# The Healthy Migrant Effect: New Findings From the Mexican Family Life Survey

| Luis N. Rubalcava, PhD, Graciela M. Teruel, PhD, Duncan Thomas, PhD, and Noreen Goldman, DSc

Questions about who does and who does not migrate to the United States remain fundamental and unresolved issues in immigration research. There is evidence that international migrants are not a random sample from their home countries.[1–3] Moreover, research suggests that most prime-aged migrants move in search of better labor market opportunities and, because they have the motivation and resources to undertake a move, they are "positively selected"—that is, they are more educated and in better psychological and physical health than are nonmigrants.[2,4] We used newly collected data to examine evidence for this "healthy migrant" hypothesis in the United States. The topic is of particular interest in the United States because studies have appealed to this type of selection process as a plausible explanation for the widely documented "Hispanic paradox." The paradox refers to the mortality advantage of Hispanic adults relative to non-Hispanic Whites despite the lower socioeconomic status of Hispanics.[2,5,6]

In spite of the popularity of the healthy migrant hypothesis, evidence for it is weak and conclusions about its importance in the United States are premature, at best. Because few studies of international migration contain information about migrants before they arrived in the United States or information about comparable nonmigrants, most have relied on comparisons between the native born and foreign born; in some cases, the latter group was restricted to legal immigrants.[7–10] These studies, which generally demonstrated that the foreign born were in better health than were natives, did not provide scientific evidence about the healthy migrant hypothesis for at least 3 reasons.[11] First, the appropriate comparison group to test the hypothesis is nonmigrants from the home country rather than natives in the United States. Second, previous studies have typically examined the health of migrants after they moved to the

*Objectives.* We used nationally representative longitudinal data from the Mexican Family Life Survey to determine whether recent migrants from Mexico to the United States are healthier than other Mexicans. Previous research has provided little scientific evidence that tests the "healthy migrant" hypothesis.

*Methods.* Estimates were derived from logistic regressions of whether respondents moved to the United States between surveys in 2002 and 2005, by gender and urban versus rural residence. Covariates included physical health measurements, self-reported health, and education measured in 2002. Our primary sample comprised 6446 respondents aged 15 to 29 years.

*Results.* Health significantly predicted subsequent migration among females and rural males. However, the associations were weak, few health indicators were statistically significant, and there was substantial variation in the estimates between males and females and between urban and rural dwellers.

*Conclusions.* On the basis of recent data for Mexico, the largest source of migrants to the United States, we found generally weak support for the healthy migrant hypothesis. (*Am J Public Health.* 2008;98:78–84. doi:10.2105/AJPH.2006.098418)

United States rather than prior to migrating. Third, most existing research relied on self-reports of health, information that has been shown to depend upon cultural factors, ethnicity, and access to health care.[12]

Our study focused on recent migration from Mexico to the United States, a migration stream that accounts for about 30% of all immigrants to the United States and more than half of undocumented immigrants.[13] Our analysis was based on survey data collected in Mexico that were well suited to test the healthy migrant hypothesis.

## METHODS

### Data

The Mexican Family Life Survey (MxFLS), is a large-scale, multipurpose, nationally representative longitudinal survey of the health and socioeconomic status of individuals and their families in Mexico.[14] In the baseline survey, conducted in 2002, all adult members of more than 8400 households in 150 communities were interviewed. Because domestic and international migration play key roles in the lives of Mexicans, the 2005 MxFLS

follow-up sought to locate and reinterview all respondents, including movers to the United States.

Several attributes of our study distinguish it from earlier work on the healthy migrant hypothesis. First, it is based on information collected in the sending country prior to the time that the migrants move. Specifically, we compared the baseline (2002) health of respondents who moved from Mexico to the United States between the 2002 and 2005 interviews with the baseline health of Mexicans who did not migrate to the United States during this time. Second, whereas most previous studies have relied exclusively on self-assessed health indicators, we used both self-assessments and physical health measurements that were less subject to systematic respondent error than were self-reports.[15] Third, we identified migrants to the United States regardless of their documented status, a critical feature because some estimates suggest that undocumented immigrants compose more than 80% of immigrants who came from Mexico in the past decade[13] and are likely to experience different selection mechanisms than are those who obtain legal status.[16–18]

The literature suggests that Mexican migrants are not only healthier but also better educated than people who remain in Mexico.[1,19] Because health and education tend to be positively correlated, the selection of migrants on education may reflect the selection on health or vice versa. For this reason, we also compared the educational attainment of migrants and nonmigrants.

Previous studies have highlighted tremendous diversity in the number and characteristics of migrants across communities in Mexico[20,21] rendering it difficult to draw generalizations from community-based studies.[22] An advantage of MxFLS is that it was nationally representative and permitted us to control premigration location in our analyses.

### Health Indicators

We examined 6 indicators of health status. Four were physical assessments conducted in the home by a trained health worker. They comprised height, body mass index (BMI; weight in kilograms divided by height in meters squared), blood pressure, and hemoglobin (Hb). The other 2 indicators were respondent assessments of their overall health.

Adult height reflects both genotype and phenotype influences.[23] Because height is largely determined in early childhood, it is usually interpreted as an indicator of health-related human capital investments in early life. In many settings, taller adults are not only in better health but they also have higher earnings.[24] BMI is a more concurrent indicator of general health and nutritional status. We identified those who were overweight (BMI$\geq$25 kg/m$^2$), which is a risk factor for heart disease, diabetes, and mortality. The third physical health measure was resting blood pressure. We defined blood pressure as "normal" (i.e., not high) if systolic was less than 120 mm Hg and diastolic was less than 80 mm Hg. High blood pressure is associated with poor physical health, stress, and heart disease.

Hemoglobin was measured by blood from a finger stick analyzed by a HemoCue photometer (HemoCue AB, Ängelholm, Sweden) brought to the respondent's home. Typically, low hemoglobin indicates low iron in the blood, although it may also indicate elevated levels of inflammation, the presence of

worms, or malaria. Low iron is associated with fatigue, elevated susceptibility to disease and reduced work capacity.[25] We used cutoffs recommended by the World Health Organization[26] to identify respondents who were iron replete (Hb$\geq$130 g/L for males and Hb$\geq$120 g/L for females).

In addition to the physical assessments, each MxFLS respondent was asked to provide a self-assessment of his or her own general health status on a 5-point scale. Although self-assessed general health status has been shown to predict later mortality,[27] an important concern is that the reference group is not explicit and may vary across respondents, which complicates interpersonal comparisons.[28] To partially address this issue, respondents were asked a second question to rate their health relative to someone the same age and gender. For both self-assessments, responses were dichotomized with good health identified as the top 2 categories of the 5-point scale.

### Sample

The MxFLS protocol entailed an interview and physical health assessment to have been conducted with every adult household member. Face-to-face interviews were conducted by enumerators and physical health assessments by health workers. In this analysis, we focused on young adults (aged 15 to 29 years at baseline) because they are the most likely to move for work-related reasons. Moves at younger and older ages are typically motivated by mobility decisions of family members or other factors. We demonstrated that the choice of age group had little impact on our key results.

At baseline, health assessments were not completed for 15% of the age-eligible respondents for this study and 6% of the remaining respondents did not complete the individual interview that recorded general health status. As of April 2007, when the data files for this analysis were constructed, no location information was obtained in the 2005 follow-up for 8% of respondents. Thus, from the approximately 9000 age-eligible respondents in the baseline sample, 6446 respondents comprised our analytic sample.

Nonrandomness of those included in the analytic sample was a concern, particularly if

selection into the sample was correlated with health status at baseline or migration after baseline. We have explored potential biases associated with missing data in 2 ways. First, in the presence of controls for age, gender, and location in 2002, the health and education levels of the 8% of respondents without location information in 2005 were no different from the corresponding measures for respondents who were relocated in 2005 ($P$=.72). Second, the probability that respondents moved to the United States during 2002 to 2005 was not significantly related to whether their health was assessed in 2002 ($P$=.96). Thus, tests of the healthy migrant hypothesis were unlikely to be contaminated by sample nonresponse or attrition.

As shown in Table 1, females composed about 57% of the sample, reflecting the somewhat higher outmigration rates from Mexico of males aged 15 to 29 years relative to females. During the approximately 3-year hiatus between the baseline and first reinterview, more than 5% of respondents had moved from Mexico to the United States, with males being about twice as likely to have moved as females. Rural dwellers, who composed about 40% of the sample, were about twice as likely to move to the United States as urban dwellers. Rural males were the most likely of these groups to have migrated to the United States, with about 1 in 10 having moved between 2002 and 2005.

The health status of Mexicans aged 15 to 29 years is reported in Table 1. The average rural male was slightly taller than 165 cm and the average rural female was about 12 cm shorter, with urban dwellers about 2 cm taller than their rural counterparts. Less than half of the respondents were overweight. Rural males were substantially less likely to be overweight than were urban males, presumably reflecting higher levels of physically demanding activity. Blood pressure was normal for almost 60% of males and 80% of females. About 6% of males and almost 20% of females had low Hb.

More than half of the respondents reported good or very good general health status, with this rating being more common among males, especially urban dwellers. The impact of specifying the reference group is reflected in the second general health status indicator: only

**TABLE 1—Rates of Migration to the United States, Levels of Health, and Education Among Mexicans Aged 15 to 29 Years: Mexican Family Life Survey, 2002–2005**

| | Males | | Females | |
| --- | --- | --- | --- | --- |
| | Rural | Urban | Rural | Urban |
| Total, no. | 1124 | 1669 | 1505 | 2148 |
| Migration from Mexico to United States, % moved 2002–2005, mean (SE) | 10.1 (0.9) | 5.6 (0.6) | 6.0 (0.6) | 2.4 (0.3) |
| Health status at baseline, mean (SE) | | | | |
| Percentage height, cm | 165.7 (0.2) | 167.6 (0.2) | 153.8 (0.2) | 155.7 (0.2) |
| Percentage not overweight (BMI < 25 kg/m$^2$) | 67.9 (1.4) | 58.5 (1.2) | 60.5 (1.3) | 57.4 (1.1) |
| Percentage normal blood pressure[a] | 58.4 (1.8) | 60.4 (1.4) | 80.0 (1.2) | 79.9 (1.0) |
| Percentage hemoglobin replete[b] | 93.6 (0.7) | 95.2 (0.5) | 80.2 (1.0) | 82.6 (0.8) |
| Percentage general health status was good[c] | 57.1 (1.5) | 72.4 (1.1) | 54.8 (1.3) | 65.3 (1.0) |
| Percentage relative general health status was good[d] | 30.4 (1.4) | 37.1 (1.2) | 27.8 (1.2) | 34.2 (1.0) |
| Years of education at baseline, mean (SE) | 7.3 (0.1) | 8.1 (0.1) | 7.3 (0.1) | 7.9 (0.1) |

*Notes.* BMI = body mass index (weight in kilograms divided by height in meters squared).
[a]Blood pressure was normal if systolic blood pressure was less than 120 mm Hg and diastolic was less than 80 mm Hg.
[b]Hemoglobin was replete if it was 130 g/L or more among males and 120 g/L or more among females.
[c]General health status was self-assessed general health and was "good" if respondent reported health as very good (top of scale) or good (second point in 5-point scale).
[d]Relative general health status was defined as self-assessed health status relative to someone of the same age and gender as the respondent. Responses were dichotomized with good health identified as the top 2 categories of the 5-point scale.

about one third of respondents rated their health as good or very good relative to someone of the same age and gender.

Education level was measured by the number of years of schooling. On average, Mexican men and women had the same level of education, with urban dwellers having completed the equivalent of 8 years of schooling and rural dwellers almost a year less.

### Analytic Strategy

To assess whether healthier Mexicans were more likely to move to the United States, we examined the relationship between the probability a respondent moved between the 2002 and 2005 interviews and his or her health and education measured in 2002. Because health was measured prior to moving, we can be confident that the move in question did not affect the respondent's health. However, it is important to underscore that our study could not reveal whether health had a causal impact on migration; rather, the analyses shed light on whether people who were healthier, for whatever reason, were also more likely to migrate.

All estimates were obtained separately by gender and sector of residence in 2002, be-

cause there is evidence that the determinants of migration from Mexico to the United States differ between men and women[29,30] and between urban and rural areas.[31] Regression results are reported for males in Table 2 and for females in Table 3. We focused on longer-term migration, because MxFLS records all moves that last (or are expected to last) at least 12 months, but not shorter-term moves. Our outcome variable in each regression was unity if the respondent either moved to the United States for at least 12 months during the 2002–2005 period or, at the time of the 2005 interview, had been in the United States less than 12 months but the respondent (or a family member) expected that the respondent would remain there for at least 1 year.

Odds ratios from logistic regressions are reported along with 95% confidence intervals. Estimates of variance–covariance matrices were based on the infinitesimal jackknife[32]; they were robust to arbitrary forms of homoskedasticity and took into account clustering in the survey design. We used Stata Statistical Software version 9 (StataCorp, College Station, Tex).

The unadjusted odds ratio that a respondent moved is displayed in the first column in

Tables 2 and 3 for each indicator of health and education. In the second column, adjusted estimates are reported from separate logistic regressions for each health covariate after we controlled for age (which is piecewise linear allowing different slopes for the 15- to 19-year age group and the 20- to 29-year age group) and an indicator variable for state of residence in 2002. The first 2 columns report results from separate regressions for each covariate listed in the table. The third column presents results from a single logistic regression that simultaneously includes all of the health and education covariates along with age and state of residence in 2002.

## RESULTS

### Males

Results for rural males (Table 2) indicated that moves to the United States were not associated with height, hemoglobin level, or education after control for age and location. Rural males were more likely to move if they were not overweight (BMI < 25 kg/m$^2$) relative to being overweight and if they had normal blood pressure relative to higher than normal blood pressure.

In contrast with the correlations between physical assessments and migration, rural men who reported good general health status were less likely to move than were other men. However, when self-reports were based on comparisons with men of the same age, there was no link between general health status and mobility. This suggests that, without a specific reference group, rural men who were likely to subsequently move tended to compare their health with others in relatively good health—possibly other migrants who had gone before them. The evidence implies that findings based on self-rated health questions need to be interpreted with care because responses apparently reflected not only respondents' information about their own health but also about the health of their (unstated) reference group.

The $\chi^2$ test statistics in Table 2 indicate that the health variables taken together were significantly associated with migration among rural males. To provide a quantitative assessment of the contribution of health in predicting

TABLE 2—Odds Ratios From Logistic Regression of Whether Rural and Urban Males Migrated to the United States From Mexico: Mexican Family Life Survey, 2002–2005

| | Rural Males (n = 1124) | | | Urban Males (n = 1669) | | |
|---|---|---|---|---|---|---|
| | Unadjusted OR (95% CI)[a] | Adjusted OR (95% CI)[b] | Simultaneous OR (95% CI)[c] | Unadjusted OR (95% CI)[a] | Adjusted OR (95% CI)[b] | Simultaneous OR (95% CI)[c] |
| Health and education in 2002 | | | | | | |
| Height, cm | 1.00 (0.97, 1.02) | 1.00 (0.98, 1.03) | 1.00 (0.97, 1.03) | 1.00 (0.96, 1.04) | 1.01 (0.98, 1.04) | 1.01 (0.98, 1.04) |
| Not overweight (BMI < 25 kg/m$^2$)[d] | 1.99 (1.32, 3.01) | 1.82 (1.17, 2.83) | 1.70 (1.04, 2.79) | 1.40 (0.86, 2.27) | 1.09 (0.66, 1.81) | 1.10 (0.66, 1.84) |
| Normal blood pressure[d] | 1.44 (0.90, 2.31) | 1.98 (1.17, 3.34) | 1.93 (1.12, 3.34) | 0.80 (0.46, 1.42) | 0.81 (0.46, 1.42) | 0.79 (0.46, 1.37) |
| Hb replete[d] | 1.89 (0.73, 4.90) | 1.70 (0.64, 4.50) | 1.71 (0.65, 4.46) | 0.86 (0.42, 1.73) | 0.99 (0.47, 2.08) | 1.03 (0.49, 2.17) |
| GHS is good[d] | 0.55 (0.37, 0.83) | 0.60 (0.39, 0.93) | 0.59 (0.37, 0.92) | 0.80 (0.52, 1.24) | 0.88 (0.56, 1.39) | 0.93 (0.58, 1.50) |
| Relative GHS is good[d] | 0.84 (0.53, 1.34) | 0.90 (0.56, 1.46) | 1.03 (0.62, 1.72) | 0.50 (0.32, 0.79) | 0.52 (0.32, 0.84) | 0.52 (0.31, 0.85) |
| Years of education | 0.96 (0.90, 1.02) | 1.00 (0.94, 1.06) | 1.00 (0.93, 1.07) | 1.02 (0.95, 1.10) | 1.01 (0.94, 1.08) | 1.01 (0.94, 1.09) |
| Marginal effect of excellent health in 2002[e] | | | 4.3% | | | –5.1% |
| Marginal effect of high migration state[f] | | | 32.3% | | | 14.0% |
| $\chi^2$ test for joint significance of all health covariates (P) | | | 18.34 (.01) | | | 11.88 (.06) |

*Notes.* BMI = body mass index; Hb = hemoglobin; GHS = general health status. Location was as of 2002.
[a]Unadjusted column includes each covariate added 1 at a time.
[b]Adjusted column includes controls for age (in a piecewise linear form that allows different slopes for the 15- to 19-year age group and 20- to 29-year age group) and state of residence in 2002.
[c]Simultaneous column includes all health and education covariates along with age and indicator variables for state of residence in 2002.
[d]Indicator variable takes the value 1 if condition is true and 0 otherwise.
[e]Marginal effect is difference in likelihood respondent would migrate if he was in "excellent" health in 2002 (BMI < 25 kg/m$^2$, Hb replete, normal blood pressure, good GHS, good relative GHS, and height at the 75th percentile of rural or urban males) relative to a male in "poor" health in 2002 (BMI ≥ 25 kg/m$^2$, Hb deficient, not normal blood pressure, GHS not good, relative GHS not good, and height at the 25th percentile of rural or urban males).
[f]Marginal effect is difference in likelihood respondent would migrate if he lived in the state from which migration to the United States was most common in 2002 relative to a male who lived in the state from which migration was least common in 2002.

migration, Table 2 reports the difference in the likelihood that a respondent would migrate if he or she was in "excellent" health relative to a person of the same age, education, and state of residence in "poor" health. "Excellent" health was defined as BMI less than 25 kg/m$^2$, Hb replete, normal blood pressure, good general health status, good relative general health status, and height at the 75th percentile. "Poor" health was defined on the basis of the complementary values of the binary health variables and height at the 25th percentile. This marginal effect was about 4%. By comparison, the marginal effect on migration of a rural male who lived in the state from which migration was most common in 2002, relative to the state from which migration was least common, was 32%, indicating that relative to location, health was a weak predictor of migration for rural men.

Urban male migrants did not appear to be selected on health. None of the physical health measurements was a significant predictor of subsequent migration. General health status,

relative to a male the same age, was negatively associated with migration. Taken together, the health characteristics were not significant, and the likelihood that an urban male migrated to the United States was slightly smaller for those in excellent compared with those in poor health.

### Females

Results for females are reported in Table 3. Among rural women, those who were iron replete were more likely to move to the United States, as were women who did *not* report good general health status. Overall, the health characteristics were significant predictors of migration, but the marginal effect of health changed migration rates by only 6.8%.

Urban female migrants were positively selected on health in 2 respects. An urban female was more likely to move to the United States if she was taller or rated her general health status as good relative to someone the same age. The health characteristics of urban female migrants were significant and the marginal effect of being in excellent versus

poor health was 5%, which was similar to that among rural women.

### DISCUSSION

We examined a population-based sample of Mexicans aged 15 to 29 years to study migration during a recent 3-year period, and we found generally weak support for the healthy migrant hypothesis. There was substantial variation in the association between health and migration between males and females and between urban and rural dwellers. Overall, associations between the likelihood of migrating to the United States and physical health measurements suggested that migrants were positively selected for health. However, most of the coefficients were small and only a few were statistically significant. By contrast, general health status measures indicated significant negative selection on health for all but urban females. These findings suggest that reliance on self-assessments of health alone may yield a misleading picture of the health of migrants

TABLE 3—Odds Ratios From Logistic Regression of Whether Rural and Urban Females Migrated to the United States From Mexico: Mexican Family Life Survey, 2002–2005

| | Rural Females (n = 1505) | | | Urban Females (n = 2148) | | |
|---|---|---|---|---|---|---|
| | Unadjusted OR (95% CI)[a] | Adjusted OR (95% CI)[b] | Simultaneous OR (95% CI)[c] | Unadjusted OR (95% CI)[a] | Adjusted OR (95% CI)[b] | Simultaneous OR (95% CI)[c] |
| Health and education in 2002 | | | | | | |
| Height, cm | 1.00 (0.97, 1.04) | 0.99 (0.96, 1.02) | 0.98 (0.95, 1.02) | 1.08 (1.04, 1.12) | 1.08 (1.03, 1.13) | 1.07 (1.02, 1.12) |
| Not overweight (BMI < 25 kg/m$^2$)[d] | 1.51 (0.97, 2.35) | 0.98 (0.57, 1.68) | 0.98 (0.57, 1.67) | 1.69 (0.99, 2.90) | 1.45 (0.89, 2.38) | 1.35 (0.82, 2.22) |
| Normal blood pressure[d] | 2.03 (0.80, 5.10) | 1.89 (0.79, 4.56) | 1.88 (0.80, 4.42) | 0.98 (0.52, 1.84) | 1.11 (0.55, 2.22) | 1.08 (0.51, 2.28) |
| Hb replete[d] | 2.65 (1.50, 4.70) | 1.90 (1.03, 3.49) | 2.02 (1.10, 3.72) | 1.02 (0.46, 2.28) | 0.99 (0.43, 2.26) | 0.83 (0.36, 1.95) |
| GHS is good[d] | 0.63 (0.39, 1.00) | 0.61 (0.40, 0.94) | 0.60 (0.39, 0.91) | 2.01 (1.02, 3.95) | 1.97 (0.97, 3.98) | 1.62 (0.81, 3.23) |
| Relative GHS is good[d] | 1.10 (0.69, 1.76) | 1.10 (0.68, 1.77) | 1.10 (0.70, 1.74) | 1.67 (0.99, 2.84) | 1.75 (1.03, 2.96) | 1.69 (1.01, 2.81) |
| Years of education | 1.04 (0.97, 1.11) | 1.07 (0.97, 1.17) | 1.07 (0.98, 1.17) | 1.09 (0.98, 1.21) | 1.08 (0.97, 1.20) | 1.06 (0.97, 1.17) |
| Marginal effect of excellent health in 2002[e] | | | 6.8% | | | 5.0% |
| Marginal effect of high migration state[f] | | | 21.0% | | | 6.8% |
| $\chi^2$ test for joint significance of all health covariates (P) | | | 15.19 (.02) | | | 19.92 (<.001) |

*Notes.* BMI = body mass index; Hb = hemoglobin; GHS = general health status. Location was as of 2002.

[a]Unadjusted column includes each covariate added 1 at a time.

[b]Adjusted column includes controls for age (in a piecewise linear form that allows different slopes for the 15- to 19-year age group and 20- to 29-year age group) and state of residence in 2002.

[c]Simultaneous column includes all health and education covariates along with age and indicator variables for state of residence in 2002.

[d]Indicator variable takes the value 1 if condition is true and 0 otherwise.

[e]Marginal effect is difference in likelihood respondent would migrate if she was in "excellent" health in 2002 (BMI < 25 kg/m$^2$, Hb replete, normal blood pressure, good GHS, good relative GHS, and height at the 75th percentile of rural or urban females) relative to a female in "poor" health in 2002 (BMI ≥ 25 kg/m$^2$, Hb deficient, not normal blood pressure, GHS not good, relative GHS not good, and height at the 25th percentile of rural or urban females).

[f]Marginal effect is difference in likelihood respondent would migrate if she lived in the state from which migration to the United States was most common in 2002 relative to a female who lived in the state from which migration was least common in 2002.

relative to those who do not move. Nonetheless, the marginal effect of the complete set of health indicators on the probability of moving to the United States was small.

Additional results (not shown) indicated that these findings were not caused by inadequate controls for socioeconomic status. Specifically, the coefficients pertaining to health and schooling were invariant to the inclusion of controls for household demographic composition and resources (measured by per capita expenditure, wealth, and housing type). Because earlier studies have suggested that migration from Mexico to the United States is more common in certain communities, among persons who have previously migrated and among the unmarried (at least for women),[16,33,34] we also added variables that denoted locality (i.e., neighborhood) of residence, whether the respondent had ever migrated to the United States prior to baseline, and marital status to the models. The associations between the health variables and migration changed little with the addition of these covariates.

Health selection may be different for older migrants, who are less likely to move for their own employment.[4,9] We estimated similar models (not shown) for adults aged 30 to 45 years, among whom only 2% moved to the United States between 2002 and 2005. The evidence for health selection was even weaker than among younger adults. Taken together, the health covariates were significant predictors of migration only for urban women aged 30 to 45 years. Taller rural and urban females were more likely to move than were their respective counterparts, as were urban females who reported their general health status as not good and rural males who were heavier.

Only 1.5% of adults older than 45 years moved to the United States between 2002 and 2005. These movers were significantly taller than were older nonmigrants but were less likely to be iron replete. They did not differ with respect to education or other health indicators. About 300 older adults reported a "serious handicap" in 2002 but only 1 individual from this group moved to the

United States during the intersurvey period. Relative to nonmovers, older movers were slightly less likely to report having used health care in the previous month. These results are suggestive that, at the extremes, poor health may deter migration to the United States, but we lack statistical power to formally test this hypothesis.

Although our analysis overcomes many of the limitations of previous research, our results are not generalizable to all US migrants for 3 reasons. First, several studies that have examined the migration process by national origin have suggested that selection may be weaker for Mexicans relative to other migrants. Pilot data from the New Immigrant Survey indicated that health selection of legal migrants is strongly positive but weaker for migrants from the border countries, Mexico and Canada.[9] Similarly, Feliciano found that, among the 31 countries for which migrants were positively selected by years of schooling, education selectivity was weakest in Mexico; her results further suggested that the degree

of selectivity was inversely proportional to distance from the United States.[1]

Second, we cannot extrapolate our findings, which are based on moves during the period 2002–2005, to earlier migration from Mexico. Changes in the nature of the migration flows over time—such as increases in flows from metropolitan areas and progressive development of social networks that reduce the barriers to migration—may have led to a decrease in the importance of health and education in facilitating migration. Durand et al. reported that Mexican-origin migrants who moved in the 1990s were less selected on education than were those who moved in the 1970s.[20] Selection on health may have followed a similar trajectory.

Third, migrants may be selected on domains of health not included here.[35] We have focused on a small set of markers that have been measured reliably and are indicative of health and nutrition in the young adult population. Health selectivity may also operate through unhealthy behaviors (e.g., smoking, drinking, and poor diet), psychosocial factors or personality characteristics associated with both poor health and migration propensities (e.g., aggression, resilience, attitudes towards risk), and extreme mental, cognitive, or physical limitations.

Several scholars, most recently Jasso et al.,[9] have lamented the long-standing deficiency of data sources for scientifically testing the healthy migrant hypothesis. The longitudinal design of MxFLS and its inclusion of physical assessments provide unique opportunities to examine how measures of human capital are associated with migration from Mexico to the United States today. The evidence is clear: the health and education levels of migrants from Mexico to the United States differed only slightly from those of nonmigrants. As additional waves of MxFLS are collected, it will become feasible to address at least 2 as-of-yet unresolved and important issues. First, it will be possible to determine whether migrants who remain in the United States for the longer term are healthier than those who return to Mexico.[11] Second, data from follow-up interviews with migrants will permit researchers to assess how the health of migrants evolves with the migration experience. Results of these analyses will contribute to the reconciliation of the evidence reported here with studies of the health of migrants based on data collected in the United States. ■

## About the Authors

*Luis N. Rubalcava is with Spectron Desarrollo, Mexico City, Mexico, and the Department of Economics, Centro de Investigación y Docencia Económicas, Mexico City. Graciela M. Teruel is with the Department of Economics, Universidad Iberoamericana, Mexico City. Duncan Thomas is with the Department of Economics, Duke University, Durham, NC. Noreen Goldman is with the Office of Population Research and the Woodrow Wilson School of Public and International Affairs, Princeton University, Princeton, NJ.*

*Requests for reprints should be sent to Graciela M. Teruel, Privada de Tamarindos #7-306, Bosques de las Lomas, México DF 05120, Mexico (e-mail: graciela.teruel@s2.uia.mx).*

*This article was accepted April 14, 2007.*

## References

1. Feliciano C. Educational selectivity in US immigration: how do immigrants compare to those left behind? *Demography.* 2005;42:131–152.

2. Palloni A, Arias E. Paradox lost: explaining the Hispanic adult mortality advantage. *Demography.* 2004;41:385–415.

3. Marmot MG, Adelstein AM, Bulusu L. Lessons from the study of immigrant mortality. *Lancet.* 1984; 323:1455–1457.

4. Palloni A, Ewbank DC. Selection process in the study of racial and ethnic differentials in adult health and mortality. In: Anderson NB, Bulatao RA, Cohen B, eds. *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life.* Washington, DC: National Academies Press; 2004:177–226.

5. Hummer RA, Rogers RG, Amir SH, Forbes D, Parker Frisbie W. Adult mortality differentials among Hispanic subgroups and non-Hispanic Whites. *Soc Sci Q.* 2000;81:459–476.

6. Sorlie PD, Backlund E, Johnson NJ, Rogot E. Mortality by Hispanic status in the United States. *JAMA.* 1993;270:2464–2468.

7. Stephen EH, Foote K, Hendershot GE, Schoenborn CA. Health of the foreign-born population: United States, 1989–90. *Adv Data.* 1994;241:1–12.

8. Abraido-Lanza AF, Dohrenwend BP, Ng-Mak DS, Turner JB. The Latino mortality paradox: a test of the "salmon bias" and healthy migrant hypotheses. *Am J Public Health.* 1999;89:1543–1548.

9. Jasso G, Massey DS, Rosenzweig MR, Smith JP. Immigrant health; selectivity and acculturation. In: Anderson NB, Bulatao RA, Cohen B, eds. *Critical Perspectives on Racial and Ethnic Differences in Health in Late Life.* Washington, DC: National Academies Press; 2004:227–266.

10. Jasso G, Massey DS, Rosenzweig MR, Smith JP. Immigration, health, and New York City: early results based on the US new immigrant cohort of 2003. *Econ Rev.* 2005;127–151.

11. Crimmins EM, Soldo BJ, Kim JK, Alley DE. Using anthropometric indicators for Mexicans in the United States and Mexico to understand the selection of migrants and the "Hispanic Paradox." *Soc Biol.* 2005;52:164–177.

12. Ren XS, Amick BC. Racial and ethnic disparities in self-assessed health status: evidence from the National Survey of Families and Households. *Ethn Health.* 1996;1:293–303.

13. Passel JS. *Size and Characteristics of the Unauthorized Migrant Population in the US. Estimates Based on the March 2005 Current Population Survey.* Washington, DC: Pew Hispanic Center; 2006. Available at: http://pewhispanic.org/files/reports/61.pdf. Accessed February 22, 2007.

14. Rubalcava L, Graciela T. *User's Guide for the Mexican Family Life Survey: First Wave.* 2006. Available at: http://www.mxfls.cide.edu. Accessed February 22, 2007.

15. Strauss J, Thomas D. Measurement and mismeasurement of social indicators. *Am Econ Rev.* 1996;86:30–34.

16. Massey DS, Espinosa KE. What's driving Mexico-U.S. migration? A theoretical, empirical, and policy analysis. *Am J Sociol.* 1997;102:939–999.

17. Massey DS, Durand J, Malone NJ. *Beyond Smoke and Mirrors: Mexican Immigration in an Age of Economic Integration.* New York, NY: Russell Sage Foundation; 2002.

18. Orrenius PM, Zavodny M. Self-selection among undocumented immigrants from Mexico. *J Dev Econ.* 2005;78:215–240.

19. Chiquiar D, Hanson GH. International migration, self-selection, and the distribution of wages: evidence

from Mexico and the United States. *J Polit Econ.* 2005; 113:239–281.

20. Durand J, Massey DS, Zenteno RM. Mexican immigration to the United States: continuities and changes. *Lat Am Res Rev.* 2001;36:107–127.

21. Fussell E. Sources of Mexico's migration stream: rural, urban, and border migrants to the United States. *Soc Forces.* 2004;82:937–967.

22. Durand J, Massey DS. Mexican migration to the United States: a critical review. *Lat Am Res Rev.* 1992; 27:3–42.

23. Martorell R, Habicht JP. Growth in early childhood in developing countries. In: Falkner F, Tanner JM, eds. *Human Growth: A Comprehensive Treatise.* 2nd ed. New York, NY: Plenum Press; 1986.

24. Strauss J, Thomas D. Health, nutrition, and economic development. *J Econ Lit.* 1998;36:766–817.

25. Haas JD, Brownlie T IV. Iron deficiency and reduced work capacity: a critical review of the research to determine a causal relationship. *J Nutr.* 2001;131: 676S–688S.

26. *Iron Deficiency Anaemia, Assessment, Prevention and Control: A Guide for Programme Managers.* Geneva, Switzerland: World Health Organization; 2001.

27. Ware JE Jr, Brook RH, Davies AR, Lohr KN. Choosing measures of health status for individuals in general populations. *Am J Public Health.* 1981;71: 620–625.

28. King G, Murray CJL, Salomon JA, Tandon A. Enhancing the validity and cross-cultural comparability of measurement in survey research. *Am Polit Sci Rev.* 2004;98:191–207.

29. Hondagneu-Sotelo P. *Gendered Transition: Mexican Experiences of Immigration.* Berkeley: University of California Press; 1994.

30. Kanaiaupuni SM. Reframing the migration question: an analysis of men, women, and gender in Mexico. *Soc Forces.* 2000;78:1311–1348.

31. Fussell E, Massey DS. The limits to cumulative causation: international migration from Mexican urban areas. *Demography.* 2004;41:151–171.

32. Efron B. The bootstrap, jacknife and other resampling plans. In: *Conference Board of the Mathematical Sciences–National Science Foundation Regional Conference Series in Applied Mathematics 38.* Philadelphia, Pa: Society for Industrial and Applied Mathematics; 1982.

33. Massey DS, Goldring L, Durand J. Continuities in transnational migration: an analysis of nineteen Mexican communities. *Am J Sociol.* 1994;99:1492–1533.

34. Massey DS, Fischer MJ, Capoferro D. International migration and gender in Latin America: a comparative analysis. *Int Migration.* 2006;44:63–91.

35. Khlat M, Darmon N. Is there a Mediterranean migrants mortality paradox in Europe? *Int J Epidemiol.* 2003;32:1115–1118.