Migration to the US and Health among Mexico-US Migrants and Non-Migrants

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Abstract

Mexico-US migration represents one of the largest migration flows across the globe. However, debates abound over whether health selection is a salient driver of migration, and furthermore how migration shapes the health of Mexican migrants. We use the Mexican Family Life Survey to compare the health profiles of (1) Mexico-US nonmigrants and future migrants and (2) Mexico-US nonmigrants and return migrants. We find that the health of Mexico-US migrants' was on par with their compatriots who do not migrate, however return migrants' health was worse on some indicators. Return migrants had higher levels of adiposity (obesity and elevated WHC) and time spent in the US was associated with obesity, elevated waist circumference, and self-reported cardiovascular disease. Our findings shed light on the drivers of Mexican immigrants' health, and underscore the important of considering the social and environmental context faced by migrants in the US as an important determinant of health.

Migration to the US and Health of Mexican Migrants and Non-Migrants

A consistent body of research demonstrates that among Latina/os, migration and generational status plays an influential role in shaping cardiovascular disease related health behaviors and health outcomes. First-generation Latina/o immigrants generally have better CVD outcomes and lower levels of CVD risk factors relative to second and third generation Latina/os who are US-born (Acevedo-Garcia & Bates, 2008). These findings, often referred to as the Immigrant or Latino health paradox, have been widely documented for Latina/os in both nationally-representative and regional data, and most consistently among those of Mexican descent (Kyriakos S. Markides & Eschbach, 2005). The health paradox has perplexed researchers because the social and economic vulnerabilities faced by immigrants in the US, would instead have predicted their poorer health as compared to the US born.

Explanations for the differential health outcomes among immigrant and non-immigrant Latinos include the health selection, return migration/salmon bias, and acculturation/assimilation hypotheses. Proponents of the health selection hypothesis argue that the healthiest immigrants make the decision to migrate or that the heartiest individuals are selected by families to migrate. Furthermore, some scholars suggest that CVD related health behaviors and risk factors are better in sending countries compared to the US (Akresh & Frank, 2008). Meanwhile, the return migration or salmon bias hypothesis proposes that immigrants who become sick or unhealthy in the US might return to their country of origin for medical care or family care (Abraido-Lanza et al., 1999). Based on these explanations, research that compares the health outcomes of immigrants and the US-born may be misspecified due to its failure to account for these potential in-migration and out-migration processes.

Meanwhile, it is argued that immigrants engage in better CVD related behaviors such as physical activity and healthier eating due to a variety of social and cultural factors (Kennedy, Kidd, McDonald, & Biddle, 2015). Furthermore, once in the US, immigrants may be part of positive social networks and cultural practices that promote their health (Jasso et al., 2004). Drawing on scholarship from sociology and psychology, health researchers suggest that the US-born and longer-stay migrants acculturate or assimilate to US norms and behaviors (Lara et al., 2005). Therefore, in comparing recent migrants to longer-term migrants or the US born, scholars suggest that the US-born as well as migrants with more time in the US engage in individual-level health behaviors that erode their health, such as smoking or sedentary activity, or shed the social and cultural practices that assure immigrant health, such as family ties and spirituality.

However, the preponderance of research to test these potential explanations has largely used cross-sectional data in the US to compare health outcomes and risk factors between the US and foreign-born. For example, researchers have used nationally-representative surveys such as the NHIS (Antecol & Bedard, 2006; Zsembik & Fennell, 2005) and NHANES (Crimmins, Kim, Alley, Karlamangla, & Seeman, 2007), and area-level surveys such as the San Antonio Heart Study and Sacramento Area Latino Study on Aging (Espinoza Sara E., Jung Inkyung, & Hazuda Helen, 2013; González, Tarraf, & Haan, 2011) to document the health advantage of immigrants compared to the US-born. In another vein, cross-sectional data has also been used to compare health among immigrants with varying years in the US or who arrived in the US at different age points (Angel, Angel, Díaz Venegas, & Bonazzo, 2010; Colon-Lopez, Haan, Aiello, & Ghosh, 2009; Derby et al., 2010). With this approach, researchers attempt to disaggregate immigrants to better capture how migration relates to health selection and behaviors that might be related to health outcomes.

Importantly, an emerging body of literature uses binational cross-sectional or longitudinal data to compare migrants to their compatriots who did not migrate (Lu, 2008; Ro & Fleischer, 2014; L. N. Rubalcava et al., 2008). Binational data through the use of linked datasets from both sending and receiving countries enable researchers to explore potential differences in health selection, behaviors, and outcomes with more appropriate comparison groups. With significant data collection hurdles, longitudinal data also enable researchers to gain access to information about individuals pre/post migration, explore health at baseline, and compare health trajectories between nonmigrants and migrants.

While the existing explanations and methodological approaches shed light on the drivers of the Latino health paradox, gaps in the research still remain. With some notable exceptions, the majority of research that has explored the health paradox hypotheses uses older data and contemporary migration flows and health patterns are distinct from these earlier migration periods. While some recent datasets do include Latino immigrants and the US born, few include an important comparison group- non-migrants from sending countries in Latin America. In addition, it is likely that the health paradox hypotheses operate in tandem to shape health outcomes, yet few studies test the multiple hypotheses together.

Therefore, this analysis addresses some of these gaps by using two waves of data from the Mexican Family and Life Survey to compare cardiovascular health, risk factors, and health-related behaviors between (RQ1) Mexico-US future migrants and nonmigrants and (RQ2) Mexico-US return migrants and nonmigrants. The Mexican Life Family and Life Survey (MxFLS) is a longitudinal, multi-thematic survey representative of individuals and households in Mexico (L. Rubalcava & Teruel, 2006). The baseline survey, collected in 2002, consisted of a sample of 19,764 individuals from 150 communities in Mexico. The second wave (MxFLS-2;

2005-2006) relocated and reinterviewed the original respondents including those who emigrated to the US; re-contact rates for MxFLS-2 reached 90%. While health data from wave 2 on Mexico-US migrants has not yet been released, migration status at wave 2 is available and is used to classify Mexico-US future migrants and nonmigrants. Furthermore, respondents were asked to provide a detailed migration history and this information is leveraged to classify US-Mexico return migrants and nonmigrants. Our first research question tests the healthy immigrant hypothesis by comparing the baseline health of Mexicans who later migrate to the US to those who remain in Mexico. Meanwhile our second research questions explores return migration by comparing the health of Mexicans who had migrated to the US, but later returned to Mexico to Mexican who remained in Mexico their entire lives.

The MxFLS is also among the most recent studies that measures health and migration in the Mexican population. Understanding the health trajectories of Mexico-US migrants is essential for understanding broader processes within Latino health. The Mexico-US migration flow represents one of the largest global migration flows, and Mexican migrants account for the largest immigrant origin group in the US[1]. Furthermore, Mexican migrants comprise 35% of the Mexican-origin population in the US and 20% of the overall Latino population (Gonzalez-Barrera & Lopez, 2013; US Census Bureau, 2013). This analysis therefore elucidates some of the potential mechanisms and drivers of Latino health in the US and provides an important examination of the Latina/o health paradox using data on Mexicans.

[1] As of 2013, however, China and India surpassed Mexico in the number of immigrants sent per year

Methods

Data

I use data from two waves (2002; 2005) of the Mexican Family Life Survey (MxFLS), a longitudinal, nationally representative sample of households in Mexico (L. Rubalcava & Teruel, 2006). The MxFLS used a multi-stage probability sample of the Mexican population. Primary sampling units were selected under criterions of national, urban-rural and regional representation on pre-established demographic and economic variables. The baseline survey in 2002 collected data on 35,000 individuals across 8,440 households in 150 communities throughout the country. The MxFLS collected socio-economic, demographic and health information on individuals and households. Participants also completed an in-home physical health assessment conducted by a trained health worker. The second wave in 2005-2006 successfully recontacted almost 90% of the original household sample, including those who migrated within Mexico or emigrated to the US. However, the full sample of these data are not yet publicly available which limited my ability to compare trajectories of health and social characteristic among migrants and nonmigrants. Nevertheless, the data include an indicator to identify Mexico-US migrants in wave 2 (i.e. individuals who were living in Mexico during Wave 1 but moved to the US in Wave 2). I use this indicator to identify non-migrants and future migrants at baseline and compare their health. I limit my analysis to individuals, ages 16 or older (n=19,048) because these individuals were surveyed on their migration history, health behaviors, and sociodemographics. This research was classified as exempt by the University of Michigan Institutional Review Board (HUM0011332).

Measures

CVD Risk Factors and CVD.

Abdominal Obesity: Measures of excess abdominal visceral adipose tissue, while associated with obesity and BMI, are suggested to be better predictors of CVD risk as they may "capture metabolic abnormalities, including decreased glucose tolerance, reduced insulin sensitivity, and adverse lipid profiles" (World Health Organization, 2008). We computed a continuous measure of waist-hip ratio using waist and hip circumference measures. We also computed dichotomous measure of elevated waist-circumference and elevated waist-hip ratio using WHO cutoff guidelines (WC >102 cm (M); >88 cm (W); WHR ≥0.90 cm (M); ≥0.85 cm (W)). For the analysis, we interchanged and compared results using elevated WHC and WHR.

Obesity: We computed a continuous measure of BMI using height and weight measures (weight/height^2 * 703), as well as clinical cutoffs for underweight (<18.4), normal (18.5-25), overweight (25.1-29.9), and obese categories (>30). We created two dichotomous variables which included only those who were categorized as obese compared to all other categories, and the second with obesity and overweight compared to normal and underweight respondents.

Blood Pressure: We used continuous measures of systolic (SBP) and diastolic (DBP) blood pressure to create clinical measures of normal blood pressure (<120/80), prehypertension (120-139/80-89), and hypertension (>140/90)[2]. In addition, I created two dichotomous measures of high blood pressure, one which included both individuals with clinical hypertension as well as those who reported that they were currently taking medication for hypertension and the second

[2] In 2018, the US updated their blood pressure guidelines however Mexico still uses the previous standards (Instituto Mexicano del Seguro Social, 2017)

with only those that had a clinical measure of hypertension based on their SBP and DBP measurements.

Diabetes: Individuals self-reported if they had a history of diabetes. This measure was used to compute a dichotomous variable of diabetic status.

Cardiovascular Disease: Individuals self-reported if they had a history of heart disease, heart attack, cholesterol/arteriosclerosis, or stroke. We created a dichotomous measure of cardiovascular disease status based on positive responses to any of these items.

CVD Health-Related Behaviors.

Current Smoker: We created a dichotomous variable for smoking status, smoker (1) or nonsmoker (0), based on a series of questions about smoking history and quantity of smoking. Nonsmokers were individuals who reported that they had never smoked in their life. Individuals who reported that they had smoked previously, but currently reported zero cigarettes in the past month were also categorized as nonsmokers. Smokers were classified as individuals who reported smoking on average 1 or more cigarettes in the past month.

Physical Exercise: We created both continuous and dichotomous measures of physical activity. The continuous measure consisted of the total minutes of physical activity that respondent engaged in during an average week. This measure was used to create a binary variable to indicate whether the individual met the criteria for the recommended amount of weekly physical activity in Mexico and the US (>150 min/week) (Pérez-Escamilla, 2016).

Migration Indicators.

Mexico-US Future Migrants: MxFLS identified individuals who migrated to the US in 2005 (although no other health or socioeconomic information about these migrants is currently

available). Using this variable, I classified individuals as Mexico-US future migrants (1) or nonmigrants (0).

Mexico-US Desired Migrants: The MxFLS asked respondents a series of migration questions including their desire for future migration. Using these questions I created a category of "desired migrants" based on individuals who: indicated in Wave 1 that they had a desire to emigrate from Mexico, chose the US as their destination, but had remained Mexico in Wave 2. As a non-migrant group with a desire to migrate, these individuals may be a better group to compare to Mexico-US migrants. Both groups may have endogenous characteristics that shape both migration and health (e.g. determination, self-confidence) that individuals with no desire to migrate do not share.

US-Mexico Return Migrant: MxFLS asks individuals to provide a roster of places they have lived since age 16; this migration roster enables me to determine if an individual ever lived in the US and their length of time in the US. Using these variables, I created an indicator of return migrants which included individuals who had reported living in the US for a period of 12 months or longer, but lived in Mexico in Wave 1 (indicating that they had returned to Mexico). In addition, I computed the length of time spent in the US as a continuous variable measured in months (non-return migrants were given a value of 0).

Controls.

Finally, I include various controls within my models to account for variables that are associated with migration and the health outcomes of interest. Controls included age, sex, education, marital status, and health insurance. I used data on highest level of education completed to create a categorical measure indicating whether the individual completed college, high school, secondary/elementary school, or no education. Marital status was a dichotomous

measure of unmarried (0) or married (1). Married included co-habiting couples and unmarried included widows. Health insurance was a dichotomous measure (yes/no) based on whether the individual indicated that they had public or private health insurance in the past year.

Statistical Analysis

Descriptive Statistics and Bivariate Relationships.

The analysis was completed using Stata 15. Descriptive statistics and frequencies of the study variable were generated to assess the quality of the data and proportion of missing cases. Any cases that were missing data on the independent, dependent, or control variables were dropped from the analysis. The final dataset for the analysis included n= 14,744 cases.

We computed descriptive statistics to obtain demographic characteristics among the entire sample and compare non-migrants, migrants, desired migrants, and return migrants at Wave 1. Pearson's chi-square tests (categorical variables) and students' t-tests (continuous) were used to explore significant differences in demographic and health characteristics among these groups.

Multivariate OLS and Logistic Regression Models.

Multivariate regression models were used to examine the relationship between health at baseline and migration (RQ1) and return migration and health at baseline (RQ2).

For RQ1, we test whether health at wave 1 is associated with Mexico-US migration at wave 2. In these models, Mexico-US migration is the dependent variable while health variables at baseline are the independent variables. In addition, we complete a sub-analysis of RQ1 by restricting the sample to Mexico-US migrants (1) and desired migrants (0). The model is specified as follows:

$$\ln(\text{migration}/1\text{-migration}) = \beta_0 + \beta_1(\text{health vars}) + \ldots \beta_k(\text{controls})$$

For RQ2, we test whether return-migration from the US is associated with each of the health variables at wave 1. In these models, now health at baseline is the dependent variable and both US-Mexico return migration and times in the US are independent variables (in separate models). The models are specified as follows using BMI and obesity as examples.

$$\text{OLS: } Y_{BMI} = \beta_0 + \beta_1(\text{return migrant}) + \ldots \beta_k(\text{controls}) + e_i$$

$$\text{Logistic: } \ln(\text{obesity}/1\text{-obesity}) = \beta_0 + \beta_1\text{months in US}) + \ldots \beta_k(\text{controls})$$

To compare models and determine the appropriate covariates to include in final models, we used likelihood-ratio tests to compare nested and full models and examined standard errors and p-values. We also tested for multicollinearity by computing correlation coefficients and conducted post-estimation tests of the regression models using variance inflation factors

Mixed Effects Models,

Data in the MxFLS are clustered on two levels, respondents are nested within families/households and families/households are grouped within states. Failure to account for clustering in the data may lead to misleading inferences. Therefore to account for nesting in the data, we also estimated a series of mixed effects models with fixed-effect and random-effects. First, we estimated a two-level model that included fixed effects for the relationship between the dependent variable and the level-1 independent variables (e.g. age, gender, etc) and a random-intercept for family. Then we estimated a three-level model that included fixed effects for the relationship between the dependent variable and the level 1- independent variables, a random-intercept for family at level-2, and a random intercept for state at level-3. I compared the results of the mixed effects models that account for nesting to the OLS and logistic regression models.

Results

Descriptive Statistics

The final analytic sample consisted of 14,744 cases. Table 3.2 presents descriptive statistics of the overall sample. There was a larger proportion of women (56 percent) than men (44 percent). The mean age was 40 years old (sd=16.62) and ranged from 15 to 107. The majority of individuals in the sample were married (70 percent). In addition, about one-fifth of the sample had achieved at least a high school education in Mexico and slightly over half of individuals reported that they had worked in the past month. Slightly less than half reported that they had any form of health insurance.

In terms of health characteristics, over 60 percent of the sample was classified as overweight or obese (63.96 percent), which was consistent with national estimates (Barquera et al., 2009). Over a quarter had elevated waist-hip ratio (28 percent) and waist circumference (26 percent). Based on anthropometric measures of systolic and diastolic blood pressure, 36 percent were classified as having hypertension/high blood pressure; when high blood pressure included those who reported taking medicine for hypertension that percentage nearly doubled to 63 percent. Based on self-report data, approximately 6 percent and 3 percent reported that they had been diagnosed with diabetes and cardiovascular disease, respectively. Finally 13 percent reported being a current smoker, and 13 percent also reported levels of physical activity that classified them as meeting the recommended weekly level of physical activity.

Migrant Groups Descriptive Statistics and Bivariate Analysis

Tables 3.3-3.5 provide breakdowns of the various migrant groups used in the analysis and compares their sociodemographic and health characteristics. There were a total of 321 Mexico-US future migrants and 14,423 nonmigrants in the sample (Table 3.3). Mexico-US migrants were

respondents who lived in Mexico during Wave 1 of the study in 2009, but were then living in the US during Wave 2 in 2012. As compared to non-migrants, future migrants were more likely to be younger, male, unmarried, and uninsured. In addition, future migrants had lower levels of obesity, elevated waist-hip ratio and waist circumference, and self-reported diabetes. Finally, Mexico-US future migrants were also more likely to have previously resided in the US, and spent more time in the US as compared to non-migrants who had also previously resided in the US.

Table 3.4 further subdivides the non-migrant group to compare Mexico-US desired migrants and Mexico-US future migrants. Desired migrants were those individuals who in Wave 1 had said they wanted to migrate to the US, but remained in Mexico in Wave 2 (n=299). In general, desired migrants and future migrants had similar sociodemographic and health characteristics. However, desired migrants were more likely to have completed high school and have health insurance.

Finally, 276 individuals in the sample were Mexico-US return migrants which was defined as individuals who had previously migrated to the US for a period of at least 12 months but were living in Mexico at Wave 1. Return migrants were more like to be male, 71 percent versus 44 percent, and were more likely to be currently working and uninsured. Return migrants also had lower levels of elevated waist-hip ratio compared to non-return migrants but otherwise were comparable health-wise.

Research Question 1: Health Selection and Migration

We first tested whether health at wave 1 is associated with migration to the US at wave 2 using a series of logistic regression models (Table 3.6). In these models, the health variables were the independent variables while Mexico-US migration status (future migrant or non-

migrant) was the dependent variable. I first entered and selected the appropriate covariates in the model before testing for association with health. The best fitting model included covariates for age, sex, education, insurance status, and traditional migration state. In this base model, being younger and male, having less education and no health insurance, and living in a traditional migration state were all independent and significant predictors of future migration to the US. Model 2,Table 3.5 shows that most of the health indicators, including obesity status, high blood pressure, self-reported diabetes, self-reported CVD, smoking, and physical activity, were not significantly associated with future migration status. Elevated WHC, however, was associated with migration; those who had an elevated waist circumference were less likely to migrate to the US (OR=0.67, 95%CI 0.46-0.98). To rule out multicollinearity or variable specification issues, we tested these models with continuous versions of these variables if available (e.g. continuous measure of BMI vs categorical measure of obesity) and we entered each of the health indicators individually with only the covariates and no other health variables.

In Table 3.7 we further explore health at baseline and migration by restricting the sample to include Mexico-US future migrants (1) and desired migrants (0). Recall that desired migrants are individuals who reported wanting to move to the US in wave 1 but had not migrated by wave 2. In these models, age, education, and insurance status were the only independent predictors of migration; those who were younger, did not complete college, and were uninsured were more likely to migrate among desired migrants and Mexico-US future migrants. In Model 2, Table 3.7, we add health variables into the model and again health factors were not significantly associated with migration.WeI also tested each of these health variables in isolation in the model and used alternate specifications of the variables for robustness checks.

Research Question 2: Return Migration and Health

Next we test whether ever migrating the US and further amount of time spent in the US is associated with health during Wave I. In these models, each of the health indicators was modeled as the dependent variable. In cases where indicators could be defined as continuous or categorical (e.g. BMI and obesity/overweight), we ran both OLS regression and logistic regression models. While point estimates varied, the substantive results for most of the outcomes did not differ. Therefore we present and discuss the outcomes of the logistic regression models for ease of interpretation. We also tested if associations between return migration or time in the US and health could be explained by differences in smoking and physical activity behaviors, by entering these variables in the model both before and after the return migration and time variables. Tables 3.8-3.14 present the base model with covariates and full models that included migration variables for each of the health indicators.

We first tested whether return migration and time in the US were associated with physical activity (Table 3.8) and smoking (Table 3.9). In both models, being a return migrant and amount of time spent in the US were not significantly associated with either physical activity or smoking. For physical activity, age, sex, education, insurance status, and traditional migration state were significant covariates, while only sex, employment status, education and insurance status were associated with smoking.

Next I tested associations between return migration and time in the US and CVD risk factors of obesity status, elevated WHC, high blood pressure, and diabetes (Tables 3.10-3.13). Across the models for high blood pressure and diabetes, there were no significant differences between return migrants and non-migrants. Nor was time in the US significantly associated with the probability of high blood pressure or self-reported diabetes. However, for both

obesity/overweight status and elevated WHC, return migration and time in the US were significant independent variables in the models. Return migrants had a 45% increased odds of having an elevated WHC compared to nonmigrants (OR=1.452, 95% CI 1.079-1.953) and each additional year spent in the U.S. increased the odds of adiposity by 3% (OR=1.03, 95% CI 1.00-1.07). Similarly return migrants were more likely to be overweight and obsese as compared to nonmigrants (OR=1.381, 95% CI 1.056-1.806), and time in the US also increased the probability of being overweight (OR=1.005, 95% CI 1.001-1.009). The inclusion of physical activity or smoking behaviors in the models did not significantly alter these findings

Finally, I tested return migration and time in the US on self-reported cardiovascular disease (Table 3.14). In these models, return migration was not significantly associated with cardiovascular disease, however time in the U.S. was associated with an increased odds of reporting heart disease, stroke, or atherosclerosis (OR=1.005, 95% CI 1.001-1.009). Again, the inclusion of smoking or physical activity did not add any explanatory power to the models or change the effects of time spent in the U.S on cardiovascular disease.

Mixed Effects Models

We next ran a series of mixed effects models to account for the clustering of respondents in both families and states. Across these models the likelihood ratio test demonstrated that the mixed effects model offered a better fit to the model than the OLS and logistic regression models. However, in general the results from the models did not change the substantive findings of the simpler models. Therefore the tables in Appendices C-F present the results of the mixed effects models for a sample of the health variables.

Important to note however is that the mixed effects models allowed me to calculate the intraclass correlation (ICC) and determine the proportion of variability in the dependent variable

that is attributable to the family-level and state-level clustering. In the mixed effects model that modeled the relationship between Mexico-US migration and health at baseline, 75 percent of the variation in migration was attributable to state of residence while 44 percent was attributable to the family level. In comparison, the mixed effects models that tested the relationship between US-Mexico return migration and time in the US had much lower ICCs for family-level and state-level variation in the health outcomes of interest. For example, the family level ICC ranged from 4-9% of the variation while the state level ICC ranged from 7-20%.

Discussion

This analysis drew on a large and multi-thematic dataset of adults in Mexico to gain a better understanding of health factors that may shape migration to the United States, and further to explore how US migration is linked to health among Mexican migrants once they return to their country of origin. In general, we found that a variety of health behaviors, cardiovascular health risk factors, and cardiovascular disease were not associated with future migration to the US. Instead, more traditional factors such as age, gender, and education were consistently associated with migration. In addition, having health insurance also reduced the odds of migration. This finding may be due, in part, to the types of employment sectors that provide health insurance to Mexican residents (private business and government employees) and the employment and economic opportunities these individuals had in Mexico compared to uninsured individuals outside of these sectors. Elevated waist circumference was negatively associated with migration to the US, although related measures obesity, BMI, and elevated waist-hip-ratio were not.

The results of the analysis in the entire sample was comparable to the sub-analysis that included only migrants and desired migrants. Desired migrants, those who said they want to

migrate to the US eventually, may have been a more appropriate comparison group than non-migrants, because they perhaps share personality or motivation factors similar to those who ultimately migrate. Health, though, may have played a stronger role in why these individuals ultimately did not migrate to the U.S. This hypothesis however did not bear out in the data where none of the health variables distinguished desired migrants from future migrants. Based on these findings, it is unlikely that one's cardiovascular health was a significant contributor to respondents' decision to migrate to the US between the waves of the MxFLS.

While I found that future migrants and nonmigrants had similar health profiles before migration, health outcomes among return migrants revealed a different and mixed story depending on the health indicator in question. Return migrants, those who had ever spent a year or longer in the US, were more likely to be obese/overweight and have an elevated waist circumference. In addition, return migrants who had lived in the US for more time also had a higher probability for obesity, elevated waist circumference, and self-reported cardiovascular disease. However there were differences in physical activity or smoking behaviors to explain these differences.

In summary I found that the health of Mexico-US future migrants was on par with their compatriots who do not migrate, but the health of US-Mexico return migrants was worse on some indicators relative to those who stayed in Mexico. These results have multiple potential explanations. Differences in health behaviors in the US relative to the US, or the assimilation hypothesis, could partially explain the health differentials between return migrants and nonmigrants. That is, US-Mexico return migrants could have adopted worse health behaviors in the US that drive these differences. While I controlled for physical activity and smoking as potential health behaviors, other factors such as diet which were not measured in the study could

have played a role in these findings. So too, return migrants could have uniquely returned to Mexico *because* they were sick or unhealthy so these findings could support the salmon bias hypothesis. However, scholars conjecture that return migration due to health is largely because of serious illness such as cancer or disability, rather than the health indicators that were significant in the analysis- obesity and waist circumference.

Alternatively, a growing body of research suggests that the worse health of Mexican migrants in the US compared to those in Mexico may be reflective of the unique social environment and migration experiences they endure in the US. In this line of inquiry, the stressors of migration as well as the process of being a marginalized and racialized immigrant in the US could contribute to deleterious health outcomes that are associated with stress response dysregulation, such as obesity and waist hip circumference. Indeed the finding that more time in the U.S. was associated with worse health points to the potential of this exposure hypothesis. Age at migration and age at return migration would likely shed further light on these findings. Sample size limitations and variable availability restricted my ability to test these age explanations and the exposure hypothesis further. However later waves of the MxFLS study continues to track return migrants, who have now reached over 1000 cases; this new data would be an important next step to clarify this potential pathway.

In addition, living in a traditional migration state played an important role across models that predicted both migration and health outcomes. Traditional migration states such as Zacatecas, Michoacán, Oaxaca, and Sinaloa, have historically sent the most migrants to the US in comparison to other regions in Mexico. It is likely that this indicator is capturing socio-contextual factors, such as regional poverty, violence, or employment opportunities, that shape migration and health but were not well measured by the other covariates in the models. The

mixed effects also supported this finding where a high proportion of the variation in US-Mexico migration was explained by the respondent's state of residence. Future work in this area would benefit from adding state-level predictors into the model to clarify the role of this state and regional context for migration and health

However I interpret my findings and their contributions, while also noting some important limitations of this analysis and data. While the structure of the MxFLS allowed me to include a number of multifaceted variables in the models, the data itself has some notable limitations. First, while many of the health measures where collected by a health professional, nearly a quarter of the sample was dropped from the analysis dues to missing health measures. It is unclear why so many cases where missing this health information, and cases with missing data did differ from the analytical sample (Appendix A). Therefore, multiple imputation or other missing data techniques may be a useful next step in this analysis. In addition, measures of physical activity, smoking, diabetes, and cardiovascular disease were all based on self-report, although these measures were often correlated or associated with the clinical measures (Appendix B).

Although migration flows from Mexico to the US have been receding as of late, Mexican migrants in the US and return migrants in Mexico represent a significant demographic in both countries. The current literature is mixed on how health might shape individual's propensity to migrant, how the US shapes migrant's health, and the various mechanisms that influence these processes. This analysis contributes to this literature by leveraging data from the MxFLS and providing novel approaches to explore these questions. The findings from the analysis demonstrate that health selection is not a salient determining factor for future migration among Mexican adults, however upon returning to Mexico adults with exposure to the US far worse in

some health measures. These findings suggest that researchers would do well to further explore and examine the unique social and health environments faced but Mexican migrants to the US and the health consequences of these environments.

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Table 1

Descriptive Statistics, MxFLS, Wave 1, n=14,744

Variable	N	Mean (sd)	%
Age		40.57(16.62)	
Male	6,527		44.27
Married	10,264		69.61
High School Education	2,966		20.12
Currently Working	7,966		54.03
Health Insurance	6,691		45.38
Relatives in the US	5133		36.35
Mexico-US Migrants	321		2.18
Mexico-US Desired Migrants	299		2.35
US-Mexico Return Migrants	276		1.87
Overweight/Obese	9301		63.96
Elevated Waist-Hip Ratio	4155		28.18
Elevated Waist-Circumference	3893		26.4
High Blood Pressure	5368		36.41
Self-Reported Diabetes	863		5.85
Self-Reported CVD	482		3.27
Current Smoker	2007		13.61
Recc Physical Activity	2046		13.88

Table 2

Descriptive Statistics & Bivariate Analysis, Nonmigrants v Migrants, MxFLS, Wave 1, n=14,744

Variable	Non-Migrants (n=14,423)			Migrants (n=321)		
	N	Mean (sd)	%	N	Mean (sd)	%
Age**		40(.14)			29(.64)	
Male*	6,359		44.09	168		52.34
Married**	10,093		69.98	171		53.27
High School Education	2,901		20.11	65		20.25
Currently Working	7,780		53.94	186		57.94
Health Insurance**	6,622		45.91	69		21.50
Return Migrant**	248		1.72	28		8.72
Months in the US*		0.9(0.09)			2.9(.65)	
Relatives in the US **	4923		35.64	210		67.74
Overweight/Obese**	9145		64.28	156		49.52
Elevated Waist-Hip Ratio**	4109		28.49	46		14.33
Elevated Waist-Circumference**	3854		26.72	39		12.15
High Blood Pressure*	5280		36.61	88		27.41
Self Reported Diabetes*	855		5.93	8		2.49
Self Reported CVD	472		3.27	10		3.12
Current Smoker	1961		13.6	46		14.33
Recc. Physical Activity	1987		13.87	59		18.38

*p<0.01;** p<0.001; chi-square tests completed for categorical variables; t-tests completed for continuous variables

Table 0

Descriptive Statistics & Bivariate Analysis, Desired Migrants v Migrants, MxFLS, Wave 1, n=14,744

Variable	Desired Migrants (n=299)			Migrants (n=321)		
	N	Mean (sd)	%	N	Mean (sd)	%
Age		30(.63)			29(.64)	
Male	156		52.17	168		52.34
Married	163		54.52	171		53.27
High School Education**	103		34.45	65		20.25
Currently Working	184		61.54	186		57.94
Health Insurance**	121		40.47	69		21.50
Return Migrant	30		10.03	28		8.72
Months in the US		3.16(.73)			2.9(.65)	
Relatives in the US	204		68.23	210		67.74
Overweight/Obese	168		57.53	156		49.52
Elevated Waist-Hip Ratio	51		17.06	46		14.33
Elevated Waist-Circumference	58		19.4	39		12.15
High Blood Pressure	87		29.1	88		27.41
Self Reported Diabetes	7		2.34	8		2.49
Self Reported CVD	9		3.01	10		3.12
Current Smoker	55		18.39	46		14.33
Recc. Physical Activity	68		22.74	59		18.38

**p<0.01; p<0.001; chi-square tests completed for categorical variables; t-tests completed for continuous variables

Table 4

Descriptive Statistics, Non Return Migrants v Return Migrants, MxFLS, Wave 1, n=14,744

Variable	Non- Return Migrants (n=14,468)			Return Migrants (n=276)		
	N	Mean (sd)	%	N	Mean (sd)	%
Age		40.59(.14)			39.60(.88)	
Male**	6330		43.75	197		71.38
Married	10055		69.50	209		75.72
High School Education	2,918		20.17	48		17.39
Currently Working**	7,783		53.79	183		66.30
Health Insurance**	6591		45.56	100		36.23
Mexico-US Migrant**	293		2.03	28		10.14
Months in the US		---			50.90(3.77	
Relatives in the US **	4943		35.7	190		68.84
Overweight/Obese	9113		63.86	188		69.12
Elevated Waist-Hip Ratio**	4105		28.37	50		18.12
Elevated Waist-Circumference	3825		26.44	68		24.64
High Blood Pressure	5265		36.39	103		37.32
Self Reported Diabetes	854		5.9	9		3.26
Self Reported CVD	473		3.27	9		3.26
Current Smoker	1957		13.53	50		18.12
Recc Physical Activity	1995		13.79	51		18.48

**p<0.01; p<0.001; chi-square tests completed for categorical variables; t-tests completed for continuous variables

Table 5

Logistic Regression Models of the Association between Mexico-US Migration and CVD Health, MxFLS Wave 1, n=14,744

US-MX Migrant	Model 1				Model 2			
	OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	0.94	0.01	0.93	0.95	0.94	0.01	0.93	0.96
Male	1.49	0.17	1.19	1.86	1.38	0.17	1.08	1.77
Married	0.75	0.10	0.59	0.96	0.76	0.10	0.59	0.98
Education								
None	2.20	0.78	1.10	4.41	2.23	0.80	1.10	4.49
Elementary	2.69	0.81	1.49	4.87	2.77	0.84	1.53	5.03
Secondary	2.46	0.74	1.36	4.44	2.48	0.75	1.37	4.48
High School	2.14	0.68	1.16	3.98	2.16	0.68	1.17	4.02
Insured	0.39	0.06	0.30	0.52	0.39	0.06	0.30	0.52
Traditional Migration State	1.60	0.19	1.26	2.02	1.61	0.19	1.27	2.04
Obese/Overweight					0.99	0.13	0.77	1.28
Elevated WHC					0.67	0.13	0.46	0.99
High Blood Pressure					0.93	0.13	0.71	1.21
Diabetes					1.17	0.44	0.56	2.42
Cardiovacular Disease					1.91	0.64	0.99	3.69
Smoker					0.97	0.17	0.70	1.37
Recc Level of Physical Activity					1.27	0.19	0.94	1.71

Table 6

Logistic Regression Models of the Association between Mexico-US Migration and CVD Health, Desired Migrant Sub-Analysis, MxFLS Wave 1, n=607

US-MX Migrant	Model 1				Model 2			
	OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	0.97	0.01	0.96	0.99	0.98	0.01	0.96	1.00
Education (College-Ref)								
None	9.17	4.91	3.21	26.19	8.59	0.00	2.97	24.86
Elementary	3.43	1.27	1.65	7.11	3.29	1.24	1.57	6.89
Secondary	2.66	0.96	1.30	5.43	2.45	0.90	1.19	5.05
High School	1.90	0.72	0.90	4.00	1.86	0.11	0.88	3.95
Insured	0.53	0.10	0.36	0.77	0.54	0.11	0.37	0.79
Obese/Overweight					0.86	0.17	0.59	1.26
Elevated WHC					0.70	0.18	0.42	1.17
High Blood Pressure					1.04	0.20	0.71	1.53
Diabetes					1.77	1.01	0.58	5.44
Cardiovascular Disease					0.99	0.49	0.38	2.61
Smoker					0.78	0.18	0.50	1.24
Recc Level of Physical Activity					0.82	0.18	0.54	1.25

Table 7

Logistic Regression Models of the Association between Exposure to the US and Physical Activity, MxFLS Wave 1, n=14,744

Recommended Level of Weekly Physical Activity	Model 1				Model 2				Model 3			
	OR	s.e.	95% CI		OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	0.995	0.002	0.991	0.998	0.995	0.002	0.991	0.998	0.995	0.002	0.991	0.998
Male	1.516	0.074	1.377	1.669	1.508	0.074	1.370	1.660	1.516	0.074	1.377	1.668
Married	0.810	0.043	0.730	0.900	0.809	0.043	0.729	0.898	0.810	0.043	0.730	0.899
Education (College=Ref)												
None	0.281	0.000	0.224	0.354	0.282	0.000	0.224	0.355	0.281	0.000	0.224	0.354
Elementary School	0.409	0.035	0.346	0.484	0.409	0.035	0.346	0.484	0.409	0.035	0.346	0.484
Secondary School	0.711	0.059	0.605	0.836	0.709	0.059	0.603	0.834	0.711	0.059	0.605	0.836
High School	0.943	0.502	0.793	1.120	0.943	0.505	0.794	1.121	0.943	0.501	0.793	1.120
Insured	1.302	0.066	1.179	1.439	1.306	0.066	1.182	1.442	1.303	0.066	1.179	1.440
Traditional Mig State	0.871	0.051	0.777	0.976	0.867	0.050	0.774	0.972	0.870	0.051	0.777	0.975
Return Migrant					1.305	0.210	0.952	1.790				
Time in the US (months)									1.001	0.002	0.996	1.005

Table 8

Logistic Regression Models of the Association between Exposure to the US and Smoking, MxFLS Wave 1, n=14,744

Smoker	Model 1				Model 2				Model 3			
	OR	s.e.	95% CI		OR	s.e.	95% CI		OR	s.e.	95% CI	
Male	3.424	0.205	3.045	3.850	3.423	0.205	3.044	3.850	3.410	0.204	3.033	3.835
Work	1.535	0.094	1.361	1.732	1.535	0.094	1.361	1.732	1.539	0.095	1.364	1.736
Education (Secondary=Ref)												
None	0.801	0.066	0.682	0.940	0.801	0.066	0.682	0.940	0.804	0.066	0.685	0.944
Elementary School	0.742	0.048	0.655	0.842	0.743	0.048	0.655	0.842	0.743	0.048	0.656	0.843
High School	0.914	0.076	0.776	1.076	0.914	0.076	0.776	1.076	0.916	0.076	0.778	1.079
College or Grad	0.819	0.079	0.678	0.989	0.819	0.079	0.678	0.989	0.822	0.079	0.680	0.992
Insured	1.160	0.059	1.050	1.282	1.161	0.059	1.050	1.282	1.164	0.059	1.054	1.286
Return Migrant					1.008	0.164	0.734	1.386				
Time in the US (months)									1.003	0.002	1.000	1.007

Table 9

Logistic Regression Models of the Association between Exposure to the US and Obesity/Overweight Status, MxFLS Wave 1, n=14,744

Overweight/Obesity	Model 1				Model 2				Model 3			
	OR	s.e.	95% CI		OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	1.018	0.001	1.016	1.021	1.018	0.001	1.016	1.021	1.018	0.001	1.016	1.021
Male	0.782	0.028	0.728	0.839	0.777	0.028	0.723	0.834	0.778	0.028	0.725	0.836
Married	2.140	0.084	1.982	2.310	2.137	0.084	1.980	2.308	2.139	0.084	1.981	2.309
Education (Elementary=Ref)												
None	0.711	0.059	0.604	0.837	0.714	0.059	0.607	0.840	0.714	0.059	0.606	0.840
Secondary School	1.273	0.091	1.107	1.464	1.274	0.091	1.107	1.466	1.272	0.091	1.106	1.464
High School	1.084	0.079	0.940	1.249	1.080	0.078	0.937	1.245	1.080	0.078	0.937	1.244
College or Grad	0.980	0.078	0.839	1.145	0.981	0.078	0.839	1.146	0.979	0.078	0.838	1.144
Insured	1.372	0.052	1.274	1.477	1.375	0.052	1.277	1.481	1.376	0.052	1.278	1.482
Traditional Migration State	0.802	0.032	0.741	0.868	0.798	0.032	0.738	0.864	0.800	0.032	0.739	0.865
Return Migrant					**1.381**	**0.189**	**1.056**	**1.806**				
Time in the US (months)									**1.005**	**0.002**	**1.001**	**1.009**

Table 10

Logistic Regression Models of the Association between Exposure to the US and Elevated Waist-Hip-Circumferences, MxFLS, Wave 1, n=14,744

Elevated WHC	Model 1				Model 2				Model 3			
	OR	s.e.	95% CI		OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	1.030	0.001	1.027	1.033	1.030	0.001	1.027	1.033	1.030	0.001	1.027	1.033
Male	0.225	0.012	0.203	0.249	0.223	0.011	0.201	0.246	0.224	0.012	0.202	0.248
Married	1.670	0.080	1.520	1.834	1.668	0.080	1.519	1.832	1.669	0.080	1.519	1.833
Work	1.113	0.052	1.016	1.219	1.114	0.052	1.017	1.220	1.114	0.052	1.017	1.220
Education (College=Ref)												
None	1.233	0.130	1.003	1.516	1.238	0.131	1.007	1.522	1.236	0.130	1.005	1.520
Elementary School	1.660	0.155	1.383	1.993	1.664	0.155	1.386	1.998	1.661	0.155	1.384	1.994
Secondary	1.335	0.128	1.105	1.612	1.330	0.128	1.102	1.607	1.332	0.128	1.103	1.609
High School	1.020	0.111	0.823	1.264	1.021	0.112	0.824	1.265	1.019	0.111	0.823	1.263
Insured	1.227	0.051	1.131	1.332	1.231	0.052	1.134	1.336	1.230	0.052	1.133	1.336
Recc. Physical Activity	0.863	0.055	0.761	0.979	0.861	0.055	0.759	0.977	0.863	0.055	0.761	0.979
Return Migrant					**1.452**	**0.220**	**1.079**	**1.953**				
Time in the US (months)									**1.003**	**0.002**	**1.000**	**1.007**

Table 11

Logistic Regression Models of the Association between Exposure to the US and High Blood Pressure, MxFLS, Wave 1, n=14,744

High Blood Pressure	Model 1				Model 2				Model 3			
	OR	s.e.	95% CI		OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	1.031	0.001	1.029	1.034	1.031	0.001	1.029	1.034	1.031	0.001	1.029	1.034
Male	2.012	0.075	1.870	2.165	2.015	0.075	1.872	2.168	2.011	0.075	1.869	2.163
Married	0.910	0.037	0.840	0.985	0.910	0.037	0.840	0.985	0.910	0.037	0.840	0.985
Education (College=Ref)												
None	0.828	0.044	0.746	0.920	0.828	0.044	0.746	0.919	0.829	0.044	0.746	0.920
Secondary School	0.808	0.041	0.732	0.891	0.808	0.041	0.732	0.892	0.807	0.041	0.731	0.891
High School	0.703	0.046	0.619	0.798	0.703	0.046	0.619	0.798	0.703	0.046	0.619	0.798
College or Grad	0.748	0.054	0.649	0.862	0.748	0.054	0.649	0.862	0.748	0.054	0.649	0.862
Traditional Migration State	0.787	0.033	0.726	0.854	0.788	0.033	0.726	0.855	0.787	0.033	0.725	0.853
Smoker	0.869	0.046	0.783	0.965	0.869	0.046	0.783	0.965	0.869	0.046	0.783	0.965
Return Migrant					0.937	0.123	0.724	1.213				
Time in the US (months)									1.001	0.002	0.998	1.004

Table 12

Logistic Regression Models of the Association between Exposure to the US and Self-Reported Diabetes, MxFLS, Wave 1, n=14,744

Diabetes	Model 1				Model 2				Model 3			
	OR	s.e.	95% CI		OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	1.047	0.003	1.042	1.052	1.047	0.003	1.042	1.052	1.047	0.003	1.042	1.052
Male	0.682	0.060	0.574	0.810	0.687	0.060	0.578	0.816	0.682	0.060	0.574	0.810
Married	0.832	0.073	0.700	0.988	0.831	0.073	0.700	0.987	0.832	0.073	0.700	0.988
Work	1.483	0.132	1.246	1.765	1.484	0.132	1.247	1.766	1.483	0.132	1.246	1.765
Education (Elementary=Ref)												
None	0.546	0.055	0.448	0.665	0.545	0.055	0.447	0.664	0.546	0.055	0.448	0.665
Secondary School	0.677	0.080	0.537	0.853	0.679	0.080	0.539	0.856	0.677	0.080	0.537	0.853
High School	0.571	0.099	0.407	0.801	0.571	0.099	0.407	0.802	0.571	0.099	0.407	0.801
College or Grad	0.599	0.114	0.412	0.869	0.599	0.114	0.413	0.870	0.599	0.114	0.412	0.869
Insured	1.249	0.094	1.078	1.447	1.246	0.093	1.076	1.444	1.249	0.094	1.078	1.447
Traditional Migration State	0.800	0.069	0.676	0.948	0.802	0.069	0.677	0.951	0.800	0.069	0.676	0.948
Return Migrant					0.681	0.237	0.345	1.347				
Time in the US (months)									0.9999	0.0031	0.9939	1.006

Table 13

Logistic Regression Models of the Association between Exposure to the US and Self-Reported CVD, MxFLS, Wave 1, n=14,744

CVD	Model 1				Model 2				Model 3			
	OR	s.e.	95% CI		OR	s.e.	95% CI		OR	s.e.	95% CI	
Age	1.044	0.003	1.038	1.051	1.045	0.003	1.038	1.051	1.044	0.003	1.038	1.051
Male	0.632	0.062	0.521	0.767	0.629	0.062	0.518	0.764	0.628	0.062	0.518	0.762
Education												
Elementary	1.469	0.185	1.147	1.881	1.467	0.185	1.146	1.879	1.463	0.185	1.143	1.874
Secondary	1.109	0.210	0.765	1.609	1.105	0.210	0.762	1.603	1.099	0.209	0.757	1.594
High School	1.570	0.337	1.031	2.390	1.569	0.337	1.030	2.389	1.565	0.336	1.028	2.384
College	1.469	0.346	0.926	2.331	1.468	0.346	0.925	2.330	1.470	0.346	0.926	2.333
Return Migrant					1.268	0.441	0.642	2.506	--	--	--	--
Time									**1.005**	**0.002**	**1.000**	**1.009**