Mother's, Household, and Community Migration Experience and Infant Mortality in Mexico

Erin Hamilton*
Andres Villarreal
Robert Hummer
Department of Sociology and Population Research Center
The University of Texas at Austin

*Please send all comments or questions to erinh@prc.utexas.edu. Many thanks to Parker Frisbie, Joseph Potter, Yolanda Padilla, and Thomas Pullum for their help and comments on this paper. This research was supported by grant 5 R24 HD042849 Population Research Center, awarded to the Population Research Center at The University of Texas at Austin by the National Institute of Child Health and Human Development (NICHD) and grant 5 T32 HD041019 Training Program in Population Studies, awarded to the Population Research Center at The University of Texas at Austin by the National Institute of Child Health and Human Development (NICHD).

Abstract

This study explores the relationship between individual, household, and community U.S. migration experience and infant mortality in Mexico. Research suggests that household and community migration experience influence health in migrant-sending communities through resources and information remitted back home. Women's own migration experience may benefit their health similarly, or the observed advantage may result from healthy migrant selectivity, an explanation for the relatively low mortality of foreign-born Mexicans in the U.S. Using 2000 Mexican Census data to explore the relationship between U.S. migration experience, measured at multiple levels, and infant mortality in Mexico, we found that rural women with U.S. migration experience had a significantly lower likelihood of infant mortality. Household and community migration experience were also correlated with lower infant mortality, although not consistently or significantly so. These relationships vary by level of urbanization in Mexico.

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Introduction

The association between migration and health has been studied extensively in the U.S. context, yielding a rich body of literature regarding the connections between health and social factors such as geographic mobility, race, ethnicity, nativity, and culture. The same confluence of issues surrounds the subject of health and migration in migrant-sending communities, although that part of the picture is less well understood. This paper explores the relationship between U.S. migration experience, measured at the individual, household, and community levels, and infant mortality in a recent, national sample of births in Mexico.

Past research shows that household and institutionalized community migration experience have independent associations with infant survival in a small sample of communities in the center-west region of Mexico (Kanaiaupuni & Donato 1999). The infant mortality rate is a standard indicator of development because infants are so vulnerable to their environments (see http://hdr.undp.org/reports/global/2003/indicator/indic_289.html). Thus, Kanaiaupuni and Donato's findings suggest that migration has a positive effect on community development over time. Other research in Mexico has documented a positive effect of household migration experience on infant birthweight (Frank & Hummer 2002; Frank 2005), more clearly articulating that migration experience and maternal and infant health in migrant-sending communities are correlated. We extend this past work by analyzing the relationship between infant mortality and household and community migration experience in two ways. First, we look at a national sample of births in Mexico, thereby considering the relationship between infant mortality and migration experiences outside the traditional migrant-sending region of the center-west part of Mexico.

Second, we consider the relationship net of the mother's own migration experience, which may be correlated with household and community migration experience.

A mother's own migration experience may influence her and her infant's health in a number of ways. To the extent that infant health is improved through the resources that migrant family and community members access through their migrations (Kanaiaupuni & Donato 1999; Frank & Hummer 2002; Frank 2005), infants born to women with recent migration experience may benefit from the same resources. Moreover, scholarly debate about the health selectivity of Mexican migrants to the United States and return migrants back to Mexico suggests that the health of women with migration experience in Mexico may be different from the health of non-migrant women (Sorlie et al. 1993; Pablos-Mendez 1994; Palloni & Morenoff 2001). On the one hand, U.S. migrants may be healthier than non-migrant women in Mexico (Sorlie et al. 1993; Palloni & Morenoff 2001); on the other, return migrants to Mexico may be less healthy than migrant women in the United States who do not return to Mexico, a phenomenon called the salmon bias (Pablos-Mendez 1994; Palloni & Arias 2004).

We explore these possibilities with an analysis of infant survivorship and mother's own migration experience in Mexico net of household and community migration experience. In doing so, we comment not only on the migration-development debate, but also on the healthy migrant selectivity debate.

Women's own migration experience

There are a number of reasons why infant health in Mexico might differ on the basis of mothers' migration experience. Through migration, women may gain financial and social resources in the United States that may help minimize the risk of poor birth outcomes. Over time and when coupled with remittances, men's immigration to the United States from Mexican

households is beneficial to infants in those households back in Mexico (Kanaiaupuni & Donato 1999; Frank & Hummer 2002; Frank 2005). To the extent that women migrants gain similar resources through their own migrations to the United States, their infants may benefit directly from those resources (e.g. Donato, Kanaiaupuni, & Stainback 2003).

The idea that resources accessed through migration to the United States may improve infant health in Mexico suggests that migration in and of itself has an indirect but causal effect on health among migrants and their families. Another explanation for the association between migration and health is that migrants are healthier than non-migrants in Mexico.[1] The risk, resources, and physical fitness demanded of a migration to the United States may yield a group of migrants who are different from non-migrants in a number of ways that could be associated with health. In other words, migrants may be a selectively healthy group. Indeed, healthy migrant selectivity is an important part of the debate surrounding the relationship between migration and health in the United States, with most scholars agreeing that migrants to the United States are selected on some number of unmeasured characteristics that result in relatively good health compared to other major racial/ethnic groups in the United States (Sorlie et al. 1994; Palloni & Morenoff 2001; Elo et al. 2004). This is a major explanation for the similar mortality rates of Mexican origin infants and adults to non-Hispanic white infants and adults, despite their dissimilar socioeconomic profiles, a pattern of findings termed the epidemiologic paradox (Markides & Coreil 1986; Forbes & Frisbie 1991; Hummer et al. 1999; Frisbie & Song 2003).

The extent to which return migrants to Mexico may be healthier than non-migrants in Mexico is less clear. Migrants who remain in the United States may be healthier than their non-migrant counterparts in Mexico (i.e., those who never left) *and* than their migrant counterparts

[1] These explanations are not incompatible. The health of migrants and their family members may reflect both a selection process and the access to resources that migrants gain through their trips to the United States.

who return to Mexico (i.e., those who left and returned). That is, selection may work in both directions—out of Mexico through emigration and back into Mexico through return migration. The selective return of unhealthy migrants to Mexico has been called the salmon bias, referring to the process by which unhealthy or elderly individuals return to their birthplace, like salmon, to die (Pablos-Mendez 1994; Abraido-Lanza et al. 1999; Palloni & Morenoff 2001). This kind of selective out migration would artificially lower the death rates of the group experiencing return migration, as the deaths occurring outside of the United States are not caught in the U.S. vital statistics system. In the case of infant mortality, this assumes that after their births in the United States, mothers are carrying their infants back to Mexico where some portion of them subsequently dies.

However, recent research suggests that the salmon bias may not explain the mortality advantage of the Mexican-origin population in the United States (regarding adults, see Elo et al. 2004; Abraido-Lanza et al. 1999). Work by Hummer and colleagues (2006) shows that the mortality advantage that infants born to Mexican immigrants hold relative to white infants is present as early as one hour after the birth of the child, suggesting that return migration is not artificially suppressing the infant mortality rate at least in the first hours or days of life, given that women cannot return migrate to Mexico within an hour of giving birth to their child. For the U.S. debate, this means that the epidemiologic paradox for infant mortality is not simply a product of data artifact.[2] For the present analysis, the lack of empirical support for the salmon bias argument in the U.S. context lends support to the idea that return migrants may not have a

[2] Hummer and colleagues (2006) cannot directly address whether selective return migration is occurring later in the year, when it is possible that a mother has returned to Mexico, thereby artificially lowering the infant mortality rate later in the infant's life. However, they calculate the number of women who would have to return to Mexico to balance out the mortality rates between Mexican origin and non-Hispanic white women, and they argue that this level of out-migration is implausible. They thus conclude that the epidemiologic paradox, insofar as it is measured by infant mortality rates, is not a product of data artifact.

selectively higher infant mortality rate in Mexico than their migrant counterparts in the United States.

Indeed, we may speculate that return migrants have the same mortality advantage that their non-returned counterparts exhibit within the United States. In other academic contexts Mexican migration is commonly described as a circular process—migrants take multiple, temporary trips to the United States (Massey et al. 1990). Thus, at any point in time, the Mexican origin population captured in statistics that report on their health in the United States is necessarily composed of a combination of permanent and circular migrants (that is, migrants who have returned or will in the future return to Mexico), suggesting that if migrants to the United States are selectively healthier than those they leave behind and than those they encounter, so are some portion of return migrants who are in fact circular migrants but have not yet return migrated.

In this analysis we test how the health of infants born in Mexico to women who have migrated to the United States and returned to Mexico compares to infants born to women who have not migrated to the United States, assessing whether women's own migration experience is associated with infant mortality in Mexico. Given that men's migration is beneficial to infants because they access resources through their migration, and theory and evidence suggesting that women migrants are selectively healthy, we expect that women's own migration will be beneficial in the same way. That is,

> **Hypothesis one**: Infants born to women with U.S. migration experience will have lower odds of mortality than infants born to women without U.S. migration experience in Mexico.

We will also compare the infant mortality rates of these two groups of women in Mexico to Mexican-origin women in the United States in order to see whether return migrants to Mexico

are indeed a selectively healthier or less healthy group than their non-migrant counterparts in Mexico and than their migrant counterparts who remained in the United States. Based on evidence that the salmon bias does not explain Mexican origin infants' low mortality rates in the United States, and given that some portion of Mexican origin women in the United States are future return migrants, we expect infants born to return migrants in Mexico to have mortality rates similar to infants born to Mexican origin women in the United States. That is,

> **Hypothesis two:** The infant mortality rate of infants born to return migrants in Mexico will be similar to the infant mortality rate of infants born to Mexican origin women in the United States. Consistent with hypothesis one, both rates will be lower than the infant mortality rate of infants born to women without migration experience in Mexico.

Household migration experience

Research on migration and infant health in Mexico mostly considers migration experience at the household level. This in part reflects data constraints. Women's migration, and their return migration in particular, is a less frequent occurrence than men's migration or return migration (Kanaiaupuni 2000); coupled with infant mortality, another rare occurrence, most data sets do not have sample sizes large enough to analyze differences in infant mortality by the mother's return migration experience. We are able to overcome this limitation using the 10% sample of the 2000 Mexican Census, which includes a sample size large enough with information on infant survival and mother's migration experience.

The emphasis on the household also stems from the theoretical perspective regarding the origins of migration that understands migration decisions as made not by individuals but within social units, namely the household (Stark & Bloom, 1985). Immigration is one way that households minimize risk in underdeveloped labor, capital, and insurance markets. Through migration, households diversify their sources of income and gain access to capital in order to consume and make investments back home. This theoretical perspective explains why household

migration experience might impact the health of non-migrants back at home—if migration is a household economic strategy, its benefits will be shared by migrants and non-migrants alike. On the other hand, as Pessar (1999) points out, not all members of migrant-sending household may benefit equally from the resources that migrants access, and women, in particular may be disadvantaged within the household political economy.

Empirical research on household migration experience and infant health suggests that migration is an initially disruptive event that may be harmful to infant health and survival, but that, over time, financial and social resources remitted back home may compensate for that initial disruption and eventually have a beneficial effect on infant health and survival (Kanaiaupuni & Donato 1999; Frank & Hummer 2002; Frank 2005). For example, greater U.S. experience of the household head is associated with lower odds of infant mortality; however, frequent trips to the United States increase the odds of infant mortality (Kanaiaupuni & Donato 1999).

One mechanism through which U.S. experience may operate to reduce the risk of infant mortality is remittances. Indeed, infants born into households receiving migrant remittances have lower odds of low birthweight, a risk factor for subsequent mortality (Mathews, Menacker, and MacDorman 2004: Table 6), than infants born into households without U.S. migration experience (Frank & Hummer 2002). The impact of remittances is not consistently beneficial, however; women receiving remittances for less than a year have higher odds of having a low birthweight infant, while women whose husbands have been remitting for more than a year are less likely to have a low birthweight infant, despite increased stress and loss of support associated with spousal migration (Frank 2005). These findings suggest that migration may have a beneficial influence on infant health through the financial and social resources that migrants

obtain in the United States and remit back to Mexico, and that the effect is contingent on reaching some level of stability.

We incorporate into our analysis a measure of remittances as a proportion of household income. Because remittances seem to benefit

> **Hypothesis three**: Infants born in households receiving remittances without a recent (current or returned) migrant will have the lowest odds of mortality. Infants in households with recent migrants but without remittances will have the highest odds of mortality.

Community migration experience

The relationship between community level migration experience and infant survivorship is related to a much broader debate about migration and development in migrant-sending communities. As a community gains migration experience, resources remitted back into that community lead to its economic development through rising incomes, which incur increased consumption, production, and investment (Durand, Kandel, Parrado, and Massey 1996). The infant mortality rate is a standard indicator of a population's well-being and a country's development because infants are so vulnerable to environmental factors such as sanitation, nutrition, and quality of and access to medical care, to name a few (Mosley & Chen 1984). Thus, a positive association between community migration experience and infant survivorship lends indirect support to the argument that migration leads to development in sending communities (e.g. Kanaiaupuni & Donato 1999).

Kanaiuapuni and Donato (1999) explored the relationship between community migration experience and infant mortality using two measures of community migration experience—the proportion of adults with migration experience and migration institutionalization, or the years since the community reached the median level of adults with migration experience. They found that community migration experience lowers the odds of infant mortality after twenty years of

migration institutionalization. Before twenty years, community migration experience increases the odds of infant mortality. They thus show that the cumulative benefits of migration at the community level can only be felt in the long term.

In our analysis, we use a measure of community migration experience that captures the number of current residents in an area that have migrated to the United States since 1995. Our national sample of Mexican communities will be heavily weighted by communities that have not experienced a great degree of migration institutionalization. Thus, to the extent that our measure of community migration experience captures current migration levels, and without being able to control for the area's migration history (i.e., its institutionalization), we expect that greater community migration experience will be associated with higher levels of infant mortality. Thus,

> **Hypothesis four:** Higher levels of community migration experience will be associated with higher odds of infant mortality.

Rural and urban differences in Mexico

Our analysis also explores how the relationship between migration experience at the individual, household and community level differs between rural and urban areas. We do this for three reasons. First, the extent to which migrants invest their remittances productively (which leads more directly to community economic development) depends in part on the social and economic context of the local sending area (Durand et al. 1996; Lindstrom 1996). Economic development varies widely between rural and urban places in Mexico, with overall inequality increasing since the 1980's (Bouillon, Legovini, & Lustig 2003). Given that rural and urban economic contexts differ, migrants from these areas may be more or less likely to productively invest their remittances into their sending communities (Durand et al. 1996). Moreover, their remittances may have a greater or smaller overall impact on the development of their home community, depending on the level of its development. Specifically, because rural places are

underdeveloped relative to urban places, remittances may make up more of a portion of a community's resources in rural places and have a greater impact on its development (Fussell and Massey 2004). Thus, infant mortality may be more sensitive to the development generated by migrant remittances in rural places.

Second, the health of rural and urban populations differs widely, an inequality that Frenk et al. (1989) call epidemiologic polarization. They show that over half of all deaths to rural people in Mexico in 1981 were due to causes such as infectious disease, while low class workers in urban areas were more likely to die from causes such as heart or lung disease (Frenk et al. 1989: Figure 3). This is consistent with the idea that rural places are less developed and disadvantaged in terms of health care. Again this suggests that small steps towards development in rural places may have a larger impact on infant mortality to the extent that infectious diseases can be attenuated through basic development and medical improvements.

Third, migration patterns vary between rural and urban places. Urban migration to the United States is a more recent phenomenon, while rural migration has been ongoing for over half a century (Durand, Massey, & Zeneno 2001). The self-sustaining nature of migration flows in rural areas may not be apparent in urban places, where there is less migrant social capital (Fussell and Massey 2004). Migrant selectivity also differs between rural and urban places in Mexico (Roberts & Hamilton 2005; Fussell 2004; Fussell and Massey 2004). Urban migrants are more heterogeneous than rural migrants (Fussell and Massey 2004) and they do not differ dramatically from other non-migrant urban residents, while rural migrants tend to be selected out of households with higher levels of education (Roberts & Hamilton 2005). If selection processes work differently in rural and urban places, we may expect that women return migrating to rural

places to be more different from their non-migrant counterparts than urban return migrants are from their non-migrant counterparts in cities.

Given that migration experience may have a bigger impact on development in rural communities, and that rural migrants are a more select group, we expect that,

> **Hypothesis five:** The association between migration experience at each level (i.e., mother's, household, and community) and infant mortality will be stronger in rural places than in urban places.

Data, measures and methods

Data come from the 2000 Mexican General Census of Population and Households long form, which included a migration supplement, and which was administered to approximately 10% of all Mexican households (INEGI 2003). The 10% data are representative at the state and municipal levels. We restrict our sample to the 593,293 women between the ages of 15 and 49 whose last child was born between 1995 and February 1999 and who are not missing information on any of our measures.

Our key outcome measure is the survivorship, through age 1, of the last child born. Infants whose age at death was less than twelve months were coded 1; those who survived through 12 months were coded 0.[3] Because children born after February 1999 (i.e., less than one year before the date of interview) were not exposed fully to risk of infant mortality, we exclude those births.

Our measure of women's own migration experience comes from the basic long form of the Census, which asks where each member in the household lived in 1995. All women who

[3] The long form of the Mexican Census asks for the age at death in days if less than one month, in months if less than one year, and in years if more than one year. As a consequence, it is impossible to determine the extent of age heaping at one year; all children whose mothers reported their child's age at death between 12 and 23 months are coded the same way (=1 year). We are thus unable to determine and account for the extent to which mothers whose children died at 10 or 11 months reported the age at death as one year. We have no reason to believe that this age heaping would systematically vary by mother's, household, or community migration experience, however.

reported that their place of residence in 1995 was the United States are coded as return migrants.[4] The long form additionally asks each individual whether they currently receive remittances from abroad and how much they receive. Our household migration measure is the composite sum of all household remittances as a proportion of total household income.

Our communities are Mexican municipal districts, which are smaller but essentially equivalent in form to U.S. counties. In 2000, there were 2442 Mexican municipal districts. Our measure of community migration experience draws from the migration supplement, which gathers information on the U.S. trips of all household members between 1995 and 2000 (see footnote 4 for an explanation of why the supplement was not used for women's own return migration). Thus our community migration experience measure is the proportion of adults with recent (since 1995) migration experience to the United States of the total number of adults in the municipal district.[5] Because our measures of household and community migration experience rely on migrant trips between 1995 and 2000, and our measure of infant mortality is based on births between 1995 and 1999, we cannot address a causal, or time, ordering of our effects. In this analysis we simply report associations uncovered between the various measures.

We include a number of covariates that are associated with both infant mortality and migration experience. Mother's age is measured continuously, and we include a quadratic term to account for the non-linear association between mother's age and infant mortality (i.e., higher

[4] The migration supplement of the long form additionally asks about all household members, present or absent in 2000, who migrated between 1995 and 2000. It is not possible to accurately merge individual information from the long form of the census with information from the migration supplement because unique identifiers are not provided. However, it is possible to merge information from the two sources at the household level. In the next stage of our analysis, before PAA, we intend to incorporate this measure of household migration experience to test whether it differs from remittances.

[5] This is not the same measure used by Kanaiaupuni and Donato (1999) or in other analyses of community migration prevalence using Mexican Migration Project data (e.g. Massey and Espinosa 1995). The Mexican Migration Project measure is the proportion of the community population with any migration experience to the United States. The Census only asks about migration experience between 1995 and 2000. This measure has been used by other scholars; for example, see Kandel and Massey's (2002) analysis of the culture of migration and student aspirations.

risk of mortality among younger and older mothers (Mathews et al. 2004)). We use the Klineman-Kessel Parity Index (Klineman and Kessel 1987), which accounts for the interaction between mother's age and birth order. The Index distinguishes first births from low parity (second-order births to women 18 and older, third- or higher-order births to women 25 and older) and high parity (second- or higher-order births to women under 18, third- or higher-order births to women under 25, and fourth- or higher-order births to women 25 and older). Marital status is a categorical indicator for currently married (either by the state or church), cohabiting, separated or divorced, or never married. Race is a dichotomous indicator to distinguish between women who self-identify as indigenous.

We include three measures that encapsulate various forms of socioeconomic status. The first is mother's education. We distinguish between no education, primary education, secondary education, and higher. Household poverty status is a composite index of eight indicators of poverty, based on the Mexican Population Council's Index of Marginalization (CONAPO 2000). The eight components include whether a household has dirt floors, does not have indoor plumbing or a private toilet, does not have electricity, does not have access to piped water, and has more than two people per room; and whether the household head is illiterate, has not completed primary education, and does not make more than two minimum daily wages.[6] This measure is a more reliable measure of socioeconomic status than reported income, and it more validly measures poverty in Mexico. The Cronbach's alpha score for our constructed household poverty index is .68. The final measure of socioeconomic status is an indicator for whether the mother has health insurance coverage. Public health insurance coverage in Mexico depends on

[6] Our calculation of the minimum wage is based on the household head's reported monthly income divided by 30 and the national minimum daily wage for three wage zones in Mexico (see http://www.sat.gob.mx/nuevo.html).

employment in the formal economy, so this measure simultaneously captures some degree of economic stability and access to health care.

We have three indicators of broader geographical and socioeconomic context. In our analysis of the entire national sample, we distinguish between rural places (<2500 people), mid-sized towns (2500-14999 people) and urban places (>15000 people). We group the latter two categories together as urban in our separate analysis by level of urbanization. We also include a regional indicator which groups together states with similar migration histories (Durand, Massey, & Zenteno 2001). The four regions are the historic region, in central-western Mexico, the border region, the central region, and the southeastern region. Finally, we incorporate a measure of community poverty, using the Mexican Population Bureau's Index of Marginalization, which ranges between -3 and 3, with larger numbers indicating greater marginalization (CONAPO 2000). This index uses the same eight indicators of poverty as the household level, except the measures are incorporated as the percents of all households or adults in the municipality with each indicator.

We first show frequency distributions and means of each variable for the entire sample and separately by level of urbanization. We used multiple logistic regression models to estimate the associations between individual and household migration experience and infant mortality. Because over 93 percent of women were located in separate households, we did not separate individual and household error terms in our analysis. Multi-level models were estimated for our models incorporating community-level effects. Stata version 9 software (StataCorp. 2005) and HLM 6.0 were used (Scientific Software International, Inc. 2005). We employed weights in our analysis to account for the sampling structure (i.e., an oversample of rural households). Our first model includes mother's own migration experience plus all individual and household level

covariates. The second model incorporates household migration experience. The third model incorporates community poverty and community migration experience.

Descriptive results

Just over one percent of infants in our sample died in their first year of life, and the overall infant mortality rate in our sample is about 11 deaths per 1000 live births (Table 1). This is lower than some reported estimates of the IMR in Mexico around 2000 (INEGI 2004) and consistent with others (INEGI 2006).[7] The rural infant mortality rate is 46% higher than the urban mortality rate (14.6 versus 10.0).

The mean age of our sample is 29 years, and this does not vary significantly by level of urbanization. Rural women are slightly more likely than urban women to be married or cohabiting and slightly less likely than urban women to be separated, divorced, or never married. About 40% of births in our sample are low parity births, while about 30% are first births or high parity births each. Rural women are more likely to have had a high parity birth. About one in twenty women in our sample self-identified as indigenous; this proportion is higher in rural areas. Rural women are also less educated—three fourths of rural women had a primary school education or less, whereas only one in three urban women did. Urban women, on the other hand, are far more likely to have a high school or higher education. Perhaps the most dramatic difference between urban and rural women is their insurance coverage. Only about 18 percent of

[7] We have not figured out the source of the disparate reports of the IMR in Mexico. It could be the method used to estimate the IMR; the Brass-Trussell method, which uses the report of children ever born and children survived, assumes unchanging fertility, which is not the case in Mexico. This question may be included on the Census because vital statistics are unreliable. We need to explore these possibilities further. If our estimate is indeed low, then we are missing a substantial portion of deaths. One reason for their absence could be that one person reports the birth dates and survivorship information for all the women in their households, and they underreport the deaths of other women's infants. We tested this possibility by limiting our analytical sample to only household heads and their spouses, and our results did not change. We were unable to otherwise identify which household member in fact answered the survey. There is also some evidence that the mortality rates of the last child born are generally low due to planned fertility following the death of a child and unplanned fertility following the death of a child due to shortened amenorrhea (see Preston, Heuveline, & Guillot, 2000: pages 231-233), but we do not believe that this would entirely account for the discrepancy between reported rates.

rural women had health insurance coverage in 2000, whereas half of urban women did. Overall, insurance coverage is low, at only 57%.

----------TABLE 1 ABOUT HERE----------

Rural households are slightly bigger than urban households in our sample, but on average these recent mothers lived in houses with four or five additional household members. Rural households score much higher on the poverty scale than urban households. Rural households have higher distributions in the historic and southeast regions of the country. Overall, our sample is about 62% urban and 14% rural; 24% of recent mothers live in mid-sized towns.[8]

Less than one percent of recent mothers lived in the United States in 1995; a higher proportion of recent mothers living in rural places have migration experience than recent mothers in urban places. When factored to represent the entire population, this means that approximately 22,000 rural women and 9,000 urban women lived in the United States in 1995 and returned to Mexico by 2000 (results not shown). Including households that receive no income from remittances, the average percent of household income made up by international remittances is low, at 2.7 for the entire sample. Remittances make up a bigger percent of rural household income than urban household income (4.6 versus 1.8). Excluding households that do not receive income from international remittances shifts the distribution substantially. Of rural households receiving some income from remittances, on average, over 60 percent of total household income comes from remittances. In urban places the equivalent value is 48 percent (results not shown).

The mean marginality index, which ranges between -3 and 3, with higher value indicating greater marginality, is higher in rural places than in urban places. Finally, municipalities in Mexico have very low proportions of adults with recent migration experience. About four

[8] Our sample sizes at the bottom do not correspond to these distributions because of the sample design and corresponding weights.

percent of adults in rural municipalities have recent migration experience; fewer, just over 2% of, adults in over municipalities have migration experience.

Multivariate results

Women's migration experience is negatively associated with infant mortality (Table 2). That is, infants born to women who lived in the United States in 1995 have lower odds of death by age one than infants born to women who were in Mexico in 1995. This association is stronger and statistically significant in rural places. Women's own migration experience is associated with almost 80% lower odds of infant mortality in rural places. The coefficient for women's migration experience remains unchanged across all three models, suggesting that the relationship does not reflect a correlation with household or community migration experience.

Remittances as a proportion of household income also have a negative correlation with infant mortality. Because these odds ratios represent the relationship between a 100% change in the proportion of household income made up by remittances, a better value is the corresponding odds ratio for one standard deviation change in the independent variable. This value is given by taking the exponent of the coefficient (which is equal to the natural log of the odds ratio) times the standard deviation for the independent variable. In model 1 for the rural sample, for example, the odds ratio for one standard deviation change in the proportion of household income made up by remittances is equal to .97 ($\exp^{(-.27*.11)}$). Thus, in rural places, not controlling for community and household migration experience, a one standard deviation change in the proportion of household income made up by remittances reduces the likelihood of infant mortality by three percent. This association is small and it loses significance in the third model. The association for remittances in urban places is in the same direction but is smaller and not significant.

----------TABLE 2 ABOUT HERE----------

Municipality migration experience is associated with lower odds of infant mortality Mexico, but the coefficient is not statistically significant. Again, the conversion of the odds ratio to represent the percent change associated with a one standard deviation change in the independent variable is a more logical value to consider. In the entire sample, the associated odds ratio for a one standard deviation change in recent community migration experience is .97, suggesting that the odds of infant mortality are three percent lower in a community where 3.6% more of its members have recent migration experience. The relationship is stronger in urban than in rural places.

Controlling for all other covariates, the coefficient for age shows that infant mortality decreases with mother's age in the middle of the age distribution, but the quadratic term confirms that the relationship is concave—there is a higher risk of infant mortality for younger and older mothers. Infants born to cohabiting mothers have slightly higher odds of mortality, although this relationship in the entire sample is driven primarily by an association for urban women. Among rural women, odds of infant mortality do not vary significantly between married, cohabiting, or divorced women, but infants born to women separated from their spouses have about 30% lower odds of mortality. The associations are reversed in urban places—divorce is associated with higher (although statistically non-significant) odds of infant mortality but there is no difference for infants born to separated parents. Infants born to never married women have about 50% higher odds of mortality in all parts of Mexico.

The association between parity and mortality does not differ by level of urbanization in Mexico. First born children have about 40% lower odds of mortality than low parity children, and high parity children are about two times more likely to die than low parity children. In all parts of Mexico, additional people in the household are associated with lower odds of infant

mortality. Infants born to indigenous and non-indigenous women have the same odds of mortality net other covariates. Lower levels of mother's education are associated with higher odds of infant mortality, and this is especially true in urban places, where infants born to mothers with no education have 80% higher odds of mortality. Being uninsured is associated with higher odds of infant mortality, especially in rural places; infants born to uninsured mothers in rural places have 26% higher odds of mortality. Household poverty is only associated with higher odds of mortality in urban places. One additional point on the household poverty scale increases the odds of infant mortality by 78% in urban places.

Level of urbanization is not associated with higher odds of infant mortality in our entire sample when controlling for all other covariates. Odds of infant mortality do vary across regions, with lower odds of mortality along the border and in the southeast compared to the historic region.

The size and direction of our covariates do not change significantly with controls for household and community migration experience in models 2 and 3.

----------TABLE 3 ABOUT HERE----------

Comparing the infant mortality rate of return migrant and non-migrant women in Mexico to Mexican origin women in the United States

To test our second hypothesis regarding the infant mortality rates of women in Mexico compared to Mexican origin women in the United States, we compare the corresponding infant mortality rates in Table 3. Data for Mexican origin women in the United States come from the National Center for Health Statistics Linked Birth/Death Data Set for 1999 (Mathews, MacDorman, & Menacker 2002). The infant mortality rate is highest for non-migrant women in Mexico, at 11.1 infant deaths per 1000 live births. It is lower for migrant women in Mexico, at

7.4 infant deaths per 1000 live births, which is consistent with the odds ratio for women's own migration experience in Table 2. However, the lowest infant mortality rate is for Mexican origin women in the United States. Only 5.5 infants die per 1000 live births to Mexican origin women in the United States. That is, on average, about 2 more infants per 1000 live births die to Mexican women who return to Mexico.

Discussion

Only one of four of our hypotheses regarding the relationship between individual, household, and community migration experience was entirely supported by our multivariate analyses. Infants born to women with migration experience in Mexico indeed have lower odds of mortality than infants born to women without migration experience, net of a slew of sociodemographic characteristics. Whether this is due to resources the mothers accessed on their trip(s) to the United States or to some kind of selection process, we cannot determine with this analysis. Because the infant mortality rate for women who return migrate to Mexico is higher than Mexican origin women who remain in the United States, we cannot say that these women are necessarily subject to the same selection process that has been touted in the literature regarding Mexican origin women in the United States. That is, if these return migrants are selected into the United States on some unmeasured characteristics that are associated with positive birth outcomes, as are Mexican origin women who do not return, then we might expect their infants to survive at the same rates back in Mexico.

However, because our models control for various measures of household socioeconomic status, particularly a composite measure reflecting basic standard of living, financial resources that women accessed through their migrations are largely controlled. We cannot control for non-financial resources that women may have gained, such as information.

A number of issues may explain the different rates for return migrants in Mexico and Mexican origin women in the United States. One could be differential medical care in the two places, assuming that the health of these two groups is more or less the same. Another could be that in fact these return migrants are selected out of the United States on the basis of poorer health (either theirs or their infant's). This may provide some small, indirect support for the salmon bias, although we cannot determine the effect that these deaths have on the U.S. rate—whether these infants were born in the United States and Mexico.

The results for remittances as a proportion of household income suggest that, especially in rural places, the resources and money remitted by migrants back home may benefit health. This association was stronger in rural places than it was in rural places. The odds ratio for remittances lost significance in the third model for rural places, suggesting that some of the correlation between household remittances and infant mortality is operating through processes at the community level.

An alternate hypothesis to the remittances "effect" is that households with international migrants are generally healthier than households without international migrants. This is an extension of the healthy migrant selectivity hypothesis—not only are migrants more healthy than non-migrants in Mexico, but so are their non-migrant household members. The correlation we uncovered in our analysis between household remittances and infant mortality could be explained by either or both process(es).

Our fourth hypothesis, that community migration experience would be associated with higher odds of mortality, was disproven. Community migration experience, as measured by the proportion of adults with recent migration experience within a municipality, is associated with lower odds of infant mortality in the entire sample as well as in both urban and rural places.

Because the odds ratios for this variable did not reach statistical significance, we cannot with certainty determine a relationship, but the direction is opposite of what we anticipated. This suggests that community out-migration may be positively associated with infant survival in the short term. This finding is not consistent with Kanaiaupuni and Donato's (1999) results for 25 communities in the central-western region of Mexico for births between 1965 and 1992. One possible explanation for this inconsistency is that we look at a national sample of births in the late 1990's, and potentially many of the communities in our sample with high proportions of migration have reached a level of institutionalization that would balance out the negative effect of community out-migration uncovered by Kanaiaupuni and Donato (1999). On the other hand, our results may be misleading simply because we cannot control for migration institutionalization.

Finally, we were right about the rural/urban differences in coefficients for some, but not all, of our measures of migration experience. Women's own and household migration experience, measured as the proportion of remittances of total household income, were both stronger and more significant in rural places. However, community migration experience is more strongly correlated with infant mortality in urban places, an unexpected result that deserves further exploration.

The inclusion of covariates in the entire sample model completely eliminated statistical differences in the infant mortality rates between urban and rural places that were apparent in the bivariate relationship. However, interesting differences in the relationship between infant mortality and our covariates were uncovered in our split sample models. The coefficients for mother's relationship status with the father told an intriguing story. In rural places, infants have the same odds of mortality when born to married or cohabiting parents, but cohabitation is a risk

factor for mortality in urban places. While infants born into married or separated unions in urban places had the same odds of mortality, rural infants born to separated mothers in rural places actually had lower odds of mortality than rural infants born to married parents. We believe that the negative correlation between separation and infant mortality in rural places could be picking up on spousal separation through migration. We cannot automatically tell which household members are migrants in the supplement, but we do know their age. In future work (i.e., before PAA), we intend to explore whether there is an absent migrant of a logical age that could be the spouse of rural women who claim to be separated.

Another interesting story was told by our coefficients for socioeconomic status. The fact that education and household poverty have stronger associations with infant mortality in urban places may suggest that these measures better reflect variation in socioeconomic status in urban places than in rural places. Although our household poverty measure was constructed to reflect forms of low socioeconomic status other than income in order to better pick up on socioeconomic variation in rural places, it did not have a significant association with infant mortality in rural places. Being uninsured, on the other hand, was a better predictor of infant mortality in rural places.

As suggested throughout this discussion, better data are needed to adequately answer some of the questions this topic poses. We are limited by the cross-sectional nature of the Census and the measures that are available to us, namely our migration and infant mortality measures. Our first (immediate) future step will be to analyze a separate measure of household migration status, namely the number of recent and current household migrants. Preliminary analyses of this variable paint an unclear picture, but we hope, through additional exploration and variable

specifications, to figure out whether this measure better represents household migration experience.

Migration is related to health outcomes on both sides of the U.S.-Mexico border. In this study we showed that infant mortality in Mexico is associated with various forms of migration experience. Most significantly, infants born to rural women with recent U.S. migration experience have much lower odds of mortality within their first year of life. However, infants born into households and communities experiencing migration also show lower odds of mortality, suggesting that migration may in fact be benefiting households and fueling development in Mexico, especially in rural places. Given the magnitude of Mexico-U.S. migration and the debate on the developmental potential of migration in sending communities, as well as ongoing interest in the connection between migration and health, these issues continue to deserve further attention.

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Table 1. Weighted Distributions and Means of Variables for Entire Sample and for Rural and Urban Samples

	Entire	Urban	Rural
Infant Mortality (%)			
Died in first year of life	1.11	1.00	1.46
Lived through first year of life	98.89	99.00	98.54
Mother's Sociodemographic Characteristics			
Mother's age (mean)	29.3	29.2	29.5
Marital status (%)			
Married	69.6	69.2	71.0
Cohabiting	19.3	18.7	21.1
Separated	4.6	4.8	3.8
Divorced	1.0	1.2	0.3
Single	5.5	6.1	3.8
Parity (%)			
First birth	30.2	32.3	23.6
Low parity	40.9	44.1	30.6
High parity	28.9	23.6	45.8
Race (%)			
Indigenous	5.0	2.6	12.6
Not indigenous	95.0	97.4	87.4
Health insurance coverage (%)			
Uninsured	43.0	51.0	17.6
Insured	57.0	49.0	82.4
Education (%)			
No education	3.9	2.3	8.8
Primary education	39.7	31.7	65.3
Junior high education	27.7	30.6	18.6
High school education or higher	28.7	35.4	7.3
Household Characteristics			
Number of people (mean)	5.6	5.5	6.0
Household poverty index (mean)	0.19	0.14	0.37
Level of urbanization (%)			
Rural	24.0	--	100.0
Mid-sized town	13.5	17.8	--
Urban	62.5	82.3	--
Community Characteristics			
Region			
Historic	24.5	22.9	29.2
Border	21.2	23.9	12.7
Center	39.7	41.1	35.2
Periphery	14.7	12.1	23.0
Community marginality index (mean)	-1.08	-1.39	-0.12
Migration Experience			
Individual experience (%)			
Mother is a return migrant	0.54	0.51	0.63
Mother is not a return migrant	99.46	99.49	99.37
Remittances as a proportion of household income (mean)	0.027	0.018	0.046
Community migration experience (mean)	0.025	0.021	0.038
Sample size	**589983**	**364812**	**225171**

Source: 2000 Mexican Census 10% Sample

*Chi-square tests for equal distributions and F tests for equal means showed significant differences at the p<.001 level across rural and urban samples for all variables.

Table 2. Odds ratios predicting the likelihood of infant mortality by mother's, household, and community migration experience

	Entire Sample						Urban Sample						Rural Sample					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
Mother's Characteristics																		
Mother was a migrant in 95	0.70		0.70		0.71		0.93		0.93		0.94		0.18	**	0.18	**	0.21	**
Mother's age (years)	0.83	**	0.83	**	0.83	**	0.82	**	0.82	**	0.82	**	0.86	**	0.87	**	0.86	**
Mother's age sqaured	1.00	**	1.00	**	1.00	**	1.00	**	1.00	**	1.00	**	1.00	**	1.00	**	1.00	**
Marital status (ref=married)																		
Cohabiting	1.09	*	1.09	*	1.12	**	1.10	†	1.10	†	1.10	†	1.08		1.08		1.09	
Separated	0.95		0.95		0.92		1.01		1.01		0.97		0.69	*	0.69	*	0.69	*
Divorced	1.21		1.22		1.22		1.25		1.25		1.25		0.99		0.99		0.93	
Single	1.58	**	1.58	**	1.61	**	1.59	**	1.59	**	1.60	**	1.53	**	1.53	**	1.58	**
Parity (ref=low parity)																		
First birth	0.59	**	0.59	**	0.71	**	0.54	**	0.54	**	0.54	**	0.78	*	0.78	*	0.78	**
High parity	2.06	**	2.06	**	2.05	**	2.03	**	2.03	**	2.02	**	2.18	**	2.17	**	2.12	**
Race (ref=not indigenous)																		
Indigenous	0.99		0.99		0.98		1.08		1.08		1.05		0.94		0.94		1.00	
Health insurance coverage (ref=insured)																		
Uninsured	1.12	**	1.13	**	1.13	**	1.08	*	1.08	†	1.08	†	1.27	**	1.27	**	1.27	**
Education (ref=some high school)																		
No education	1.78	**	1.78	**	1.90	**	1.81	**	1.81	**	1.76	**	1.42	*	1.41	*	1.27	†
Primary education	1.47	**	1.47	**	1.56	**	1.48	**	1.48	**	1.48	**	1.19		1.18		1.10	
Junior high education	1.22	**	1.22	**	1.29	**	1.21	**	1.21	**	1.21	**	1.04		1.04		0.99	
Household Characteristics																		
Number of people	0.82	**	0.82	**	0.83	**	0.81	**	0.81	**	0.81	**	0.84	**	0.84	**	0.86	**
Household poverty index	1.47	**	1.46	**	1.52	**	1.83	**	1.83	**	1.78	**	1.14		1.13		1.17	
Rural	1.00		1.00		1.00		--		--		--		--		--		--	
Mid-sized town	1.02		1.02		1.01		--		--		--		--		--		--	
Remittances as a proportion of income	0.81	†	0.82	†	0.89		0.84		0.85		0.88		0.76	*	0.78	†	0.82	
Community Characteristics																		
Geographic location																		
Border	0.88	*	0.88	*	0.86	*	0.89	†	0.89	†	0.87	†	0.81	*	0.81	*	0.72	†
Center	1.10	*	1.10	*	1.08		1.08		1.08		1.05		1.14	†	1.13	†	1.11	
Periphery	0.87	**	0.86	**	0.84	**	0.83	**	0.83	**	0.77	**	0.91		0.90		0.90	
Community marginality index					1.02						1.05						1.00	
Community out-migration					0.44						0.15						0.71	

Source: 2000 Mexican Census 10% Sample

† marginally significant at .10; * significant at .05; ** significant at .01

Table 3. Infant Mortality Rates of Mexican Women: Non-migrants and return migrants in Mexico versus Mexican Origin women in the United States

Mexico		United States
Non-migrant	Returned Migrant	Mexican Origin
11.1	7.4	5.5

Source: for Mexico, 2000 Mexican Census; for the United States, Mathews, MacDormand & Menacker 2002: Table B.