Physical attractiveness and women's HIV risk in rural Malawi

Margaret Frye[1] and **Sophia Chae**[2]

[1]Princeton University, USA

[2]Population Council, USA. The author's affiliation is included for informational purposes only. This work was not conducted under the auspices of the Population Council

Abstract

BACKGROUND—Qualitative evidence from sub-Saharan Africa, where a generalized AIDS epidemic exists, suggests that attractiveness may play a role in shaping individual-level HIV risk. Attractive women, who are often blamed for the epidemic and stigmatized, are believed to pose a higher HIV risk because they are viewed as having more and riskier partners.

OBJECTIVE—We examine the association between perceived attractiveness and HIV infection and risk in rural Malawi in the midst of the country's severe AIDS epidemic.

METHODS—We use interviewers' ratings of respondents' attractiveness, along with HIV test results and women's assessments of their own likelihood of infection, to estimate the association between perceived attractiveness and HIV infection and risk for a random sample of 961 women aged 15–35.

RESULTS—Results show that women who are rated by interviewers as 'much less' or 'less' attractive than other women their age are 9% more likely to test positive for HIV. We also find that attractiveness is associated with women's own assessments of their HIV risk: Among women who tested negative, those perceived as 'much less' or 'less' attractive than average report themselves to be at greater risk of HIV infection.

CONCLUSIONS—These results suggest that attractiveness is negatively associated with HIV risk in Malawi, countering local beliefs that hold attractive women responsible for perpetuating the epidemic.

CONTRIBUTION—This study highlights the need to consider perceived physical attractiveness, and sexual desirability more broadly, as an under-examined axis of inequality in HIV risk in high-prevalence settings.

1. Introduction

Physical appearance – specifically perceived attractiveness – has been shown across contexts to be a salient determinant of the social patterning of sexual relations (Agnew and Thompson 1994; Dijkstra, Buunk, and Blanton 2000; McClintock 2011; Zaikman et al.

2016). In Western settings, research shows that perceived attractiveness influences sexual relations, as well as sexual risk behaviors, through two distinct processes. First, attractiveness shapes people's assessments of their own sexual desirability and determines their subjective positioning within a given sexual or social hierarchy (Green 2013; Hakim 2010). All else being equal, more attractive individuals approach their sexual lives with a greater sense of agency and choice, while their less attractive peers make choices under more constrained circumstances and perceive themselves as having more delimited options for potential partners (Martin and George 2006). Second, working within these boundaries of perceived agency and choice, people select their partners according to individually specific preferences and tastes, and physical attractiveness is an important criterion when making these selections (Luo and Zhang 2009; McClintock 2014).

Despite a wealth of research investigating these dynamics in Western contexts, no studies have yet examined the extent to which perceived attractiveness influences perceptions of sexual agency and partner selection in sub-Saharan Africa. Given the high prevalence of HIV in many African countries, individuals' sexual lives are forcibly intertwined with the AIDS epidemic, and decisions made regarding partner selection influence individuals' risk of contracting HIV. Qualitative accounts of the social dynamics of the AIDS epidemic in ub-Saharan Africa suggest that attractiveness is understood locally as playing a role in shaping individual-level risk, particularly for women (Frye and Gheihman 2015; Kaler 2004; Santow, Bracher, and Watkins 2008; Stadler 2003; Watkins 2004). Men believe that attractive women pose a higher HIV risk because they have more (and more risky) partners; for example, in South Africa, "young 'beautiful women' were said to 'buy their own coffins' [die of AIDS]" (Stadler 2003: 128). Attractive women are therefore subjected to stigma and blamed for the epidemic: Kaler (2004: 295) describes how men in Malawi explain the increasing prevalence of AIDS in their communities by observing that "there are more beautiful women than in the past."

Despite this widespread cultural narrative, sociological evidence suggests that the association may run in the opposite direction – that more attractive women may actually be less likely to become infected with HIV. Research in both Western and African contexts reveals that an attractive appearance is an important resource in the sexual and romantic arena, particularly for women. Attractive women have long been theorized to have greater bargaining power than less attractive women, and to be able to use their appearance to garner more desirable (and potentially safer) partners (Becker 1978; Jaeger 2011; Laumann et al. 2005; Martin and George 2006; Waller 1937). Evidence from Kenya and Tanzania suggests that young women invest in their appearance as a means to improve their status in the romantic and sexual field (Mojola 2014; Wamoyi 2010). If these efforts lead to a greater degree of agency in selecting potential partners or to more bargaining power in negotiating sexual relationships, then more attractive women may actually have a lower likelihood of contracting HIV.

We study this question in the context of rural Malawi's widespread AIDS epidemic. Drawing on a unique data set that includes interviewer-assessed measures of attractiveness, we assess the association between women's perceived attractiveness and HIV infection, as well as the association between perceived attractiveness and perceptions of HIV risk.

Contrary to local popular beliefs (Kaler 2004; Stadler 2003), more attractive women are not at increased risk of HIV. Instead, women who are perceived as less attractive than average are at greater risk: They are more likely to be infected with HIV, and are also more likely to consider themselves at risk of infection if they are HIV negative. As the first to empirically assess the link between perceived attractiveness and the likelihood of HIV infection, this study highlights appearance as an important dimension in the social patterning of sexual relations, and thus of HIV risk, in an African setting.

2. Background

2.1 HIV/AIDS, physical appearance, and partner selection

For the past three decades, southern Africa has remained at the epicenter of the international AIDS epidemic: In most countries across the region, more than 10% of adults aged 15–49 are currently infected, with adult prevalence remaining above 20% in Botswana, Lesotho, and Swaziland (World Health Organization 2017). The rate of new infections for women in sub-Saharan Africa is particularly high during adolescence and young adulthood: In 2015, 66% of new infections among those aged 15–24 were women (World Health Organization 2017). This is the point in the life course at which most women seek to get married and start families, and due to the widespread nature of the AIDS epidemic in moderate-to-high-prevalence countries, individuals have no choice but to navigate the HIV/AIDS epidemic when selecting sexual partners.

Qualitative research has shown that when considering a potential sexual partner, both men and women in Malawi make "social diagnoses" that seek to ascertain the likelihood that he or she might be infected (Santow, Bracher, and Watkins 2008). This strategy has also been observed outside of sub-Saharan Africa: Gay men in the United States engage in "sero-guessing" to attempt to identify lower risk partners based on visible markers and behaviors (Zablotska et al. 2009). Men and women rely on different strategies to make these social diagnoses. Psychological research shows that across contexts, when selecting partners and assessing potential risk, men tend to place a greater emphasis than women on physical attractiveness, including dress and other facets of physical appearance (Buss 1989; Fisman 2006; Li et al. 2002). In Malawi, through debates and discussion, men identify ways of determining a woman's sexual history through her appearance – signs that she may have had more previous partners or that her previous sexual experiences may have been more risky (Kaler 2004; Santow, Bracher, and Watkins 2008; Watkins 2004). Men in Malawi advise each other on the merits of choosing "unbeautiful" women (Frye and Gheihman 2015; see also Stadler 2003 for a similar finding from South Africa). Men also warn of the dangers that attractive women pose to the men's self-control: They perceive themselves as unable to resist having unprotected sex if they find themselves alone with attractive women. As one man remarked to his friends in a bar, "You forget that there is either AIDS or condom use because of their beauty […] you just go for them regardless of what may come later on" (Frye and Gheihman 2015).

Women, by contrast, tend to place a greater emphasis on status and resources, seeking partners who can provide for them financially (Buss 1989; Fisman 2006; Li et al. 2002). A recent ethnographic study of women's relationships in rural Malawi found that when

discussing potential partners with one another, only young adolescents mentioned physical attractiveness, while most women instead focused on men's behavior and economic situations (Verheijen 2013: 117). Women's social diagnoses of men in their communities center around behavioral patterns that they believe indicate risk of infection, such as drinking, frequent travel away from home, and working near large markets or trading centers (Schatz 2005; Smith and Watkins 2005).

While women may not place as high a value on physical attractiveness as men do when selecting a partner, they may instead use their own attractiveness as a resource to secure a higher quality partner (Becker 1978; Jaeger 2011; Laumann et al. 2005; Martin and George 2006; Waller 1937). Research conducted in Ghana, Tanzania, and Kenya indeed reveals that women invest time and money in augmenting their own appearance through fashion, cosmetics, and hairstyles, with the explicit goal of securing more desirable partners (Fiaveh et al. 2015; Mojola 2014; Wamoyi 2010).

2.2 Attractiveness and sexual risk behavior

Among the factors potentially driving a positive relationship between women's attractiveness and HIV risk are differences in women's sexual behavior. In the United States, women who are perceived to be more attractive tend to have sex more frequently (Agnew and Thompson 1994; Kelley 1978) and have a higher total number of sexual partners compared to average or unattractive people (McClintock 2011). One possible mechanism underlying this association between physical attractiveness and sexual activity is that women who are actively seeking to attract men may invest more time and money in their appearance. In African contexts, perceived attractiveness is indeed closely tied to consumption of clothing and cosmetics (Mojola 2014; Fiaveh et al. 2015). Attractive women may be more sexually active on average because those who are in the market for new partners invest more in these types of material goods. Regardless of the underlying mechanism, such an association between attractiveness and sexual activity would likely place attractive women in Malawi at a higher risk of HIV.

Female attractiveness may also be positively associated with HIV risk due to men's sexual risk behavior, specifically their reduced likelihood of practicing safe sex with women who they consider attractive (Kruse and Fromme 2005). In Western contexts, when men consider their partner to be more attractive they are less likely to discuss sexual history or possible risks with them (Agocha and Cooper 1999; Joffe and Dockrell 1995) or to use a condom during sex (Kelaher et al. 1994). Even when men perceive an attractive woman as being riskier than other women, they nonetheless express interest in having sex with her (Dijkstra, Buunk, and Blanton 2000). In sub-Saharan Africa, local understandings of male sexuality suggest that men become impulsive and unthinking when faced with attractive women. As Moolman (2004: 117) writes, "Men's sexual appetites are seen as powerful and volatile, uncontrollably aroused by a woman's dress sense, presence, or movements" (see also Stadler 2003).

2.3 Attractiveness and women's sexual agency

Other research predicts that women's attractiveness will be negatively associated with HIV risk, because rather than having sex with more partners, attractive women may have access to better (i.e., safer) partners. While rural women living in sub-Saharan Africa are often portrayed as vulnerable and powerless, qualitative research has shown that many women display considerable autonomy in shaping their sexual and romantic lives (Poulin, Dovel, and Watkins 2016; Watkins and Swidler 2013). They choose which men to partner with and when to end relationships (Poulin 2007), leverage social networks to ascertain whether a potential partner is trustworthy and likely to treat them well (Kaler 2004), publicly confront both their male partners and other women in cases of suspected infidelity (Schatz 2005), and demand that their husbands change their behavior when they spend too much money on drinking or entertainment, threatening divorce if they do not (Smith and Watkins 2005). But not all women do these things: Relationship power and sexual agency are differentially distributed within the population. For example, we know that women who are more highly educated are more able to make autonomous decisions about who they partner with, while women facing more acute poverty are more constrained in their relationship choices (Conroy 2014; Verheijen 2013). Sexual agency also matters for HIV risk: Women who are better able to actualize their own relationship ideals are less likely to perceive themselves as being at risk of infection years later (Frye and Trinitapoli 2015).

The question of whether attractiveness leads to a greater degree of sexual agency in sub-Saharan Africa has not yet been empirically examined, though qualitative evidence from Ghana shows that women believe that attractiveness gives them power within relationships: Women describe themselves as "us[ing] their beauty" to select "real men" and avoid those they perceive as being "irresponsible" (Fiaveh et al. 2015: 657). Recent sociological research on sexual behavior has focused on how attractiveness contributes to erotic capital, the physical attributes and techniques of self-presentation that elicit erotic responses from others (Green 2013; Hakim 2010). Across contexts, erotic capital has been shown to grant women access to a larger pool of potential partners and an enhanced capacity to make autonomous choices about their sexual lives (Farrer 2010; Green 2013; Martin and George 2006). It therefore seems likely that attractive women in Malawi have more sexual agency than less attractive women. If this is true, then attractive women might select men who are more economically supportive, faithful, and reliable, and avoid those who show signs of making impulsive decisions, drinking frequently, or pursuing multiple concurrent partners. Attractive women are thus presumably less likely to partner with men who will infect them with HIV, either in the initial stages of their relationship or after they are married.

2.4 The setting: Rural Malawi

Malawi is one of the poorest countries in Africa, and also one of the countries hardest hit by the AIDS epidemic (NSO-Macro 2017). In 2010, among the reproductive-age population (15–49), 10.6% were HIV positive and prevalence levels were higher among women (12.9%) than men (8.1%) (NSO-Macro 2017). According to 2016 estimates, prevalence has declined slightly to 8.8% but the gender discrepancy has persisted (NSO-Macro 2017). Rates of HIV infection differ by region in Malawi: In both 2010 and 2016, prevalence was about twice as high in the southern region than it was in the northern and central regions (NSO-

Macro 2017). HIV testing and counseling were not readily available in Malawi until 2005, when services spread to district hospitals and rural health clinics (UNAIDS and WHO 2006). District hospitals began providing free antiretroviral treatment (ART) between 2005 and 2006, and access has scaled up since then to rural locales (World Health Organization 2009).[3]

In Malawi, marriage is nearly universal and occurs at relatively young ages, with women marrying about five years earlier than men (median age: 18.2 years for women and 23.0 years for men; NSO Macro 2017). The AIDS epidemic added a layer of complexity to relationship formation, which men and women are forced to navigate as they try to avoid HIV infection. In a study of unmarried adolescents in Malawi, men and women similarly report that evidence of a lack of HIV infection was the most important characteristic they sought in a future spouse (Clark, Poulin, and Kohler 2009). This study also demonstrates gender differentials in other characteristics desired in a future spouse: Women prefer an employed spouse while men strongly value an attractive spouse. Men's remarks about women's appearance demonstrate that Malawian men generally consider certain physical attributes to be attractive in women, such as a "plump" or "fat" physique, curvy body (often with references to the buttocks or legs), a light or brown complexion, and the wearing of Western-style or 'modern' clothing (Chiweshe and Bhatasara 2013; Coly 2015; Frye and Gheihman 2015; Gilman 2011; Hansen 2000; Hunter 2010; Kaler, Watkins, and Angotti 2015; Oloruntoba-Oju 2007; Smith and Watkins 2005).

3. Data and methods

Our study draws on survey and biomarker data from the Malawi Longitudinal Study of Families and Health (MLSFH), formerly known as the Malawi Diffusion and Ideational Change Project (MDICP). Beginning in 1998, this survey has collected longitudinal data on a cohort of men and women in three rural sites in Malawi: Rumphi (northern region), Mchinji (central region), and Balaka (southern region). The variation found between these three sites in terms of language, ethnicity, kinship and lineage systems, and religion captures much of the diversity found in rural Malawi. Thus far, the MLSFH has conducted seven waves of data collection (1998, 2001, 2004, 2006, 2008, 2010, 2012). In 1998 the MLSFH interviewed approximately 1,500 ever-married women and 1,000 of their husbands. In subsequent surveys the MLSFH continued to re-interview respondents as well as any new spouses of male or female respondents who married between surveys. In 2004 a sample of approximately 1000 adolescents aged 15–24 years was added to rejuvenate the sample, allowing for comparisons of married and unmarried adolescents; this sample was then incorporated into subsequent waves of data collection. (See Kohler et al. (2015) for further details on the study sample and data collection procedures in the MLSFH.)

Our study primarily uses data collected in the 2006 wave; however, we also incorporate data on several measures that was collected in the 2004, 2008, and 2010 waves (see Measures section for further details). Only the 2006 and 2008 waves collected data on both perceived

---

[3]In the study setting, ART became available between August 2007 and March 2008, after the data we use for our analysis was collected (Baranov, Bennett, and Kohler 2015). Thus, at the time of data collection, very few MLSFH respondents had access to ART. Individuals in the study area had to travel a median distance of 27 km to obtain treatment.

physical attractiveness and HIV status; thus we were constrained to these two waves for this study. We chose the 2006 survey for two reasons. First, the majority of seroconversions that were documented in the MLSFH study occurred between 2004 and 2006, making 2006 the best option for examining newly diagnosed infections. Second, the 2006 survey provides data on interviewers, which we use as a robustness check for our measure of perceived attractiveness (see footnote 10; no available interviewer data exists for the 2008 survey wave).

The MLSFH survey is administered using face-to-face interviews. In each of the study sites the study team recruited interviewers who met the following criteria: fluency in English, completed secondary school, and a successful completion of a detailed training regimen (Anglewicz et al. 2009). The median age of MLSFH interviewers was 24 years, ranging from 19 to 39 years, and 68% were male. Due to the skewed gender ratio of interviewers, the study team permitted cross-gender interviewing in an effort to control budget costs. Approximately half of the women in our analytic sample were interviewed by male interviewers.

Because we use interviewer ratings of attractiveness, bias might arise from interviewers differentially evaluating respondents based on their own characteristics. In regression models predicting 2006 attractiveness ratings for the 678 women with valid data on interviewer characteristics, we found that older interviewers evaluated respondents as significantly more attractive than did younger interviewers, but no significant differences were detected across interviewer gender.[4] We attempted to limit this bias by restricting the analytic sample to women in a similar age range as the interviewers. Thus, we limited the analytic sample to women aged 15–35 years.[5] In 2006, 1,059 women in this age range participated in the survey interview.[6] For the analysis predicting HIV infection our analytic sample consists of 787 women, after the exclusion of 176 women for whom test results were not available, 57 women with missing data on at least one independent variable included in our models, and 39 who were missing information on both the outcome and control variables. For the analysis predicting perceived risk of HIV infection our analytic sample comprises 890 women: We excluded 71 women who tested positive for HIV in either 2004 or 2006, 5 women who had missing data on the outcome variable, 92 with missing data on key independent variables of interest, and 1 with missing data on both the outcome and control variables. In total, across both sets of analyses, 961 women were included in our analytic sample.[7]

---

[4]We also tested whether interviewer gender might mediate the effect of attractiveness by running regression models of HIV infection and perceived risk of HIV infection with controls for interviewer characteristics, and again found that interviewer gender was not statistically significant. Finally, we compared the attractiveness ratings of 433 women in our analytic sample who were interviewed in 2010 and for whom interviewer gender data were available in both survey years. 199 of these women were interviewed by the opposite gender in 2010: 42% received the same rating and 43% received a rating that was within ±1 of the 2006 rating. The same pattern was observed among women who were interviewed by same-gender interviewers in 2006 and 2010. The fact that we find no gender differences is consistent with research examining interviewer assessments of physical attractiveness in US surveys: male interviewers tend to evaluate men as more attractive compared to female interviewers, but no interviewer gender differences are found for female respondents (Nedelec and Beaver 2011).

[5]While the full age range of interviewers was from 19 to 39, the vast majority (88%) were under age 30 and only 7% were older than 35; thus we decided to restrict the sample to women aged 15–35. Results were substantively identical to those presented here when we used the full age range of 15–49.

[6]In 2006 the overall response rate was 67.5%, with 19.8% attrition due mainly to migration. Among 15–35-year-old female respondents eligible to be interviewed, the response rate was 60% for the 2006 survey wave.

3.1 Measures

3.1.1 Dependent variables—This study examines two dimensions of HIV risk: actual HIV infection and perceived risk of HIV infection. The first outcome variable, HIV infection, is constructed from results obtained through HIV testing of survey respondents in 2006. A few days after the survey interview was conducted a separate team of trained and certified HIV testing and counseling (HTC) counselors visited respondents' homes to administer HIV testing. All information about HIV testing was kept confidential from the survey interviewers. In 2006 the MLSFH used finger-prick rapid HIV testing, which allowed respondents to learn their HIV status almost immediately. Of those interviewed in 2006, 92% of respondents participated in HIV testing and 98% of these opted to learn their HIV status. If respondents did not get tested or received an indeterminate result,[8] we checked to see if they were tested in 2004. Of 73 respondents without a test result for 2006, 69 were tested in 2004 of whom 11 tested positive. We coded these 11 women as HIV positive in 2006 and coded the remainder as missing for HIV status, due to the possibility that they might have seroconverted during the inter-survey period.

The second outcome variable – perceived risk of HIV infection – is measured using an interactive technique that was designed to collect information on subjective expectations from respondents with limited numeracy (Anglewicz and Kohler 2009). Respondents were given ten beans on a plate and told: "Pick the number of beans that represents how likely you think it is that you are infected with HIV/AIDS now." Possible responses ranged from zero to ten, with zero representing no risk of current infection and ten representing 100% risk of infection. Although Malawians tend to overestimate the likelihood of negative events, research using MLSFH and other survey data from Malawi confirms that this technique elicits assessments of child mortality, HIV prevalence, and food shortages that vary meaningfully with observable characteristics and reported experiences (Anglewicz and Kohler 2009; Delavande and Kohler 2009). Responses to this measure are highly skewed, with 62% of the sample choosing 0 beans and only 26 respondents selecting more than five beans (see Figure 1).[9]

3.1.2 Independent variables—Our key predictor variable measures the survey interviewers' perception of the attractiveness of respondents. After completing the interview, interviewers filled out a short questionnaire consisting of ten questions about the interview. One of these questions asked interviewers to rate the respondent's physical attractiveness: "Personally, how would you rank the respondent's physical attractiveness relative to other persons of about the same age and sex?" Possible responses included: much less attractive than average, below average, average, more attractive, and much more attractive than average.

---

[7]Findings may be biased if women who were excluded from analyses are different from those who were included. We tested whether women who were excluded from the analytic sample differed from those in the analytic sample on independent variables (Appendix Table A-1). Overall, we observed few significant differences between the two groups. Women who were not in the analytic sample for analyses of HIV infection were significantly younger, were more likely to reside in the central and southern regions, and had a slightly higher mental health score. For analyses of perceived risk of HIV infection, women not in the analytic sample were significantly younger, less wealthy, reported a greater number of lifetime sexual partners, and were more likely to live in the central region.

[8]Only two women received an indeterminate result in 2006.

[9]As mentioned above, our analysis of perceived risk of infection excludes women who tested positive for HIV in 2004 or 2006.

Because heterogeneity may exist in interviewers' criteria for measuring attractiveness, we also utilized attractiveness data from the 2008 and 2010 waves (if available) to generate a mean attractiveness rating for each respondent.[10] Because respondents were matched with different interviewers at each wave, averaging multiple ratings for each respondent allows us to smooth out discrepancies related to idiosyncrasies in particular interviewers' assessments. Overall, attractiveness assessments were highly consistent over time for the majority of respondents (see Figure 2 for a comparison of attractiveness ratings for 2006 and 2010). In ancillary analyses we also tested whether women whose ratings across interviewers are more divergent might have a distinct pattern of outcomes, by controlling for the variance in attractiveness assessments across waves (available on request). The results did not change and the variance variable was not significant, suggesting that the minority of women who received attractiveness ratings that were discrepant by more than one value on the scale were not different in terms of either HIV infection or perceived HIV risk.

Averaging attractiveness ratings across waves could be a concern if HIV-positive respondents are more likely to experience declines in attractiveness between surveys. To examine whether this pattern was observed in the data, we created a variable subtracting the 2006 attractiveness score from that of 2010 and then plotted an overlay of histograms of this variable for HIV-positive and HIV-negative respondents, with HIV status measured in 2006 (Figure 2). Positive values indicate that women were rated as more attractive in 2010 than in 2006. For instance, with a value of positive two, a woman might be rated as below average (2) in 2006 and more attractive than average (4) in 2010. Comparing across the two HIV status groups, this figure shows that in contrast to HIV-negative women, women who tested positive for HIV in 2006 were more likely to have their attractiveness ratings increase over time rather than decrease (37% versus 29%), suggesting that attractiveness ratings were not impacted by physical manifestations of illness for these women.[11] This figure also shows that attractiveness ratings stayed fairly constant across the four-year period for all women: Over 85% of both HIV-positive and HIV-negative respondents experienced no more than a one-level change in attractiveness ratings.

When plotting the mean attractiveness score against HIV status and perceived risk of HIV infection using a LOESS smoothing function (Figure 3), we observed a distinct nonlinear pattern. For both HIV prevalence and self-assessed HIV risk, this figure shows a steeply negative association between attractiveness and HIV risk among women who were evaluated by interviewers as less attractive than average. For both outcomes, this negative trend flattens out around the level corresponding to evaluations of women as being of "average"

---

[10]We also ran regression models using the 2006 measure of attractiveness and controlling for interviewer characteristics (information on interviewers' age, gender, and marital status was available for 72% of the 2006 sample), and a separate set of models clustering on interviewer IDs. The interviewer data was not missing at random (respondents in the central region were much more likely to be missing this information) and including these variables in our models would result in a significant reduction in sample size. For these reasons we opted to present analyses using mean attractiveness scores. While results using a 2006 measure of attractiveness with interviewer controls were qualitatively similar to those presented here, the coefficient of attractiveness was only marginally significant in models of HIV infection, likely due to the reduced sample size.

[11]Using qualitative data on conversations about HIV in the same regions of Malawi where our survey data was collected, Kaler, Angotti, and Ramaiya (2016) find that antiretroviral therapy is locally believed to change the appearance of HIV-positive women from thin and sickly to plump and 'beautiful.' Antiretroviral therapy became available in some communities in 2007; thus it is possible that improvements in health related to initiating treatment could account for this finding of an increase in attractiveness ratings over time among HIV-positive women. Without data on antiretroviral therapy use, we cannot assess this empirically.

attractiveness relative to other women of their age. Based on these results, we created a binary indicator of attractiveness, differentiating between women who are rated less than 3 on attractiveness (below average attractiveness) and those who are rated greater than or equal to 3 (average or more attractiveness).[12]

We test three potential mechanisms that could mediate the relationship between attractiveness and HIV risk: spousal/partner infidelity, number of lifetime sexual partners, and women's estimate of the likelihood that their partner was infected with HIV at the beginning of their relationship. If women who are more attractive enjoy more bargaining power in their relationships they may be less likely to say that they suspect that their partner has been unfaithful. Spousal or partner infidelity has been shown to be associated with HIV infection (Goodreau et al. 2012), and, due to the prominent public health campaigns in Malawi warning against the risks associated with concurrent partnerships, the perception that one's partner is unfaithful is also likely to increase one's perceived risk of HIV infection. Moreover, attractiveness may be related to whether one's spouse is unfaithful, i.e., less attractive women may be at greater risk of having unfaithful spouses/partners than more attractive women. We used responses to two questions to create a variable measuring spousal/partner infidelity. Ever-married women were asked the following question about their current or most recent spouse: "During your time married together, did your husband have a girlfriend, or did he have sex with someone else apart from you and his other wife/ wives?" Possible responses were: yes, I know; no; I suspect; I can't know what he does; probably not; don't know. We combined the latter four responses into the category "uncertain." Among never-married respondents who reported ever having sex, we utilized responses to the question: "Do you think [NAME] had other sexual partners during the time you were in a sexual relationship with him?" Possible responses were: no, yes, and don't remember. We renamed the last category as "uncertain", to match the response categories of ever-married respondents. This question was not asked of never-married respondents who reported never having had sex. Prior studies have shown that female adolescents in sub-Saharan Africa tend to underreport sexual activity (Mensch, Hewett, and Erulkar 2003; Zaba 2004), and using survey data from Kenya, Mensch, Hewett, and Erulkar (2003) demonstrated that 7 out of 65 women who reported themselves to be virgins tested positive for HIV. Thus, we include these 49 women in our analytic sample and assign them "no" for the partner infidelity question.[13]

The second mechanism we test is number of lifetime sexual partners. This variable might mediate the association between attractiveness and HIV risk if this association is due to differences in women's own level of risky sexual behavior, and not partner characteristics or bargaining power. More attractive women may have had more lifetime partners, and having a larger number of lifetime sexual partners puts individuals at greater risk of HIV infection. This information was collected using the following question: "How many people overall have you ever had sex with?"

---

[12]ROC score comparisons testing whether a binary or continuous specification of attractiveness provides a better fit showed that both were almost identical. We also ran regression models using both specifications and obtained similar results; these results are included in the Appendix Table A-2 for reference.
[13]We also ran regression models excluding respondents who reported never having had sex and obtained similar results as those presented here.

Finally, we examine whether the perceived likelihood that men were infected at the start of the relationship mediates the association between attractiveness and HIV risk. We view this variable as relating to women's assessments of their partners' desirability at initial stages of the relationship, and thus as related to partner selection. If more attractive women enjoy more agency in choosing their sexual partners, then they may be less likely to report that they believe their partners were infected when they first got together. This information was collected using the following question: "When you began your relationship with [NAME], what do you think was the likelihood [NAME] was infected with HIV?" Possible answers were no likelihood, low, medium, high, and don't know. We combined low, medium, and high into one value representing likelihood. Responses to this variable were missing for the 49 women in our sample who had never had sex, and we assigned these women to "no likelihood."[14]

We also include several control variables that are likely related to attractiveness and HIV risk. Previous research suggests that attractiveness is likely correlated with age, education, wealth, and marital status (Judge, Hurst, and Simon 2009; Langlois et al. 2000; Mojola 2014), so it is important to account for these factors in our analysis. Age is included in models as a continuous variable. Educational attainment is coded as none, primary, and secondary. To capture household economic status we used principal components analysis to construct a household wealth index, using information on 17 common household goods and housing characteristics (Filmer and Pritchett 1999).[15] We coded wealth scores into three categories: low (bottom 25%), medium (middle 50%), and high (upper 25%). Marital status is categorized as currently married, formerly married (divorced, separated, or widowed), and never married.

We also control for physical and mental health, because health is likely to affect physical appearance (interviewers may be more likely to rate women in poor health as less attractive than those in better health) and to be associated with both actual HIV infection and perceived likelihood of HIV infection. The survey collected data on physical and mental health using the SF-12 questionnaire, a validated instrument composed of 12 questions capturing various dimensions of physical and mental health (Ware, Kosinski, and Keller 1996). Physical and mental health scores, which are continuous in nature, were computed using responses to these questions. Higher scores represent higher levels of physical and mental health. HIV prevalence varies widely by region, with rates highest in the south and lowest in the north (NSO-Macro 2017); thus we include a control for region of residence (central, south, or north). Finally, we controlled for the number of waves of attractiveness data (1, 2, or 3) used to construct our attractiveness measure.

3.2 Analytic strategy

We use logistic regression to examine the association between below average attractiveness and HIV infection. Following Frye and Trinitapoli (2015), we use negative binomial

---

[14]We also ran regression models excluding respondents who reported never having had sex and obtained similar results to those presented here.
[15]The household goods used in the index are a bed, sofa, table, lamp, tv, radio, cell phone, mosquito net, solar electricity panels, bike, motorcycle, oxcart. Housing characteristics include whether the household has electricity, a generator, a pit latrine (unimproved), a sanplat latrine (improved), and a metal roof.

regression for our probabilistic measure of perceived risk of HIV infection, to account for the overdispersion displayed in Figure 1.[16] To facilitate substantive interpretation of the results of the models we present average marginal effects (AMEs). For logistic regression models this measure can be interpreted as the change in probability of the outcome corresponding to a given change in the predictor variable while holding all other covariates at their sample values. For negative binomial regressions, AMEs can be interpreted as the change in the predicted count of the outcome variable (here, beans representing likelihood of infection) corresponding to a given change in the predictor variable, again holding all other covariates at their observed sample values. This method of reporting results is increasingly preferred over odds ratios and rate ratios for nonlinear models, because ratios are difficult to interpret in terms of relative magnitude (particularly for negative effects, when the ratios are less than one) and do not provide direct information about the probability of a given outcome occurring, which prevents readers from drawing inferences about the substantive significance of covariates (Deeks 1998; Hanmer and Kalkan 2013; Long and Freese 2006). We also report odds ratios (for logistic regression models) and incidence rate ratios (for negative binomial regression models) in Appendix A-3, for readers more accustomed to this method of communicating results.

To estimate each average marginal effect, predicted values were calculated twice for each respondent, first assigning a baseline value of the predictor variable (example: no education) to all respondents and then assigning a comparison value of the same predictor variable (example: secondary education) to all respondents, holding all other covariates at their observed values. The difference between these two estimates is the individual-level 'marginal effect' of primary education on the outcome variable. We calculated the average marginal effect by averaging this quantity across all respondents. For numeric variables we estimate the average marginal effect by comparing women in the 75th percentile to those in the 25th percentile.

4. Results

4.1 Descriptive statistics

Descriptive statistics for all variables are displayed in Table 1. In the analytic sample, 11% of women are rated below average attractiveness. HIV prevalence is 9%, and the mean value for our probabilistic measure of perceived risk of HIV infection is 1.2 beans. On average, respondents are 25.4 years old and most have at least some primary education. The analytic sample is evenly distributed across the three regions. With respect to marital status, 81% are currently married, 9% formerly married, and 10% never-married. More than 20% of respondents reported that their husband or partner was unfaithful and 17% reported being uncertain. The average number of lifetime sexual partners was 1.8. Eighty-six percent of women expressed certainty that their partner was not infected with HIV when they first became a couple. The mean mental and physical health scores are 56 and 53 respectively. The majority of respondents had three waves of attractiveness data available for use.

---

[16]We also tried different specifications of perceived risk, including a binary indicator denoting no risk (0 beans) and any risk (1–10 beans), and a binary variable distinguishing between low (0–3 beans) and high risk (4–10). Regression results were not sensitive to different specifications (available on request).

Figure 4 depicts the relationship between perceived attractiveness and four variables representing advantage and desirability in the sexual domain. Although our multivariate analysis focuses on a dichotomous measure of attractiveness due to the curvilinear relationship shown in Figure 3, here we use the continuous measure of attractiveness in order to better demonstrate these bivariate relationships. In the upper two panels we show a LOESS function of mean attractiveness scores across women's age and household wealth scores, with 95% confidence intervals around the smoothed line. Panel 1 shows that younger women tend to be rated as more attractive than older women. In Panel 2 we use the wealth scores derived from the principal components analysis described above, and show that women residing in households with greater wealth are perceived to be more attractive on average. Because marital status and educational attainment are categorical variables we present density plots of mean attractiveness in the bottom two panels. As shown in Panel 3, never-married women tend to have higher attractiveness scores than married women, while formerly married women have lower scores than married or never-married women. Panel 4 shows that women with secondary education have higher attractiveness scores than women with primary education, while women with no schooling have lower scores relative to both groups.

As this figure shows, interviewers' subjective assessment of physical attractiveness is not made in isolation, but instead is influenced by indicators of other sociodemographic attributes, which may be perceived through the women's physical appearance (e.g., tailored versus traditional clothing conveys information about social class background) or may have been relayed during the survey interview (e.g., information about their educational status and sexual history may lead interviewers to make implicit judgments about their desirability as a potential partner). These social underpinnings of assessments of physical attractiveness should be kept in mind when considering the relationships between attractiveness and HIV risk, presented below.

4.2 Regression analyses

4.2.1 Models predicting HIV infection—Average marginal effects (AMEs) from logistic regression models predicting HIV infection and perceived HIV risk are shown in Table 2. First, we examine the bivariate relationship between attractiveness and HIV infection (Model 1). Below-average attractiveness is strongly associated with HIV infection: The probability of HIV infection is 10% higher for women rated as below average in attractiveness compared to those rated as average or higher. In Model 2, with the full set of covariates included in the model and held at their observed values, women who are rated as less attractive than average are 9% more likely to be HIV positive. Given that the prevalence for this sample is less than 9%, the magnitude of this effect is quite substantial. Indeed, the magnitude of the change in predicted probability associated with a change in the attractiveness variable is larger than that of any other variable in the model.

In ancillary analyses we added each potential mediator – spousal/partner infidelity, number of lifetime sexual partners, perceived likelihood that partner was infected at the start of the relationship – separately, in order to test whether they mediated the relationship between attractiveness and HIV infection. The coefficient of attractiveness changed minimally with

the addition of these variables, providing no evidence of mediation. For simplicity, we therefore present the full version of the model, with all covariates included (Model 2).

In addition to perceived attractiveness, several other covariates in Model 2 are significant predictors of HIV infection. Marital status, in particular the effect of being formerly married (divorced, widowed, or separated), is associated with an 8% increased likelihood compared to women who are currently married. Women who are 30 years old (in the 75th percentile) are 6% more likely to have HIV than those aged 20 (25th percentile). The likelihood of HIV infection also varies by region: Relative to the central region, women in the south are 7% more likely to be infected with HIV. The probability of HIV infection is 5% higher for women who reported spousal/partner infidelity; this effect is marginally significant. No significant difference exists in the likelihood of HIV infection between women who reported no spousal/partner infidelity and those who reported being uncertain. Women who report 2 lifetime partners are 2% more likely to be currently infected than are those who report 1 lifetime partner. Educational attainment, wealth, mental health, physical health, and likelihood that partner was infected at the start of the relationship are not associated with HIV infection.

4.2.2 Models predicting perceived likelihood of HIV infection—Next, we examined the relationship between attractiveness and perceived risk of current HIV infection, using negative binomial regression for our probabilistic measure of perceived HIV risk (Models 3–5). In ancillary analyses we again added each potential mediator – spousal/partner infidelity, number of lifetime sexual partners, perceived likelihood that partner was infected at the start of the relationship – separately, in order to test whether the coefficient for attractiveness changed substantially with the addition of these covariates. We found that the variable measuring women's perceived likelihood that their partner was infected at the start of their relationship partially mediated the association between attractiveness and perceived risk of HIV, but no evidence of mediation for the other two measures. We therefore present three versions of this model: one with only the attractiveness measure (Model 3), one with all covariates except for perceived likelihood that partner was infected (Model 4), and one with all measures included (Model 5).

In the model exploring the bivariate relationship (Model 3), the predicted number of beans increases by 0.70 for below-average attractive women compared to average or more attractive women. Considering that 60% of the sample chose 0 beans, a difference of 0.7 beans is considerable. After adding the controls, the average marginal effect is 0.64 and remains significant (p=0.018; Model 4). This effect is larger in magnitude than those of all the other covariates in the model, with the exception of the spousal infidelity variables: Women who are certain of their husband or partner's infidelity report 1.17 more beans, on average, than women who report their partners to be faithful. Women who are uncertain about their partner's fidelity report 0.60 more beans on average.

In addition to attractiveness and spousal infidelity, Model 4 shows that region is statistically significant: Women living in the north report 0.4 fewer beans, on average, compared to women living in the central region. Women report lower perceived risk of HIV if they are in better physical health: Respondents with a physical health score of 57, corresponding to the

75th percentile, report 0.12 fewer beans, on average, relative to respondents with a physical health score of 52, corresponding to the 25th percentile. Women also report a higher perceived risk of HIV if they report a greater number of lifetime sexual partners. Educational attainment, wealth, marital status, and mental health are not significantly associated with perceived risk of HIV.

Turning to Model 5, the average marginal effect of the below-average attractiveness measure decreases from 0.64 to 0.57 with the addition of the variable representing women's perceived likelihood that their partner was infected at the start of the relationship, remaining statistically significant (p=0.04). This suggests that this measure partially mediates the association between attractiveness and perceived risk of infection, providing some support for the theory that partner selection (attractive women have more agency and choice over their sexual partners) may underlie this association. This variable is itself a highly significant predictor of perceived risk: Women who say there is some likelihood that their partner had HIV when they first got together place 1.7 more beans, on average, when assessing their own risk of infection (p<0.001), and women who respond "don't know" to this question place 1.1 more beans than women who say there is no chance their partner was infected.

4.2.3 Assessing the association between attractiveness and HIV risk for men

—While this study has primarily focused on the association between attractiveness and HIV risk for women, we conducted an identical set of analyses to examine whether a similar association exists for the men in our data set (*N*=992). Consistent with other samples from this region, we find that in our data a much lower percentage of men aged 15–35 were infected with HIV in 2006 relative to women (2% for men relative to 9% for women) and a larger percentage of men report no perceived risk of HIV, or 0 beans (73% versus 60% for women). We find no associations between attractiveness and HIV risk for men in either bivariate or multivariate models. We used both a binary (below average versus average or above) and a continuous (average ratings across the three waves of data) measure of attractiveness, and examined both HIV infection and any perceived risk of HIV infection. The attractiveness measures did not approach statistical significance in any of these models. While we are more constrained by issues of statistical power for men than we are for women, particularly for the models predicting HIV infection, this evidence suggests that the strong association that we find between below-average attractiveness and HIV risk does not hold for male respondents. Future studies should further explore the gendered nature of this association.

5. Discussion

This study is the first to examine the association between perceived physical attractiveness and HIV risk. We do so in rural Malawi in the midst of the country's generalized AIDS epidemic, using interviewers' ratings of female respondents' attractiveness. We find that physical attractiveness is an important axis of risk for women in this context. Women who were rated by interviewers as "much less" or "less" attractive than other women their age were considerably more likely to test positive for HIV. Among HIV-negative women, we also find that attractiveness is associated with women's own assessment of their HIV risk: Women who are perceived as less attractive than average report themselves to be at higher

risk of HIV infection. We found evidence that women's assessment of the likelihood that their partner had HIV at the start of their relationship partially mediates the association between attractiveness and HIV risk, though we found no evidence that this measure mediates the association between attractiveness and HIV infection. Neither spousal/partner infidelity nor number of lifetime sexual partners was found to mediate the relationship between physical attractiveness and HIV risk.

Consistent with other research, we find that perceived attractiveness is not randomly distributed across the population but is associated with other dimensions of advantage and desirability in the sexual domain (Judge, Hurst, and Simon 2009; Langlois et al. 2000; Mojola 2014). On average, women who are perceived as more attractive are younger, less likely to have ever been married, have gone further in school, and have greater household wealth compared to women who are rated as less attractive. These descriptive findings show that women with greater access to capital are significantly more likely to be perceived by interviewers as more attractive, supporting qualitative studies from across sub-Saharan Africa showing that men tend to link women's attractiveness to material consumption (Kaler 2006; Mojola 2014; Stadler 2003).

Being perceived as less attractive than one's peers is an important indicator of increased risk of contracting HIV. Our finding of a negative association between attractiveness and HIV risk contrasts starkly with local cultural beliefs, which aver that beautiful women are more likely to be infected (Frye and Gheihman 2015; Kaler 2004; Santow, Bracher, and Watkins 2008; Stadler 2003). Despite this apparent contradiction, it is possible that the beliefs about women's behavior that underpin this cultural model are in fact true: HIV infection and perceived HIV risk are only indirectly related to sexual behavior, and attractive women may still behave in ways that make them appear more risky to local observers. Indeed, despite being empirically invalid, it is possible that these cultural beliefs about HIV risk may actually be driving the pattern we document here, through a selection effect: Men may avoid sex with attractive women or be more likely to use condoms with them, potentially contributing to the pattern that we observe.[17] Additionally, if interviewers' assessments of women's physical attractiveness are dramatically different from those of typical Malawian men, it is possible that the cultural belief could be true, despite the fact that the association runs in the opposite direction in the survey data. We return to this point below.

Alternatively, these results could be driven by the opportunities and choices of women: Attractive women may enjoy advantages in the sexual domain that allow them to access more stable relationships with less risky partners. Physical attractiveness may be an important resource in the sexual domain that women can draw upon in order to assert agency and protect themselves from risk. Rather than attractiveness being associated with having more partners and more frequent sexual activity, as has been demonstrated in Western contexts (Agnew and Thompson 1994; Kelley 1978; McClintock 2011), in the context of Malawi's AIDS epidemic, attractive women may draw upon "erotic capital" to negotiate

---

[17] It is worth noting that, as mentioned above, an important component of the cultural beliefs linking female attractiveness with HIV risk is men's inability to control their sexual desire in the face of attractive women. Thus, if our results were driven by men avoiding sex with attractive women or more consistently using protection, this pattern would still be inconsistent with local cultural understandings of the epidemic.

safer sexual partnerships with less risky and more reliable men (Fiaveh et al. 2015; Green 2013; Hakim 2010). The fact that perceptions of partners' HIV status at the start of the relationship partially attenuates the association between attractiveness and perceived HIV risk suggests that more attractive women at least perceive their partnerships to be safer, though we did not find evidence that this mechanism underlies the association between attractiveness and infection.

The idea that attractiveness is a resource or form of capital that women can draw upon to minimize their likelihood of infection may seem at odds with the consistent finding in the literature that wealth is positively associated with HIV infection among men (Poulin, Dovel, and Watkins 2016). We might expect attractive women to use this 'capital' to select wealthier men, thus putting themselves at greater risk. Yet research suggests that this association between men's wealth and HIV status is likely due to wealthy men having a higher total number of sexual partners and, in particular, more casual or concurrent partners (Awusabo-Asare and Annim 2008; Berhan and Berhan 2013; Kohler and Thornton 2012). If less attractive women are able to exert less agency or control over their sexual lives, they may be more likely to engage in such casual and concurrent partnerships. Evidence also suggests that when considering potential partners, women in Malawi try to avoid men who go to bars, travel frequently away from home, and work in town, all of which are indicators of relative wealth in rural Malawi (Schatz 2005; Smith and Watkins 2005). In other words, women may not view wealthy men as the most desirable, due to their reputation for having more extramarital partners and being less likely to be faithful, and may instead seek men with other attributes.

Of course, these results do not establish a causal association between attractiveness and HIV risk. An alternative interpretation of these results is that women who are infected with HIV could be rated as less attractive because they are already symptomatic and thus look unhealthy, or because they know they are infected and thus suffer from diminished mental health and take less care of their appearance. Though we cannot rule out this alternative, we point to four pieces of evidence that, when taken together, argue against this interpretation. First, we find that the results do not change with the inclusion of mental and physical health, and that neither physical nor mental health are themselves significant predictors of HIV infection. Second, we find that the values for interviewer-rated attractiveness for HIV-positive women do not decline either two or four years after they test positive: in fact they increase slightly on average over this time (see Figure 2). And third, we leveraged the longitudinal nature of our data to examine whether HIV infection or perceived risk of infection measured in 2006 are significantly associated with interview-rated attractiveness in 2010. We find no significant effects for either HIV risk measure in these models (Appendix A-4).[18] Together, these findings suggest that the HIV infections documented here are largely

---

[18]We are grateful to an anonymous reviewer for suggesting this additional analysis. We use the 2010 attractiveness scores here because they are the latest point at which interviewer-rated attractiveness was measured, and thus are likely most vulnerable to bias related to infection-related declines in attractiveness. To facilitate comparison with other analyses in this article, we created a binary measure differentiating respondents who were rated as below average attractiveness from those who were rated as average or above. We also experimented with a categorical measure of perceived attractiveness using ordered logistic regression, and results were substantively identical.

presymptomatic and are not influencing women's physical appearance during the observation period.

The final piece of evidence suggesting that these results are not driven by HIV infection leading women to be less attractive is that we find a similar pattern of results for the models predicting perceived risk of HIV infection, with the sample limited to women who did not test positive for HIV in 2004 or 2006. Specifically, being rated as less attractive than average is associated with an increased likelihood of reporting a non-zero risk of HIV infection. In short, women who are rated as less attractive perceive their own sexual histories to be considerably more risky than do women who are rated as average or above average in attractiveness. The fact that we find such a similar pattern for self-assessed risk suggests a behavioral or relational mechanism, i.e., differences in the sexual experiences or the sexual partners of less attractive women that lead these women to be more likely to get HIV, rather than a biological effect of the disease on these women's physical appearance.

The present study has some limitations, which should be carefully considered. First, our data was collected in 2006, and it is possible that the association between perceived attractiveness and HIV infection has changed over the past ten years. The 2006 round has the largest number of new HIV infections in the MLSFH longitudinal survey, and was one of only two rounds that included both attractiveness ratings and HIV testing (Kohler et al. 2015). Nonetheless, future research should investigate the association between perceived attractiveness and HIV infection using more recent data sets and in other contexts.

Another limitation of the present study is that our score for attractiveness reflects how the women in the sample were perceived by the individuals who interviewed them, who are likely to be considerably younger, more educated, and wealthier than the men who date or marry them. Hence, the magnitude of the relationship between female attractiveness and HIV risk may vary depending on how interviewers' views on female attractiveness differ from those of ordinary Malawian men. Given that MLSFH collects information from both women and their male partners, a question that asks respondents to evaluate the physical attractiveness of their partners would allow us to gain additional insight into how HIV risk intersects with perceived attractiveness on the ground. Additionally, for future surveys that use interviewer-rated attractiveness measures, qualitative data asking interviewers to describe criteria used to make these assessments may help to shed additional light on what these subjective measures mean.

Attractiveness scores could have also been influenced by women's responses to survey questions. In particular, interviewers may have perceived women who reported that they might be infected to be less attractive than women who expressed certainty about their serostatus. Our measure of HIV infection is not subject to this type of bias, as separate research staff administered HIV testing and interviewers were not informed of respondents' infection status. However, the perceived risk variable was answered before interviewers rated respondents' attractiveness, and thus these responses may have influenced their evaluations. We have no way of examining this issue empirically, and thus results for the perceived risk measure should be interpreted with some caution.

Our results may also be biased due to missing data. In particular, the 215 observations that were missing information on HIV infection may not be a random sample of female survey respondents. Likely due primarily to data limitations, our study was unsuccessful in determining a mechanism underlying the relationship between attractiveness and HIV infection. Future research should explore potential mediators that might explain this relationship. And, finally, as mentioned above, the cross-sectional nature of our study makes it impossible to establish a causal relationship between attractiveness and HIV infection.

Despite these limitations, the observed negative association between attractiveness and both HIV infection and self-assessed HIV risk builds upon existing knowledge of the social and cultural factors contributing to HIV transmission, and underscores the importance of considering gendered power dynamics when designing effective HIV interventions. These results broadly support a deeper investigation into how sexual life is socially patterned in high-prevalence settings. The fact that physical attractiveness appears to be a strong protective factor against HIV infection suggests that more attention should be paid to understanding how differences in perceived sexual desirability may lead to inequities in women's capacity to choose when and with whom they have sex. Programs aimed at increasing women's autonomy and negotiating power within relationships might help to attenuate some of these inequities.

Additionally, these results suggest that local cultural understandings that portray attractive women as more likely to be infected and hold them responsible for the epidemic are false. While these local understandings of HIV risk are undeniably modern, they also echo enduring misogynistic tropes of 'femme fatales' ensnaring male victims and using their beauty for harm, which have been documented across contexts and over time (Dijkstra 1996; Goldenberg and Roberts 2004; Jankowiak and Ramsey 2000). The belief that the epidemic is driven by beautiful women also reflects a longstanding cultural anxiety around female beauty and sexual allure in sub-Saharan Africa that has recently been called into question. In Malawi, as well as in neighboring countries, women's organizations and feminist activists have recently organized protests resisting miniskirt bans and other efforts to enforce conservative standards of dress for women (Cammack 2012; Tamale 2016). The findings presented here suggest that these beliefs are based not on perceptions of actual epidemiological trends but rather on structures of gendered power that scapegoat women and castigate them for 'weakening' men, and may support these movements' efforts to challenge these dynamics.

A robust literature in economics and sociology has focused on the connections between physical attractiveness and social inequality, demonstrating that attractive women garner more resources and power than less attractive women, leading to an array of social advantages that accrue throughout the life course (Green 2013; Jaeger 2011; Mulford et al. 1998). A separate line of work, primarily in social psychology, suggests that perceived physical attractiveness is an important element shaping romantic preferences and sexual behavior (Agocha and Cooper 1999; Feingold 1990; McClintock 2011). The current study suggests that these two literatures should be better integrated, and that scholars should focus more on the extent to which differences in perceived physical attractiveness lead to inequalities in the sexual and romantic domain. For example, researchers could examine the

degree to which perceived attractiveness is associated with outcomes such as relationship power, intimate partner violence, contraceptive use, and unwanted pregnancies.

Finally, this study highlights the need to consider physical attractiveness, and sexual desirability more broadly, as the under-examined axis of inequality shaping HIV risk. While scholars know that AIDS in Africa is primarily spread through sex and that sexual life is structured by desire, research has thus far failed to incorporate sexual desirability into models of HIV infection. Our study demonstrates that the negative association between attractiveness and HIV risk is not due to a distinct advantage in the sexual domain among women who are perceived as being particularly attractive, but instead is driven by the fact that women who are perceived as being less attractive are at a disadvantage compared to the rest of the population, in terms of their ability to avoid risky situations and protect themselves from infection. While much of the literature on attractiveness and sexual behavior focuses on the experiences of women who are at the higher end of the distribution in terms of perceived attractiveness (Agnew and Thompson 1994; Kelley 1978; Kruse and Fromme 2005; Zaikman et al. 2016), our study suggests that it may instead be women on the lower end of this distribution whose sexual experiences are most notably distinct, at least in ways that shape their HIV risk.

Acknowledgments

Appendix: Supplementary tables

Table A-1

Distribution of independent variables by outcome and sample status, MLSFH 2006

	HIV risk			Perceived risk of HIV infection		
	Sample	Not in sample		Sample	Not in sample	
Below-average attractiveness	11.1	8.5		9.3	7.1	
Age	25.7	23.7	***	25.1	23.6	**
Educational attainment						
None	19.8	21.0		20.1	15.5	
Primary	67.9	63.8		66.7	70.1	
Secondary	12.3	15.1		13.2	14.4	
Wealth						

	HIV risk		Perceived risk of HIV infection	
	Sample	**Not in sample**	**Sample**	**Not in sample**
Low	30.8	31.7	30.6	23.1 *
Medium	44.9	41.7	44.0	69.2
High	24.4	26.6	25.4	7.7
Region		*		***
Central	34.0	38.6	33.5	54.1
South	31.6	36.4	32.7	20.4
North	34.3	25.0	33.8	25.5
Marital status				
Married	81.1	79.8	81.7	80.6
Formerly married	8.8	8.1	7.3	5.1
Never married	10.1	12.1	11.0	14.3
Spousal/partner infidelity				
No	61.0	64.4	63.4	61.7
Yes	21.1	22.1	19.6	22.3
Uncertain answer	17.9	13.5	17.1	16.0
# of lifetime sexual partners	1.8	1.8	1.7	2.0 *
Partner was infected with HIV when relationship started				
Zero likelihood	85.7	87.1	86.0	86.7
Non-zero likelihood	11.1	10.7	10.8	12.2
Uncertain answer	3.3	2.2	3.3	1.0
Mental health score	55.5	56.6 *	56.0	56.5
Physical health score	52.5	53.1	52.8	53.8
N	787	272	890	98

Notes: For analyses of HIV infection, the following numbers of women have missing data on independent variables: educational attainment (1); wealth (73); spousal/partner infidelity (5); # of lifetime sexual partners (7); mental health score (15); and physical health score (15). For analyses of perceived risk of HIV infection, the following number of have missing data on independent variables: educational attainment (1); wealth (72); spousal/partner infidelity (4); # of lifetime sexual partners (6); mental health score (14); and physical health score (14).

Table A-2

Average Marginal Effects (AMEs)[a] from logistic regression models predicting HIV infection and negative binomial regression models predicting perceived HIV risk using continuous measure of mean attractiveness, MLSFH 2006

	HIV infection		Some perceived HIV risk		
Variable	**Model 1** **AME**	**Model 2** **AME**	**Model 3** **AME**	**Model 4** **AME**	**Model 5** **AME**
Mean attractiveness score (25th to 75th percentile)	−0.03 * (0.01)	−0.02 * (0.01)	−0.27 * (0.12)	−0.26 * (0.12)	−0.23 + (0.12)
Age		0.07 *** (0.02)		0.16 (0.15)	0.21 (0.15)
Educational attainment (ref: None)					
Primary		0.02 (0.02)		0.29 (0.19)	0.29 (0.18)

Variable	HIV infection		Some perceived HIV risk		
	Model 1 AME	Model 2 AME	Model 3 AME	Model 4 AME	Model 5 AME
Secondary		0.05 (0.05)		0.05 (0.29)	0.04 (0.28)
Wealth (ref: Low)					
Medium		0.01 (0.02)		−0.08 (0.19)	−0.11 (0.18)
High		0.04 (0.03)		−0.02 (0.25)	−0.06 (0.25)
Region (ref: Central)					
South		0.06* (0.03)		0.01 (0.20)	−0.12 (0.20)
North		−0.03 (0.02)		−0.46* (0.19)	−0.48* (0.19)
Marital status (ref: Married)					
Formerly married		0.09* (0.04)		0.04 (0.29)	−0.11 (0.27)
Never married		−0.04 (0.04)		0.04 (0.31)	−0.14 (0.28)
Mental Health Score (25th to 75th percentile)		−0.01 (0.01)		−0.02 (0.06)	0.01 (0.06)
Physical Health Score (25th to 75th percentile)		−0.00 (0.01)		−0.12*** (0.04)	−0.11** (0.04)
Spousal/partner infidelity (ref: No)					
Yes		0.04 (0.02)		1.16*** (0.27)	1.17*** (0.27)
Uncertain answer		−0.02 (0.02)		0.59** (0.21)	0.48* (0.20)
Number of lifetime sexual partners		0.02*** (0.01)		0.14* (0.06)	0.09+ (0.06)
Partner was infected with HIV when relationship started (ref: no likelihood)					
Non-zero likelihood		−0.02 (0.03)			1.68*** (0.43)
Uncertain answer		−0.01 (0.05)			1.16+ (0.65)
N	787	787	890	890	890

Notes: All models control for number of waves of attractiveness data.

***
p<0.001,

**
p<0.01,

*
p<0.05,

+
p<0.10

[a]In logistic regression models, AME represents the discrete change in predicted probability, and in negative binomial regression models, AME represents the discrete change in the predicted count of the outcome measure (here, beans representing perceived risk of HIV) associated with all observations moving from one value to another. For categorical variables, AME represents the discrete change associated with all observations moving from the reference category to the category displayed in each row. For binary variables, AME represents the discrete change associated with all observations moving from 0 to 1. For numeric variables (average attractiveness, age, number of lifetime partners, mental health, physical health), AME represents the discrete change associated with moving from the 25th percentile to the 75th percentile. All other covariates are held at their observed values.

Table A-3

Odds ratios (ORs) from logistic regression models predicting HIV infection and Incidence-Rate Ratios (IRRs) from negative binomial regression models predicting perceived HIV risk, MLSFH 2006 (Corresponding to results presented in Table 2)

	HIV infection		Some perceived HIV risk		
Variable	**Model 1 OR**	**Model 2 OR**	**Model 3 IRR**	**Model 4 IRR**	**Model 5 IRR**
Below-average attractiveness	3.80*** (1.16)	3.98*** (1.48)	1.83** (0.40)	1.71* (0.35)	1.60* (0.32)
Age		1.11** (0.03)		1.01 (0.01)	1.02 (0.01)
Educational attainment (ref: None)					
Primary		1.44 (0.53)		1.27 (0.22)	1.27 (0.21)
Secondary		2.19 (1.36)		1.04 (0.29)	1.03 (0.28)
Wealth (ref: Low)					
Medium		0.92 (0.35)		0.93 (0.15)	0.90 (0.14)
High		1.76 (0.81)		1.02 (0.20)	0.95 (0.19)
Region (ref: Central)					
South		2.41* (0.84)		1.05 (0.16)	0.95 (0.14)
North		0.59 (0.27)		0.67* (0.12)	0.68* (0.11)
Marital status (ref: Married)					
Formerly married		2.70** (1.03)		1.08 (0.26)	0.95 (0.22)
Never married		0.33 (0.36)		0.91 (0.24)	0.83 (0.22)
Mental Health Score (25th to 75th percentile)		0.98 (0.01)		1.00 (0.01)	1.00 (0.01)
Physical Health Score (25th to 75th percentile)		0.99 (0.02)		0.97** (0.01)	0.98** (0.01)
Spousal/partner infidelity (ref: No)					
Yes		1.91+ (0.65)		2.43*** (0.39)	2.42*** (0.37)
Uncertain answer		0.76 (0.34)		1.73** (0.29)	1.58** (0.26)
Number of lifetime sexual partners		1.30** (0.11)		1.13* (0.07)	1.08 (0.05)
Partner was infected with HIV when relationship started (ref: no likelihood)					
Non-zero likelihood		0.69 (0.32)			2.79*** (0.50)
Uncertain answer		0.71 (0.62)			2.15* (0.68)
Constant	0.15*** (0.05)	0.01*** (0.01)	1.04 (0.20)	2.13 (1.49)	1.16 (0.78)
Pseudo R^2	0.06	0.25	0.00	0.04	0.05

Variable	HIV infection		Some perceived HIV risk		
	Model 1 OR	Model 2 OR	Model 3 IRR	Model 4 IRR	Model 5 IRR
N	787	787	890	890	890

Notes: All models control for number of waves of attractiveness data.

*** p<0.001,

** p<0.01,

* p<0.05,

+ p<0.10

Table A-4

Average Marginal Effects (AMEs)[a] from logistic regression models predicting below-average attractiveness in 2010, using covariates observed in 2006

Variable	Model 1 AME	Model 2 AME	Model 3 AME	Model 4 AME
HIV Infection	0.05 (0.04)	0.03 (0.05)		
Perceived HIV Risk (# of beans, 25th to 75th percentile)			0.01 (0.01)	0.01 (0.01)
Age (25th to 75th percentile)		0.03 (0.02)		0.01 (0.02)
Educational attainment (ref: None)				
Primary		−0.12* (0.05)		−0.12** (0.05)
Secondary		−0.15** (0.06)		−0.14* (0.06)
Wealth (ref: Low)				
Medium		−0.05 (0.03)		−0.04 (0.03)
High		−0.07+ (0.04)		−0.07* (0.04)
Region (ref: Central)				
South		−0.07* (0.03)		−0.05* (0.02)
North		0.05 (0.04)		0.06 (0.04)
Marital status (ref: Married)				
Formerly married		0.00 (0.05)		−0.03 (0.04)
Never married		0.09 (0.08)		0.07 (0.07)
Mental Health Score (25th to 75th percentile)		0.00 (0.01)		0.01 (0.01)
Physical Health Score (25th to 75th percentile)		−0.01 (0.01)		−0.01 (0.01)
Spousal/partner infidelity (ref: No)				
Yes		−0.05 (0.03)		−0.04 (0.03)
Uncertain answer		−0.07* (0.03)		−0.06* (0.03)

Variable	Model 1 AME	Model 2 AME	Model 3 AME	Model 4 AME
# of lifetime sexual partners (25th to 75th percentile)		0.01 (0.01)		0.02 (0.01)
Partner was infected with HIV when relationship started (ref: no likelihood)				
Non-zero likelihood		0.00 (0.04)		0.00 (0.04)
Uncertain answer		−0.03 (0.07)		0.02 (0.08)
N	616	584	701	644

Notes: All models control for number of waves of attractiveness data.

***
p<0.001,

**
p<0.01,

*
p<0.05,

+
p<0.10

a In logistic regression models, AME represents the discrete change in predicted probability associated with all observations moving from one value to another. For categorical variables, AME represents the discrete change associated with all observations moving from the reference category to the category displayed in each row. For binary variables, AME represents the discrete change associated with all observations moving from 0 to 1. For numeric variables (perceived risk of HIV, age, number of lifetime partners, mental health, physical health), AME represents the discrete change associated with moving from the 25th percentile to the 75th percentile. All other covariates are held at their observed values.

References

Agnew CR, Thompson VD. Causal inferences and responsibility attributions concerning an HIV-positive target: The double-edged sword of physical attractiveness. Journal of Social Behavior and Personality. 1994; 9(1):181–190.

Agocha VB, Cooper ML. Risk perceptions and safer-sex intentions: Does a partner's physical attractiveness undermine the use of risk-relevant information? Personality and Social Psychology Bulletin. 1999; 25(6):751–765. DOI: 10.1177/0146167299025006009

Anglewicz P, Adams J, Obare F, Kohler HP, Watkins S. The Malawi Diffusion and Ideational Change Project 2004–06: Data collection, data quality, and analysis of attrition. Demographic Research. 2009; 20(21):503–540. DOI: 10.4054/DemRes.2009.20.21 [PubMed: 20148128]

Anglewicz P, Kohler HP. Overestimating HIV infection: The construction and accuracy of subjective probabilities of HIV infection in rural Malawi. Demographic Research. 2009; 20(6):65–96. DOI: 10.4054/DemRes.2009.20.6 [PubMed: 19672478]

Awusabo-Asare K, Annim SK. Wealth status and risky sexual behaviour in Ghana and Kenya. Applied Health Economics and Health Policy. 2008; 6(1):27–39. DOI: 10.2165/00148365-200806010-00003 [PubMed: 18774868]

Baranov V, Bennett D, Kohler HP. The indirect impact of antiretroviral therapy: Mortality Risk, mental health, and HIV-negative labor supply. Journal of Health Economics. 2015; 44:195–211. DOI: 10.1016/j.jhealeco.2015.07.008 [PubMed: 26516983]

Becker, GS. The economic approach to human behavior. Chicago: University of Chicago Press; 1978.

Berhan Y, Berhan A. Meta-analysis on risky sexual behaviour of men: Consistent findings from different parts of the world. AIDS Care. 2013; 25(2):151–159. DOI: 10.1080/09540121.2012.689812 [PubMed: 22640010]

Buss DM. Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. Behavioral and Brain Sciences. 1989; 12(1):1–14. DOI: 10.1017/S0140525X00023992

Cammack D. Malawi in crisis, 2011–12. Review of African Political Economy. 2012; 39(132):375–388. DOI: 10.1080/03056244.2012.688651

Chiweshe MK, Bhatasara S. Ndezve Varume Izvi: Hegemonic masculinities and misogyny in popular music in Zimbabwe. Africa Media Review. 2013; 21(1):151–170.

Clark S, Poulin M, Kohler HP. Marital aspirations, sexual behaviors, and HIV/AIDS in rural Malawi. Journal of Marriage and Family. 2009; 71(2):396–416. DOI: 10.1111/j.1741-3737.2009.00607.x [PubMed: 20161389]

Coly AA. Un/Clothing African womanhood: Colonial statements and postcolonial discourses of the African female body. Journal of Contemporary African Studies. 2015; 33(1):12–26. DOI: 10.1080/02589001.2015.1021209

Conroy AA. Gender, power, and intimate partner violence: A study on couples from rural Malawi. Journal of Interpersonal Violence. 2014; 29(5):866–888. DOI: 10.1177/0886260513505907 [PubMed: 24227592]

Deeks J. When can odds ratios mislead? British Medical Journal. 1998; 317(7166):1155–1157. DOI: 10.1136/bmj.317.7166.1155a

Delavande A, Kohler HP. Subjective expectations in the context of HIV/AIDS in Malawi. Demographic Research. 2009; 20(31):817–874. DOI: 10.4054/DemRes.2009.20.31 [PubMed: 19946378]

Dijkstra, B. Evil sisters: The threat of female sexuality and the cult of manhood. New York: Alfred A. Knopf; 1996. http://www.weibnc.com/wp-content/uploads/brkpdfs2014/Evil-Sisters-The-Threat-of-Female-Sexuality-and-the-Cult-of-Manhood-by-Bram-Dijkstra-Shadow-History.pdf

Dijkstra P, Buunk BP, Blanton H. The effect of target's physical attractiveness and dominance on STD-risk perceptions. Journal of Applied Social Psychology. 2000; 30(8):1738–1755. DOI: 10.1111/j.1559-1816.2000.tb02465.x

Farrer J. A foreign adventurer's paradise? Interracial sexuality and alien sexual capital in reform era Shanghai. Sexualities. 2010; 13(1):69–95. DOI: 10.1177/1363460709352726

Feingold A. Gender differences in effects of physical attractiveness on romantic attraction: A comparison across five research paradigms. Journal of Personality and Social Psychology. 1990; 59(5):981–993. DOI: 10.1037/0022-3514.59.5.981

Fiaveh DY, Izugbara CO, Okyerefo MPK, Reysoo F, Fayorsey CK. Constructions of masculinity and femininity and sexual risk negotiation practices among women in urban Ghana. Culture, Health and Sexuality. 2015; 17(5):650–662. DOI: 10.1080/13691058.2014.989264

Filmer D, Pritchett L. The effect of household wealth on educational attainment: Evidence from 35 countries. Population and Development Review. 1999; 25(1):85–120. DOI: 10.1596/1813-9450-1980

Fisman R. Gender differences in mate selection: Evidence from a speed dating experiment. The Quarterly Journal of Economics. 2006; 121(2):673–697. DOI: 10.1162/qjec.2006.121.2.673

Frye, M., Gheihman, N. Bees to a flower: Men's activation of sexual culture in Malawi. Paper presented at the 7th African Population Conference; Johannesburg. 30 November–4 December 2015; 2015.

Frye M, Trinitapoli J. Ideals as anchors for relationship experiences. American Sociological Review. 2015; 80(3):496–525. DOI: 10.1177/0003122415581333 [PubMed: 27110031]

Gilman, L. The dance of politics: Gender, performance, and democratization in Malawi. Philadelphia: Temple University Press; 2011.

Goldenberg, JL., Roberts, TN. The beast within the beauty: An existential perspective on the objectification and condemnation of women. In: Greenberg, J.Koole, SL., Pyszczynski, T., editors. Handbook of experimental existential psychology. New York: Guilford Press; 2004. p. 71-85.

Goodreau SM, Cassels S, Kasprzyk D, Montaño DE, Greek A, Morris M. Concurrent partnerships, acute infection and HIV epidemic dynamics among young adults in Zimbabwe. AIDS and Behavior. 2012; 16(2):312–322. DOI: 10.1007/s10461-010-9858-x [PubMed: 21190074]

Green, AI., editor. Sexual fields: Toward a sociology of collective sexual life. Chicago: University of Chicago Press; 2013.

Hakim C. Erotic capital. European Sociological Review. 2010; 26(5):499–518. DOI: 10.1093/esr/jcq014

Hanmer MJ, Kalkan KO. Behind the curve: Clarifying the best approach to calculating predicted probabilities and marginal effects from limited dependent variable models. American Journal of Political Science. 2013; 57(1):263–277. DOI: 10.1111/j.1540-5907.2012.00602.x

Hansen, KT. Salaula: The world of secondhand clothing and Zambia. Chicago: University Of Chicago Press; 2000.

Hunter, M. Love in the time of AIDS: Inequality, gender, and rights in South Africa. Indianapolis: Indiana University Press; 2010.

Jaeger MM. 'A thing of beauty is a joy forever'? Returns to physical attractiveness over the life course. Social Forces. 2011; 89(3):983–1003. DOI: 10.1093/sf/89.3.983

Jankowiak W, Ramsey A. Femme fatale and status fatale: A cross-cultural perspective. Cross-Cultural Research. 2000; 34(1):57–69. DOI: 10.1177/106939710003400104

Joffe H, Dockrell JE. Safer sex: Lessons from the male sex industry. Journal of Community and Applied Social Psychology. 1995; 5(5):333–346. DOI: 10.1002/casp.2450050505

Judge TA, Hurst C, Simon LS. Does it pay to be smart, attractive, or confident (or all three)? Relationships among general mental ability, physical attractiveness, core self-evaluations, and income. Journal of Applied Psychology. 2009; 94(3):742–755. DOI: 10.1037/a0015497 [PubMed: 19450010]

Kaler A. AIDS-talk in everyday life: The presence of HIV/AIDS in men's informal conversation in southern Malawi. Social Science and Medicine. 2004; 59(2):285–297. DOI: 10.1016/j.socscimed. 2003.10.023 [PubMed: 15110420]

Kaler A. 'When they see money, they think it's life': Money, modernity and morality in two sites in rural Malawi. Journal of Southern African Studies. 2006; 32(2):335–349. DOI: 10.1080/03057070600656333

Kaler A, Angotti N, Ramaiya A. 'They are looking just the same': Antiretroviral treatment as social danger in rural Malawi. Social Science and Medicine. 2016; 167:71–78. DOI: 10.1016/j.socscimed.2016.08.023 [PubMed: 27608050]

Kaler A, Watkins SC, Angotti N. Making meaning in the time of AIDS: Longitudinal narratives from the Malawi Journals Project. African Journal of AIDS Research. 2015; 14(4):303–314. DOI: 10.2989/16085906.2015.1084342

Kelaher M, Ross MW, Rohrsheim R, Drury M, Clarkson A. Dominant situational determinants of sexual risk behaviour in gay men. AIDS. 1994; 8(1):101–106. DOI: 10.1097/00002030-199401000-00015 [PubMed: 8011220]

Kelley J. Sexual permissiveness: Evidence for a theory. Journal of Marriage and the Family. 1978; 40(3):455–468. DOI: 10.2307/350927

Kohler HP, Watkins SC, Behrman JR, Anglewicz P, Kohler IV, Thornton RL, Mkandawire J, Honde H, Hawara A, Chilima B, Bandawe C, Mwapasa V. Cohort profile: The Malawi Longitudinal Study of Families and Health (MLSFH). International Journal of Epidemiology. 2015; 44(2):394–404. DOI: 10.1093/ije/dyu049 [PubMed: 24639448]

Kohler HP, Thornton RL. Conditional cash transfers and HIV/AIDS prevention: Unconditionally promising? The World Bank Economic Review. 2012; 26(2):165–190. [PubMed: 24319306]

Kruse MI, Fromme K. Influence of physical attractiveness and alcohol on men's perceptions of potential sexual partners and sexual behavior intentions. Experimental and Clinical Psychopharmacology. 2005; 13(2):146–156. DOI: 10.1037/1064-1297.13.2.146 [PubMed: 15943547]

Langlois JH, Kalakanis L, Rubenstein AJ, Larson A, Hallam M, Smoot M. Maxims or myths of beauty? A meta-analytic and theoretical review. Psychological Bulletin. 2000; 126(3):390–423. DOI: 10.1037/0033-2909.126.3.390 [PubMed: 10825783]

Laumann, EO., Ellingson, S., Mahay, J., Paik, A., Youm, Y. The sexual organization of the city. Chicago: University of Chicago Press; 2005.

Li NP, Ballety JM, Kenrick DZ, Linsenmeier JA. The necessities and luxuries of mate preferences: Testing the tradeoffs. Journal of Personality and Social Psychology. 2002; 82(6):947–955. DOI: 10.1037/0022-3514.82.6.947 [PubMed: 12051582]

Long, SJ., Freese, J. Regression models for categorical dependent variables using Stata. College Station; StataCorp LP: 2006.

Luo S, Zhang G. What leads to romantic attraction: Similarity, reciprocity, or beauty? Evidence from a speed-dating study. Journal of Personality. 2009; 77(4):933–964. DOI: 10.1111/j. 1467-6494.2009.00570.x [PubMed: 19558447]

Martin JL, George M. Theories of sexual stratification: Toward an analytics of the sexual field and a theory of sexual capital. Sociological Theory. 2006; 24(2):107–132. DOI: 10.1111/j. 0735-2751.2006.00284.x

McClintock EA. Handsome wants as handsome does: Physical attractiveness and gender differences in revealed sexual preferences. Biodemography and Social Biology. 2011; 57(2):221–257. DOI: 10.1080/19485565.2011.615172 [PubMed: 22329089]

McClintock EA. Beauty and status: The illusion of exchange in partner selection? American Sociological Review. 2014; 79(4):575–604. DOI: 10.1177/0003122414536391

Mensch BS, Hewett PC, Erulkar AS. The reporting of sensitive behavior by adolescents: A methodological experiment in Kenya. Demography. 2003; 40(2):247–268. DOI: 10.1353/dem. 2003.0017 [PubMed: 12846131]

Mojola, SA. Love, money, and HIV: Becoming a modern African woman in the age of AIDS. Oakland: University of California Press; 2014.

Moolman B. The reproduction of an 'ideal' masculinity through gang rape on the Cape Flats: Understanding some issues and challenges for effective redress. Agenda. 2004; 18(60):109–124.

Mulford M, Orbell J, Shatto C, Stockard J. Physical attractiveness, opportunity, and success in everyday exchange. American Journal of Sociology. 1998; 103(6):1565–1592. DOI: 10.1086/231401

Nedelec JL, Beaver KM. Beauty is in the sex of the beholder: An examination of the effects of interviewer characteristics on assessments of respondent attractiveness. Personality and Individual Differences. 2011; 51(8):930–934. DOI: 10.1016/j.paid.2011.07.025

NSO-Macro. Malawi Demographic and Health Surveys: 1992, 2000, 2004, 2010, and 2016. Zomba and Calverton: ORC Macro; 2017.

Oloruntoba-Oju, T. Body images, beauty culture and language in the Nigeria, African context. African Regional Sexuality Resource Centre (ARSRC); 2007. Understanding Human Sexuality Seminar Series

Poulin M. Sex, money, and premarital partnerships in southern Malawi. Social Science and Medicine. 2007; 65(11):2383–2393. DOI: 10.1016/j.socscimed.2007.05.030 [PubMed: 17764797]

Poulin M, Dovel K, Watkins SC. Men with money and the 'vulnerable women' client category in an AIDS epidemic. World Development. 2016; 85:16–30. DOI: 10.1016/j.worlddev.2016.04.008

Santow, G., Bracher, M., Watkins, S. Implications for behavioural change in rural Malawi of popular understandings of the epidemiology of AIDS. Paper presented at the IUSSP Seminar on Potential and Actual Contributions of Behavioral Change to Curbing the Spread of HIV; Entebbe, Uganda. 18–20 February 2008; 2008.

Schatz E. 'Take your mat and go!': Rural Malawian women's strategies in the HIV/AIDS era. Culture, Health and Sexuality. 2005; 7(5):479–492. DOI: 10.1080/13691050500151255

Smith KP, Watkins SC. Perceptions of risk and strategies for prevention: Responses to HIV/AIDS in rural Malawi. Social Science and Medicine. 2005; 60(3):649–660. DOI: 10.1016/j.socscimed. 2004.06.009 [PubMed: 15550312]

Stadler JJ. The young, the rich, and the beautiful: Secrecy, suspicion and discourses of AIDS in the South African Lowveld. African Journal of AIDS Research. 2003; 2(2):127–139. DOI: 10.2989/16085906.2003.9626567 [PubMed: 25872108]

Tamale S. 'Keep your eyes off my thighs': A feminist analysis of Uganda's 'miniskirt law'. Feminist Africa. 2016; 21:83–90.

UNAIDS and World Health Organization (WHO). AIDS Epidemic Update: December 2006. Geneva: UNAIDS; 2006.

Verheijen, J. Balancing men, morals and money: Women's agency between HIV and security in a Malawi village. Leiden: African Studies Centre; 2013. African Studies Collection 53http://hdl.handle.net/1887/21741

Waller W. The rating and dating complex. American Sociological Review. 1937; 2(5):727–734. DOI: 10.2307/2083825

Wamoyi J. Transactional sex amongst young people in rural northern Tanzania: An ethnography of young women's motivations and negotiation. Reproductive Health. 2010; 7(1):2–24. DOI: 10.1186/1742-4755-7-2 [PubMed: 20429913]

Ware JE, Kosinski M, Keller SD. A 12-item short-form health survey: Construction of scales and preliminary tests of reliability and validity. Medical Care. 1996; 34(3):220–233. DOI: 10.1097/00005650-199603000-00003 [PubMed: 8628042]

Watkins SC. Navigating the AIDS epidemic in rural Malawi. Population and Development Review. 2004; 30(4):673–705. DOI: 10.1111/j.1728-4457.2004.00037.x

Watkins SC, Swidler A. Working misunderstandings: Donors, brokers, and villagers in Africa's AIDS industry. Population and Development Review. 2013; 38(1):197–218. DOI: 10.1111/j.1728-4457.2013.00560.x

World Health Organization. World Health Statistics 2009. Geneva: World Health Organization; 2009.

World Health Organization. UNAIDS/WHO Global HIV/AIDS Online Database. 2017

Zaba B. Age at first sex: Understanding recent trends in African demographic surveys. Sexually Transmitted Infections. 2004; 80(suppl. 2):ii28–ii35. DOI: 10.1136/sti.2004.012674 [PubMed: 15572637]

Zablotska IB, Imrie J, Prestage G, Crawford J, Rawstorne P, Grulich A, Jin F, Kippax S. Gay men's current practice of HIV seroconcordant unprotected anal intercourse: Serosorting or seroguessing? AIDS Care. 2009; 21(4):501–510. DOI: 10.1080/09540120802270292 [PubMed: 19266409]

Zaikman Y, Vogel EA, Vicary AM, Marks MJ. The influence of physical appearance and personality on the exhibition of the sexual double standard. Sexuality and Culture. 2016; 20(3):255–276. DOI: 10.1007/s12119-015-9332-z
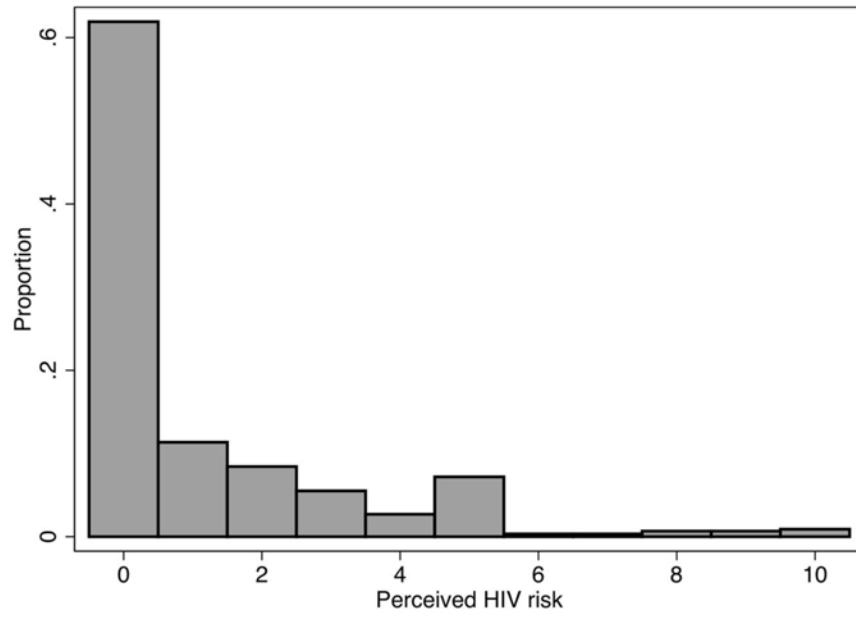
Figure 1.
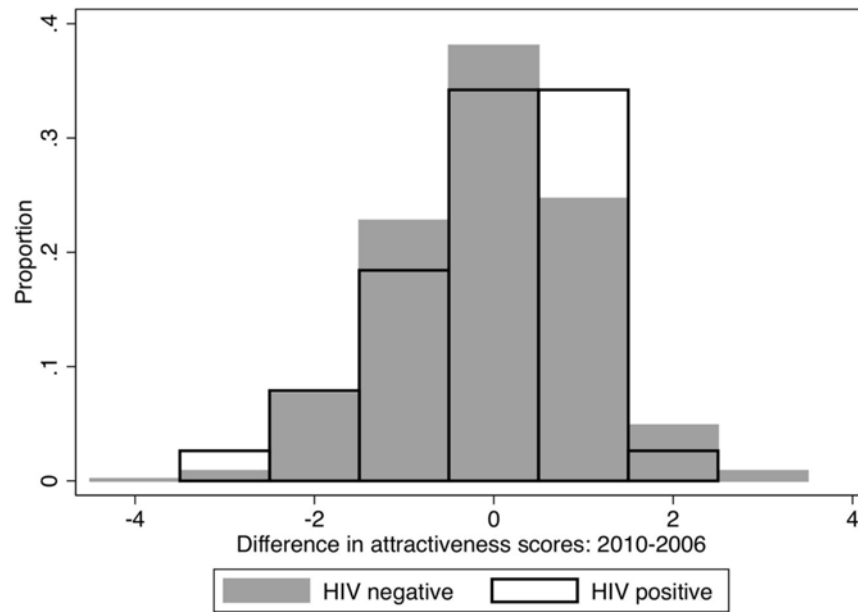Histogram of responses to question about perceived risk of HIV infection, 2006

Figure 2. Histogram of the difference in interviewer-rated attractiveness between 2010 and 2006, graphed separately for HIV-positive and HIV-negative women
Notes: Positive values represent an increase in attractiveness ratings over time and negative values represent a decline in attractiveness ratings over time. Attractiveness ratings range from 1 (much less attractive than average) to 5 (much more attractive than average). HIV status is measured using results of MLSFH-administered HIV tests in 2006. Results show that HIV-positive women were more likely to experience an increase in attractiveness over time, relative to HIV-negative women.
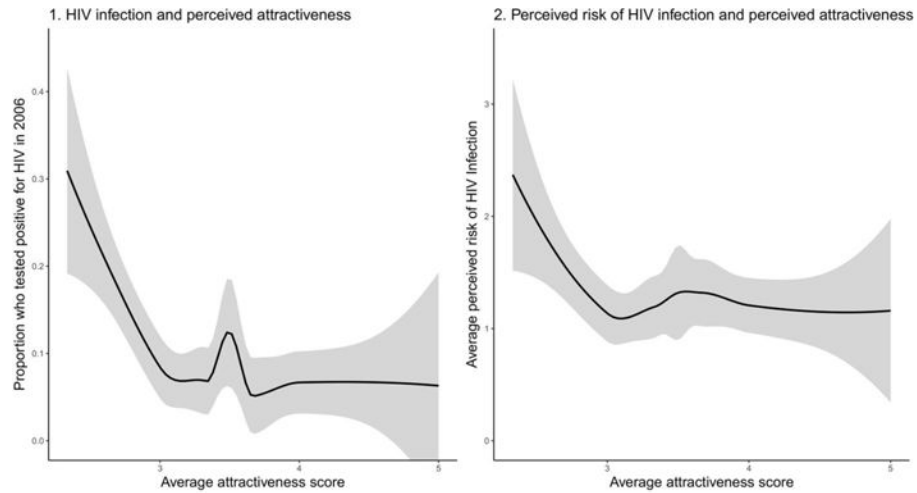
Figure 3. Bivariate associations between perceived attractiveness and HIV risk measures
Notes: Both panels were generated using a LOESS smoothing function, with the shaded region representing a 95% confidence interval around the mean estimate at each value of the interviewer-rated attractiveness scale. Both graphs show a strong negative trend at lower levels of the perceived attractiveness scale, with an evening out around the value of 3, corresponding to average ratings of perceived attractiveness.
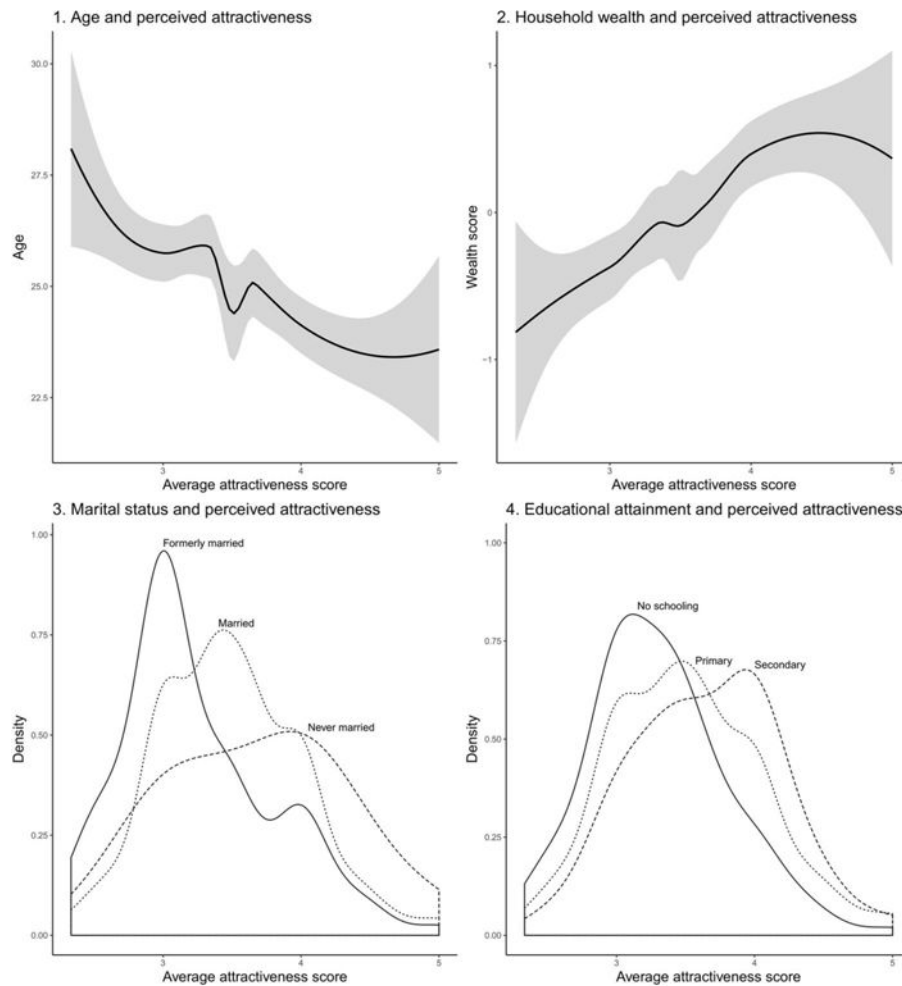
Figure 4. Bivariate associations between perceived attractiveness and sociodemographic variables

Notes: The top two panels were generated using a LOESS smoothing function, with the shaded region representing a 95% confidence interval around the mean estimate at each level of attractiveness. The bottom two panels were generated by constructing density plots for each category of the variable of interest. Panel 1 (age) shows that women rated as less attractive are older, on average, while Panel 2 (household wealth) shows that women rated as less attractive are less wealthy, on average. Panel 3 (marital status) shows that never-married women are rated as more attractive and formerly married women are rated as less attractive, on average, relative to married women. Panel 4 (education) shows that women with no schooling are rated as less attractive than women who have completed at least some schooling.

Table 1

Descriptive statistics of female analytic sample, MLSFH 2006

Variable	Mean/Percentage
Below Average Attractiveness (%)	10.6
HIV positive (%)	8.6
Perceived HIV risk[a] (mean)	1.2
Age (mean)	25.4
Education (%)	
None	20.6
Primary	66.5
Secondary	12.9
Wealth (%)	
Low	24.9
Medium	50.1
High	25.1
Region (%)	
Central	33.4
South	34.0
North	32.6
Marital status (%)	
Married	80.9
Formerly married	8.8
Never married	10.3
Spousal/partner infidelity (%)	
No[b]	62.0
Yes	21.2
Uncertain answer	16.8
Number of lifetime sexual partners (mean)	1.8
Partner was infected with HIV when relationship started (%)	
Zero likelihood[b]	85.9
Non-zero likelihood	10.9
Uncertain answer	3.2
Mental health score (mean)	55.7
Physical health score (mean)	52.6
Waves of attractiveness data (%)	
One	12.9
Two	28.2
Three	58.9
N	961

Notes:

[a]Excludes HIV-positive women (*N*=68).

[b]Includes women who reported never having had sex (*N*=50).

Table 2

Average Marginal Effects (AMEs)[a] from logistic regression models predicting HIV infection and negative binomial regression models predicting perceived HIV risk, MLSFH 2006

Variable	HIV infection		Some perceived HIV risk		
	Model 1 AME	Model 2 AME	Model 3 AME	Model 4 AME	Model 5 AME
Mean attractiveness score (25th to 75th percentile)	0.10*** (0.02)	0.09*** (0.02)	0.70** (0.26)	0.64* (0.26)	0.57* (0.26)
Age		0.06*** (0.02)		0.16 (0.15)	0.22 (0.15)
Educational attainment (ref: None)					
Primary		0.02 (0.02)		0.27 (0.19)	0.28 (0.19)
Secondary		0.05 (0.04)		0.04 (0.29)	0.03 (0.28)
Wealth (ref: Low)					
Medium		−0.00 (0.02)		−0.09 (0.19)	−0.12 (0.19)
High		0.04 (0.03)		0.02 (0.25)	−0.06 (0.24)
Region (ref: Central)					
South		0.07* (0.03)		0.06 (0.20)	−0.07 (0.20)
North		−0.03 (0.02)		−0.42* (0.18)	−0.44* (0.19)
Marital status (ref: Married)					
Formerly married		0.08* (0.04)		0.09 (0.31)	−0.06 (0.28)
Never married		−0.05 (0.03)		−0.11 (0.29)	−0.20 (0.27)
Mental Health Score (25th to 75th percentile)		−0.01 (0.01)		−0.02 (0.06)	−0.01 (0.06)
Physical Health Score (25th to 75th percentile)		−0.00 (0.01)		−0.12** (0.04)	−0.10** (0.04)
Spousal/partner infidelity (ref: No)					

Variable	HIV infection		Some perceived HIV risk		
	Model 1 AME	Model 2 AME	Model 3 AME	Model 4 AME	Model 5 AME
Yes		0.05$^+$ (0.03)		1.17*** (0.27)	1.19*** (0.27)
Uncertain answer		−0.01 (0.02)		0.59** (0.21)	0.48* (0.20)
Number of lifetime sexual partners		0.02** (0.01)		0.13* (0.06)	0.09 (0.06)
Partner was infected with HIV when relationship started (ref: no likelihood)					
Non-zero likelihood		−0.02 (0.02)			1.68*** (0.44)
Uncertain answer		−0.02 (0.05)			1.08$^+$ (0.63)
N	787	787	890	890	890

Notes: All models control for number of waves of attractiveness data.

*** p<0.001,

** p<0.01,

* p<0.05,

$^+$ p<0.10

[a] In logistic regression models, AME represents the discrete change in predicted probability, and in negative binomial regression models, AME represents the discrete change in the predicted count of the outcome measure (here, beans representing perceived risk of HIV) associated with all observations moving from one value to another. For categorical variables, AME represents the discrete change associated with all observations moving from the reference category to the category displayed in each row. For binary variables, AME represents the discrete change associated with all observations moving from 0 to 1. For numeric variables (age, number of lifetime partners, mental health, physical health), AME represents the discrete change associated with moving from the 25th percentile to the 75th percentile. All other covariates are held at their observed values.