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Migration, Marital Change, and HIV Infection in Malawi

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Abstract

Research on the relationship between migration and HIV infection in sub-Saharan Africa often suggests that migrants are at higher risk of HIV infection because they are more likely to engage in risk behavior than non-migrants, and tend to move to areas with a relatively higher HIV prevalence. While migration may be a risk factor for HIV infection, I instead focus on the possibility that the HIV positive are more likely to migrate. Using a longitudinal dataset of permanent rural residents and migrants from Malawi, I find that migrants originating from rural areas are indeed more likely than non-migrants to be HIV positive and to have engaged in HIV risk behavior. The increased HIV risk among migrants may be due to the selection of HIV positive individuals into migration; I find that HIV positive individuals are more likely migrate than those who are HIV negative. The explanation for this phenomenon appears to be marital instability, which occurs more frequently among HIV positive individuals and leads to migration after marital change.

Introduction

It has long been accepted that population mobility played an important role in the spread of HIV throughout sub-Saharan Africa. Starting in the 1950s, urban centers in sub-Saharan Africa (SSA) experienced rapid population growth (Preston 1979), due in part to an increasing rural-urban labor migration (Oucho and Gould 1993). Urban centers are believed to have then become hubs for the rapid spread of HIV early in the epidemic (Kreiss et al. 1986; Mann et al. 1986), and migration linked high HIV prevalence cities with rural areas of lower prevalence (Barongo et al. 1992; Orubuloye et al. 1993).

Given these circumstances it is not surprising that migrants are at greater risk of HIV infection than non-migrants throughout SSA. Migrants report more sexual partners and less frequent condom use (Anarfi 1993 for Ghana; Brokerhoff and Biddlecom 1999 for Kenya; Chirwa 1997 for Malawi). Migration studies with HIV biomarkers have shown higher HIV prevalence among migrants, in South Africa (Lurie et al. 2003a; Welz et al. 2007), Senegal (Pison et al. 1993), and Uganda (Nunn et al. 1995); and short-term mobility was associated with HIV infection among migrants in Senegal and Guinea-Bissau (Legarde et al. 2003).

Two plausible explanations have been offered for these findings, the first of which suggests that migration affects HIV risk behavior. Some studies have found that men separated by migration from their wife often find substitutes, leading to sexual activity with new (and potentially riskier) partners, such as commercial sex workers (Anarfi 1993; Chirwa 1997; Lurie et al. 1997; Wolffers et al. 2002). While the focus of this literature is on male labor migrants, female migrants have also been shown to average more sexual partners than

female non-migrants (Kishamawe et al. 2006; Orubuloye et al. 1993), and stay-at-home wives of migrants may be more likely to have extra marital sexual partners (henceforth referred to as EMSP) than wives of non-migrants (Helleringer et al. 2007). Migration may also affect HIV risk behavior because migrants from rural areas frequently go to cities where social constraints on sexual behavior are thought to be weaker than in rural areas (Anarfi 1993; Grmek 1990; Setelg51 1990). Other theories have sought to explain the greater HIV risk among migrants by characteristics of migrants' destinations, particularly cities. Since HIV prevalence is higher in cities, migrants are more likely to be exposed to HIV even if the number of sexual partners does not differ between rural and urban residents. Once infected, migrants may serve as conduits of HIV to rural areas by infecting their stay-at-home spouses or sexual partners (Kishamawe et al. 2006; Lurie et al. 1997).[1]

A persistent assumption in much of the early research on HIV infection and migration was that migration is an independent risk factor for HIV infection, in other words, that migration (particularly to urban centers) precedes HIV infection. However, longitudinal data for sub-Sahara are rare, and longitudinal data that include information on HIV status at both origin and destination are even less common. Thus, most research on migration and HIV cannot empirically compare the HIV status of migrants before and after they move.

While migrants are at greater risk of contracting HIV, recent research also shows that HIV/AIDS infection can affect migration. Evidence from Malawi (Floyd et al. 2008), South Africa (Hosegood et al. 2004; Ford and Hosegood 2005), Tanzania (Urassa et al. 2001), and Zimbabwe (Gregson, Mushati and Nyamukapa 2007) shows that an adult death (particularly the head of household) often prompts household members to migrate elsewhere. Individuals also move to care for relatives who are sick from AIDS-related illnesses (Robson et al. 2006). However, this research typically does not focus on the HIV status of the migrants themselves, but rather of the household member whose death or illness caused the migration of others. Others, however, have suggested that individuals who become sick while living away from their homes often return home to receive palliative care (Chimwaza and Watkins 2004 for Malawi; Clark et al. 2007 for South Africa; Urassa et al. 2001 for Tanzania).

An alternative conception of the relationship between migration and HIV infection is that marriage-related processes influence migration and contribute to higher HIV rates among migrants. Several studies in Africa have found that HIV positive individuals are more likely to experience marital dissolution (either via divorce or the death of a spouse) than the HIV negative (Floyd et al. 2008 for Malawi; Gregory et al. 2007 for Tanzania; Lopman et al. 2009 for Zimbabwe; Porter et al. 2004 for Uganda); and individuals whose marriage ended in divorce or widowhood are more likely to be HIV positive than the currently married (Boerma et al. 2002 for Tanzania; Bioleau et al. 2009 for Malawi; Gregson et al. 2001 for Zimbabwe; Welz et al. 2007 for South Africa). Research also shows a link between marital dissolution and migration throughout SSA: since marriage typically involves one spouse moving to the home of the other, marital dissolution often results in the departure of at least one spouse (Arnoldo 2004 for Mozambique; Boerma et al. 2002 for Tanzania; Reniers 2003 for Malawi; Watts 1983 for Nigeria). Thus, the higher HIV prevalence among migrants could be due to divorced or widowed HIV positive individuals who move after marital dissolution. Such a scenario could contribute significantly to the spread of HIV in SSA, either through remarriage of HIV positive migrants to an uninfected person, or through less institutionalized sexual relations (Lopman et al. 2009 for Zimbabwe).

[1]The link between urban migration and HIV risk may have weakened over time: Coffee et al. (2005) show that rural-urban migration is no longer associated with increased risk of HIV infection in some areas of sub-Saharan Africa, and Coast (2006) found that some migrants are aware of the higher HIV prevalence in urban areas and claimed to have changed their behavior in response to the increased risk of HIV infection.

In this paper, I examine the relationship between migration and HIV infection. I take advantage of a unique dataset that integrates a longitudinal study of a large sample in rural Malawi with a study that tracked and interviewed migrants from the survey sample. Unlike many studies of migration and HIV, both survey respondents and migrants were tested for HIV. While research has consistently shown that migration is associated with greater risk of HIV infection, the results here suggest an additional explanation for the relationship between migration and HIV: that marital patterns- particularly marital change- play an important mediating role.

I begin by confirming that HIV prevalence is higher among migrants than non-migrants in Malawi. Next, I ask: does migration precede HIV infection or are HIV positive respondents more likely to migrate? After finding evidence that HIV positive individuals are indeed more likely to migrate, I examine why migration might be selective with respect to HIV status. Finally, I discuss the implications of my findings for AIDS research in SSA.

Background: Internal Migration in Malawi

In Malawi, 11.8% of all adults aged 15-49 are HIV positive (UNAIDS 2008). As with many AIDS-affected countries in SSA, there are large differences in HIV prevalence between urban centers and rural areas: for the 14% of Malawi residents living in urban areas in 2004, HIV prevalence was approximately 17%, compared with 11% in rural areas (MDHS 2004). There are also regional differences in HIV prevalence, with the highest HIV rates in the southern region (MDHS 2004), which also has the highest population density of the three regions in Malawi (Malawi NSO 2008).

There are two important motivations for migration in Malawi: to earn money with which to supplement subsistence agriculture, and at the beginning or end of a marriage. Male labor migration has long been, and continues to be, an important source of income in Malawi, as it is elsewhere in the region. Compared with neighboring countries, however, Malawi is an anomaly in terms of its history of urban growth. While increases in rural-urban migration contributed to rapid urbanization in the 1960s and 1970s for most sub-Saharan African countries (Preston 1979), rural-urban migration was restricted in Malawi during the long rule of President Banda (1963-1994), but increased rapidly after a new government was elected in 1994 (England 2004). International migration, however, has been a life-cycle stage for young Malawian men since the colonial period, as many went (and continue to go) to work in mines or agricultural estates in South Africa, Zambia, or Zimbabwe (Kalipeni 1992; Kydd and Christiansen 1982).

Marriage is nearly universal in Malawi: by age 30, 99% of women and 97% of men have been married and 79% and 91% are currently married (MDHS 2004). Marital patterns, and thus mobility patterns by sex, differ by ethnic group and across the three regions of the country (Mtika and Doctor 2002; Reniers 2003). The dominant ethnic group in the northern region of Malawi, the Tumbuka, practices a tradition of patrilocal residence after marriage, in which the wife moves to the home of the husband upon marriage. Ethnic groups in the southern region are characterized by a matrilocal tradition in which men move to the home of their wife (Reniers 2003). Residents of the central region do not strictly adhere to either matrilocal or patrilocal traditions.

Marital dissolution is also frequent in Malawi compared to other countries in SSA: nearly half of all first marriages end in divorce within 20 years (Reniers 2003). Divorce as well as widowhood is likely to lead to the departure of either husband or wife depending on the marital residential pattern of the region; in the southern region men typically return home after marital dissolution (Reniers 2003; Schatz 2005). Remarriage is nearly universal in Malawi, where approximately 90% of women remarry within 10 years after divorce (Reniers

2003). Because marriage is nearly universal, divorce and remarriage rates are relatively high, and migration typically occurs at the beginning and end of a marriage in Malawi, one can expect to find a close relationship between marriage and migration patterns in Malawi.

DATA

The data for the analyses below come from the Malawi Diffusion and Ideational Change Project (MDICP), a panel survey that examines the role of social networks in changing attitudes and behavior regarding family size, family planning, and AIDS in rural Malawi. The first round, in 1998, interviewed 1541 ever-married women of childbearing age and 1065 of their husbands in three districts of Malawi (one district per region). In 2001 and 2004, the second and third rounds of the survey re-interviewed the same respondents along with new spouses for respondents who remarried between the two survey waves. In the third round MDICP added approximately 1,000 adolescents between the ages of 15-25 (of which 68% were never-married in 2004), and collected HIV biomarkers for all consenting respondents (2004 HIV testing protocol is described in Bignami-Van Assche et al. 2004). Among all 2004 MDICP respondents, 9% refused HIV testing; and 68% of individuals tested also received their HIV test results (Obare et al. 2009). In 2006, the MDICP returned for a fourth wave of data collection to re-interview all MDICP respondents and again test for HIV. Further details MDICP data collection and sampling procedures can be found in Watkins et al. 2003 and Anglewicz et al. 2007.

During 2006 fieldwork, the MDICP collected information for respondents who were interviewed in at least one previous MDICP wave but had since permanently moved to a location outside of a MDICP sample village. For these migrating respondents, MDICP administered a “migration autopsy” questionnaire to family members or neighbors of the migrant. This questionnaire included detailed information on the city, town, village and neighborhood where the migrant moved, along with information for contacting migrants such as the names of other members of the migrant's new household and phone numbers if available. The overall 2006 MDICP sample consisted of 4,528 respondents, of whom a total of 807 individuals (17.8%) had relocated by 2006.

In the spring of 2007, the MDICP used information from migration autopsies to trace these migrants and administer the 2006 MDICP survey questionnaire and an HIV test. These data offer a rare and valuable opportunity to examine the relationship between HIV infection and migration in sub-Saharan Africa, for several reasons. First, the migration study data include both rural-urban and rural-rural migrants, which I use to test the claim that urban migrants are at particular risk of HIV infection. Second, these data also permit examining rural-rural migration, a potentially important but seldom studied possible route of HIV spread. Third, and particularly important for this paper, the migrants were asked about their motivations for leaving home. Since other migration studies typically sample based on reason for migration, this information provides rare insight into migration patterns. Finally, I integrate data from the special migration study with the longitudinal MDICP data and examine characteristics of migrants both before and after migration.

MDICP Migration Study Background

Because detailed data on internal migration in SSA is unusual, the following section describes the migration study sample. First, I show MDICP sample characteristics and the extent of migration from MDICP sample villages. Next, I compare the characteristics of the overall MDICP migrant sample and those successfully traced and interviewed by the MDICP migration study.

Migration Study Sample

In 2006, the fourth wave of the MDICP survey, approximately 70% of the 4,528 sample members was interviewed. Absence due to migration (as reported by family members or neighbors) was the most frequent reason why individuals were not interviewed: approximately 18% (807) of the 2006 MDICP sample moved sometime between the first wave in 1998 and 2006. Of these migrants, 11% moved outside of Malawi and no attempts were made to reach them. The target sample for the migration study was thus the 718 men and women who had been interviewed at least once by the MDICP prior to 2006 and who had subsequently relocated permanently to another location within Malawi (urban or rural).

In this research, the term “migrant” is defined as an individual who at one point resided in a MDICP sample village and later moved to another location with the intention to stay. The permanence of this move is established from (1) migration autopsies described above, and (2) self-reports of MDICP migrants interviewed in 2007. Some MDICP respondents who were interviewed in a previous MDICP wave and did not permanently move since 1998 may still have been migrants prior to their inclusion in the MDICP sample: in 2006, 47% of men and 34% of women reported that they had stayed outside of their current district of residence for six months or more since they were 15 years old. However, all of these men and women who in 2006 reported having lived at another location since age 15 now consider themselves to be permanent residents of an MDICP village. Nonetheless, the definition of migration used in this paper may underestimate the extent of migration among MDICP respondents.

Of these 718 migrants, the 2007 migration study team traced approximately 60% and interviewed 56% (N=402) (the remaining 4% were dead, hospitalized, or refused to be interviewed). Of respondents who were not traced by the migration team, approximately 28% were not found at the location described in their migration autopsy. Often, the family members or neighbors could only provide a general location, which is not surprising since street names and house numbers are rare even in urban areas of Malawi. When information was specific, it was occasionally incorrect. Our default was to search by name: this was problematic, however, because migrants sometimes changed their name after migration and were therefore not known at their place of destination. A more detailed description of outcomes for all 718 migrants can be found in Anglewicz (2007).

Migration Study Sample Characteristics

Background information for the 718 migrants that compose the MDICP migration study target sample and the 402 migrants found by the migration study team in 2007 are shown in Table 1.

Differences in migration patterns reflect differences in migration by region, sex and age. More men from the matrilocal South migrated (45%) than men from the other two regions, and more women from the patrilocal North migrated (38%) than women from the Center or South. Although either the husband or the wife may move at marriage, women typically marry at younger ages than men (Reniers 2003). The age and sex distribution of the migrants who were located is roughly similar to the age distribution of the migration target sample (t-tests comparing age show no statistically significant differences at the $p \leq 0.05$ level).

Of the 718 MDICP respondents who moved within Malawi, 20% (146 migrants) moved to an urban area,[2] the most common of which was Lilongwe, the centrally-located nation's

[2]I define urban migration as a move to one of the regional capitals of Malawi (Mzuzu for the Northern region, Lilongwe for the Central, Blantyre for the Southern region), or to the capital of one of Malawi's 22 districts.

capital, where approximately 31% of all rural-urban migrants were living. A slightly larger percentage of male migrants moved to an urban area than female MDICP respondents (23% for men and 19% women). Statistical tests show no significant differences in urban residence between migrants who were located by the migration team and those who were not ($p \leq 0.05$).

The motivation for moving is important for understanding the relationship between migration and HIV status. As shown in Table 1, marriage-related reasons (divorce, widowhood or new marriage) account for approximately 31% of the reasons for migration, compared to 39% who moved for work.[3] Of individuals who migrated for marriage-related reasons, 15% (32) of the target sample and 15% (21) of the sample interviewed moved for a first marriage. Thus, the vast majority of migrants who moved for marriage-related reasons were married at least once. Again, differences by sex are evident and not surprising: women were more likely to move for marriage than for work, men for work than for marriage. The "other" category groups together all reasons for migration that did not fit into the above categories, e.g. to attend school, visit a relative, following parents or relatives to a new location, and imprisonment.[4] It is, of course, possible that migrants had more than one reason for moving. Interviewers were instructed to indicate the primary reason for migration in the 2006 migration autopsies and for migrants interviewed in 2007.

Methods and Results

Are Migrants at Greater Risk of HIV Infection?

A central goal of the migration study was to compare HIV infection among migrants and non-migrants. Of the 402 respondents interviewed in the migration study, 364 (90.5%) consented to an HIV test. Figure 1 displays highly significant differences in HIV prevalence between MDICP migrants and non-migrants, for both men and women. Overall, approximately 14% of the 364 MDICP migrants tested were HIV positive, significantly greater than the 5.3% HIV positive tested in the 2006 MDICP survey wave (Obare et al. 2009).

Next, I use multivariate regressions to examine whether MDICP migrants are more likely than non-migrants to engage in activities that presumably put them at risk of HIV infection. I combine data from the 2007 MDICP migration survey with the 2006 MDICP data for non-migrants,[5] and run regressions using three measures of HIV risk (perceived spousal EMSP, number of lifetime sexual partners, and worry of HIV infection) and actual HIV status as dependent variables.

There are two independent variables of particular interest in the analyses below, both related to migration from a MDICP sample village. The first is a binary indicator to represent respondents who migrated from the MDICP sample to either another rural area or to an urban area and were interviewed by the migration study team in 2007. Next, I include an indicator for rural or urban destination. If migrants are at greater risk of HIV infection

[3]Reasons for migration in Table 1 were asked directly for migrants interviewed by the migration study team in 2007. Reasons for migration for migrants not interviewed are from the migration autopsies, which were administered to relatives or friends of the migrant.

[4]Full tabulation of all reasons for migration is provided in the appendix, for (1) the MDICP migration target sample and (2) respondents interviewed by the migration study team (Table A1).

[5]As previously noted, it is possible that respondents who were interviewed by the main MDICP survey team ("non-migrants") could have migrated once or more in their lifetime. For these individuals, the migration occurred either (1) before 1998 (when the first MDICP survey took place), or (2) in between MDICP waves with a return to the MDICP sample village by another wave of data collection. With regards to (2), among respondents considered "non-migrants", the following percentages of men and women reported living outside the district for one month or more in the previous year: 16.1% of men 8.9% women in 2001, 15.3% and 9.8% in 2004, 14.8% and 10.4% in 2006.

primarily due to rural-urban migration (as often assumed) one would expect the indicator for rural-urban migration to be statistically significant.

Results for men and women (Table 2) clearly show that both male and female MDICP migrants are at significantly higher risk of HIV infection than non-migrants. Migrants are more exposed to risk of HIV infection than non-migrants: migrants report a significantly higher number of lifetime sexual partners. In addition, just as some theories speculate that stay-at-home wives of male migrants are likely to have have an EMSP, male migrants are significantly more likely than non-migrants to suspect their wife of having an EMSP. Given the increased HIV risk behavior among migrants (or their spouses) it is not surprising to find that both male and female migrants also have significantly higher *perceived* risk of HIV infection: this is important, since those who do not know their actual serostatus are likely to be motivated by their perceptions (Anglewicz and Kohler 2009). Moreover, migrant men and women are considerably more likely *actually* to be HIV positive than non-migrants. Table 2 shows that female migrants have 2.5 times greater odds of being HIV positive than female non-migrants, and male migrants are more than two times more likely to be HIV positive than their non-migrant counterparts.

As noted earlier, in Malawi, as elsewhere in the region, HIV prevalence is substantially higher in the cities than in the countryside (MDHS 2004). Strikingly, the differences that I find between migrants and non-migrants are *not* explained by migration to an urban area. Of all four HIV risk measures for both men and women, only one shows a significant difference for rural-urban migrants: men who migrate to an urban area are more likely to report an EMSP.

In summary, migrant patterns of behavior put them at higher risk of HIV infection (perceived as well as actual). The highly significant differences in HIV status between migrants and non-migrants are no surprise, but rather are consistent with findings from other studies in the region. Also consistent with the literature is the finding that migrants have a greater number of lifetime sexual partners than non-migrants- both for men and women. Given the previous literature that emphasizes the particular dangers of urban areas, an unexpected finding is the absence of difference between rural and urban areas in reported risk-related sexual behavior or in HIV serostatus.

While it is apparent that migrants are at higher risk of HIV infection, it is not possible to discern from these regressions the reason why. Is it due to relaxed social constraints after migration, the tendency to have more sexual partners, or is there another possibility? In the next section I use longitudinal data to identify why migrants are at higher risk of HIV infection than non-migrants.

Does HIV Status Influence Migration?

If the greater risk of HIV infection for migrants was due to the importance of a regular sexual relationship and/or to the weaker social constraints on sexual behavior in urban areas, one would expect that there would be little difference in risk between migrants and non-migrants prior to moving (while controlling for past migration experience). To test this possibility, below I analyze 2004 and 2006 waves of the MDICP survey, both of which included testing for HIV. Of the 718 migrants in the target sample, 402 MDICP respondents (56%) were interviewed in 2004 but had migrated by 2006. Of these migrants, 344 (85%) were tested for HIV in 2004. Using these 344 individuals who interviewed and HIV tested by MDICP in 2004 and later migrated, I examine whether there is any difference in HIV infection between migrants and residents prior to migration. In doing so, I also identify other characteristics associated with migration for rural Malawians.

To do so, I run logistic regression models in which the dependent variable is a binary indicator for migration between 2004 and 2006 (i.e. the 344 individuals described above). Independent variables include HIV infection and a set of expected correlates of migration. Since it is reasonable to expect a relationship between migration and health status, I include 2004 self-rated health. Since some MDICP respondents move to find better land for farming purposes, I include an indicator of whether the respondent owns land in the village. Next, since migration may be a reoccurring event where migrants leave a rural home for work and return periodically (Chirwa 1997; Lurie et al. 2003), I include a variable for individuals who had lived outside of their 2004 village of residence for six months or more since the age of 15. Because marriage patterns in Malawi influence migration (Mtika and Doctor 2002; Reniers 2003), I also include indicators for marital status (currently married, never-married, divorced or separated, or widowed), as well as a set of background characteristics: age, household economic status, region of residence and level of education.

I also include the three variables from Table 2 as measures of HIV risk: worry of HIV infection, spousal EMSP, and number of sexual partners. There are two purposes to including these measures: (1) to control for any underlying HIV risk predisposition that might be associated with both HIV status and migration, and (2) to see if migrants are different from non-migrants in these characteristics prior to migration.

Finally, because marriage-related characteristics may explain the increased HIV risk for migrants, I examine whether the HIV status of a spouse is associated with a greater likelihood of migrating between 2004 and 2006. As the original MDICP sample consisted of ever-married women and their spouses, we have the spouse's HIV status for a sub-sample of MDICP respondents. Of the 3,180 respondents successfully interviewed by MDICP in 2004, 73% were currently married (69% of men and 75% of women); and of the currently-married respondents, we have test results for the spouses of 742 women and 605 men.[6] In Model 2, I include the HIV status for the respondent's spouse to see if individuals whose spouse was HIV positive in 2004 are more likely to move between 2004 and 2006.

The most important finding of this analysis is that both male and female MDICP respondents who were HIV positive in 2004 are significantly more likely to migrate after the 2004 MDICP survey than those who tested negative. This result is particularly strong for men: results in Table 3 show that HIV positive men were more than two times more likely to migrate after 2004 than were HIV negative men. Similarly, women who are HIV positive have approximately 90% greater odds of migrating than women who were negative. In addition, the HIV status of a spouse is significantly associated with migration for men: men whose wife was found HIV positive in 2004 were more than four times more likely to migrate than men whose wives were HIV negative (Model 2).

Several HIV risk measures are also significantly associated with migration. Both men and women who are worried about HIV infection in 2004 are more likely to migrate between 2004-06 than those who are not worried about HIV infection. Also, women who migrate have more lifetime sexual partners in 2004, and men are significantly more likely to suspect their spouse has had an EMSP. So migrants are not only at greater risk of HIV infection after migration (shown in Table 2), but they are also at greater risk prior to migration.

Other correlates of migration differ by sex. Ownership of land is an important factor that strengthens the ties between men and their village of origin. As Table 3 shows, men who own land are significantly less likely to migrate. Although women in Malawi also own land (especially in the matrilineal South), land ownership is not significantly associated with

[6]Since more than one wife could have been tested, polygamous men were dropped from the analysis.

migration for women. Since residents of the southern region practice a matrilocal marital tradition, it is not surprising that men from the south are more likely to move than men from the central region.

Marital status in 2004 is an important predictor of mobility for women but not men. Women who are never married, divorced, or widowed had more than two times greater odds of migration than women who were currently married in 2004. There is also a strong and significant relationship between education and migration for women: women with at least primary education are more likely to migrate than women with no education. The strong effect of education on migration reflects the fact that men and women often attend primary and secondary school outside of their village of origin in Malawi (Poulin 2006). Men with more education are also more likely to migrate, but, rather unexpectedly, the results are not as consistent or significant as for women.

Interestingly, there is no evidence that previous history of migration leads to greater likelihood of later migration, as previous migration experience is *not* significantly associated with a greater likelihood of moving between 2004 and 2006.

These results show that HIV positive individuals are more likely to migrate than those who are HIV negative, which supports the hypothesis that HIV infection is not necessarily due to migration. However, one confounding factor is prior migration experience: it is possible that some individuals migrated before 2004, became infected with HIV during this previous migration, and then migrated again after 2004. To examine whether individuals or spouses who migrated prior to 2004 became HIV infected from this previous migration, I test whether individuals and spouses with previous history of migration are more likely to be HIV positive than non-migrants. I run regressions in which the dependent variable is the indicator of previously living elsewhere for six months or more since age 15. Independent variables include the same as those included in Table 3.

The results (Table 4) show that women who are HIV positive in 2004 are more likely to have lived outside the village since age 15 than HIV negative women.[7] However, there is no relationship between prior migration experience and HIV status for men. These results are similar to Kishamawe et al. (2005), who find that migrant women are at greater risk of HIV infection but men are not. HIV positive respondents are not more likely to have a spouse who migrated previously; in fact, women who were HIV positive in 2004 were less likely to have a spouse with who migrated previously. These results support the claim that HIV positive men are more likely to migrate than HIV negative men, but the results are less clear for women.

It is important to note that the methods used in this section are not appropriate for establishing a causal link between HIV status and migration. There could be unmeasured confounders that influence both HIV status and migration in the models for this section. For example, individuals who move from their village of origin are less risk-averse than non-migrants, and this risk-aversion could also lead to a greater likelihood of engaging in behavior that puts one at risk of contracting HIV. Fixed effects regression models control for such unobserved characteristics as risk aversion (Allison 2005). However, because very few MDICP respondents have an observed change in HIV status between 2004 and 2006, I cannot run fixed effects regression to estimate the effect of HIV status on migration. Similarly, a suitable instrumental variable that could affect HIV status but not migration is not apparent in these data. Nonetheless, the strong association between HIV status and

[7]Not shown are similar regressions in which the dependent variable as having lived outside the village for one month or more in the past year. There is no significant association between respondents' or spouses' migration status and HIV status in these models.

migration (particularly for men) is sufficient to question the common assumption in migration research that HIV infection typically occurs as a result of migration.

Why are migrants more likely to be HIV positive?

HIV positive individuals may be more likely to migrate for several reasons: as a result of HIV/AIDS stigma or discrimination, after the death of the household head, to be cared for if sick, to gain better access to HIV drug treatments, or due to greater divorce and remarriage rates among HIV positive individuals.

To understand why HIV positive individuals appear to be more likely to migrate, I turn to the reported reasons for migration. If HIV positive individuals are more likely than the HIV negative to divorce, or to be divorced by, their spouse, and then migrate afterwards, we would expect to see a higher HIV prevalence among individuals who migrated for "marriage-related" reasons than for individuals who migrated for work. By contrast, if men become HIV positive through extramarital partners at their new work location, we would expect that they would be more likely to be HIV positive than men whose migration was related to marriage.

Reasons for migration are presented in Table 1. Because there are numerous reasons for migration (several of which apply to only few migrants), I group them into three categories. The first category is work, which includes looking for work and having been offered a job in a new location. Work-related migration makes up approximately 28% of all reasons for migration given by the 402 2007 MDICP migration study respondents. Category 2 consists of marriage-related migration (approximately 35% of migrants). The marriage category includes individuals who returned to their home after divorce or the death of a spouse and those moved to join a new spouse. Most moving for new marriage were previously married. Of individuals moving to marry a new spouse, 72% were previously married and only 28% were marrying for the first time. The final category combines the remaining reasons for migration, none of which individually composes more than 16% of the reasons for migration.

These three categories of reasons for migration are regressed on background characteristics, along with the variable of primary interest: HIV status. Because the three categories of the dependent variable are unordered, I use multinomial regressions (Allison 1999).

Table 5 shows that individuals who moved for marriage-related reasons are significantly more likely to be HIV positive than individuals who left for other reasons. Women who moved following separation, divorce, widowhood or to marry a new husband were more than 11 times more likely to be HIV positive than women who migrated for another reason. Similarly, men who moved because of a marital change were more than 10 times more likely to be HIV positive than men who moved for other reasons. The size of the effect of HIV is relatively large for men and women, which may be partly due to the small sample size for this analysis.

In contrast, men and women who moved for work-related reasons were *not* significantly more likely to be HIV positive than respondents who moved for other reasons. Because men and women who move for marriage-related reasons are significantly more likely to be HIV positive, it thus appears that marital change- marital dissolution or remarriage- provides the primary explanation for why HIV positive individuals are more likely to migrate than rural Malawians who are HIV negative.

To further examine the relationship between HIV infection, marital change and migration, I conduct two additional analyses of differences between MDICP migrants and non-migrants.

First, if marital dissolution were the primary explanation for the relatively high HIV prevalence among migrants, one would expect that migrants interviewed in 2007 whould be more likely to have experienced a recent divorce, and whould also have more lifetime marriages than respondents interviewed by the main MDICP survey in 2006 (non-migrants).[8] To test the latter possibility, I run Poisson regressions where the dependent variable is the number of lifetime marriages in 2006/07. As with previous analysis, independent variables representing (1) migration and (2) HIV status are of particular interest.

Next, I run logistic regressions where the dependent variable is an indicator for experiencing a divorce between 2004 and 2006. Based on the results above, one would expect that MDICP migrants would be more likely to experience divorce than non-migrants. In these regressions, the sequence of divorce and migration is important in order to distinguish between individuals who migrate because they divorced and those who divorced because of migration. To make this important distinction, I use the timing of divorce and the marital status at the time of migration, and divide the migration variable into two separate variables: (1) migrants who were not married at the time of migration (divorce happened before migration), and (2) migrants who were married at the time of migration (divorce happened after migration). The reference category is non-migrants. Finally, since marital dissolution can be affected not only by one's own HIV status, but by the HIV status of a spouse, I also run a second set of models with spouse's HIV status as independent variables in the regressions for divorce between 2004 and 2006.

Results (shown in Tables 6) show that male migrants have significantly more lifetime marriages than male non-migrants. There is no significant difference for women's number of marriages, which perhaps indicates that migrating women are more likely to be HIV positive, and more likely to have experienced a divorce, but are not more likely to remarry after divorce than female non-migrants. Previous research on remarriage in sub-Saharan Africa has also found that women are less likely to remarry than men- particularly for HIV positive women (Gregory 2007) or widows (Ntozi 1997; Reniers 2003). Also, as expected, HIV positive men and women also have had a significantly greater number of marriages.

The relationship between migration and divorce between 2004 and 2006 differs by sex (Table 7). Unmarried female migrants are significantly more likely to have experienced divorce between 2004 and 2006 than female non-migrants, but there is no difference for married migrants. Results for men show that the divorced or widowed are more likely to migrate, *and* migrants are more likely to divorce: unmarried migrant men are more than eight times more likely to have divorced between 2004 and 2006 than non-migrants, and married migrants are also significantly more likely to experience divorce between 2004-06 than non-migrants. Furthermore, both men and women who are HIV positive in 2004 were more likely to experience a divorce, and women whose spouse was found HIV positive in 2004 were also more likely to divorce between 2004 and 2006. These regressions verify that there is indeed a strong relationship between HIV status, marital dissolution, and migration.

The finding that men and women who move for marriage-related reasons are more likely to be HIV positive than individuals who move for other reasons is consistent with previous studies that have found that HIV positive individuals are more likely to experience marital dissolution, either through divorce or widowhood (Floyd et al. 2008 for Malawi; Gregory et al. 2007 for Tanzania; Lopman et al. 2009 for Zimbabwe; Porter et al. 2004 for Uganda); and that marital dissolution and/or starting a new marriage is often accompanied by migration (Arnoldo 2004 for Mozambique; Boerma et al. 2002 for Tanzania; Reniers 2003

[8]While it would be useful to know if migrants were also more likely to experience a death of a spouse as well as a divorce, the small sample size of respondents who were widowed between 2004 and 2006 precludes such analysis.

for Malawi; Watts 1983 for Nigeria). This study provides a link between these two areas of research, by showing that, primarily due to marital dissolution and remarriage, HIV positive individuals are more likely to migrate than those who are HIV negative.

Discussion

In this research, I expand the previous discussion on migration and HIV infection and provide evidence for the possibility that HIV positive individuals are more likely to migrate. Much previous research, primarily using cross-sectional data, has shown that HIV prevalence is substantially higher among migrants. These findings, combined with what was known or believed about the sexual patterns of migrants (especially male migrants) and characteristics of cities in SSA, led to reasonable conclusions that migrants became infected after they left their rural home. We get quite a different picture for Malawi, however, where the availability of longitudinal survey data and a study of migrants in their places of destination provide information on migrants and HIV both before and after their migration. It is clear that migrants are indeed more likely to be HIV positive. However, it appears that HIV infection often precedes rather than follows migration, with marital change providing the link between HIV and migration.

I began my analysis replicating previous findings: migrants who were tracked to their new destination were more likely to be HIV positive than non-migrants. However, this was not due to their move to a city (as previously assumed on the basis of simple comparison between prevalence in rural and urban areas); it also held for migrants who moved to another rural area. Then, taking advantage of longitudinal data to document links between migration, HIV status and marital status, the results show that those who had tested positive in MDICP study villages in 2004 were more likely to subsequently move than those who had tested negative. Finally, I drew on the interviews with migrants at their destination to make sense of these results. Migrants who reported that they had moved for marriage-related reasons were more likely to be HIV positive than those who migrated for other reasons, which indicates that marital change is the primary reason for why HIV positive individuals are more likely to migrate.

The results presented here are consistent with a body of research on the relationship between marital change and HIV infection in sub-Saharan Africa. This literature shows that HIV positive individuals are more likely to experience marital dissolution, either through death or divorce. Given the high HIV prevalence context, it is not surprising that both quantitative and qualitative data from Malawi show that those who suspect their spouse of having an EMSP prefer to divorce rather than to remain in a marriage and risk infection (Watkins 2004; Reniers 2008). Then, since marriage is a primary reason for migration throughout sub-Saharan Africa, in retrospect we can see the connection between marital change, HIV infection, and migration logically proceeds from earlier literature. This connection, however, has not previously been made explicit and supported empirically.

Are Malawian migration and marriage patterns unusual? This seems unlikely: other studies in SSA have found that marriage and migration are closely tied (Arnoldo 2004; Boerma et al. 2002; Reniers 2003; Watts 1983). It is the case that marital patterns are more varied in Malawi than in other countries, but the high proportions currently married in most countries in the region are evidence of the widespread importance placed on marriage as a regular economic and sexual partnership. Thus, it is likely that were there migration data for other countries with similar nuptuality patterns, the same association between HIV infection and marriage would be evident.

Are MDICP data representative of rural Malawi? Anglewicz et al. (2009) conducted a comparison of the 2004 MDICP ever-married sample with the ever-married rural sample from 2004 Malawi Demographic and Health surveys to assess the representativeness of the MDICP sample (a comparison of all individuals by marital status was not conducted, only the ever-married). Results of this comparison showed that MDICP had a higher percentage of currently married respondents than 2004 MDHS (among those ever married). So the MDICP seems to over-represent currently married men and women. Since unmarried women are more likely to migrate then currently married, the MDICP sample may underestimate the extent of migration in rural Malawi.

Another potential source of bias could come from differences between migrants interviewed and not interviewed by the MDICP migration study. Approximately 40% of MDCIP migrants were not traced. If migrants who were not found differ from those who were in characteristics related to HIV infection, the results presented here may be biased. To investigate the possibility of this selection bias, I use 2004 data for the 344 individuals who migrated after the MDICP 2004 survey, and compare characteristics prior to migration between those who were interviewed by the migration study (N=198) and those who were not traced (N=146). I run a logistic regression in which the dependent variable is the indicator of whether the migrant was interviewed. Independent variables (from the 2004 MDICP, i.e. before migration) include sex, age, region of residence, household amenities, education, marital status, number of children, perceived HIV risk, and HIV serostatus. Results for this regression, (Appendix Table A2) show only one significant difference: the migration study team was more likely to find migrants originating from the northern region than the south. There are no other differences, most notably in HIV-related characteristics, between migrants traced and those not found.

The expansion of HIV testing facilities to rural areas of sub-Saharan Africa could influence the relationship between HIV infection, marital dissolution and migration. Many more individuals now have the potential to confirm their HIV status and that of their spouse, and therefore can base their decisions about divorce on *actual* HIV risk, rather than *perceived* risk. This could reduce the spread of HIV, since perceived infection is more common than actual infection: residents of rural Malawi often overestimate their likelihood of HIV infection (Anglewicz and Kohler 2009) and that of their spouse (Anglewicz et al. 2008).

The results in this paper suggest that HIV prevalence could increase in rural areas of sub-Saharan Africa. If HIV positive individuals who migrate are likely to remarry in their migration destination, the epidemic could be increasingly spread through marriage of HIV positive migrants to HIV negative new spouses. In fact, some HIV positive individuals may migrate for the exact purpose of increasing their likelihood of remarriage, since residents in the village of origin may know or suspect their HIV positive status (Watkins 2004), which may dissuade potential marital candidates who attempt to reduce HIV risk through partner selection (Reniers 2008). Research that could provide insight into the likelihood of remarriage among the HIV positive often shows sex differences: HIV positive women in Tanzania are less likely to remarry, but there is no difference for men in remarriage by HIV status (Gregory 2007); and widowers are more likely to remarry than widows in Uganda (Ntozi 1997) and Malawi (Reniers 2003). However, as HIV testing access increases throughout sub-Saharan Africa and more individuals are aware of their HIV status, selective remarriage may between sero-concordant HIV positive and HIV negative individuals may become more common (Helleringer and Reniers 2009). Since HIV discordant couples represent at least two-thirds of HIV infected couples in several sub-Saharan African countries (de Walque 2007), and HIV appears to be increasingly spread within marriage (Zaba et al 2008), remarriage among HIV positive individuals is an important issue for the

spread of the HIV/AIDS epidemic in sub-Saharan Africa, and further research is necessary to better understand remarriage, HIV infection and migration in sub-Saharan Africa.

There are also important implications of the findings of this study for data collection in HIV-affected areas. If HIV positive individuals are more likely to migrate than those who are HIV negative, accounting for migration becomes critical for panel surveys. Increased migration among HIV positive individuals can lead to a downward-bias in HIV prevalence estimates in rounds of panel survey data collection following HIV testing.

Overall, the body of evidence provided in the analyses in this paper should, at the very least, lead to (1) a re-examination of the relationship between HIV infection and migration in sub-Saharan African countries, (2) more attempts to understand the relations between HIV infection and marital patterns, and (3) the collection of longitudinal data on migrants and non-migrants alike.

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Appendix

Table A1

Reasons for migration for all MDICP migrants and migrants interviewed, by sex, MDICP 2006 migration autopsies

	All Migrants						Migrants Interviewed					
	Women		Men		Total		Women		Men		Total	
Reason for migration	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
1. To look for work/ offered job	67	16.7%	115	36.4%	182	25.4%	47	20.3%	65	38.2%	112	27.9%
2. Attending school	18	4.5	19	6.0	37	5.2	8	3.5	9	5.3	17	4.2
3. Divorce or separation	51	12.7	19	6.0	70	9.8	36	15.6	9	5.3	45	11.2
4. Widowed	33	8.2	7	2.2	40	5.6	20	8.7	3	1.8	23	5.7
5. Remarriage	56	13.9	21	6.7	77	10.7	38	16.5	13	7.7	53	13.3
6. First marriage	25	6.2	7	2.2	32	4.5	20	8.7	3	1.7	21	5.2
7. Illness	17	4.2	11	3.5	28	3.9	7	3.0	1	0.6	8	2.0
8. Taking care of sick relative	16	4.0	20	6.3	36	5.0	9	3.9	13	7.7	22	5.5
9. New land for farming	51	12.7	47	14.9	98	13.6	27	11.7	35	20.6	62	15.4
10. Conflict with others in village	27	6.7	13	4.1	40	5.6	1	0.4	5	2.9	6	1.6
11. Other reason	41	10.2	37	11.7	78	10.9	18	7.8	14	8.2	32	8.0
N	402		316		718		231		170		401	

Table A2

Logistic regression results for differences between migrants interviewed and not interviewed, using 2004 data prior to migration

2004 behaviors and characteristics	Odds	SE
Sex	0.85	0.21
Age	1.02	0.02
Education		
No education (ref)	---	---
Primary	1.46	0.56
Secondary	1.09	0.57
Household amenities		
Iron sheet roof	1.02	0.26
Bicycle	0.77	0.22
Radio	1.50	0.55
Region of residence		
Central (ref)	---	---
South	1.34	0.37
North	2.70**	0.93
HIV positive	1.24	0.48
Marital characteristics		
Number of children	0.95	0.06
Currently married (ref)	---	---
Never married	1.18	0.38
Divorced or separated	1.13	0.66
Widowed	3.53	4.03
HIV risk		
Perceived HIV risk	1.02	0.24
N	344	
R^2	0.041	

Notes:
† p ≤ 0.10;
* p ≤ 0.05;
** p ≤ 0.01.

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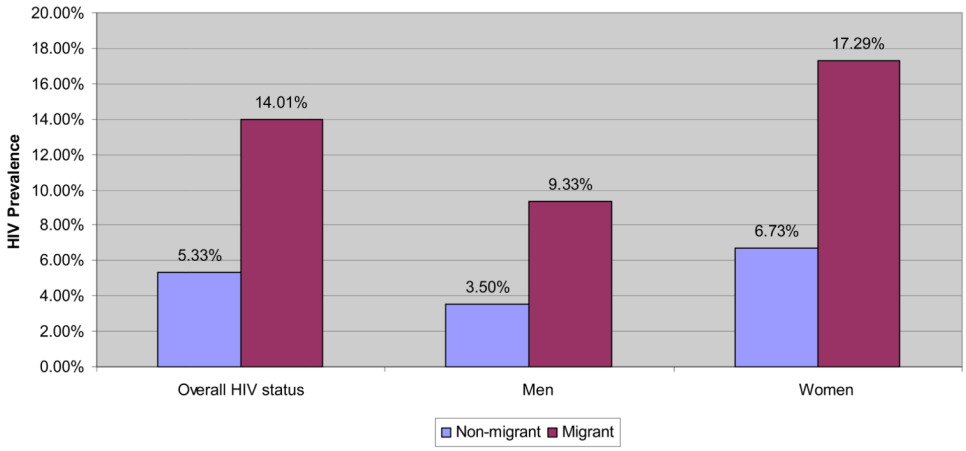

Figure 1. HIV Prevalence for MDICP Migrants and non-Migrants, by Gender

Note: Chi-squared test for difference in HIV prevalence between migrants and non-migrants is significant at $p \leq 0.01$ for both men and women

Table 1

Background characteristics for migration study respondents: target sample and respondents interviewed by migration team

	Target Sample			Sample Interviewed		
	Female	**Male**	**Total**	**Female**	**Male**	**Total**
Age distribution						
10-19	12.4%	8.1%	10.4%	12.6%	10.0%	11.5%
20-29	31.4	22.2	27.1	34.6	22.4	29.4
30-39	31.1	29.2	30.2	29.9	30.0	29.9
40-49	18.8	21.9	20.2	17.3	19.4	18.2
50-59	5.0	14.1	9.2	4.3	13.5	8.2
60-69	1.4	4.6	2.9	1.3	4.7	2.7
Region of origin						
Central	30.1	25.9	28.3	28.6	27.7	28.2
South	29.9	46.2	37.0	27.7	41.8	33.7
North	40.0	27.9	34.7	43.7	30.5	38.1
Reason for migration						
Marriage-related	41.0	17.1	30.6	49.3	16.5	35.4
Work-related	29.4	51.3	39.0	20.4	45.3	27.9
Other	29.6	31.6	30.4	30.3	38.2	36.7
Rural-urban migration	18.5	22.8	20.4	19.1	21.2	20.0
N	402	316	718	231	171	402

Table 2

Regression results for differences in HIV risk behavior and actual HIV status between migrants and non-migrants, for women, MDICP 2006-2007 data

	Perceived spousal EMSP		Number of sexual partners		Perceived HIV risk		Actual HIV infection	
2006/2007 behaviors and characteristics	**Odds**	**S.E.**	**Coef.**	**S.E.**	**Odds**	**S.E.**	**Odds**	**S.E.**
Age	1.01	0.01	0.00	0.00	0.99†	0.01	1.02	0.02
Household amenities								
Iron	1.07	0.17	-0.04	0.05	1.02	0.13	1.43	0.56
Bicycle	1.11	0.14	-0.05	0.04	1.01	0.10	0.85	0.27
Radio	1.06	0.14	0.00	0.04	1.09	0.12	1.02	0.38
Region of residence								
South	---	---	---	---	---	---	---	---
Central	0.86	0.12	-0.13**	0.04	0.67**	0.08	0.97	0.37
North	0.52**	0.08	-0.38**	0.05	0.60**	0.08	0.95	0.38
Level of education								
No education (ref)	---	---	---	---	---	---	---	---
Primary school	1.23	0.17	-0.02	0.04	1.10	0.13	4.18*	2.61
Secondary school	1.32	0.35	0.01	0.08	1.42†	0.28	3.91†	2.89
Marital characteristics								
Polygamous	4.36**	0.59	0.05	0.04	2.03**	0.24	0.49	0.22
Number of children	1.04	0.02	-0.01	0.01	1.04*	0.02	0.94	0.05
Marital duration	1.00	0.01	0.00	0.00	0.99	0.01	1.01	0.02
Currently married (ref)	---	---	---	---	---	---	---	---
Divorced or separated	3.39**	0.66	0.25**	0.06	1.22	0.21	5.15†	4.51
Widowed	1.15	0.29	-0.07	0.08	0.61*	0.14	*a*	*a*
Never Married *b*			-0.79**	0.11	0.52**	0.11	*a*	*a*
Perceived spousal EMSP *b*							0.87	0.49
Respondent EMSP *b*							1.92†	0.66
Received HIV test result *b*					0.72**	0.07		

2006/2007 behaviors and characteristics	Perceived spousal EMSP		Number of sexual partners		Perceived HIV risk		Actual HIV infection	
	Odds	S.E.	Coef.	S.E.	Odds	S.E.	Odds	S.E.
MDICP migrant	1.03	0.19	0.17**	0.05	2.60**	0.41	2.53*	0.99
Rural-urban migrant	0.85	0.38	-0.13	0.13	1.19	0.39	1.46	1.06
N [c]	1746	1873		1867		1465		
R^2	0.095	0.044		0.045		0.126		
Age	1.02	0.02	-0.00†	0.00	0.98*	0.01	1.00	0.01
Household amenities								
Iron	0.93	0.31	0.04	0.04	0.82	0.13	1.47	0.41
Bicycle	1.38	0.36	0.06*	0.03	1.03	0.12	1.14	0.27
Radio	0.58*	0.16	-0.10**	0.03	1.05	0.14	1.11	0.28
Region of residence								
South	---	---	---	---	---	---	---	---
Central	1.16	0.33	-0.11**	0.03	0.66**	0.09	0.58*	0.15
North	1.08	0.35	-0.48**	0.04	0.57**	0.08	0.48*	0.14
Level of education								
No education (ref)	---	---	---	---	---	---	---	---
Primary school	2.15†	0.84	0.09*	0.03	1.12	0.17	1.10	0.29
Secondary school	1.68	0.86	0.01	0.05	0.84	0.18	1.64	0.72
Marital characteristics								
Polygamous	2.25**	0.59	0.46**	0.03	1.38*	0.20	1.76*	0.43
Number of children	0.98	0.04	-0.01	0.00	1.00	0.02	0.86**	0.05
Marital duration	0.98	0.02	0.01**	0.00	1.01	0.01	0.99	0.01
Currently married (ref)	---	---	---	---	---	---	---	---
Divorced or separated	8.69**	4.16	0.11	0.09	1.46	0.54	3.54**	1.04
Widowed	*a*	*a*	0.28*	0.13	5.15*	3.33	6.97**	2.33
Never Married [b]			-0.40**	0.05	0.97	0.17	*a*	*a*
Perceived spousal EMSP [b]							1.35	0.30
Respondent EMSP [b]							1.37	0.69

2006/2007 behaviors and characteristics	Perceived spousal EMSP		Number of sexual partners		Perceived HIV risk		Actual HIV infection	
	Odds	S.E.	Coef.	S.E.	Odds	S.E.	Odds	S.E.
Received HIV test result [b]					0.71**	0.08		
MDICP migrant	2.55**	0.79	0.15**	0.04	2.27**	0.40	2.07**	0.56
Rural-urban migrant	1.10	0.67	0.16†	0.08	1.62	0.54	0.77	0.46
N [c]	1219		1513		1507		952	
R^2	0.076		0.090		0.037		0.068	

Notes:

[a] Dropped out due to multicollinearity.

[b] Not included in all regressions. Results did not change substantively when these variables are included.

[c] Sample sizes differ due to non-response or non-applicability.

Poisson regression is used for number of sexual partners, ordered logistic regression for perceived risk, and the other two models are logistic regressions.

† $p \leq 0.10$;

* $p \leq 0.05$;

** $p \leq 0.01$.

Table 3

Logistic regression results for the association between 2004 MDICP survey characteristics and migration between MDICP 2004 and 2006

	Women				Men			
	Model 1		Model 2		Model 1		Model 2	
2004 behaviors and characteristics	**Odds**	**SE**	**Odds**	**SE**	**Odds**	**SE**	**Odds**	**SE**
Age	0.99	0.01	1.00	0.02	1.02	0.02	1.00	0.02
Education								
No education (ref)	---	---	---	---	---	---	---	---
Primary	21.92**	13.15	24.35**	18.64	2.95*	1.35	2.36	1.24
Secondary	31.87**	21.02	50.55**	48.67	2.27	1.20	1.63	1.41
Household amenities								
Iron sheet roof	0.73	0.24	1.11	0.56	1.81*	0.49	2.89†	1.58
Bicycle	1.32	0.26	0.77	0.28	1.07	0.24	1.21	0.51
Radio	1.05	0.24	1.09	0.47	0.63†	0.16	0.57	0.28
Region of residence								
Central (ref)	---	---	---	---	---	---	---	---
South	1.38	0.32	2.21†	0.96	3.24**	0.95	42.71**	45.35
North	0.65†	0.17	0.20**	0.11	1.37	0.45	7.27†	8.26
Health status								
Excellent (ref)	---	---	---	---	---	---	---	---
Very good	0.96	0.24	0.59	0.27	0.73	0.22	1.00	0.50
Good	0.95	0.21	0.80	0.31	0.62†	0.16	0.93	0.48
Fair	0.68	0.22	0.36†	0.21	0.81	0.29	1.77	1.07
Poor	0.65	0.72	*a*	*a*	1.25	1.06	*a*	*a*
HIV positive	1.87*	0.59	1.97	1.11	2.41*	1.06	1.80	1.06
Owns land	0.78	0.17	0.34*	0.16	0.61*	0.15	1.91	1.41
Previously lived outside the village	1.03	0.21	1.21	0.42	1.12	0.25	0.77	0.32
Marital characteristics								
Number of children	0.99	0.05	1.02	0.08	0.81**	0.05	0.82**	0.06

	Women				Men			
	Model 1		Model 2		Model 1		Model 2	
2004 behaviors and characteristics	**Odds**	**SE**	**Odds**	**SE**	**Odds**	**SE**	**Odds**	**SE**
Currently married (ref)	---	---			---	---		
Never married	3.42**	0.99			0.85	0.34		
Divorced or separated	1.87†	0.72			*a*	*a*		
Widowed	2.60**	1.25			*a*	*a*		
HIV risk[b]								
Number of sexual partners	1.20†	0.12	1.22	0.21	0.93	0.10	0.86	0.14
Perceived HIV risk	1.28*	0.14	1.28	0.26	1.24†	0.15	1.23	0.28
Suspected spousal EMSP	0.86	0.18	0.76	0.27	2.28*	0.64	3.88*	2.09
Spouse HIV positive			1.66	0.94			4.03*	2.57
N [c]	1476		742		1167		605	
R^2	0.162		0.185		0.144		0.248	

Notes:

[a] Dropped out due to multicollinearity.

[b] I tested two interaction terms between HIV status and (1) having lived outside of the current village of residence since age 15, and (2) living outside the current district of residence for one month or more in the past year. Neither of these interactions were significantly associated with migrating between 2004-06 (results not shown).

[c] The difference in sample sizes between Models 1 and 2 for men and women is due to the smaller number of spouses of respondents who were both tested and surveyed by MDICP in 2004.

† $p \leq 0.10$;

* $p \leq 0.05$;

** $p \leq 0.01$.

Table 4

Logistic regression results for the association between 2004 characteristics and behaviors and migration status prior to 2004

	Women				Men			
	Past migration		Spouse past migration		Past migration		Spouse past migration	
2004 behaviors and characteristics	Odds	SE	Odds	SE	Odds	SE	Odds	SE
Age	1.02*	0.01	1.01	0.01	1.02*	0.01	0.99	0.01
Education								
No education (ref)	---	---	---	---	---	---	---	---
Primary	1.35†	0.22	1.27	0.24	1.28	0.25	0.89	0.21
Secondary	3.78**	1.01	1.28	0.48	1.98**	0.51	1.20	0.41
Household amenities								
Iron sheet roof	0.65*	0.13	1.48†	0.32	1.43*	0.26	0.93	0.24
Bicycle	1.27†	0.17	0.99	0.16	1.00	0.14	0.99	0.19
Radio	1.34†	0.20	1.11	0.20	1.25	0.20	1.59†	0.39
Region of residence								
Central (ref)	---	---	---	---	---	---	---	---
South	1.88**	0.31	2.33**	0.46	2.49**	0.42	1.96**	0.45
North	1.38†	0.24	1.25	0.25	1.15	0.21	1.25	0.31
Health status								
Excellent (ref)	---	---	---	---	---	---	---	---
Very good	1.02	0.17	1.17	0.24	0.91	0.16	0.75	0.18
Good	0.80	0.12	1.18	0.22	1.39*	0.21	0.86	0.18
Fair	0.91	0.17	0.97	0.22	0.96	0.21	0.74	0.22
Poor	1.34	0.76	2.55	2.43	0.85	0.53	*a*	*a*
HIV positive	1.65*	0.38	0.44*	0.15	0.77	0.24	1.11	0.42
Marital characteristics								
Number of children	0.97	0.03	1.02	0.03	1.00	0.02	1.02	0.03
Currently married (ref)	---	---			---	---		
Never married	0.51**	0.12			0.65*	0.13		

	Women				Men			
	Past migration		Spouse past migration		Past migration		Spouse past migration	
2004 behaviors and characteristics	**Odds**	**SE**	**Odds**	**SE**	**Odds**	**SE**	**Odds**	**SE**
Divorced or separated	0.94	0.26			*a*	*a*		
Widowed	1.38	0.42			*a*	*a*		
HIV risk								
Number of sexual partners	1.08	0.07	1.17 *	0.09	1.12 **	0.05	1.07	0.06
Perceived HIV risk	0.93	0.12	0.94	0.15	0.90	0.12	1.16	0.22
Suspected spousal EMSP	1.41 *	0.25	1.24	0.25	1.40	0.50	0.74	0.33
N	1442		831		1154		660	
R^2	0.054		0.040		0.066		0.030	

Notes:

a Dropped out due to multicollinearity.

† $p \leq 0.10$;

* $p \leq 0.05$;

** $p \leq 0.01$.

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Table 5

Multinomial logistic regression results for factors influencing migration for work-related or marriage-related reasons, MDICP 2006 data

	Work-related migration versus other reason for migration		Marriage-related migration versus other reason for migration	
Women	**Odds**	**S.E.**	**Odds**	**S.E.**
Age	0.95	0.03	1.00	0.02
Household amenities				
Iron sheet roof	8.41**	0.54	1.55	0.47
Bicycle	1.65	0.47	0.80	0.37
Radio	1.01	0.53	0.88	0.38
Region of residence				
Central (ref)	---	---	---	---
South	1.61	0.65	0.74	0.43
North	5.00*	0.69	1.85	0.48
Education				
No schooling (ref)	---	---	---	---
Primary	0.96	0.64	1.45	0.44
Secondary	0.93	0.85	0.77	0.65
Polygamous marriage	1.24	0.50	1.95	0.39
Number of children	1.35*	0.13	0.93	0.10
HIV positive	5.87	0.91	11.59**	0.77
N	222			
Pseudo R^2	0.169			

	Work-related migration versus other reason for migration		Marriage-related migration versus other reason for migration	
Men	**Odds**	**S.E.**	**Odds**	**S.E.**
Age	1.00	0.02	1.01	0.03
Household amenities				
Iron sheet roof	2.66*	0.47	0.24	0.95
Bicycle	0.81	0.43	0.61	0.62
Radio	1.52	0.50	0.17**	0.65

	Work-related migration versus other reason for migration		Marriage-related migration versus other reason for migration	
Women	**Odds**	**S.E.**	**Odds**	**S.E.**
Region of residence				
Central (ref)	---	---	---	---
South	0.71	0.53	0.21*	0.72
North	2.53	0.56	0.09*	0.99
Education				
No schooling (ref)	---	---	---	---
Primary	0.87	0.66	2.09	0.86
Secondary	0.92	0.88	9.87*	1.16
Polygamous marriage	0.62	0.60	1.44	0.79
Number of children	1.01	0.08	1.27*	0.11
HIV positive	1.90	0.75	10.38**	0.79
N	148			
Pseudo R^2	0.197			

Notes: 19 cases where the respondent refused an HIV test are dropped from this regression.

* $p \leq 0.05$;

** $p \leq 0.01$.

Table 6

Regression results for the association between migration status and number of lifetime marriages

	Number of marriages			
	Women		Men	
2006/07 behaviors and characteristics	**Coef.**	**S.E.**	**Coef.**	**S.E.**
Age	0.03**	0.01	0.01**	0.00
Age^2	-0.00**	0.00	---	---
Household amenities				
Iron sheet roof	-0.11	0.07	-0.07	0.07
Bicycle	-0.06	0.05	0.03	0.06
Radio	-0.02	0.05	-0.02	0.06
Region of residence				
South (ref)	---	---	---	---
Central	-0.14*	0.06	-0.11†	0.06
North	-0.21**	0.06	-0.15*	0.07
Education				
No schooling (ref)	---	---	---	---
Primary	-0.02	0.06	-0.02	0.07
Secondary	-0.10	0.11	-0.09	0.10
Marital characteristics				
Currently married (ref)	---	---	---	---
Divorced	0.11	0.08	0.05	0.19
Widowed	-0.21*	0.11	0.09	0.23
Polygamous marriage	0.02	0.06	0.53**	0.06
Number of children	-0.02	0.01	0.00	0.01
Perceived spousal EMSP	-0.01	0.05	0.03	0.10
Respondent EMSP	-0.10	0.13	-0.04	0.06
HIV positive	0.15†	0.08	0.23*	0.10
MDICP migrant	0.04	0.07	0.14*	0.07
Constant	-0.22	0.18	0.11	0.12
N	1422		971	
R^2	0.022		0.057	

Notes:

† $p \leq 0.10$;

* $p \leq 0.05$;

** $p \leq 0.01$.

Table 7

Logistic regression results for the association between migration status and divorce between 2004 and 2006

	Divorce between 2004 and 2006							
	Women				Men			
	Model 1		Model 2		Model 1		Model 2	
2004 MDICP characteristics and behaviors	**Odds**	**S.E.**	**Odds**	**S.E.**	**Odds**	**S.E.**	**Odds**	**S.E.**
Age	1.01	0.02	0.98	0.04	1.01	0.02	1.05	0.03
Education								
No schooling (ref)	----	----	----	----	----	----	----	----
Primary	1.30	0.49	0.48	0.33	2.25	1.32	2.64	2.93
Secondary	1.38	0.92	0.69	1.00	0.76	0.64	*a*	*a*
Household amenities								
Iron sheet roof	0.64	0.35	0.27	0.34	1.36	0.71	2.26	1.87
Bicycle	0.58†	0.18	0.61	0.39	0.63	0.25	0.96	0.69
Radio	0.98	0.30	0.49	0.30	0.84	0.33	1.48	1.30
Region of residence								
South (ref)	----	----	----	----	----	----	----	----
Central	0.66	0.23	0.30	0.25	0.82	0.35	3.35	2.89
North	0.47†	0.19	0.71	0.57	0.39†	0.20	1.46	1.33
Polygamous marriage	1.52	0.46	0.79	0.46	3.67**	2.02	4.17†	3.17
Respondent EMSP	2.37†	1.11	*a*	*a*	1.05	0.47	2.57	1.85
Perceived spousal EMSP	0.81	0.25	0.85	0.53	0.77	0.49	3.59†	2.76
Number of children	0.88†	0.06	0.94	0.12	0.81*	0.07	0.72**	0.09
Self-rated health status								
Excellent (ref)	----	----	----	----	----	----	----	----
Very good	1.49	0.55	1.45	1.02	1.65	0.72	0.97	0.78
Good	1.25	0.43	0.69	0.47	0.91	0.41	1.01	0.75
Fair or poor	0.61	0.31	0.23	0.29	1.21	0.67	0.26	0.31
Spouse stays outside village	3.04**	1.00	7.63*	6.73				
HIV status	4.08**	1.36	6.74**	4.56	3.14*	1.71	4.22	4.09

	Divorce between 2004 and 2006							
	Women				Men			
	Model 1		Model 2		Model 1		Model 2	
2004 MDICP characteristics and behaviors	**Odds**	**S.E.**	**Odds**	**S.E.**	**Odds**	**S.E.**	**Odds**	**S.E.**
Marital status and migration								
Non-migrant (ref)	----	----	----	----	----	----	----	----
Widowed/divorced at time of migration [b]	4.60**	2.40			8.48**	5.52		
Married at time of migration	1.94	0.81			3.36*	1.60		
Migrant			11.45**	7.46			3.33	3.17
HIV status of spouse			4.03†	3.18			0.42	0.60
N [c]	1429		711		1137		517	
R^2	0.143		0.264		0.146		0.214	

Notes:

[a] Dropped out due to multicollinearity;

[b] Migrants who were never married throughout the interval from 2004 to 2006 were dropped from the regressions. There were no cases of migrants who divorced both before and after migration between 2004 and 2006. All respondents who moved for the purpose of joining a new spouse at their home are considered married at the time of migration. There are no cases of respondents who divorced, remarried, and then migrated for a reason besides getting married to a new spouse who lived elsewhere between 2004 and 2006. Not all migrants who were unmarried at the time of migration experienced divorce between 2004 and 2006: some experienced divorce before 2004 and others were widowed.

[c] The difference in sample sizes between Models 1 and 2 for men and women is due to the smaller number of spouses of respondents who were both tested and surveyed by MDICP in 2004.

† $p \leq 0.10$;

* $p \leq 0.05$;

** $p \leq 0.01$.