Impact of Migration on Fertility and Abortion: Evidence From the Household and Welfare Study of Accra

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Abstract

Over the last few decades, total fertility rates, child morbidity, and child mortality rates have declined in most parts of sub-Saharan Africa. Among the most striking trends observed are the rapid rate of urbanization and the often remarkably large gaps in fertility between rural and urban areas. Although a large literature has highlighted the importance of migration and urbanization within countries' demographic transitions, relatively little is known regarding the impact of migration on migrants' reproductive health outcomes in general and abortion in particular. In this article, we use detailed pregnancy and migration histories collected as part of the Household and Welfare Study of Accra (HAWS) to examine the association between migration and pregnancy outcomes among women residing in the urban slums of Accra, Ghana. We find that the completed fertility patterns of lifetime Accra residents are remarkably similar to those of residents who migrated. Our results suggest that recent migrants have an increased risk of pregnancy but not an increased risk of live birth in the first years post-move compared with those who had never moved. This gap seems to be largely explained by an increased risk of miscarriage or abortion among recent migrants. Increasing access to contraceptives for recent migrants has the potential to reduce the incidence of unwanted pregnancies, lower the prevalence of unsafe abortion, and contribute to improved maternal health outcomes.

Keywords Migration • Abortion • Fertility • Reproductive health • sub-Saharan Africa

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Introduction and Conceptualization

Over the coming decades, urbanization is expected to continue or accelerate in the developing world, with Africa and Asia urbanizing most rapidly (United Nations 2012). Internal rural-to-urban migration accounts for more than one-half of the growth of cities in Africa (Barrios et al. 2006). One of the most significant recent trends in migration has been the entry of women into migration streams that in previous decades had been primarily male, with an increasing number of female migrants moving on their own (Martin 2003; Zlotnik 2003). Many rural-to-urban migrants settle in slums, contributing to a projection of a doubling of slum settlements over the next 30 years (UN-HABITAT 2009).

Over the past five decades, total fertility rates have declined across sub-Saharan Africa (Sneeringer 2009), with particularly rapid declines in urban areas. Although urban fertility rates have consistently been lower historically, the difference between urban and rural fertility rates has increased substantially from 0.3 children in 1960 to 1.9 children in 2000 (Garenne 2008). Given that migrants from rural areas constitute an increasingly large fraction of the urban population, the increasing rural-urban gaps are rather remarkable. From an individual perspective, migration to urban centers constitutes a fundamental change in environment and lifestyle, which may be associated with increased risky sexual behavior, unintended pregnancies, and mistimed births (Brockerhoff and Biddlecom 1999; Greif and Nii-Amoo Dodoo 2011; Sudhinaraset et al. 2012).

Most research in the area of migration and fertility has relied on the theoretical framework proposed by Goldstein and Goldstein (1982). The framework is based on three mechanisms: disruption, adaptation, and selection. In the context of reproductive health, each of the three factors may increase or decrease sexual activity and risk of pregnancy (Brockerhoff and

Bittlecom 1999). “Disruption” can be interpreted as interruption in what otherwise would have been the anticipated fertility schedule of migrants. For example, separation of spouses or a desire to delay childbearing until after the move may reduce fertility in the short term (Brockerhoff and Yang 1994; Chattopadhyaya et al. 2006). Women who migrate to cities to marry or to join husbands are less likely to live with their spouses in the first few months, potentially lowering the probability of fertility in those years (Brockerhoff 1995; Bongaarts et al. 1984). On the other hand, disruption may also cause an increase in conception, unintended pregnancies, and potentially abortion if spousal separation increases risk of extramarital sexual behavior (Anarfi 1993; Brockerhoff and Bittlecom 1999).

“Adaptation” refers to the socialization of migrants: that is, the adjustment to the social, cultural, and sexual norms of the destination’s residential environment as well as to the economic constraints and opportunities that they face as a result of the move (Brockerhoff 1995; Chattopadhyaya et al. 2006; Lindstrom 2003). Female migrants who moved before their completed fertility may adjust their desired fertility to match the norms of the destination, thus reducing total fertility rates. Rural-urban migrants may also discover a change in lifestyle constraints in their new location. Newly arrived married couples may reduce or postpone having children until they can adapt to the new economic conditions (Lindstrom 2003; White et al. 2005). Generational analysis of migrants in Ghana found evidence for the effects of adaptation in that migrants’ fertility begins to approach levels characteristic of the second generation, and differences between second-generation migrants and urban natives almost disappear (White et al. 2005).

On the other hand, rural-urban migration can also lead to a change of social networks and the removal of traditional village controls over sexual behavior (Anarfi 1993). Migrants may find themselves in an environment that is conducive to high-risk sexual behaviors, which may be especially predominant in slums where migrants tend to move (Greif and Nii-Amoo Dodoo 2011). Contraceptive use may also be low during the first two years after migrants' arrival (Brockerhoff 1995). This increase in sexual behavior and reduced use of contraception may result in an increased risk of pregnancy.

Finally, the selection hypothesis captures the notion that mobile individuals differ from nonmigrating populations with respect to predisposed individual characteristics. These characteristics may be observable (such as level of education or employment status) or may be largely unobservable (e.g., ambition and openness to change) (Borjas 1987; Chattopadhyaya et al. 2006; Goldstein and Goldstein 1982). The decision to move, potentially over a long distance, to a new socioeconomic and cultural environment demonstrates a degree of risk-taking because consequences of the move are often uncertain and social networks at the destination are smaller or nonexistent (Brockerhoff and Biddlecom 1999). For example, the earnings of the immigrant population may be higher than the earnings of the native population because individuals with high earning potential are more likely to self-select into migration (Borjas 1987). Previous research has found substantial support for the selection hypothesis among both rural-urban and urban-rural migrants in Ghana (Chattopadhyaya et al. 2006). Another recent study on child mortality of rural-to-urban migrants found that migrants had lower child mortality before they migrated than rural nonmigrants and that their mortality levels dropped further after they arrived in urban areas (Bocquier et al. 2011); these outcomes are evidence of both selection and adaptation.

Few studies have examined the effect of migration on abortion. Research on migration and sexual behavior has generally focused on HIV rates and condom use (Brockerhoff and

Biddlecom 1999; Greif and Nii-Amoo Dodoo 2011). In Kenya, migrants were found to be more likely than nonmigrant counterparts to engage in sexual practices conducive to HIV infection, such as multiple partners and low condom use (Brockerhoff and Biddlecom 1999). For Nairobi, migration to slums was also found to be associated with an increased likelihood of risky sexual behavior (Greif and Nii-Amoo Dodoo 2011). In China, rural-to-urban migrant males were found to be significantly less likely to report condom use at first sex and consistent contraceptive use with the first partner compared with nonmigrants and urban-to-urban migrants (Sudhinaraset et al. 2012). However, to the best of our knowledge, no study has investigated whether female migration has an impact on rates of induced abortion.

In this article, we use the detailed data on migration and reproductive health collected as part of the Housing and Welfare Study of Accra (HAWS) to examine the relationship between mobility and reproductive health outcomes in the context of migration to poor residential neighborhoods, which has become the primary force underlying the rapid rates of urbanization observed in developing countries (UN-HABITAT 2009; Bloom et al. 2010). We take advantage of a unique data set that collected both full pregnancy histories and detailed migration histories in order to estimate the effect of migration on both completed fertility and pregnancy outcomes, including miscarriage, stillbirth, and induced abortion.

To disentangle the roles of disruption, adaptation, and selection in fertility and pregnancy outcomes, we start by comparing reproductive health outcomes of long-term residents with those of migrants. We find that completed fertility schedules of migrants are very similar to those of long-term Accra residents, suggesting both adaptation and selection effects. We then conduct an event-history analysis to evaluate the risk of pregnancy, stillbirth, and lost birth (abortion or miscarriage) of new arrivals compared with those who had never moved and those who are longer-term residents. We find that the probability of live birth is unchanged for new arrivals compared with those who had never moved, but the risk of pregnancy and lost birth is increased in the first two years after the move, suggesting that both selection and adaptation mechanisms are relevant in this context. To disentangle selection from adaption effects, we use individual fixed-effects models to compare the risk of adverse pregnancy outcomes among migrants before and immediately after the move. Our data allow us to apply a fixed-effects estimator to account for the unobservable individual-level factors affecting the decision to migrate as well as to have a child. We again find an increase in risk of pregnancy and lost birth in the years immediately following a move. The observed increases suggest a strong influence of the role of adaptation in the sexual behavior of migrant female populations: that is, female migrants appear to increase sexual activity after a move, but reduce their completed fertility via abortion or miscarriage.

The rest of the article is organized as follows. We provide background information on Ghana's fertility history and abortion laws in the following section. We then describe the data and the analytical methods. We present the summary statistics and analytical results, and then we conclude by discussing the policy implications of our findings.

Background

Reproductive Health in Ghana

In the last 20 years, fertility in Ghana has declined rapidly from a total fertility rate of 6.4 in 1988 to a rate of 4.0 in 2008 (Ghana Statistical Service (GSS) 2009b). Infant mortality fell from 77 to 50 per 100,000 live births from 1988 to 2007, while contraceptive use among women aged 15–49 increased from 12 % to 21 % (GSS 2009b). HIV prevalence is relatively low in Ghana compared with sub-Saharan Africa, estimated to be about 1.5 % in 2011 (Ghana AIDS Commission 2012). Women's median age at first marriage is 18.7 in rural areas and 21.3 in urban areas. Women in the Greater Accra urban region marry five years later than women in the more rural region of the Upper East (22.9 years vs. 17.8 years); fertility varies substantially by region, mother's education, and wealth, with wealthier, more-educated urban women having the fewest children (GSS 2009a).

Abortion in some circumstances has been legal in Ghana since 1985. Abortion, by law, must be performed by a registered medical practitioner and is allowed when the physical or mental health of the pregnant woman is threatened, when the child is likely to be born with a serious physical abnormality, or when the pregnancy resulted from rape or incest. In all other situations, it is illegal (Morhee and Morhee 2006). Despite the long-term legality of abortion, unsafe abortion is the second-largest cause of maternal mortality in Ghana (Schwandt et al. 2013; Sundaram et al. 2012). In 2010, Ghana's maternal mortality rate was estimated to be 350 maternal deaths per 100,000 live births (95 % confidence interval = 210–630), which is much higher than the average in the developing world of 210 per 100,000 live births (World Health Organization et al. 2012). The 2007 Ghana Maternal Health Survey estimated the ratio to be even higher, at 580 maternal deaths per 100,000 live births (GSS 2009b). Of these maternal deaths, 11 % are the result of unsafe abortion (GSS 2009b; Sundaram et al. 2012). Stigma associated with abortion is high and prevents women from seeking medically safe abortions at a health facility, opting for clandestine abortions instead, which may lead to hemorrhaging, infection, or death. Additionally, a survey of health care facilities in 10 districts found that fewer than one in seven public health facilities reported offering legal abortion services (Aboagye et al. 2007). Nearly one-half of Ghanaian women who recently obtained an abortion underwent the procedure unsafely (Sundaram et al. 2012). Negative encounters with health care providers discourage women from seeking safe abortions or treating post-abortion complications safely with family planning services (Schwandt et al. 2013).

Women receive abortions for various reasons, the most common of which is not having the financial means to take care of a child (Sedgh 2010). Other reasons include the presence of relationship problems with the woman's partner, the desire to continue working or schooling, and the desire for spacing or limiting childbearing (Adanu et al. 2005; Sedgh 2010). Women often do not disclose their abortion to their male partners because they fear the partner's reaction, including domestic violence or relationship dissolution (Schwandt et al. 2011).

Other studies have linked the legalization of abortion with lower fertility trends (Agyei-Mensah 2006; Finlay and Fox 2013, Geelhoed et al. 2002). These studies have observed that the increase in modern contraceptive use in Ghana has not kept pace with the observed declines in fertility, suggesting that the empirical gap could be explained by increased induced abortion. Finlay and Fox (2013) used multivariate longitudinal regression to show that the timing of the liberalization of the abortion laws coincided with the onset of Ghana's fertility decline. Abortion as a method of birth control has thus been explored as a possible means for women to reduce their completed fertility in Ghana.

Migration in Ghana

Migration is very common in Ghana, with at least one migrant in more than 43 % of all households in 2005–2006 (Ackah and Medvedev 2012). More than 80 % of Ghanaian migrants stay in Ghana; and among them, 70 % go to urban areas (Ackah and Medvedev 2012). About 50.9 % of the total population lives in an urban area (GSS 2012). The Greater Accra and Ashanti regions attract more than one-half of all internal migrants, and migrants make up a substantial share of the population in these regions (Ackah and Medvedev 2012). Migration does not have to be permanent and can be two-directional; among households with migrants, 37 % have at least one returned migrant.[4] However, differences in characteristics between migrants who return and those who do not have not been found to be significant or meaningfully large with respect to age, gender, and education (Ackah and Medvedev 2012).

The urbanization rate in Ghana is comparable with other sub-Saharan African countries. The average annual rate of change in the urban population of sub-Saharan Africa was 3.82 % between 1970 and 2011 (United Nations 2012). Accra's growth rate between 2005 and 2010 was 3.30 %, comparable with other sub-Saharan African cities—such as Nairobi (4.50 %), Lagos (3.76 %), and Bamako (4.32 %)—during the same period (UN-HABITAT 2013).

Data

The data used in this article come from the Housing and Welfare Study of Accra (HAWS), which was conducted between 2009 and 2010 in a collaborative effort between the Institute of Statistical, Social and Economic Research (ISSER) at the University of Ghana and the Harvard School of Public Health. The purpose of the HAWS survey was to assess the current health status and living standards of the population in 37 enumeration areas classified as slums. The "slum" attribute was defined by the GSS, and was given to enumeration areas ranked in the bottom quartile on an index based on the housing and socioeconomic characteristics collected in the 2000 census (Megill 2002). The GSS index includes household-level dwelling characteristics, including lighting, water supply, toilet facilities, cooking fuel, cooking space, bathing facilities, and highest level of schooling and educational grade by any member of the household (Megill 2002).

The HAWS survey consists of a household interview and individual interviews with all women aged 18 and older in the household. The individual woman's questionnaire consists of

[4] Returned migrants are defined as individuals who were away from the household for some time in the last five years but have since returned to the household (Ackah and Medvedev 2012).

sections on background characteristics, migration, health insurance, general health, mental health, nutrition, malaria, a full pregnancy history, prenatal and postnatal care, immunizations for children born in the last five years, marriage and sexual activity, reproductive health, family planning, and fertility preferences. A total of 2,095 women completed the individual interview, of which 1,488 had had at least one pregnancy.

The HAWS data set is unique in two ways. First, it focuses on urban dwellers in the poorest neighborhoods of Accra, where residential mobility is particularly common and health service provision may be more limited. Second, because the study collected full pregnancy histories in combination with detailed migration histories, we are able to identify reproductive health patterns before and after residential changes. The data set includes the outcome of each pregnancy, as well as the month and year of each pregnancy termination. It also includes the month and year of each residential move for the past four moves of each woman interviewed, the location she moved from, whether she knew anyone when moving, and the reason for the move. Information about residential duration in data sets such as the Demographic and Health Surveys (DHS) includes information only on duration in current residence, which makes it impossible to link birth outcomes to residential duration.

The HAWS survey interviewed only women in the slum areas of Accra, who may be systematically different from other Accra residents. The DHS in 2008 did not stratify based on slum areas; only 5 of 35 enumeration areas from the 2008 DHS overlapped with the HAWS study area (Montana 2011). Table 1 compares descriptive statistics for both the HAWS and DHS 2008 surveys for residents ages 18–49 in the Greater Accra region and shows *t* tests for the difference in means. Compared with DHS Accra residents, women in the HAWS data set are less educated and less likely to be Akan or Ewe ethnicity. They have a lower average age at first birth, are less likely to be married, and are more likely to have terminated a pregnancy.[5] However, they do not differ significantly in terms of average number of total children ever born or the length of time at their current residence (the only residential duration information available in the DHS).

About 75 % of women in the complete HAWS data set moved at least once.[6] The average number of moves was 1.59. The most common age to move was in the late teens and early 20s, with the average age of any move at 22.8 years. About 55 % of the sample moved either one or two times over a lifetime. We show the distribution of moves in the sample in Online Resource 1.

[place Table 1 about here]

Figure 1 shows a map of Ghana, with all cross-regional moves indicated by arrows from the origin to the destination. The map shows the density of all cross-regional origins and destinations of moves. Although women move to and from regions across the country and abroad, most moves in the sample are to the Greater Accra region. Moving from the Ashanti, Eastern, and Northern regions to the region of Greater Accra are the most popular cross-regional residential moves. This is partly a reflection of the data source in that all women were residing in Accra at the time of the interview, but reiterates the previously mentioned fact that 70 % of moves in Ghana are to urban areas.

[place Figure 1 about here]

[5] Measures of variables across data sets were not obtained in the same way for every variable. For example, the DHS asked, "Have you ever had a pregnancy that was terminated?" For the HAWS data, the participant was asked to list every pregnancy and identify the outcome as live, stillbirth, or lost. Reporting bias can act on these measures differently, which makes these rough rather than exact comparisons. Individual sample weights were used to calculate summary statistics of DHS variables.

[6] For consistency in both descriptive statistics and analysis, we regard a move to be a "true" move only if it was out of the neighborhood in which the woman was residing. This constituted 85 % of all moves; see Online Resource 1 for the distribution of all types of moves.

The migration history in the HAWS survey includes the location of the past three homes that a woman lived in prior to the current home where the study found her, the month and year of each move, the reason why she moved, and whether she knew someone at her destination when she moved. Figure 2 provides an overview of the migration patterns observed in the data and also the context for where and why women in this population are moving. Although about 55 % of women moved from Greater Accra (which includes the urban center of Accra), residential moves were observed from all regions of Ghana. The most common reason for moving was improved living conditions, followed closely by marriage. More than 70 % of women knew someone when moving: most commonly, a spouse. However, in many cases, women reported moving to unknown neighborhoods, with almost 30 % of women reporting not knowing anyone in the location to which they moved.

[place Figure 2 about here]

Analytical Methods

Total Fertility

The analytical work in this article is divided into three parts. In the first part, we investigate the effect of migration on the total number of children ever born. We use a Poisson model to compare the total fertility of those who had never moved with those who had moved within the area of Greater Accra and with those who had moved from another region. We also compare average cumulative children ever born by mother's age for our sample and the DHS data in order to compare migrants at destination with their nonmigrant counterparts at origin. All analyses were conducted in R (version 3.0.1) and Stata (version 12).

We conduct Poisson regressions with a log link to investigate whether having moved has an effect on total fertility (Eq. (1)).

$$Y_i \sim Poisson(\lambda_i). \quad (1)$$

Here, Y_i is one of three outcomes: the total number of children ever born, children ever born and still alive, or children born since 2005 and still alive. The incidence rate of birth, λ_i, is modeled by our explanatory variables of interest and individual covariates $\mathbf{X}_i$:

$$\lambda_i = \exp\left(\beta_0 + \beta_1 MovedWithinAccra_i + \beta_2 In\text{-}migratedFromOutsideAccra_i + X_i\gamma\right) \quad (2)$$

where $MovedWithinAccra_i$ is an indicator for whether the individual had moved but only within Accra, and $In\text{-}migratedFromOutsideAccra_i$ is an indicator for whether the individual moved from outside the Greater Accra region to inside the Greater Accra region. The parameters β_1 and β_2 are the parameters of interest—the effect of moving on completed fertility compared with those who had never moved. $\mathbf{X}_i$ is a vector of individual covariates including mother's age group, ethnicity, education (an indicator for completed at least middle school), and ever married. We also interact age group with education because the effect of age on fertility may differ across education groups. Move status was determined by whether an individual woman claimed to have ever moved outside the neighborhood that she was living in. Moves within the same neighborhood were not determined to be substantial enough to constitute a "true" move and thus were not counted as having moved. We calculate incidence rate ratios with robust standard errors.

Event-History Analysis for Pregnancy Outcomes

In the second part of the analysis, we conduct an event-history analysis using a person-year data structure. Each person-year between the ages of 15 and 47 and between the years of 1980 and 2009 constitutes an observation in the analysis. We chose these ages and years so that each pregnancy outcome would yield positive probabilities of occurring in our data (Chattopadhyay et al. 2006). Similar to Chattopadhyay et al. (2006), we chose a time interval of one year. Because we are interested in the effect of residential duration on reproductive health outcomes in a given year, we eliminate multiple pregnancy observations that were claimed to have happened in the same year.[7] We compare the risk of pregnancy, live birth, and pregnancy outcomes of those who had moved with a comparison group of never-movers.

The linear probability model is shown in Eq. (3).

$$\begin{aligned} Y_{it} = {} & \alpha_1 + \rho_1 Residence(0-24mo.)_{it} + \rho_2 Residence(25-48mo.)_{it} + \rho_3 Residence(49-72mo.)_{it} \\ & + \rho_4 Residence(>72mo.)_{it} + \mathbf{X}_{it}\beta + \mathbf{Z}_i\gamma + \varepsilon_{it}, \end{aligned} \quad (3)$$

where Y_{it} is a binary indicator variable for a pregnancy outcome for individual i in time t, $\mathbf{X}_{it}$ is a vector of individual time-varying controls, and $\mathbf{Z}_i$ is a vector of individual time-invariant controls.

Our parameters of interest are ρ_1, ρ_2, ρ_3, and ρ_4. $Residence(0–24mo.)_{it}$ is an indicator of whether individual i in year t had been living in their residence between 0 and 24 months, $Residence(25–48mo.)_{it}$ is an indicator of an individual i at time t living in their residence between 25 and 48 months, and similarly for the other residential duration–status indicators. $\mathbf{X}_{it}$ is a vector of time-varying covariates, including marital status, an indicator for whether the marriage occurred within the past year, mother's age group, an indicator for whether the woman already has a child, a dummy indicator for whether a previous child had died before time t, and the period of birth in five-year intervals to control for the time trend.[8] We include the dummy

[7] This could be possible if a woman has multiple stillbirths in the same year, for example. It could also be due to measurement error. However, whether the stillbirth happened once or twice in a person-year doesn't affect our analysis because the binary indicator of stillbirth for that person-year is 1, regardless. It is also rare, occurring in only 3.2 % of observations.

[8] Results were robust to including year fixed effects instead of period fixed effects.

variable for "already had a child" because first and higher-order births belong to different biological and life processes and because first-order births are associated with risk of abortion (Sundaram et al. 2012). These covariates were chosen based on the theoretical model and previous literature (Chattopadhyay et al. 2006; White et al. 2005). $\mathbf{Z}_i$ is a vector of time-invariant controls that includes both ethnicity and education (an indicator of having finished at least middle school). Again, we interact age group with education because the effect of age on a pregnancy outcome may differ across education groups.

Pregnancy and reproductive health indicators were obtained from detailed pregnancy histories of all women who had given birth. The year of the pregnancy was recorded for all pregnancies on the roster, as well as the outcome of the pregnancy. Induced abortion was differentiated from spontaneous abortion (lost birth or miscarriage) by a positive response to the question, "Did you or someone else put a hand to this pregnancy?" This question, which uses a common euphemism in Accra for induced abortion, was asked only if the outcome of the pregnancy was indicated as a lost birth. However, stigma of abortion is quite high in Ghana, resulting in potentially large measurement error owing to reporting bias. We thus also combine miscarriage and abortion for one estimate of lost birth from either cause. Separate results for miscarriage and abortion are shown in Online Resource 1.

Accounting for Selection Bias

Finally, in the third part of the analysis, we use individual fixed effects to account for the systematic differences between those who choose to move and those who do not. Using fixed effects accounts for all characteristics that are unique to that individual and constant over time, including unobserved characteristics such as fertility preferences, risk aversion, and general attitudes. Because we wish to analyze differences observed within each woman over time, our analysis is restricted to women who moved at least once. We thus compare the risk of pregnancy outcomes for each woman before and after moves and then average those over all women in the sample.

The regression Eq. (4) describes our linear probability fixed-effects model:

$$Y_{it} = \alpha_i + \rho_1 Residence(0-24mo.)_{it} + \rho_2 Residence(25-48mo.)_{it} + \rho_3 Residence(49-72mo.)_{it} \\ + \mathbf{X}_{it}\beta + \varepsilon_{it}, \tag{4}$$

where Y_{it} is a binary indicator of pregnancy outcome for individual i in year t; α_i is the individual fixed effect, which accounts for selection bias; $Residence(0–24mo.)_{it}$ is an indicator of whether individual i in year t had moved in the last 0–24 months (and similarly for $Residence(25–48mo.)_{it}$ and $Residence(49–72mo.)_{it}$); and $\mathbf{X}_{it}$ is the same matrix of time-varying covariates from the previous analyses. The reference category is a residential duration of more than 72 months.

Results

Total Fertility

We divide women in our sample into three migration status groups: those who never moved (N = 530), those who moved in their lifetime but only within Accra (N = 455), and those who moved in their lifetime across regions (N = 1,108). We show the descriptive statistics for the full data set in Table 2. Those who never moved were younger, were less likely to be married, and had fewer total children than those who had moved.

[place Table 2 about here]

Next, we examine the average cumulative children ever born for those in the HAWS data by migration status and compare with the DHS data by region (Fig. 3). The curves labeled

"Never moved," "In-migrated from outside Accra," and "Moved within Accra" come from the HAWS sample, and those labeled by region come from the DHS sample. We see remarkably similar profiles for the HAWS data profiles compared with those in the DHS who live in Greater Accra, regardless of move status. From age 15 to about 35, the observed profiles are directly atop of each other, but those of other regions are dramatically elevated, showing the contrast between rural and urban fertility patterns. A divergence occurs for the HAWS and Greater Accra DHS data following age 35, which may be due to selective, smaller sample sizes of women at those ages in the HAWS data.

[place Figure 3 about here]

Table 3 shows the results from the Poisson regression models for three outcomes: total children ever born, total children born and still alive, and total children born and still alive since 2005.[9] Table 3 shows the incidence rate ratios for these outcomes, with robust standard errors. The reference category is the group of those who had never moved. None of the estimates for migration status group were significant at the .05 level after the model was adjusted for covariates, including marital status (ever married or not), age, education, an interaction of age and education, and ethnicity. Goodness-of-fit chi-squared tests for all models were statistically insignificant, indicating that the Poisson model is appropriate and fits the data well.

[place Table 3 about here]

The predicted number of children ever born was 2.1 for all three migration status groups when all covariates were at their means. This prediction varied depending on women's characteristics. For example, an Akan woman over age 40 who has been married and did not finish primary school had predicted numbers of children of 5.1, 5.3, and 5.2 (respectively) for

[9] The distribution of the outcome of total children ever born by each migration status group is shown in Online Resource 1.

never-movers, moved within Accra, and in-migrated from outside Accra; and an Akan woman who is under 25, not married, and did finish primary school had a predicted number of children of 0.19, regardless of migration status.

Risk of Pregnancy and Pregnancy Outcome by Move Status

We create an event-history analysis to investigate the effect of moving on pregnancy in the first 0–5 years post-move. We compare those who moved in the past 0–24, 25–48, 49–72, and >72 months with the group of never-movers. We construct a panel data set, where one observation is a person-year between the ages of 15 to 47 and between the years 1980 and 2009. The final sample size for our data is 31,936 person-years, composed of 2,022 women.[10]

We generate our summary statistics and analysis based on this sample. Our sample contains a total of 3,989 pregnancies. Of these, 3,364 were live births, 520 were lost births (either miscarriage or induced abortions), and 105 were stillbirths. Of the 520 lost births, 206 were identified as induced abortions, and 314 were reported as miscarriages. In total, 350 (17.3 %) women reported at least one lost birth, and the number of lost births per 100 pregnancies was 13. Another 80 women (4.0 %) reported at least one stillbirth, and the number of stillbirths per 100 pregnancies was 2.6. A total of 147 women (7.3 %) reported having at least one induced abortion, and the number of reported abortions per 100 pregnancies was 5.2. Having multiple induced abortions is not uncommon in Ghana (Sundaram et al. 2012). A study of a hospital in Accra found that 37 % of the women in the sample who presented with complications from induced abortions had obtained a previous induced abortion (Adanu et al. 2005). The measure of abortions per 100 pregnancies is low in our sample compared with other measures from recent

[10] The process for how we obtained the sample size is described in the Online Resource 1.

urban surveys in Accra: specifically, the Women's Health Study of Accra (11.2/100 pregnancies), and a clinic-based surveillance survey using preceding birth technique (14.0/100 pregnancies), although neither study focused on the slum population (Oliveras et al. 2008). For this reason, for all of our analyses, we combine miscarriages and abortions. We show the separate analyses for miscarriages and abortions in Online Resource 1; results for both outcomes follow the same pattern as the combined measure.

Table 4 shows the descriptive statistics of person-years in the data set, by residential duration. For person-years with a shorter residential duration, women were younger, less likely to be married, and less likely to already have a child than those who had lived in the area longer. However, they were most likely to have married in the past year compared with any other duration and compared with those who had never moved. Women with a residential duration of 0–24 months or 25–48 months were the most likely to have a pregnancy, a live birth, an abortion, or a miscarriage.

[place Table 4 about here]

Because we create the person-year data set, we inevitably have pregnancy years occurring in the same year as moves. For person-years in which a pregnancy occurs, we can distinguish whether the pregnancy or the move came first in the year if both birth month and month of move are not missing.[11] However, for person-years in which a birth did not occur, it does not make sense to infer which event came first. Thus, we do not want to induce bias by categorizing our explanatory variable by our outcome variable. Therefore, the coefficient on ρ_1 should be interpreted as an association between a migration and pregnancy outcome that occurred in the same year, not a causal effect of moving on pregnancy.

[11] Month of move is missing for 84 % of all moves that happen in the same year as the current person-year. Birth month is missing for 25 % of all births. Death month is missing for 56 % of births who died since birth.

The results from the linear probability multivariate models for all outcomes are shown in Table 5. Logistic models were substantively similar to linear probability models, and results are shown in Online Resource 1. The risk of pregnancy for women who had moved in the past 0–24 months and 25–48 months (compared with those who had never moved) was elevated by 2.7 and 1.9 percentage points, respectively, with no significant change in risk of live birth. The risk of lost birth for women who had moved in the past 0–24 and 25–48 months was also highly significantly elevated—by 1.5 and 0.90 percentage points, respectively. There was no significant effect of any residential duration on stillbirth compared with never-movers. When all covariates were at their means, the change in risk of pregnancy represented an increase from 11.7 % for never-movers to 13.6 % for those with a residential duration of 25–48 months (risk ratio of 1.17), and the change in risk of lost birth represented an increase from 1.1 % for never-movers to 2.0 % for those with a residential duration of 25–48 months (risk ratio of 1.8). The increase in risk of lost birth was more than proportional to the increase in risk of pregnancy. By contrast, the increase in risk of live birth for the same groups was 10.3 % to 11.3 %—a risk ratio of 1.1, which is less than proportional to the increase in risk of pregnancy.

[place Table 5 about here]

Consistent with previous literature, the mother's age of 30 and older was negatively associated with pregnancy and live birth compared with those younger than age 25, for those with only primary education or less. Having completed at least middle school was negatively associated with pregnancy and lost birth in the lowest age group. Being married was positively associated with pregnancy and live birth, but not with lost birth or miscarriage. Having been married within the past year was also positively and strongly significantly associated with pregnancy and live birth.

We show the results graphically in Fig. 4 with parameter estimates and 95 % confidence intervals for each residential duration compared with those who never moved; the dark horizontal line indicates no change in risk from those who never moved. As residential duration increased, risk of pregnancy, live birth, and lost birth decreased. There was an elevated risk of pregnancy and lost birth for those with a residential duration of 0–24 and 25–48 months compared with those who had never moved, with no elevated risk of live birth.

[place Figure 4 about here]

Fixed-Effects Analysis

The results from the fixed-effects analysis, which accounts for selection bias, are shown in Table 6. As stated earlier, all women who never moved are excluded from this analysis. We find that the first 24 months of residence are associated with a 2.2 percentage point increase (17.7 %) in the likelihood of pregnancy. Subsequently, the likelihood decreases in magnitude when compared with a residential duration of more than 72 months.

[place Table 6 about here]

The same model was applied to pregnancy outcomes, including live birth, stillbirth, and any lost birth (either abortion or miscarriage). There was no significant association between any residential duration with live birth or with stillbirth. The association between the first 24 months of residence and lost birth was positive and significant, at 1.0 percentage points (61 %).

Consistent with previous research and theory, mother's age over 30 was negatively associated with all outcomes compared with age under 25, while being married was positively significantly associated with the likelihood of pregnancy and live birth (Brockerhoff and Biddlecom 1999; Chattopadhyaya et al. 2006). Already having a child was negatively associated with the likelihood of having another pregnancy, live birth, or lost birth.

Discussion

This article investigates the relationship between migration and reproductive health outcomes in the modern urban sub-Saharan setting of Accra. We use a unique data set on detailed pregnancy and migration histories collected as part of the Household and Welfare Study of Accra (HAWS) to investigate the effect of migration on the likelihood of pregnancy and live birth, and on the risk of induced abortion, stillbirth, and miscarriage.

We find no difference in total children ever born for those who had never moved, those who had moved within Accra, and those who had in-migrated from outside Accra. Conceptually, these results are consistent with both selection and adaptation mechanisms as influential factors in the impact of migration on sexual behavior and fertility. Those who move to an urban environment may be different than their rural counterparts in their desired fertility. For example, they may seek easier access to modern contraception that can help them reduce their completed fertility. They may desire to invest in better educational opportunities for their children and thus desire a smaller number of children to invest in. Alternatively (and perhaps concurrently), migrants quickly adapt to their new surroundings and adjust their desired fertility and behaviors to match urban natives at destination.

However, we do find an elevated increase of risk of pregnancy and lost birth in the 48 months after migration, although there is no significant increase in live birth in this time period. The change in probability of lost birth represents an increase from 1.1 % for never-movers to 2.0 % for those that had moved 25–48 months before—almost an 80 % increase. One of the concerns with observing pregnancy outcomes directly after the move is that women could already have been pregnant prior to the move. From this perspective, the results for the period

25–48 months after the move are interesting because the move had to have happened before the pregnancy began.

The findings presented in this article can be interpreted in a number of ways. First, women may increase sexual activity after a move because of their adaptation to the urban slum environment, subsequently find that they do not want the resulting pregnancy at that time, and terminate their pregnancy via induced abortion. Alternatively, sexual behavior may stay the same while desired fertility changes upon moving, resulting in more unwanted pregnancies. If contraception is not used and migration results in increased access to and knowledge of abortive measures, women may choose to use induced abortion to keep their fertility low. Third, the move may result in physical or occupational changes, such as an increase or decrease in weight gain or the carrying of heavy loads or bending, which are risk factors for miscarriage (Florack et al. 1993).

Although the results from the basic group comparisons are consistent with both adaption and selection theories, the same is not true for the fixed-effects models for which we are able to account for selection bias. We find that even after reducing the influence of selection, the likelihood of pregnancy is highest in the first 24 months of residence after a move. Subsequently, the likelihood decreases in magnitude and significance. After controlling for individual fixed effects as well as age, fertility characteristics, marital status, and a time trend, we find that the first 24 months of residence are associated with a 2.2 percentage point increase (17.7 %) in the likelihood of pregnancy. The association between the first 24 months of residence and lost birth was positive and significant, at 1.0 percentage points (61 %). These results are similar to those of the linear event-history model comparing movers with never-movers, which is evidence that selection is not the driving force in the effect of migration on pregnancy outcomes. The results are consistent with the theory of adaptation to the new environment as the cause of the increase in pregnancy and lost birth following a move.

This study has several limitations. The HAWS data are representative of women living in slums in Accra. As we show in this article, this group of women is highly migratory and differs from the Ghanaian average with respect to their education and assets. It is thus not clear whether the results presented would extend to the larger population of women in Ghana.

Additionally, although the level of detail of the HAWS data in regards to migration and pregnancy history is high in comparison with the DHS or other data sources, potential biases remain. First, the data collected in the survey represent the average slum population at a given point in time. By definition, this includes women who just moved into these areas, and women who move out of slums are not included. Thus, the results are representative only of women who stay long enough in the slum for observing completed fertility. If pregnancy or birth make women more likely to migrate out again, we may underestimate the true impact of migration; and if giving birth means that women become less mobile, the opposite would be true. Although the fixed-effects analysis accounts for selection bias, it does not account for women who out-migrate and are lost to follow-up. Because of the nature of the data, we do not have information on women who moved to Accra and subsequently moved away; and we are able to ascertain neither the frequency of such moves nor whether and in which direction this would bias our results.

Second, some women may not report abortion because of stigma, which can lead to reporting bias if the propensity to report is correlated with migrant status. Stigma of abortion is a significant problem in Ghana, and it is very likely that not all abortions were reported in the HAWS data (Sundaram et al. 2012).

Third, we may have residual confounding from omitted time-varying factors, such as health status. We also have no data on the reasons why women decided to obtain an abortion, whether this decision was based on health status or choice, or whether abortions were obtained in a clinical setting or in a clandestine setting.

Finally, because of the nature of the data, we can only make associations about pregnancy and pregnancy outcomes that occur for residential durations of 0–24 months. More research should be conducted to disentangle the temporal directionality of the two events among female migrants, for example, with in-depth qualitative interviews. However, for the estimates of residential duration of 25–48 months, we are sure that the move occurred before the pregnancy began. The pattern of high-to-low risk for pregnancy and lost birth outcomes also suggests that the estimates for 0–24 months after a move are indicative of the underlying trend that a move increases the risk of these fertility outcomes.

This study has important policy implications. Abortion has become more common in Ghana, especially among women aged 20–24. In the 2007 Ghana Maternal Health Survey, the number of abortions per 1000 women was 15 among those aged 15-49 and 25 among those aged 20-24. However, 30 % of abortions occurred in the respondent's home, thus increasing the risk of injury and morbidity to the mother (GSS 2009b). Almost one-half of all abortions obtained in Ghana are unsafe (Sundaram et al. 2012). Unsafe abortion is the second leading cause of maternal mortality in Ghana, at 350 maternal deaths per 100,000 live births (95 % CI, 210–630), which is higher than the average in the developing world (World Health Organization et al. 2012). Thus, from a public health point of view, targeting recent migrants by providing both easy access to contraception and information on public hospital services may improve maternal health outcomes. Other studies have connected the legalization of abortion with lower fertility trends

(Agyei-Mensah 2006; Finlay and Fox 2013). These studies have observed that the increase in modern contraception usage in Ghana has not kept pace with the observed declines in fertility, suggesting that the empirical gap could be explained by increased induced abortion. Abortion as a method of birth control has thus been explored as a possible means for women to reduce their completed fertility in Ghana. In this article, we show that a possible conclusion may be that recent migrants are at risk of such induced abortive measures, although more research should be conducted to fully understand the relationship between migration and induced abortion and miscarriage.

The Ghanaian experience may also inform the larger sub-Saharan African context. In sub-Saharan Africa, 14% of maternal deaths are due to unsafe abortion (WHO 2011). As sub-Saharan Africa's rapid urbanization continues, the concern over the welfare of migrants will become more and more important to policy-makers. Internal migration accounts for more than one-half the growth of cities in Africa (Barrios et al. 2006). One of the most significant trends in migration has been the entry of women into migration streams that had in previous decades been primarily male, with an increasing number of female migrants moving on their own (Martin 2003, Zlotnik 2003).

This article explores the association between migration and reproductive health outcomes in a modern urban slum setting of Accra, Ghana. Our analysis complements other research in the field of migration and reproductive health by providing evidence of an increase in risk of pregnancy and abortion for recent migrants. This research highlights the importance of implementing policy to improve urban migrant women's access to reproductive health care services to reduce unwanted pregnancies and mistimed births.

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Tables and Figures

Table 1 Sociodemographic characteristics of female residents of Accra aged 18–49 in the DHS (2008) and HAWS data sets

	DHS 2008[a] (N = 622[b])	HAWS (N = 1797[c])	2-Sample t Test p Value
Age (years)	29.996	28.91	.003
No Education (%)	0.084	0.237	<.0001
Only Primary School (%)	0.144	0.166	.113
At Least Middle School (%)	0.772	0.594	<.0001
Akan (%)	0.436	0.303	<.0001
Ewe (%)	0.164	0.112	.001
Ga (%)	0.234	0.246	.522
Other Ethnicity (%)	0.166	0.338	<.0001
Age at First Birth (years)	21.208	20.457	<.0001
Ever Married (%)	0.648	0.608	.054
Ever Terminated Pregnancy (%)	0.248	0.351	<.0001
Number Children Ever Born	1.689	1.607	.307
Up to 24 Months at Residence (%)	0.156	0.159	.965
25–48 Months at Residence (%)	0.175	0.193	.348
49–72 Months at Residence (%)	0.102	0.110	.620
>72 Months at Residence (%)	0.360	0.334	.141
Never Moved (%)	0.194	0.204	.662

[a] Ghana Demographic and Health Survey 2008. Sample restricted to women in the Accra region.
[b] Summary statistics calculated using individual sample weights.
[c] Sample restricted to women aged 18–49.

Table 2 Sociodemographic characteristics by respondent migration status

	Never Moved	Moved Within Accra	In-Migrated From Outside Accra
Sample Size	530	455	1,108
Ever Married, *N* (%)	250, 0.472	324, 0.712	807, 0.728
At Least Middle School, *N* (%)	336, 0.634	287, 0.631	557, 0.503
Ethnicity: Akan, *N* (%)	73, 0.138	124, 0.273	420, 0.379
Ethnicity: Ewe, *N* (%)	49, 0.092	47, 0.103	140, 0.126
Ethnicity: Ga, *N* (%)	291, 0.549	174, 0.382	89, 0.080
Ethnicity: Other, *N* (%)	117, 0.221	110, 0.242	459, 0.414
Age (years), Mean (SD)	31.02 (13.53)	35.55 (14.19)	33.63 (14.19)
Total Children Ever Born, Mean (SD)	1.68 (2.19)	2.44 (2.47)	2.20 (2.323)
Total Ever Born and Still Alive, Mean (SD)	1.52 (1.97)	2.21 (2.19)	1.96 (2.02)
Total Ever Born and Still Alive Since 2005, Mean (SD)	0.27 (0.56)	0.40 (0.71)	0.40 (0.64)

Note: Standard deviation is shown in parentheses.

Table 3 Completed fertility incidence rate ratios using Poisson regression of total children ever born, total alive children ever born, and total alive ever born since 2005

	Total Ever Born	Total Ever Born and Still Alive	Total Ever Born and Alive Since 2005
Moved Within Accra	1.026	1.025	1.215†
	(0.0486)	(0.0495)	(0.132)
In-Migrated From Outside Accra	1.013	0.993	1.045
	(0.0479)	(0.0483)	(0.105)
Ever Married	4.054***	4.263***	5.835***
	(0.403)	(0.397)	(0.732)
Age 25–29	1.651***	1.619***	0.814†
	(0.148)	(0.146)	(0.0998)
Age 30–40	2.739***	2.566***	0.610***
	(0.218)	(0.208)	(0.0762)
Age >40	4.156***	3.603***	0.0754***
	(0.323)	(0.278)	(0.0205)
At Least Middle School	0.616***	0.599***	0.757*
	(0.0616)	(0.0616)	(0.0849)
At Least Middle × Age 25–29	1.171	1.189	1.345†
	(0.153)	(0.159)	(0.224)
At Least Middle × Age 30–40	1.259*	1.352**	1.569**
	(0.142)	(0.158)	(0.262)
At Least Middle × Age >40	1.196†	1.328*	1.103
	(0.130)	(0.148)	(0.477)
Ethnicity: Ewe	1.051	1.069	1.061
	(0.0551)	(0.0553)	(0.119)
Ethnicity: Ga	1.069	1.044	1.110
	(0.0503)	(0.0493)	(0.112)
Ethnicity: Other	1.003	0.949	1.028
	(0.0462)	(0.0427)	(0.0941)
N	2,093	2,093	2,093

Notes: Coefficients displayed are exponentiated to reflect incidence rate ratios (for example, 1.026 is a 2.6 % increase in the rate of children ever born). Reference categories are never-movers, age <25, and Akan ethnicity. Robust standard errors are shown in parentheses.

$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 4 Sociodemographic characteristics by duration of residence

	Duration 0–24 Months	Duration 25–48 Months	Duration 49–72 Months	Duration >72 Months	Never Moved	Total
Age in Years, Mean (SD)	24.58	25.89	26.83	27.09	25.03	26.29
	(6.987)	(7.299)	(7.589)	(9.143)	(8.403)	(8.564)
At Least Middle School, *N* (%)	2,199	1,867	1,381	9,240	3,424	18111
	(0.597)	(0.599)	(0.595)	(0.546)	(0.582)	(0.567)
Married, *N* (%)	1,979	1,856	1,445	9,551	2,401	17232
	(0.537)	(0.596)	(0.622)	(0.564)	(0.408)	(0.540)
Married in Past Year, *N* (%)	470	215	109	871	245	1910
	(0.128)	(0.069)	(0.047)	(0.051)	(0.042)	(0.060)
Previous Child Died, *N* (%)	73	65	66	494	201	899
	(0.020)	(0.021)	(0.028)	(0.029)	(0.034)	(0.028)
Already Have Child, *N* (%)	1,717	1,693	1,373	9,256	2,573	16612
	(0.466)	(0.543)	(0.591)	(0.547)	(0.438)	(0.520)
Ethnicity: Akan, *N* (%)	248	226	140	696	99	1409
	(0.067)	(0.073)	(0.060)	(0.041)	(0.017)	(0.044)
Ethnicity: Ewe, *N* (%)	69	74	42	278	77	540
	(0.019)	(0.024)	(0.018)	(0.016)	(0.013)	(0.017)
Ethnicity: Ga, *N* (%)	92	78	64	577	505	1316
	(0.025)	(0.025)	(0.028)	(0.034)	(0.086)	(0.041)
Ethnicity: Other, *N* (%)	185	184	126	682	144	1321
	(0.050)	(0.059)	(0.054)	(0.040)	(0.024)	(0.041)
Pregnancy, *N* (%)	546	439	315	2077	612	3989
	(0.148)	(0.141)	(0.136)	(0.123)	(0.104)	(0.125)
Live Birth, *N* (%)	432	364	269	1,768	531	3364
	(0.117)	(0.117)	(0.116)	(0.104)	(0.090)	(0.105)
Lost Birth, *N* (%)	99	66	36	248	71	520
	(0.027)	(0.021)	(0.016)	(0.015)	(0.012)	(0.016)
Abortion, *N* (%)	39	29	11	94	33	206
	(0.011)	(0.009)	(0.005)	(0.006)	(0.006)	(0.006)
Miscarriage, *N* (%)	60	37	25	154	38	314
	(0.016)	(0.012)	(0.011)	(0.009)	(0.006)	(0.010)
Stillbirth, *N* (%)	15	9	10	61	10	105
	(0.004)	(0.003)	(0.004)	(0.004)	(0.002)	(0.003)
Observations	3,684	3,115	2,322	16,935	5,880	31,936

Table 5 Linear probability estimates for effect of residential duration on pregnancy outcome compared with those who had never moved

	Pregnancy (1)	Live Birth (2)	Lost Birth (3)	Still Birth (4)
Residence 0–24 Months	0.027***	0.010	0.015***	0.002
	(0.007)	(0.007)	(0.003)	(0.001)
Residence 25–48 Months	0.019*	0.010	0.009*	0.001
	(0.008)	(0.007)	(0.003)	(0.001)
Residence 49–72 Months	0.013	0.008	0.003	0.002
	(0.008)	(0.007)	(0.003)	(0.002)
Residence >72 Months	0.004	-0.001	0.004†	0.001
	(0.006)	(0.005)	(0.002)	(0.001)
Age 25–29	-0.003	-0.008	0.005	0.000
	(0.009)	(0.008)	(0.003)	(0.001)
Age 30–40	-0.056***	-0.055***	-0.002	0.001
	(0.009)	(0.008)	(0.003)	(0.001)
Age >40	-0.125***	-0.125***	-0.003	0.003
	(0.011)	(0.009)	(0.005)	(0.003)
At Least Middle School	-0.033***	-0.034***	0.001	-0.001
	(0.005)	(0.005)	(0.002)	(0.001)
At Least Middle × Age 25–29	0.030**	0.021*	0.006	0.002
	(0.011)	(0.010)	(0.005)	(0.002)
At Least Middle × Age 30–40	0.021*	0.023*	0.000	-0.001
	(0.010)	(0.009)	(0.004)	(0.002)
At Least Middle × Age >40	0.006	0.013	-0.005	-0.002
	(0.012)	(0.009)	(0.006)	(0.004)
Previous Child Had Died	0.023	0.022	0.002	-0.001
	(0.015)	(0.014)	(0.005)	(0.002)
Already Had Child	-0.008	-0.003	-0.006†	0.001
	(0.006)	(0.006)	(0.003)	(0.001)
Married	0.117***	0.111***	0.005†	0.002

Table 5, continued

	Pregnancy	Live Birth	Lost Birth	Still Birth
	(1)	(2)	(3)	(4)
	(0.007)	(0.006)	(0.003)	(0.001)
Married in Past Year	0.064***	0.062***	0.001	0.001
	(0.010)	(0.010)	(0.004)	(0.002)
1985–1989	-0.016	-0.016†	0.001	-0.001
	(0.010)	(0.009)	(0.004)	(0.002)
1990–1994	-0.040***	-0.048***	0.009*	0.000
	(0.010)	(0.009)	(0.004)	(0.002)
1995–1999	-0.071***	-0.074***	0.004	-0.002
	(0.009)	(0.009)	(0.004)	(0.002)
2000–2004	-0.067***	-0.074***	0.008*	-0.001
	(0.009)	(0.008)	(0.004)	(0.002)
2005–2009	-0.098***	-0.103***	0.006	0.000
	(0.009)	(0.008)	(0.004)	(0.002)
Ethnicity: Ewe	0.004	0.002	0.002	0.000
	(0.006)	(0.005)	(0.003)	(0.001)
Ethnicity: Ga	0.014**	0.014**	0.001	-0.001
	(0.006)	(0.005)	(0.003)	(0.001)
Ethnicity: Other	-0.010+	-0.003	-0.005*	-0.001
	(0.005)	(0.005)	(0.002)	(0.001)
Constant	0.153***	0.145***	0.006	0.002
	(0.011)	(0.010)	(0.004)	(0.002)
N	31,936	31,936	31,936	31,936

Notes: Coefficients displayed reflect parameter estimates based on a linear probability model. Reference categories are never-movers, age <25, 1980–1984, and Akan ethnicity. Clustered standard errors are shown in parentheses.
†$p < .10$; *$p < .05$; **$p < .01$; ***p ‹ .001

Table 6 Linear probability estimates using individual fixed effects of effect of residential duration on pregnancy outcomes

	Pregnancy (1)	Live Birth (2)	Lost Birth (3)	Stillbirth (4)
Residence 0–24 Months	0.022**	0.011†	0.010**	0.001
	(0.007)	(0.006)	(0.003)	(0.001)
Residence 25–48 Months	0.014†	0.012†	0.004	-0.001
	(0.007)	(0.006)	(0.003)	(0.001)
Residence 49–72 Months	0.010	0.011	-0.001	0.000
	(0.008)	(0.007)	(0.003)	(0.002)
Age 25–29	-0.006	-0.008	0.000	0.001
	(0.009)	(0.008)	(0.004)	(0.002)
Age 30–40	-0.119***	-0.100***	-0.019***	0.000
	(0.013)	(0.012)	(0.005)	(0.002)
Age >40	-0.264***	-0.232***	-0.031***	-0.001
	(0.019)	(0.017)	(0.008)	(0.004)
Previous Child Died	-0.006	-0.010	0.003	0.000
	(0.023)	(0.022)	(0.007)	(0.003)
Already Had Child	-0.180***	-0.173***	-0.007*	0.001
	(0.008)	(0.008)	(0.003)	(0.001)
Married	0.222***	0.211***	0.009†	0.002
	(0.012)	(0.011)	(0.005)	(0.002)
Married in Past Year	-0.026*	-0.021†	-0.004	0.000
	(0.012)	(0.012)	(0.004)	(0.002)
Period 1985–1989	0.062***	0.057***	0.006	-0.001
	(0.012)	(0.012)	(0.004)	(0.002)
Period 1990–1994	0.073***	0.056***	0.017***	0.000

Table 6, continued

	Pregnancy	Live Birth	Lost Birth	Stillbirth
	(1)	(2)	(3)	(4)
	(0.014)	(0.013)	(0.005)	(0.002)
Period 1995–1999	0.082***	0.066***	0.018**	-0.002
	(0.016)	(0.015)	(0.006)	(0.003)
Period 2000–2004	0.127***	0.100***	0.027***	0.001
	(0.019)	(0.017)	(0.008)	(0.003)
Period 2005–2009	0.132***	0.101***	0.031***	0.001
	(0.021)	(0.020)	(0.009)	(0.004)
N	22,307	21,021	5,859	1,548
Number of Clusters	1,174	1,085	296	72

Notes: Clustered standard errors are shown in parentheses. Coefficients displayed represent parameter estimates based on a linear probability model. All models include individual fixed effects. Reference categories are residential duration >72 months, age <25, and 1980–1984.
$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

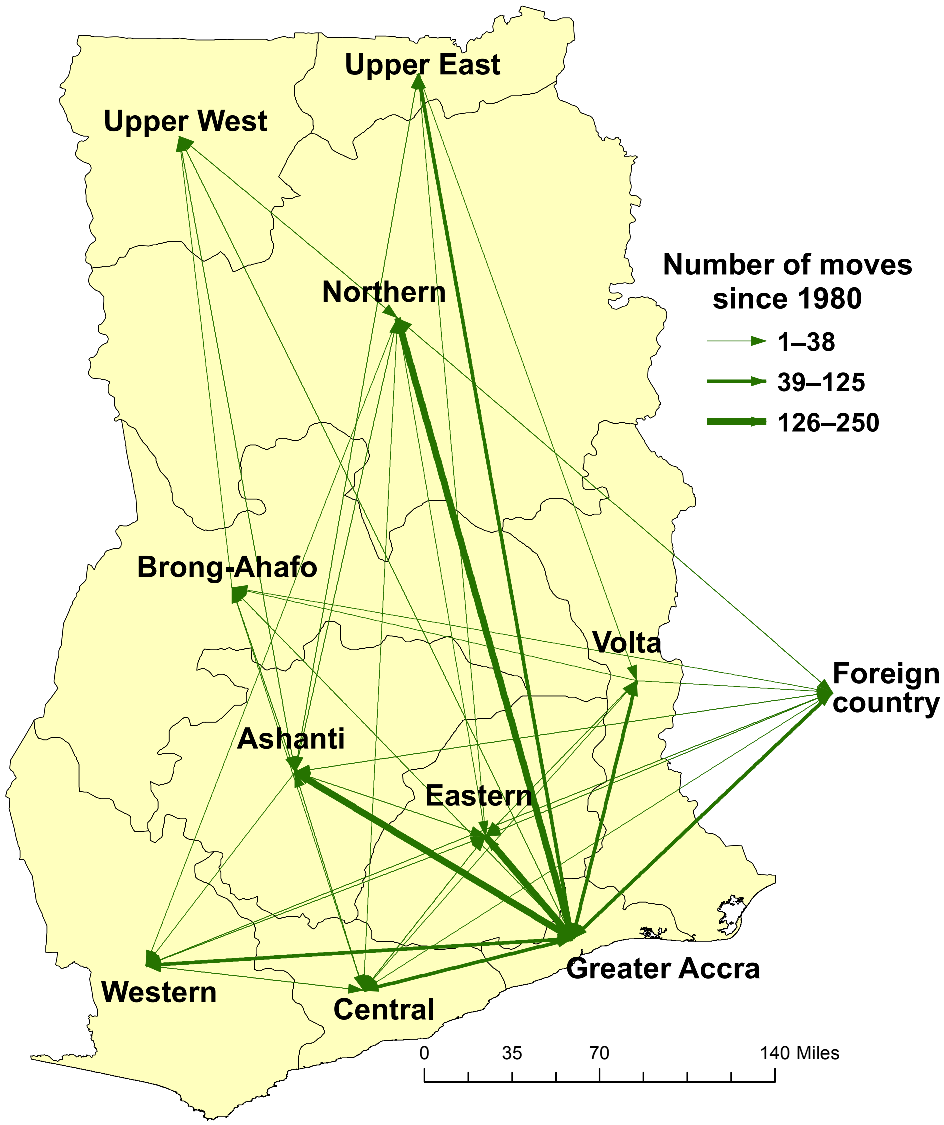

Fig. 1 Frequency of moves by origin and destination

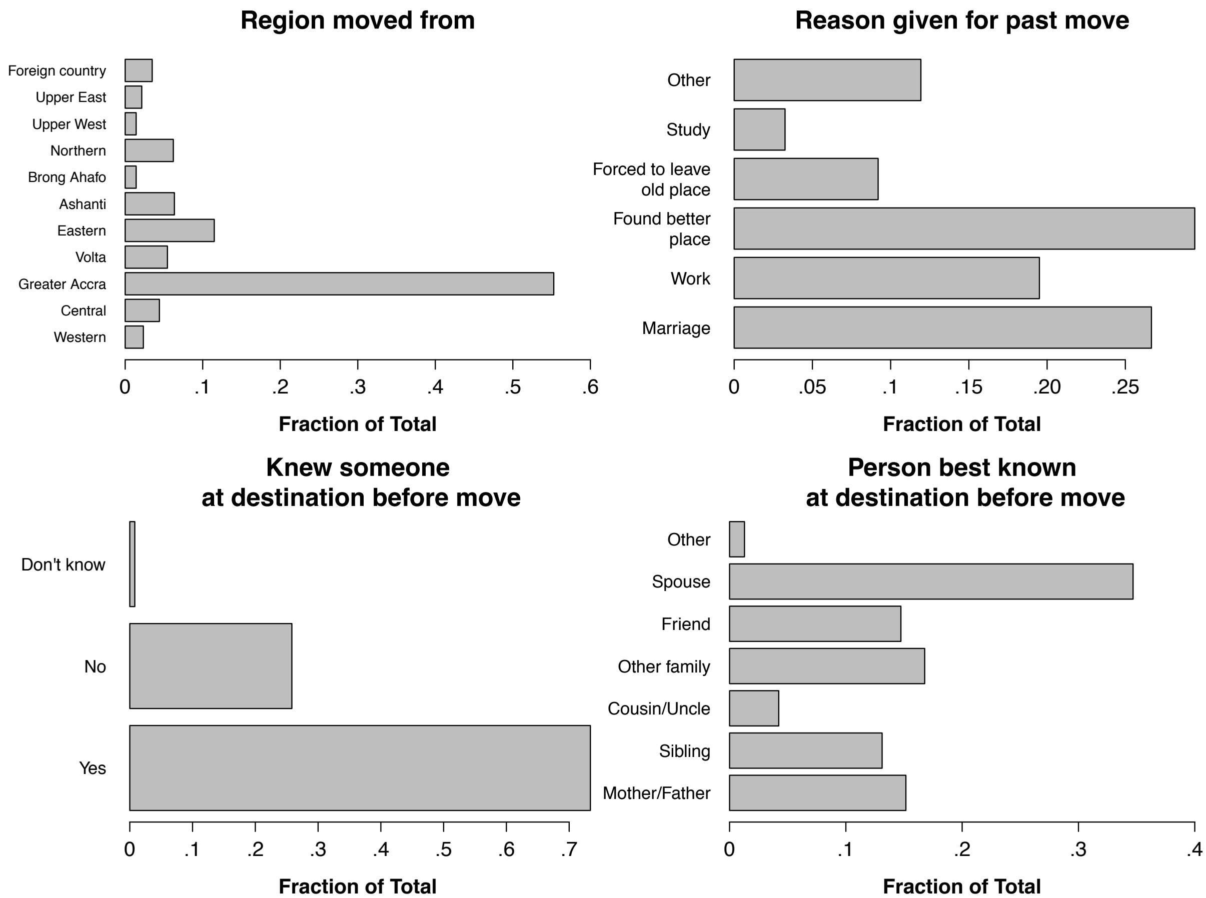

Fig. 2 Distributions of move characteristics in HAWS sample, clockwise starting from upper left: the region women moved from, the reason given for a past move, the person best known by at the destination before the move, and whether women knew anyone at the destination before the move

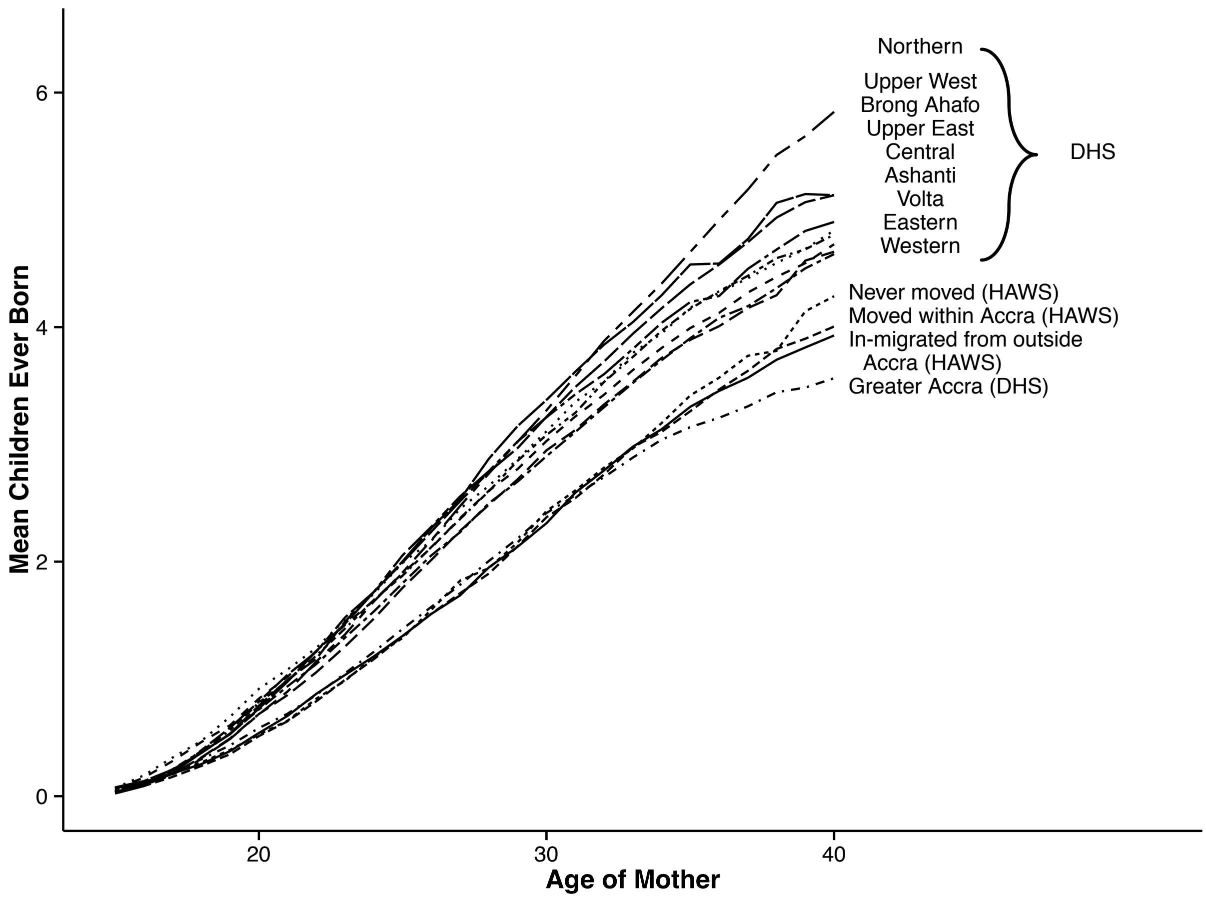

Fig. 3 Average cumulative children ever born in HAWS sample and DHS 2008 samples

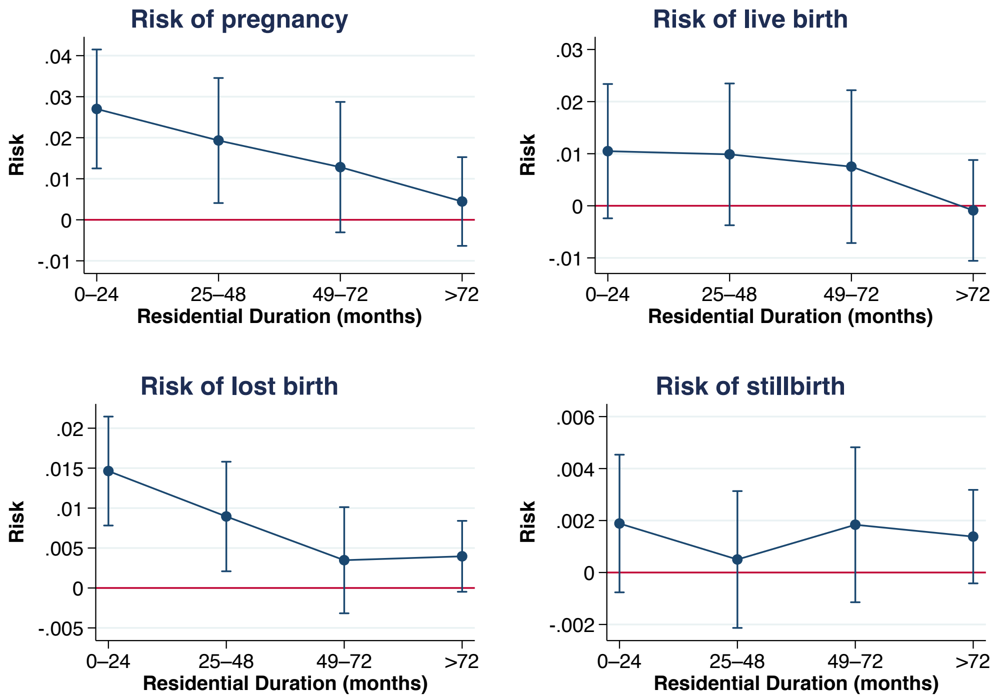

Fig. 4 Risk of fertility outcome by residential duration as compared with those who never moved. Point estimates and 95 % confidence intervals for risk of pregnancy or pregnancy outcome for movers compared with those who had never moved (linear probability models). The dark horizontal line is no change compared with never-movers

Online Resource 1

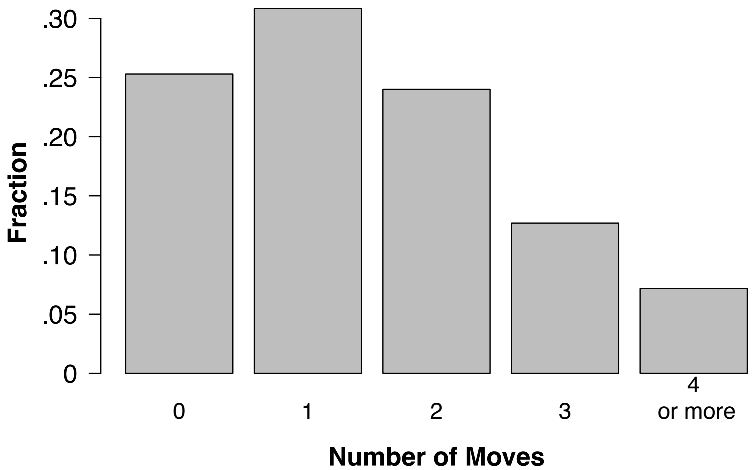

Fig. 5 Distribution of number of total lifetime moves among women in HAWS sample, N = 1,488

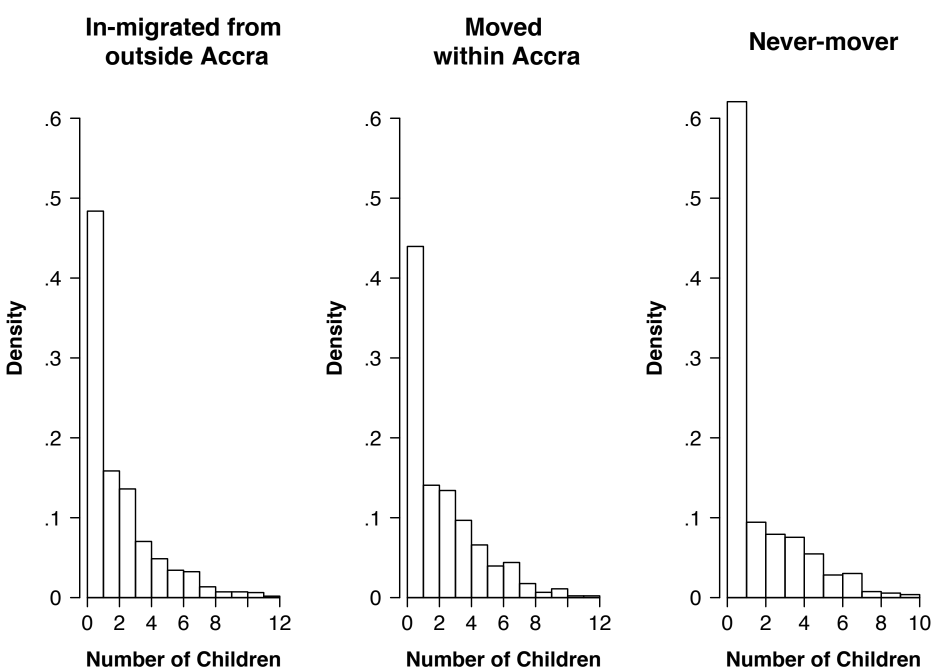

Fig. 6 Distribution of total number children alive by lifetime mover status

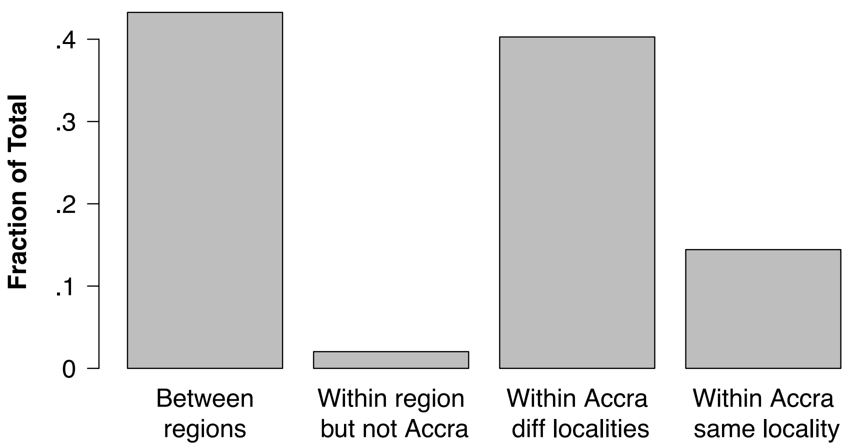

Fig. 7 Distribution of distance of moves identified in HAWS sample

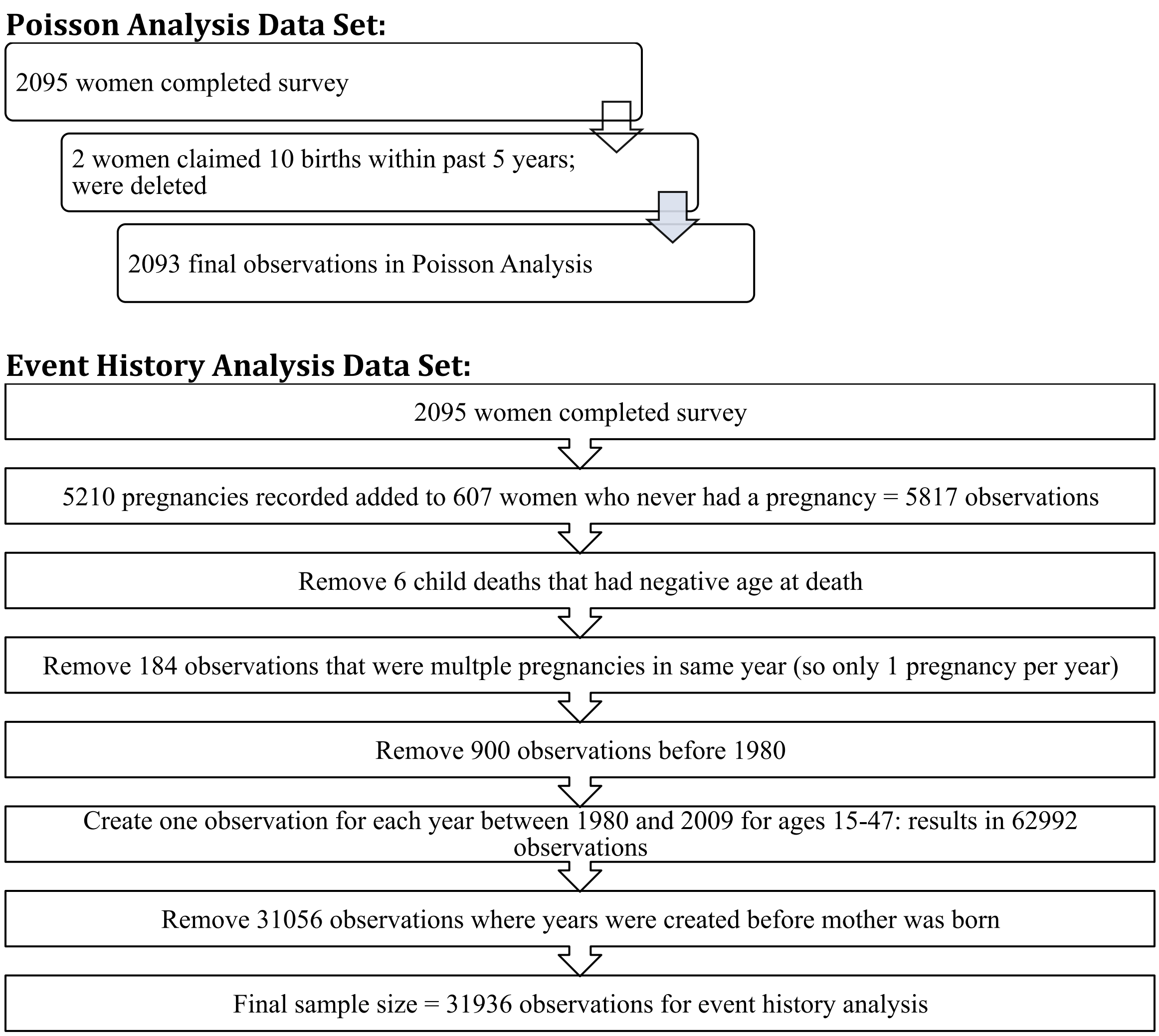

Fig. 8 Process for obtaining the final sample size for all analyses

Table 7 Linear probability estimates for effect of residential duration on lost birth, miscarriage, and abortion outcomes compared with those who had never moved

	Lost Birth	Miscarriage	Abortion
	(1)	(2)	(3)
Residence 0–24 Months	0.0146***	0.0107***	0.00390†
	(0.00348)	(0.00278)	(0.00210)
Residence 25–48 Months	0.00895*	0.00602*	0.00293
	(0.00350)	(0.00272)	(0.00221)
Residence 49–72 Months	0.00348	0.00475†	–0.00128
	(0.00339)	(0.00282)	(0.00195)
Residence >72 Months	0.00396†	0.00371*	0.000248
	(0.00226)	(0.00178)	(0.00143)
Age 25–29	0.00484	0.00671*	–0.00187
	(0.00334)	(0.00274)	(0.00187)
Age 30–40	–0.00186	0.000748	–0.00261
	(0.00298)	(0.00239)	(0.00171)
Age >40	–0.00305	0.00252	–0.00556***
	(0.00517)	(0.00494)	(0.00150)
At Least Middle School	0.00114	0.00224	–0.00110
	(0.00248)	(0.00168)	(0.00186)
At Least Middle × Age 25–29	0.00626	0.00223	0.00403
	(0.00479)	(0.00392)	(0.00265)
At Least Middle × Age 30–40	–0.000422	–0.00153	0.00111
	(0.00389)	(0.00308)	(0.00241)
At Least Middle × Age >40	–0.00486	–0.00597	0.00111
	(0.00578)	(0.00541)	(0.00209)
Previous Child Had Died	0.00238	0.00220	0.000178
	(0.00454)	(0.00400)	(0.00217)
Already Had Child	–0.00551†	–0.00554*	0.0000268
	(0.00293)	(0.00246)	(0.00161)
Married	0.00475†	0.00786***	–0.00310†

Table 7, continued

	Lost Birth	Miscarriage	Abortion
	(1)	(2)	(3)
	(0.00283)	(0.00231)	(0.00161)
Married in Past Year	0.000908	0.00133	–0.000422
	(0.00391)	(0.00343)	(0.00192)
1985–1989	0.00140	–0.00195	0.00335†
	(0.00360)	(0.00295)	(0.00202)
1990–1994	0.00861*	0.00463	0.00398*
	(0.00376)	(0.00312)	(0.00196)
1995–1999	0.00420	0.00135	0.00286+
	(0.00353)	(0.00308)	(0.00159)
2000–2004	0.00773*	0.00279	0.00494**
	(0.00366)	(0.00315)	(0.00173)
2005–2009	0.00575	0.000259	0.00549**
	(0.00352)	(0.00302)	(0.00171)
Ethnicity: Ewe	0.00175	0.000697	0.00105
	(0.00311)	(0.00210)	(0.00247)
Ethnicity: Ga	0.00106	0.00482*	–0.00375**
	(0.00276)	(0.00232)	(0.00143)
Ethnicity: Other	–0.00516*	–0.000227	–0.00494**
	(0.00244)	(0.00177)	(0.00173)
Constant	0.00591	–0.000974	0.00688**
	(0.00416)	(0.00320)	(0.00259)
N	31,936	31,936	31,936

Notes: Clustered standard errors are shown in parentheses. Reference categories are never-movers, age <25, 1980–1984, and Akan ethnicity.
$^{\dagger}p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Table 8 Logistic regression estimates for effect of residential duration on pregnancy outcome compared with those who had never moved

	Pregnancy (1)	Live Birth (2)	Lost Birth (3)	Stillbirth (3)
Residence 0–24 months	1.358***	1.199*	2.240***	2.131
	(0.0992)	(0.0926)	(0.424)	(1.050)
Residence 25–48 months	1.268**	1.188*	1.754**	1.412
	(0.0974)	(0.0956)	(0.366)	(0.789)
Residence 49–72 months	1.183*	1.143	1.291	2.042
	(0.0955)	(0.0982)	(0.309)	(1.041)
Residence >72 months	1.099	1.050	1.329†	1.827
	(0.0665)	(0.0659)	(0.229)	(0.795)
Age 25–29	0.934	0.883†	1.338	1.068
	(0.0601)	(0.0600)	(0.261)	(0.466)
Age 30–40	0.628***	0.598***	0.848	1.249
	(0.0462)	(0.0460)	(0.195)	(0.471)
Age >40	0.304***	0.251***	0.769	1.798
	(0.0425)	(0.0343)	(0.345)	(0.997)
At Least Middle School	0.718***	0.680***	1.073	0.793
	(0.0372)	(0.0366)	(0.175)	(0.277)
At Least Middle × Age 25–29	1.351***	1.322**	1.234	1.787
	(0.114)	(0.118)	(0.289)	(0.914)
At Least Middle × Age 30–40	1.231*	1.292**	1.020	0.796
	(0.116)	(0.125)	(0.289)	(0.413)
At Least Middle × Age >40	0.695	0.619†	0.688	0.733
	(0.164)	(0.155)	(0.380)	(0.551)
Previous Child Had Died	1.214	1.232†	1.148	0.836
	(0.144)	(0.152)	(0.300)	(0.487)
Already Had Child	0.936	0.977	0.721†	1.294
	(0.0524)	(0.0576)	(0.126)	(0.389)
Married	3.050***	3.461***	1.337†	1.699
	(0.216)	(0.267)	(0.229)	(0.677)

Married in Past Year	1.414***	1.460***	1.012	1.264
	(0.0913)	(0.0968)	(0.196)	(0.508)
1985–1989	0.916	0.907	1.094	0.724
	(0.0614)	(0.0623)	(0.318)	(0.316)
1990–1994	0.771***	0.700***	1.734*	0.962
	(0.0541)	(0.0502)	(0.468)	(0.425)
1995–1999	0.589***	0.548***	1.337	0.539
	(0.0400)	(0.0389)	(0.372)	(0.264)
2000–2004	0.615***	0.546***	1.658†	0.819
	(0.0409)	(0.0380)	(0.459)	(0.359)
2005–2009	0.438***	0.371***	1.478	0.833
	(0.0284)	(0.0257)	(0.403)	(0.353)
Ethnicity: Ewe	1.046	1.028	1.102	1.068
	(0.0618)	(0.0625)	(0.182)	(0.395)
Ethnicity: Ga	1.145**	1.166**	1.076	0.793
	(0.0598)	(0.0658)	(0.174)	(0.274)
Ethnicity: Other	0.890*	0.943	0.707*	0.631
	(0.0469)	(0.0516)	(0.114)	(0.227)
N	31,936	31,936	31,936	31,936

Notes: Odds ratios standard errors are shown in parentheses. Reference categories are never-movers, age <25, 1980–1984, and Akan ethnicity.
† $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$