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Abstract

International migration between Mexico and the United States has profound implications for immigrant-sending communities in Mexico. We hypothesize that international migration may increase the risk of overweight and obesity among children in immigrant-sending households, particularly among low-SES children. We use the Mexican Family Life Survey to examine whether having family members in United States increases the prevalence of overweight and alters the socioeconomic gradient associated with overweight among children. As expected, we find that living in a migrant-sending household has a significant and positive effect on overweight and BMI percentile among children even after controlling for past weight status. We also find that international migration is associated with a flatter (less positive) SES gradient on children's weight. Overall, the results suggest that international migration may have important negative consequences for the health of Mexican children in immigrant-sending communities.

Introduction

Migration impacts not only the receiving society, but also the sending community (Massey 1988; Glick-Schiller, Basch, and Christina Blanc-Szanton 1992). Immigrants continue to influence their families and communities through remittances, return migration, visits, letters, and phone calls. The connections between immigrants and family and friends back home are thought to have far reaching implications for the sending society, altering feelings of relative deprivation, tastes and preferences, land use (Glick-Schiller et al 1992; Stark and Taylor 1989; Bilsborrow and DeLargy 1990) and health in the sending society (Nobles 2007). We examine the influence of familial international migration on an important health indicator, children's weight, in Mexico.

Although obesity is more common in developed countries, the prevalence of obesity is rapidly increasing in developing countries (Prentice 2006; Popkin and Gordon-Larsen 2004). In Mexico, overweight and obesity doubled for women over the ten year period from 1985 to 1995, increasing from 33% to 66% (Riveria et al 2002). Perhaps not coincidentally, this increase corresponded with the peak in emigration from Mexico and increased US investment and trade with Mexico (Massey, Durand, and Malone 2002). International immigration may influence the levels and patterns of obesity in Mexico because emigrants do not cut off all ties once they leave Mexico. Rather, the social and economic exchange networks for many Mexicans expand to include family members and friends who live and work in the United States. More than one in six (17%) Mexican children have a father who migrated in the past or is currently living in the United States (Nobles 2007) and large percentages of Mexican emigrants maintain contact with their families and communities of origin (Levitt 1998).

This is important because past research suggests that obesity spreads through social networks largely as a function of norms concerning appropriate body size (Chritakis and Fowler 2008). Mexican-American children are twice as likely to be obese as Mexican resident children (Hernandez et al 2003; Ogden et al 2006), but as our results suggest, the levels and patterns of obesity in immigrant-sending households in Mexico more closely resemble the patterns among Mexican Americans than those of other Mexicans. We suggest that social networks and exchanges between Mexican immigrants in the U.S. and Mexicans living in Mexico may serve as a social and economic conduit that ultimately impacts the levels and patterns of child obesity in sending communities in Mexico.

Of course, we do not argue that international migration is solely responsible for the increase in child obesity in Mexico. In Mexico, as in most developing countries, the rise in obesity (sometimes referred to as the "nutrition transition") is thought to be linked to a broad set of changes in the society that accompany economic development, including urbanization, income growth, innovations in communications and transportation, and residential mobility. In general, economic development is associated with increases in the prevalence of overweight and a changing socioeconomic gradient in overweight such that the health burden shifts from the most advantaged to the poor (Monteiro et al 2004). To handle concerns about endogeneity we control for a host of development factors at the community, family, and household level while examining how social networks and remittances may be influencing health in sending regions. Our idea is that, beyond local area economic development, the global connections brought about by Mexican labor migration have changed the content and composition of social networks in Mexican

sending communities, and these changes have had serious implications for children's health, especially with respect to overweight and obesity (Christakis and Fowler 2007).

PAST RESEARCH

Mexico-to-US Migration and Obesity

Recent research on increases and the spread of obesity in populations emphasizes the roles of social networks and environments. Work conducted by Christakis and Fowler (2007) suggests that obesity spreads through social networks largely as a function of changing norms about appropriate body size. Using a unique longitudinal data source in which it was possible to identify entire friendship networks, they find that the odds of becoming obese are 57% greater for an individual if they had a friend who also became obese. Also of great importance, especially when considering networks that cross international borders, the influence of social networks on obesity reached across great distances. They found social distance, not geographical distance, to be an important indicator of whether an individual was influenced by their family's or friend's obesity. Therefore, a neighbor who is not a friend had no influence while a close friend who lived far away was a significant predictor. Moreover, these results appear to be robust even after adjusting for the effects of selection of similar people into the same social networks. On the basis of this evidence, Christakis and Fowler argue that people are likely to emulate the eating and exercise behaviors and pick up ideas about appropriate body size from significant others.

The idea that social connections influence health is also deeply embedded in research and theory about immigrant health. Prior research often finds a negative association between immigrants' health and duration of residence in the United States

(Antecol and Bedard 2006; Sanchez-Vaznaugh et al 2008; Abraido-Lanza, Chao, and Florez 2005). Such results are commonly interpreted through the lens of the negative health assimilation model, which posits that increased exposure to the American environment and integration into American society is associated with poorer health behaviors like smoking, drinking, and the adoption of obesity-promoting behaviors concerning diet and physical activity (Lara et al 2004; Abraido-Lanza et al 2005).

Obesity is a health condition that is especially likely to spread through immigrants' social networks. For example, increased duration of U.S. residence is associated with increases in obesity among immigrants (Antecol and Bedard 2006; Sanchez-Vaznaugh et al 2008). The most common interpretation of this pattern is that exposure to the "obesiogenic" American environment, which includes a high availability of cheap energy dense foods, low opportunities for physical activity in the United States, and increasing prevalence (and hence social acceptability) of overweight in the population, is associated with increases in weight (Antecol and Bedard 2006). Among Mexican-American school age children, about 40% are at-risk-for overweight or overweight while in Mexico the corresponding prevalence is only 20% (Ogden et al 2006; Hernandez et al 2003).

Young children of immigrants may be especially susceptible to overweight and obesity in the US. Child obesity is far more prevalent in the United States than in Mexico (Ogden et al 2006; Hernandez et al 2003). In addition, children of Mexican immigrants are more likely to be overweight than Hispanic children of natives and non-Hispanic white children of natives (Van Hook, Baker, and Altman 2009). These children may be particularly vulnerable as they readily adapt to and adopt American culture and its

unhealthy behaviors faster than either adult or adolescent immigrants. Past research on other child outcomes suggests that this may be true. For example, English language proficiency is an important indicator of social integration and acculturation, and children often learn English faster than their immigrant parents (Portes and Zhou 1993). Tellingly, boys in English-speaking immigrant families gain weight faster during elementary school than boys from non-English-speaking immigrant families (Van Hook and Baker 2010). This suggests that changes in social networks, especially greater social interaction with American children, may play an important role in the development of obesity among the children of immigrants and this may be especially true for Mexican children.

Economic and Social Remittances

Just as norms about body weight and diet may diffuse through social networks involving immigrants and U.S. natives, they also may diffuse through social networks extending across international borders between immigrants and friends and family in Mexico. This expectation can be understood within the framework of transnationalism, a major theoretical perspective that emphasizes the international relationships and public spaces formed by migration (Glick-Schiller et al 1992). When immigrants leave their country of origin, they do not cut off all ties. Rather, immigrants visit relatives, send remittances and gifts, and continue communication with their relatives at home. Thus, migration not only affects migrants, but the whole community. Remittances are often cited as evidence of transnationalism. Even though remitters have moved, they still feel obligated to those in their home community and thus may retain that identity.

Remittances come in both social and economic forms. Social remittances are the ideas, norms, beliefs, and values that migrants transmit back to their sending regions.

Social remittances have been shown to influence household labor, religious practices, parenting, civil and political participation (Levitt 1998; Foner 2008) and could potentially influence diet, physical activity, and norms concerning weight. Often, non-migrants are eager to emulate the consumption patterns of those in developed countries. Having close ties to individuals in developed countries may result in even quicker adoption of norms (James 1987; Douglas and Craig 1997).

Economic remittances may also increase the prevalence of overweight and obesity in sending communities. In Mexico, economic remittances are often used to supplement the income of households in sending regions and have had a significant impact on the purchasing power of individuals. In 2007, Mexico received more remittances in volume than any other country and this accounted for 2.5% of their gross domestic product (Fajnzylber and López 2007). Economic remittances could change consumption patterns in ways that could increase the risk of obesity. Indeed, in many developing countries, those with higher incomes and wealth have higher rates of obesity and overweight, possibly because income enables people to purchase obesity-promoting products and lifestyles, such as high-calorie food in grocery stores and restaurants, cars, televisions, and video games. The positive association between income and obesity tends to be stronger for men and children (Riveria et al 2002; 2004; Hernandez et al 2003).

Past research suggests that the effect of social and economic remittances on overweight may be moderated by social class. One major reason is that social networks tend to not cross class lines, especially social networks consisting of close friends (McPherson, Smith-Lovin, and Cook 2001). Therefore, the messages received in social networks would be expected to differ across classes as Mexican immigrants in the US

would be more likely to interact and consider those of similar social classes as friends. Class-specific messages and beliefs would then be transmitted back to close friends and relatives in Mexico.

More specifically, prior research on variations in obesity by socioeconomic status in the United States and Mexico lead us to expect that children in families with low SES will be influenced in ways that promote obesity more than children in high SES families. In the United States, obesity among Hispanic children is among the highest of all race/ethnic groups and, generally, uniform across income and parental educational categories (Wang and Zhang 2006; Balistreri and Van Hook 2009). However, in Mexico, child obesity tends to be much lower and is concentrated among children from households with more income and higher levels of maternal education (Riveria et al 2002; Hernandez et al 2003). Comparing Mexican with U.S. children, low SES children in Mexico are likely to weigh much less than their US counterparts. As a consequence, low SES children in Mexico stand the most to gain (with respect to obesity) through their interactions with their (much heavier) US counterparts.

Another reason the effects of migration are likely to be moderated by social class is that past research suggests that the effects of economic remittances or income shocks on weight vary by social class. For example, Du and colleagues (2004) found that in China, rapid increases in income are associated with a move away from a more traditional Chinese diet and towards a more Westernized diet, heavier in fat and energy dense foods and subsequently associated with increases in weight. Moreover, socioeconomic status moderated this relationship, such that the effect of increasing income on diet and body composition was far more detrimental to the poor. In Mexico,

the extra income received from remittances is normally spent on family maintenance, such as clothing, health care, and food (Massey and Parrado 1994). Remittances thus are likely to increase the amount of food available in a low-income household. Moreover, remittances may bring about dietary changes. Remittances are negatively associated with expenditures on traditional foods such as maize, beans, and chilies and is positively related to expenditures on luxury food items like meat, milk, and fruit (Kaiser and Dewey 1991).

Overall, the aims of this study are to examine the relationship between international migration flows and the association with overweight and SES among school age children in Mexico. The magnitude of migration flows between Mexico and the United States mean that many children are connected in some way to those with international migration experience. Having relationships with U.S. immigrants (which we refer to as "exposure to U.S. migration") may bring about increased income through remittances, increased exposure to American dietary habits, and changing norms about appropriate body size, diet, and physical activity. We therefore hypothesize that exposure to migration will be associated with an overall increase in overweight among children. However, we also hypothesize that this effect will be moderated by social class such that the detrimental effect for lower SES children will be greater than for higher SES children.

DATA

In this project we use the 2002 and 2005 waves of the Mexican Family Life Survey (MxFLS), a longitudinal, nationally representative sample of households in Mexico. The baseline wave of data (2002) surveyed 8,440 households and 35,677 individuals in 150 communities in Mexico, and successfully followed up 90% of the

original household sample in 2005. The survey included an oversample for rural communities with populations less than 2,500 people. The survey collected social, economic, demographic, and health behavior information for individuals, families, and communities. We confine the sample to children between the ages of six and eleven in 2002, so as to examine the effects of exposure to migration among a school aged sample. In the data there are 3,656 children in this age range in 2002 who are reinterviewed in 2005. We limit the sample to children with valid height and weight measurements in both the 2002 and 2005 waves (3,133 children), excluding children with outliers on BMI percentile measures (16 children). Finally, we limit the sample to children with valid measures on the independent variables, leaving an analytical sample of 2,824 children.

We limit our analysis to the 6-11 age range for several reasons. Middle childhood represents an important developmental phase for BMI change. This time period is marked by rapid adiposity gains among children and group differences (such as by SES or exposure to migration) may emerge during this time period (Whitaker et al 1997). By examining this age group in 2002 and their subsequent weight in 2005 we are able to examine the factors that are associated with *change* in weight status for this age group. Also, research has found that differences in overweight between Mexicans and Mexican Americans children emerged during the ages of 6 to 11, but there were no differences among younger children (Oria and Sawyer 2007). Research in Mexico has demonstrated a persistent and significant positive effect of socioeconomic status on overweight and obesity for this age group. Recent research suggests that among adults, especially women, the relationship between individual SES and overweight may be negative, but among children research has consistently found a positive relationship for elementary

school aged children (Hernandez et al 2003; Rivera et al 2003; Rivera et al 2004). Lastly, this is a common categorization of children's ages representing elementary school aged children (Ogden et al 2006).

Dependent variables

Our outcome measures include at-risk-for overweight or overweight (hereafter referred to as at-risk-for overweight) and percentile BMI. These variables are constructed according to the Center for Disease Control guidelines to determine overweight status in children. Past researchers have raised concerns about using this measurement on non-US populations as this measure was created using a largely white US population of children. However, this is the measure recommended by the World Health Organization and prior research has found a high level of agreement between this measure and the one developed by the International Task Force on Obesity (Wang and Wang 2000). We use measured height and weight to construct body mass index (weight/height^2). BMI percentiles that standardize for age and sex are created from the BMI values. At-risk-for overweight is defined as having a BMI value at or greater than the 85th percentile. We use BMI from the 2005 wave of the MxFLS to construct the dependent variables, and we use percentile BMI from the 2002 wave as a control variable.

Independent Variables

Exposure to US Migration

All independent variables are based on the 2002 wave of the MxFLS. Information is collected on extended family members of household members, including where they are living. Exposure to migration is a household level variable that counts the number of family members (parents, grandparents, children, siblings, parents-in-law,

siblings-in-law, aunts, uncles, or cousins) that household members report as living in the United States. Each household member is allowed to list at least four relatives and we use the largest value listed by any household member. This is done because it is difficult to assess the overlap across household members in the specific relatives they report having in the US. We leave this measure as continuous because we assume that having more relatives abroad is associated with increased exposure to migration and that the influence of exposure on children's health is greater for those who have more exposure.

Mother's Education

We use mother's education as an indicator of SES. Mother's education is measured as a continuous indicator of the highest grade that the mother completed ranging from 0 to 16. In preliminary analyses, we tested a quadratic (squared) term, but it was not significant. Among the various indicators of SES, maternal educational attainment appears to be particularly important for improving children's health in both developing and developed countries (Cleland and van Glikken 1988; Glewwe 1999).

Wealth Index

We use a wealth index as additional indicator of SES. The wealth index measures whether the household contains certain appliances (washing machine, stove, telephone), has electricity, has a telephone, the type of plumbing, and the material of the floor. The wealth index is centered and continuous. We initially included a quadratic term in the models but it was not significant. Research in developing countries often employs a wealth index to measure household socioeconomic status (Titaley et al. 2008; Hong, Banta, and Betancourt 2006).

Community Development

Economic development and migration are closely tied. US immigrants disproportionately come from developing countries, but migration tends to alter the context of the sending regions. This leads to economic development in many of the societies, transforming rural places into urbanized areas and lowering the cost of migration, which increases the likelihood that others will migrate (Massey 1988; Massey 1990). Problems arise because economic development is closely tied to increases in the prevalence of obesity and may relate to the changing SES gradient (Popkin 1998; Monterio et al 2004). We attempt to reduce some of this bias by controlling for two measures of community development. The first is GDP of the Mexican state in pesos for 2007. This data is obtained by INEGI and Banxico y SHCP. This variable is highly skewed, so the variable is transformed using the natural log and then centered.

The second measure is community socioeconomic status and is derived from the MxFLS data. In each community that was surveyed by MxFLS, an individual was identified as being informed about the community. He/she was asked a series of questions about the community, including questions about the facilities the community has and the services that are available for the residents. A community development scale was created by summing dichotomous variables that indicate whether 50% or more of the residents have telephone service, the community has a health supplier, a high school, a credit provider, and whether the individual believes that the community has a wealthy infrastructure.

Additional Controls

Additional control variables include a dummy variable measuring whether the child lives in a rural area (population less than 2,500), gender, region of the country

(center, northwest, northeast, and southwest), age in months, a dummy variable for whether the child lives with both parents, and household size. Table 1 presents descriptive statistics for all of the variables for our analytical sample. All transformed variables (centered, logged) are presented in their raw form.

[Table 1 about here]

DATA ANALYSIS

To examine the relationships among children's exposure to US migration, family socioeconomic status, and weight, we estimate nested logistic regression and ordinary least squares models, with clustered standard errors at the household level to correct for household level sample clustering. We use logistic regression to model the dichotomous outcome, at-risk-for overweight, and OLS to model the continuous outcome, percentile BMI. For each outcome, we first estimate the relationship between weight and exposure to US migration, household wealth, mother's education, community development, and the controls (model 1). In a second model, we add the interaction between wealth index and exposure to US migration to examine whether SES moderates the relationship between exposure to US migration. We do not include the interaction between mother's education and exposure to migration because the relationship was not as strong. The third model adds percentile BMI in 2002. By controlling for prior BMI we are able to examine whether exposure to US migration and SES are associated with *growth* in percentile BMI and *change* in at-risk-for overweight.

RESULTS

Descriptive Findings

Table 2 presents the percentage at-risk for overweight and mean BMI percentile in 2001 and 2005 by exposure to US migration. Children are considered exposed to migration if they have at least one household member who has a relative in the U.S. In 2001 the differences in overweight or percentile BMI between children exposed to migration and those not exposed are small. However, children exposed to migration appear to have gained more weight than children not exposed to migration in the 2001-2005 time period. By 2005 they had a significantly higher percentile BMI (61.1 vs. 63.2, $p < 0.05$) and a marginally significant higher prevalence of at-risk-for overweight (32.5 vs. 29.6, $p < 0.1$) compared to children not exposed to migration.

[Table 2 about here]

Table 3 and 4 further breaks down the descriptive results to examine variation in at-risk-for overweight and percentile BMI and exposure to migration by the socioeconomic indicators: wealth and mother's education. Wealth and mother's education are broken down into quartiles, ranging from the first or lowest quartile to the fourth or highest quartile. Examining the wealth index, it appears that those not exposed to US migration exhibit a linear positive trend, whereby increases in wealth are associated with higher prevalence of at-risk-for overweight and percentile BMI. However, for children exposed to migration, the gradient in at-risk-for overweight and percentile BMI is relatively flat. Examining mother's education, we find a similar relationship, where the gradient is positive for children not exposed to migration and relatively flat for those who are exposed. In general, the descriptive results show that at lower levels of SES, children exposed to migration have significantly higher prevalence of at-risk-for-overweight and percentile BMI compared to children not exposed to US migration.

Overall, the descriptive results suggest that exposure to immigration is associated with both an increase in children's weight and a flatter SES gradient. But these patterns may not hold after controlling for characteristics associated with living in a migrant-sending household in Mexico. To assess this possibility, we next turn to the multivariate models.

[Table 3 about here]

[Table 4 about here]

Multivariate Models

Table 4 presents the results of the nested logistic regression models (odds ratios) and OLS regression models (coefficients) for at-risk-for overweight and percentile BMI, respectively. The first model shows that wealth is significantly and positively related to at-risk-for overweight and percentile BMI among this sample of Mexican school aged children. However, mother's education and the community socioeconomic status are not significantly associated with either outcome. Consistent with our expectations, having relatives in the United States is positively related to percentile BMI ($p < 0.01$) and at-risk-for overweight ($p < 0.1$), though the relationship between at-risk-for overweight and exposure to US migration is only marginally significant. The state's GDP is positive and marginally significant ($p<.1$) for percentile BMI. Of the controls, age is positively associated, living in the southwest region of Mexico as compared to the northeast is positively associated, and household size is negatively associated with percentile BMI. Living in a rural area and household size is associated with lower odds of at-risk-for overweight.

[Table 4 about here]

Model 2 adds the interactions between the socioeconomic variables (wealth and mother's education) and exposure to migration. The interaction between mother's education and exposure to migration was not significant and was subsequently dropped from the models. The interaction between wealth and exposure to migration is significant in both models as is the main effect of wealth in the logistic regression model predicting at-risk-for overweight and the OLS model predicting percentile BMI. Though, the main effect of exposure to migration is only marginally significant for at-risk-for overweight ($p<0.1$). The interaction between exposure to US migration and wealth is significant and negative for both outcomes, indicating that while wealth is positively associated with overweight and percentile BMI: being exposed to migration is associated with a lessening of that gradient.

Model 3 controls for percentile BMI in 2002, which effectively transforms it into a model predicting change in percentile BMI from 2002 to 2005. Once this variable is included in the model wealth is no longer significantly associated with at-risk-for overweight and is only marginally significantly associated with percentile BMI. However, the effect of exposure to migration remains positively and significantly associated with both outcome variables. Also, the interaction between wealth and exposure to US migration remains negatively associated with both outcomes. This suggests that the effect of exposure to US migration on weight gain differs by wealth such that migration is associated with the most weight gain among children with low levels of wealth, but less weight gain (loss) among children with high levels of wealth. Figure 1 displays predicted probabilities of at-risk-for overweight by wealth quartiles for children with no exposure to migration and those with one family member in the United

States using the mean for continuous variables and the reference category for dichotmous variables. Among children who are not exposed to migration, the odds of overweight increase monotonically with wealth, such that children with the highest wealth have the highest probability of overweight.

[Figure 1 about here]

However, the relationship between wealth and the probability of overweight is different for children who have been exposed to migration. We find a pattern similar to that found for school aged Mexican-American children residing in the United States. For this group, the wealth gradient is almost completely flat. Also, among those with low wealth, the probability of overweight is much higher for those who have been exposed to migration. For those with the highest wealth, exposure to migration is protective against at-risk-for overweight. A similar pattern is found for percentile BMI.

Tests of Robustness

Several additional models were also run as tests of robustness. First, we wondered whether the migration of close relatives (e.g., parents or sibling) might influence children's weight more than extended relatives. We therefore examined whether having immediate relatives, parents or siblings in the U.S. had an additional effect beyond that of having other relatives in the U.S. This variable was insignificant in all models. Since immediate relatives may be more likely to send economic remittances than extended relatives, this finding suggests that ideational remittances rather than economic remittances drive the association between exposure to migration and weight gain.

Prior research has suggested that urbanization is an important factor driving the increase in obesity (Popkin 1998). To examine whether the results differ by urban and rural status, separate models were run by rural/urban status. Similar to other research on nutrition transition, it appears that exposure to migration had a larger effect on children living in rural than those living in urban areas, although the interaction between rural status and exposure to migration is not significant. We speculate that rural areas are not as far along in the nutrition transition as urban areas (i.e., obesity is less prevalent), so children in rural areas would be more strongly influenced by migration than children in urban areas.

Lastly, analyses were conducted to check whether exposure to migration is confounded by the effects of having one or both parents absent. Research examining stunting has found that having migrant parents may be associated with negative health outcomes, especially when the mother is a migrant and that this is largely attributable to less parental time given to children and less breast feeding (Nobles 2007). Three dichotomous variables were created measuring whether the mother was absent, the father, or both parents. These variables failed to reach significance in all analyses and did not influence the effect of exposure to migration on either of the dependent variables.

DISCUSSION & CONCLUSIONS

Migration has far reaching implications, influencing not only the migrant and those in the receiving society, but also those still in Mexico. Migration changes the composition of social networks of those remaining in Mexico to include family members in the US, and these social networks appear to influence children's weight. In this paper we find support for the idea that increased exposure to US migration is positively

associated with overweight. This association is very robust. The conditional main effect of having relatives in the U. S. is positive and significant for weight status even after controlling for prior weight status, community development, and a host of other controls.

International migration may influence children's weight through two avenues. First, exposure to US migration may affect children's weight through the influence of social and economic remittances on health, preferences, and resources. Social remittances are the ideas, norms, beliefs, and values that migrants transmit back to their sending regions (Levitt 1998). These may influence parents' ideas about what foods are appropriate for children, beliefs about physical recreation and leisure activities, and perceptions of appropriate body size. We find more support for the importance of social remittances over economic remittances because there is no additional effect of having immediate family members as US migrants. If economic remittances are the key factor we would expect a stronger effect on weight status for children who have immediate family members in the U.S. because these individuals would be more likely to send remittances and children would be more likely to benefit from them. Also, the influence of exposure to migration remains significant even after controlling for community development, suggesting that this relationship goes beyond the idea that increased migration promotes increased development resulting in higher prevalence of obesity.

Second, though not the focus of this paper, we suggest that international circular migration networks may constitute one of the factors that have brought about the nutrition transition in Mexico. The nutrition transition theory, as described by Popkin and his colleagues (Popkin and Gordon-Larsen 2004; Popkin 2001; Drewnowski and Popkin 1997) and supported by other research (Leatherman and Goodman 2005; Leiberman

2003; Melgar-Quinonez and Kaiser 2004; Monteiro et al 2004; Sobal and Stunkard 1989; Wang 2001), is a world-wide historical process occurring over the past two decades involving shifts in food consumption and physical activity patterns. The major idea is that economic development and globalization lead to increases in obesity. In less developed countries, obesity tends to be relatively rare. But as economic development proceeds (accompanied by rising incomes, urbanization, and increasing availability of inexpensive, high-caloric foods), obesity increases. For example, factors such as economic development, globalization, and foreign investment have all been cited as factors influencing the nutrition transition (Leatherman and Goodman 2004; Popkin 1998; Popkin and Gordon-Larsen 2004). International migration may constitute yet another contributing factor to the nutrition transition. While we understand that migration and development are endogenous, we attempt to control for some of this influence by including measures of community development.

Our second major finding is that exposure to migration is associated with a shift in the SES gradient on children's weight. We find that wealth is positively associated with weight status among children even after controls for prior weight are entered in the model. However, wealth is moderated by exposure to U.S. migration. Among children not exposed to migration, we find the expected positive linear gradient documented by other research, but among children exposed to migration, the SES gradient is flat. This flat SES gradient mirrors the one found in research that examines Mexican-American children (Wang and Zhang 2006) and Hispanic children of immigrants in the United States (Balistreri and Van Hook 2009).

Prior research stresses the need to examine the impact of migration on both the receiving and source communities. Mexican migration has had a large impact on not only the US, but also in Mexico. Recent research suggests that large amounts of familial migration may influence Mexican children's health in the form of stunting (Nobles 2007). The research we present here further shows that patterns of overweight among Mexican children are influenced by exposure to US migration. The results of this paper, however, are largely descriptive. Future research avenues would benefit by examining how exposure to migration influences diet and consumption patterns, beliefs about health and body size, and beliefs about leisure activity. Exposure to migration is likely to influence not only the receiving society, but also family members and friends for their home country. Given the profound volume of Mexico to US migration it is necessary to understand how this movement of people influences a host of outcomes.

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Table 1. Descriptive Statistics

	Mean	Std. Dev.
BMI Percentile 2001	59.23	28.50
BMI Percentile 2005	62.21	29.23
At-risk-for overweight 2001	31.10	0.46
At-risk-for overweight 2005	24.50	0.43
Relatives in the United States	0.95	1.20
Wealth Index	7.14	2.06
Mother's Education	6.34	3.73
Rural	48.58	0.50
Male	48.76	0.50
Age in months	105.60	20.32
Northeast	18.84	0.41
West	22.06	0.39
Central	21.18	0.41
Northwest	17.10	0.41
Southwest	20.82	0.38
Household size	5.82	0.41
Lives with both parents	81.94	0.38
State GDP (2007 in pesos)	89852.34	40657.63
Community Socioeconomic Status	2.19	1.57

Table 2. At-Risk-For Overweight and BMI Percentile in 2001 and 2005 by Exposure to Migration

	No US Migrant Relatives	US Migrant Relatives	Difference	
BMI Percentile 2001	59.2	59.3	0.1	
BMI Percentile 2005	61.1	63.2	2.1	*
At-risk-for overweight 2001	24.6	24.4	-0.2	
At-risk-for overweight 2005	29.6	32.5	2.9	†

† = p < 0.1, * = p < 0.05, ** = p < 0.01, *** = p < 0.001

Table 3. Percent At-risk-for Overweight by Socioeconomic Status and Exposure to Migration, 2005

	No US Migrant Relatives	US Migrant Relatives	Difference	
Mother's Education				
1st Quartile	24.9	29.6	4.7	
2nd Quartile	24.4	32.7	8.4	**
3rd Quartile	36.3	34.0	-2.3	
4th Quartile	38.9	34.8	-4.1	
Wealth Index				
1st Quartile	22.7	27.9	5.2	†
2nd Quartile	30.1	32.6	2.6	
3rd Quartile	35.6	34.9	-0.7	
4th Quartile	38.5	35.1	-3.4	

† = p < 0.1, * = p < 0.05, ** = p < 0.01, *** = p < 0.001

Table 4. Mean Percentile BMI by Socioeconomic Status and Exposure to Migration, 2005

	No US Migrant Relatives	US Migrant Relatives	Difference	
Mother's Education				
1st Quartile	57.68	63.82	6.14	**
2nd Quartile	58.18	63.69	5.51	**
3rd Quartile	66.85	62.07	-4.79	*
4th Quartile	63.08	63.56	0.48	
Wealth Index				
1st Quartile	55.86	62.08	6.22	**
2nd Quartile	62.77	61.36	-1.41	
3rd Quartile	64.97	64.74	-0.23	
4th Quartile	67.50	63.90	-3.60	

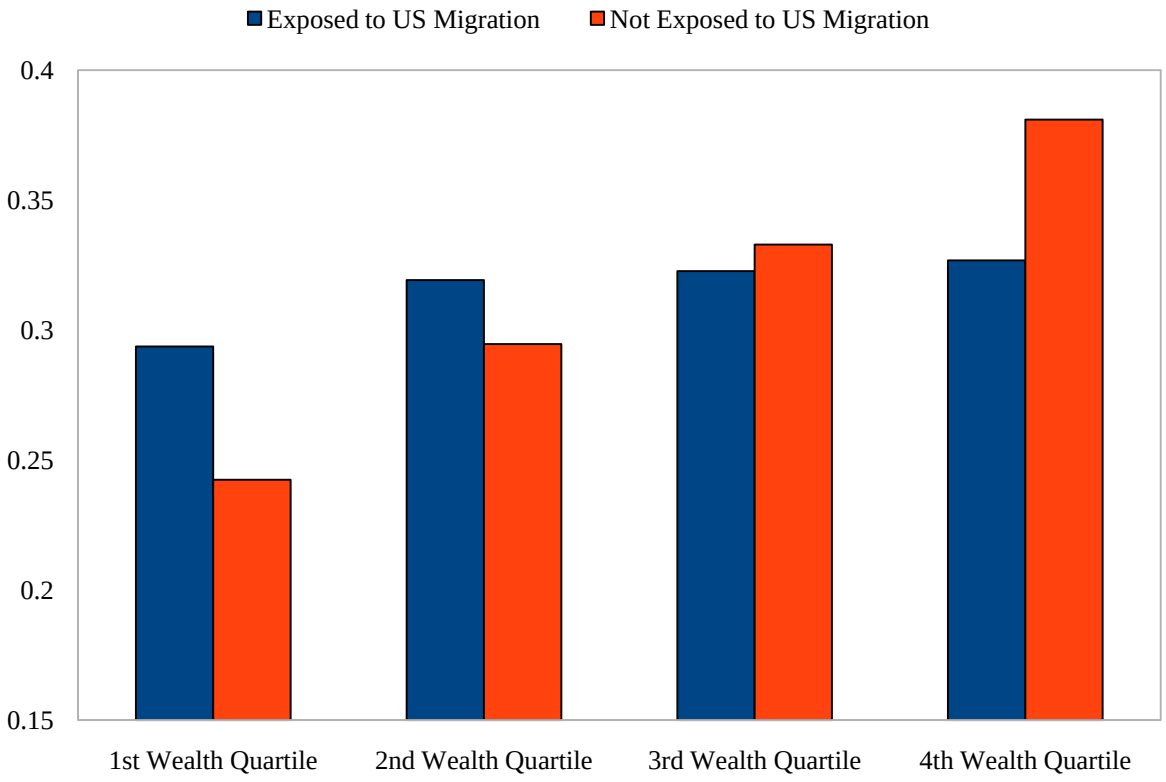
† = $p < 0.1$, * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$

TABLE 5. OLS and Logistic Regressions for At-risk-for Overweight and Percentile BMI Among 6-11 Year Old Children

	BMI Percentile, 2005			At-risk-for Overweight, 2005		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Intercept	63.88 ***	64.75 ***	27.311 ***	-	-	-
Mother's education	-0.31	-0.322	-0.217	0.99	0.989	0.975
Wealth Index	1.35 ***	1.9895 ***	0.6118 †	1.09 **	1.13 ***	1.042
Relatives in the US	1.36 **	1.2328 *	1.1623 **	1.07 †	1.069 †	1.101 *
X Wealth Index		-0.715 **	-0.499 **		0.958 *	0.964 *
State GDP	4.58 †	4.1111 †	1.397	1.26	1.221	1.075
Community Socioeconomic Status		-0.241	-0.181		1.012	0.967
Rural	-1.75	-1.512	-1.533	0.80 †	0.808	0.696 *
Boy	-0.85	-0.893	-1.062		1.1	1.174 †
(Girl)				1.10		
Age in months	0.05 †	0.0475 †	0.0205	1.00	0.999	0.992 **
(Northeast)						
West	2.15	0.6095	-0.088	0.89	0.86	0.754
Central	1.10	1.7357	-0.72	0.88	0.874	0.803
Northwest	2.84	2.7361	-1.083	0.98	0.979	0.902
Southwest	4.68 †	4.7403 †	0.4881	1.11	1.112	0.887
Household size	-1.20 ***	-1.218 ***	-0.356	0.93 **	0.934 **	0.962
Lives with both parents	0.56	0.6044	-0.813	1.06	1.067	0.99
BMI Percentile in 2002	-0.22		0.638 ***	1.01		13.22 ***

† p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Figure 1. Predicted Probabilities of at-risk-for overweight by Wealth and Exposure to US Migration



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