Migration and Health in Malawi

Authors
Philip Anglewicz, Tulane University School of Public Health and Tropical Medicine
Hans-Peter Kohler, University of Pennsylvania
Mark VanLandingham, Tulane University School of Public Health and Tropical Medicine
Lucinda Manda-Taylor, Malawi College of Medicine

Abstract
Although it has long been established that migration and health status are closely linked, identifying the *effect* of migration on health remains an unresolved challenge for much migration research. This challenge has remained due primarily to data limitations, such as the inability to measure all characteristics that affect migration and health, or the lack of longitudinal data necessary to distinguish between the effect of migration on health and the selection of individuals of differing health status into migration streams. Furthermore, migration and health research has seldom focused on sub-Saharan Africa, despite the high and increasing rates of internal migration in SSA. This research examines these two gaps in research on the relationship between migration and health by (1) addressing several central methodological challenges that often preclude establishing a causal connection between migration and health, and (2) initiating a regional focus on SSA.

Introduction

It has long been established that migration and health are closely linked, although the exact relationship has varied across settings. Many studies suggest that moving to a new location can improve health and well-being, and research often shows that individuals who previously migrated are in better health than native populations (Anson 2004; Feranil 2005; Rubia et al. 2002; Singh & Hiatt 2006). Despite the better health of migrants, it has been challenging to empirically establish that migration *causes* better health, due to the need to address possible selection bias: that healthier (or in some cases, less healthy) individuals are more likely to migrate (Jasso et al. 2004; Landale et al. 2000; Marmot et al. 1984; Palloni & Morenoff 2001.

Despite the large body of research dedicated to studying the relationship between migration and health, hypotheses have not been empirically tested with the appropriate methodological approaches, primarily due to data limitations. Examining the extent of selection bias requires data on the health of individuals *prior* to migration. Identifying the *effect* of migration on health status, as opposed to merely examining differences in health status for individuals after migration with non-migrant populations, is facilitated by longitudinal data. However, longitudinal data that include health status for individuals before and after migration (in their destination) are rare.

Another challenge to migration and health research is a limited geographic focus. Empirical research on migration and general health has largely neglected sub-Saharan Africa (SSA), despite the high and increasing migration rates in this region. Populations in SSA have historically been considered to be highly-mobile compared to those of other regions (Byerlee 1974; Nkamleu & Fox 2006; UNECA 2006). A focus on rural-urban migration and health in SSA is particularly warranted, as current rates of urbanization in SSA are a close second behind Asia, and are expected to become the highest among global regions in the coming decades (UN 2009). Overall, the urban population in SSA is expected to triple in size by 2050, at which point it will be 20% of the world's urban population (UN 2009).

The rapid urbanization of SSA has important implications for migration and health in the region. Migrants into urban areas have traditionally been shown to be vulnerable to various negative health outcomes (McMichael 2000; Szreter 1997). The crowding and unsanitary conditions in

SSA cities facilitate the proliferation of infectious and vector-borne diseases (Githeko et al. 2000; Johnson & Appleton 2000; Wilson 1995). Migration can also affect mental health. The act of migration is often accompanied by a wide range of stressors, such as loss of social support, communication difficulties, and perceived or actual discrimination (Bhugra 2004; Cantor-Graae & Selten 2005; Carta et al. 2005; Ellis et al. 2008; Maggi et al. 2010; WHO 2001). Of course, the effect of urban migration could also be positive, as it could facilitate better access to health services in urban areas, increased wages, and higher quality education. Urban migration could also release individuals from social constraints on sexual behavior are thought to be weaker than in rural areas (Setel 1999).

Although the region is undergoing rapidly urbanization, the majority of SSA residents still live in rural areas (UN 2009). Africa also has the second largest number of rural residents, at about 18% of the world's total, and is expected to be 27% of the global rural population by 2050 (UN 2009). Intra-rural migration has consistently been the most common spatial migration pattern in SSA (compared to rural-urban, urban-urban, and urban-rural) (Adeponju 2006; Anina 1995; Oucho & Gould 1993). Despite the predominance of rural-rural migration, it has been studied much less frequently.

This research will (1) address several methodological challenges facing migration and health research, and (2) focus on an under-researched but increasingly-relevant geographic area for migration and health: sub-Saharan Africa. To do so, we utilize an opportunity presented through two related studies set in Malawi. These studies provide data from before and after migration that is necessary to examine possible selection of individuals with differential health to migration streams, and the effect of migration on health.

This research will identify whether migration selects individuals of different health status than non-migrants, and the effect of migration on health. We also consider two important features of the relationship between migration and health in Malawi. First, we consider several dimensions of health: in addition to physical health, we also include mental health in our analysis, as well as the mediating effect of HIV status in the relationship between migration and health. Secondly, we consider the possibility that the relationship between migration and health differs by

migration stream, and compare both migration selection and migration effect for rural-rural and rural-urban migrants.

Setting and Background

The limited body of research on migration and health in sub-Saharan Africa suggests that it is a unique and important setting for migration research. Evidence shows that the exceptionally high levels of HIV infection unique to SSA have affected migration patterns: an adult death often prompts household members to migrate elsewhere (Floyd et al. 2008; Gregson, Mushati & Nyamukapa 2007; Ford & Hosegood 2005; Urassa et al. 2001); individuals who become sick often return home to receive palliative care (Chimwaza and Watkins 2004; Clark et al. 2007; Urassa et al. 2001); and marital dissolution disproportionately affects the HIV infected (Floyd et al. 2008; Gregory et al. 2007; Lopman et al. 2009; Porter et al. 2004), who often move after divorce, separation and widowhood (Anglewicz 2012; Boerma et al. 2002). Furthermore, levels of migration in SSA are relatively high and are steadily increasing: rates of (1) internal migration and (2) urbanization are expected to be highest in the world in the coming decades (UN 2009). This suggests that the relationship between migration and health in SSA is likely to be different from other regions in several aspects.

Malawi exemplifies the rapid transition from rural to urban throughout SSA. Malawi, at the same time, is one of the *least* urbanized countries in the world, but has one of the *highest* rates of urban population growth. Malawi was ranked seventh least urbanized country in the world in 1975 and eleventh least urbanized in 2009 (UN 2009), but experienced the eighth highest rate of urban population growth in the world from 1995-2010 and is projected to have second highest urban population growth from 2010-2025 (UN 2009).

There are two important motivations for migration in Malawi: to earn money with which to supplement subsistence agriculture, and to move in with a spouse at the beginning of marriage or away from a home shared with a spouse at the 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. Although 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 (Englund 2002). International migration, however, has been a lifecycle stage for young Malawian men since the colonial period: 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% of women and 91% of men are currently married (NSO and ORC Macro 2005). 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 the husband moves to the home of the 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 with other countries in sub-Saharan Africa: nearly half of all first marriages end in divorce within 20 years (Reniers 2003). Divorce and widowhood are likely to lead to the departure of either the husband or the 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

Relatively little is known about the relationship between migration and health in SSA, largely due to limitations in study design. Cross-sectional data, like Demographic and Health Surveys (DHS), can be used to show differences in health status after migration, but cannot identify whether these differences existed before migration (i.e., health selection), or only afterwards.

Data from Demographic Surveillence Sites (DSS) provide greater flexibility than cross-section data but still have limitations: DSS sites typically don't follow out-migrants who leave the study site, so one can examine whether out-migrants have different health status from those moving into the study, but one would need data after migration to identify the effect of migration on health.

We use longitudinal panel data to address these limitations. Our data come from two related sources: the Malawi Longitudinal Study of Families and Health (MLSFH),[1] and the Migration and Health in Malawi Project. The MLSFH was designed as a couples' survey, targeting a population-based representative sample of approximately 1,500 ever-married women and 1,000 of their husbands in three rural sites of Malawi. Following a household enumeration in the three designated survey sites in 1998, a random sample of approximately 500 ever-married women aged 15–49 were selected to be interviewed in each site, along with all of their spouses. The first follow-up in 2001 included all respondents from the first wave, along with any new spouses. The MLSFH returned to interview all respondents in 2004, 2006, 2008 and 2010; and also added two new samples: (1) approximately 1,500 young adults aged 15-27 in 2004 (both ever- and never-married); and (2) approximately 800 parents of existing MSLFH respondents in 2008. As in 2001, all new spouses of respondents were added to the sample in each wave of data collection. The additions to the original sample increased the target sample size in 2004 to approximately 4,500 respondents, of whom 3,261 (74%) were successfully interviewed. Response rates were similar in subsequent survey rounds. MLSFH initiated HIV testing for all respondents in 2004, with follow-up testing in 2006 and 2008. Descriptions of the MLSFH data and sampling are presented in Watkins et al. (2003) and Kohler et al. (2014). Bignami et al. (2003), Anglewicz et al. (2009), and Kohler et al. (2014) discuss sample limitations and present analysis of data quality.

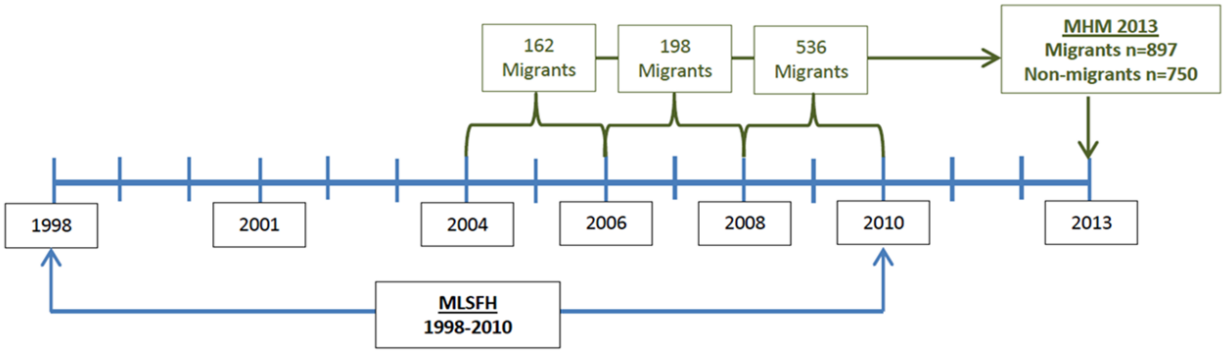
Starting in 2012, the Migration and Health in Malawi (MHM) Project was designed to trace and interview MLSFH respondents who previous resided in an MLSFH sample village but moved to another part of rural or urban Malawi. Using data from the 2010 MLSFH, we identified 1,096 individuals who were interviewed by MSLFH at least once since the third wave (in 2004), but

[1] Between 1998 and 2004 the MLSFH was known as the Malawi Diffusion and Ideational Change Project (MDICP).

were identified by friends or family members as either permanent or temporary migrants when attempting to interview them in the sixth wave, in 2010. These 1,096 respondents formed the target sample for the migration component of the MHM.

The MHM attempted to trace the location of these migrants by using a migration tracking technique. The MHM returned to the previous MLSFH village of residence for these migrants, and requested information on their current location from friends and family members who remained in the pre-migration village. Perhaps unsurprisingly, the MHM was able to collect very detailed information on the current location for the majority of migrants: the location was unknown for only 77 of 1,096 migrants (5.1%). An additional 83 (5.5%) moved internationally, and 39 (2.6%) died. These groups were left out of the final target sample for migrants, leaving the final target sample size at 897.

The final target sample of MHM included two groups: the 897 migrants and a random sample of 750 "non-migrants", who permanently resided in the MLSFH target villages through 2010. Data collection took place for both groups in 2013, and the study successfully found and interviewed 723 migrants (80.6%) and 607 non-migrants (80.9%). A figure showing the structure and populations from the MLSFH and MHM studies is below:



Measures

The survey administered by MHM to these respondents included extensive information on migration, health, economic status, marriage history, transfers, household composition, and a range of other measures. For this research we focus on physical and mental health, measured by the MSLFH and MHM via the SF-12 form. The SF-12 is among the most widely used measures

for rapid subjective health self-assessment worldwide (Jenkinson, Tarani, Coulter, & Bruster, 2001). SF-12 results are normed for a particular population with the mean score for both mental and physical set to 50.

The MHM also collected an extensive "residence roster," in which respondents list the previous ten locations where they lived for six months or more, starting with the current location. The residence roster also includes the reason for migration. The reasons selected for response options were chosen based on a related previous study (Anglewicz 2012). The roster also includes the duration at residence, age at move, number of people known at the location prior to moving there, and list of up to five co-residents at the location. We expect that the relationship between migration and health varies by reason for migration, so this measure is of central interest for this research.

We also use the MHM data to distinguish different migration streams. Rural-rural migrants include all individuals who moved to another rural part of Malawi, at least 20km outside of an MLSFH sample area. Rural-urban migrants are all individuals who moved to one of Malawi's three regional capitals (Mzuzu in the North, Lilongwe in the Central, Blantyre in the South), and the third largest city (and former capital), Zomba. Finally, rural-town migrants are those who moved from an MLSFH sample village to the capital of one of Malawi's 22 districts. We examine whether the relationship between migration and health differs by these migration streams.

Methods

Our analysis proceeds in two parts, for the two research questions of interest here (migration selection and migration effect).

Migration Selection

First we identify migration selection; whether individuals of differing health status are selected into migration streams in Malawi. To examine this, we use random effects regression models of the following form:

$$\log [Y_{it+1} / Y_{it+1}] = \beta_0 + H_{it} \beta_1 + M_{it} \beta_2 + r_{it} + \varepsilon_{it}$$

The dependent variable is the log odds that individual *i* will migrate in between a MLSFH wave. The outcome for individual *i* occurs between times *t* and *t+1* (i.e. by the next wave of MLSFH data), and independent variables are measured at time *t*. H_{it} represents individual health (either mental or physical, M_{it}, represents a set of variables that we expect to be related to both migration and health, r_{it} is the random effect for the survey interval, and ε_{it} is a random, logistically-distributed disturbance term for person *i* at time *t*.

We run our random effects regression models in four steps. In the first step, we identify factors associated with future migration, regardless of the migration stream. To do so, we run models in three steps, adding sets of variables at each step. We begin with regression models with only mental and physical health, to identify whether migrants differ in health status, without accounting for other factors influencing migration. In the second set of regressions, we add age and the measure of MLSFH wave. In the third set of regressions we include the full set of measures that likely affect both health and the likelihood to migrate, including HIV status, number of children, level of education, household wealth, marital status, previous migration, and ownership of land at area of residence. In this fourth stage we examine whether migration selection differs by stream: we divide the dependent variable by migration stream, creating rural-rural, rural-town, and rural urban migrants and run multinomial regression models with the same independent variables (and non-migrants as the reference category). We run all models separately for men and women.

For our analysis of migration selection, random effects regression is appealing for several reasons. First, random effects regression allows us to include data from several MLSFH survey intervals while controlling for the dependence of individual outcomes across MLSFH waves (one individual can contribute multiple survey intervals). Second, the random effects models that we use also include a variable for survey wave that enables us to measure trends in migration and health (while controlling for other factors) (Alison 2005; Hsaio 2003). It is important to note that while random effects are useful for longitudinal data analysis with repeated measurements for the same individuals, they do not control for unobserved time-invariant individual attributes

that may affect divorce, widowhood, and remarriage. These time-invariant characteristics may be important: some, like risk-taking propensity, may affect both migration and health, which implies that random effects regression results may be biased.

Migration Effect

Our second research question of interest is whether migration affects health. In addition to health status, it is likely that individuals who migrate are different from non-migrants in many other characteristics. For example, by virtue of their willingness and ability to move, migrants are likely less risk-averse than non-migrants in many settings. While some characteristics that differ between migrants and non-migrants are relatively easily observed in data (e.g. level of education), other characteristics, like risk-taking propensities, are difficult to measure or are not measured at all. This is an important issue for migration research, because many such unobserved characteristics are likely to be associated with both migration and health status. Therefore, any empirical model that does not account for unobserved characteristics of migrants is likely to present biased estimates for the effect of migration on health status.

To address this issue, we will use fixed effects regression that decomposes the residual ε_{it} into a fixed component α_i that reflects fixed unobserved endowments (e.g., individual risk aversion, genetic and early-life components of health, preferences, etc.) and a time-varying component ν_{it}. The use of fixed effects is appealing because it enables us to control for any time-invariant (observed or unobserved) differences across respondents that may affect health status. The basic form of the fixed effects model we intend to use can be expressed as the following linear model:

$$Y_{it} = \beta_0 + X_{it}\beta_1 + M_{it}\beta_2 + P_{it}\beta_3 + \pi\alpha_i + \nu_{it},$$

where Y_{it} represents the health status of individual *i* at time *t* (SF-12 measures of mental and physical health); X_{it} represents a vector of observed background characteristics, such as age, level of education, migration history, and economic status; M_{it} is an measure of migration status in between MLSFH waves; P_{it} represents observed perceptions and behaviors that likely affect health status. The error term consists of two parts: (α_i) represents individual-specific components that are time-invariant for a person but vary across individuals (in the present

context, a persons risk aversion, genetic and early-life components of health, preferences are of primary importance), and (ν_i) represents a random error term that varies within individuals over time, has a mean of zero and constant variance.

If unobserved time-invariant characteristics of individuals are correlated with a person's migration behavior and with health (a likely scenario given that migration is likely to selective with respect to health and some of its unobserved determinants), then α_i will be correlated with the independent variables in the above equation (specifically M_{it}). Such a correlation between the error term and the independent variables in the above equation will lead to biased estimates whenever $\pi \neq 0$ of the effect of migration on health status. Fixed effects regression is an approach that eliminates possible correlation between the error term and independent variables by utilizing difference scores for all variables between waves if fixed individual characteristics are the primary source of such a correlation. Because fixed factors of individuals remain constant over time, they are eliminated when the difference scores are created. In doing so, all observed variables whose effect is constant (such as age or level of schooling), along with any unobserved time-invariant characteristics (represented by α_i) drop out of the model. Thus, if certain respondents have a greater risk tolerance that simultaneously affects migration and health, this unobserved characteristic will be differenced out of the above equation when using fixed effects (Allison 2005, Hsiao 2003).

We run our fixed effects regression models in similar manner to the first set of two steps. First, we run models with mental and physical health as dependent variables (separately for men and women). Next, we examine the possibility that the relationship between migration and health varies by migration stream, and separate the independent variable measure for migration into (1) rural-rural migrants, (2) rural-town migrants, and (3) rural-urban migrants (all compared to non-migrants); thereby identifying whether the effect on physical and mental health differs by migration stream.

Results

Given that migration follow-up studies are rare in most settings, particularly SSA, we begin by presenting tabulations of internal migration patterns in Malawi. The predominant migration

stream among MHM respondents is rural-to-rural migration. Over 60% of male and female migrants moved to another rural area, compared with 20-26% moving to towns, and 10% to urban areas (Figure 1).

Health Selection

Next, we turn to the random effects regressions for factors selecting individuals into migration streams (Table 1 for women, Table 2 for men). The first set of regressions shows results for health selection without controlling for ways in which migrants may differ from non-migrants. Although there is no significant relationship between mental health and migration for men or women, we find that physically healthier men and women are more likely to migrate. As seen from the results of the second models, this relationship is partly explained by age: after controlling for age (significant at $p<0.00$), the relationship between physical health and migration drops from significance, likely because younger individuals are more likely to be healthy and to migrate.

Moving to the full set of regressions (model 3), we find that after including other measures, the relationship between health and migration is again significant for men, and with a larger effect size: men with better physical health are significantly more likely to migrate. Also significant is HIV status, in which HIV positive individuals are more likely to migrate than those who are HIV negative (a phenomenon previously examined in Anglewicz 2012). It seems likely that accounting for HIV status explains why the relationship between health and migration becomes stronger for men. However, although HIV positive women are also more likely to migrate, there is no significant relationship between migration and either mental or physical health for women.

Beyond health and HIV status, we find differences between men and women in factors predicting migration. Not surprisingly in light of Figure 1, marriage-related measures are significantly associated with migration among women: women who are widowed or never married are significantly more likely to migrate than currently-married women. Similarly, women from the predominantly matrilocal region, Balaka, are significantly less likely to migrate than women from Mchinji, which is not predominantly matrilocal in lineage. Among men,

factors that predict migration include previous migration and residence in Rumphi- which is predominantly patrilocal.

Finally, we examine differences in health selection by migration stream (Table 3). In these results we see that individuals who are HIV positive tend to move to cities: the relative risk that an HIV positive will be rural-rural migrants rather than a non-migrant is about double that of HIV negative. We also find a strong connection between mental health and rural-urban migration, in which worse mental health significantly increases the likelihood that respondents will be a rural-urban migrant instead of non-migrant. We find limited evidence of physical health selection by migration stream: better physical health significantly increases the likelihood that respondent will be a rural-rural migrant instead of non-migrant. We do not find much evidence that those moving to towns are different from non-migrants in our health outcomes of interest.

Effect of Migration on Health

Next, we examine whether migration affects physical or mental health. We find limited evidence for the former: Table 4 shows no significant effect of migration on health for men or women. Similarly, even when dividing the migration variable into the separate migration streams, we find no evidence that migration affects physical health.

There is a stronger connection between migration and mental health, however. As shown in Table 6, there is a significant improvement in mental health for male migrants. At the same time, we see a significant decline in mental health among those who become HIV positive, which isn't surprising. However, an interaction between HIV positive status and migration shows that male migrants who become HIV positive experience a significant improvement in mental health. We do not find a significant relationship for women, however. Next, dividing the migration variable by stream (Table 7), we see that the improvement in mental health seems centered around rural-urban migrants, who experience a gain of 7 points in SF-12 mental health score. As above, we next run an interaction with HIV status, and find that those who become HIV positive and move to an urban area experience a significant improvement in mental health.

Discussion

In this research, we use longitudinal data with a migration follow-up to identify the effect of migration on health, and the selection of individuals of different health status into migration streams. For the latter, we find evidence that physically healthier individuals are more likely to migrate, but so are HIV positive individuals. When HIV positive individuals move, it appears to be to urban centers in Malawi. As with the HIV positive, those with relatively worse mental health are also more likely to move to cities, which suggests a connection between migration, mental health, and HIV status.

This connection extends to the effect of migration on health. While there is no significant effect of migration on physical health for men or women, we find that male migrants experience a significant improvement in mental health. Tying to HIV status, we find that the gains in mental health for male migrants seem to be attributable to HIV positive individuals moving to cities.

Why the improvement in mental health status among HIV positive male urban migrants? One explanation is that they start with worse mental health to begin with, as shown in the health selection analysis. An additional reason could be due to the improved access to HIV antiretroviral drugs that are perhaps more easily accessible in Malawi's urban centers. Finally, the anonymity of cities may be comforting for HIV positive individuals whose HIV status may be scrutinized in rural areas of Malawi (Watkins 2004).

While we benefit from the longitudinal panel study design, there are some limitations to this research. Most importantly, when we divide the sample into migration stream and sex, we are left with a relatively small sample size (likely reflected by the large effect size in the last regressions). Another caveat of any longitudinal study is potential attrition bias, one form of which is possible differences in characteristics between migrants successfully found versus those not traced. In Table 8 we compare characteristics (before migration) between these two groups and indeed find that the migrants surveyed by MHM were older, and we had greater success in finding women. Still, we do not find differences for other characteristics, which suggests that the differences here are relatively minor.

Acknowledgements

The Migration and Health in Malawi Project has been funded by NICHD R21HD071471-01 "Migration and Health in Malawi." The Malawi Longitudinal Study of Families and Health has been funded by NICHD R01HD053781 "Consequences of High Morbidity and Mortality in a Low-Income Country" NICHD R01HD044228 "AIDS/HIV Risk, Marriage and Sexual Relations in Malawi" NICHD R01HD/MH41713 "Gender, Conversational Networks and Dealing with STDs."

Tables and Figures

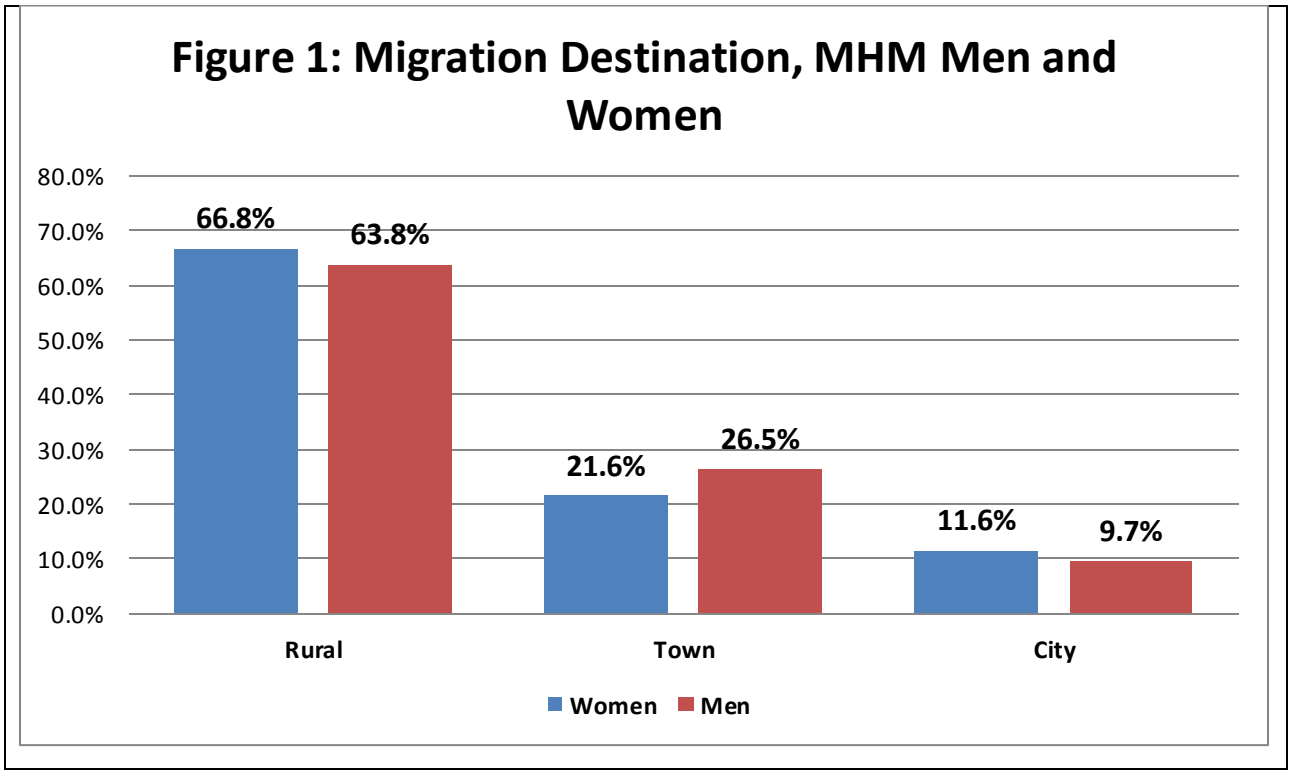


Table 1: Random effects regression results for factors predicting migration in a future wave, MLSFH women, 2004-2008

	Model 1		Model 2		Model 3	
	Odds	SE	Odds	SE	Odds	SE
Physical Health	1.02*	0.01	1.01	0.02	0.99	0.02
Mental Health	1.00	0.01	0.99	0.01	1.00	0.01
Age			0.96***	0.01	0.98	0.01
HIV positive					2.69**	1.23
Number of children					0.85**	0.07
Region of residence						
Mchinji (ref)					----	----
Balaka					0.31***	0.12
Rumphi					0.65	0.22
Education						
No education (ref)					----	----
Primary					1.93*	0.73
Secondary +					2.48	1.45
Household wealth					1.04	0.08
Marital status						
Currently married (ref)					----	----
Divorced/widowed					2.17**	0.75
Never married					9.10***	5.01
Migrated previously					1.36	0.26
Number in household					1.04	0.05
Land ownership					0.98	0.02
MLSFH 2008			7.47***	2.14	8.66***	3.89

*p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

Table 2: Random effects regression results for factors predicting migration in a future wave, MLSFH men, 2004-2008

	Model 1		Model 2		Model 3	
	Odds	SE	Odds	SE	Odds	SE
Physical Health	1.03**	0.01	1.03	0.02	1.06**	0.03
Mental Health	1.00	0.01	1.00	0.01	1.00	0.02
Age			0.96***	0.01	0.96**	0.01
HIV positive					4.33**	2.84
Number of children					1.01	0.05
Region of residence						
Mchinji (ref)					----	----
Balaka					1.09	0.40
Rumphi					0.35**	0.15
Education						
No education (ref)					----	----
Primary					1.67	0.79
Secondary +					1.24	0.75
Household wealth					1.07	0.10
Marital status						
Currently married (ref)					----	----
Divorced/widowed					2.53	1.71
Never married					1.76	0.78
Migrated previously					2.10**	0.63
Number in household					0.94	0.04
Land ownership					1.00	0.01
MLSFH 2008			5.12***	1.65	5.20***	2.27

*p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

Table 3: Random effects multinomial logistic regression results for 2006/08 factors predicting future 2008/10 migration, by migration stream

	Women		Men	
Moved to other rural area (compared to non-migrant)				
	RRR	SE	RRR	SE
Physical health	1.01	1.01	1.02	1.02
Mental health	1.01	1.01	1.01	1.01
HIV positive	2.08***	1.27	1.48	1.49
Moved to town (compared to non-migrant)				
	RRR	SE	RRR	SE
Physical health	0.97*	1.02	1.02	1.03
Mental health	0.99	1.01	1.00	1.02
HIV positive	1.30	1.61	1.35	2.12
Moved to city (compared to non-migrant)				
	RRR	SE	RRR	SE
Physical health	1.05	1.05	1.15	1.10
Mental health	0.96*	1.03	0.89**	1.05
HIV positive	5.54**	2.33	44.38**	4.67

Models also include all other control variables shown in Tables 1 & 2; *p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

Table 4: Fixed effects regression results for effect of migration on physical health, men and women

	Women		Men	
	Coef.	SE	Coef.	SE
Migration	0.19	0.82	0.41	0.87
HIV positive	-1.09	1.84	1.73	2.57
Household wealth	-0.17	0.17	0.02	0.18
Number living in household	0.01	0.07	0.03	0.05
Amount land owned	0.00	0.02	-0.01	0.01
Region of residence				
Mchinji (ref)	----	----	----	----
Balaka	----	----	0.43	4.03
Rumphi	21.03**	8.68	-6.99	5.59
Marital status				
Currently married (ref)	----	----	----	----
Divorced/widowed	1.14*	0.67	-1.50	1.20
Never married	3.37**	1.31	0.48	0.88
MLSFH survey				
2006 (ref)	----	----	----	----
2008	0.39	0.50	-0.15	0.45
2013	1.94***	0.67	0.64	0.61

*p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

Table 5: Fixed effects regression results for effect of migration on physical health by migration destination, men and women

	Women				Men			
	Model 1		Model 2		Model 1		Model 2	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Non-migrant (ref)	----	----	----	----	----	----	----	----
Rural-rural migrant	-0.52	0.82	-0.52	0.82	0.63	0.80	0.62	0.80
Rural-town migrant	-1.18	1.64	-1.20	1.64	0.54	1.45	0.53	1.45
Rural-urban migrant	-1.70	3.17	-2.64	3.39	0.42	3.17	0.72	3.26
HIV positive	-1.00	1.84	-1.30	1.88	1.72	2.57	1.71	2.57
Household wealth	-0.16	0.17	-0.14	0.17	0.03	0.18	0.03	0.18
Number living in household	0.01	0.07	0.02	0.07	0.03	0.05	0.03	0.05
Amount land owned	0.00	0.02	0.00	0.02	-0.01	0.01	0.00	0.01
Region of residence								
Mchinji (ref)	----	----	----	----	----	----	----	----
Balaka	----	----	----	----	0.67	4.38	-0.24	4.94
Rumphi	19.61**	9.22	26.16**	12.46	-7.09	5.65	-7.54	5.77
Marital status								
Currently married (ref)	----	----	----	----	----	----	----	----
Divorced/widowed	1.16*	0.67	1.18*	0.67	-1.50	1.20	-1.50	1.20
Never married	3.12**	1.33	3.07**	1.33	0.47	0.88	0.48	0.88
MLSFH survey								
2006 (ref)	----	----	----	----	----	----	----	----
2008	0.50	0.51	0.52	0.51	-0.26	0.46	-0.27	0.46
2013	2.24***	0.65	2.27***	0.65	0.52	0.63	0.52	0.63

*p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

Table 6: Fixed effects regression results for effect of migration on mental health, men and women

	Women				Men			
	Model 1		Model 2		Model 1		Model 2	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Migration	-0.33	1.16	-0.45	1.22	1.77*	1.16	1.15	1.19
Interaction: migration*HIV positive	----	----	0.89	2.74	----	----	9.87**	4.13
HIV positive	-3.88	2.60	-4.08	2.68	-8.18**	3.43	-10.76***	3.59
Household wealth	0.17	0.24	0.18	0.24	0.85***	0.24	0.81***	0.24
Number living in household	0.03	0.09	0.03	0.09	-0.12*	0.07	-0.12*	0.07
Amount land owned	-0.05	0.03	-0.05	0.03	0.02*	0.01	0.02	0.01
Region of residence								
Mchinji (ref)	----	----	----	----	----	----	----	----
Balaka	----	----	----	----	-1.95	5.39	-1.78	5.37
Rumphi	-22.95*	12.25	-22.94*	12.25	-1.56	7.47	-1.75	7.45
Marital status								
Currently married (ref)	----	----	----	----	----	----	----	----
Divorced/widowed	-2.76***	0.95	-2.75***	0.95	-1.89	1.60	-1.82	1.60
Never married	0.05	1.84	0.00	1.85	-0.82	1.18	-0.97	1.18
MLSFH survey								
2006 (ref)	----	----	----	----	----	----	----	----
2008	-1.50**	0.71	-1.49**	0.71	-1.75***	0.60	-1.73***	0.59
2013	-0.73	0.94	-0.72	0.94	-3.82***	0.82	-3.80***	0.81

*p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

Table 7: Fixed effects regression results for effect of migration on mental health by migration destination, men and women

	Women				Men			
	Model 1		Model 2		Model 1		Model 2	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Non-migrant (ref)	----	----	----	----	----	----	----	----
Rural-rural migrant	-1.16	1.16	-1.16	1.16	-0.33	1.07	-0.32	1.07
Rural-town migrant	-1.67	2.31	-1.65	2.31	2.07	1.93	2.08	1.93
Rural-urban migrant	-0.24	4.47	0.86	4.78	7.72**	3.23	5.98*	3.35
Interaction: rural-urban migration *HIV positive	----	----	-8.75	13.55	----	----	21.03**	8.04
HIV positive	-3.84	2.60	-3.50	2.66	-7.69**	3.43	-7.68**	3.43
Household wealth	0.18	0.24	0.16	0.24	0.83***	0.24	0.83***	0.24
Number living in household	0.04	0.09	0.03	0.09	-0.12*	0.07	-0.12*	0.07
Amount land owned	-0.05	0.03	-0.05	0.03	0.02*	0.01	0.02*	0.01
Region of residence								
Mchinji (ref)	----	----	----	----	----	----	----	----
Balaka	----	----	----	----	2.61	5.85	7.95	6.59
Rumphi	-22.91*	13.01	-30.53*	17.57	0.32	7.55	3.01	7.70
Marital status								
Currently married (ref)	----	----	----	----	----	----	----	----
Divorced/widowed	-2.71***	0.95	-2.73***	0.95	-2.03	1.61	-2.02	1.61
Never married	-0.27	1.87	-0.21	1.87	-1.07	1.17	-1.12	1.17
MLSFH survey								
2006 (ref)	----	----	----	----	----	----	----	----
2008	-1.33*	0.72	-1.35*	0.72	-1.85***	0.62	-1.81***	0.62
2013	-0.44	0.91	-0.47	0.91	-3.53***	0.84	-3.53***	0.84

*p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

Table 8: Differences Between Migrants Found and Not Found, MHM Study

	Not Found	Found
Female	44.8%	56.4%**
Age	32.4	35.0*
HIV positive	10.7%	14.1%
Married	54.2%	62.0%
Last interviewed		
2004	27.8%	72.2%
2006	21.6%	78.4%
2008	16.0%	84.0%

*p≤ 0.10 **p ≤ 0.05; ***p ≤ 0.01

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