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Maternal migration and child health: An analysis of disruption and adaptation processes in Benin

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Abstract

Children of migrant mothers have lower vaccination rates compared to their peers with non-migrant mothers in low-income countries. Explanations for this finding are typically grounded in the disruption and adaptation perspectives of migration. Researchers argue that migration is a disruptive process that interferes with women's economic well-being and social networks, and ultimately their health-seeking behaviors. With time, however, migrant women adapt to their new settings, and their health behaviors improve. Despite prominence in the literature, no research tests the salience of these perspectives to the relationship between maternal migration and child vaccination. We innovatively leverage Demographic and Health Survey data to test the extent to which disruption and adaptation processes underlie the relationship between maternal migration and child vaccination in the context of Benin—a West African country where migration is common and child vaccination rates have declined in recent years. By disaggregating children of migrants according to whether they were born before or after their mother's migration, we confirm that migration does not lower children's vaccination rates in Benin. In fact, children born after migration enjoy a higher likelihood of vaccination, whereas their peers born in the community from which their mother eventually migrates are less likely to be vaccinated. Although we find no support for the disruption perspective of migration, we do find evidence of adaptation: children born after migration have an increased likelihood of vaccination the longer their mother resides in the destination community prior to their birth.

Keywords

Migration; Child health; Vaccination; Africa; Benin

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1. Introduction

Despite significant improvements in global vaccination coverage in recent decades, vaccination rates have been declining in some sub-Saharan African countries (Miller and Sentz, 2006). In Benin, for example, the Demographic and Health Survey Program[1] reports that the percentage of one-year-olds fully vaccinated declined from 59 to 47 percent between 2001 and 2006. Because vaccination is a central component of efforts to reduce Africa's high levels of child morbidity, disability, and mortality (Brockerhoff and Derose, 1996; Defo, 1994), there is a clear need for research to identify the social factors that interfere with vaccination in the region.

Emerging evidence suggests that migration—which features prominently in Africa's demographic landscape—poses significant obstacles to ensuring that children are vaccinated in low-income countries. Despite the fact that migrants tend to be positively selected on economic and social characteristics (Borjas, 1989), children with migrant mothers are less likely to be vaccinated compared to their non-migrant peers in contexts as diverse as Ethiopia (Kiros and White, 2004), India (Kusuma et al., 2010), Mexico (Hildebrandt et al., 2005), and Nigeria (Antai, 2010).

Why do children of migrants experience a vaccination penalty? Most explanations are grounded in the disruption and adaptation perspectives of migration. Researchers argue that moving disrupts women's economic well-being, social networks, and ultimately their health-seeking behaviors, which, in turn, lowers their likelihood of securing preventative care, including immunizations, for their children (Kiros and White, 2004; Kusuma et al., 2010). Once women have the opportunity to adapt to their new community, their health behaviors, and thus their children's health outcomes, begin to mirror that of their non-migrant peers.

Despite the intuitive appeal of the disruption and adaptation perspectives, no research tests the salience of either to the association between maternal migration and child vaccination. This is due, at least in part, to the lack of detailed data on the various stages of women's migration, including preparation for the move, executing the decision to migrate, and settling into the destination community. One way to circumvent these data limitations is to compare the vaccination experiences of children born at various stages of the migration process. Previous research typically treats children whose mothers have ever migrated as a homogenous subpopulation, however, distinguishing between children born before and after their mother migrated can help clarify the extent to which migration disrupts children's receipt of vaccinations. Furthermore, accounting for the duration of time between a mother's move and her child's birth may uncover evidence of adaptation in the destination community, as reflected by additional gains in children's likelihood of vaccination.

Recognizing that the temporal nature of migration relative to other life events may be key to developing a nuanced understanding of its consequences (Portes and Walton, 1981), in this paper we leverage data on the timing of women's migration in relation to their children's birth to better understand how the migration process influences children's vaccination. The

1The full press release can be found here: http://dhsprogram.com/Who-We-Are/News-Room/Immunization-rates-decreasing-in-Benin.cfm.

exceptionally high levels of female migration in Benin—over 40 percent of reproductive-age women have migrated according to the 2006 Benin Demographic and Health Survey—and evidence of declines in vaccination rates in recent years make it an ideal setting for this study.

2. Background

2.1. Migration in sub-Saharan Africa

With some of the world's highest levels of internal and international migration (Ricca, 1989), migration is a critical dimension of sub-Saharan Africa's demographic profile. Africa's rapid urbanization is an important cause and consequence of migration; however, migration streams remain diverse throughout the subcontinent, with high levels of movement between rural areas (Mberu, 2005; Oucho, 1998). Spatial inequalities in employment opportunities, living conditions, and infrastructure, as well as major life transitions (e.g., marriage), are common motivators for individuals and their families to relocate (Adepoju, 2003). Historically, migration was dominated by men in Africa, but rates of female participation have risen steadily in recent decades (Adepoju, 2005; Posel and Casale, 2003). As a result, researchers increasingly recognize that African women are not only tied migrants who move with their husbands or other family members, but in many instances relocate autonomously in pursuit of economic and educational opportunities (Adepoju, 2003).

The migratory context in Benin—a small West African country—is, in many respects, indicative of the broader migration trends across sub-Saharan Africa as a whole. Migration is a salient part of life in Benin (Jenkins and Curtis, 2005) and often takes place as early as childhood and adolescence (Kielland, 2007; Ouensovi and Kielland, 2001). Although individuals and families in Benin migrate due to diverse circumstances, like most migration in Africa, it is typically pursued in hopes of securing a better livelihood and greater economic security. Because subsistence agriculture is a primary source of livelihood in Benin, environmental degradation is a prominent push factor (Doevenspeck, 2011). In addition to diverse motives, like other low-income countries, Benin's migration patterns display notable diversity (Smith-Greenaway and Thomas, 2014). For instance, among the nearly 40 percent of Beninese women who report having migrated, approximately15 percent relocated from an international context, 19 percent between rural areas, 30 percent between urban areas, and 36 percent moved between rural and urban areas.

Historically, research on migration in Africa focused on its implications for urbanization and economic development (Todaro, 1971). More recently, research on migration in Africa has expanded to explore its implications for health-related outcomes. Motivated by the region's high fertility rates and severe HIV/AIDS epidemic, extensive research focuses on the effect of migration on sexual and reproductive issues. For instance, several studies assess whether men's labor migration influences sexual behaviors, and as a result, their risk of sexually transmitted diseases (Brockerhoff and Biddlecom, 1999; Caldwell et al., 1997; Lurie et al., 1997). Other research explores whether migration—particularly women's movement from rural to urban areas—contributes to reductions in fertility by shifting women's reproductive desires and behaviors to align with those of their urban peers (Brockerhoff and Yang, 1994;

Caldwell and Caldwell, 1993; Timaeus and Graham, 1989). Research increasingly investigates how migration, particularly of mothers, influences children's well-being (Ford and Hosegood, 2005; Liang and Chen, 2007; Madhavan et al., 2012; Omariba and Boyle, 2010).

2.2. Maternal migration and child health

Increasing evidence suggest that children of migrants in low-income countries experience poorer health and higher risk of mortality compared to their peers with non-migrant mothers (Bocquier et al., 2010; Brockerhoff, 1995). Some of these disadvantages likely stem from the fact that children with migrant mothers are less likely to be vaccinated. For instance, a recent study shows that children born to rural–rural migrants are less likely to be fully vaccinated compared to their peers with rural non-migrant mothers in southern Ethiopia (Kiros and White, 2004). Antai (2010) found the same results when comparing Nigerian children of rural–urban migrants to their peers with rural non-migrant mothers. Studies from Asian and Latin American contexts corroborate these observations: among migrants in Delhi, India, children whose mothers migrated from rural areas receive substantially fewer vaccines compared to children with non-migrant peers, particularly children whose mothers moved to the area soon before the time of the interview (Kusuma et al., 2010). Furthermore, in Mexico, Hildebrandt et al. (2005) show that, although children of migrants experience better nutrition and survival, their vaccination rates are lower compared to their non-migrant peers.

2.2.1. Disruption and adaptation processes—Children with migrant mothers may be less likely to be vaccinated due to the fact that the physical act of relocating is a disruptive process that interferes with women's economic and social well-being, and, in turn, their willingness or ability to seek and secure healthcare. In terms of economic factors, although migrant women may eventually experience financial gains after relocating, they likely face financial strain around the time of moving due to additional expenses incurred from traveling and securing housing (Omariba and Boyle, 2010). Compounding these strains, women may stop working in anticipation of the move or have to search for new employment in the destination community. From this perspective, despite the fact that migrant women are likely positively selected and among the wealthiest and most highly-educated women in their origin community (Ssengonzi et al., 2002) and may even experience long-term economic gains as a result of migration, the cost of moving likely creates financial hardships in the short term. If this is the case, a woman's limited access to resources, and her need to actively search for employment, may divert her attention from priorities such as securing transport and taking time off from work to access healthcare for her children (Omariba and Boyle, 2010), thereby reducing her children's likelihood of vaccination.

In addition to placing women under financial strain, migration may also interfere with women's social networks and support systems. In contexts like Benin, where vaccination is not a ubiquitous practice, knowledge about the costs and benefits of such services is not widespread (Jheeta and Newell, 2008). In fact, in some Beninese communities misinformation about, and suspicion of, vaccination is widespread, leading parents to be reticent of immunizing their children (Fourn et al., 2009). In such a context, women often turn to kin and non-kin networks for information and, more importantly, assurance that vaccines will benefit—not harm—their children. Extensive research shows that social networks are instrumental in encouraging women to use health services in low-income contexts (Lindstrom and Munoz-Franco, 2006); however, migrant mothers' social networks may be disrupted precisely at the time when they need a strong social support system to navigate a new healthcare setting. Moreover, in the culturally, religiously, and ethnically diverse context of Benin, migrant mothers may face strained social interactions with service providers due to language or cultural barriers, or even discrimination. A review of research from several developing countries, including Benin, shows that a principal reason women do not vaccinate their children is health-service workers' unfriendly demeanor, which discourages women's use of services (Favin et al., 2012) and thus prevents children's receipt of vaccination.

Although the economic and social disruption associated with migration can lead to health disadvantages, these disadvantages should be short-lived and wane over time. From this perspective, the extent to which migration disrupts women's economic and social circumstances, and in turn their health-seeking behaviors, will lessen as their length of residence in the destination community increases. For example, the longer a woman has lived in the destination community, the greater opportunity she will have to achieve economic stability, develop a strong social network, and integrate into local institutions (Brockerhoff, 1994). From this perspective, children born immediately after migration may experience some disadvantages, but the vaccination rates of children born several months after their mothers relocate should mirror those of their peers with non-migrant mothers.

As outlined, the disruption and adaptation perspectives provide a clear picture of the possible hurdles that women and their children face *after* migration. However, these perspectives provide little insight into the potentially unique experiences of women in the months preceding migration, and the disadvantages children born during this period face. As a result, questions of how children born before migration fare remain unanswered. On the one hand, because vaccines should be given within the first few weeks of life, children born before migration should be vaccinated prior to the time of migration; thus, they may not be subject to migration's disruptive effects. On the other hand, children born prior to the move might be disadvantaged. Children whose mothers are about to migrate may experience financial constraints if their mother either voluntarily or involuntarily discontinues employment in preparation for the impending move. Furthermore, in anticipation of migration, women may reduce their household spending to save for the related costs they will incur, resulting in less disposable income to travel to and cover the cost of healthcare-related expenses around the time of their child's birth. This suggests that although children born well before migration may be entirely unaffected, children born immediately before migration might be less likely to be vaccinated due to pre-migration disruptions.

Adopting the disruption and adaptation perspectives of migration, we hypothesize the following:

H1 (a) Children born after migration will experience a lower likelihood of ever-vaccination compared to their non-migrant peers; however (b) a longer duration of residence in the destination community before the child's birth will increase the child's likelihood of ever-vaccination.

H2 In general, migration will not disrupt the likelihood of ever-vaccination among children born before migration occurs, but it could lower the likelihood of ever-vaccination among children born in the months immediately before migration.

3. Study context

Benin is an interesting context for studying the relationship between maternal migration and child vaccination due to (1) high levels of mobility among women and (2) relatively low rates of vaccination. Benin's high fertility rates correspond with the country's high levels of unmet need for family planning, resulting in the average woman having nearly six children (Institut National de la Statistique etde l'Analyse Économique (INSAE) [Bénin] et Macro International Inc., 2007). The high fertility rate combined with widespread poverty—nearly 40 percent of Benin's population live on less than $1.50 per day (United States Global Health Programs, 2011)—leads to a precarious health situation for women and their young children, as reflected in the country's persistently high levels of maternal and child mortality.

In recent decades, Benin has invested heavily in improving access to maternal and child healthcare, including providing no-cost malaria treatment for pregnant women, improving the quality of obstetric care, and increasing vaccine supply and availability (Atkinson and Cheyne, 1994). Benin's national immunization program is heavily supported by international agencies and programs, including USAID, Peace Corps, and GAVI (United States Global Health Programs, 2011). The combination of domestic and international support has enabled the Ministry of Health to provide immunizations for free or at minimal cost in local health clinics. Mobile immunization campaigns are also common in Benin. In these intensive village to village campaigns, healthcare workers fan across the country and set up vaccination clinics in an attempt to reach all eligible children—especially children living in districts where access to high-quality health services is limited.

Despite general availability of vaccines throughout Benin, uptake continues to be an issue in the country—a sizeable proportion of the child population remains vulnerable to vaccine-preventable diseases in a context where such diseases continue to circulate (Fourn et al., 2009). As one might expect, a woman's use of prenatal services is closely linked to her children's later immunization. Approximately three-fourths of mothers in our sample received prenatal care in their last pregnancy and gave birth in a health clinic under the supervision of a trained health professional; descriptive analyses confirm that these women are more likely to get their children vaccinated (Institut National de la Statistique etde l'Analyse Économique (INSAE) [Bénin] et Macro International Inc., 2007). Thus, identifying whether migration weakens women's connection to the formal health system, and, in turn, their likelihood of vaccinating their children, will help inform efforts to reverse Benin's recent declines in vaccination rates.

4. Data and methods

4.1. Data

Data for this study come from the 2006 Benin Demographic and Health Survey (BDHS). The BDHS is a nationally representative household survey that uses a probability sampling framework to draw a multistage, stratified random sample of Benin's population. Within the sampling framework, 750 clusters, based on census enumeration areas, are the primary sampling unit. The BDHS uses a household listing operation to randomly select a sample per cluster, resulting in a total sample of 17,511 households. Within each household, eligible men and women (age 15–49 years) are interviewed. The BDHS asks mothers detailed questions about each live birth using a retrospective birth history calendar, including information on receipt of vaccinations. The BDHS collected vaccination data only for children born in the five years preceding the survey; therefore, we focus on the 15,570 children born between 2001 and 2006.

We further restrict in three ways. First, because the BDHS asks mothers to report vaccination information only for children who are alive, we exclude the 8 percent of children who died before the survey. This may bias our sample toward healthier children, which could inflate our estimates of vaccination. However, we do not anticipate that this will influence the observed associations between maternal migration and ever-vaccination, which is the study's central focus. Second, we exclude the small percentage (7 percent) of children who are missing data on key variables. Third, we omit children younger than one month at the time of the survey. Although the World Health Organization (WHO) recommends that children receive some vaccinations immediately after birth, focusing our analyses on a slightly older sample ensures that children have adequate time to receive at least one vaccination. After these restrictions, our analytic sample includes 13,106 children age 1–59 months.

4.2. Measures

4.2.1. Ever-vaccination—In these analyses, we focus on a binary indicator of whether a child received any of the WHO-recommended vaccines (e.g., BCG, DT, polio, or measles). We focus on any vaccination, rather than full vaccination, for substantive and methodological reasons. Completely unvaccinated children are an exceptionally vulnerable group in Benin, given that they have no immunity in an epidemiologically risky environment burdened by vaccine-preventable diseases. Thus, it is important to identify the social factors that increase children's risk of being in this particularly vulnerable state. Furthermore, because vaccines are received at various times throughout the first year of life, an analysis of the number of vaccinations or completion would require data on the timing of each vaccination to facilitate our interest in timing processes; however, there is excessive missing data on the timing of vaccination. In fact, we have information on the timing of vaccination for merely 24 percent of the sample of ever-vaccinated children. It is worth noting, however, that among these children, 95 percent were reported to have been vaccinated at least once within the first month of life. Although this is a select group, the fact that most of these children were vaccinated "on time" suggests that vaccinated children born before their mother migrated were also immunized before migration. If some of the vaccinated children who were born before migration were actually immunized in the destination community, our estimates of the implications of migration would be downward biased, making the true estimates even more compelling.

We constructed our dichotomous indicator of ever-vaccination by combining data from vaccination cards and from mothers' recall when the vaccination card was not present. Previous research shows that mothers' recall is a reasonably accurate measurement approach (Langsten and Hill, 1998), and its use prevents severe sample attrition (Desai and Alva, 1998). In ancillary analyses, we control for whether vaccination data were collected from a mother's report versus a vaccination card; results did not differ from those shown here.

4.2.2. Maternal migration—The BDHS household survey records the migratory status of each household member, and among those who migrated, their duration of residence in their current home (recorded in months). We use information on migrant mothers' duration of residence, interview date, and the focal child's birth date to create a binary measure of whether children were born before or after their mother migrated. In addition to the sequencing of maternal migration and child birth, we also analyze the duration of time between the two events. This continuous measure captures the number of months that elapsed between maternal migration and the child's birth or—in the instance of children born before migration—between the child's birth and maternal migration. For example, a value of five indicates the child was born either five months before or after the move took place.[2]

4.2.3. Control variables—We control for a number of confounders to isolate the association between maternal migration and child vaccination. Ideally, we would have time-varying measures of women's economic and social indicators—including pre- and post-migration measures—to confirm whether migration disrupts women's socioeconomic well-being and social ties, and in turn their children's vaccination. Unfortunately, such data are not available, limiting our ability to identify the precise processes linking migration to child vaccination. However, the rich nature of DHS data enables us to control for a robust set of confounders at the time of the survey. In terms of child characteristics, we control for sex, age (measured in months), sibship size, and mother's age at the time of the child's birth. In terms of maternal and household characteristics, we control for mother's level of formal education, marital status, and ethnicity. As for household factors, we account for the number

2Among children of migrant mothers, on average, there is a 90-month span between birth and migration or vice versa; however, the standard deviation (79.01) shows tremendous heterogeneity—this further motivates our exploration of whether mothers' duration of residence, in addition to the ordering of migration and child birth, has distinct effects on child vaccination. The relatively high average duration of time between migration and birth is driven by the fact that many children in our sample were born several years after their mother migrated, thus the measure is right skewed. In separate sets of supplemental models (not shown but available upon request), we (1) focused on children whose mothers had migrated less than 10 years before their birth and (2) took the square root of the variable to normalize its distribution. Both sets of analyses produced results that are consistent in terms of size and significance as those shown here, suggesting the variable's distribution is not driving our findings. In addition to these analyses, we performed additional models that tested for threshold effects, including whether (1) having a mother migrate at a particular age or (2) a particular duration of time between maternal migration and the child's birth differentially influences the likelihood of ever-vaccination. To do so, we used the nlcheck diagnostic tool in Stata, which allowed us to test the assumption that the relationship between ever-vaccination and time between the child's birth and migration (or vice versa) is linear. The test categorizes the continuous timing variable into bins, refits the model with dummy variables representing each bin, and then performs a Wald test. The non-significant values for models testing linearity of (1) time between child's birth and mother's migration and (2) time between mother's migration and child's birth confirm we did not violate the linearity assumption and our continuous measurement of time is appropriate.

of children younger than five in the household and the DHS-constructed wealth index. The DHS asks each household head about their ownership of various assets (e.g., radio, television, refrigerator, bicycle, and car) and characteristics of the house (e.g., availability of electricity, source of drinking water, type of toilet facility, and number of rooms). The DHS aggregates these variables into a principal component factor analysis to score households by their economic status. The scores are used to categorize households into the five wealth quintiles we use here: poorest, poor, middle, rich, or richest (for a more detailed discussion, see Bollen et al., 2007; Filmer and Pritchett, 1999 Houweling et al., 2003).[3]

We also control for whether the child's birthplace was a rural or urban setting[4] and the child's region of residence at the time of the survey (Alibori, Atakora, Atlantique, Borgou, Collines, Donga, Kouffo, Littoral, Mono, Quémé, Plateau, or Zou).

4.2.4. Origin community—In analyses focused on the subsample of children with migrant mothers, we include a categorical indicator of the type of community from which the child's mother migrated: a community abroad (reference group), city, town, or countryside.

4.3. Methods

We begin the analysis with a descriptive look at the sample, including differences between children with migrant versus non-migrant mothers; we further distinguish between children born before versus after their mother moved. We then estimate a series of logistic regression models that appropriately handle the binary nature of the vaccination measure. All models are estimated with robust standard errors to address the fact that some children share the same households and clusters (i.e., primary sampling unit) and to ensure the models produce accurate *p*-values.

In a first set of multivariate analyses, we use the full sample to analyze the likelihood of ever-vaccination for children born before versus after migration compared to their peers with non-migrant mothers. Specifically, we test if children born after migration have lower vaccination rates (Hypothesis 1a), and if children born before migration, particularly several months before, are sheltered from migration's disruptive nature (Hypothesis 2). Our second set of multivariate analyses (Table 3) focus on the subsample of children with migrant mothers to test for evidence of adaptation. Specifically, we test whether a greater lapse of time between migration and a child's birth leads to a greater likelihood of vaccination (Hypothesis 1b).

3In ancillary analyses (not shown but available upon request) we used the continuous factor score of household wealth to test the robustness of our findings to measurement specifications and confirm that our central findings are robust to various measurements of household wealth.

4A small sample of children (5 percent) were born in rural areas but lived in urban areas at the time of the survey or vice versa; supplemental models (not shown) confirm that classification of these children according to their residential context at the time of the survey, not at birth, does not meaningfully influence either the size or significance of the results. Moreover, in supplemental models, rather than control only for the child's birth residence, we control for characteristics of mother's origin community and current residence. These results confirm two important findings. First, comparable proportions of children born in the mother's origin community live in rural contexts as their peers born in the destination community. That is, because streams of migration are diverse in Benin, children born before or after migration are not disproportionately living in rural or urban settings. Second, controlling for the origin and destination context rather than only the child's birth context does not significantly alter the findings.

5. Results

Table 1 provides descriptive statistics for the full sample of children and the subsamples by maternal migration. Among the full sample of children, approximately 10 percent have *never* been vaccinated, raising questions of the social barriers interfering with vaccination despite the general availability of immunizations in Benin. The level of unvaccinated children is slightly higher among non-migrants with approximately 12 percent of children with non-migrants unvaccinated. While children whose mothers migrated after their birth have comparable levels of vaccination as those whose mothers never migrated, the results show that children whose mothers moved before their birth experience an advantage: nearly 94 percent of these children are vaccinated. That is, contrary to prior literature and Hypothesis 1a, children born to women who have already migrated have higher levels of vaccination.

The descriptive results further show that migration is a common experience among mothers in Benin. Although more than one half of children have non-migrant mothers (58.50 percent), more than one-third (36.23 percent) have mothers who migrated before their birth, and approximately 5 percent have mothers who migrated after they were born. The descriptive statistics show that children of migrants generally share similar characteristics, regardless of whether migration occurred before or after their birth. However, in accordance with other research, children with migrant mothers are positively selected on traits positively associated with good health. For example, children of migrants have fewer siblings, have better-educated mothers who are more likely to be monogamously married, and are more likely to live in wealthier households compared to children of non-migrant mothers.

Are there are significant differences in children's likelihood of vaccination by maternal migration status after accounting for these differences? To assess our first hypothesis—whether migration is a disruptive life event (Hypothesis 1a)—Table 2 shows results of the logistic regression models predicting the odds of having ever been vaccinated. These results show that children whose mothers migrated before they were born—the phase we anticipate is the most disruptive to child vaccination—experience a *higher* likelihood of vaccination compared to their non-migrant peers. In fact, children born after migration have a 25.9 percent higher likelihood of being vaccinated compared to children with non-migrant mothers. To put the magnitude of the association into perspective, the boost in the likelihood of vaccination among children born after their mother migrated is comparable to the advantage associated with having a mother who attended primary school (estimate not shown).

Unlike their peers born in the destination community, children born in their mother's origin community are significantly less likely to be vaccinated than non-migrants. That is, contrary to Hypothesis 2, children whose mothers migrated after they were born have a 34.5 percent lower likelihood of vaccination than their peers with non-migrant mothers. A chi-square test confirms that the differences in vaccination between children whose mothers migrated before versus after their birth are statistically significant (14.26, $p < .001$). In accordance with prior research, these results show that mother's education and marital status are strongly associated with a higher likelihood of vaccination. Aligning with research showing ethnic and religious disparities in child mortality in Africa (Brockerhoff and Hewett, 2000), these findings also confirm strong disparities in vaccination receipt between ethnic groups.

The models shown in Table 3 incorporate the measure of duration of time between the child's birth and maternal migration to test for evidence of the adaptation perspective. Focused only on the subsample of children with migrant mothers, Model 1 includes a continuous measure (in months) of the duration of time that lapsed between the child's birth and maternal migration (or vice versa). These results provide support for the adaptation hypothesis: the longer the duration between mother's migration and child's birth, the greater the child's likelihood of vaccination.

Given the divergent vaccination profiles of children born before versus after their mother's migration, this effect could vary depending on when children were born in the migration process. In Models 2 and 3 we disaggregate children according to whether their mother migrated before or after they were born. Results in Model 2 show clear support for the adaptation perspective (Hypothesis 1b): the more months a mother spends in the destination community before giving birth, the greater her child's likelihood of vaccination. For example, a child born 12 months after the mother migrated has a greater likelihood of being vaccinated compared to a child born 11 months after the move. Although significant at the $p < .05$ level, it is important to note that the size of the effect is quite small—translating into less than one-half a percent increase in the likelihood of vaccination for each month between the mother's migration and the child's birth. This suggests that, although all children born after migration experience a vaccination benefit, women's opportunity to adapt to the destination community yields a further increase in the odds of vaccination, although the added advantage is small.

Turning to children whose mothers migrated after their birth, Model 3 shows that each additional month the mother stays in the child's birth community before moving is associated with a significantly lower likelihood of vaccination. That is, contrary to the notion that children born closer to the time of migration will experience some of its disruptive effect, children who live in the origin community for a longer period of time prior to migration experience the lowest likelihood of vaccination. In fact, each additional month a child spends in their mother's origin community is associated with a 3 percent lower likelihood of vaccination, meaning that children whose mothers postpone moving for an additional year experience almost a 40 percent lower likelihood of vaccination.

Because our analysis focuses on ever-vaccination, which could mask inequalities in the extent of vaccination between children, in supplemental models we reduced the sample to children 12 months or older (the age at which the WHO recommends complete vaccination) to analyze the likelihood of full vaccination (for a similar approach, see Kiros and White, 2004). These results are comparable in both size and statistical significance to those shown here, supporting the conclusions we make based on our analysis of ever-vaccination.

6. Discussion and conclusions

Migration is a salient aspect of life in Africa that has significant implications for children's health. Motivated by evidence that children of migrants are less likely to be vaccinated than their peers with non-migrant mothers (Antai, 2010; Hildebrandt et al., 2005; Kiros and White, 2004; Kusuma et al., 2010), we leverage data on when children were born in relation to their mother's migration to investigate the extent that disruption and adaptation processes are implicated in the vaccination context of Benin.

Unlike prior cross-sectional studies that group all children whose mothers have ever moved (before or after their birth) as having migrant mothers, in this paper, we leverage data on the timing of migration to disaggregate children according to whether (and if so, when) they were born before or after migration. The disruption perspective posits that children born immediately after migration, and possibly those born immediately before, should have the lowest likelihood of vaccination. We find little evidence that this is the case: children whose mothers completed their migration before their birth have a *higher* likelihood of vaccination compared to their peers with non-migrant mothers. Conversely, children whose mothers migrated after their birth have a lower likelihood of vaccination. And, contrary to the disruption hypothesis, the longer time lapse between their birth and migration, the less likely the child is to have received immunization. Together, these findings provide little support for the disruption perspective of migration. However, these results do align with the adaptation perspective: among children born after the mother migrates, each month that the mother has to settle into the new community prior to giving birth is associated with a significant increase in the odds of child vaccination.

These results challenge the notion that migration is a universally disruptive process, at least in terms of child vaccination. Instead, the findings cast a positive light on migration as a process that can advantage children in Benin. The disruption perspective of migration highlights the logistical challenges associated with moving; however, it pays little attention to migration's potential benefits. Many demographers agree that individuals and families use migration as a strategy to improve their economic (Stark, 1991; Todaro, 1976), social (Massey, 1990), and cultural (Kandel and Massey, 2002) conditions in ways that will improve their livelihood (De Jong, 2000). Situating our findings within this broader literature suggests that, in some sense, it is unsurprising that once the timing of migration is considered, women's migration is positively associated with child vaccination.

In particular, the economic and social benefits associated with migration may be central explanations for why children born after migration are more likely to be vaccinated compared to their peers born before migration and those with non-migrant mothers. From an economic perspective, migrants likely move to areas where they perceive better employment opportunities than their origin communities provide; migration may thus be associated with improvements in a family's economic prospects. Moreover, women may purposively migrate to neighborhoods with more satisfactory housing, access to infrastructure, and health services (Montgomery and Hewett, 2005). Although vaccinations are generally available in all provinces of Benin (United States Global Health Programs, 2011), the vaccination boost among children born after their mother migrates could be attributable to better outreach programs, higher-quality health services, and an overall more supportive health environment in some communities versus others. Unfortunately, it is not possible to confirm whether this is the case with our data. We have no data on the health context of communities from which women migrate and only limited data on the contexts where they settled, challenging our ability to confirm whether migration occurs from less to more advantaged communities, and whether improvements in healthcare drive our findings. There is a clear need for future work that catalogs the differences between women's origin and destination communities and explores whether these differences account for changes in women's and children's health.

In addition to greater resources and a more supportive health environment, another explanation for the vaccination boost associated with migration is that moving strengthens women's social ties and support system. That is, migrants often intentionally move to places where they have a support system that can offset the costs and risks associated with moving (Massey and Espana, 1987; Massey, 1990). In fact, a recent study of migrants in Benin confirms that more than two-thirds of recent migrants have at least one family member in the new setting, and one half indicated they have another relative who plans to migrate to the community (Doevenspeck, 2011). This suggests migration could strengthen women's social support. Based on evidence that having a mother with a strong social network is associated with considerable health benefits for children (Adams et al., 2002), greater support among migrants might explain the higher likelihood of vaccination among children born after migration.

Drawing from the broader literature on migration and health suggests that beyond its economic and social benefits, other mechanisms could also be at work. In some regards, the finding that children born after a mother's migration have higher vaccination is consistent with the well-documented "immigrant paradox": Hispanic migrants have superior health compared to their non-immigrant Caucasian peers (Guendelman, 1998; Hummer et al., 2007). A common explanation is that women whose children are predisposed to good health are the ones who migrate (Guendelman, 1998). Although we draw parallels with caution, extrapolating from this literature suggests that migrant women in Benin may be positively selected on unobserved traits that increase their likelihood of seeking and securing vaccinations for their children. This idea is supported by other work arguing that migrant women's personalities are characterized by greater motivation, higher aspirations, and stronger intentions compared to their non-migrant peers—each of which could increase their children's likelihood of vaccination (Kiros and White, 2004). Of course, because personality traits are stable across the life course, if selection processes are driving our findings, children born to mothers who eventually migrate should experience the same vaccination advantage, which is not the case.

Prospective data that follow women throughout their reproductive years and migratory experiences—cataloging the health experiences of all their children, born before or after migration—would be immensely valuable for gaining a clearer understanding of the mechanisms driving our study's findings. Such data would enable researchers to leverage diversity in sibling experiences to pinpoint the role that mother's migration plays in the likelihood of vaccination while accounting for observed and unobserved differences between mothers. Because the DHS collects vaccination information only for children born in the five years preceding the survey, only a small proportion of our sample (5.48 percent, $N = 299$ children in 146 families) have a sibling present in the data who was born on the other side of the migration process as themselves. Descriptive analyses of these families, however, do highlight within-family variation in vaccination among children born at different stages of a mother's migration. In fact, 10 percent of families have one sibling vaccinated and another unvaccinated. In over 6 percent of families, the child born after migration is vaccinated whereas the sibling born before migration is unvaccinated; the opposite is true in approximately 3 percent of families. That is, twice as many families with sibling-differences in vaccination status show that siblings born after migration are favored—corroborating our findings based on the full sample. Furthermore, among the majority of families in which both siblings were born before migration, the sibling who lived in the origin community longer is less likely to be vaccinated than the sibling who resided there for a shorter duration. There are few between-sibling differences in vaccination status among families in which both siblings were born after migration, reflecting the very small advantage associated with greater time between migration and birth (see Table 3). These exploratory analyses provide some support that our findings are not merely a reflection of unobserved differences between women, yet panel data that track siblings and numerous family transitions (e.g., residential moves, financial resources, and social support) are needed to provide a thorough comparison of siblings over time and the family processes that contribute to within-family inequality.

In addition to rich panel data, data that simultaneously tracks changes in family's community contexts over time would facilitate important research on whether environmental factors underlie the divergent experiences of children at various stages of the migration process. In ancillary analyses, we explored whether the degree of urbanization in women's origin versus destination communities helps explain the divergent experiences of children born before versus after migration. We found no evidence that it does. However, the degree of urbanization is a weak indicator of a community's health environment (Van de Poel et al., 2007); a more thorough investigation of community-level processes in origin and destination communities may yield a different conclusion.

Although future work is needed to identify the processes underlying the results shown here, this study lays the groundwork for recognizing that the temporal nature of migration in relation to other life events is relevant to understanding its consequences. Whereas previous research treats children with migrant mothers as a homogenous group and concludes that all children of migrants are disadvantaged, we show that a different story emerges once we disaggregate children according to their birth before or after migration. In fact, if we had adopted the traditional approach of classifying all children whose mothers had ever-migrated at the time of the survey as having a migrant mother, we would have falsely concluded that migration has a non-significant relationship with vaccination in Benin (estimates not shown, but are available upon request). Future research must pay close attention to the timing of migration in relation to other life events to uncover associations that may otherwise be overlooked.

The fact that we find that children born after their mother migrated have a higher likelihood of vaccination can be read as good news. Additionally, the child health advantages associated with migration appear to accumulate as the duration of women's residence in the destination community lengthens prior to their giving birth. This finding stands in contrast to recent evidence that some migrants in low-income countries live in unfavorable conditions that increase their children's mortality risk as their duration of residence lengthens (Omariba and Boyle, 2010; Smith-Greenaway and Thomas, 2014). Of course, even though our study results suggest that women better secure immunizations for their children the longer they live in the destination community, this advantage may not translate into better physical health outcomes for children. Future research is needed to simultaneously analyze the associations between the timing of maternal migration and multiple indicators of child health.

Although this paper leaves much for future research, our results confirm that once the timing of migration is considered, it appears to be less of a disruptive life event and more of a strategic decision that women use to improve their families' well-being, including receipt of preventative care. Planning and controlling childbearing is challenging enough for African women, let alone coordinating it with migration. However, it appears that women who give birth after they reach their destination community and have several months to settle are in the best position to safeguard their children's health. Thus, efforts to help migrants settle into their destination community quickly will allow children to fully benefit from their mother's migration. Furthermore, intervention programs targeting families in the most impoverished communities—families who are unable to migrate in pursuit of more favorable circumstances—may be particularly effective strategies for increasing child vaccination coverage in Benin, and potentially other African contexts.

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Table 1

Descriptive statistics for full sample and subsamples of children by maternal migration. *Source:* Benin DHS 2006.

	Full sample %/Mean (SD)	Non-migrant %/Mean (SD)	Migrated before child born %/Mean (SD)	Migrated after child born %/Mean (SD)
Ever-vaccination	90.23	88.28	93.62 *	89.28
Maternal migration				
Nonmigrant	58.50			
Migrated before child born	36.23			
Migrated after child born	5.27			
Time between migration and child birth			17.76 (13.98)	102.44 (79.55)
Child characteristics				
Female	49.49	49.56	50.59	50.02
Child's age in months	28.50 (15.83)	28.77 (15.84)	34.49 (14.72) *	27.19 (15.76) *
Sibship size	4.05 (2.34)	4.22 (2.42)	3.22 (2.09) *	3.90 (2.22) *
Mother's age at child's birth	27.09 (6.37)	26.92 (6.55)	25.33 (6.17) *	27.64 (6.04) *
Maternal characteristics				
Years of school				
Marital status	1.25 (2.74)	0.84 (2.25)	1.91 (3.08) *	1.79 (3.19) *
Monogamous (ref)	55.78	52.20	61.95 *	61.62 *
Polygynous	40.01	43.52	29.20 *	34.97 *
Never married	2.03	2.01	3.98 *	1.78
Widowed	0.94	0.97	1.18	0.86
Divorced/separated	1.24	1.30	3.69 *	0.77 *
Ethnicity				
Adja (ref)	17.77	17.07	15.93	19.04 *
Bariba	9.71	13.38	4.87 *	3.91 *
Dendi	3.15	4.31	1.18 *	1.67 *
Fon	39.71	34.38	39.68	48.88 *
Yoa/Lokpa	4.12	2.94	7.96 *	5.65 *
Betamaribe	8.32	8.75	13.72 *	7.56 *
Peulh	6.55	9.23	2.65 *	2.28 *
Yoruba	10.14	9.38	13.57 *	10.41
Other	0.53	0.56	0.44	0.60
Household & community characteristics				
Number of children five years and younger	2.26 (1.33)	2.44 (1.47)	1.89 (1.13) *	2.09 (1.09) *
Household wealth				
Poorest (ref)	23.81	27.63	17.86 *	20.62 *

	Full sample %/Mean (SD)	Non-migrant %/Mean (SD)	Migrated before child born %/Mean (SD)	Migrated after child born %/Mean (SD)
Poor	21.26	23.55	16.22 *	18.12 *
Average	20.80	21.86	16.37 *	19.21 *
Rich	19.15	17.70	22.71 *	19.21
Richest	14.98	9.26	26.84 *	22.84 *
Rural birth community	64.39	70.15	52.80 *	57.41 *
Region of residence				
Alibori	8.13	13.19	0.32 *	0.95 *
Atakora	9.48	11.43	11.08	6.16 *
Atlantique	11.29	8.74	18.22 *	14.33 *
Borgou	10.48	11.56	12.24	8.45 *
Collines	6.88	6.22	6.27	7.98 *
Donga	8.32	9.82	4.37 *	6.63
Kouffo	5.13	4.09	9.18 *	6.26 *
Littoral	6.15	3.94	4.81	9.91
Mono	6.46	6.78	6.85	5.82 *
Quémé	11.99	9.37	14.56 *	16.11 *
Plataeu	4.98	5.08	3.06 *	5.07
Zou	10.72	9.78	9.04	12.34 *
Migrant mother's origin community				
Abroad (ref)			14.92	15.43
City			34.75	29.14
Town			20.16	18.49
Countryside			30.16	36.94

*$p < 0.05$ from tests of equal means (*t*-test) or proportions (chi-square) compared to non-migrants.

Table 2

Analyzing disruption perspective: logistic regression results of the associations between maternal migration timing and ever-vaccination among full sample. *Source:* Benin DHS 2006.

	OR	Coeff	SE
Maternal migration			
Nonmigrant	–		
Migrated before child born	1.259	0.230 *	0.091
Migrated after child born	0.655	−0.423 **	0.151
Child characteristics			
Female	1.050	0.048	0.050
Child's age in months	1.005	0.005 **	0.002
Sibship size	1.002	0.002	0.024
Mother's age at child's birth	0.996	−0.004	0.009
Maternal characteristics			
Years of school	1.093	0.089 **	0.028
Marital status			
Monogamous (ref)	–		
Polygynous	1.191	0.175	0.242
Never married	1.501	0.406	0.381
Widowed	0.833	−0.183	0.311
Divorced/separated	0.905	−0.100	0.067
Ethnicity			
Adja (ref)	–		
Bariba	0.959	−0.042	0.347
Dendi	0.508	−0.677 *	0.334
Fon	1.995	0.691 **	0.256
Yoa/Lokpa	0.645	−0.439	0.376
Betamaribe	0.529	−0.636	0.372
Peulh	0.198	−1.622 ***	0.327
Yoruba	1.230	0.207	0.260
Other	0.946	−0.055	0.531
Household & community characteristics			
Number of children five years and younger	0.895	−0.111 ***	0.031
Household wealth			
Poorest (ref)	–		
Poor	1.471	0.386 ***	0.079
Average	2.148	0.764 ***	0.094
Rich	2.481	0.909 ***	0.132
Richest	5.524	1.709 ***	0.233
Rural birth community	0.951	−0.050	0.085

	OR	Coeff	SE
Region of residence			
Alibori (ref)	–		
Atakora	1.217	0.197	0.180
Atlantique	0.982	−0.018	0.260
Borgou	1.047	0.046	0.171
Collines	0.573	−0.557*	0.229
Donga	0.576	−0.552	0.327
Kouffo	1.229	0.206	0.161
Littoral	1.351	0.301	0.359
Mono	2.485	0.910*	0.392
Quémé	0.475	−0.745*	0.310
Plataeu	0.288	−1.246***	0.236
Zou	0.785	−0.242	0.398
Constant		2.068***	0.340
Model Fit			
Log-likelihood	−3733.48		

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Analyzing the adaptation perspective: logistic regression results of the associations between maternal migration timing and ever-vaccination among migrant subsample. *Source:* Benin DHS 2006.

	Migrant subsample								
	Model 1			**Model 2 – migrated before child born**			**Model 3 – migrated after child born**		
	OR	**Coeff**	**SE**	**OR**	**Coeff**	**SE**	**OR**	**Coeff**	**SE**
Maternal migration									
Migrated before child born	–			–			–		
Migrated after child born	0.599	−0.513**	0.159	–			–		
Time between migration and child birth	1.002	0.002*	0.001	1.002	0.002*	0.001	0.968	−0.032*	0.013
Controls									
Child characteristics									
Female	1.158	0.147	0.093	1.240	0.215*	0.094	0.896	−0.109	0.362
Child's age in months	1.004	0.004	0.004	1.005	0.005	0.004	1.015	0.015	0.013
Sibship size	0.995	−0.005	0.045	0.991	−0.009	0.046	1.013	0.013	0.097
Mother's age at child's birth	0.975	−0.026	0.015	0.972	−0.028	0.016	0.971	−0.030	0.040
Maternal characteristics									
Years of school	1.033	0.033	0.039	1.029	0.029	0.042	1.088	0.084	0.089
Marital status									
Monogamous (ref)	–			–			–		
Polygynous	0.565	−0.190	0.134	0.883	−0.124	0.140	0.482	−0.730*	0.343
Never married	1.124	0.117	0.557	0.702	−0.354	0.543	1.218	0.197	0.339
Widowed	4.031	1.394	1.101	3.004	1.100	1.107	0.739	−0.303	0.41
Divorced/separated	0.683	−0.382	0.373	0.456	−0.784	0.405	1.157	0.145	0.793
Ethnicity									
Adja (ref)	–			–			–		
Bariba	2.972	0.589	0.459	1.378	0.321	0.422	11.683	2.458*	1.210
Dendi	1.033	−0.570	0.618	0.762	−0.272	0.698	0.117	−2.144*	0.918
Fon	1.010	1.089***	0.288	3.009	1.102***	0.307	2.773	1.020	0.526

	Migrant subsample								
	Model 1			Model 2 – migrated before child born			Model 3 – migrated after child born		
	OR	Coeff	SE	OR	Coeff	SE	OR	Coeff	SE
Yoa/Lokpa	0.337	0.033	0.457	0.962	−0.039	0.482	1.647	0.499	0.884
Betamaribe	2.434	0.010	0.391	0.806	−0.215	0.428	3.149	1.147	0.831
Peulh	3.027	−1.086**	0.414	0.266	−1.325**	0.468	1.118	0.112	0.829
Yoruba	1.008	0.889*	0.364	1.969	0.678	0.401	8.661	2.159**	0.693
Other	1.393	1.108	1.225	2.198	0.787	1.241	1.412	0.345	1.605
Household & community characteristics									
Number of children five years and younger	2.087	0.008	0.039	0.999	−0.001	0.042	1.128	0.121	0.109
Household wealth									
Poorest (ref)	–			–			–		
Poor	2.417	0.331*	0.137	1.387	0.327	0.168	1.825	0.602	0.386
Average	5.674	0.736***	0.150	2.071	0.728***	0.172	3.285	1.189**	0.376
Rich	1.011	0.882***	0.183	2.302	0.834***	0.191	4.140	1.421**	0.544
Richest	0.302	1.736***	0.233	5.816	1.761***	0.270	7.902	2.067**	0.624
Rural birth community	0.399	0.011	0.140	0.972	−0.028	0.174	1.590	0.463	0.327
Region of residence									
Alibori (ref)	–			–			–		
Atakora	0.379	−1.198	0.625	0.459	−0.779	0.623	0.086	−2.451	1.253
Atlantique	0.183	−0.918	0.753	0.556	−0.588	0.735	0.160	−1.830*	0.863
Borgou	0.299	−0.969	0.694	0.575	−0.554	0.668	0.070	−2.661*	1.295
Collines	0.377	−1.697*	0.736	0.240	−1.426	0.744	0.097	−2.335	1.368
Donga	0.688	−1.208	0.878	0.384	−0.958	0.803	0.153	−1.880	1.061
Kouffo	2.154	−0.975	0.741	0.566	−0.569	0.698	0.096	−2.342*	1.140
Littoral	0.131	−0.374	0.792	0.785	−0.242	0.771	4.572	1.520	0.857
Mono	0.136	0.767	0.992	4.095	1.410	1.281	0.741	−0.299	1.063
Quémé	0.265	−2.030**	0.774	0.162	−1.818*	0.779	0.078	−2.546*	1.270
Plataeu	1.200	−1.992*	0.834	0.182	−1.704*	0.807	0.055	−2.905*	1.291

	Migrant subsample								
	Model 1			**Model 2 – migrated before child born**			**Model 3 – migrated after child born**		
	OR	**Coeff**	**SE**	**OR**	**Coeff**	**SE**	**OR**	**Coeff**	**SE**
Zou	1.331	−1.330	0.879	0.287	−1.247	0.866	0.298	−1.210	0.902
Origin community									
Abroad (ref)	–			–			–		
City	1.033	0.182	0.233	1.001	0.001	0.240	2.387	0.870	0.490
Town	1.331	0.286	0.183	1.098	0.093	0.215	3.610	1.284*	0.552
Countryside	1.033	0.033	0.159	0.877	−0.132	0.176	1.865	0.623	0.375
Constant		3.055***	0.759		3.025***	0.805		2.297	1.304
Model Fit									
Log-likelihood	−1247.035			−1040.433				−179.097	

*$p < .05$.

**$p < .01$.

***$p < .001$.