

The promise of education for increasing awareness of HIV-positive status in southern and eastern Africa?: Differences by age and gender

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Abstract: Education is positively linked to HIV testing among the general population in sub-Saharan Africa, but because of underlying differences in the risk of HIV infection that does not necessarily mean that the same is true for *diagnosis among those already living with HIV*. Knowing one's HIV-positive status is a critical first step to entering life-saving HIV care and treatment and preventing onward transmission. Understanding education-HIV diagnosis relationships can shed light on which HIV-positive individuals are being missed by current HIV testing interventions. Despite improvements in the proportion of people living with HIV who know their status, rates of diagnosis are substantially lower for HIV-positive men and young adults. Perplexingly, these two groups also represent those most likely to benefit from expanded education access. Using population-level data from four southern and eastern African countries, I examine the association between HIV diagnosis and educational attainment, the moderating effect of age on these associations, and differences by gender. Preliminary findings reveal no statistically significant associations between education and HIV diagnosis, but these findings are moderated by age. Among older adults there is a strong, positive relationship, but among young adults those with more education are less likely to be diagnosed.

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Extended Abstract:

Introduction

Education is often cited as a mechanism to improve health and longevity in sub-Saharan Africa (Bloom 2007, LeVine, LeVine et al. 2011, Smith-Greenaway 2013). In resource rich settings, education is associated with improved uptake of chronic care and better chronic health outcomes, but less is known about such associations in the context of sub-Saharan Africa (Mirowsky and Ross 2005, Heestermans, Browne et al. 2016). One of the most pervasive chronic health issues in this setting is HIV, which requires lifelong care and treatment. HIV diagnosis is a critical entry point to accessing life-saving care and treatment -- treatment that, in-turn, further slows the spread of the virus in the region. Education is known to be positively associated with the uptake of HIV testing among the general population in many settings in sub-Saharan Africa (Cremin, Cauchemez et al. 2012, Staveteig, Croft et al. 2017, Muyunda, Musonda et al. 2018). However, there is limited and inconsistent evidence about educational associations specific to HIV diagnosis among the HIV-positive adult population in the region (Green, Tordoff et al. 2020).

Increasingly, there is concern that HIV testing initiatives may be missing those most likely to be living with HIV. As self- or home-testing and community-based testing interventions have expanded, they are not yielding expected results in identifying the undiagnosed HIV-positive population. Innovative programs and policies are needed that not only expand HIV testing, but tailor such interventions to reach those living with unknown HIV infections (De Cock, Barker et al. 2019). A better understanding of educational associations with HIV diagnosis may provide important insight into who is being missed with current HIV testing programs, and what policy levers may be most effective for reaching the undiagnosed.

If educational associations with HIV diagnosis do not mirror the positive relationships with HIV testing in the general population, this may suggest that the knowledge, risk assessment, and financial resources conferred by education are not the main predictors of HIV testing uptake among the HIV-positive adult population. On the other hand, if, similar to HIV testing more broadly, there is a positive association between education and HIV diagnosis, this suggests the need for HIV testing efforts targeting the needs of the lower educated population most at-risk for living with HIV. Finally, because greater HIV risk is associated with lower education levels, it is plausible that there is a different educational distribution among the HIV-positive population when compared to the larger population (Leon, Baker et al. 2017). This may also reflect key differences in the education-related skills and resources available to the HIV-positive population vs. the general population, which may shape any education-HIV diagnosis associations.

In 2019, 13% of the ~20 million HIV-positive adults in the high prevalence region of southern and eastern Africa remained unaware that they were living with HIV. While this is a marked improvement from the 22% who were undiagnosed in 2015, this remains a critical unmet need for addressing the epidemic in the region (UNAIDS 2019). This gap in HIV diagnoses is not equally distributed across the population of adults living with HIV (UNAIDS 2019). Among HIV-positive young adults (15-24) in the region, only 65% are estimated to be diagnosed with HIV (Giguère, Eaton et al. 2021). This is particularly concerning as young adults account for approximately a third of new HIV infections every year, and if untreated, these new infections may continue to drive the epidemic (Nash, Yotebieng et al. 2018, UNAIDS 2019). Further, the increased morbidity and mortality associated with untreated HIV infections among young adults threatens to seriously hamper the demographic promise from sub-Saharan Africa's increasingly young population (Ashford 2007, Nash, Yotebieng et al. 2018).

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Age differences in HIV diagnosis and treatment are well documented, but they are not well understood. Gaps in HIV diagnoses among young HIV-positive adults are particularly perplexing given that most HIV testing interventions in the region have prioritized younger populations, and higher testing rates among younger populations when compared to older groups (Vollmer, Harttgen et al. 2017, Lloyd-Sherlock and Amoakoh-Coleman 2020). Further, we know that younger adults tend to be more educated on average, and those with more education are more likely to test for HIV (Ante-Testard, Benmarhnia et al. 2020). This suggests that younger HIV+ adults would be at least equally, if not more likely, than other age groups to test for and receive an HIV diagnosis. Yet the converse remains true.

A cohort perspective suggests that age and education may intersect in important ways to help explain disparities in HIV diagnoses. Given extensive educational reforms in the region over the past 40 years, those in older age groups had less access to education, but among those who did access education, their schooling was more likely to be higher quality in comparison with younger age groups (UNESCO 2015). Thus, being more educated in an older age group is potentially more differentiating than within younger age groups, for whom attending school is more normative (Frye and Lopus 2018). Evidence from South Africa demonstrates that the cognitive benefits from education (i.e., literacy and risk assessment) may be particularly important for facilitating HIV diagnosis among older adults (Rosenberg, Gómez-Olivé et al. 2020). Further, older adults also witnessed a period when HIV was linked with greater community mortality, potentially increasing their desire to be diagnosed and treated early.

These differences in diagnosis by education and age may also operate differently for men and women in the region. Young men are the least likely group of HIV-positive adults to be diagnosed in the region, but they are more likely to be more educated and to have greater employment opportunities than older men or women (Dovel, Dworkin et al. 2020, Giguère, Eaton et al. 2021). Young women, in contrast, may have a distinctive advantage in accessing HIV testing. In the past decade, HIV testing has been tightly integrated with women's reproductive health services, and young women with more education are more likely to use these services (Dovel, Yeatman et al. 2015, Okedo-Alex, Akamike et al. 2019). These gendered realities suggest differences in education and HIV diagnosis between men and women that may vary by age cohort.

In this paper, I use population-level data across four southern and eastern African countries to examine these associations. First, I examine whether education is associated with HIV diagnosis across the four countries in southern and eastern Africa. Second, I examine whether age modifies the relationship between education and HIV diagnosis. Finally, I stratify my analyses by gender to determine if these associations differ for men and women in the region.

Data and Methods

I use nationally-representative, cross-sectional data from the Population HIV Impact Assessment (PHIA) study. I focus on four countries in southern and eastern Africa for which data collection was completed by July 2018 and for which data is now publicly available: Malawi, Tanzania, Zambia, and Zimbabwe. These countries are among those with the highest HIV prevalence in the world, their data collection occurred in a similar timeframe, and they are relatively similar in their history of the HIV epidemic.

PHIA data were collected using a two-stage sampling process in which enumeration areas were selected based on probability proportional to size and households within enumeration areas randomly selected. PHIA interviewed all eligible men and women ages 15-64 who lived in or slept in the house the

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prior night. Data are divided into three datasets—household surveys, individual surveys, and biologic lab results—that are linked using a unique identifier. Household surveys include household resources/wealth and number of household members; individual surveys include self-reported educational attainment, age, and engagement with HIV care and treatment; and bio-marker data includes HIV status and viral load. Details on the PHIA study can be found at: <https://phia-data.icap.columbia.edu/>.

Planned Analyses

I conduct my analyses using multivariable models to measure the association between education and HIV diagnosis while controlling for factors such as number of children, employment, wealth, rurality, and country-level fixed effects.

I measure education as a continuous, independent variable in my models, based on the year of schooling completed. This continuous measure provides a clear, detailed understanding of educational gradients related to HIV care management, and provides an opportunity to explore and adjust for non-linearity in these relationships (Walsemann, Gee et al. 2013). In the context of sub-Saharan Africa, there is a greater than 90% school enrollment rate, but only a 69% and 43% completion rate for primary and secondary school, respectively (World Bank 2019). Therefore, this continuous measure will capture much of the variation in educational attainment that occurs year-by-year within primary or secondary schooling, rather than at the junctures of *entry into or completion of* a given level of schooling.

For HIV Diagnosis, I use a binary measure that differentiates those PLWH who were tested and know their HIV-positive status before the study vs. those who tested HIV positive as part of PHIA data collection but were previously unaware of their HIV-positive status. The PHIA study conducted HIV diagnostic tests for all willing study participants (via rapid and confirmatory tests). Knowledge of HIV-positive status and testing history before the study are based on self-report.

Age is measured continuously, and is centered at the mean for ease of interpretation. I test the moderating influence of age on the education-HIV diagnosis relationship by including statistical interactions between education and age in my model.

Gender is measured using a binary variable for men and women. I control for gender in non-stratified models, and then stratify models by gender to assess differences in these relationships for men vs. women.

Preliminary Findings

As seen in Figures 1 and 2, in unadjusted and adjusted models, those living with HIV who have more education are no more likely to be diagnosed than those with less education. Country-specific breakdowns reveal that education is negatively associated with the likelihood of HIV diagnosis in Malawi and Zimbabwe ($p < .05$), but only in unadjusted models before accounting for other covariates such as employment and wealth. When stratified by gender (Figure 3), these statistically insignificant relationships persist for men and women.

As demonstrated in Figure 4, age moderates the relationship between education and HIV diagnosis. In older age groups, those with more education are more likely to be diagnosed, but the converse is true among younger age groups. This pattern persists for both men and women in gender-stratified analyses (Figures 5 and 6). Future analyses will include a comparison of HIV prevalence, testing, and diagnosis by education level, gender, and age.

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Figure 1. HIV Diagnosis and Education - Unadjusted Odds Ratios and 95% Confidence Intervals

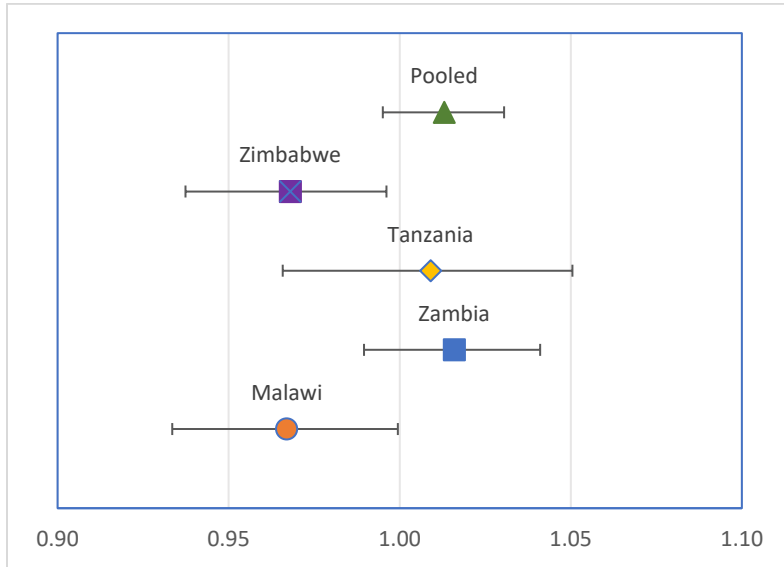
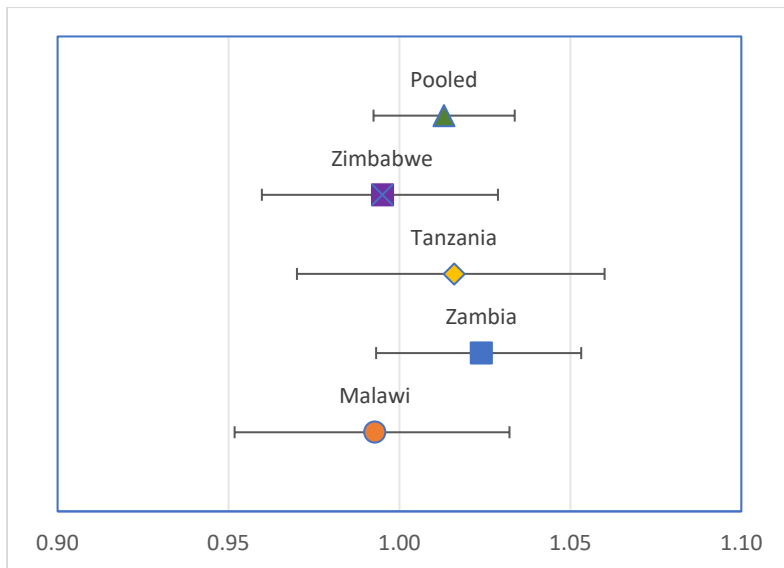


Figure 2. HIV Diagnosis and Education - Adjusted Odds Ratios and 95% Confidence Intervals



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Figure 3. HIV Diagnosis and Education by Gender, Odds Ratios and 95% Confidence Intervals

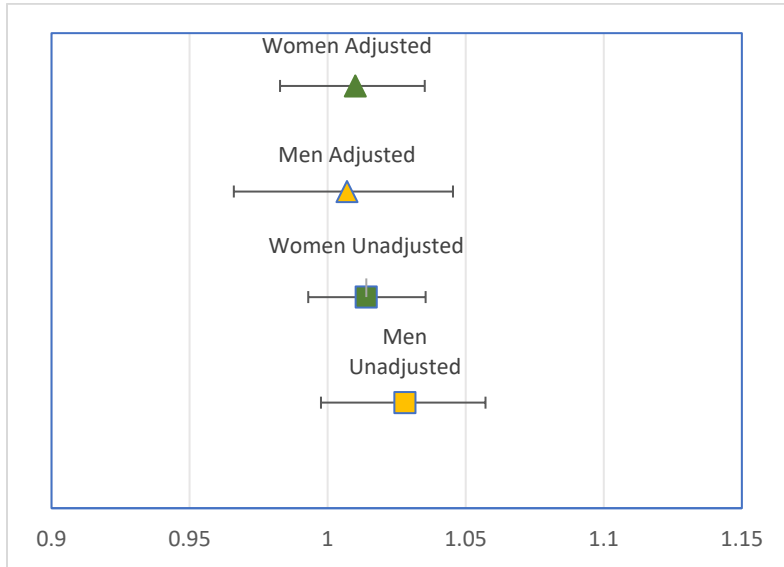
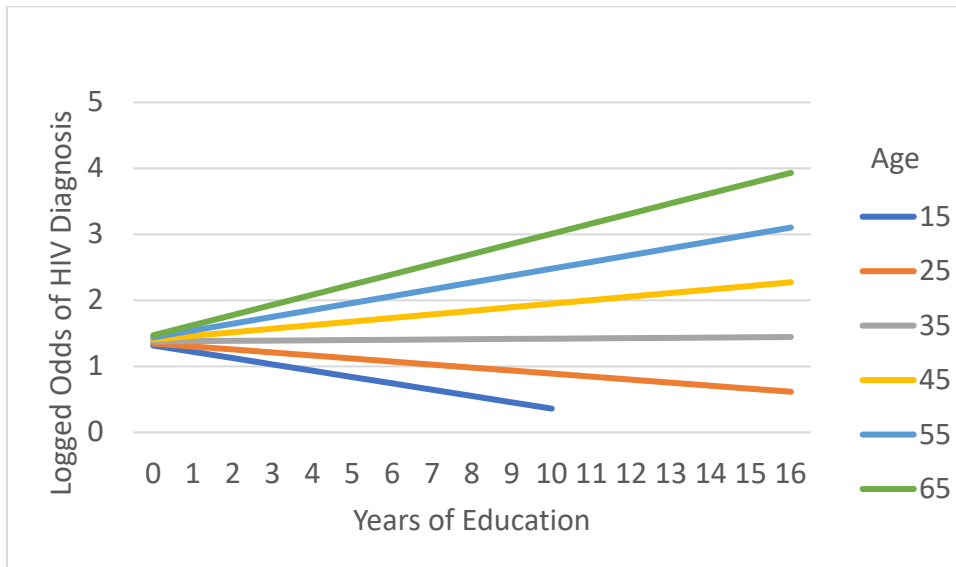


Figure 4. Logged Odds of HIV Diagnosis by Education and Age



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Figure 5. Logged Odds of HIV Diagnosis by Education and Age for Women

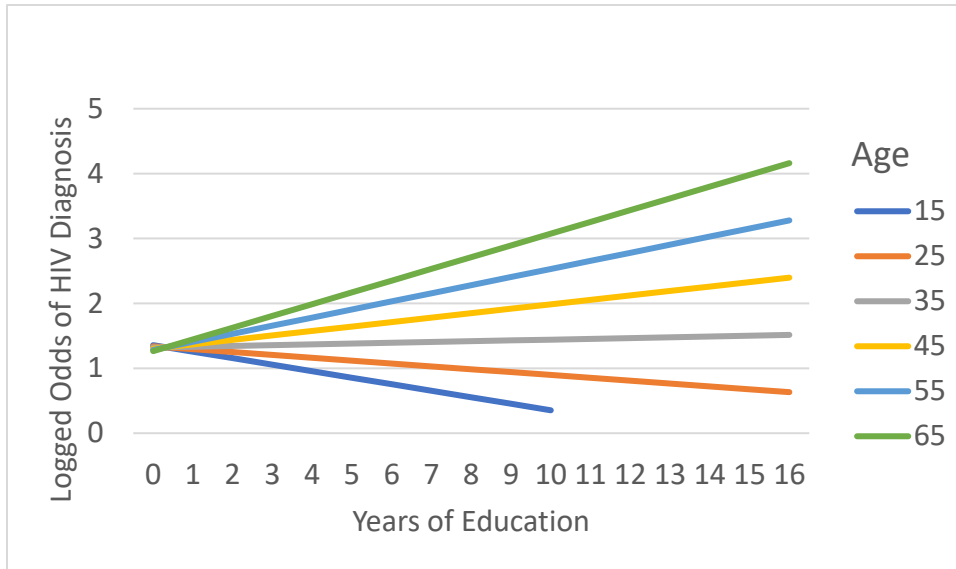
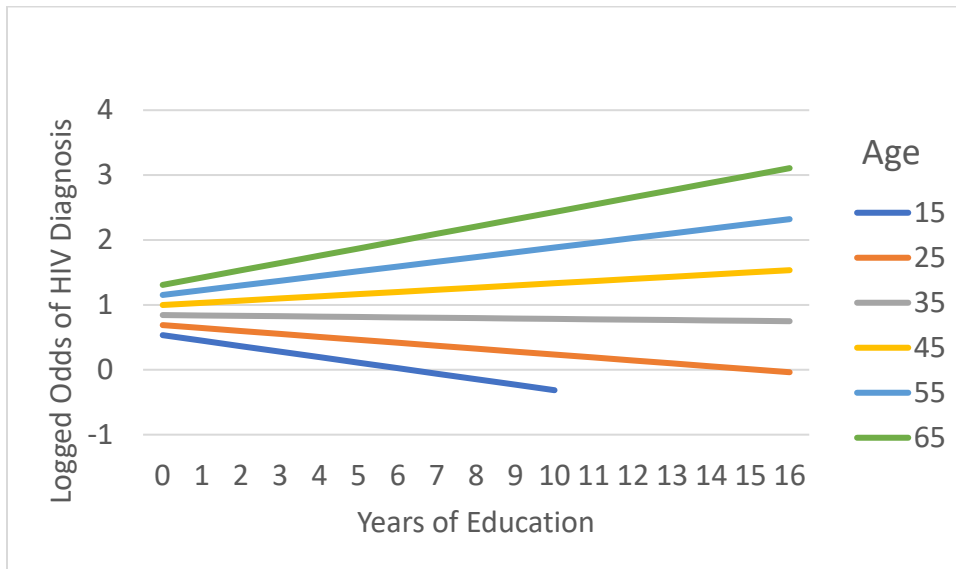


Figure 6. Logged Odds of HIV Diagnosis by Education and Age for Men



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The promise of education for increasing awareness of HIV-positive status in southern and eastern Africa?: Differences by age and gender

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