The Effects of International Migration on the Risk of Low Birth Weight in Mexico

Introduction

Mexico is considered the second-largest recipient of remittances in the world (Newland et al., 2004). According to official estimates from the Mexican Government, approximately 11 million Mexican-born people are living in the U.S. (National Population Council [CONAPO], 2002). Although estimates may differ given different methodologies and sources of information, in general the annual influx of Mexicans that have migrated to the US has been estimated to range between 300,000 to 450,000 people between 1990 and 2000 (Hill et al., 2005). A decade ago, the total Mexican population in the U.S. accounted for approximately one-eighth of Mexico's labor force (Escobar Latapi et al. 2008) and current estimates are likely to show an even more dramatic increase. The most common means by which international migration directly impacts receiving countries is through remittances. In the case of Mexico, remittances have steadily increased over the last two decades. An early estimate of the amount of money remitted from the U.S. to Mexico in the early 1990s represents approximately $2 billion dollars (Massey et al., 1994). However, over the last decade, remittances grew at an annual average rate of 15.6 percent, reaching $23.1 billion dollars by 2006 (Canas, et al. 2006). The magnitude of total money remitted represents almost 80 percent of Mexico's oil exports and is roughly equivalent to 2.5 percent of the country's GDP (IMF, 2006).

When investigating the effects of migration, it is important to consider other potential consequences of the movement of people between the sending and receiving places. In the receiving places, migration may have immediate effects on local labor markets as well as increasing the demand for basic services such as housing and health care. Analyzing the impact of migration on sending places leads to a more complex problem. On the one hand, losing part of

the population among the working ages negatively affects the local economy as productivity for these age groups is diminished. Additionally, at the household level, out-migration may lead to some instability in family formation or growth given that, in many cases, it is the head of the family or household who migrates (Massey et al., 1994). On the other hand, once migrants start remitting money to their families in the sending location, they may experience financial benefits as economic resources increase. This increased economic support may in turn lead to increases in consumption expenditures and savings. These effects have been shown to be more important in rural communities with a long history of sending migrants, particularly in certain central and southern states of Mexico, including Jalisco, Michoacan, Zacatecas, Durango, and Oaxaca (Unger, 2005). The income received by families in the sending location from family members in the U.S. results in improved and sustained living standards and helps to promote local economies (Canas et al., 2007).

As stated by Hamilton, et al. (2008), if international migration influences the level of socioeconomic development through more financial resources via remittances, then it may also have an impact on infant health outcomes. Among other basic necessities, the additional resources received by households may be spent on additional food and health services. Past research has found empirical evidence that at both household and community levels, migration experience is associated with lower odds of infant mortality (Kanaiupuni et al., 1999). Furthermore, other studies have also found a positive association between household migration experience and infant birth weight in Mexico (Hildebrand et al. 2005; Frank et al., 2002; Frank, 2005). In particular, it has been identified that households with migration experience tend to have lower odds of infant mortality and low birth weight.

While the implication is that the migratory process is likely to have direct effects on the total amount of remittances generated, the migratory process may impact the household and community indirectly. These other channels are related to the level of attachment or exposure of migrants to U.S. practices. Specifically, migration may also have an impact on health outcomes through nonmonetary channels, such as the transfer of health information (Hildebrand et al., 2005). Through exposure to U.S. practices, migrants may gain health knowledge resulting in higher health attainment. Hildebrand, et al. (2005) provide evidence that mothers in migrant families are found to have higher levels of health knowledge, and there is evidence of health knowledge spillovers of mothers to non-migrant households.

The purpose of this paper is to provide new empirical evidence linking migration to the U.S. in Mexican households with infant health outcomes. By using new data for Mexico, the ENADID 2006, this research focuses on the effects of migration on low birth weight (LBW). A review of relevant literature on the mechanisms through which international migration experience in household and communities may impact infant health outcomes is detailed below.

Literature Review

The most direct pathway through which migration has the potential to influence local economic development in Mexico is through remittances. In this sense, there are several venues by which remittances can impact the broader socio-economic development of communities. One of the topics that has received much attention among scholars is how remittances modify both a household's expenditure behaviors and potential associations with infant health outcome (Kanainaupuni, 1999; Massey et al., 1997; Durand et al., 1996, 2001; Amuedo-Dorantes et al., 2006).

As explained by Hildebrandt (2005), sending migrants abroad generates a flow of remittances to sending communities with subsequent short and long term effects. For example, at an individual level, remittances can be seen as increasing households' disposable incomes, which finances increased consumption, housing expenditures, or the education costs of children still living at home. Recent research has provided empirical evidence to support this argument. Amuedo-Dorantes et al. (2006a) finds further that migrant households dedicate a considerable proportion of total remittance earnings to healthcare expenditures. Their study reports that the single largest category for the use of remittances is the one related to health expenses. Based on data from the Mexican Migration Project (MMP), 46 percent of remitters declare health expenses as the primary purpose for their remittances. In a related study, Amuedo et al., (2006b) assesses the relationship between remittances and healthcare access of the Mexican population in sending communities. Through the estimation of the elasticity of health care, their findings indicate that healthcare expenditures rise in response to the receipt of remittances. Primary expenditures are also significantly higher among households with higher remittance inflows, where spending accounts for between 5 to 9 percent of remittance receipts for primary health care services. Research on the impact of migration on health outcomes of Mexicans, in particular on infant health outcomes, has attracted the attention of scholars from different disciplines. One of the first studies analyzing the effect of international migration on infant health in Mexico came from Kanaiaupuni et al., (1999). This piece of work is one of the most influential and frequently cited studies in this area. Their study explores whether children of international migrants experience lower rates of mortality than non-migrants. By applying multilevel statistical methods, these authors were able to examine how migration patterns in communities affect infant survival in Mexico. They hypothesized that migration effects are not linear; instead, migration results in a

cumulative process with varying health effects at different stages. Their argument first states that at initial stages of migration, communities may suffer some instability due to the absence of heads of families. The absence of the head of the family may negatively affect the primary source of economic and social support in the household. In this sense, migration may worsen health outcomes in the short run, as families may have less money to spend on consumption needs and medical care. However, once migration becomes institutionalized as a part of local life in communities, migration may positively affect the standard of living and infant survival probabilities. Their study found communities in Mexico with more than 20 years of exposure to migration rates of at least a 25 percent threshold had much lower odds of infant deaths. This effect appeared to be due, in large part, to high annual remittances, or *migradollars*, to the communities. In a related study, Frank et al., (2002) examined the relationship between the U.S. migration experience and the risk of low birth weight in Mexico using data from ENADID 1997. In this study, the authors hypothesized that at the household level, the migration process would negatively affect the risk of low birth weight among Mexican infants. They concluded that infants born in migrant households in Mexico were less likely to be of low birth weight when compared to infants born in non-migrant households. A key result from this study found that the risk of low birth weight was reduced for pregnant women living in Mexican households that received remittances from abroad.

It has been long documented that LBW is strongly associated with neonatal mortality and developmental problems in childhood through adulthood. Birth weight is considered a good predictor of immediate and future health standards of a new born; more specifically, low birth weight is directly associated with infant morbidity and neonatal mortality (Wilcox, 2001). Empirical evidence has also shown that LBW infants have higher probabilities of infection,

handicapped conditions during childhood, mental deficiencies and problems related to cognitive development, as well as susceptibility to chronic diseases such as hypertension later in life (Barker, 1994). Studies analyzing the implications of LBW in the economic literature have shown that there is a direct effect on human capital accumulation in infants with adverse birth outcomes. A recent study by Behrman et al., (2004) found evidence that differences in birth weights have direct implications on educational attainment, adult height, and labor-market payoffs. Hence, the study of the risk factors associated to LBW is important for its effects on total productivity and, consequently, on the overall economy in the long term (Hildebrant et al., 2005).

It is also well known that low birth weight is partially a consequence of the conditions faced by the mother during pregnancy. Among the main non-genetic factors that are attributed to low birth weight are gestational age, prenatal care, maternal health behaviors (alcohol consumption and smoking), and maternal stress (Chevalier et al., 2007). A variable that it is highly correlated with and that can potentially affect all these variables is maternal education. Infants whose mothers have lower levels of education are less likely to provide resources dedicated to medical care, nutrition, sanitary facilities, and water supply (Behrman et al., 1989). Maternal marital status may influence birth outcomes and infant mortality rates (Sussman et al., 1999). Past studies have shown that unmarried mothers have higher odds of infant mortality (Bird et al., 2000). The quality of housing can also have a strong influence on infant health. For example, access to water and lack of adequate sanitation facilities expose the child's health to the effects of environmental contaminants. Conversely, higher quality sanitary facilities and improved water supply are directly associated with better health outcomes. The access to resources such as health care is often cited as a factor explaining why health differences in urban areas are generally

better than in rural areas. Women living in rural areas may experience limited access to healthcare as well as lower educational levels, fewer employment opportunities, and, in general, higher rates of poverty (Hillemeier et al. 2007). All these factors indeed may influence infant and child health conditions.

As stated before, an additional factor most consistently associated to LBW and other birth outcomes is the gestational age of the infant. Some authors have argued that gestational age is a better predictor of neonatal survival than birth weight alone (Varloove-Vanhorick et al., 1986). The incidence of low birth weight is correlated with two pathologic conditions and one normal condition. The pathologic conditions include preterm delivery and intrauterine growth retardation (IUGR) (Vandenbsoche et al., 1998). The normal condition refers to births resulting in a healthy but constitutionally small baby. Recent evidence suggests that in developing countries, pre-term births account for almost two-thirds of all LBW while the opposite holds true in developed countries (Hosain et al., 2005).

Regional differences may also influence infant health conditions and, in general, survival chances of children. One of the reasons is that accessibility to services is inequitably distributed across a country. It may be also the case that one area of the country has higher prevalence for some diseases compared to other areas (Frank et al., 2002). For the case of Mexico, regional differences in health are influenced by geographic disparities in levels of accessibility and utilization of health services (Bobadilla et al., 1990).

This paper contributes to the existing literature in this area by providing new evidence on factors associated with LBW using the most recent data available for Mexico, the ENADID, 2006. This analysis allows for testing the possible association of international migration experiences of households on birth outcomes, the latter concept operationalized as low birth weight. The goal is

to provide an analysis allowing for the identification of channels, other than solely remittances, that associate migration with LBW. Particular attention is given to maternal health conditions and gestational age as biological determinants of LBW. The mother's socioeconomic conditions as influencing birth outcomes are considered as well. Therefore, this study seeks to test two main hypotheses: (1) the odds on the incidence of LBW will be lower for infants born in households engaged in international migration compared to households with no migration experience; (2) the positive effect of migrant households on birth outcomes remains robust after including a separate set of different explanatory variables.

Data and Methods

Data used in this study come from the 2006 Encuesta Nacional de la Dinamica Demografica (ENADID) (National Survey of Demographic Dynamics). The 2006 survey updates information and issues that were addressed in the immediately preceding ENADID survey administered in 1997. Institutions such as the Secretaria de Salud (Ministry of Health) and the Consejo Nacional de Poblacion (National Council of Population) participated in the conceptual and methodological design of the survey. The sampling frame for the survey was built using the cartographic and demographic information from the 2000 General Census of Population and Housing (INEGI, 2000). The ENADID 2006 is a nationally representative survey which collects information from each of the 32 Mexican states, making a total sample of 41,926 households. The survey was conducted in the last quarter of 2006 and provides information related to fertility, infant and maternal health, infant and general mortality, national and international migration experiences, and contraceptive practices. The total sample included in the analysis corresponds to 39,449 infants, in which 2,489 are reported to be LBW (<2,500 g) and 36,960 are normal weight (≥2,500 g). The sample for this analysis only includes singleton births, as it has long been

established that lower birth weights are highly correlated with multiple births (Khader et al., 2005).

This database is well suited for this research for two reasons. First, the survey contains retrospective information about birth outcomes and maternal health for the last pregnancy for women between the ages of 15 to 54. Second, a module of questions related to international migration is also included in the survey which contains information on whether a member of a particular household has emigrated to U.S. either in search of a job or for other reasons. This allows maternal and infant health characteristics to be combined with international migration information at the household level. Multivariate logistic regression methods are used to model low birth weight as a function of a set of proximate determinants (length of gestation period); intermediate determinants (maternal age, pregnancy problems, prenatal care) and socioeconomic determinants (mother's education, income level, housing infrastructure).

The analysis includes a variable that incorporates the migration experience of the household. This variable is utilized in order to identify the effect of international migration on LBW. It is obtained in the ENADID when it questions whether household members have ever been in the United States searching for work. This question is asked to all household members who normally live in the household. In this study, the migrant household variable is operationalized as a binary variable with value of 1 if any member of the household at least 15 years of age or older had migrated to the U.S. since January 2001, 0 otherwise. In order to provide reliable estimates on the relationship between household migration experience and LBW, only those infants born after the migratory trip occurred are included.

Maternal education was categorized in order to distinguish between women who had received no formal education, those who have had less than a primary school education (<6 years) and had

not graduated from elementary school, and those who had completed primary school or more (≥6 years). This categorization of maternal education has been strongly associated to infant health outcomes (Frank et al., 2002). In order to examine the possible existence of a gradient effect of household's income upon birth weight outcomes, the total household income is also included and coded in four quartiles. This categorization suggests that the fourth quartile represents the highest income group, while the first quartile represents the lower income group.

Maternal age is also a potential confounder in perinatal studies, where the risk of neonatal death or poor birth outcomes is higher for mothers under 18 or over 40 years of age (Rothman et al., 2008). In order to capture for possible effects of maternal age, three different age groups, <20 years, 20-34 years, and ≥ 35 years were included in the analysis. Parity was operationalized using the Kleinman- Kessel Parity Index (1987), in which variables detailing birth order and maternal age were combined to create three different parity categories, including: a) First birth; b) Low parity (second-order births to women 18 and older, third order births to women 25 and older); and c) High parity (second- or higher-order births to women under 18, third- or higher-order births to women under 25, and fourth- and higher-order births to women 25 and older). Dichotomous variables were created for each of these three categories. Marital status was then categorized as a dummy variable with value 1 if the mother was married at the time of the infant's birth and a value of 0 if otherwise.

The survey also includes information about antenatal health care as well as the presence of maternal health problems during pregnancy. A dummy variable was created to indicate whether or not the mother received prenatal care (yes=1 and no=0). Problems during pregnancy (such as vaginal bleeding, urinary tract infection, diabetes, hypertension, high fever, and other type of problems such as abdominal pain; tiredness; backache; swollen ankles; feet and legs; were also

categorized into a single dichotomous variable with value of 1 if women responded to have had any of these problems during their pregnancies and 0 if they did. Gestational age is reported in the survey as the length of pregnancy in months. This variable is then converted to weeks and coded as a dummy variable for pre-term births with value 1 for those infants born at less than 37 completed weeks of gestation and 0 otherwise.

The analysis also accounts for differences in urban-rural birth outcomes as an important factor for assessing the type of health problems in communities with different levels of urbanization. Hence, two dummy variables were created in order to categorize large metropolitan areas ($\geq$100,000 inhabitants) and non-metropolitan areas (<100,000 inhabitants). Following Frank et al. (2002), in order to characterize infant's housing conditions, several variables such as, the availability of indoor water facilities, sanitary drainage, and electricity, are used. A variable called poor infrastructure is created to indicate if a household reported to have any of the following: dirt floors, lack of indoor sanitation or water facilities and lack of electricity. The possible effects of regional differences on infant birth outcomes are also included through a set of regional dummy variables. Included with these was an additional dummy variable, commonly operationalized in past studies representing the historic migrant sending region (Hamilton et al., 2008; Massey et al., 1994). These regions are classified according to mother's residence: Border, Capital, Center, Southeastern, and Historic[1].

Tables 3 and 4 show the odds ratios of low birth weight using different operationalizations of the migration variable. In the first case, it was possible to differentiate those migrant households that were the recipients of recipient of remittances from those migrant households reporting not being

[1] The regions were classified as follows: Border: Baja California, Baja California Sur, Chihuahua, Coahuila, Nuevo Leon, Sinaloa, Sonora, Tamaulipas; Center: Colima, Guerrero, Guanajuato, Michoacan, Morelos, Nayarit, Oaxaca, Puebla, Queretaro, Tlaxcala; Southeastern: Campeche, Chiapas, Quintana Roo, Tabasco, Veracruz, Yucatán; Capital: Distrito Federal, Estado de Mexico; and Historic: Aguascalientes, Durango, Guanajuato, Jalisco, Michoacán, San Luis Potosí, and Zacatecas.

receivers. A sample design for households was specified when running all the regression models.

Results

Given that the main interest of this study is to examine possible differences in the distributions of characteristics between households experiencing migration to the U.S. versus those who do not, a table with the percentages of each one of the variables is included in the analysis is provided in Table 1.

Table 1 about here

T-test values are provided in the last column, which examine the differences in means between migrant and non-migrant households and whether these differences are statistically significant. Column 1 presents the distribution of characteristics for all households. Column 2 presents the distribution of characteristics included in this analysis for infants born in households with migration experience, while column 3 presents the distributions of households without migration experience. Approximately 7.0 percent of the births in the sample were LBW, and about 13 percent of infants were reported to be premature. These numbers appear to be similar to those obtained in other studies (Frank et al., 2002; Frank 2005; Hildebrant et al., 2005), which round the percentage of LBW infants in the population to between 7 to 11 percent for LBW. The percentage of households classified as migrants were approximately 6.3 percent of the sample. This percentage is close to the value of 6.9 percent obtained by Frank et al. (2002) from the ENADID 1997.

Variables used to capture the mother's demographic profile in the complete sample indicate that more than two-thirds of mothers were between the age of 20 and 34, mostly married, living predominantly in metropolitan areas with more than 100,000 inhabitants, did not report having

problems during pregnancy, received some kind of prenatal care, and were generally low parity. In regards to maternal socioeconomic conditions, around 4 percent of mothers did not report any level of formal education and two thirds of mothers in the sample completed at least one year of primary school education. Additionally, approximately 25 percent of the sample was estimated to have poor infrastructure conditions in their dwelling unit.

Interesting differences in infant-maternal health and maternal characteristics are found when comparing migrant and non-migrant households (Columns 2 and 3, Table 1). First, infants in migrant households have lower percentages of LBW (5.6 percent) compared to infants in non-migrant households (6.3 percent). The same pattern holds for premature births in migrant households compared to non-migrant households. Mothers in migrant households have a slightly higher percentage of prenatal care use compared to mothers in non-migrant households. The t-test values for differences in the means between migrant and non-migrant households indicate statistically significant differences in these two variables. The distributions of other variables in the analysis are as expected based on the migration experience of the household, indicating mothers in migrant households tend be younger, with lower income, and living in rural areas compared to mothers of non-migrant households. There are no significant mean differences between migrant and non-migrant households in variables such as poor infrastructure, health problems during pregnancy, and parity. Furthermore, high levels of significance in means between migrants and non-migrant households are reached across regions in Mexico.

Table 2 shows the odds ratios of low birth weight with several covariates using multivariate logistic regression.

Table 2 about here

Model I shows the bivariate relationship between the outcome of interest, low birth weight, and the variable measuring migration experience of the household. Model II provides estimates of the socio-economic status, place of residence, and housing infrastructure. Model III controls for mother's age, prenatal care, and maternal health related problems during pregnancy. In order to identify the regional differences in infant birth outcomes, Model IV adds dummy variables for the region in which the infant was born. The odds ratio of low birth weight for infants born in migrant households was significantly lower as compared to infants born in non-migrant households. Migrant households show approximately 20 percent lower odds of having low birth weight children (see Model I). The significant effect was not changed through the different inclusion of covariates suggesting a robust association between migration and low birth weight. As expected, the size of locality also influences birth outcomes. The results show that non-metropolitan areas have 18 percent higher odds of children having low birth weight as compared to metropolitan areas. Although the odds ratio for mothers with no formal education resulted in higher LBW as compared to mothers with at least one year of education, there was no statistical significance in this variable. The findings also suggest that adjusting for the mother's socioeconomic characteristics, households in the second quartile of total income are associated with 25 percent higher odds of low birth weight as compared to those in the highest quartile of the income distribution (see model II). Poor infrastructure in the dwelling unit is also associated with higher odds of lower birth weight, while mothers' having health coverage during pregnancy have approximately 12 percent lower odds of having children with low birth weight. Once adjusting for the mother's characteristics, women reporting health problems during pregnancy have significantly higher odds of their children having low birth weight as compared to those with no health problems (see model III). Marital status seems to affect the odds of low birth

weight as married mothers exhibit 12 percent lower odds than single mothers. Not having prenatal care was only significant in the full model (model IV) and it is associated with 45 percent higher odds of low birth weight. Contrary to our expectations, mothers aged less than 20 years, have lower odds of low birth weight as compared to the reference group (mothers age 20-34). Moreover, first born infants have higher odds of low birth weight than low parity infants, whereas high parity showed no statistical significance. Regional differences on the odds of low birth weight can be examined in model IV. Two regions reached significant odds ratios: the Border and Center regions. Infants born in the Border region exhibit approximately 15 percent lower odds of low birth weight as compared to those born in the Capital, while there are 36 percent higher odds of low birth weight for infants born in the Center region compared to the Capital. Finally, notice that the variable controlling for premature births was included in each one of the model specifications in order to control for its biological significant association with birth outcomes. As in the case of this study, its inclusion allows examination of whether the positive effect of migrant households is due to lowering the odds of low birth weight or if it is the prematurity indicator that is the variable capturing the effect on low birth weight. Accordingly to the expectations, premature births exhibit six fold higher odds of LBW as compared to full-term births (model I) and once the model includes the rest of the covariates, premature births have approximately five fold higher odds of low birth weight (model IV). These findings seem to support the hypothesis that the odds of the incidence of LBW will be lower for infants born in households engaged in international migration compared with household with no migration experience; also, the positive effect of migrant households on birth outcomes remains robust after including a separate set of different explanatory variables. Nonetheless, the next step of this research consists in examining the extent the channel through

which migration affects birth outcomes is related to remittances received by households or whether there is evidence for other potential mechanisms.

Table 3 shows the odds ratios classifying migrant households being both receivers of remittances and non-receivers of remittances.

Table 3 about here

It was expected that migrant households with remittances would exhibit a statistically significant lower odds of low birth weight births compared to immigrant non-remittance households. However, it was found that migrant households that do not receive of remittances have 29 percent lower odds of having low birth weight births (model IV). Conversely, no significance in lowering the odds ratio was found for migrant household with remittances. The rest of the covariates exhibited the same pattern as discussed in Table 2.

In Table 4, we included the migration variable as an interaction of the total household's income with the dummy variable for migrant households. Here, the purpose is to determine whether total household income is the channel through which international migration affects the odds of low birth weight in migrant households.

Table 4 about here

Results from Table 4 indicate that the total income in migrant households does not have a significant effect in lowering the odds of low birth weight.

Discussion

The main purpose of this paper was to provide new evidence on the effects of international migration on the risk associated with low birth weight in Mexico. The general notion is that Mexican households tend to benefit from the U.S. migration. The pathways through which migration affects Mexican households were primarily categorized into three factors – economic,

noneconomic, and selection (Frank 2005). The economic factors include the financial remittances received from the U.S. It was assumed that remittances received will be used towards providing better education and medical care and other basic needs within the household. The noneconomic pathway through which migration positively affects health outcomes is that of social remittances that are defined as "the ideas, behaviors, identities, and social capital that flow from receiving to sending country communities" (Levitt, 1998, pp. 927). Here it is assumed that migrants who return to their communities not only bring remittances but carry with them the values, norms, and practices they were exposed to in the U.S. The diffusion of these new practices, particularly dealing with health care practices, will lead to better health outcomes at the individual and community levels (Kanaiaupuni et al., 1999). The third pathway through which migration affects health outcomes is the selection of study participants. It is possible that the selection of study participants disproportionately favors healthy individuals, which would biase the results upward (Frank , 2005; Palloni et al., 2004).

While the present study results are consistent with previous studies, some additional inferences can be drawn. First, although the migration households in Mexico seem to have lower odds of low birth weight children, the mechanisms through which migration affects birth outcomes is far from clear. Similar to a previous study by Frank et al., (2002), we also differentiated the migrant household variable by receipt of remittances from abroad. It was found that migrant households without remittances were likely to have lower odds of low birth weights compared to migrant households with remittances. In analyzing the channels through which migration affects birth outcomes, the findings provide no compelling evidence for remittances as the mechanism associated with lowering the odds of low birth weight. This is also reflected in the household income variable. That is, infants born in the third income quartile showed a decline in low birth

weight but with no statistical significance. The infants born in the second income quartile only showed significant higher odds of low birth weight.

We find two explanations for this. First, although ENADID 2006 has included several questions to elucidate income, errors associated with reporting income remain a significant problem. We found a significant discrepancy between percentage of migrant households and households receiving remittances. That is, in the present data although about 6 percent of the households reported households with migrants, only less than one percent of the households reported receiving remittances, or *migra dollars,* from abroad. These percentages were approximately 7 percent and 2 percent respectively in 1997 ENADID. It is possible that either a large percentage of the households are not reporting the receipt of remittance from abroad or only a small percentage of the households in fact receive remittances from the U.S. If the latter is true, it leads to the second explanation of social remittances. The strong and robust association between migrant households and low birth weight may provide new insights about the possibility that households may be benefitting from international migration indirectly. One may argue that if the majority of the households were not receiving financial remittances and given the higher percentage of migrant households, one may see the influence of social remittances affecting low birth weight in Mexico. Hildebrand and McKenzie (2005) posit the idea that households may gain some type of health knowledge from the migration experience to the United States. This in turn may generate spillovers that can be transmitted from one migrant family to another and eventually this process may also benefit non-migrant households. This and many other studies have showed that migrants may learn basic health knowledge such as nutrition, diet, exercise, fewer number of children, etc. while living abroad and then pass this information to their family members (Frank, 2005; Massey and Parrado, 1994; Menjivar, 2002; Kanaiaupuni and Donato,

1999; Coale and Watkins, 1986). The basic assumption here is that the diffusion of these innovative health care practices will slowly become the norm of the communities; this would have a significant impact on health outcomes.

While the present study has provided some evidence on the mechanisms through which migration affects low birth weight in Mexico, further studies are needed to clarify our understanding on this topic. The available data sources on migration and health are limited in capturing in-depth information on different sub-populations within Mexico, such as non-migrants in Mexico, internal Mexican migrants, and characteristics of migrant households and communities (Frank and Hummer, 2002). Future studies must also include changes at the macro levels since migration from Mexico to the U.S. is not a recent phenomenon. The migration phenomenon has been institutionalized in many communities within Mexico and changes due to this may reflect at the macro level. Additionally, one may be interested in testing whether this health knowledge is associated with lower risk of low birth weight or infant mortality, but also consider more extended set of maternal health variables. These research questions are left for further research.

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Table 1. Percentage distributions of Risk Factors used in the Analysis

	Column1		Column 2	Column 3	Column 4
	N-size (Unweighted)	Total	Migrant	Non-Migrant	t-test
Member of Migrant Household					
Yes	2,649	6.71	100.00	0.00	
No	36,800	93.29	0.00	100.00	
Low Birth Weight					
Yes	2,489	6.31	5.61	6.34	1.27* (0.010)
No	36,960	93.69	94.39	93.66	
Maternal Age					
<= 20 years	5,261	13.34	18.80	13.06	-7.13* (0.000)
20-34 years	27,500	69.71	69.33	69.73	0.35 (0.719)
> 34 years	6,688	16.95	11.86	17.21	6.02* (0.000)
Maternal Education					
None	1,694	4.29	5.07	4.26	-1.70* (0.043)
< 6 years	23,941	60.69	56.36	60.90	3.93* (0.000)
6 years or more	4,726	11.98	13.78	11.89	-2.46* (0.014)
Married					
Yes	22,575	57.23	49.90	57.42	3.50* (0.005)
No	16,874	42.77	50.10	42.58	
Locality size					
<100,000	24,326	61.66	76.76	60.91	-13.79* (0.000)
>=100,1000	15,123	38.34	23.24	39.09	
Infraestructure					
Poor	10,240	25.96	25.80	25.97	0.158 (0.874)
Not Poor	29,209	74.04	74.20	74.03	
Health coverage					
Yes	20,675	52.41	39.64	53.05	11.35* (0.000)
No	18,774	47.59	60.36	46.95	
Income					
1st quartile	3,035	22.79	27.08	22.59	-1.68* (0.041)
2nd quartile	3,417	25.66	26.74	25.61	0.09* (0.022)
3rd quartile	3,375	25.34	22.92	25.46	1.87* (0.040)
4th quartile	3,490	26.21	23.26	26.35	-0.23 (0.812)
lealth problems during pregnancy					
Yes	16,958	42.99	56.68	57.03	-0.3 (0.7639)
No	22,491	57.01	43.32	42.97	
Mother's residence					
Border	8,188	20.76	11.65	21.21	9.97* (0.000)
Capital	2,418	6.13	2.99	6.29	5.80* (0.000)
Center	10,016	25.39	33.71	24.98	-8.47* (0.000)
Historic	10,081	25.55	34.46	25.11	-9.05* (0.000)
Southestearn	6,626	16.8	8.76	17.20	9.53* (0.000)
Prenatal care					
Yes	38,433	97.42	97.92	97.40	-1.377 (0.168)
No	1,016	2.58	2.08	2.60	
Parity					
First birth	9,374	23.76	25.48	23.68	-1.79 (0.073)
Low parity	18,892	47.89	45.94	47.99	1.73 (0.083)
High parity	10,686	27.09	27.99	27.04	-0.901 (0.367)
Preterm					
Yes	5,045	12.79	11.91	12.83	1.16* (0.044)
No	34,404	87.21	88.09	87.17	
Total N of Infants	39,449	37,577	1,872		

Notes:

Migrant households were defined as households with at least one migrant to the U.S. prior the start of 2001.

p-values are reported in parentesis. * significant at 5% or higher

Table 2. Odds Ratios of Factors Associated to Low Birth Weight in Mexico by Migratory Staus

	Model I	Model II	Model III	Model IV
Migation Status [Non-Migrant Households]				
Migrant	0.79 *	0.74 *	0.75 *	0.72 *
	(0.042)	(0.027)	(0.034)	(0.015)
Locality size [>=100,000]				
<10,000		1.22 *	1.24 *	1.18 *
		(0.002)	(0.001)	(0.012)
Maternal Education [less 6 years]				
Non Education		1.03	1.03	1.02
		(0.744)	(0.971)	(0.845)
6 years or more		0.93	0.99	0.99
		(0.575)	(0.717)	(0.956)
Income [4th quartile]				
1st quartile		1.11	1.15	1.17
		(0.314)	(0.180)	(0.134)
2nd quartile		1.25 *	1.25 *	1.26 *
		(0.025)	(0.027)	(0.024)
3rd quartile		0.89	0.87	0.86
		(0.273)	(0.212)	(0.160)
Infraestructure [Not Poor]				
Poor		1.24 *	1.26 *	1.26 *
		(0.001)	(0.001)	(0.001)
Health coverage [No]				
Yes		0.86 *	0.86 *	0.88 *
		(0.010)	(0.012)	(0.033)
Age of the Mother [20-34 years]				
<20 years			0.60 *	0.59 *
			(0.000)	(0.000)
> 34 years			0.91	0.91
			(0.245)	(0.245)
Married [No]				
Yes			0.88 *	0.87 *
			(0.040)	(0.023)
Health problems during pregnancy [No]				
Yes			2.15 *	2.15 *
			(0.000)	(0.000)
Prenatal care [Yes]				
No			1.43	1.45 *
			(0.060)	(0.052)
Parity [Low Parity]				
First birth			1.16 *	1.16 *
			(0.048)	(0.044)
High parity			1.14	1.13
			(0.058)	(0.081)
Mother's residence [Capital]				
Border				0.85 *
				(0.046)
Historic				1.19
				(0.073)
Center				1.36 *
				(0.001)
Southestearn				1.02
				(0.859)
Preterm [No]				
Yes	6.52 *	6.78 *	5.35 *	5.32 *
	(0.000)	(0.000)	(0.000)	(0.000)

p-values are reported in parentesis.

* significant at 5% or higher

Table 3. Odds Ratios of Factors Associated to Low Birth Weight in Mexico by Households Receivers of Remittances

	Model I		Model II		Model III		Model IV	
Migation Status [Non-Migrant Households]								
Migrant Remittances	0.86		0.76		0.82		0.78	
	(0.758)		(0.573)		(0.0681)		(0.0613)	
Migrant No Remittances	0.79	*	0.74	*	0.75	*	0.72	*
	(0.084)		(0.032)		(0.036)		(0.016)	
Locality size [>=100,000]			1.22	*	1.24	*	1.18	*
<10,000			(0.002)		(0.001)		(0.012)	
Maternal Education [less 6 years]								
Non Education			1.03		0.99		1.02	
			(0.744)		(0.968)		(0.844)	
6 years or more			0.92		1.03		0.99	
			(0.575)		(0.716)		(0.953)	
Income [4th quartile]								
1st quartile			1.11		1.15		1.16	
			(0.317)		(0.185)		(0.138)	
2nd quartile			1.25	*	1.25	*	1.26	*
			(0.025)		(0.027)		(0.025)	
3rd quartile			0.89		0.87		0.86	
			(0.274)		(0.21)		(0.159)	
Infraestructure [Not Poor]								
Poor			1.24	*	1.26	*	1.26	*
			(0.001)		(0.001)		(0.001)	
Health coverage [No]								
Yes			0.86	*	0.86	*	0.88	*
			(0.010)		(0.012)		(0.033)	
Age of the Mother [20-34 years]								
<20 years					0.60	*	0.59	*
					(0.000)		(0.000)	
> 34 years					0.91		0.91	
					(0.244)		(0.245)	
Married [No]					0.88	*	0.87	*
Yes					(0.040)		(0.023)	
Health problems during pregnancy [No]					2.15	*	2.16	*
Yes					(0.000)		(0.000)	
Prenatal care [Yes]					1.43		1.45	*
No					(0.060)		(0.042)	
Parity [Low Parity]								
First birth					1.16	*	1.16	*
					(0.048)		(0.044)	
High parity								
					1.14		1.13	
Mother's residence [Capital]					(0.059)		(0.081)	
Border							0.85	
							(0.096)	
Historic							1.19	
							(0.073)	
Center							1.36	*
							(0.001)	
Southestearn							1.02	
							(0.858)	
Preterm [No]								
Yes	6.52	*	6.78	*	5.35	*	5.32	*
	(0.000)		(0.000)		(0.000)		(0.000)	

p-values are reported in parentesis.

* significant at 5% or higher

Table 4. Odds Ratios of Factors Associated to Low Birth Weight in Mexico with Interaction

	Model I	Model II	Model III	Model IV
Migation Status [Non-Migrant Households]				
Total Income*Migrant Households	1.00	1.00	1.00 *	1.00 *
	(0.082)	(0.233)	(0.034)	(0.015)
Locality size [>=100,000]				
<10,000		1.15 *	1.24 *	1.18 *
		(0.030)	(0.001)	(0.012)
Maternal Education [less 6 years]				
Non Education		0.91	0.99	0.99
		(0.468)	(0.971)	(0.956)
6 years or more				
		1.01	1.03	1.02
		(0.866)	(0.717)	(0.845)
Income [4th quartile]				
1st quartile		1.03	1.15	1.17
		(0.786)	(0.180)	(0.134)
2nd quartile		1.20 *	1.25 *	1.26 *
		(0.046)	(0.027)	(0.024)
3rd quartile		0.88	0.87	0.86
		(0.246)	(0.212)	(0.160)
Infraestructure [Not Poor]				
Poor		1.15 *	1.26 *	1.26 *
		(0.028)	(0.001)	(0.001)
Health coverage [No]		0.90 *	0.86	0.88 *
Yes		(0.050)	(0.012)	(0.033)
Age of the Mother [20-34 years]				
<20 years			0.60 *	0.59 *
			(0.00)	(0.00)
> 34 years			0.91	0.92
			(0.245)	(0.243)
Married [No]				
Yes			0.88 *	0.89 *
			(0.040)	(0.030)
Health problems during pregnancy [No]				
Yes			2.15 *	2.15 *
			(0.000)	(0.000)
Prenatal care [Yes]				
No			1.43	1.45 *
			(0.060)	(0.050)
Parity [Low Parity]				
First birth			1.16 *	1.16 *
			(0.048)	(0.044)
High parity			1.14	1.13
			(0.058)	(0.081)
Mother's residence [Capital]				
Border				0.85
				(0.096)
Historic				1.19
				(0.073)
Center				1.36 *
				(0.001)
Southestearn				1.02
				(0.859)
Preterm [No]				
Yes	6.52 *	6.15 *	5.35 *	5.32 *
	(0.000)	(0.000)	(0.000)	(0.000)

p-values are reported in parentesis.

* significant at 5% or higher