent condom use, age at sexual debut, access to radio, access to ART services, or travel away from home.

Rural women and men had significant 60% and 50% lower odds of testing HIV-positive, respectively, when compared with urban women and men. Among both men and women, significantly higher odds were observed for residents of the Southern Region compared with the Northern Region. Odds were higher among current or formerly married individuals compared with unmarried individuals. Individuals in the richer and richest wealth quintiles had higher odds of testing HIV-positive compared with the poorest wealth quintile. Concerning employment, as Table 3 shows, no significant difference in HIV prevalence was seen when comparing unskilled/manual labor with the unemployed, while the odds were significantly higher among the employed, whether clerical, skilled, or technical/managerial employment.

Among women, significantly higher odds were observed for those with better access to ART services compared with those with no access (Figure 4). The odds of testing HIV-positive rose as the lifetime number of partners increased, among both women and men.

Figure 4. Unadjusted odds ratios of HIV seropositivity by access to ART services and lifetime number of partners among Malawian women and men, MDHS 2010



Results of multivariate logistic regressions

Table 4 shows the adjusted results of multivariable logistic regressions. The association between HIV prevalence and educational attainment observed in bivariate models disappeared in the multivariate models. Significant associations remained between HIV seropositivity and age, residence, region, marital status for the formerly married, and lifetime number of partners. Women with secondary school education had significant 60% higher odds of testing HIV positive compared with women with only primary school education. The odds reduced to 30% and were no longer significant when adjusted for wealth index, access to ART services, religion, ethnicity, access to radio, consistent condom use, and comprehensive HIV knowledge. Women with tertiary education had 50% higher odds than those with primary education, but this was not significant. Among men, significant odds were observed for men with tertiary education, at 70% higher odds, compared with primary education.

Table 4. Multivariate analysis of factors associated with HIV prevalence among Malawian women and men

	Women		Men	
Variable	**OR**	**CI**	**OR**	**CI**
Highest level of education attained (Reference: primary)				
Secondary	1.3	1.0 - 1.9	0.9	0.7 - 1.3
Tertiary	0.8	0.4 - 1.8	1.0	0.4 - 2.3
Age (Reference: 15-19)				
20-24	0.7	0.4 - 1.2	4.0*	1.4 - 11.6
25-29	1.4	0.9 - 2.4	6.6***	2.2 - 20.0
30-34	2.4**	1.4 - 4.1	10.2***	3.4 - 30.7
35-39	2.9***	1.7 - 5.2	17.9***	5.9 - 54.3
40-44	2.5**	1.4 - 4.4	24.0***	7.9 - 73.3
45-49	2.4**	1.3 - 4.4	15.6***	4.9 - 49.9
50-54	-	-	13.8***	4.3 - 44.1
Residence (Reference: urban)				
Rural	0.6**	0.4 - 0.8	0.6**	0.4 - 0.8
Region (Reference: Northern)				
Central	1.1	0.7 - 1.8	1.5	0.9 - 2.7
Southern	1.9**	1.2 - 2.9	1.7*	1.0 - 2.7
Religion (Reference: Catholic)				
Muslim	1.0	0.6 - 1.8	0.5	0.2 - 0.9
No/Other religion	1.0	0.3 - 3.1	0.8	0.4 - 1.9
Ethnicity (Reference: Chewa)				
Tumbuka	1.0	0.6 - 1.7	1.3	0.7 - 2.7
Lomwe	1.4	0.9 - 2.1	2.5***	1.4 - 4.2
Yao	1.2	0.6 - 2.3	3.3***	1.6 - 6.6
Ngoni	0.9	0.6 - 1.5	1.5***	0.9 - 2.4
Other	0.9	0.6 - 1.4	2.1**	1.2 - 3.6
Occupation (Reference: not employed)				
Unskilled/Manual	1.0	0.7 - 1.4	0.9	0.4 - 1.8
Clerical/Skilled	1.6**	1.2 - 2.3	0.9	0.4 - 1.9
Technical/Managerial	0.7	0.3 - 1.6	0.8	0.3 - 2.2
Poorest (Reference: poorest)				
Poorer	1.2	0.8 - 1.9	1.0	0.6 - 1.7
Middle	1.6*	1.1 - 2.3	1.2	0.7 - 2.0
Richer	1.5	1.0 - 2.2	1.1	0.7 - 1.8
Richest	2.2**	1.4 - 3.5	1.5	0.9 - 2.6
Access to radio media (Reference: less than once a week)				
At least once a week	1.1	0.8 - 1.3	0.9	0.6 - 1.2
Consistent condom use in past 12 months (Reference: No)				
Yes	N/A	N/A	0.9	0.6 - 1.4
Marital Status (Reference: never married)				
Currently married	1.7	0.8 - 3.3	1.7	0.9 - 3.1
Formerly married	4.0***	2.0 - 8.3	3.5**	1.6 - 7.7
Lifetime number of partners (Reference: one partner)				
Two partners	2.0***	1.5 - 2.6	2.0*	1.1 - 3.6
Three partners	3.8***	2.8 - 5.3	2.9***	1.6 - 5.0
Four or more partners	6.8***	4.5 - 0.2	3.6***	2.0 - 6.5
HIV Comprehensive knowledge score	1.1	0.9 - 1.4	1.4*	1.0 -1.8
Access to ART services within the buffer (Reference: No access to ART services)				
Access to one facility with ART services	1.7	0.9 - 3.4	1.2	0.7 - 2.2
Access to two or more facilities with ART services	1.3	0.7 - 2.6	1.0	0.6 - 1.8
Weighted number	4964		5331	

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

4. Discussion

The most obvious finding to emerge from this study is that, after controlling for risk behaviors and social economic variables, educational attainment was no longer significantly associated with HIV status. Both among women and men, significant positive associations with HIV seropositivity were observed with lifetime number of sexual partners, marital status, wealth index, region, and age. Comprehensive HIV knowledge was associated with HIV seropositivity among men only.

Our results agree with other studies demonstrating that risky behavior is the most important factor associated with prevalence of HIV. Our result, that HIV prevalence is associated with lifetime number of sex partners, is similar to findings from other analyses of DHS data and cohort studies. Further analysis of nationally representative surveys from Ethiopia DHS surveys in 2005 and 2011, the Malawi 2010 DHS, and the Ghana 2011 DHS show the lifetime number of sex partners to be one of the main predictors of HIV seropositivity (Kenyon, Tsoumanis, and Schwartz 2015; Akwara et al. 2005)**.** Cohort studies in Tanzania and South Africa also have shown that HIV seropositivity was associated with high lifetime number of sex partners, among other risk factors (Geis et al. 2011; Wand and Ramjee 2012; Mtenga et al. 2015)**.** Although most of these studies found that young age of sexual debut was associated with HIV seropositivity, our results did not corroborate this finding. Age of sexual debut may have not have been reported correctly, either because respondents did not feel it socially acceptable to start sex at a young age, or because of recall bias.

We also found that, among women, being previously married was independently associated with higher odds of HIV seropositivity. This finding agrees with other studies showing that HIV seropositivity is high among couples and previously married men and women in Malawi and other sub-Saharan countries (Grant and Soler-Hampejsek 2014; Muula 2010; Tenkorang 2014; Hong, Mishra, and Govindasamy 2008). It is likely that this is a selected subgroup of people whose spouses who may have died of AIDS or whose marriages dissolved because of risky behaviors or AIDS-related discrimination. Often, married couples have unprotected sex, which in itself is a high-risk behavior whether in marriage or outside. These two factors—lifetime number of sex partners and previous marriage—indicate the importance of emphasis on behavioral change interventions.

Among both women and men, living close to a facility with ART services was not associated with higher HIV seropositivity. In Malawi women access healthcare services more than men do. In addition to the many health care programs that target women, women are caretakers of children. Therefore, they naturally have more contact with health facilities and may use HIV care services more frequently and earlier than men. Therefore we expected to observe an association of access to ART services at least among women. Our measurements of service access is a proxy based on

the facility survey conducted three years later. Service provision at the time of the DHS or before may not be well reflected.

An interesting finding was the association of higher HIV seropositivity among men with comprehensive knowledge about HIV/AIDS, an association that has been reported before in Ethiopia (Hong, Mishra, and Govindasamy 2008). We think this could be due to previous knowledge about HIV provided through previous HIV Counselling and Testing sessions. Other factors significantly associated with seropositivity were urban residence and living in the Southern Region of Malawi. The Southern Region is the most populated and probably most urban region of the country. Urbanization is associated with better access to healthcare services and therefore may also be associated with better HIV care and survival. Also noted to be associated with seropositivity was the wealth index. Taken together, urban residence, living in the Southern Region, and high wealth status may be associated with better access to care and survival. The dataset was not designed to explore these factors, but our findings suggest that further exploration is warranted in subsequent DHS data and in prospective studies.

The strength of our results is that the data are from nationally representative data set, and we undertook a rigorous exploration of the dataset to include only variables that had large sample size and adequate variation. We also thought carefully about the biological plausibility of explanatory variables included in our mathematical models. Variables that did not have biological plausibility were included in the baseline table to demonstrate representativeness of the data but were excluded from our mathematical models. Our results are therefore reliable and valid within the context of the study. However, the results have critical limitations and therefore caution needs to be exercised when interpreting these results.

We could not extensively explore explanatory factors for HIV prevalence due to limitations in the dataset: lack of sufficient data at the individual level. Sometimes the data structure made analysis difficult. For example, partners' characteristics that have been shown to be important by other authors (Harling and Bärnighausen 2016) could not be modelled in our analysis because some data were not available in the DHS database Since HIV prevalence is a factor of both incidence and survival time, we planned to assess factors associated with HIV prevalence from these two aspects. While the DHS data were adequate on individual behavioral measures, data on access to ART services was at the cluster level, collected from the 2013-2014 Malawi Service Provision Assessment (SPA), which was conducted three years after DHS data collection was completed. Because of these limitations, our results should be interpreted with caution.

Despite these limitations, our results corroborate findings from other authors demonstrating that risky behavior is the most important factor associated with prevalence of HIV. Notwithstanding the fact that our analysis is based on cross-sectional data, risky sexual behavior contributes to HIV

prevalence through incidence. Our finding that prevalence of HIV is associated with lifetime number of sex partners is similar to findings by other further analysis of DHS data and cohort studies (Kenyon, Tsoumanis, and Schwartz 2015; Akwara et al. 2005**;** Geis et al. 2011; Wand and Ramjee 2012; Mtenga et al. 2015)**.**

We also found that, among women, being previously married was independently associated with higher odds of being HIV-positive. This finding agrees with other studies in Malawi and other sub-Saharan countries showing that HIV seropositivity is high among couples and previously married men and women (Grant and Soler-Hampejsek 2014; Muula 2010; Tenkorang 2014; Hong, Mishra, and Govindasamy 2008). As mentioned in the Results section, it is likely that this is a selected subgroup whose spouses who may have died of HIV or whose marriages dissolved because of risky behaviors or AIDS-related discrimination.

5. Conclusion

Our analysis suggests that educational attainment is not associated with HIV prevalence after controlling for a number of sociodemographic characteristics and behavioral factors. Unlike the case with other diseases, higher levels of education do not appear to be protective against HIV seropositivity. Given the evidence that higher socioeconomic status improves access to health care in general, and to ARTs in particular, interventions might focus on reducing risky behaviors in this target population. Considering that educational institutions offer opportunities of easier targeting, HIV-prevention health promotion activities need to be supported and highly emphasized among students.

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