HHS Public Access

Author manuscript

Demogr Res. Author manuscript; available in PMC 2019 November 22.

Published in final edited form as:

Demogr Res. 2016 ; 34: 845–884. doi:10.4054/DemRes.2016.34.30.

Human capital on the move: Education as a determinant of internal migration in selected INDEPTH surveillance populations in Africa

Carren Ginsburg[1], **Philippe Bocquier**[2,1], **Donatien Béguy**[3], **Sulaimon Afolabi**[1], **Karim Derra**[5], **Orvalho Augusto**[4], **Mark Otiende**[7], **Frank Odhiambo**[6,12], **Pascal Zabré**[9], **Abdramane Soura**[8], **Michael J. White**[10,1], **Mark A. Collinson**[1,11,12]

[1]Medical Research Council/Wits Rural Public Health and Health Transitions Research Unit (Agincourt), School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa.

[2]Centre de Recherche en Démographie et Sociétés, Université Catholique de Louvain, Louvain-la-Neuve, Belgium.

[3]African Population and Health Research Centre, Nairobi, Kenya.

[4]Centro de Investigação em Saúde de Manhiça, CISM, Manhiça, Mozambique.

[5]Clinical Research Unit of Nanoro (CRUN), Nanoro, Burkina Faso.

[6]KEMRI & CDC − Centre for Global Health Research, Kisumu, Kenya.

[7]Kenya Medical Research Institute, Wellcome Trust Research Programme, Kilifi, Kenya.

[8]Institut Supérieur des Sciences de la Population (ISSP), Université de Ouagadougou, Burkina Faso.

[9]Centre de Recherche en Santé de Nouna, Nouna, Burkina Faso.

[10]Population Studies and Training Centre, Brown University, U.S.A.

[11]Umeå Centre for Global Health Research, Umeå University, Sweden.

[12]INDEPTH Network, Accra, Ghana.

Abstract

BACKGROUND—Education, as a key indicator of human capital, is considered one of the major determinants of internal migration, with previous studies suggesting that human capital accumulates in urban areas at the expense of rural areas. However, there is fragmentary evidence concerning the educational correlates of internal migration in sub-Saharan Africa.

OBJECTIVES—The study questions whether more precise measures of migration in Health and Demographic Surveillance System (HDSS) populations support the hypothesis that migrants are self-selected on human capital and more educated people are more likely to leave rural areas or enter urban areas within a geographical region.

METHODS—Using unique longitudinal data representing approximately 900,000 people living in eight sub-Saharan African HDSS sites that are members of the INDEPTH Network, the paper uses

Event History Analysis techniques to examine the relationship between formal educational attainment and in-and out-migration, over the period 2009 to 2011.

RESULTS—Between 7% and 27% of these local populations are moving in or out of the HDSS area over this period. Education is positively associated with both in-and out-migration in the Kenyan HDSS areas; however, the education effect has no clear pattern in the HDSS sites in Burkina Faso, Mozambique, and South Africa.

CONCLUSIONS—Empirical results presented in this paper confirm a strong age profile of migration consistent with human capital expectation, yet the results point to variability in the association of education and the propensity to migrate. In particular, the hypothesis of a shift of human capital from rural to urban areas is not universally valid.

1. Introduction

Migration of skilled individuals has received much attention amongst migration scholars and in policy discourses surrounding economic growth and development. Debate has focused on the consequences of such mobility on origin and destination locations (Clemens 2009; World Bank 2009; Gibson and McKenzie 2011), with theoretical and empirical research suggesting potential detrimental economic and development impacts of skilled out-migration on sending countries and regions. Although contemporary research on these issues has emphasised international migration, the majority of human population movements are observed to take place within national boundaries (Skeldon 2008). Such movements are often prompted by economic drivers and are considered to occur amongst the relatively better educated who relocate from a country's periphery to the bigger cities (Clemens 2009; World Bank 2009). This internal mobility of human capital may have significant consequences on a region's economic growth, service provision, and domestic policy; however, these internal population dynamics have been less researched. In sub-Saharan Africa, where economic growth and poverty reduction continue to be national priorities in the post-2015 United Nations development agenda, understanding the contemporary relationships between human capital and patterns of internal migration can help inform policy concerning labour force development, regional redistribution of resources, and urbanisation.

Across the African continent there is fragmentary evidence concerning the educational correlates of internal migration, and a paucity of data with which to unravel this relationship. Sub-Saharan African populations are dynamic and geographic mobility within these countries is high. While attention is generally focussed on the rural-urban migration stream, and particularly the movement from countryside to large cities, other types of geographic mobility, such as rural-to-rural or urban-to-rural movements, have also been observed (United Nations Population Division 2008). For instance, analysis of retrospective life history data from Ghana revealed that non-negligible fractions of interregional movers are urban-to-rural or rural-to-rural (Reed, Andrzejewski, and White 2010). Furthermore, internal migration in these settings is often temporary and circulation between subnational areas is common (Potts 2009). Drawing on the theory of migration selection (Lee 1966), studies of the relationships between human capital characteristics and internal migration have been premised on the assumption that education acts as a fundamental driver of movement, and

that the mobility of skills is inexorably from rural (less-developed) to urban (more-developed) areas (World Bank 2009). Mobility of skills in relation to other types of internal migration streams, such as urban-to-rural, have not generally been considered. Labour market theory holds that individuals with higher levels of human capital will migrate to enter the formal labour market (Harris and Todaro 1970), where the formal labour market is expected to function in a similar way in different contexts. However, in the sub-Saharan African context, where labour markets are segmented between the informal and formal sectors in varying proportions (De Vreyer and Roubaud 2013) and where there are large disparities in the levels and distribution of educational attainment, this generalisation may not hold nearly as tightly. Moreover, the tendency for studies to employ data highly aggregated by time and space (often by necessity) can serve to mask considerable differences in the ways in which human capital drives internal migration from setting to setting.

Given the important role of education in economic and social development (Tabutin and Schoumaker 2004), and given the fact that migrants are key participants in such development, it is important to examine these dynamics across different contexts. Governments and development agencies have recognised that policy interventions and resource allocation decisions are best based on a sound knowledge of population trends and processes (World Bank 2009). Furthermore, scholars have highlighted an urgent need for "co-ordinated, evidence-informed responses to migration" across the African region (Vearey 2014), thus calling for a broader and more consolidated perspective.

This paper aims to make a contribution to this knowledge gap. The paper uses longitudinal data from eight Health and Demographic Surveillance System (HDSS) sites in sub-Saharan Africa, located in both urban and rural areas in the West, East and Southern parts of the continent. The study undertakes analysis using more precise measures of migration in HDSSs, and in doing so provides a more rigorous test of the interrelated hypotheses that migrants are self-selected on education, that educational attainment is positively associated with out-migration from rural areas, and that more educated individuals are more likely to relocate to urban destinations. A comparative framework assists in examining these claims. The paper analyses and describes the two-way migration flows in relation to each HDSS area, and examines the relationship between internal migration and levels of human capital, as measured by educational attainment, in these multiple settings.

2. Literature review

2.1. Urbanisation and circulation in sub-Saharan Africa

The urban transition in sub-Saharan Africa has resulted in the rapid growth of cities and their surrounding territory. Furthermore, substantial increases in both the absolute urban population and the fraction of the population living in urban agglomerations is projected over the coming decades (United Nations Development Programme 2009; United Nations Population Fund 2010; United Nations Population Division 2014). Such high levels of urbanisation have led to a growing concern amongst policymakers about urban poverty generally (UN-Habitat 2013), depopulation of rural areas, and the ability of cities to sustain the demands placed by a growing urban population (Mabogunje 2007). However, the urban

expansion in sub-Saharan Africa has its own distinct features (White, Mberu, and Collinson 2008). Studies have suggested that reported rates of urbanisation are over-estimated and that increases in urbanisation are in fact occurring at a much slower rate than projected, and may even reverse (Bocquier 2005; Potts 2009). The sizable impact of natural increases on urban growth has been emphasised, while it has also been argued that the dominance of a rural–urban internal migration stream cannot be assumed in all settings (Tacoli 2008; Potts 2012). In particular, less permanent forms of urban settlement and high levels of circular mobility have been observed in the sub-Saharan African region (Potts 2009). For many originating from rural areas, urban residence is temporary and migration to the cities is employed as a livelihood strategy to maintain rural households to which they will ultimately return (White, Mberu, and Collinson 2008). These more temporary forms of migration and circulation are difficult to measure and are poorly documented or completely unmeasured in many regions. An examination of the patterns of internal migration and the social determinants of movement in different settings and with respect to different migration flows across sub-Saharan Africa would be of value in developing a broader understanding of these dynamics.

2.2. Determinants of internal migration

Migration is found to vary along the life course, and the life-cycle model, which posits a link between life-course transitions and patterns of movement, has been used as a basis for numerous studies of mobility (see Speare 1970; Sandefur and Scott 1981; Kulu and Milewski 2007). Migration patterns have commonly been described in relation to age, and scholars have noted that age profiles and movement behaviour are largely consistent across different populations (Courgeau 1985; Rogers 1988). In the sub-Saharan African context, migration has been found to follow a uni-modal distribution on age with peaks in early adulthood and declines upon exit from the labour market (Oucho and Gould 1993; Beauchemin and Bocquier 2004; Collinson 2009). Children participate in migration at early ages corresponding with movement of parents or caregivers (Long 1992; Collinson 2009; Madhavan et al. 2012). The regularities of migration by age vary for males and females due to differences in the timing of life-course events between the sexes (Rogers 1988). Females may move at younger ages in connection with marriage, while movements amongst males may be prompted by economic opportunities or employment (Agesa and Agesa 1999; Clark and Cotton 2013). Males may also be more likely to participate in return migration prompted by retirement or ill health (Collinson 2009).

A number of studies have considered how socio-demographic factors such as marriage, family structure, or cultural norms may influence migration. However, in the economic literature, educational attainment has been identified as a primary determinant of internal migration, particularly in the rural-to-urban direction (World Bank 2009). Economic theories of migration hold that skills flow to the place of highest return (Massey et al. 1993; World Bank 2009). Thus, educational attainment, representing an individual’s human capital, acts as an enabler of migration by improving employment opportunities and the likelihood of securing work. The theory of selection holds that migrants are most commonly positively selected on human capital characteristics with relatively higher levels of education and occupational status as compared with non-migrants of a particular population (Findley 1977; Speare and Harris 1986; Borjas, Bronars, and Trejo 1992; Chiswick 2000; Feliciano 2005).

Research has also shown a positive association between high-and low-skilled migration (Gibson and McKenzie 2011), suggesting that migration self-selection by level of skill may not be linear. The relationship is further complicated by the fact that educational aspirations may themselves drive movement and influence migration intentions as well as migration behaviour (De Jong and Fawcett 1981; De Jong 2000). Thus human capital acquisition may be both a driver and a consequence of movement. While anticipatory behaviour on the part of the (prospective) migrant may make it difficult to completely resolve issues of potential endogeneity, a clearer grasp of the endogeneity of migration and education decisions would be gained through an analysis platform that tracks individuals' educational transitions and migration events over time.

Notwithstanding these different theoretical perspectives, the study of migration and education produces results that are often divergent and inconsistent (Williams 2009). In sub-Saharan Africa, empirical evidence on the relationship between internal migration and human capital is fragmentary, having been conducted using a range of methodologies and data sources. Country-or area-specific studies, focused on analysing educational attainment and migration, have corroborated the relationship between mobility and the accumulation of skills in urban as opposed to rural areas (Brockerhoff and Eu 1993; Oucho and Gould 1993; Todaro 1997; Mberu 2005; Reed, Andrzejewski, and White 2010). African regional studies have offered insights into gender disparities in the education and migration relationship. In a study of eight sub-Saharan African countries, females with relatively higher levels of education were more likely to participate in rural-urban migration compared with females who were unschooled (Brockerhoff and Eu 1993), while a Kenyan study found the relationship between education and migration to be significant and positive for males (Agesa and Agesa 1999). A study of rural Ghana found that females with higher levels of education were more likely than males with the same educational attainment to migrate to urban areas, while males with higher levels of education were less likely to move to rural areas (Reed, Andrzejewski, and White 2010).

2.3. Contextual factors

Internal migration trends are also strongly influenced by factors related to a country or region's economic and structural context (Oucho 1998). Sub-Saharan African countries continue to experience widespread poverty and inequality, despite sustained economic growth across the region (United Nations Economic Commission for Africa 2013; World Bank 2013). Some parts of sub-Saharan Africa are marked by political instability, limited resources, and adverse climate conditions (World Bank 2013). With regards to the region's educational landscape, sub-Saharan Africa has seen an increase in enrolment rates in primary-level education; however, levels of secondary school enrolment and school completion rates remain low (UNESCO 2011; United Nations Economic Commission for Africa 2013). Adult literacy rates display strong regional variation, with levels falling below world averages in some settings (UNESCO 2008, 2011). Furthermore, significant gender disparities in educational attainment, school attendance, and adult literacy persist in some areas (Tabutin and Schoumaker 2004; UNESCO 2011; United Nations Economic Commission for Africa 2013). Educational attainment influences labour market participation and earnings, but this relationship is dependent on the labour market context. In sub-Saharan

Africa, labour markets may be predominantly informal or mainly formal, and the demand for skills will depend on these and other labour market characteristics (De Vreyer and Roubaud 2013). Participation in the urban informal sector requires a lower level of skills as compared with the urban formal sector, and this sector is particularly favoured by rural migrants (Todaro 1997). The ways in which these factors may impact on the distribution and mobility of skills has not been explored in many settings. While detailed contextual analysis requires rich, nationally representative data, a comparative analysis framework can provide some insight into the ways in which different labour market contexts may operate to shape the mobility pattern in urban and rural areas.

2.4 Data sources and constraints

Building a consolidated evidence base of the patterns and determinants of migration across Africa has been hampered by a lack of consistency in definitions, measures, timing, and analysis techniques. Censuses or Demographic and Health Surveys are the most common sources of data on internal migration in Africa at the national level, but these are conducted infrequently and in some countries not at all (Brockerhoff 1995; Potts 2008). These surveys collect data on migration status, which allows for comparisons to be drawn between in-migrants and non-migrants in a population, but they tend not to focus on migration events themselves. Population censuses are further designed to address more permanent forms of relocation occurring across larger spatial boundaries. These instruments may thus fail to identify frequent or temporary movements, or moves occurring over shorter distances between more homogeneous settlement areas. Cross-sectional data have additional limitations when applied to analyses of migration, due to the repeatable nature of movement over time (Oucho 1998), and considerable effort is required to reconcile such data (Bell et al. 2015). Furthermore, the emphasis on analyses of rural-urban flows in many internal migration studies may overlook the variety of circular movements and patterns of return migration that are being documented in smaller population-specific studies (Beguy, Bocquier, and Zulu 2010). Such small geographical areas may experience even more rapid change in local population dynamics as a result of in-or out-migration and circular mobility.

HDSSs have been developed in locations where population vital registration is poor or absent. The HDSS approach provides detailed, prospective, longitudinal data on demographic, health, and socio-economic dynamics within these geographically demarcated areas, usually the size of an administrative district. This is achieved by conducting a baseline census of the full population at the outset, with subsequent tracking of individual demographic events - births, deaths, in-and out-migrations - on an ongoing basis, at prescribed intervals within the study population. In contrast with cross-sectional migration measures that focus on in-migration status, HDSSs measure migration events over time. The HDSS also collects socio-economic measures including educational attainment from each member of the population at regular intervals. The HDSS platform therefore enables a detailed exploration of determinants of two-way migration flows and dynamics over time. These data offer an important perspective that cannot be attained using traditional survey and census methodologies.

To summarise, the literature reveals the following gaps in relation to the study of internal migration and education: 1) the emphasis on studies of determinants of migration in the literature has been on rural-to-urban movements, with much less focus on other migration streams; 2) the empirical literature on migration and education has tended to focus on educational attainment; however, many such studies have not been able to consider a gradient in level of education, and have not generally allowed for the analysis of education status at the time of the migration event (often using education at the time of a survey or census as a proxy); 3) migration data generally represent migration status rather than migration events - analysis of migration events has the advantage of incorporating a space and time dimension.

Against the background outlined, this paper aims to address the gaps in the literature discussed above by conducting a multi-centre analysis of dynamics of migration in relation to levels of human capital using HDSS data. The paper contributes reliable comparative findings on the selectivity of migrants in relation to education and will address the hypothesis, proposed in selection theory, that better-educated people will leave rural areas and enter urban areas within a geographical region with a common labour market context. The paper comprises two parts. The first part provides a description of the patterns of in- and out-migration by age and sex in each HDSS area. In so doing, the paper offers the opportunity to consider migration streams that are not commonly analysed in studies of internal migration. The second part of the paper examines the association between in- and out-migration and educational attainment by sex for each geographical area, in order to explore the flows of migration in relation to levels of human capital. The comparative aspect of the study provides some insights as to context, and, moreover, identifies an important platform on which to base future multi-country research on socio-economic and health outcomes associated with migration.

3. Methods

3.1. Study population

The findings presented in this paper are based on data from eight HDSS sites that are members of the International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH). The INDEPTH Network is an initiative that has brought together HDSS sites from low-and middle-income countries with the purpose of standardising data and techniques to enable cross-country comparative research (see Sankoh and Byass 2012 for more details concerning the methods and objectives of the INDEPTH organisation). The HDSS sites represented in the current analysis are clustered within three sub-Saharan African contexts, and they represent a mix of rural, semi-rural, and urban locations. The sites included in the study were selected to provide a set of illustrative contexts to explore the mechanisms of in- and out-migration in the West, East, and Southern regions of the continent. These are Nanoro, Nouna, and Ouagadougou in Burkina Faso; Kilifi, Kisumu, and Nairobi in Kenya; Manhiça in Mozambique, and Agincourt in South Africa (see Figure 1 for a map of the HDSS site locations). These HDSS sites are part of the Multi-centre Analysis of the Dynamics of Internal Migration And Health (MADIMAH) initiative within INDEPTH which commenced in 2011 with the aim of producing comparative studies on

questions concerning migration and health (Gerritsen et al. 2013). Necessary criteria for inclusion in MADIMAH were longitudinal updates of education status in the HDSS and a dedicated, local analytic team to work on this topic. The present study does not aim to cover all possible situations on the continent, or to produce a set of representative findings. The populations included in the study represent small sub-districts from which detailed longitudinal data are collected. These small areas offer situations that are illustrative of West, East, and Southern African sub-district populations that are diverse enough to highlight a range of mechanisms by which education may relate to in- and out-migration, across a continuum of (rural-urban) settlement types. Through detailed examination of the dynamics of these demarcated geographical areas, insights about local-level migration flows that operate within a region's labour market can be elicited.

A profile of the eight HDSS sites is outlined in Table 1. The Nairobi HDSS is the most densely populated of the HDSS sites, with Nouna having the lowest population density. The Kilifi and Kisumu HDSS sites in rural Kenya have the largest populations under surveillance. The HDSS sites also differ in relation to the contiguity of the population under surveillance: the two urban sites in Nairobi and Ouagadougou comprise non-contiguous areas, while the rural-based sites are all contiguous.

In order to provide some information on the context in which the sites are based, Table 2 presents a set of indicators of the four countries represented in the analyses. South Africa has the largest urban population of the four countries at 63% and the largest GDP per capita, while Kenya has the smallest proportion of people living in urban areas (24%), and Mozambique has the lowest GDP per capita (World Bank 2012a, 2012b). The Kenyan formal labour market employs approximately 18% of waged workers, with the remaining 82% of the work force employed in the informal sector (Kenya National Bureau of Statistics 2012; Tijdens and Wambugu 2012). However, in Nairobi, formal sector employment was estimated at approximately 88% of the city's labour force around the year 1999 (Bocquier et al. 2009), indicating that Nairobi concentrates most of the formal employment of the country's labour market. Of the four countries, South Africa has the largest formal labour market employing both skilled and unskilled labour. In South Africa as a whole, the formal sector (including agricultural and household employment) provides approximately 70% of all jobs (Statistics South Africa 2014). In Gauteng Province, South Africa's most densely populated urban centre, the formal sector employs approximately 85% of the labour force (Statistics South Africa 2014). In contrast, in urban Mozambique, formal sector employment is only 30% (Jones and Tarp 2013), but many Mozambican workers seek employment in the South African labour market as the countries have strong economic ties (Almeida-Santos, Roffarello, and Filipe 2014). Of the four countries represented, Burkina Faso has the smallest formal labour market nationally, employing only 5% of the workforce (Dayo 2014). In Ouagadougou, informal sector employment was estimated at approximately 73% of the labour force in 2001, a figure close to the mean (76%) for seven capital cities in French-speaking West Africa (Roubaud and Torelli 2013).

In relation to educational indicators, the level of adult literacy in Burkina Faso is substantially lower than in the other countries represented in the analyses, while the gender disparity in literacy levels in Mozambique is particularly high (UNICEF 2014). Furthermore,

school participation across the four countries is dissimilar, with high levels of school enrolment reported in South Africa and Kenya and relatively low levels of school participation evident in Mozambique and Burkina Faso (UNESCO 2008).

3.2 Variables

3.2.1 In- and out-migration—In the HDSS setting, information on migration of household members is gathered retrospectively at each data collection round. An out-migration event is recorded if a household member was absent from the household between the current data collection round and the preceding data collection round for a duration exceeding a specified time threshold. An in-migration event is confirmed if a household gained a new resident member for a minimum period of time between the current and preceding observations (Bocquier 2015). In-migrants may include both new residents to the HDSS area, or migrants returning to the HDSS following a period of absence.

Definitions of in- and out- migration may differ across HDSS sites in relation to the specified time thresholds used to determine HDSS membership (varying from 3 to 6 months of residence within the boundaries of the HDSS) (Adazu 2009). In order to achieve consistency across sites in this study, residency in an HDSS was standardised using the more conservative 6-month residency threshold. Therefore an in-migrant is an individual who has lived in the HDSS area for at least 6 months, while an out-migrant is someone who moved away from the HDSS area for at least 6 months between observation points.

Migration is defined in this study as a move that crosses the geographical boundaries of the HDSS site (in either an inward or an outward direction). Moves between households within the study area are recorded but discarded from the present migration analysis. Moves between households or locations not attached to the study areas are not recorded. Consequently, migration as analysed in this study excludes moves within the HDSS boundaries, moves for durations of less than 6 months into or outside of the HDSS area, and moves that occur between two locations situated outside of the HDSS site.

3.2.2 Educational attainment—Individual-level data representing educational attainment were collected for each site. In order to standardise measures of education across the HDSS sites, a variable representing educational attainment was derived from the site's own education status data. This variable contrasts those individuals who had no formal education with those who had either some primary or some secondary (or higher) levels of education. Given the different thresholds of education that are achievable in relation to age, the analysis of educational attainment and migration excludes children who would not yet have commenced schooling (0−4 years of age), as well as a school-aged group of children (aged 5−14 years) who would potentially be enrolled in the school system. This further limits the importance, in this study, of education-motivated migration related to access to primary-or secondary-level schooling. The analytical sample for the regression analysis of the migration-education relationship is therefore based on individuals aged 15 to 65 years who may be employed or seeking employment over the period of analysis. Educational attainment has been included in the analyses as a time-variant measure. In the HDSS setting, education data are usually collected less frequently than are regular event updates (such as

in- and out-migration), therefore an individual may in- and out-migrate before an education measure is collected. A category for missing education data was included in analyses to control for any bias that might be present in the models as a result of a missing education value being associated with other covariates – age and calendar year – in their effect on migration. The analyses were repeated excluding observations with missing education values (below 10% in all sites, except Kilifi with 18%) and the results found to be consistent with those obtained when observations with missing education values were included in the models (results not shown). The models that include the observations with missing education values are reported on in this paper: however, the effects for unknown levels of education are not displayed or interpreted. Significant hazard ratios for this category relate to the association between migration and response by a proxy respondent who might not know the level of education of the migrant they are reporting on.

3.3 Statistical analysis

The descriptive statistics and models were generated using Event History Analysis (EHA) techniques. This approach is appropriate for the examination of repeated events (such as migration) within the context of an individual's life course (Yamaguchi 1991; Kulu and Milewski 2007). Prior to commencing with EHA analyses, detailed data consistency and quality checks were conducted, and data were transformed into a biographical "residency episode" structure (see Gerritsen et al. 2013). This structure implies that events (including births, deaths, in- and out-migration, and education measures) for individuals are recorded sequentially and in continuous time (i.e., dates are attached to each event). The models allow for repeatable migration events over an individual's life course: thus individuals may contribute more than one migration event over time.

In this study the HDSS population is the population at risk in all analyses. This implies that both in- and out-migration rates are computed using the same population at risk, following standard procedures in migration analysis. The same applies to models of in- and out-migration: the relative risks are interpreted as the risks associated with in- or out-migration based on characteristics relative to those of the HDSS population. In the case of out-migration, the population at risk corresponds to the time contributed by individuals within the HDSS. When an individual leaves and re-enters the population through return migration, the individual is included in the population at risk from the time of re-entry until censoring. For in-migration, the denominator represents the population at risk of 'receiving' an in-migrant, and not the population from which the migrant originated. In order to analyse in-migration, analysis time is reversed from age 65 (the upper age limit of the analysis) until the occurrence of an in-migration event, or to birth/enumeration if no in-migration event occurs. In this way in- and out-migration analyses are symmetrical and easier to compare (see Beguy, Bocquier, and Zulu 2010 for further discussion of this method).

The analyses presented in this paper are based on the three years 2009–2011 for all sites, with the exception of Nanoro and Ouagadougou whose data were analysed from 1 January 2010. These two sites conducted their initial censuses in the year 2009 and complete migration data for this year are not available.

In- and out-migration rates were computed by 5-year age categories for each site, stratified by sex. Rates are expressed as the number of events (in- or out-migrations) divided by the person time of the population at risk, expressed in years (person years at risk, or PYAR). A set of Cox semi-parametric proportional hazards models was produced for each site in order to examine formal educational attainment as a determinant of in- and out-migration. These models control for age in the non-parametric part of the Cox model and calendar year as covariates. Models were stratified by sex to control for gender compositional effects in the patterns of in- and out-migration and educational attainment. All analyses were performed using STATA version 13.

4. Results

4.1 Sample characteristics

The characteristics of the analytical samples from each HDSS site are presented in Table 3. These frequency distributions have been derived using person-years over the period of analysis, and thus they represent the total exposure to migration for the site populations. For each site, the exposure of the population at risk is documented by categories of gender, calendar year, and educational attainment. Amongst the Burkina Faso sites, the gender composition (of the person-years observed) is roughly equal, with the exception of Nanoro, which has a majority of females in the population (65%). In Kenya, the Nairobi HDSS is 58% male, while the rural sites have a higher female representation (55%). The two Southern African sites comprise approximately 60% female residents over the period. The largest proportion of residents in the Burkina Faso HDSS sites had no formal education over the time period (75%, 69%, and 38% of the resident populations of Nanoro, Nouna, and Ouagadougou respectively). In contrast, the highest proportion of individuals in the Kenyan and Mozambican HDSSs had achieved some primary education (48%, 66%, 61%, and 59% of the resident populations of Kilifi, Kisumu, Nairobi, and Manhiça respectively). Within the Agincourt HDSS, the majority of individuals (75%) reported some secondary-level education over the period. For all sites, the exposure by calendar year was roughly evenly distributed. Individuals with unknown education values ranged from approximately 2% to 10% of the sample for all sites, with the exception of the Kilifi HDSS, where education level was unknown for 18% of the sample.

4.2 In- and out-migration rates by age and sex

In order to provide a foundation for understanding the relationship between migration and education, age-specific in- and out-migration rates for each site are presented in Figures 2 and 3, with rates for males and females shown in separate figures. An inspection of the rates of out-migration by site indicates that between 7 and 21 per 100 PYAR of these local populations are moving over the period, however, the rates vary substantially by age group. Out-migration rates across all sites reach a peak in early adult years (ages 15–29) for both males and females. The rates for in-migration are of a similar magnitude to those of out-migration, with between 7 and 27 per 100 PYAR of individuals in-migrating over the period. The age distribution of in-migration resembles that of out-migration, with movement occurring most frequently between ages 15–29.

4.2.1 West African sites—Among the sites in Burkina Faso, approximately 21 per 100 PYAR of 20–24 year-old females are observed to migrate out of the Ouagadougou HDSS. Out-migration from the rural sites reaches as high as 37 per 100 PYAR amongst 20–24 year-old males moving from the Nanoro site, while the lowest rate of out-migration (13 per 100 PYAR) is observed amongst males aged 20–24 from Nouna. The rates of in-migration into the Ouagadougou site are relatively high in early adulthood, with 13 and 18 per 100 PYAR of 20–24 year-old males and females respectively entering this urban area. The rate of in-migration amongst females entering the Nouna HDSS exceeds that of males, with 24 per 100 PYAR of in-migration occurring amongst 15–19 year-old females.

4.2.2 East African sites—Amongst the HDSS sites in Kenya, rates of mobility reach as high as 31 per 100 PYAR of 20–24 year-old females out-migrating from the Nairobi HDSS, with 27 per 100 PYAR of similar-aged males out-migrating from this HDSS. The modal rates of out-migration from the Kilifi and Kisumu HDSSs are observed between the ages of 20–24, with 27 and 20 per 100 PYAR of males and 26 and 23 per 100 PYAR of females within this age group moving out of these HDSS sites respectively. The Nairobi HDSS exhibits the highest ratio of in-migration of all sites over the period, with approximately 43 per 100 PYAR of males and females aged 20–24 entering the HDSS area. This is consistent with Nairobi occupying a position as a major urban destination. The Kisumu HDSS experiences the lowest rates of in-migration of the Kenyan HDSSs in the study.

4.2.3 Southern African sites—Of the two Southern African HDSS sites, Agincourt in South Africa displays the higher rates of mobility. Rates of out-migration amongst males and females aged 20–24 moving from Agincourt are 27 and 24 per 100 PYAR respectively. Rates of in-migration are particularly high with 34 per 100 PYAR of 30–34 year-old males entering the area. Low relative rates of in- and out-migration are observed in Manhiça. Out-migration amongst both males and females peaks between ages 20–24 at approximately 19 and 15 per 100 PYAR respectively, while in-migration within this age range is 16 and 13 per 100 PYAR amongst males and females.

The age-sex profiles highlight the prevalence of both in- and out-migration flows in relation to both urban and rural HDSS areas. Intensity of migration differs little by gender, with few exceptions. The age patterns conform to the expected, and emphasise that young adults are the most active part of the population and have a greater propensity to migrate.

4.3 Determinants of migration: Cox proportional hazards models

The Cox proportional hazards models of in- and out-migration are presented by site for West, East and Southern African regions respectively, and stratified by sex. The models explore education as a determinant of in- and out-migration, controlling for calendar year and age (see the full models in Tables A-1, A-2, and A-3 of the Appendix). The coefficients and corresponding hazard ratios of the education variable are presented in Figures 4–6. Results are interpreted in terms of relative risk using the hazard ratios, where the reference category is males or females with no formal education.

4.3.1 West African sites—In the Ouagadougou HDSS, education, for both sexes, is a significant but weak determinant of migration to or from the study area. In this mix of slum and non-slum urban areas, educational attainment is in fact negatively associated with both in- and out-migration for both sexes. For instance, males and females who had achieved some secondary schooling have a 22% and 32% lower risk of in-migration compared with those in the resident population who have no formal education (hazard ratios of 0.78 and 0.68 respectively). The rural perspective illustrated in the Nanoro and Nouna models helps to refine the Burkina Faso urban perspective on human capital distribution.

In the Nanoro site in Burkina Faso the primary-level educated are generally those who are less likely to migrate, with education following a J-shaped distribution. Females with some secondary schooling have the highest risk of in- or out-migrating from Nanoro (hazard ratios indicate 1.65 times higher risk of in-migration and 1.41 times the risk of out-migration relative to the existing population), in contrast to those with no education, and even more so compared to those with primary education.

The J-shape apparent in the Nanoro site is also seen in the Nouna HDSS, except in the case of female out-migration, where levels of primary and secondary education do not display much difference. Thus males with secondary schooling have a 1.98 times higher risk of out-migration and 1.46 times higher risk of in-migration relative to those in the population who are unschooled, while the estimated hazard ratio of secondary- schooled females out-migrating from the Nouna HDSS is 1.35, indicating positive selection on education.

4.3.2 East African sites—The Cox regression models of the Nairobi HDSS reveal a strong positive association between both in- and out-migration and education in the slums. Males and females with some secondary schooling have 2.55 and 3.29 times the risk of out-migration compared to those with no schooling. Primary and secondary levels of education are even stronger predictors of in-migration, with males and females displaying 4.65 and 6.65 times the risk of in-migrating into the Nairobi HDSS relative to those residents in the HDSS with no formal education. The hazard ratio of 6.65 represents the largest observed effect of human capital on migration propensity in this study. Given the higher coefficients for secondary schooling in the models, it appears that secondary-level-educated individuals circulate more than individuals with primary-level education.

In the Kilifi HDSS, the positive association between education and in- and outmigration is apparent amongst females only. Females with some secondary schooling have 1.98 times the risk of in-migrating into Kilifi and 1.58 times the risk of out- migrating from this HDSS relative to those HDSS residents reporting no formal education. In the Kisumu HDSS the positive relationship between migration and education is evident amongst both males and females, with the effect of secondary education exceeding that of primary-level education. For example, the risk of secondary-educated males and females out-migrating from Kisumu is 1.40 and 1.42 times the risk of out-migration amongst those with no formal education.

4.3.3 Southern African sites—Amongst the two Southern African sites, education does not appear to be strongly associated with either in- or out-migration. The estimated hazard ratio for out-migration amongst females is 1.37 times higher for the primary-

educated leaving the Manhiça HDSS as compared to those with no formal education, while primary-educated females have a 1.15 times higher risk of moving out of Agincourt as compared to those reporting no schooling.

5. Discussion

This is the first multi-country comparative study of education as a determinant of internal migration based on longitudinal data from multiple HDSS sites in Africa. The study employs longitudinal analysis techniques, applied to migration data that have been standardised across eight HDSS sites to allow for the systematic comparison between the sites. These data are unique in allowing for in- and out-migration events to be measured simultaneously and with temporal accuracy for the full population of a district.

Age is central to the human capital argument, as younger individuals have more years in which to benefit from human capital differentials and should therefore be more likely to move (Schwartz 1976). Thus the first aim of this paper is to contribute comparative evidence on the patterns of in- and out-migration by age and sex from sub-district populations represented by eight HDSS centres in sub-Saharan Africa. Indeed, the age profiles confirm that in these study populations, young adults are particularly likely to migrate, just as has been found repeatedly in other settings.

Previous studies of internal migration in sub-Saharan Africa have emphasised high levels of internal mobility, in particular in a rural-to-urban direction; however, these studies have not had the temporal detail available when using HDSS data. The findings of the present study corroborate these trends by demonstrating high levels of both in- and out-migration occurring amongst males and females, particularly during the young adult years. Thus, empirical evidence of two-way flows is a contribution of this paper. Migration literature on sub-Saharan Africa has further highlighted differential patterns of migration by sex and has emphasised the feminisation of migration streams (Cross et al. 2006; Adepoju 2008). This trend is apparent in relation to the HDSS populations observed here.

The results of this study are further able to offer insight into patterns of circulation. Scholars have commented upon the distinctiveness of this pattern relative to that of permanent migration, however, measurement challenges have prevented conclusive systematic evidence from emerging in published literature. The HDSS provides an opportunity to empirically evaluate simultaneously in- and out-flows during sub-annual periods of time. By documenting the levels of in- and outflow to and from the HDSS populations, the present set of analyses show bi-directional and reasonably balanced patterns of mobility that are consistent with high circulation.

The paper’s second aim is to explore migrant selectivity by examining the relationship between internal migration and levels of human capital as measured by educational attainment, in eight HDSS sites situated in West, East, and Southern Africa. The different regions present contrasting pictures. In the Ouagadougou HDSS in urban Burkina Faso there is no evidence of positive selectivity in relation to education and in- or out-migration. This is consistent with the labour market context in the country. In Burkina Faso, migration is

potentially less visibly labour-market-driven due to the dominance of the informal economy and hence there is a weaker expected connection between human capital (as indicated by education) and migration (International Monetary Fund 2012; De Vreyer and Roubaud 2013). Conversely, more-highly educated individuals do not migrate out of the city due to limited opportunities elsewhere and a lack of incentive to move. Of the two rural Burkina Faso sites investigated, migration is positively selected on education where individuals have achieved some secondary or higher levels of schooling. The positive relationship between migration from rural areas of Burkina Faso to the cities and higher educational attainment has been demonstrated in another study (Beauchemin and Schoumaker 2005). Such migration has been linked to individuals seeking employment or further study opportunities outside of these HDSS areas. However, the effect of primary-level education appears to be negatively selected on in- and out-migration, while people with no education are situated somewhere between the primary- and the secondary-educated. The education-migration relationship is not linear and follows roughly a J-shape in these rural Burkina Faso HDSS areas.

Conversely, in the Kenyan HDSS sites under observation there is evidence of positive selection on migration and education. This reflects the fact that migration within this country is formal-sector-driven (Bocquier et al. 2009). In Nairobi, migration is highly positively selected upon education level, and skills accumulate in the urban area. This is consistent with a study on the determinants of in- and out-migration in the Nairobi HDSS between 2003 and 2007, which found the same positive association as the present study, only weaker due to the inclusion of a number of other social and economic characteristics (Beguy, Bocquier, and Zulu 2010). A study of migrants entering Kisumu city found that males migrate to find employment (Clark and Cotton 2013), while Kilifi experiences higher circulation of educated females that is expected to relate to economic drivers.

The Southern African HDSS sites suggest that mobility is not selected on education levels. This is corroborated by other studies commenting on rural-to-urban migration of the South African black population (Clarke and Eyal 2013; Reed 2013). The out-migration reflected in the Agincourt HDSS relates to unskilled employment, with male out-migrants often taking up jobs in the mining sector and females frequently moving to take up employment as domestic workers (Collinson 2010). Agincourt in-migration has been identified as return migration, where migrants who have become ill in urban areas return home to receive care from family members (Clark et al. 2007). Approximately 30% of the Agincourt HDSS population comprises former Mozambican refugees who relocated to South Africa in the late 1980s as a result of civil war. Research has produced evidence of substantial assimilation amongst former Mozambican refugees, with former refugees now considered to be self-selected immigrants who display similar patterns of migration to that of the South African Agincourt population (Collinson 2010). Migration from Manhiça has been linked to work in the mining or agricultural sectors. It is well documented that this region is dominated by employment opportunities in South African mines and in industry. These trends can be explained as a corollary of a historical pattern whereby government policies encouraged labour migration of males but discouraged relocation of families at these places of employment (Crush 2000). The size and structure of the South African formal labour market creates demand for both skilled and unskilled labour within the region. Taken together, these

various contextual features may serve to weaken the conventional relationship between education and migration.

The study shows that with respect to most of the HDSS sites analysed, educated female migration is an important flow. Female migration is usually not conceived of as being driven by education levels to the same extent as male migration, with women sometimes accompanying men to their workplace locations, moving for marriage, or relocating to care for other family members such as an older relative (Collinson 2009; Beguy, Bocquier, and Zulu 2010). However, in the Nairobi slums as well as in the HDSS sites in rural Kenya and Burkina Faso, educational attainment predicts a greater propensity to migrate for females compared to males. This corroborates findings from a study of rural Ghana (Reed, Andrzejewski, and White 2010), which may indicate a shift towards increased employment opportunities for educated women in certain labour market contexts.

The study allows for certain inferences to be made about how relationships between education and migration may diverge in different contexts. By examining a set of HDSS sites in three different parts of the continent it is possible to observe within- country similarities and across-country differences. One may consider whether these across-country differences may be attributed to contextual factors such as the phase in a country's migration system development, the economic opportunities in a country at a given time, or the different overall education levels within a country. The processes of transition and development across different parts of sub-Saharan Africa are not homogenous (Tabutin and Schoumaker 2004) and the present study reinforces this.

The results of the study highlight some useful directions for further research, while certain study limitations should also be noted. In order to allow for comparability across diverse regions and to bridge modest variations in data collection methodologies, it was necessary to sacrifice some detail in the data and exclude some measures from the models. In particular, education in the models is not only measuring human capital, net of other dimensions, but is also a proxy for other unobserved socio-economic covariates. Therefore the effects observed in relation to education may be confounded with other covariates (such as occupational status, marital status, socio-economic status, etc.). It is envisaged as part of the MADIMAH initiative that HDSS sites will follow up on this paper with site-specific analyses, which would allow for the inclusion of more detailed measures of human capital and socio-economic context and thus add more depth to the study of human capital and internal migration dynamics. Building on this foundation, the MADIMAH project has commenced a second phase of multi-centre research on the health outcomes associated with migration.

In most parts of sub-Saharan Africa the measurement of demographic phenomena must often resort to estimates or models; however, HDSS data allows for the direct calculation of population-based statistics (Streatfield et al. 2014). HDSSs thus provide a unique and valuable source of detailed migration data. Such longitudinal data provide complementary insights on active migration patterns that can be interpreted alongside national-level or cross-sectional findings, and macro-level economic trends. For example, future research based on census data may add value by exploring how specific contextual variables impact the

migration matrix in different countries or regions. To note, the results of this study generally converge with studies at national or capital city levels where available.

In conclusion, this paper offers a unique perspective on the selectivity of migrants in relation to education in sub-Saharan Africa. The analysis presented provides an empirical foundation from which to unpack whether the higher-educated necessarily leave rural areas or enter urban areas, as implied in the migration selection literature. In some contexts this seems to be the case, particularly when urban labour markets are able to use the education endowments of the in-migrants. The three triangulated points of the data in Kenya highlight this. However, in contexts where the formal labour market does not support large proportions of skilled workers and the rural education infrastructure is under-developed, there appears to be less association and even a negative association between migration and education. This is evident in the Burkina Faso case studies. Southern Africa presents a different scenario, where the socioeconomic history of labour migration and consequent rural impoverishment has produced a unique set of factors. Under-developed rural education systems coupled with a labour economy that supports a combination of skilled and unskilled employment opportunities has resulted in high levels of labour migration that are not determined by education level.

The study approach demonstrates the benefits of temporal and directional data on migration. At the same time, the results challenge some commonly held generalities about rural-urban migration, at least as applies to several African regions. While age and education continue to be implicated in determining migration patterns, the way in which human capital (through education) unfolds in the migratory process depends on the context. Thus the study concludes that the hypothesis that more-educated people are more likely to leave rural areas or accumulate in urban areas is not universally valid. Lastly, the results point optimistically to the knowledge that can be gained by careful population monitoring with HDSS at the district or sub-district level.

6. Acknowledgements

We greatly value the contribution of each participating HDSS centre in providing data for this multi-centre study (see details below). The Multi-centre Analysis of the Dynamics of Internal Migration And Health (MADIMAH) project has received funds from the Swedish International Development Agency (Sida: 2012–000379), the National Research Foundation, South Africa, the Wallonia-Brussels Federation of Belgium and the INDEPTH Secretariat. We further acknowledge institutional support from the School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, South Africa; Centre de Recherche en Démographie et Sociétés, Université Catholique de Louvain, Louvain-la-Neuve, Belgium; and the African Population and Health Research Centre, Nairobi, Kenya, as critical bases for the MADIMAH project leadership. We gratefully acknowledge the South African Medical Research Council (SAMRC) and the University of the Witwatersrand Research Committee for funding Carren Ginsburg's Career Development Award. Michael White's participation in this publication was made possible with help from the Lifespan/Tufts/Brown Center for AIDS Research (Grant No: P30AI042853).

The Nanoro HDSS (CRUN) is grateful to the Malaria Clinical Trial Alliance (MCTA) and the Institute of Tropical Medicine, Antwerp, through the Belgian Cooperation, for their financial support. The Nouna HDSS wish to acknowledge the Ministry of Health Burkina Faso, the Ministry of Research of the State of Baden-Württemberg and the Institute of Public Health of Heidelberg. The Ouagadougou HDSS extends thanks to the Wellcome Trust (Grant No: WT081993MA) for their support. The Kilifi HDSS acknowledges the Wellcome Trust for funding data collection activities. The Nairobi Urban HDSS (NUHDSS) would like to acknowledge the Rockefeller Foundation (USA), the Wellcome Trust (UK), the William and Flora Hewlett Foundation (USA), Comic relief (UK), Swedish International Development Cooperation (SIDA) and the Bill and Melinda Gates Foundation (USA). The Agincourt HDSS gratefully acknowledges the Wellcome Trust, UK, (Grants 058893/Z/99/A; 069683/Z/02/Z; 085477/Z/08/Z),

The William and Flora Hewlett Foundation, National Institute on Aging (NIA) of the NIH, and The Andrew W Mellon Foundation, USA.

References

Adazu K (2009). Health and demographic surveillance migration methodology and data: A promise for cross-site comparative analyses In: Collinson M, Adazu K, White M, and Findley S (eds.). The dynamics of migration, health and livelihoods. Indepth Network perspectives. Surrey: Ashgate: 19−32.

Adepoju A (2008). Migration in sub-Saharan Africa. Sweden: Nordic Africa Institute, Current African Issues 37.

Agesa J and Agesa RU (1999). Gender differences in the incidence of rural to urban migration: Evidence from Kenya. Journal of Development Studies 35(6): 36–59. doi: 10.1080/00220389908422601.

Almeida-Santos A, Roffarello LM, and Filipe M (2014). Mozambique 2014 [electronic resource] African Economic Outlook. http://www.africaneconomicoutlook.org/en/countries/southern-africa/mozambique/

Beauchemin C and Bocquier P (2004). Migration and urbanisation in Francophone West Africa: An overview of the recent empirical evidence. Urban Studies 41(11): 2245–2272. doi: 10.1080/0042098042000268447.

Beauchemin C and Schoumaker B (2005). Migration to cities in Burkina Faso: Does the level of development in sending areas matter? World Development 33(7): 1129–1152. doi: 10.1016/j.worlddev.2005.04.007.

Beguy D, Bocquier P, and Zulu EM (2010). Circular migration patterns and determinants in Nairobi slum settlements. Demographic Research 23(20): 549–586. doi:10.4054/DemRes.2010.23.20.

Bell M, Charles-Edwards E, Ueffing P, Stillwell J, Kupiszewski M, and Kupiszewska D (2015). Internal migration and development: Comparing migration intensities around the world. Population and Development Review 41(1): 33–58. doi:10.1111/j.1728-4457.2015.00025.x.

Bocquier P (2005). World urbanization prospects: An alternative to the UN model of projection compatible with the mobility transition theory. Demographic Research 12(9): 197–236. doi: 10.4054/DemRes.2005.12.9.

Bocquier P, Agwanda A, Khasakhala A, Nyandega I, and Owuor S (2009). Biography of three generations of Nairobi residents - thirty years of social urban history. Dakar: Codesria.

Bocquier P (2015). Migration analysis using demographic surveys and surveillance systems In: White MJ (ed.). International handbook of migration and population distribution. Dordrecht: Springer: 205–224.

Borjas GJ, Bronars SG, and Trejo SJ (1992). Self-selection and internal migration in the United States. Journal of Urban Economics 32(2): 159–185. doi:10.3386/w4002. [PubMed: 12345051]

Brockerhoff M and Eu H (1993). Demographic and socioeconomic determinants of female rural to urban migration in sub-Saharan Africa. International Migration Review 27(3): 557–577. doi: 10.2307/2547100. [PubMed: 12289973]

Brockerhoff M (1995). Child survival in big cities: The disadvantages of migrants. Social Science & Medicine 40(10): 1371–1383. doi:10.1016/0277-9536(94)00268-X. [PubMed: 7638646]

Chiswick BR (2000). Are immigrants favourably self-selecetd? An economic analysis In: Brettell CB and Hollifield JF (eds.). Migration theory: Talking across disciplines. New York: Routledge: 63–82.

Clark S and Cotton C (2013). Transitions to adulthood in urban Kenya: A focus on adolescent migrants. Demographic Research 28(37): 1053–1092. doi:10.4054/DemRes.2013.28.37.

Clark SJ, Collinson MA, Kahn K, Drullinger K, and Tollman SM (2007). Returning home to die: Circular labour migration and mortality in South Africa. Scandinavian Journal of Public Health 69(Suppl): 35–44. doi:10.1080/14034950701355619. [PubMed: 17676501]

Clarke R and Eyal K (2013). Microeconomic determinants of spatial mobility in post-apartheid South Africa: Longitudinal evidence from the National Income Dynamics Study. Development Southern Africa 31(1): 168–194. doi:10.1080/0376835X.2013.857592.

Clemens M (2009). Skill flow: A fundamental reconsideration of skilled-worker mobility and development. Washington DC: Center for Global Development, CGD Working Paper 180.

Collinson M (2009). Age-sex profiles of migration: Who is a migrant? In: Collinson M, Adazu K, White M, and Findley S (eds.). The dynamics of migration, health and livelihoods. Indepth Network perspectives. Surrey: Ashgate: 49–62.

Collinson MA (2010). Striving against adversity: The dynamics of migration, health and poverty in rural South Africa. Global Health Action 3: 5080. doi:10.3402/gha.v3i0.5080.

Courgeau D (1985). Interaction between spatial mobility, family and career life-cycle: A French survey. European Sociological Review 1(2): 139–162.

Cross C, Omoluabi E, Oucho JO, and Kamunga Cibangu F (2006). Synthesis and conclusions: What are Africa's issues in migration? In: Cross C, Gelderblom D, Roux N, and Mafukidze J (eds.). Views on migration in sub-Saharan Africa: Proceedings of an African Migration Alliance workshop. Pretoria: HSRC Press: 245–289.

Crush J (2000). Migrations past: An historical overview of cross-border movement in Southern Africa In: McDonald DA (ed.). On Borders: Perspectives on international migration in Southern Africa. New York: St Martin's Press: 12–24.

Dayo T (2014). Burkina Faso 2014 [electronic resource]. African Economic Outlook. http://www.africaneconomicoutlook.org/en/countries/west-africa/burkina-faso/

De Jong GF and Fawcett JT (1981). Motivations for migration: An assessment and a value-expectancy research model In: De Jong GF and Gardner RW (eds.). *Migration decision making.* New York: Pergamon: 13–58. doi:10.1016/B978-0-08-026305-2.50008-5.

De Jong GF (2000). Expectations, gender, and norms in migration decision-making. Population Studies 54(3): 307–319. doi:10.1080/713779089. [PubMed: 28489514]

De Vreyer P and Roubaud F (2013). Urban labor markets in sub-Saharan Africa. Washington DC: World Bank Publications, Africa Development Forum series. doi:10.1596/978-0-8213-9781-7.

Derra K, Rouamba E, Kazienga A, Ouedraogo S, Tahita MC, Sorgho H, Valea I, and Tinto H (2012). Profile: Nanoro Health and Demographic Surveillance System. International Journal Epidemiology 41(5): 1293–1301. doi:10.1093/ije/dys159.

Emina J, Beguy D, Zulu EM, Ezeh AC, Muindi K, Elung'ata P, Otsola JK, and Ye Y (2011). Monitoring of health and demographic outcomes in poor urban settlements: Evidence from the Nairobi Urban Health and Demographic Surveillance System. Journal of Urban Health 88(Suppl 2): S200–S218. doi: 10.1007/s11524-011-9594-1. [PubMed: 21713553]

Feliciano C (2005). Educational selectivity in U.S. immigration: How do immigrants compare to those left behind? Demography 42(1): 131–152. doi:10.1353/dem.2005.0001. [PubMed: 15782899]

Findley SE (1977). Planning for internal migration: A review of the issues and policies in developing countries. Washington DC: Government Printing Office, International Research Document No. 4.

Gerritsen A, Bocquier P, White M, Mbacke C, Alam N, Beguy D, Odhiambo F, Sacoor C, Phuc HD, Punpuing S, and Collinson MA (2013). Health and Demographic Surveillance Systems: Contributing to an understanding of the dynamics in migration and health. Global Health Action 6: 21496. doi:10.3402/gha.v6i0.21496. [PubMed: 23849188]

Gibson J and McKenzie D (2011). Eight questions about brain drain. Journal of Economic Perspectives 25(3): 107–128. doi:10.1596/1813-9450-5668.

Harris JR and Todaro MP (1970). Migration, unemployment and development: A two-sector analysis. The American Economic Review 60(1): 126–142.

International Monetary Fund (2012). Burkina Faso: Strategy for accelerated growth and sustainable development 2011−2015. Washington DC: International Monetary Fund Publication Services.

Jones, S. and Tarp, F. (2013). Jobs and welfare in Mozambique. WIDER, Working Paper No. 2013/045.

Kahn K, Collinson MA, Gomez-Olive FX, Mokoena O, Twine R, Mee P, Afolabi SA, Clark BD, Kabudula CW, Khosa A, Khoza S, Shabangu MG, Silaule B, Tibane JB, Wagner RG, Garenne ML, Clark SJ, and Tollman SM (2012). Profile: Agincourt Health and socio-Demographic Surveillance System. International Journal of Epidemiology 41(4): 988–1001. doi:10.1093/ije/dys115. [PubMed: 22933647]

Kenya National Bureau of Statistics (2012). Kenya facts and figures 2012. Nairobi: Kenya National Bureau of Statistics.

Kulu H and Milewski N (2007). Family change and migration in the life course: An introduction. Demographic Research 17(19): 567–590. doi:10.4054/DemRes.2007.17.19.

Lee ES (1966). A theory of migration. Demography 3(1): 47–57. doi:10.2307/2060063.

Long LH (1992). Changing residence: Comparative perspectives on its relationship to age, sex, and marital status. Population Studies 46(1): 141–158. doi:10.1080/0032472031000146056.

Mabogunje AL (2007). Global urban poverty research: The African case. Washington DC: Woodrow Wilson International Center for Scholars, Urban Update No. 10.

Madhavan S, Schatz E, Clark S, and Collinson M (2012). Child mobility, maternal status, and household composition in rural South Africa. Demography 49(2): 699–718. doi:10.1007/s13524-011-0087-3. [PubMed: 22271363]

Massey DS, Arango J, Hugo G, Kouaouci A, Pellegrino A, and Taylor JE (1993). Theories of international migration: A review and appraisal. Population and Development Review 19(3): 431–466. doi:10.2307/2938462.

Mberu BU (2005). Who moves and who stays? Rural out-migration in Nigeria. Journal of Population Research 22(2): 141–161. doi:10.1007/BF03031826.

Odhiambo FO, Laserson KF, Sewe M, Hamel MJ, Feikin DR, Adazu K, Ogwang S, Obor D, Amek N, Bayoh N, Ombok M, Lindblade K, Desai M, ter Kuile F, Phillips-Howard P, van Eijk AM, Rosen D, Hightower A, Ofware P, Muttai H, Nahlen B, DeCock K, Slutsker L, Breiman RF, and Vulule JM (2012). Profile: The KEMRI/CDC Health and Demographic Surveillance System - Western Kenya. International Journal of Epidemiology 41(4): 977–987. doi:10.1093/ije/dys108. [PubMed: 22933646]

Oucho JO and Gould WTS (1993). Internal migration, urbanization, and population distribution In: Foote KA, Hill K, and Martin LG (eds.). Demographic change in sub-Saharan Africa. Washington DC: National Academy Press: 256–296.

Oucho JO (1998). Recent internal migration processes in sub-Saharan Africa; determinants, consequences, and data adequacy issues In: Bilsborrow RE (ed.). Migration, urbanization and development: New directions and issues. New York: UNPF/Kluwer Academic Publishers: 89–120. doi:10.1007/978-94-011-4852-8_3.

Potts D (2008). Recent trends in rural-urban and urban-rural migration in sub-Saharan Africa: The empirical evidence and implications for understanding urban livelihood insecurity. London: King's College London, Environment, Politics and Development Working Paper Series 6.

Potts D (2009). The slowing of sub-Saharan Africa's urbanization: Evidence and implications for urban livelihoods. Environment and Urbanization 21(1): 253–259. doi:10.1177/0956247809103026.

Potts D (2012). Whatever happened to Africa's rapid urbanisation? World Economics 13(2): 17–29.

Reed HE, Andrzejewski CS, and White MJ (2010). Men's and women's migration in coastal Ghana: An event history analysis. Demographic Research 22(25): 771–812. doi:10.4054/DemRes.2010.22.25.

Reed HE (2013). Moving across boundaries: Migration in South Africa, 1950–2000. Demography 50(1): 71–95. doi:10.1007/s00027-012-0273-4. [PubMed: 22956415]

Rogers A (1988). Age patterns of elderly migration: An international comparison. Demography 25(3): 355–370. doi:10.2307/2061537. [PubMed: 3234573]

Rossier C, Soura A, Baya B, Compaore G, Dabire B, Dos Santos S, Duthe G, Gnoumou B, Kobiane JF, Kouanda S, Lankoande B, Legrand T, Mbacke C, Millogo R, Mondain N, Montgomery M, Nikiema A, Ouili I, Pison G, Randall S, Sangli G, Schoumaker B, and Zourkaleini Y (2012). Profile: The Ouagadougou Health and Demographic Surveillance System. International Journal of Epidemiology 41(3): 658–666. doi:10.1093/ije/dys090. [PubMed: 22685112]

Roubaud F and Torelli C (2013). Employment, unemployment and working conditions in urban labor markets of sub-Saharan Africa: Main stylized facts In: de Vreyer P and Roubaud F (eds.). Urban labor markets in sub-Saharan Africa. Washington DC: World Bank: 37–79. doi:10.1596/9780821397817_ch01.

Sacarlal J, Nhacolo AQ, Sigauque B, Nhalungo DA, Abacassamo F, Sacoor CN, Aide P, Machevo S, Nhampossa T, Macete EV, Bassat Q, David C, Bardaji A, Letang E, Saute F, Aponte JJ, Thompson R, and Alonso PL (2009). A 10 year study of the cause of death in children under 15 years in Manhica, Mozambique. BMC Public Health 9: 67. doi:10.1186/1471-2458-9-67. [PubMed: 19236726]

Sandefur GD and Scott WJ (1981). A dynamic analysis of migration: An assessment of the effects of age, family and career variables. Demography 18(3): 355–368. doi:10.2307/2061003. [PubMed: 7262373]

Sankoh O and Byass P (2012). The INDEPTH Network: Filling vital gaps in global epidemiology. International Journal of Epidemiology 41(3): 579–588. doi:10.1093/ije/dys081. [PubMed: 22798690]

Schwartz A (1976). Migration, age, and education. Journal of Political Economy 84(4): 701–719. doi: 10.1086/260472.

Scott JA, Baum E, Moisi JC, Ojal J, Gatakaa H, Nyundo C, Molyneux CS, Kombe F, Tsofa B, Marsh K, Peshu N, and Williams TN (2012). Profile: The Kilifi Health and Demographic Surveillance System (KHDSS). International Journal of Epidemiology 41(3): 650–657. doi:10.1093/ije/dys062. [PubMed: 22544844]

Sie A, Louis VR, Gbangou A, Muller O, Niamba L, Stieglbauer G, Ye M, Kouyate B, Sauerborn R, and Becher H (2010). The Health and Demographic Surveillance System (HDSS) in Nouna, Burkina Faso, 1993−2007. Global Health Action 3: 5284. doi:10.3402/gha.v3i0.5284.

Skeldon R (2008). International migration as a tool in development policy: A passing phase? Population and Development Review 34(1): 1–18. doi: 10.1111/j.1728-4457.2008.00203.x.

Speare A Jr. (1970). Home ownership, life cycle stage, and residential mobility. Demography 7(4): 449–458. doi:10.2307/2060237. [PubMed: 5524649]

Speare A Jr. and Harris J (1986). Education, earnings, and migration in Indonesia. Economic Development and Cultural Change 34*(2):* 223–244. doi:10.1086/451525.

Statistics South Africa (2014). QLFS trends 2008−2014 [electronic resource]. Pretoria: Statistics South Africa http://beta2.statssa.gov.za/?page_id=1854&PPN=P0211

Streatfield PK, Khan WA, Bhuiya A, Alam N, Sie A, Soura AB, Bonfoh B, Ngoran EK, Weldearegawi B, Jasseh M, Oduro A, Gyapong M, Kant S, Juvekar S, Wilopo S, Williams TN, Odhiambo FO, Beguy D, Ezeh A, Kyobutungi C, Crampin A, Delaunay V, Tollman SM, Herbst K, Chuc NTK, Sankoh OA, Tanner M, and Byass P (2014). Cause-specific mortality in Africa and Asia: Evidence from INDEPTH Health and Demographic Surveillance System sites. Global Health Action 7: 25362. doi: 10.3402/gha.v7.25365. [PubMed: 25377324]

Tabutin D and Schoumaker B (2004). The demography of sub-Saharan Africa from the 1950s to the 2000s: A survey of changes and a statistical assessment. Population 59(3/4): 457–519, 522−555. doi:10.2307/3654914.

Tacoli C (2008). From migration to increased mobility: The blurring of the ruralurban divide in many low and middle-income nations Paper presented at the Migration and Development: Future Directions for Research and Policy Conference, New York, February 28 − March 1 2008.

Tijdens K and Wambugu A (2012). Wages in Kenya: Wage indicator survey 2012. Amsterdam: Wage Indicator Foundation.

Todaro MP (1997). Urbanization, unemployment and migration in Africa: Theory and policy. New York: Population Council, Policy Research Division Working Paper 104.

UN-Habitat (2013). State of the world's cities 2012/2013: Prosperity of cities. New York: UN.

UNESCO (2008). Education for all by 2015 − will we make it? EFA global monitoring report. Oxford: UNESCO Oxford University Press.

UNESCO (2011). Global education digest 2011 Regional profile: Sub-Saharan Africa. Montreal: UNESCO Institute for Statistics.

UNICEF (2014). UNICEF statistics: Literacy [electronic resource]. UNICEF Data http://data.unicef.org/education/literacy

United Nations Development Programme (2009). Human Development Report 2009 Overcoming barriers: Human mobility and development. New York: UNDP.

United Nations Economic Commission for Africa (2013). Assessing progress in Africa toward the Millennium Development Goals: MDG report 2013. Tunisia: African Development Bank Group, United Nations Development Programme.

United Nations Population Division (2008). An overview of urbanization, internal migration, population distribution and development in the world. New York: Population Division, Department of Economic and Social Affairs, UN/POP/EGM-URB/2008/01.

United Nations Population Division (2014). World urbanization prospects: the 2014 revision. New York: Department of Economic and Social Affairs, Population Division.

United Nations Population Fund (2010). Population situation analysis (PSA): A conceptual and methodological guide. New York: UNFPA.

Vearey J (2014). Healthy migration: A public health and development imperative for South(ern) Africa. South African Medical Journal 104(10): 663–664. doi:10.7196/samj.8569. [PubMed: 25363047]

White MJ, Mberu BU, and Collinson MA (2008). African urbanization: Recent trends and implications In: Martine G, McGranahan G, Montgomery M, and Fernandez-Castilla R (eds.). The new global frontier: Cities, poverty and the environment in the 21st Century. London: Earthscan: 301–315.

Williams N (2009). Education, gender, and migration in the context of social change. Social Science Research 38(4): 883–896. doi:10.1016/j.ssresearch.2009.04.005. [PubMed: 20645440]

World Bank (2009). World Development Report 2009: Reshaping economic geography. Washington DC: World Bank. doi:10.1596/978-0-8213-7946-2.

World Bank (2012a). World Bank data: Urban population [electronic resource]. Washington DC: World Bank http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS

World Bank (2012b). World Bank data: GDP per capita [electronic resource]. Washington DC: World Bank http://data.worldbank.org/indicator/NY.GDP.PCAP.CD

World Bank (2013). Africa's pulse: An analysis of issues shaping Africa's economic future Washington DC: World Bank, Volume 8.

Yamaguchi K (1991). Event history analysis. Newbury Park: Sage Publications.

Appendix

Table A-1:

Cox proportional hazards models for ages 15−65 years: Determinants of in- and out-migration by sex and HDSS site − West Africa

	Nanoro HDSS - Rural				Nouna HDSS - Mostly rural				Ouagadougou HDSS - Urban			
	In-migration		Out-migration		In-migration		Out-migration		In-migration		Out-migration	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Hazard Ratios (95% Confidence Interval)											
Calendar Year	n.a.	n.a.	n.a.	n.a.	0.79***	0.85***	0.92**	0.92**	n.a.	n.a.	n.a.	n.a.
2009					(0.74 − 0.84)	(0.80 − 0.91)	(0.86 − 0.98)	(0.87 − 0.98)				
Ref: Calendar Year 2010	1	1	1	1	1	1	1	1	1	1	1	1
Calendar Year	1.48***	1.25***	1.15***	0.96	0.85***	0.97	1.01	1.04	1.16***	1.11***	1.33***	1.34***
2011	(1.35 − 1.61)	(1.17 − 1.34)	(1.08 − 1.23)	(0.91 − 1.02)	(0.80 − 0.91)	(0.92 − 1.03)	(0.95 − 1.08)	(0.99 − 1.11)	(1.10 − 1.23)	(1.05 − 1.17)	(1.26 − 1.40)	(1.27 − 1.41)
Ref: Education No Formal	1	1	1	1	1	1	1	1	1	1	1	1
Education Some	0.69***	0. 9	0.83***	0.98	0.50***	0.67***	0.89***	1.25***	0.79***	0.84***	0.74***	0.96
Primary	(0.60 − 0.81)	(0.79 − 1.03)	(0.75 − 0.91)	(0.88 − 1.09)	(0.46 − 0.54)	(0.62 − 0.72)	(0.83 − 0.96)	(1.17 − 1.33)	(0.73 − 0.85)	(0.78 − 0.90)	(0.69 − 0.80)	(0.89 − 1.03)
Education Some	1.18**	1.65***	1.01	1.41***	1.46***	0.94*	1.98***	1.35***	0.78***	0.68***	0.72***	0.82***

	Nanoro HDSS - Rural				Nouna HDSS - Mostly rural				Ouagadougou HDSS - Urban			
	In-migration		Out-migration		In-migration		Out-migration		In-migration		Out-migration	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Secondary	(1.04 − 1.33)	(1.46 − 1.87)	(0.92 − 1.11)	(1.26 − 1.57)	(1.36 − 1.56)	(0.87 − 1.01)	(1.85 − 2.12)	(1.25 − 1.45)	(0.73 − 0.84)	(0.64 − 0.74)	(0.67 − 0.77)	(0.77 − 0.88)
Wald Chi-square	461.7	856.8	168.6	301.6	897.6	565.3	790.7	444.8	1471	1537	3744	3193
Log Likelihood	-11892	-24836	-20814	-29252	-37847	-50096	-39057	-48893	-37617	-41484	-39882	-44430
Subjects	11926	20759	11927	20760	28074	29222	28076	29226	29778	29448	29779	29452
Time at risk	17264	32192	17282	32211	63013	62799	63045	62838	45973	44471	45984	44483
Failures	2043	3760	3365	4326	5101	6686	5227	6517	5383	5834	5849	6331

*** p<0.01,
** p<0.05,
* p<0.1

All Wald Chi-square are significant at the 1 per 1000 level

Note: Unknown values of education not shown.

Table A-2:

Cox proportional hazards models for ages 15−65 years: Determinants of in − and out-migration by sex and HDSS site − East Africa

	Kilifi HDSS − Mostly rural				Kisumu HDSS − Mostly rural				Nairobi HDSS − Urban			
	In-migration		Out-migration		In-migration		Out-m igration		In-migration		Out-migration	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	Hazard Ratios (95% Confidence Interval)											
Calendar Year	0.97**	0.911	0.85***	0.88***	0.90***	0.89***	1.08***	1.08***	1.07***	1.10***	0.93***	0.92***
2009	(0.94 − 1.00)	(0.88 − 0.94)	(0.83 − 0.87)	(0.85 − 0.90)	(0.86 − 0.94)	(0.86 − 0.93)	(1.05 − 1.12)	(1.05 − 1.12)	(1.03 − 1.11)	(1.05 − 1.14)	(0.89 − 0.97)	(0.88 − 0.96)
Ref: Calendar Year 2010	1	1	1	1	1	1	1	1	1	1	1	1
Calendar Year	0.88***	0.85***	0.86***	0.89***	0.83***	0.85***	0.88***	0.89***	0.95***	1	1.06***	1.07***
2011	(0.86 − 0.91)	(0.83 − 0.88)	(0.84 − 0.89)	(0.87 − 0.91)	(0.79 − 0.87)	(0.82 − 0.88)	(0.85 − 0.92)	(0.86 − 0.92)	(0.92 − 0.99)	(0.96 − 1.04)	(1.02 − 1.10)	(1.02 − 1.11)
Ref: Education No Formal	1	1	1	1	1	1	1	1	1	1	1	1
Education Some	0.69***	1.16***	0.93**	1.42***	1.16*	1.43***	1.23***	1.35***	3.82***	5.36***	2.39***	3.06***
Primary	(0.65 − 0.75)	(1.11 − 1.22)	(0.87 − 1.00)	(1.36 − 1.48)	(0.98 − 1.36)	(1.27 − 1.62)	(1.06 − 1.42)	(1.21 − 1.51)	(2.97 − 4.92)	(4.18 − 6.88)	(1.92 − 2.97)	(2.49 − 3.76)
Education Some	1.01	1.98***	0.96	1.58***	1.39***	1.62***	1.40***	1.42***	4.65***	6.65***	2.55***	3.29***
Secondary	(0.94 − 1.09)	(1.86 − 2.10)	(0.89 − 1.03)	(1.49 − 1.67)	(1.18 − 1.64)	(1.43 − 1.84)	(1.21 − 1.62)	(1.26 − 1.59)	(3.61 − 5.99)	(5.17 − 8.54)	(2.04 − 3.17)	(2.67 − 4.06)
Wald Chi-square	20299	24338	12748	14466	1276	2497	598.3	672.1	411.8	547.7	142.1	236.2
Log Likelihood	−204853	−233268	−247777	−266902	−100919	−151675	−143701	−182436	−149982	−117241	−119030	−92052
Subjects	86821	103187	86826	103187	70919	86354	70937	86377	41991	31283	41995	31284
Time at risk	166972	211206	167061	211333	153785	186753	153875	186879	78553	56217	78563	56223
Failures	25676	28181	30075	31429	12174	17739	16932	21086	19416	15424	15388	12109

*** p<0.01,
** p<0.05,
* p<0.1

All Wald Chi-square are significant at the 1 per 1000 level

Note: Unknown values of education not shown.

Table A-3:

Cox proportional hazards models for ages 15−65 years: Determinants of in- and out-migration by sex and HDSS site − Southern Africa

	Agincourt HDSS − Mostly rural				Manhiça HDSS − Rural			
	In-migration		Out-migration		In-migration		Out-migration	
	Male	Female	Male	Female	Male	Female	Male	Female
	Hazard Ratios (95% Confidence Interval)							
Calendar Year 2009	1.16***	1.03	1.24***	1.10***	1.23***	1.04	1.20***	1.02
	(1.09 − 1.24)	(0.97 − 1.09)	(1.17 − 1.32)	(1.04 − 1.16)	(1.15 − 1.31)	(0.98 − 1.11)	(1.13 − 1.28)	(0.96 − 1.08)
Ref: Calendar Year 2010	1	1	1	1	1	1	1	1
Calendar Year 2011	1.08**	0.97	1.23***	1.16***	0.80***	0.90***	1.30***	1.11***
	(1.01 − 1.15)	(0.91 − 1.02)	(1.15 − 1.31)	(1.09 − 1.22)	(0.75 − 0.86)	(0.85 − 0.96)	(1.22 − 1.38)	(1.04 − 1.17)
Ref: Education No Formal	1	1	1	1	1	1	1	1
Education Some Primary	0.81***	0.80***	0.88	1.15**	0.95	1.12***	0.97	1.37***
	(0.70 − 0.93)	(0.70 − 0.91)	(0.74 − 1.04)	(1.01 − 1.31)	(0.87 − 1.04)	(1.04 − 1.20)	(0.89 − 1.06)	(1.27 − 1.47)
Education Some Secondary	0.93	0.87**	0.96	1.09	0.71***	0.85***	0.65***	1.11**
	(0.82 − 1.05)	(0.78 − 0.97)	(0.82 − 1.12)	(0.97 − 1.23)	(0.64 − 0.79)	(0.78 − 0.94)	(0.59 − 0.72)	(1.01 − 1.22)
Wald Chi-square	439.1	1688	64.01	36.59	371.1	274.9	470.4	424.2
Log Likelihood	−36331	−49498	−41945	−58760	−38149	−48657	−42874	−50441
Subjects	19587	26933	19593	26943	23405	33312	23414	33330
Time at risk	36862	54320	36876	54352	49505	76621	49530	76669
Failures	5563	6959	6069	8042	5337	6364	5913	6602

*** p<0.01,
** p<0.05,
* p<0.1

All Wald Chi-square are significant at the 1 per 1000 level

Note: Unknown values of education not shown.

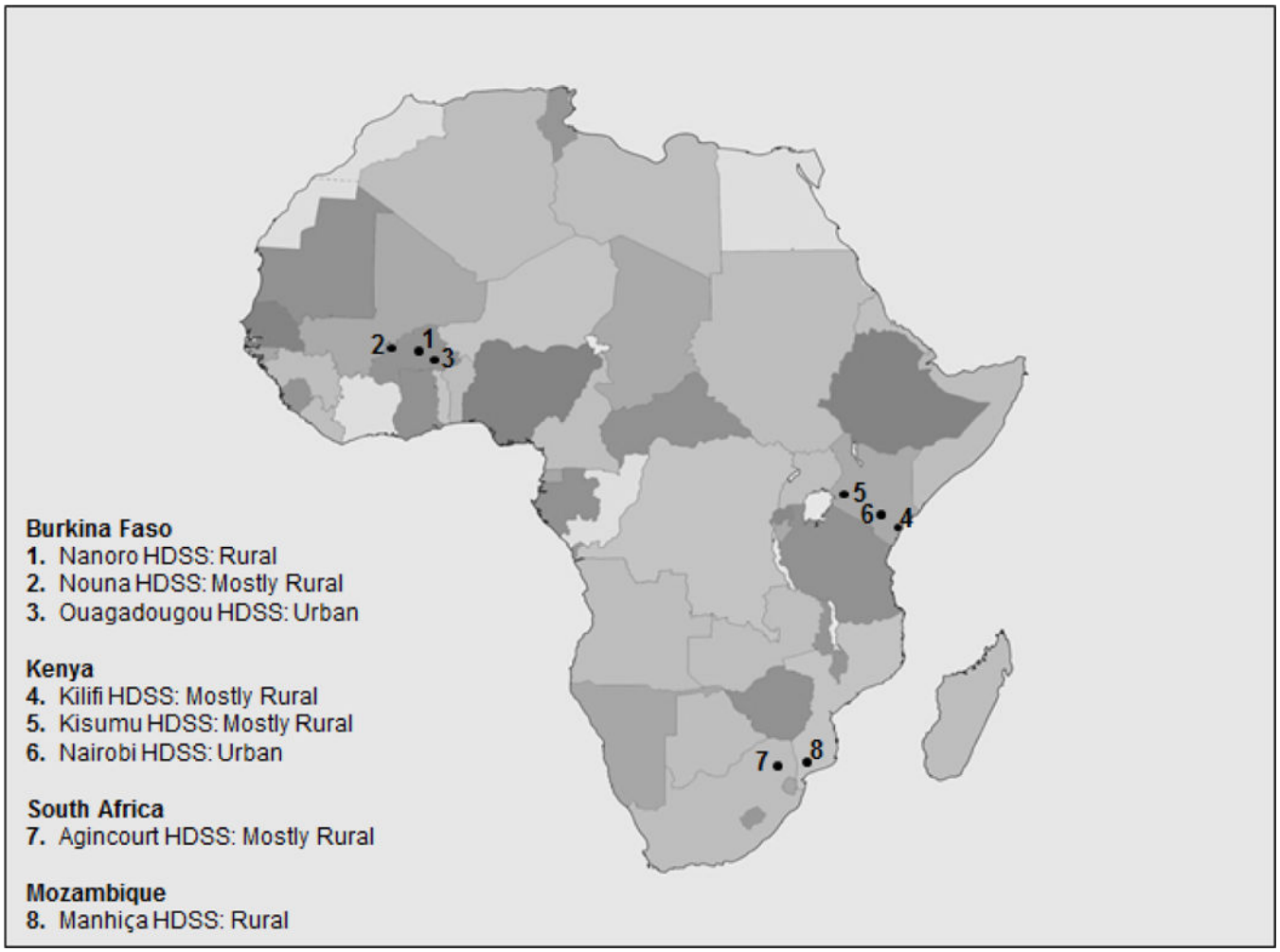

Figure 1:
Map of HDSS site locations in Africa

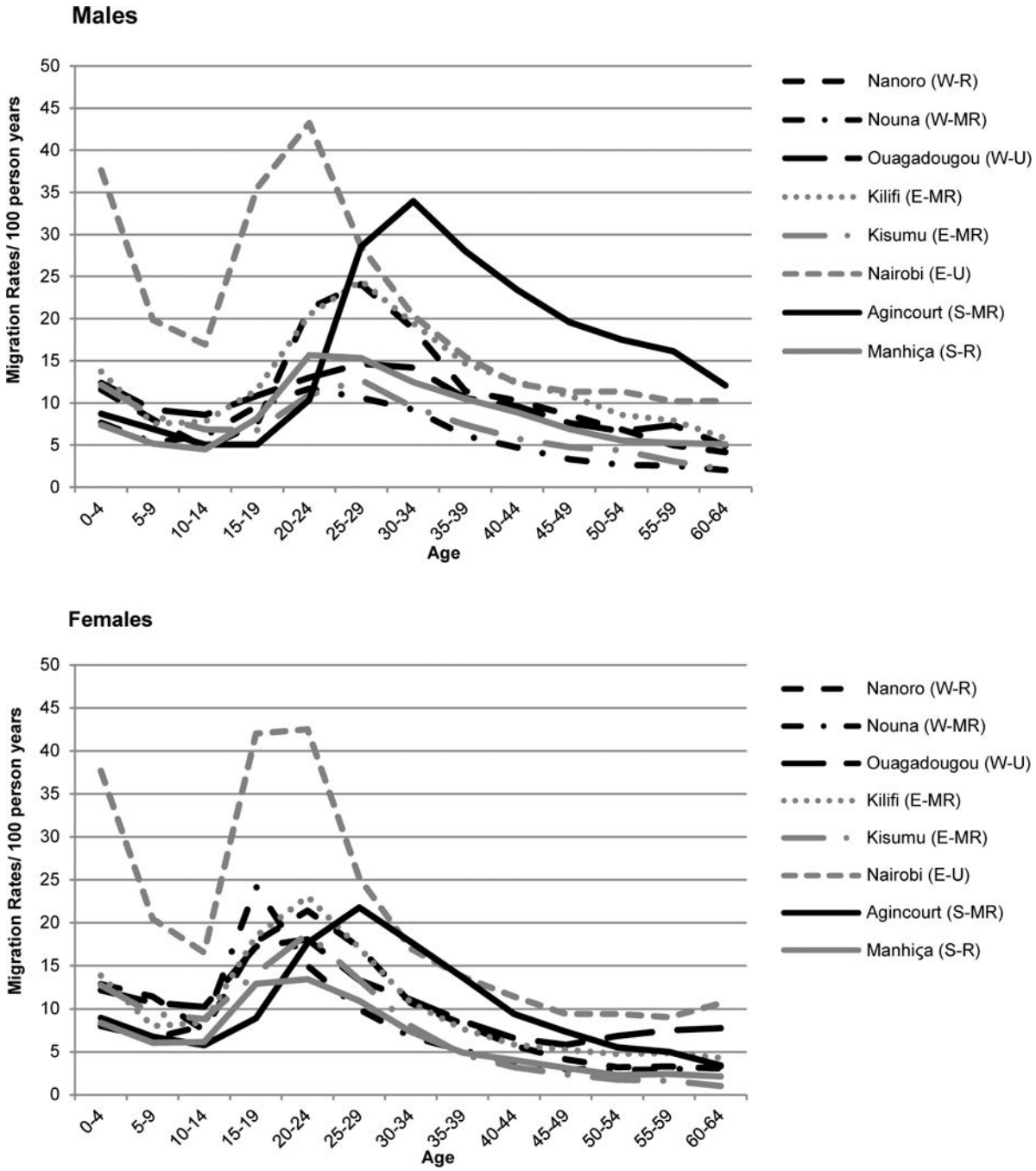

Figure 2: In-migration age profiles: All HDSS sites

Note: W: West Africa; E: East Africa; S: Southern Africa; R: rural; MR: mostly rural; U: urban

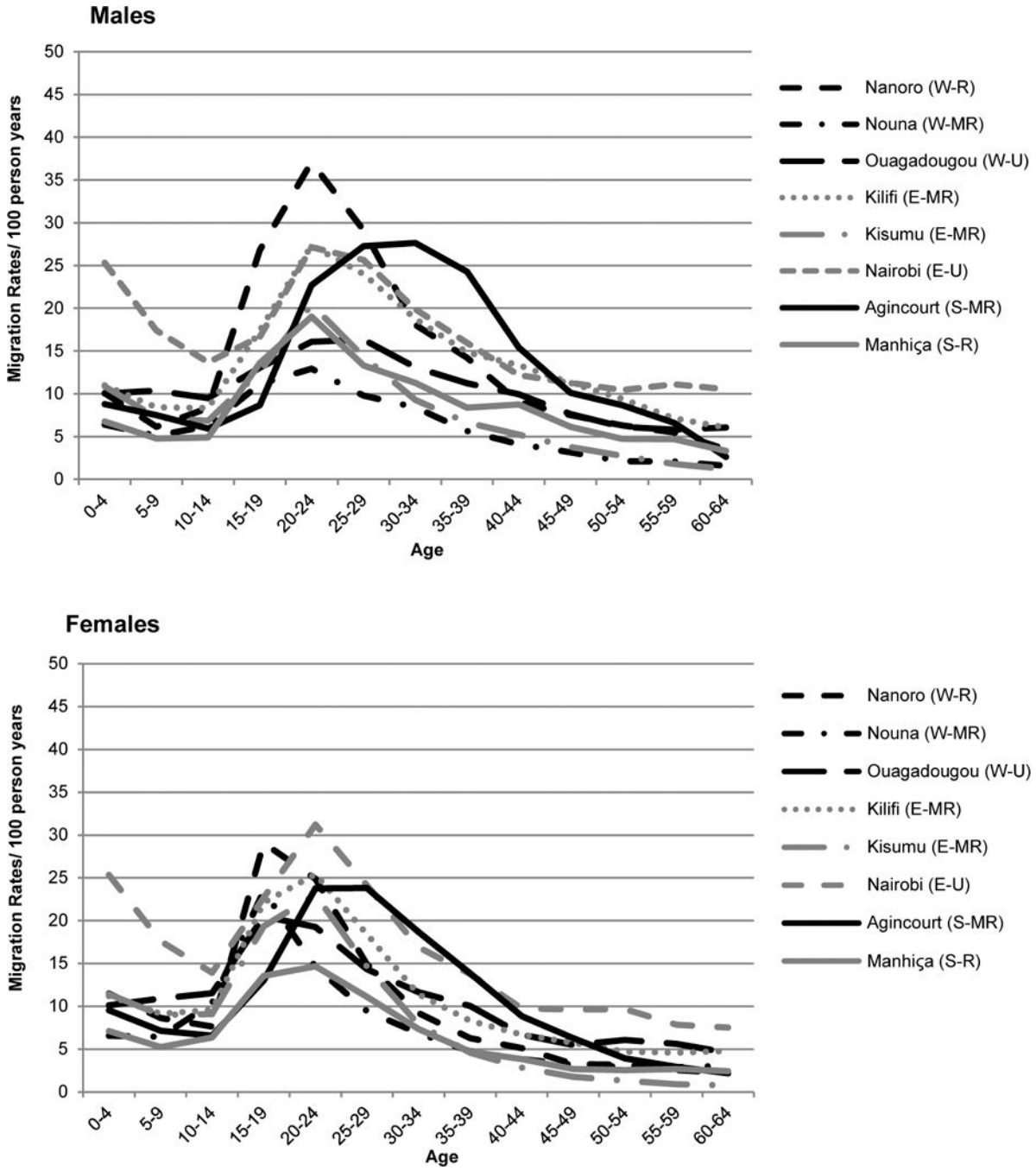

Figure 3: Out-migration age profiles: All HDSS sites

Note: W: West Africa; E: East Africa; S: Southern Africa; R: rural; MR: mostly rural; U: urban

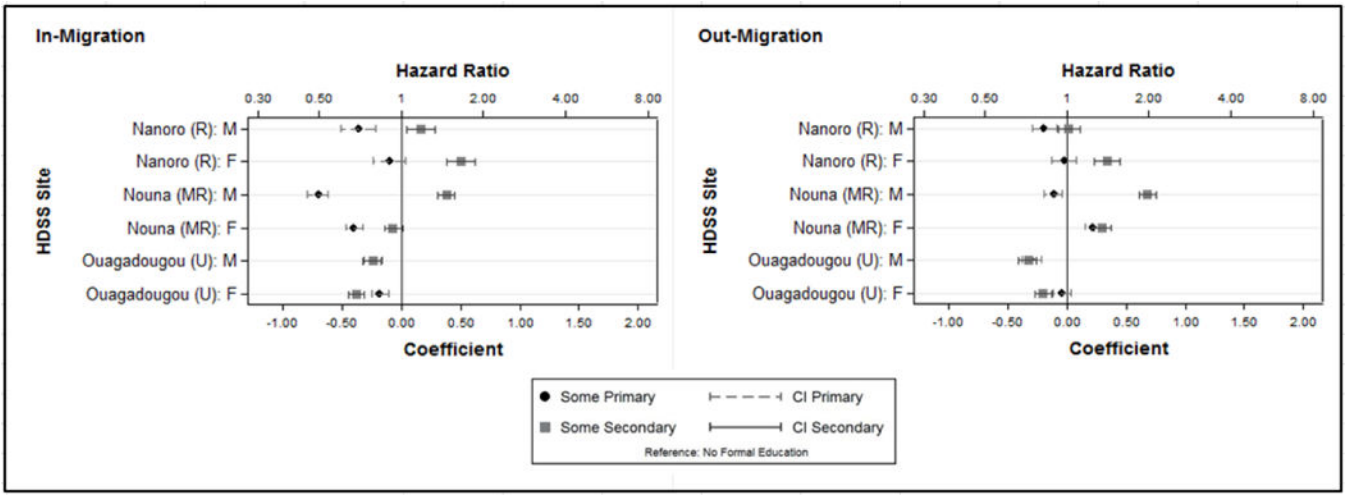

Figure 4: Education coefficients and hazard ratios of Cox proportional hazards models for in- and out-migration by sex in West Africa, ages 15–65 years*

* Models control for calendar year Note: (R): rural; (MR): mostly rural; (U): urban; M: male; F: female

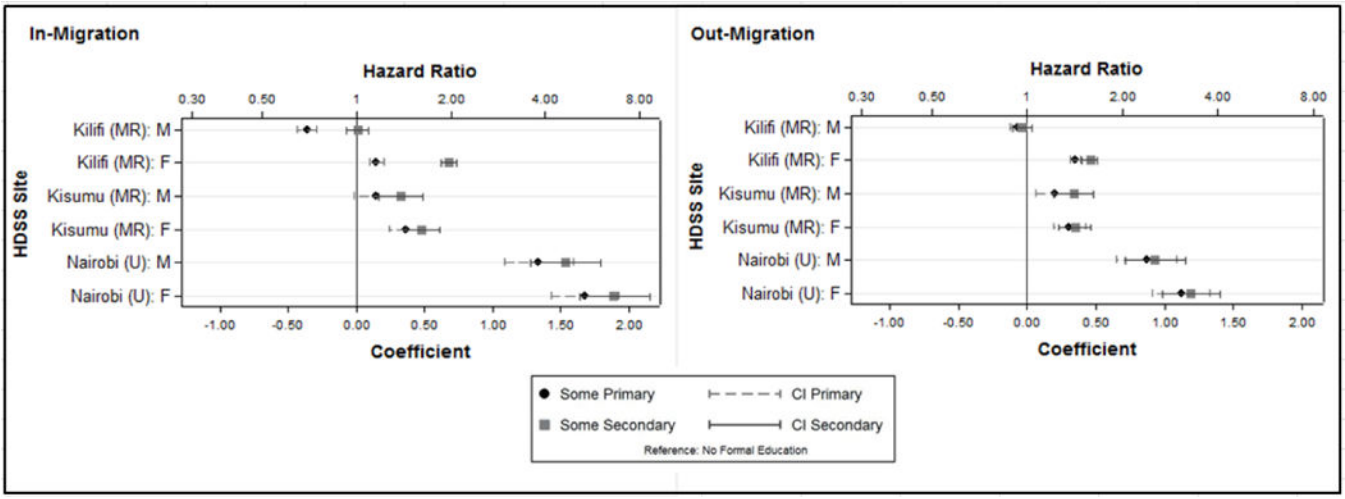

Figure 5: Education coefficients and hazard ratios of Cox proportional hazards models for in- and out-migration by sex in East Africa, ages 15–65 years*

* Models control for calendar year Note: (MR): mostly rural; (U): urban; M: male; F: female

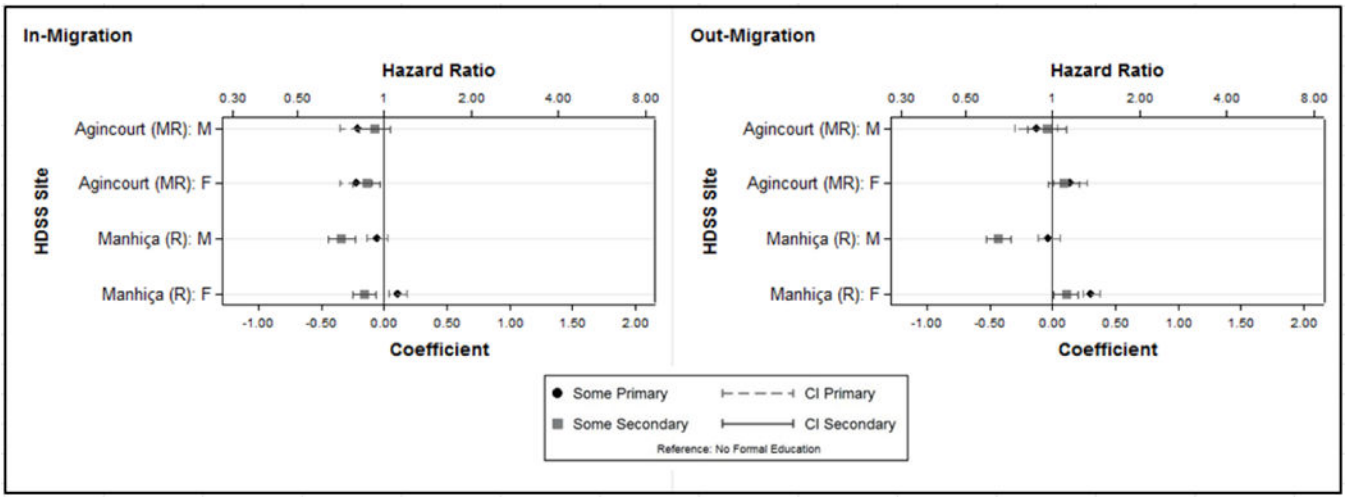

Figure 6: Education coefficients and hazard ratios of Cox proportional hazards models for in- and out-migration by sex in Southern Africa, ages 15–65 years*

* Models control for calendar year *Note:* (R): rural; (MR): mostly rural; M: male; F: female

Table 1:
HDSS sites included in this multi-centre analysis

HDSS site	Population size (approximate)	Size of site (km^2)	Settlement type	Population density estimate (persons per km^2)	Inception year	Contiguity and location
West Africa						
Nanoro HDSS Burkina Faso (Derra et al. 2012)	61,000	594.3	Rural	102.6	2009	Contiguous site situated in centre of Burkina Faso, 85km from capital, Ouagadougou
Nouna HDSS Burkina Faso (Sie et al. 2010)	84,336	1,756	Mostly rural	48	1992	Contiguous site situated north west of Burkina Faso, 300km from capital, Ouagadougou
Ouagadougou HDSS Burkina Faso (Rossier et al. 2012)	81,717	14.73	Urban	5,547.7	2008	Non-contiguous site comprising three informal areas: Nonghin, Polesgo, and Nioko 2, and two formal areas: Kilwin and Tanghin, north of city.
East Africa						
Kilifi HDSS Kenya (Scott et al. 2012)	261,919	900	Mostly rural	291	2000	Contiguous site situated north of Mombasa on Indian Ocean coast of Kenya
Kisumu HDSS Kenya (Odhiambo et al. 2012)	223,406	700	Mostly rural	319.2	2001	Contiguous site located in Rarieda, Siaya, and Gem districts, northeast of Lake Victoria, Nyanza Province, western Kenya
Nairobi HDSS Kenya (Emina et al. 2011)	71,000	0.97	Urban	73,195.9	2002	Non-contiguous site comprising Viwandani and Korogocho slum settlements (7km apart) in capital, Nairobi
Southern Africa						
Agincourt HDSS South Africa (Kahn et al. 2012)	91,178	420	Mostly rural	217.1	1992	Contiguous site situated in northeast South Africa close to border with Mozambique
Manhiça HDSS Mozambique (Sacarlal et al. 2009)	90,000	500	Rural	180	1996	Contiguous site located in southern Mozambique, 80 km north of capital, Maputo

Table 2:

Country indicators

Country	Estimated level of urbanisation (%) 2012[a]	GDP per capita (current US$) 2012[b]	National education indicator: adult literacy rate (%), 2008–2012[c]		
			Male	Female	Total
Burkina Faso	27	652	36.7	21.6	28.7
Kenya	24	933	78.1	66.9	72.2
Mozambique	31	570	67.4	36.5	50.6
South Africa	63	7314	93.9	92.2	93.0

Sources:

[a](World Bank 2012a);

[b](World Bank 2012b);

[c](UNICEF 2014).

Table 3:

Characteristics of the analytical sample* by HDSS site over the analysis period 1 January 2009/2010 to 1 January 2012

	Nanoro HDSS** West Africa - Rural		Nouna HDSS West Africa - Mostly rural		Ouagadougou HDSS** West Africa - Urban		Kilifi HDSS East Africa - Mostly rural		Kisumu HDSS East Africa - Mostly rural		Nairobi HDSS East Africa - Urban		Agincourt HDSS Southern Africa - Mostly rural		Manhiça HDSS Southern Africa - Rural	
	Person Years	%	Person Years	%	Person Years	%	Person Years	%	Person Years	%	Person Years	%	Person Years	%	Person Years	%
Gender																
Male	17,282	35	63,045	50	45,984	51	167,061	44	153,875	45	78,563	58	36,876	40	49,530	39
Female	32,211	65	62,838	50	44,483	49	211,333	56	186,879	55	56,223	42	54,352	60	76,669	61
Calendar Year																
2009	~	~	40,188	32	~	~	123,747	33	111,624	33	43,516	32	29,933	33	40,644	32
2010	24,467	49	41,957	33	45,467	50	126,462	33	113,350	33	44,879	33	30,410	33	42,400	34
2011	25,026	51	43,739	35	44,999	50	128,186	34	115,781	34	46,392	34	30,886	34	43,153	34
Education																
No Formal	36,983	75	86,844	69	34,717	38	82,168	22	18,334	5	3,385	3	6,954	8	29,609	23
Some Primary	5,619	11	21,762	17	22,721	25	182,205	48	224,124	66	81,595	61	12,991	14	74,606	59
Some Secondary	3,828	8	12,966	10	28,580	32	45,312	12	64,596	19	47,488	35	68,301	75	19,692	16
Unknown	3,063	6	4,313	3	4,449	5	68,710	18	33,701	10	2,318	2	2,983	3	2,292	2
Total	49,493	100	125,885	100	90,467	100	378,395	100	340,755	100	134,786	100	91,229	100	126,199	100

*Age group 15 – 65 years

**Sites for which analysis period commences on 1 January 2010