

BMJ Open Cohort profile: internal migration in sub-Saharan Africa – The Migration and Health in Malawi (MHM) study

Philip Anglewicz,¹ Mark VanLandingham,¹ Lucinda Manda-Taylor,² Hans-Peter Kohler³

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¹Department of Global Community Health and Behavioral Science, Tulane University School of Public Health and Tropical Medicine, New Orleans, Louisiana, USA

²Malawi College of Medicine, University of Malawi, Zomba, Malawi

³Department of Sociology and Population Studies Center, University of Pennsylvania, Philadelphia, Pennsylvania, USA

Correspondence to

Dr Philip Anglewicz; panglewi@tulane.edu

ABSTRACT

Purpose The Migration and Health in Malawi (MHM) study focuses on a key challenge in migration research: although it has long been established that migration and health are closely linked, identifying the effect of migration on various health outcomes is complicated by methodological challenges. The MHM study uses a longitudinal panel premigration and postmigration study design (with a non-migrant comparison group) to measure and/or control for important characteristics that affect both migration and health outcomes.

Participants Data are available for two waves. The MHM interviewed 398 of 715 migrants in 2007 (55.7%) and 722 of 1013 in 2013 (71.3%); as well as 604 of 751 (80.4%) for a non-migrant reference group in 2013. The total interviewed sample size for the MHM in both waves is 1809. These data include extensive information on lifetime migration, socioeconomic and demographic characteristics, sexual behaviours, marriage, household/family structure, social networks and social capital, HIV/AIDS biomarkers and other dimensions of health.

Findings to date Our result for the relationship between migration and health differs by health measure and analytic approach. Migrants in Malawi have a significantly higher HIV prevalence than non-migrants, which is primarily due to the selection of HIV-positive individuals into migration. We find evidence for health selection; physically healthier men and women are more likely to move, partly because migration selects younger individuals. However, we do not find differences in physical or mental health between migrants and non-migrants after moving.

Future plans We are preparing a third round of data collection for these (and any new) migrants, which will take place in 2018. This cohort will be used to examine the effect of migration on various health measures and behaviours, including general mental and physical health, smoking and alcohol use, access to and use of health services and use of antiretroviral therapy.

INTRODUCTION

It has long been assumed that migration and health are closely linked, but empirical results vary across settings and health measures. Many studies suggest that moving to a new location can improve health and well-being, and research often shows that individuals

Strengths and limitations of this study

- This Migration and Health in Malawi (MHM) study features longitudinal panel data for migrants (before and after migration) and a comparison group of non-migrants.
- These data are used to examine key issues in migration research, such as migration health selection, the effect of migration on health and the health status of return migrants.
- Although the MHM study includes migrants to different destinations (rural, town, urban), all originate from rural areas; migrants originating from towns or cities are not included. The MHM also does not include in-migrants to the sample area, only those leaving.

who previously migrated are in better health than their non-mobile counterparts.^{1–4} Other studies have concluded that moving—to cities, for example—can have deleterious effects on health outcomes, for example, acquisition of HIV and other sexually transmitted infections.^{5–7}

It has been challenging to empirically establish that migration *causes* changes in health due to the need to address (1) possible selection bias, that healthier (or in some cases, less healthy) individuals are more likely to migrate;^{8–14} (2) the ‘salmon bias’ hypothesis, that less healthy individuals are more likely to return to areas of origin, and thus remaining migrants are relatively healthy;^{9 12 14–19} and (3) the possibility that the effect of migration on health status changes over time: some research shows that the better health of migrants declines as they spend more time in their postmigration residence.^{14 20–23}

The above hypotheses have seldom been adequately 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, but research on migration across settings often relies on cross-sectional

data to compare non-migrants with migrants *after* migration.^{24–30} 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 very rare in any setting, particularly in sub-Saharan Africa (SSA).

The relatively few existing studies on migration in SSA frequently use one of two study designs. The most common are cross-sectional studies with information for migrants after moving, sometimes including retrospective migration histories. The second type, such as Demographic Surveillance Sites (DSS), are geographically based in one location, with longitudinal measures collected for (1) individuals who migrate and return to the area of origin ('circular' or 'temporary' migrants), or (2) 'in' migrants, who move into the DSS site from elsewhere.^{5 31–33} Individuals who move out of the study area ('permanent' migrants) are typically not followed,^{31 33 34} an approach that is unbiased only if in-migrants are the same as permanent out-migrants, which is very unlikely to be the case in most settings.

The Migration and Health in Malawi (MHM) study addresses several key methodological challenges in research on migration and health. Longitudinal data enable the study to (1) use statistical methods that reduce biases which distort the estimation of causal effects of migration on health outcomes and (2) measure and control for the selection effects that are missing from much of the existing research on health and migration: differences in health outcomes between non-migrants and migrants prior to migration.

The MHM provides one of the first population-based longitudinal data sets on migration and health in SSA, which addresses several limitations of previous studies. A common limitation is the focus on migrant subgroups, rather than all migrants. Research on migration and health in SSA has disproportionately been on labour migration,^{25 35 36} despite the fact that many migrate for marriage-related, climate-related and household-related reasons.^{5 26 37 38} Due in part to the interest in labour migration, the spatial movement of interest has primarily been rural–urban migration,^{16 39 40} and the gender focus has often been on male migrants.^{40–42} At the same time, rural-to-rural migration is the most common type of movement in many parts of SSA,^{43–45} emerging research has shown that rates of female migration is increasing in SSA⁴⁵ and there are important differences in migrant characteristics by destination.⁴⁶ The MHM data also include men and women across a broad age range from young adulthood (age 15) to old age.

These data also contain a wide range of measures, many of which are rarely collected for migrants. Health measures used in previous research have been limited, with predominant focus on outcomes like fertility, child health and mortality, and HIV infection (SSA),^{5–7 11 27 47–51}

and very little research on the relationship between migration and general health (mental and physical). The MHM includes extensive information on health status, HIV infection, sexual behaviour, remittances and transfers, migration history and social networks for migrants and non-migrants, including measurements on the above characteristics both before and after migration (at post-migration locations). The range of health measures is a particular asset for the MHM since it is likely that the relationship between migration and health varies by health measure and migrant group. For example, research has often found that physically healthier individuals are more likely to migrate, but some studies have found migrants to have worse mental health,^{14 20} and more likely to be HIV positive or practice risky sexual behaviour.^{6 26 27} In addition, research has found that the reason for migration differs between men and women in SSA (with men moving for work and women moving for marriage-related reasons), and by destination (urban, town, rural).⁴³ We therefore expect to find differences in the relationship between migration and health by health measure, sex and migration stream.

Primary research goals of the MHM are to (1) identify the selection effect of individuals with differing health status into migration in Malawi ('migration selection'); (2) estimate the causal effect of migration on mental and physical health status ('migration effect of health') by using longitudinal data from before and after migration and by employing statistical approaches that control for unobserved determinants of migration and health and (3) measure several key aspects of migration and health that have previously been neglected in SSA, including (a) spatial direction (rural-urban, rural-rural), (b) reason for migration (eg, work, marital change, death of family member), (c) duration of migration, (d) gender and (e) distance from origin.

Cohort description

Setting

Our study is set in Malawi, a low-income setting with a moderate HIV epidemic. Malawi is divided into three regions (southern, central, northern) and 28 districts. The largest cities in Malawi are the three regional capitals, Blantyre (southern), Lilongwe (central) and Mzuzu (northern). Each district has an administrative centre, which is a common destination for migrants from rural areas.

The MHM is integrated with another study in Malawi, the Malawi Longitudinal Study of Families and Health (MLSFH). The MLSFH is a longitudinal panel survey that examines how families and individuals in rural Malawi cope with the high morbidity and mortality caused by the HIV/AIDS epidemic. The MLSFH began in 1998 in three sites of rural Malawi, Rumphu, in the northern region, Mchinji in the central region and Balaka in the south. The original MLSFH sample included ever-married women and their spouses. The MLSFH study team returned to reinterview the same respondents (along with

new spouses for respondents who remarried between the two waves) for five additional waves of survey data collection in 2001, 2004, 2006, 2008 and 2010. The MLSFH target sample increased from 2791 in 1998 to 6306 in 2010. The MLSFH sample added to the sample in the following ways: (1) all new spouses for individuals who married in between waves, (2) a sample of young adults aged 15–25 in 2004 and (3) a sample of parents of respondents in 2008. The MLSFH survey has had consistently high participation rates of >70% (93% in 1998, 77% in 2001, 74% in 2004) and <3% refused to be interviewed in every wave. Comparisons of background characteristics between the MLSFH data and the rural sample of the Malawi DHS found relatively few substantive differences.⁵² The MLSFH offered HIV testing and test results to participants in 2004, 2006 and 2008. The MLSFH conducted extensive pre-HIV and post-HIV test counselling for all participants, and all those who tested positive for HIV were referred to health facilities for confirmatory testing and determining of eligibility for ART. MLSFH data collection in each year took place between May and August. More information about the MLSFH study can be found in the MLSFH Cohort Profile.⁵²

Eligibility criteria

In all waves of MLSFH, the most common reason for non-participation is migration. Migrants were identified through attempts to interview all respondents in the MLSFH target sample. While visiting the house of a respondent, the MLSFH team was informed of migration activity of previous respondents by friends and family members who remain in the MLSFH premigration village of the respondent. To qualify as a 'migrant', friends and family members must report that the individual has moved from the MLSFH village to another location (as opposed to being temporarily gone with the intention to return).

Sampling

The MHM sample includes these MLSFH migrants. The MHM has conducted two waves of data collection to date, in January–April 2007 and July–November 2013. Each wave was based on previous MLSFH respondents who were eligible for migration: those eligible for the MHM 1 study were the 4950 respondents in the 2006 MLSFH target sample, and the 5914 individuals MLSFH 2010 respondents were eligible for the MHM 2. Among those eligible, the first wave identified 804 individuals who were previously interviewed by MLSFH and were reported to have moved elsewhere during MLSFH data collection in 2006. During 2010 MLSFH data collection, the second wave identified 1096 individuals who were interviewed at least once since 2001 and had moved elsewhere.

Of those who moved, some migrated to areas outside of Malawi. Specifically, 89 individuals of the MHM 1 target sample and 83 of the MHM 2 target samples were residing outside of Malawi at the time of the respective survey. In both MHM 1 and 2, the most common country

of destination was Zambia, followed by Mozambique, reflecting the proximity of these countries to Malawi. The MHM did not seek to trace these international migrants, thus reducing the wave 1 target sample to 715 and second wave to 1013.

After removing international migrants, the MHM sought to trace all remaining internal migrants. The first step to do so was to identify their current location. For this purpose, the migration study team first returned to the MLSFH village where the migrant previously resided and administered a Migration Tracking Survey to friends or family members remaining in the MLSFH sample village. The tracking survey included information on the current location of the migrant (including city, town or village of residence, phone number), the reason for migration and other information surrounding the circumstances of the move. This information was used to trace migrants in the second step of the MHM study.

In addition to internal migrants, two other samples are included in the MHM. Following the MLSFH sampling strategy, the MHM interviewed all new spouses for migrants who married since a previous interview (130 in 2007 and 120 in 2013). Second, due to the duration of time since previous interview, the MHM 2 included a 'non-migrant' comparison group of 751 individuals, randomly selected from the MLSFH roster, who had not moved at the most recent wave (approximately 250 per site).

Despite challenges in finding mobile individuals in a low-income country setting, the MHM traced and reinterviewed the majority of these internal migrants. The MHM interviewed 398 of 715 migrants in 2007 (55.7%) and 722 of 1013 in 2013 (71.3%); the MHM also interviewed 80.4% (604) of the non-migrant reference group in 2013. Overall, the total interviewed sample size for the MHM in both waves is 1809, which includes 983 migrants, 222 new spouses and 604 non-migrants. Of the migrants and their new spouses, 325 were interviewed at least twice, either in both waves of MHM, or in the first MHM wave and a subsequent MLSFH wave (ie, return migration). A flow chart of MLSFH respondents eligible for MHM and MHM outcomes is shown in figure 1.

Measures

Measures of health and health-related behaviours are central to the MHM. The MHM has conducted HIV testing and counselling at respondents' homes using Determine and Unigold rapid tests, following the same procedures as the MLSFH. The MHM also collects extensive information on health behaviours, such as sexual behaviour, smoking and alcohol use, access to and use of health services, and use of antiretroviral therapy (ART). Other measures collected by the MHM are summarised in table 1.

The MHM also collects information on general mental and physical health, using the 12-Item Short Form Health Survey (SF-12) set of questions. The SF-12 has been shown to accurately capture physical and mental health status

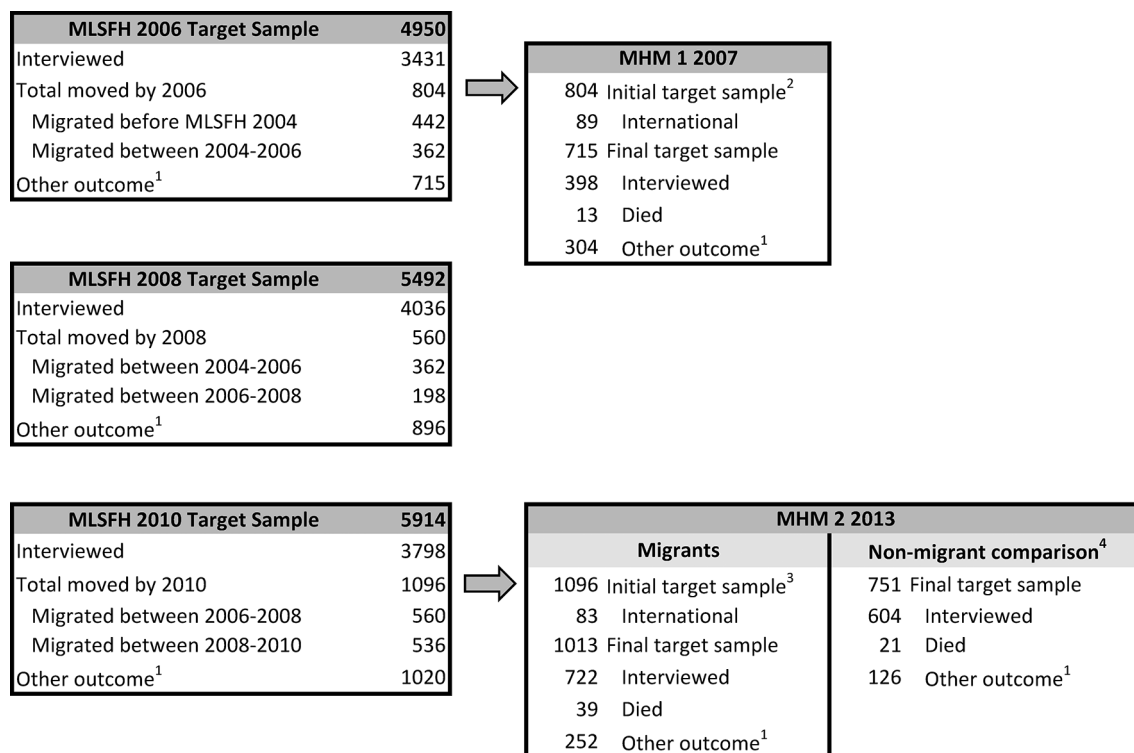


Figure 1 MHM sample flow chart. The Migration and Health in Malawi (MHM) studies also interviewed new spouses of migrants, 130 in 2007 and 120 in 2013. ¹The 'other' outcome includes such reasons as temporarily away, sick/hospitalised, refused. A full tabulation of other outcomes for the MHM is shown in [table 4](#). ²The sample for MHM 1 was all individuals interviewed in a previous Malawi Longitudinal Study of Families and Health (MLSFH) wave but moved elsewhere by 2006. ³The sample for MHM 2 was all individuals interviewed since 2001 but moved elsewhere by 2010. ⁴The non-migrant comparison group in MHM 2 was randomly selected from the MLSFH roster from individuals who were interviewed in 2010.

in a wide range of settings,^{53–55} including SSA.^{56–57} SF-12 scores are shown to be more robust measures of health than the single five-point scale of health that is commonly used in migration research.¹⁰ SF-12 summary measures range from 0 to 100, with higher scores indicating better health. Two summary measures, a mental health component summary score and a physical health component summary score, are calculated by aggregating data from the eight subscales.⁵⁴ The MHM/MLSFH-SF12 mental health score is strongly correlated with more detailed measures of depression and anxiety that are available for some non-MHM respondents.⁵⁸

The MHM also provides detailed measures of migration and the motivation for changing residence. Among the more important measures is a full residence history for MHM respondents in 2013, which includes a list of all locations where they lived for ≥ 6 months, along with characteristics of the location and reasons for moving there. Given the dearth of migration information in surveys in SSA, the residence histories can provide needed insight into migration patterns of a highly mobile population.

Study participant characteristics

Characteristics of the migrants in 2007 and 2013 (ie, after migration) and the non-migrant comparison group in 2013 are shown in [table 2](#). Like the MLSFH, the majority of participants are female, and average age is between

34 and 41 years in both waves. Unlike many data sources in SSA (such as Demographic and Health Surveys), the MHM has a substantial percentage of participants beyond reproductive ages: $>10\%$ of migrants were 50 years or older in both MHM waves.

Differences between migrants and non-migrants in some measures are evident in [table 2](#). HIV status is higher among migrants, at 14.1% in wave 1 and 14.3% in wave 2, compared with 6.3% among non-migrants in wave 2. However, mental and physical health, measured by the SF-12 summary score, is similar between these groups.

We measure different patterns of movement for MHM migrants. Over 46% of migrants had lived outside of their district for ≥ 6 months since the age of 15 in MHM 2 compared with 51% in MHM 1. Return migration was not uncommon in MHM 2: 25.8% of migrants in 2013 were found in MLSFH villages of origin, and $>26\%$ in 2007 and 13% in 2013 had lived outside their district for ≥ 1 month in the past year. Although rural-to-urban migration has received considerable attention in the literature, intrarural migration is the most common migration stream: in 2013, 65.2% of all migrants moved to another rural area, and 22.5% of migrants moved to a district capital, or 'town'. Rural-to-urban migration was less common, as only 12.3% of migrants moved to one

Table 1 Migration and Health in Malawi (MHM) data collection content

MHM 1, 2007	MHM 1, 2013
GPS coordinates	GPS coordinates
HIV testing and counselling (Determine and Unigold rapid tests)	HIV testing and counselling (Determine and Unigold rapid tests)
Health measures <ul style="list-style-type: none"> ▶ Overall self-rated health ▶ Self-rated health compared with peers 	Health measures <ul style="list-style-type: none"> ▶ Overall self-rated health ▶ Self-rated health compared with peers ▶ SF-12 mental and physical health
Family and household structure <ul style="list-style-type: none"> ▶ Complete listing of household members, some select family members 	Family and household structure <ul style="list-style-type: none"> ▶ Complete listing of household members, some select family members
Financial and non-financial transfers <ul style="list-style-type: none"> ▶ Exchanges to and from respondents involving family and household members 	Financial and non-financial transfers <ul style="list-style-type: none"> ▶ Exchanges to and from respondents involving family and household members ▶ Exchanges to and from most important transfers partners
Marriage and sexual behaviour <ul style="list-style-type: none"> ▶ Complete marriage history ▶ Sexual behaviour and partnerships ▶ HIV/AIDS-related perceptions and behaviours ▶ HIV/AIDS social network partners characteristics 	Marriage and sexual behaviour <ul style="list-style-type: none"> ▶ Complete marriage history ▶ Sexual behaviour ▶ HIV/AIDS-related perceptions and behaviours
Migration patterns <ul style="list-style-type: none"> ▶ Ties with previous village of residence 	Migration histories <ul style="list-style-type: none"> ▶ Complete migration history for respondent ▶ Migration patterns of family and household members
	Other features of Malawi <ul style="list-style-type: none"> ▶ Economic shocks ▶ Diet and lifestyle ▶ Healthcare use

of Malawi's three regional capitals, Lilongwe, Blantyre or Mzuzu.

Non-response

To assess potential bias due to non-response, we examine the extent to which the sample of migrants found in each wave may be different from those not found. We compare background characteristics at baseline between migrants found and those not found in 2007 and 2013. Results, in [table 3](#), show few differences: in 2007, MHM was less likely to find migrants from the southern region and more likely northern region migrants, was less likely to find migrants with no schooling and found relatively wealthier migrants. The 2013 MHM wave was more likely to find female migrants compared with male migrants and less likely to find migrants from the southern region compared with the other two MHM regions.

A full tabulation of migration tracking, including outcomes of attempts to interview, is found in [table 4](#). The most prominent reasons for non-response among migrants were (1) moving again (to an unknown or relatively distant location) and (2) not having sufficient information to trace the migrant at their new location. Since our approach to finding these migrants relied on gathering information on their location from friends and

family members remaining in MLSFH sample villages, we expect that migrants not found left fewer friends or family behind to report on their location and/or had fewer or weaker ties with MLSFH village residents after moving. We also expect that information on current location is less accurate for less recent migrants. Refusal rates were <3% in both waves of MHM. There were very few instances of missing items, observations in these cases were dropped from the analysis.

Findings to date

The first wave of MHM was designed to examine the relationship between migration and HIV infection in Malawi. As elsewhere, the MHM 1 found that there is a significant association between migration and HIV infection in Malawi, in which, according to χ^2 tests, migrants have a significantly higher HIV prevalence than non-migrants,^{43 59} as shown in [figure 2](#) for both MHM waves (with results from χ^2 tests).

Contrary to a common assumption that migration is an independent risk factor for HIV infection, the MHM instead found that, in Malawi, the higher prevalence of HIV among migrants is due to the selection of HIV-positive individuals into migration streams rather than any effect of migration on HIV infection.^{43 59} The higher HIV prevalence among migrants before moving was established by multiple

Table 2 Background characteristics for Migration and Health in Malawi (MHM) 2007 and 2013

	MHM 1, 2007 Migrants	MHM 2, 2013 Non-migrants	MHM 2, 2013 Migrants
Female	57.3%	59.9%	56.5%
Mean age	34.4	40.9	35.0
Age group (years)			
<20	5.5%	4.8%	6.6%
20–29	34.7%	27.2%	41.4%
30–39	29.9%	21.7%	21.0%
40–49	17.6%	17.4%	14.3%
50–59	8.8%	13.6%	9.2%
60+	3.5%	15.3%	7.5%
Region of residence			
South	29.6%	35.0%	29.1%
Central	36.7%	31.2%	39.9%
North	33.7%	33.8%	31.0%
Marital status			
Married	77.2%	81.1%	79.7%
Divorced/separated	4.8%	7.5%	11.2%
Widowed	8.5%	9.9%	5.1%
Never married	9.5%	1.5%	4.0%
Level of schooling			
None	17.6%	22.8%	13.0%
Primary	59.3%	63.3%	65.6%
Secondary or higher	23.1%	13.9%	21.3%
Mean number of living children	3.6	4.8	4.1
Health measures			
HIV positive	14.1%	6.3%	14.3%
SF-12 physical health score (mean)	–	53.4	53.5
SF-12 mental health score (mean)	–	54.8	53.9
Diet and lifestyle			
Ever drink alcoholic beverages	–	22.2%	24.7%
Ever smoke tobacco or use smokeless tobacco	–	18.3%	15.4%
Have spending money for self	–	57.5%	45.7%
Average number of days per week eat outside house	–	0.56	0.67
Migration stream			
Rural–rural	–	–	65.2%
Rural–town	–	–	22.5%
Rural–urban	–	–	12.3%
Return migration	–	–	25.7%
Moved to			
Different district	32.3%	–	20.5%
Different region	10.0%	–	7.8%
Ever lived outside district for 6+ months since age 15	51.3%	–	46.9%
Stayed outside district for 1+ month in last year	26.6%	–	13.2%
N	398	604	722

Percentages of those accepting HIV testing were 90.5% in MHM 1, 94.8% of MHM 2 non-migrants and 94.2% of MHM 2 migrants. Other than HIV positive, there were <1% missing values for all measures.

Table 3 Premigration differences between migrants found and those not found

	MHM 1		MHM 2	
	Not found	Found	Not found	Found
Female	53.6%	57.2%	44.4%	56.2%***
Mean age	35.0	33.9	36.7	37.0
Age group (years)				
<20	11.2%	11.8%	0.5%	0.4%
20–29	24.1%	29.4%	45.0%	40.5%
30–39	29.4%	29.4%	22.0%	24.4%
40–49	22.8%	18.7%	13.9%	15.8%
50–59	10.5%	7.9%	8.6%	9.6%
60+	2.0%	2.8%	10.0%	9.3%
Region of residence				
South	41.3%	32.5%*	36.5%	29.1%*
Central	28.4%	29.5%	38.3%	39.9%
North	30.3%	38.0%*	25.2%	31.0%
Marital status				
Married	75.8%	72.8%	80.5%	77.0%
Divorced/separated	1.5%	2.2%	2.5%	4.5%
Widowed	0.4%	2.0%	4.4%	5.2%
Never married	22.3%	23.0%	12.6%	13.3%
Level of schooling				
None	21.7%	12.4%**	16.5%	18.4%
Primary	63.3%	68.5%	64.5%	65.2%
Secondary or higher	15.0%	19.1%	19.0%	16.4%
Mean number of living children	3.2	3.4	3.3	3.3
HIV positive	10.1%	12.1%	10.1%	8.3%
N	317	398	252	722

Difference between migrants found and not found is significant at * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$. Premigration characteristics measured for found and not found at 2004 for MHM 1 and 2008 for MHM 2; for time-varying measures, the last available measure is used for migrants not found. Household wealth is measured using principal components analysis of 12 household amenities. MHM 2 not found does not include deceased respondents or those moving internationally.

MHM, Migration and Health in Malawi.

logistic regressions in which the dependent variable was migrating in a future wave, and the key independent variable was HIV status before migration (also controlling for multiple confounders, such as age). Results for the selection of HIV-positive individuals into migration were statistically significant and consistent by sex.^{43 59} Similarly, figure 3 compares HIV prevalence between migrants and non-migrants at baseline using χ^2 tests, and again shows a significantly higher HIV prevalence among migrants before migration. The selection of HIV-positive individuals into migration streams appears due to the connection between marriage, HIV status and migration in Malawi, in which HIV-positive individuals are more likely to experience marital dissolution and subsequently move,^{43 59} either returning to rural homes for care or potentially to gain better access to ART.

Follow-up research on the relationship between HIV infection and migration using MHM 2 found similar results. Using several waves of data and random effects logistic regressions where the dependent variable was migration in the future, and the independent variable of interest was HIV status from a prior wave (controlling for data collection wave, sex, age and previous migration), results were consistent: HIV-positive individuals are significantly more likely to migrate than the HIV-negative (unadjusted OR 2.26, adjusted 2.71, 95% CI 1.62 to 4.54).⁶⁰ Next, classifying migrants by destination (rural, town, urban), MHM research also found that being HIV-positive significantly increased the relative risk that respondent will be a rural–urban migrant (unadjusted relative risk ratio 2.41, adjusted 4.09, 95% CI 1.68 to 9.97), a rural–town

Table 4 Visit outcomes for final target samples, Migration and Health in Malawi (MHM) 2007 and 2013

Outcome of Visit	MHM 1, 2007 Migrants		MHM 2, 2013 Non-migrants		MHM 2, 2013 Migrants	
	N	%	N	%	N	%
Completed	398	55.7	604	80.4	722	71.3
Refused	15	2.1	2	0.3	15	1.5
Dead	13	1.8	21	2.8	39	3.8
Moved	34	4.8	60	8.0	37	3.7
Temporarily away	9	1.3	29	3.9	12	1.2
Sick/hospitalised	3	0.4	3	0.4	4	0.4
Other/not found	243	33.9	32	4.3	184	18.2
Total	715	100.0	751	100.0	1013	100.0

The 'other' category includes several other reasons for non-interview, none of which individually represents a substantial proportion of the overall category, such as imprisonment, identity unknown and incapable of interview. This table does not include international migrants (89 in 2007 and 83 in 2013), for whom visits were not attempted.

migrant (unadjusted relative risk ratio 2.03, adjusted 3.62, 95% CI 1.24 to 10.54) and a rural-rural migrant (unadjusted relative risk ratio 2.48, adjusted 6.28, 95% CI 1.77 to 22.26), instead of a non-migrant. Being HIV positive also significantly increased the risk that a respondent will (1) return migrate and (2) permanently migrate instead of not migrating.⁶⁰

MHM research has also focused on the relationship between migration and health. The MHM has examined two processes involved in this relationship: migration selection (differences in health status between migrants and non-migrants before migration) and migration effect (differences in health status after migration). To examine migration selection, logistic regressions were estimated for a dependent variable indicating future migration, using the SF-12 score of mental or physical health prior to migration as the main independent variable. Figure 4 shows results for migration selection: before migration, male and female MHM migrants have significantly better physical health (measured by SF-12 summary scores) than non-migrants (unadjusted OR 1.04 for women, 1.05 for men). But after controlling for age (accounting for the fact that migrants are significantly younger than non-migrants), the difference disappears.⁶¹ We also find differences in health selection by destination: classifying migrants by destination (rural-rural, rural-town, rural-urban, all compared with non-migrants) finds that selection of healthier individuals into migration is strongest for rural-rural and rural-urban migrants, and is not evident for rural-town migrants.

There is a different story after migration, however. To examine health differences between non-migrants and migrants (after migration), we ran OLS regressions where the dependent variable is the SF-12 score of mental or physical health after migration, and the independent variable of interest is a binary indicator of migration status. Before controlling for age, there is no difference in health status after migration between migrants and non-migrants (figure 5). After age is added to regression models, however, female migrants are in significantly worse mental and physical health compared with their non-migrant peers, and there is still no significant difference in health status among men. As with migration health selection, we find differences in the effect of migration on health by destination, with significant improvements in mental health for male rural-urban migrants.⁶¹

Another purpose of the MHM data is to reduce attrition bias in longitudinal analyses of MLSFH data, an important potential bias when migrants are systematically different from non-migrants. For this purpose, several studies have combined the MHM and MLSFH data to (1) examine whether migrants are systematically different in various outcomes, such as HIV testing, marriage and divorce and education; and (2) reduce bias due to loss-to-follow-up.⁶²⁻⁶⁴

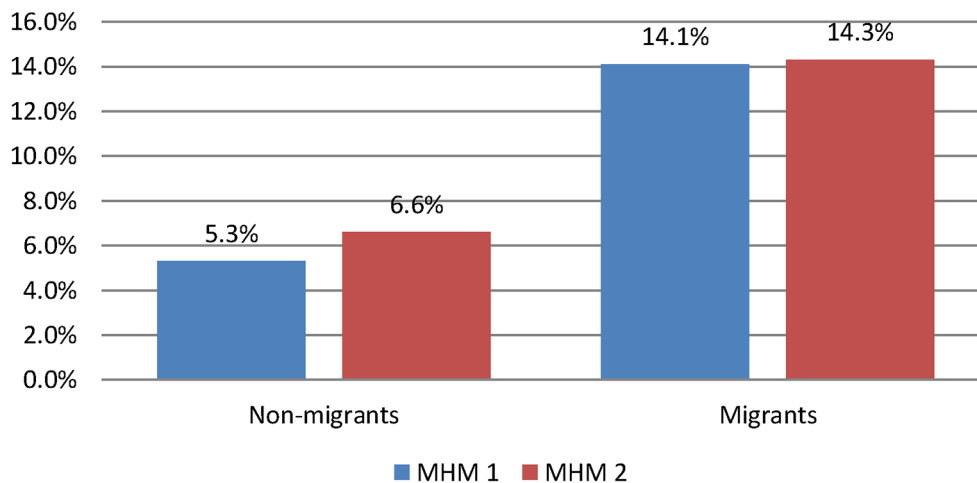


Figure 2 HIV prevalence by migration status after migration, Migration and Health in Malawi (MHM) 1 and MHM 2. MHM 1 non-migrants come from the 2006 MLSFH; differences between migrants and non-migrants χ^2 tests statistically significant at $p < 0.00$.

DISCUSSION

Overall, results to date for the MHM study show that the relationship between internal migration and health in Malawi varies by health measure. For HIV infection, we find strong evidence that those who are HIV positive are more likely to move in the future than those who are HIV negative. The reason appears to be due to marital dissolution, which HIV-positive individuals are more likely to experience and is often followed by migration. This result is consistent across destinations, with HIV-positive individuals more likely to move to other rural areas, towns and cities.

At the same time, we find that physically healthier men and women are more likely to move. Results from the MHM 2 study show that men and women with better physical health are selected into migration. Unlike HIV status, the relationship between physical health and migration varies by destination, with the healthier individuals moving to other rural areas and cities, but not towns. There is no statistically significant relationship between

migration and mental health, however; and there are no statistically significant differences in health status after migration among men and women.

Our findings to date have several implications for public health programmes. The fact that HIV-positive individuals are more likely to move means that their behaviour after migration will likely affect the future course of the epidemic: are they more likely to remarry after they move? If so, do they seek others who are HIV positive as potential spouses, or do they marry HIV-negative individuals? In addition, since some have called for specifically targeting migrants in HIV prevention campaigns, our results suggest that this approach may not be effective in reducing incidence if many migrants are already HIV positive. This research also has implication for health systems: are HIV-positive individuals moving to better access ART? Such a pattern should inform the supply of ART at various locations. At the same time, it is important to note that migrants are in better physical health before moving, and there are no significant differences in health

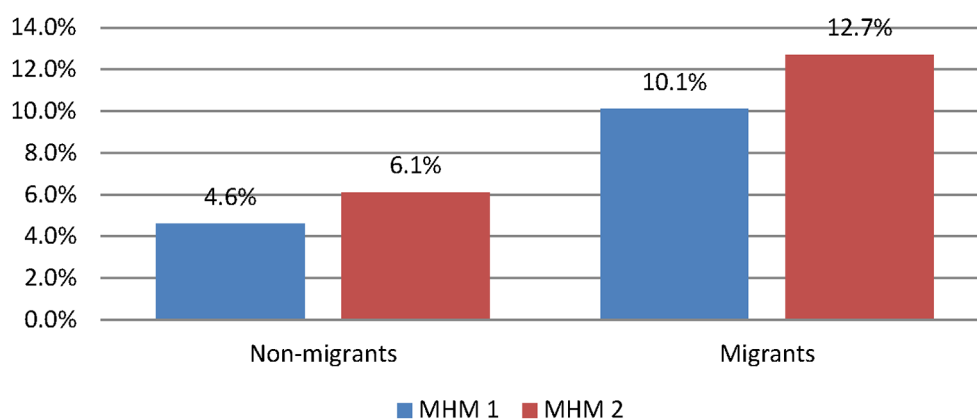


Figure 3 HIV prevalence by migration status before migration, Migration and Health in Malawi (MHM) 1 and MHM 2. HIV status is the most recent available for migrants; differences between migrants and non-migrants χ^2 tests statistically significant at $p < 0.00$.

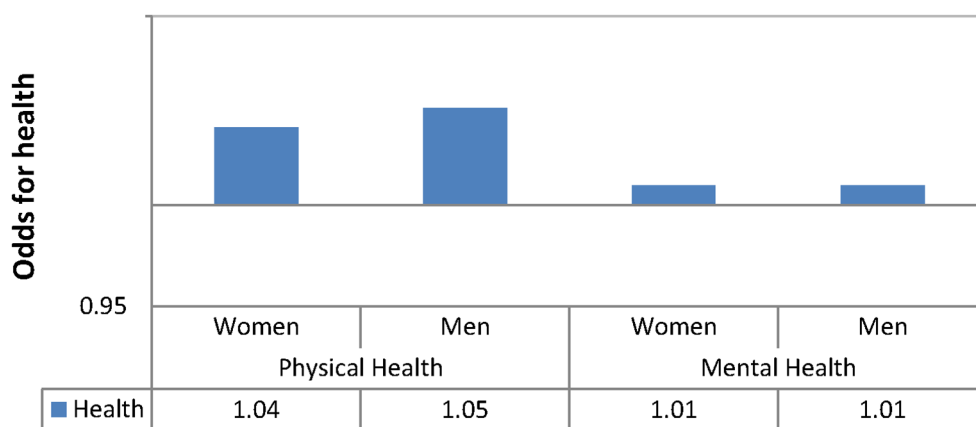


Figure 4 Logistic regression ORs for the relationship between migration and health, before migration. Health (independent variable) is measured by SF-12 summary scores of mental or physical health, migration (dependent variable) is a binary measure of migrant or non-migrant. Difference in physical health status before migration is statistically significant at $p < 0.05$ for both men and women.

status after moving (not controlling for age). Although migrants may use HIV-related services more than non-migrants, use of health services may not differ for other health conditions by migration status.

Strengths and limitations

Much migration research in SSA is motivated by a perceived connection between migration and HIV risk and/or status. Critical empirical investigations of these potential connections have been hampered by a lack of longitudinal data that includes premigration and postmigration observation. Such data are essential for distinguishing between migration selection and the causal effect of migration on HIV and other health outcomes. Building from the MLSFH, the MHM addresses this limitation and is among the first population-based longitudinal data sets on migration and health in SSA.

The MHM is also exceptional with regard to its study population and measures. Much research on migration has focused on male labour migrants. In addition to these male migrants, the MHM also includes female labour migrants, as well as individuals moving for other reasons than work (see online supplementary table A1 for a full list of reasons for migration among MHM respondents). As shown in table 1, both waves of the MHM capture substantial numbers of individuals over >50 , a population that is increasing in size in SSA, and for which little is known about migration patterns. The MHM data are the first to include extensive information on a wide array of measures (table 1) both before and after migration (at postmigration locations). The MHM also measures features of migration that are often not included in migration data, such as return migration, full residence

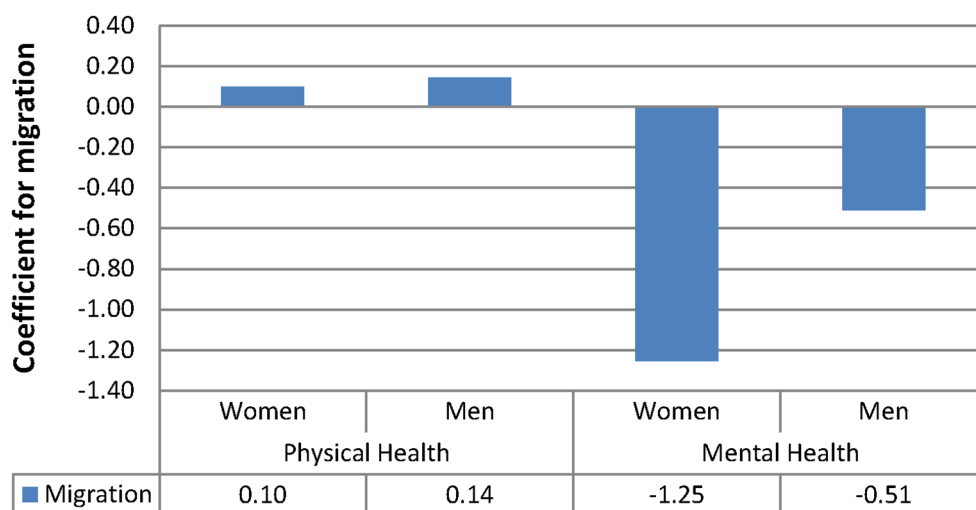


Figure 5 Health effect: OLS regression coefficients for relationship between migration and health, after migration. Health (dependent variable) is measured by SF-12 summary scores of mental or physical health, migration (independent variable) is a binary measure of migrant or non-migrant. The relationship between migration and health is not statistically significant (at $p < 0.05$).

histories, different migration destinations (rural–rural, rural–town, rural–urban), duration at residence, GPS measures before and after migration, and future migration plans. Finally, given that MLSFH participants generally reflect characteristics of the rural population of Malawi,⁵² and the relatively few differences in characteristics between migrants found and not found, our results likely reflect the populations of interest in Malawi.

The MHM has several limitations. The MHM residence histories list only locations where the respondent has lived for ≥6 months; residences of <6 months are not included. Some of these shorter-term residences could still become permanent (and could contribute meaningfully to health status). In addition, while the MHM is well-suited to measure migration streams originating from rural areas, it is limited in the extent to which it can measure migration from urban areas within Malawi. The MLSFH does not systematically include individuals moving into sample areas, so the MHM is only able to measure out-migration for this population. Although we find few statistically significant differences in characteristics between migrants found and those not found (table 3), it is possible that these groups differ in other characteristics, some of which may be related to individual health; and they may also differ in health after migration (and they may have died at a higher rate than those found). These possible biases would affect our analysis of migration health selection and the impact of migration on health.

Future plans

The MHM will conduct a third wave of data collection, beginning in 2018. This data collection will follow the same approach as previous waves by interviewing all migrants formerly interviewed by the MHM and any individuals who moved out of the MLSFH sample area to another location within Malawi by 2018 (along with new spouses). In addition to this new data collection, we also intend to examine other research topics related to migration and health, including differences by age (specifically focusing on older respondents), for reproductive health measures and other health measures, distance of migration and the relationship between migration and transfers.

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Contributors HPK and PA initially conceived the manuscript. PA conducted the statistical analysis and wrote the first draft of the paper. HPK, LMT and MV reviewed the paper before submission and provided comments and edits.

Competing interests None declared.

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Data sharing statement Information about the MHM is available on the MLSFH project website at <https://malawi.pop.upenn.edu/>. Researchers interested in using MHM data that have not yet been made publicly available on the MLSFH website can submit a two-page description of their proposed analysis plan to the MHM Principal Investigator (mail to: panglewi@tulane.edu). If approved, researchers will then be asked to sign a Data Use Agreement to access and utilize the data. For comparisons of migrants and non-migrants, MHM data can be linked to the public use MLSFH data that can be requested at <https://malawi.pop.upenn.edu/malawidata-mlsfh>. All analyses of the restricted MHM data are conducted in collaboration with members of the MHM study team.

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