Title

Estimating the effects of Mexico to U.S. migration on elevated depressive symptoms: evidence from pooled cross-national cohorts.

Authors

Murchland, Audrey
Zeki Al Hazzouri, A
Zhang, Lanyu
et al.

Publication Date

2021-12-01

DOI

10.1016/j.annepidem.2021.08.014

Peer reviewed

HHS Public Access

Author manuscript

Ann Epidemiol. Author manuscript; available in PMC 2024 September 27.

Published in final edited form as:

Ann Epidemiol. 2021 December ; 64: 53–66. doi:10.1016/j.annepidem.2021.08.014.

Estimating the effects of Mexico to U.S. migration on elevated depressive symptoms: evidence from pooled cross-national cohorts

Audrey R. Murchland, MPH[a,b,*], **A. Zeki Al Hazzouri, PhD**[c], **Lanyu Zhang, MS**[d], **Tali Elfassy, PhD**[d], **Leslie Grasset, PhD**[e], **Alicia R. Riley, PhD**[a], **Rebeca Wong, PhD**[f], **Mary N. Haan, DrPH**[a], **Richard N. Jones, ScD**[g,h], **Jacqueline M. Torres, PhD**[a], **M. Maria Glymour, ScD**[a]

[a]Department of Epidemiology and Biostatistics, University of California, Los Angeles, CA

[b]Department of Epidemiology, Harvard University T.H. Chan School of Public Health, Harvard University, Cambridge, MA

[c]Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY

[d]Division of Epidemiology, Department of Public Health Sciences, Miller School of Medicine, University of Miami, Miami, MIA

[e]Univ. Bordeaux, Inserm, Bordeaux Population Health Research Center, UMR 1219; Inserm, CIC1401-EC, F-33000 Bordeaux, France

[f]Department of Preventive Medicine and Community Health and Sealy Center on Aging, University of Texas Medical Branch, Galveston, TX

[g]Department of Psychiatry and Human Behavior, Warren Alpert Medical School, Brown University, Providence, RI

[h]Department of Neurology, Alpert Medical School, Brown University, Providence, RI

Abstract

Purpose: Migrating from Mexico to the U.S. is a major, stressful life event with potentially profound influences on mental health. However, estimating the health effects of migration is challenging because of differential selection into migration and time-varying confounder mediators of migration effects on health.

Methods: We pooled data from the Mexican Health and Aging Study (N = 17,771) and Mexican-born U.S. Health and Retirement Study (N = 898) participants to evaluate the effects of migration to the U.S. (at any age and in models for migration in childhood or adulthood) on depressive symptom-count, measured with a modified Centers for Epidemiologic Studies-Depression scale. We modeled probability of migrating in each year of life from birth to either age at initial

*Corresponding author. Department of Epidemiology, Harvard University T H Chan School of Public Health, Boston, MA CA 94143, USA. amurchland@g.harvard.edu, audrey.murchland@ucsf.edu (A.R. Murchland).

Declaration of Competing Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

migration to the U.S. or enrollment and used these models to calculate inverse probability of migration weights. We applied the weights to covariate-adjusted negative binomial GEE models, estimating the ratio of average symptom-count associated with migration.

Results: Mexico to U.S. migration was unrelated to depressive symptoms among men (ratio of average symptom-count= 0.98 [95% CI: 0.89, 1.08]) and women (ratio of average symptom-count = 1.00 [95% CI: 0.92, 1.09]). Results were similar for migration in childhood, early adulthood, or later adulthood.

Conclusions: In this sample of older Mexican-born adults, migration to the U.S. was unrelated to depressive symptoms.

Keywords

Immigration; Selection; Depression; Mental Health

Background

With an estimated 272 million people migrating globally every year, understanding potential adverse effects of migration on health is of substantial global health significance [1,2]. Mexican-born individuals are the largest immigrant group in the United States (U.S.) and average lower levels of depression, anxiety, and substance use disorders [3–9] compared to U.S.-born Mexican Americans. This finding is surprising because stressors and traumas commonly associated with migration can adversely affect mental health [8,10–14].

Attempts to reconcile these findings to clarify the impact of migration from Mexico to the U.S. on mental health have been limited by available data [15–17]. Without harmonized cross-national data, observational studies may be confounded due to health selection. Studies comparing migrants to non–migrants in the country of origin have shown that health influences migration probability [4,7,11,17]. Generally, migrants to the U.S. average better health in childhood, are taller, and have fewer physical limitations than non–migrants [10,16,18]. However, some migration selection factors, such as education and employment status, change over time and may, thus, constitute time-varying confounder mediators: covariates that change over time and where variability pre-exposure represents confounding and variability post-exposure represents mediation[7,19,20]. For example, underemployment in Mexico may push healthy individuals to migrate for employment opportunities in the U.S. [21]. Migration to the U.S., however, may positively or negatively influence an individual's labor market opportunities [19,22,23]. Thus, comparisons of the health of migrants to that of non–migrants may be biased unless such migration selectivity (confounding) is accounted for using methods that appropriately accommodate time-varying confounder mediators [7]. To our knowledge, no prior study of the effects of migration on mental health has properly accounted for time-varying confounder mediators.

In this paper, we evaluate the mental health effects of migration comparing Mexican-born individuals who did or did not migrate to the U.S.; we apply age-specific inverse probability of migration weights to account for selective migration in a pooled cohort of Mexican-born adults age 50 and older living in the U.S. or Mexico.

Methods

Sample

The Health and Retirement Study (HRS) is a national cohort study of U.S., non–institutionalized adults ages 50 years and older and their spouses. HRS oversampled Hispanics. Study participants are interviewed approximately every 2 years with new enrollment periods every 6 years to maintain representation of the community-dwelling U.S. population ages 50+ [24,25].

The Mexican Health and Aging Study (MHAS) is an HRS sister study, with a comparable study design and harmonized measures [26]; MHAS added new enrollees in 2012 to maintain representation of the community-dwelling Mexican population age 50+. All respondents provided informed consent. The University of California, San Francisco IRB determined this study was exempt from human subjects' regulations.

We pooled data from the 2000 through 2012 waves of HRS (seven study waves) and the 2001, 2003, and 2012 waves of MHAS (three study waves), allowing for new enrollment across waves. We merged harmonized data for Mexicans living in Mexico who participated in the MHAS (N = 17,771) with data for Mexican-born migrants living in the U.S. who participated in HRS (N = 898). Additional details on dataset construction and harmonization are described elsewhere [27]. The analytic sample was restricted to core interviews (i.e. not a proxy interview) of adults age 50 years and older with complete covariate information and at least one CES-D (Center for Epidemiologic Studies Depression) score. Both MHAS and HRS were designed to nationally representative for people ages 50+, thus corresponding with our analysis. Due to missing CES-D scores, n = 655 observations from N = 331 participants (1.1% of observations) were excluded, for a final sample of N = 18,669 participants. All MHAS interviews, and 87% of HRS interviews were conducted in Spanish.

Exposure: Migration

Among the U.S.-based HRS sample, Mexican-born individuals were identified by self-reported country of birth, and age at initial migration was self-reported. Among participants in the Mexico-based MHAS, all respondents were asked: "Not counting vacations and short visits, have you ever worked or lived in the U.S.?" as well as age at initial migration. Migration status was then operationalized as ever migrant (U.S. residing migrant or return migrants) versus never migrant. Using self-reported age at initial migration, migration history was reconstructed for each year from birth to the age of study enrollment.

Outcome: Elevated depressive symptoms

At each wave (seven waves in HRS and three waves in MHAS), depressive symptoms were measured using a modified eight-item (HRS) or nine-item (MHAS) version of the CES-D scale querying symptoms experienced in the past week [28,29]. Seven items were identical in HRS and MHAS and were used to create a harmonized scale score: a sum of the five "negative" indicators and two reverse-coded "positive" indicators ("yes" and/or "no" response; score range 0–7) (eTable 1). The negative indicators measured whether the participant experienced the following sentiments all or most of the time: depression,

everything is an effort, sleep is restless, felt alone, and felt sad. The positive indicators measured whether the participant felt happy and enjoyed life, all or most of the time. The modified eight-item CES-D is comparable with the original 20-item scale [29,30]; the harmonized seven-item scale is reliable among both HRS and MHAS participants (HRS Cronbach alpha = 0.86 and MHAS Cronbach alpha = 0.81). Our primary analyses modeled depressive symptom count.

Covariates

Covariates were selected based on existing literature on Mexico-U.S. migration selection factors and predictors of late-life mental health [7,11,16,17,27] and availability in both datasets. Demographic characteristics included self-reported age (in years, centered at 65) at symptom assessment, birth year (centered at 1924), maternal educational attainment (<8 years, ≥8 years, or “do not know”), and paternal educational attainment (<8 years, ≥8 years, or “do not know”). Pre-migration values of time-varying covariates used to account for selection into initial migration included: smoking initiation (ever smoker vs. not yet/nene/never smoker; using age of smoking initiation), entry into labor market participation (using age of first job), marital status (married vs. not married; using age of initiation and dissolution of up to four marriages), adult height (self-reported and assumed to have been achieved at age 17 and unknown prior to age 17), and years of education completed (assuming school start age of 6 years). Post-migration values of covariates were not used.

Statistical analysis

Our preferred model estimated the association between migration status and elevated depressive symptoms at each assessment wave using inverse probability of migration weighted generalized estimating equations [31] to account for the within-subject correlation across repeated measures. We estimated models with negative binomial distribution (log link), so the regression coefficients refer to a difference in the log of the mean symptom-count at each assessment, or equivalently, the ratio of average symptom-count among people who migrate compared to those who do not migrate. The GEE was based on an independent working correlation matrix, which is necessary to correctly incorporate the weights used to account for selection into migration [32].

We present models with versus without inverse probability weighting to account for selective migration and additionally adjusted for alternative covariate sets to facilitate comparison with another research. In Model 1, we adjusted for potential confounders, age at evaluation, sex, and birth year. In Model 2, we additionally adjusted for potential childhood confounders that would probably have occurred before exposure to migration (parental education). We would have ideally adjusted for potential confounders of the association according to Figure 1A in Model 3. However, in actuality, these confounding relationships are time-dependent and are more likely to be represented by Figure 1B, i.e., potentially influenced by the decision to migrate. Therefore, in Model 3, to estimate an unbiased total effect, we account for time-varying confounding through inverse probability weighting (IPW) to account for pre-migration selectors into initial migration without adjusting for post-migration factors. IPWs are often used to estimate causal effects in marginal structural models when there is time-varying confounding or selection bias [33–35].

We calculated migration weights using a pooled logistic regression evaluating the probability that each individual migrated to the U.S. for the first time at each year of his and/or her life (from birth to study enrollment [mean = 61 years] or from birth to age of initial migration to the U.S. [mean = 28 years]), adjusting for covariates that would have been established by that age. For each respondent, we calculated the cumulative probability of having the migration history s/he actually had by multiplying the probability of the migration decision in each year of life conditional on past migration history. Once an individual had migrated, this probability was set to one because we did not evaluate the effects of return-migration. We calculated stabilized weights that were trimmed at the first and 99th percentiles. Additional details and further analytic justification are described elsewhere [27].

We additionally stratified results by gender to assess effect modification, because of the gendered nature of migration decisions and experiences historically [2,36,37]. We also evaluated the estimated effects of age-specific migration, comparing migration before age 18, between ages 18 and 24, and after age 24, each compared to not migrating within the respective age range or earlier. Age cut-offs were selected based on the distribution of the probability of migration by age for men and women in both harmonized datasets and the 2002 U.S. Census [27].

Sensitivity analyses

Consistent with current recommendations to evaluate whether results are robust to alternative conceptually consistent modeling decisions [38], we considered several alternative approaches to modeling CES-D as sensitivity analyses, including dichotomizing CES-D (>4/7 symptoms) and using a logit link and evaluating a latent variable for depressive symptoms with and without items expressing differential item functioning. Results were very similar to those from primary analyses and are presented in the appendix.

All analyses were conducted using SAS 9.4.

Results

Compared to non–migrants, migrants were older, were more likely to be male, had completed more education, and had higher parental education (Table 1). At their first assessment (the baseline assessment), average depressive symptom-count was 2.3 among migrants (2.5 among female migrants and 1.8 among male migrants) and 2.0 among non–migrants (2.7 among female non–migrants and 1.8 among male non–migrants).

Migration status among men was not associated with depressive symptom-count (0–7 symptoms) when adjusting for birth year and age (ratio of average symptom-count for migrants to non–migrants = 0.97 (95% CI: 0.92, 1.02)) or when additionally adjusting for parental education and applying weights that incorporated time-varying migration selection factors (Fig. 2 and eTable 2). Among women, adjusting only for birth year and age, U.S. migration was associated with fewer depressive symptoms (ratio of average symptom-count = 0.87 [95% CI: 0.81, 0.93]). Additional adjustment for parental education attenuated the association slightly (ratio of average symptom-count = 0.90 (95% CI: 0.84, 0.96)). When

models were additionally weighted to account for selective migration, the point estimate was null though confidence intervals were wide (ratio of average symptom-count = 1.00 [0.92, 1.09]). Estimates from all alternative specifications of depressive symptoms were similar (eFig. 1; eTables 2,4,6–9).

Migration before age 18 was non–significantly associated with fewer depressive symptoms for both men and women (ratio of average symptom-count for both = 0.93 [95% CI: 0.80, 1.08]). Additional adjustments for parental education and selection into migration further attenuated the association (Fig. 3 and eTable 3).

Migration between ages 18 and 24 was non–significantly associated with fewer depressive symptoms among men (Fig. 3 and eTable 3). Among women, migration between ages 18 and 24 was associated with fewer depressive symptoms in models adjusted for birth year, age at evaluation, and parental education (ratio of average symptom-count = 0.81 [95% CI: 0.69, 0.95]). The coefficient was very similar but not statistically significant after accounting for time-varying migration selection factors (ratio of symptom-count = 0.84 [95% CI: 0.63, 1.13]).

Finally, migration after age 24 was non–significantly associated with fewer depressive symptoms among men (Fig. 3 and eTable 3). Among women, in models adjusted only for birth year and age at evaluation, migration after age 24 was associated with fewer depressive symptoms (ratio of average symptom-count = 0.89 (95% CI: 0.81, 0.97); the association was slightly attenuated after adjusting for parental education (ratio of average symptom-count = 0.91 [95% CI: 0.84, 0.99]) and was no longer significant after accounting for time-varying migration selection factors (ratio of average symptom-count = 1.03 [95% CI: 0.93, 1.13]).

Discussion

Previous studies have been unable to clarify the influence of migration on mental health in later life due to complex migration selection factors [3–6,8,9,12,13]. The current study overcomes this challenge by pooling harmonized data from two large studies of community dwelling older adults to create a cohort of Mexican-born individuals to compare depressive symptoms among those who migrated to the US to those who had never emigrated from Mexico, adjusting for selection into initial migration. We found that migrants had fewer depressive symptoms in unadjusted models. However, once we accounted for factors that influence initial migration, the association was no longer significant. While we cannot rule out modest benefits of migrating, our results suggest that previously hypothesized migrant advantages, and disadvantages in mental health may be explained by migrant selection.

Prior studies of the consequences of migration on migrant health have led to contradictory interpretations that have proved difficult to reconcile without data to adequately account for selection or appropriate comparison groups [3–6,8,9,12,13]. On one hand, prior findings suggest that migrants residing in the U.S. have lower levels of depression and other mental health outcomes compared to U.S.-born Mexican Americans [39,40]. However, the relevant comparison group would be non–migrants from the country of origin. On the other hand, findings of deleterious effects of migration on substance use and mental health [5,6,8,9]

suggest that migrants may have worse mental health compared with non–migrants. For example, one study of people ages 18–65 comparing U.S.-residing migrants from Mexico to non–migrant family members residing in Mexico (to account for migration selection) found that migrants had a higher risk for first onset of any depressive or anxiety disorder following migration than their non–migrant family members (OR=1.42 [95% CI: 1.04, 1.94]) [8]. By accounting for migrant selection through IPW, our null findings emphasize the role of selection as an important driver of previously hypothesized mental health advantages and disadvantages associated with migration. Furthermore, our findings from models that do not adjust for selection challenge assumptions about the poor mental health profile of U.S. immigrants [41].

In addition to selection, there are several components of the migrant experience that add complexity, and could contribute to the potentially contradictory observed effects on mental health outcomes. First, cohort differences in the drivers of migration may reduce comparability of studies [12,42–44]. Participants in the current study generally migrated prior to the Immigration Reform and Control Act of 1986 (IRCA) and were likely motivated by employment opportunities. In the post-IRCA period, migration from Mexico to the U.S. for family reunification increased; such migrants may have less health selection than those migrating for employment. Much of the literature (e.g. those using the Mexican Family Life Survey [17]) include participants who largely migrated in the post-IRCA period. Migrants in more recent cohorts are more likely to be impacted by the increasingly punitive public policies supporting mass deportation of undocumented immigrants. These policies led to widespread fear of deportation among Latinx (including Mexican-origin) adults and may harm mental health outcomes among Mexican immigrants and their family members [45]. Such changes in the drivers of migration make it essential to correctly account for confounding in efforts to estimate migration effects. While we do not have sufficient data to evaluate the relative importance of health selection or effect modification across different cohorts, the approach we adopt here to account for migrant selection addresses a fundamental methodological challenge in migration research and could be extended to other, larger migrant cohorts.

Second, it is possible that the mental health consequences of migration reflect a mixture of positive and negative influences that vary by sending and receiving context or demographic characteristics. For example, in some specifications migration at ages 18–24 appeared advantageous for women while results for men consistently showed no evidence of harmful nor beneficial effect, regardless of age at migration. The protective effect for women who migrated in early adulthood, while interpreted with caution, is notable given the likely gendered economic drivers of U.S. migration in our sample. Migration for employment was more common for men, while family reunification was a more common driver of women's migration [46,47].

Third, the short-term mental health effects of migration may differ from the long-term effects. For example, a study comparing migrants to their non–migrant family members found an increased risk of incident psychiatric conditions in the immediate post-migration period [8,12]. Relocation imposes immediate physical and psychological stressors: strained financial resources, separation from family, disruption of place identity, and/or changing

environmental exposures [12]. Over the longer term, advantageous resources that protect mental health may accumulate, such as economic opportunity or health care access [12,48,49]. However, existing literature has also shown that immigrant health and health behaviors deteriorate with longer durations of residence in the U.S. [12,13,50], consistent with the acculturative stress hypothesis [11,51]. Our findings are consistent with this literature, but our study does not capture the non–durable consequences of migration at earlier stages of the lifecourse.

In this study, we utilize IPW estimated marginal structural models to adjust for pre-exposure confounders due to a complex time-varying factors that both influence selection into migration and are influenced by migration (i.e., confounder-mediators). To draw causal inferences from our models, as from any observational study, we must adopt several assumptions: exchangeability, consistency, positivity, and no model misspecification. First, there were potential confounders of initial migration and late–life depressive symptomatology that were not available in one or both datasets and therefore could not be accounted for in our models, potentially threatening the exchangeability assumption. Second, for the exposure of initial migration, we feel threats to consistency occur when differing ‘types’ of migration – such as economic migration, migration fleeing violence, or migration for family reunification – have different effects on depression. We do not have sufficient data to evaluate these potential differences, so our results should be interpreted as an average across different migration types in our sample. Third, we previously assessed the positivity assumption graphically, and did not observe obvious violations[27]. Finally, with respect to model misspecification, we evaluated several different models. Results were quite similar across these models, so we believe that any violations of this assumption do not account for our findings.

Our study has important limitations, which we ameliorated to the fullest extent possible. Our measure of depressive symptoms was a brief self-assessment over the past week. We compared several alternative operationalizations of CES-D and confirmed results were quite similar. We emphasize the continuous specification of symptoms because it avoids arbitrary dichotomization [52–54] and has the best statistical power. Subtle differences across studies in depressive symptom assessments could introduces additional heterogeneity that attenuate effects. However, sensitivity analyses revealed that only two items displayed differential item functioning by study and results excluding these items were similar.

As previously acknowledged, potential unmeasured confounding or effect modification is a concern because many theoretically important variables that may influence migration, such as region of birth in Mexico, legal authorization to migrate, family history of depression, and reason for migration [12,42,44,54–56], were not measured in one or both surveys or were measured inconsistently across the two surveys. However, since the study results are null, any potential biases would have to balance out perfectly across the levels of the factors in our sample to explain our results, which cannot be ruled out but is unlikely. Future work should seek to replicate this study in data sources with additional measures of pre-migration characteristics and quantify the plausible strength of bias from specific variables. The relatively small number of Mexican-born participants in HRS may not fully represent the U.S.-Mexican migrant population. Our study evaluated only effect of initial migration

and did not address the effects of return migration from the U.S. to Mexico. Previous work has suggested that return migrants are more similar in health to U.S. residing migrants than are never migrants [57], but emigration selection may also vary across contexts. Future work should aim to reconstruct detailed migration histories and model selection into return migration.

Strengths of the study include the harmonized, cross-national samples, which allowed for counterfactual comparisons not frequently evaluated in the literature. We used advanced methods to construct time-varying selection weights to account for confounder-mediators of the migration decision. We took advantage of years of planning in the designs of the HRS and MHAS which made harmonized analyses possible to demonstrate an approach that can be leveraged in future studies with other cross-national migrant populations.

Overall, in pooled cross-national study of Mexican-born older adults residing in the U.S. and Mexico, we observed little difference in depressive symptoms when comparing migrants and non–migrants while accounting for selective factors into migration.

Sources of funding

This work was supported by a grant from the National Institutes of Health, National Institute on Aging (RF1AG055486, MPIs: A. Zeki Al Hazzouri/M. M Glymour). The Mexican Health and Aging Study is funded by the National Institutes of Health/National Institute on Aging (R01AG018016, R.W., PI) and the National Institute of Statistics and Geography in Mexico.

Data:

Data from HRS and MHAS are publicly available.

Appendix

Sensitivity Analyses

Consistent with current recommendations to evaluate whether results are robust to alternative conceptually consistent modeling decisions (35), we considered several alternative approaches to modeling CES-D as sensitivity analyses including: (1) modeling a binary indicator for elevated depressive symptoms as >4/7 symptoms (most consistent with some prior work approximating probable diagnostic thresholds (28, 55)); (2) using item-response theory (IRT) to estimate a continuous depressive symptom score, based on 7 items; (3) using a modified item-response theory (IRT) based score using only the 5 items with no evidence of differential-item functioning by study; and (4) using binary measures based on dichotomizing the IRT continuous scores in the top 20th percentile (both for the 7-item and 5-item scales). Further, in a subset of the analytic sample (N = 18,655; 2,437 migrants, 16,218 non–migrants), an additional variable, ‘had a lot of energy’, could be added to the CES-D scale. In this subset, (5) we modeled the 8-item CES-D again as a count outcome and as a binary indicator, >4/8 symptoms.

Estimates from alternative specifications of depressive symptoms explored in sensitivity analyses were very similar to the primary analyses, although the association between

migration ages 18–24 and lower depressive symptoms among women was not observed in most other specifications (eTables 2,4,6–10). First, modeling a binary indicator for elevated depressive symptoms as >4/7 symptoms using logistic regression GEE models provided similar results to the negative binomial GEE models (eTables 2 and 4; eFig. 1). Second, using item-response theory to estimate a continuous depressive symptom score provided similar results to the negative binomial GEE models for both a 7-item score and a 5-item score using only items with no evidence of differential-item functioning (eTables 5–9) (both modeled continuously and as a binary measure for the top 20th percentile of each score). Finally, results from models using an 8-item CES-D in a subset of the analytic sample that incorporated a measure of energy were again very similar to those from the primary analysis (eTable 10).

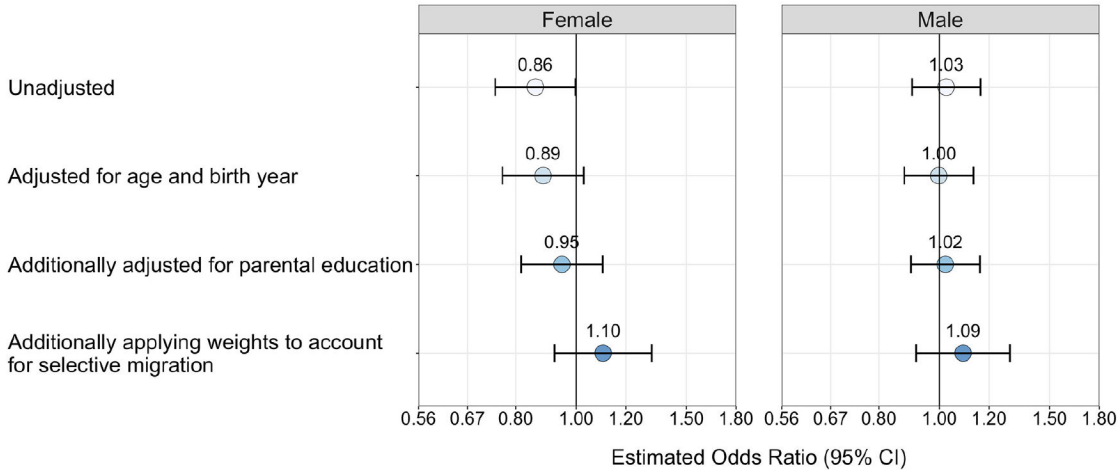
eTable 1

Comparison of depressive symptom measures used in the Health and Retirement Study and the Mexican Health and Aging Study.

	Health and Retirement Study, Wave II and higher, and all waves of the AHEAD	**MHAS 2001 – 2012**
Response Format	Yes and/or No	Yes and/or No
Opening line	Now think about the past wk and the feelings you have experienced. Please tell me if each of the following was true for you much of the time this past wk. Much of the time during the past wk _____.	These questions refer to how you have felt during the past wk. For each question please tell me if the majority of the time:
Items		
*1	You felt depressed	You felt depressed
*2	You felt that everything you did was an effort	You felt that everything you did was an effort
*3	Your sleep was restless	You felt that your sleep was restless
*4	You were happy	You felt happy
*5	You felt lonely	You felt lonely
*6	You enjoyed life	You felt that you enjoyed life
*7	You felt sad	You felt sad
8	You could not get going	You felt tired
+9	You had a lot of energy	You felt you had a lot of energy

* Item was used in harmonized measure created for study.

+ Item not included in original HRS CES-D scale and only available in a subsample of the analytic datasetSources: Steffick D. Documentation of Affective Functioning Measures in the Health and Retirement Study. Ann Arbor, MI: Survey Research Center, *University of Michigan; 2000; Mexican Health and Aging Study, 2001*, www.mhasweb.org.



eFig. 1.

Sensitivity analysis displaying estimated odds ratio and 95% confidence intervals relating migration and elevated depressive symptoms (>4/7) from logistic regression GEE, clustering by participant, pooling data from the Health and Retirement Study (2000–2012) and the Mexican Health and Aging Study (2001, 2003, 2012).

eTable 2

Sensitivity analyses comparing estimated associations and 95% confidence intervals relating migration and depressive symptoms from logistic and negative binomial GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

	Unadjusted Model	**Model 1[a]**	**Model 2[b]**	**Model 3[c]**
	Binary outcome (>4/7 symptoms)			
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Males	1.03 (0.90, 1.16)	1.00 (0.88, 1.13)	1.02 (0.90, 1.16)	1.09 (0.92, 1.30)
Females	0.86 (0.74, 1.00)	0.89 (0.76, 1.03)	0.95 (0.82, 1.10)	1.10 (0.92, 1.32)
	Count outcome with negative binomial distribution			
	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)
Males	0.98 (0.93, 1.03)	0.97 (0.92, 1.02)	0.98 (0.93, 1.03)	0.98 (0.89, 1.08)
Females	0.85 (0.80, 0.91)	0.87 (0.81, 0.93)	0.90 (0.84, 0.96)	1.00 (0.92, 1.09)

[a] Model 1 is adjusted for age at measure and birth year.

[b] Model 2 is adjusted for age, birth year, and parental education.

[c] Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

Ratio of symptom-count is based on the exponentiated coefficient from the negative binomial model.

eTable 3

Estimated ratio of average symptom-count and 95% confidence intervals relating age-specific migration and depressive symptom-count from negative binomial GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

	Unadjusted Model	Model 1*	Model 2†	Model 3‡
	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)
Migration before age 18				
Males	0.90 (0.77, 1.04)	0.93 (0.80, 1.08)	0.96 (0.83, 1.12)	0.97 (0.80, 1.19)
Females	0.91 (0.78, 1.06)	0.93 (0.80, 1.08)	0.97 (0.83, 1.13)	1.00 (0.84, 1.19)
Migration between ages 18 and 24				
Males	0.92 (0.84, 1.00)	0.91 (0.83, 1.00)	0.92 (0.84, 1.00)	0.99 (0.86, 1.14)
Females	0.76 (0.65, 0.90)	0.78 (0.67, 0.92)	0.81 (0.69, 0.95)	0.84 (0.63, 1.13)
Migration after age 24				
Males	1.04 (0.97, 1.12)	1.01 (0.95, 1.09)	1.03 (0.96, 1.10)	0.98 (0.87, 1.11)
Females	0.88 (0.80, 0.96)	0.89 (0.81, 0.97)	0.91 (0.84, 0.99)	1.03 (0.93, 1.13)

*Model 1 is adjusted for age at measure and birth year.

†Model 2 is adjusted for age, birth year, and parental education.

‡Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

eTable 4

Sensitivity analyses estimating odds ratios and 95% confidence intervals relating age-specific migration and elevated depressive symptoms (>4/7 symptoms) from logistic GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

	Unadjusted Model	Model 1*	Model 2†	Model 3‡
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Migration before age 18				
Males	0.97 (0.70, 1.34)	1.03 (0.74, 1.42)	1.11 (0.81, 1.53)	1.12 (0.76, 1.64)
Females	0.98 (0.71, 1.35)	1.01 (0.73, 1.40)	1.11 (0.80, 1.54)	1.22 (0.84, 1.77)
Migration between ages 18 and 24§				
Males	0.89 (0.72, 1.10)	0.88 (0.71, 1.08)	0.88 (0.71, 1.09)	0.93 (0.72, 1.19)
Females	0.75 (0.54, 1.04)	0.78 (0.56, 1.09)	0.83 (0.60, 1.16)	0.85 (0.54, 1.35)
Migration after age 24§				
Males	1.12 (0.95, 1.32)	1.07 (0.91, 1.26)	1.09 (0.93, 1.29)	1.12 (0.90, 1.40)
Females	0.87 (0.73, 1.05)	0.89 (0.74, 1.08)	0.95 (0.78, 1.14)	1.11 (0.89, 1.38)

[*] Model 1 is adjusted for age at measure and birth year.

[†] Model 2 is adjusted for age, birth year, and parental education.

[‡] Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

[§] Models adjusted for migration in prior age range.

eTable 5

Sensitivity analysis evaluating differential item functioning for CES-D items using logistic regression to predict each depressive symptom, controlling for overall factor score. Estimated odds ratio and 95% confidence intervals relating HRS participation (HRS vs. MHAS) and CES-D factor to evaluate differential item functioning, pooling data from the Health and Retirement Study (2000–2012) and the Mexican Health and Aging Study (2001, 2003, 2012).

CES-D Factor[*] (Yes and/or No)	OR associated with HRS participation (95% CI)
Felt depressed	1.00 (0.83, 1.20)
Everything was an effort	1.37 (1.20, 1.57)
Sleep was restless	1.05 (0.93, 1.19)
I was happy (reverse coded)	0.94 (0.82, 1.09)
Felt lonely	1.12 (0.95, 1.32)
I enjoyed life (reverse coded)	0.51 (0.45, 0.58)
Felt sad	0.97 (0.80, 1.19)
Felt Tired	N/A

All models adjusted for overall factor score.

[*] wording reflects wording in HRS as opposed to MHAS.

eTable 6

Sensitivity analyses using different ways to operationalize elevated depressive symptoms in logistic GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

Outcome: self-reported CES-D scale binary outcome >4/7 symptoms		
	Males	**Females**
	OR (95% CI)	OR (95% CI)
Model 0[‡]	1.03 (0.90, 1.16)	0.86 (0.74, 1.00)
Model 1[§]	1.00 (0.88, 1.13)	0.89 (0.76, 1.03)
Model 2[//]	1.02 (0.90, 1.16)	0.95 (0.82, 1.10)
Model 3[¶]	1.09 (0.92, 1.30)	1.10 (0.92, 1.32)
Outcome: binary outcome top 20th percentile IRT score from 7-item scale[*]		
	Males	Females
	OR (95% CI)	OR (95% CI)
Model 0	1.04 (0.91, 1.18)	0.85 (0.73, 0.98)
Model 1	1.01 (0.89, 1.15)	0.87 (0.75, 1.01)
Model 2	1.03 (0.91, 1.18)	0.93 (0.80, 1.08)
Model 3	1.11 (0.93, 1.33)	1.09 (0.91, 1.31)
Outcome: binary outcome top 20th percentile IRT score from 5-item scale[†]		
	Males	Females

Outcome: self-reported CES-D scale binary outcome >4/7 symptoms		
	Males	**Females**
	OR (95% CI)	OR (95% CI)
Model 0	1.05 (0.92, 1.19)	0.81 (0.70, 0.94)
Model 1	1.02 (0.89, 1.16)	0.82 (0.71, 0.96)
Model 2	1.04 (0.91, 1.19)	0.88 (0.76, 1.02)
Model 3	1.10 (0.91, 1.32)	1.04 (0.87, 1.25)

[*] 7-item IRT containing: felt depressed, felt everything was an effort, sleep was restless, were happy, felt lonely, enjoyed life, and felt sad.

[†] 5-item IRT containing: felt depressed, sleep was restless, were happy, felt lonely, and felt sad.

[‡] Model 0 is unadjusted.

[§] Model 1 is adjusted for age at measure and birth year.

[‖] Model 2 is adjusted for age, birth year, and parental education.

[¶] Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

eTable 7

Sensitivity analyses using different ways to operationalize number of depressive symptoms in negative binomial GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

Outcome: self-reported CES-D scale count outcome (0–7)		
	Males	**Females**
	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)
Model 0[‡]	0.98 (0.93, 1.03)	0.85 (0.80, 0.91)
Model 1[§]	0.97 (0.92, 1.02)	0.87 (0.81, 0.93)
Model 2[‖]	0.98 (0.93, 1.04)	0.90 (0.84, 0.96)
Model 3[¶]	0.98 (0.89, 1.08)	1.00 (0.92, 1.09)
Outcome: continuous calculated depressive score outcome from 7-item IRT[*]		
	Males	Females
	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)
Model 0	0.99 (0.95, 1.02)	0.87 (0.82, 0.92)
Model 1	0.98 (0.94, 1.01)	0.88 (0.83, 0.93)
Model 2	0.98 (0.95, 1.02)	0.91 (0.86, 0.96)
Model 3	0.99 (0.94, 1.03)	0.97 (0.90, 1.04)
Outcome: continuous calculated depressive score outcome from 5-item IRT[†]		
	Males	Females
	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)
Model 0	0.99 (0.96, 1.02)	0.88 (0.84, 0.93)
Model 1	0.98 (0.95, 1.01)	0.89 (0.85, 0.94)
Model 2	0.98 (0.96, 1.01)	0.92 (0.87, 0.96)

Outcome: self-reported CES-D scale count outcome (0–7)		
	Males	**Females**
Model 3	0.99 (0.95, 1.03)	0.97 (0.91, 1.03)

*7-item IRT containing: felt depressed, felt everything was an effort, sleep was restless, were happy, felt lonely, enjoyed life, and felt sad.

†5-item IRT containing: felt depressed, sleep was restless, were happy, felt lonely, and felt sad.

‡Model 0 is unadjusted.

§Model 1 is adjusted for age at measure and birth year.

‖Model 2 is adjusted for age, birth year, and parental education.

¶Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

eTable 8

Sensitivity analyses evaluating age-specific effects of migration using different ways to operationalize the seven-item factor score with logistic and negative binomial GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

Outcome: continuous calculated depressive score outcome from 7-item IRT[1]				
	Unadjusted Model	**Model 1[a]**	**Model 2[b]**	**Model 3[c]**
	exp(linear Beta estimate) (95% CI)	**exp(linear Beta estimate) (95% CI)**	**exp(linear Beta estimate) (95% CI)**	**exp(linear Beta estimate) (95% CI)**
Migration before age 18				
Males	0.94 (0.87, 1.02)	0.96 (0.88, 1.04)	0.99 (0.91, 1.07)	0.98 (0.88, 1.09)
Females	0.91 (0.81, 1.04)	0.93 (0.82, 1.05)	0.97 (0.86, 1.09)	0.99 (0.86, 1.14)
Migration between ages 18 and 24				
Males	0.94 (0.90, 0.99)	0.94 (0.89, 0.98)	0.94 (0.89, 0.99)	0.96 (0.91, 1.02)
Females	0.80 (0.71, 0.89)	0.81 (0.73, 0.91)	0.84 (0.75, 0.94)	0.84 (0.71, 0.99)
Migration after age 24				
Males	1.02 (0.98, 1.07)	1.01 (0.97, 1.05)	1.02 (0.97, 1.06)	0.99 (0.94, 1.05)
Females	0.89 (0.83, 0.95)	0.90 (0.83, 0.96)	0.92 (0.86, 0.99)	0.99 (0.91, 1.08)
Outcome: binary outcome top 20th percentile factor scores from 7-item IRT[1]				
	Unadjusted Model	Model 1[a]	Model 2[b]	Model 3[c]
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Migration before age 18				
Males	1.04 (0.75, 1.44)	1.11 (0.80, 1.53)	1.18 (0.86, 1.63)	1.28 (0.86, 1.90)
Females	0.97 (0.71, 1.34)	1.00 (0.73, 1.39)	1.10 (0.80, 1.52)	1.22 (0.85, 1.77)
Migration between ages 18 and 24				
Males	0.88 (0.71, 1.10)	0.87 (0.70, 1.08)	0.87 (0.70, 1.09)	0.96 (0.74, 1.25)
Females	0.71 (0.51, 0.99)	0.74 (0.53, 1.04)	0.79 (0.56, 1.10)	0.82 (0.51, 1.30)
Migration after age 24				
Males	1.13 (0.96, 1.34)	1.08 (0.92, 1.28)	1.10 (0.93, 1.31)	1.09 (0.86, 1.37)

Outcome: continuous calculated depressive score outcome from 7-item IRT[1]				
	Unadjusted Model	**Model 1[a]**	**Model 2[b]**	**Model 3[c]**
	exp(linear Beta estimate) (95% CI)	**exp(linear Beta estimate) (95% CI)**	**exp(linear Beta estimate) (95% CI)**	**exp(linear Beta estimate) (95% CI)**
Females	0.87 (0.72, 1.05)	0.89 (0.74, 1.07)	0.94 (0.78, 1.14)	1.09 (0.88, 1.36)

[1] 7-item IRT containing: felt depressed, felt everything was an effort, sleep was restless, was happy, felt lonely, enjoyed life, and felt sad.

[a] Model 1 is adjusted for age at measure and birth year.

[b] Model 2 is adjusted for age, birth year, and parental education.

[c] Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

eTable 9

Sensitivity analyses evaluating age-specific effects of migration using different ways to operationalize the five-item factor score with logistic and negative binomial GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

Outcome: continuous calculated depressive score outcome from 5-item IRT[1]				
	Unadjusted Model	**Model 1[a]**	**Model 2[b]**	**Model 3[c]**
	exp(linear Beta estimate) (95% CI)	**exp(linear Beta estimate) (95% CI)**	**exp(linear Beta estimate) (95% CI)**	**exp(linear Beta estimate) (95% CI)**
Migration before age 18				
Males	0.94 (0.87, 1.01)	0.96 (0.89, 1.03)	0.98 (0.91, 1.05)	0.98 (0.88, 1.08)
Females	0.93 (0.83, 1.04)	0.94 (0.84, 1.05)	0.98 (0.88, 1.09)	1.00 (0.88, 1.14)
Migration between ages 18 and 24				
Males	0.95 (0.90, 0.99)	0.94 (0.90, 0.98)	0.94 (0.90, 0.98)	0.96 (0.91, 1.02)
Females	0.82 (0.74, 0.91)	0.83 (0.75, 0.92)	0.85 (0.77, 0.94)	0.86 (0.74, 0.99)
Migration after age 24				
Males	1.03 (0.99, 1.07)	1.01 (0.97, 1.05)	1.02 (0.98, 1.06)	1.00 (0.95, 1.06)
Females	0.90 (0.84, 0.96)	0.90 (0.85, 0.96)	0.93 (0.87, 0.99)	0.99 (0.91, 1.06)
Outcome: binary outcome top 20th percentile factor scores from 5-item IRT[1]				
	Unadjusted Model	Model 1[a]	Model 2[b]	Model 3[c]
	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Migration before age 18				
Males	1.12 (0.82, 1.53)	1.18 (0.86, 1.62)	1.25 (0.91, 1.71)	1.32 (0.89, 1.96)
Females	0.95 (0.69, 1.30)	0.97 (0.71, 1.34)	1.07 (0.78, 1.46)	1.21 (0.84, 1.74)
Migration between ages 18 and 24				
Males	0.91 (0.73, 1.14)	0.90 (0.72, 1.12)	0.90 (0.72, 1.13)	0.99 (0.76, 1.28)
Females	0.72 (0.52, 1.00)	0.75 (0.54, 1.03)	0.79 (0.57, 1.10)	0.83 (0.52, 1.32)

Outcome: continuous calculated depressive score outcome from 5-item IRT[1]	Unadjusted Model	Model 1[a]	Model 2[b]	Model 3[c]
	exp(linear Beta estimate) (95% CI)	exp(linear Beta estimate) (95% CI)	exp(linear Beta estimate) (95% CI)	exp(linear Beta estimate) (95% CI)
Migration after age 24				
Males	1.11 (0.93, 1.31)	1.06 (0.90, 1.26)	1.08 (0.91, 1.28)	1.04 (0.81, 1.33)
Females	0.81 (0.67, 0.97)	0.82 (0.67, 0.99)	0.86 (0.71, 1.05)	1.02 (0.81, 1.28)

[1] 5-item IRT containing: felt depressed, sleep was restless, was happy, felt lonely, and felt sad.

[a] Model 1 is adjusted for age at measure and birth year.

[b] Model 2 is adjusted for age, birth year, and parental education.

[c] Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

eTable 10

Sensitivity analyses comparing estimated associations and 95% confidence intervals relating migration and depressive symptoms (8-item scale) from logistic and negative binomial GEE models, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012) (N = 18,655; 2,437 migrants, 16,218 non-migrants).

	Unadjusted Model	Model 1[a]	Model 2[b]	Model 3[c]
	Binary outcome (>4/8 symptoms)			
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Males	1.02 (0.91, 1.15)	0.99 (0.88, 1.11)	1.02 (0.91, 1.14)	1.05 (0.90, 1.23)
Females	0.78 (0.68, 0.90)	0.80 (0.70, 0.93)	0.86 (0.75, 0.99)	1.01 (0.85, 1.20)
	Count outcome with negative binomial distribution			
	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95% CI)	Ratio of Average Symptom-Count (95%CI)
Males	0.95 (0.91, 1.00)	0.94 (0.90, 0.98)	0.95 (0.91, 1.00)	0.95 (0.87, 1.04)
Females	0.84 (0.79, 0.90)	0.85 (0.80, 0.91)	0.88 (0.82, 0.94)	0.98 (0.90, 1.05)

[a] Model 1 is adjusted for age at measure and birth year.

[b] Model 2 is adjusted for age, birth year, and parental education.

[c] Model 3 is adjusted for age, birth year, parental education, and IPW weights (stabilized and trimmed).

Ratio of symptom-count is based on the exponentiated coefficient from the negative binomial model.

eTable 11

Baseline characteristics of the sample by migration status, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

	Return Migrants to Mexico (n = 1,541)	Migrants to the U.S. (n = 898)	Non-Migrant in Mexico (n = 16,230)

	Return Migrants to Mexico (*n* = 1,541)	Migrants to the U.S. (*n* = 898)	Non-Migrant in Mexico (*n* = 16,230)
Baseline age (years), mean (SD)	63.0 (9.4)	58.6 (8.1)	61.2 (9.0)
Birth year, mean (SD)	1941 (12.1)	1947 (11.3)	1943 (11.4)
Female, %	19.1	53.0	56.7
Age first married, mean (SD)	24.5 (8.1)	24.2 (7.2)	24.0 (10.1)
Mother's education, %			
Missing and/or Do not know	11.9	11.6	12.2
None	46.3	32.2	46.9
Some primary	29.3	26.5	27.8
Primary	7.4	16.7	9.0
More than primary	5.1	13.0	4.1
Father's education, %			
Missing and/or Do not know	13.4	19.6	14.7
None	42.6	30.5	39.7
Some primary	30.5	21.7	29.5
Primary	7.7	14.7	9.6
More than primary	5.7	13.5	6.5
Own education (years), mean (SD)	5.1 (4.7)	6.3 (4.4)	5.3 (4.7)
Ever Smoke, %	71.9	47.8	47.7
Age first smoked, mean (SD)	19.1 (9.1)	20.3 (11.1)	20.6 (9.6)
Ever worked, %	94.9	86.9	79.0
Age at first job, mean (SD)	14.5 (7.8)	26.1 (8.5)	17.3 (10.1)
Baseline Depressive Symptoms, %			
0	31.4	41.3	29.1
1	20.7	16.8	18.2
2	12.9	11.6	13.1
3	9.0	6.2	9.6
4	8.8	6.1	9.3
5	7.6	6.8	8.4
6	5.2	5.5	7.0
7	4.4	5.7	5.5
Baseline Elevated Depressive (>4/7) Symptoms, %	17.2	17.9	20.8

eTable 12

Baseline characteristics of the sample by study participation, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

	MHAS Participants (*n* = 17,771)		HRS Participants (*n* = 898)	
	Males (*n* = 8,282)	Females(*n* = 9,489)	Males(*n* = 422)	Females(*n* = 476)
Baseline age (years), mean (SD)	61.7 (9.0)	61.0 (9.0)	59.3 (8.1)	58.0 (8.0)

	MHAS Participants (*n* = 17,771)		HRS Participants (*n* = 898)	
	Males (*n* = 8,282)	**Females(*n* = 9,489)**	**Males(*n* = 422)**	**Females(*n* = 476)**
Birth year, mean (SD)	1943 (11.4)	1943 (11.5)	1947 (11.1)	1947 (11.5)
Age first married, mean (SD)	26.2 (10.4)	22.1 (9.7)	25.9 (7.0)	22.7 (7.1)
Mother's education, %				
Missing and/or Do not know	12.8	10.3	13.0	11.7
None	47.1	31.5	32.9	46.6
Some primary	27.2	27.3	25.6	28.7
Primary	8.7	16.4	17.1	9.0
More than primary	4.3	14.5	11.4	4.1
Father's education, %				
Missing and/or Do not know	14.4	14.7	16.8	22.1
None	1.2	39.0	32.5	28.8
Some primary	29.1	30.1	23.2	20.4
Primary	9.1	9.7	15.4	14.1
More than primary	6.3	6.5	12.1	14.7
Own education (years), mean (SD)	5.8 (5.1)	4.8 (4.3)	6.4 (4.5)	6.2 (4.2)
Ever Smoke, %	73.5	29.0	66.8	30.9
Age first smoked, mean (SD)	18.8 (8.2)	24.0 (11.3)	19.2 (11.2)	22.3 (10.7)
Ever worked, %	97.4	65.4	95.5	79.2
Age at first job, mean (SD)	14.5 (7.0)	20.1 (12.0)	23.7 (7.8)	28.7 (8.6)
Baseline Depressive Symptoms, %			47.2	36.1
0	36.1	23.4	16.4	17.2
1	21.1	16.0	12.3	10.9
2	13.9	12.3	6.4	6.1
3	8.7	10.3	6.6	5.7
4	7.3	10.9	5.5	8.0
5	5.9	10.3	2.8	7.8
6	4.1	9.2	2.8	8.2
7	2.9	7.5		
Baseline Elevated Depressive Symptoms (>4/7), %	12.9	27.1	11.1	24.0

References

[1]. United Nations, Department of Economic and Social Affairs, Population Division (2019). International Migrant Stock 2019. (United Nations database, POP/DB/MIG/Stock/Rev.2019).

[2]. Smith J, Daynes L. Borders and migration: an issue of global health importance. The Lancet Global Health 2016;4:e85–ee6. [PubMed: 26823220]

[3]. Alegría M, Álvarez K, DiMarzio K. Immigration and Mental Health. Curr Epidemiol Rep 2017;4:145–55. [PubMed: 29805955]

[4]. Ro A, Fleischer NL, Blebu B. An examination of health selection among US immigrants using multi-national data. Soc Sci Med 2016;158:114–21. [PubMed: 27132066]

[5]. Borges G, Cherpitel CJ, Orozco R, Zemore S, Wallisch L, Medina-Mora ME, et al. Substance use and cumulative exposure to American society: findings from both sides of the US–Mexico border region. Am J Public Health 2016;106:119–27. [PubMed: 26562124]

[6]. Nobles J, Rubalcava L, Teruel G. Migration and mental health: the immigrant advantage revisited. Population Association of America 2013 Annual Meeting 2013.

[7]. Breslau J, Borges G, Tancredi DJ, Saito N, Anderson H, Kravitz R, et al. Health selection among migrants from Mexico to the US: childhood predictors of adult physical and mental health. Public Health Rep 2011;126:361–70. [PubMed: 21553665]

[8]. Breslau J, Borges G, Tancredi D, Saito N, Kravitz R, Hinton L, et al. Migration from Mexico to the United States and subsequent risk for depressive and anxiety disorders: a cross-national study. Arch Gen Psychiatry 2011;68:428–33. [PubMed: 21464367]

[9]. Borges G, Breslau J, Orozco R, Tancredi D, Anderson H, Aguilar-Gaxiola S, et al. A cross-national study on Mexico-US migration, substance use and substance use disorders. Drug Alcohol Depend 2011;117:16–23. [PubMed: 21296509]

[10]. Ullmann SH, Goldman N, Massey DS. Healthier before they migrate, less healthy when they return? The health of returned migrants in Mexico. Soc Sci Med 2011;73:421–8. [PubMed: 21729820]

[11]. Breslau J, Aguilar-Gaxiola S, Borges G, Castilla-Puentes RC, Kendler KS, Medina-Mora ME, et al. Mental disorders among English-speaking Mexican immigrants to the US compared to a national sample of Mexicans. Psychiatry Res 2007;151:115–22. [PubMed: 17363072]

[12]. Goldman N, Pebley AR, Creighton MJ, Teruel GM, Rubalcava LN, Chung C. The consequences of migration to the United States for short-term changes in the health of Mexican immigrants. Demography 2014;51:1159–73. [PubMed: 24788391]

[13]. Abraído-Lanza AF, Chao MT, Flórez KR. Do healthy behaviors decline with greater acculturation?: implications for the Latino mortality paradox. Soc Sci Med 2005;61:1243–55. [PubMed: 15970234]

[14]. Jass G, Massey DS. Immigrant health: selectivity and acculturation: IFS Working Papers, Institute for Fiscal Studies (IFS). Institute for Fiscal Studies; 2004. Accessed from http://hdl.handle.net/10419/71469. [Accessed 1 April 2019].

[15]. Barquera S, Durazo-Arvizu RA, Luke A, Cao G, Cooper RS. Hypertension in Mexico and among Mexican Americans: prevalence and treatment patterns. J Hum Hypertens 2008;22:617. [PubMed: 18305546]

[16]. Crimmins EM, Soldo BJ, Ki Kim J, 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;52:164–77. [PubMed: 17619609]

[17]. Rubalcava LN, Teruel GM, Thomas D, Goldman N. The healthy migrant effect: new findings from the Mexican family life survey. Am J Public Health 2008;98:78–84. [PubMed: 18048791]

[18]. Bostean G Does selective migration explain the Hispanic paradox? A comparative analysis of Mexicans in the US and Mexico. J Immigr Minor Health 2013;15:624–35. [PubMed: 22618355]

[19]. Chiquiar D, Hanson GH. International migration, self-selection, and the distribution of wages: evidence from Mexico and the United States. J Political Econ 2005;113:239–81.

[20]. Rogler LH. International migrations: a framework for directing research. Am Psychol 1994;49:701. [PubMed: 8092613]

[21]. Cornelius WA. Immigration Mexican development policy and the future of US-Mexican relations. Working papers in U.S.-Mexican studies, 8. La Jolla, California: Program in United States-Mexican Studies, University of California at San Diego; 1981.

[22]. Blank S. Hearth and home: The living arrangements of Mexican immigrants and US-born Mexican Americans. Springer; 1998. p. 35–59.

[23]. Chavez LR. Shadowed lives: Undocumented immigrants in American society. Cengage Learning; 2012.

[24]. Sonnega A, Faul JD, Ofstedal MB, Langa KM, Phillips JWR, Weir DR. Cohort profile: the health and retirement study (HRS). Int J Epidemiol 2014;43:576–85. [PubMed: 24671021]

[25]. Wallace RB, Herzog AR, Weir DR, Ofstedal MB, Langa KM, Fisher GG, et al..HRS/AHEAD Documentation Report Documentation of Chronic Disease Measures in the Health and

Retirement Study (HRS/AHEAD). 2005. Ann Arbor, MI: Survey Research Center, University of Michigan; 2005.

[26]. Wong R, Michaels-Obregón A, Palloni A, Gutiérrez-Robledo LM, González–González C, López-Ortega M, et al. Progression of aging in Mexico: the Mexican health and aging study (MHAS) 2012. salud pública de méxico 2015;57:s79–s89. [PubMed: 26172238]

[27]. Zeki Al Hazzouri A, Zhang L, Murchland AR, Grasset L, Torres JM, Jones RN, et al. Quantifying lifecourse drivers of international migration: a cross-national analysis of Mexico and the United States. Epidemiology 2020;32:50–60.

[28]. Bugliari D, Campbell N, Chan C, Hayden O, Hurd M, Main R, et al. RAND Hrs Data Documentation, Version P. Santa Monica, CA: RAND Center for the Study of Aging; 2016.

[29]. Steffick D, Wallace RB, Herzog AR, Ofstedal MB, Fonda SJ, Langa K. Documentation of Affective Functioning Measures in the Health and Retirement Study. Ann Arbor, MI: Survey Research Center at the University of Michigan; 2000.

[30]. Turvey CL, Wallace RB, Herzog R. A revised CES-D measure of depressive symptoms and a DSM-based measure of major depressive episodes in the elderly. Int Psychogeriatr 1999;11:139–48. [PubMed: 11475428]

[31]. Walsemann KM, Geronimus AT, Gee GC. Accumulating disadvantage over the life course: evidence from a longitudinal study investigating the relationship between educational advantage in youth and health in middle age. Res Aging 2008;30:169–99.

[32]. Tchetgen EJT, Glymour MM, Shpitser I, Rejoinder WJ. To weight or not to weight? on the relation between inverse-probability weighting and principal stratification for truncation by death. Epidemiology 2012;23:132–7.

[33]. Cole SR, Hernán MA. Constructing inverse probability weights for marginal structural models. Am. J. Epidemiol. 2008;168:656–64. [PubMed: 18682488]

[34]. Robins JM, Hernan MA, Brumback B. Marginal structural models and causal inference in epidemiology. Epidemiology 2000;11:550–60. [PubMed: 10955408]

[35]. Breskin A, Cole SR, Westreich D. Exploring the subtleties of inverse probability weighting and marginal structural models. Epidemiology (Cambridge, Mass) 2018;29:352. [PubMed: 29384789]

[36]. Feliciano C Gendered selectivity: US Mexican immigrants and Mexican non-migrants, 1960–2000. Latin American Research Review 2008;43(1):139–60.

[37]. Kanaiaupuni SM. Reframing the migration question: an analysis of men, women, and gender in Mexico. Social forces 2000;78:1311–47.

[38]. Hoffmann S, Schönbrodt F, Elsas R, Wilson R, Strasser U, Boulesteix A-L. The multiplicity of analysis strategies jeopardizes replicability: lessons learned across disciplines. R Soc Open Sci 2021;8:201925. [PubMed: 33996122]

[39]. González HM, Tarraf W, Whitfield KE, Vega WA. The epidemiology of major depression and ethnicity in the United States. J Psychiatr Res 2010;44:1043–1051. [PubMed: 20537350]

[40]. Vega WA, Kolody B, Aguilar-Gaxiola S, Alderete E, Catalano R, Caraveo-Anduaga J. Lifetime prevalence of DSM-III-R psychiatric disorders among urban and rural Mexican Americans in California. Arch Gen Psychiatry 1998;55:771–8. [PubMed: 9736002]

[41]. Takeuchi DT. Vintage wine in new bottles: infusing select ideas into the study of immigration, immigrants, and mental health. J Health Soc Behav 2016;57:423–35. [PubMed: 27803266]

[42]. Durand J, Massey DS, Zenteno RM. Mexican immigration to the United States: continuities and changes. Lat Am Res Rev 2001;36:107. [PubMed: 17595734]

[43]. Fussell E Sources of Mexico's migration stream: rural, urban, and border migrants to the United States. Social Forces 2004;82:937–67.

[44]. Massey DS, Espinosa KE. What's driving Mexico-U.S. Migration? A theoretical, empirical, and policy analysis. Am J Sociol 1997;102:939–99.

[45]. Asad AL. Latinos' deportation fears by citizenship and legal status, 2007 to 2018. Proc Natl Acad Sci 2020;117:8836–44. [PubMed: 32253307]

[46]. Cerrutti M, Gaudio M. Gender differences between Mexican migration to the United States and Paraguayan migration to Argentina. Ann Am Acad Pol Soc Sci 2010;630:93–113.

[47]. Cerrutti M, Massey DS. On the auspices of female migration from Mexico to the United States. Demography 2001;38:187–200. [PubMed: 11392907]

[48]. Marmot M, Bell R. Fair society, healthy lives. Public Health 2012;126:S4–S10. [PubMed: 22784581]

[49]. Wong R, Palloni A, Soldo BJ. Wealth in middle and old age in Mexico: the role of international migration. Int Migr Rev 2007;41:127–51. [PubMed: 29375172]

[50]. Lara M, Gamboa C, Kahramanian MI, Morales LS, Bautista DEH. Acculturation and Latino health in the United States: a review of the literature and its sociopolitical context. Annu Rev Public Health 2005;26:367–97. [PubMed: 15760294]

[51]. Rogler LH, Cortes DE, Malgady RG. Acculturation and mental health status among Hispanics: convergence and new directions for research. Am Psychol 1991;46:585. [PubMed: 1952420]

[52]. MacCallum RC, Zhang S, Preacher KJ, Rucker DD. On the practice of dichotomization of quantitative variables. Psychol Methods 2002;7:19. [PubMed: 11928888]

[53]. Royston P, Altman DG, Sauerbrei W. Dichotomizing continuous predictors in multiple regression: a bad idea. Stat Med 2006;25:127–41. [PubMed: 16217841]

[54]. Harrell FE Jr. Statistical Principles to Live By. Charleston, South Carolina: Department of Biostatistics, Bioinformatics, and Epidemiology, Medical University of South Carolina; 2006. Book of Abstracts p. 61.

[55]. Fussell E, Massey DS. The limits to cumulative causation: international migration from Mexican urban areas. Demography 2004;41:151–71. [PubMed: 15074129]

[56]. Lindstrom DP. Economic opportunity in Mexico and return migration from the United States. Demography 1996;33:357–74. [PubMed: 8875068]

[57]. Riosmena F, Wong R, Palloni A. Migration selection, protection, and acculturation in health: a binational perspective on older adults. Demography 2013;50:1039–64. [PubMed: 23192395]

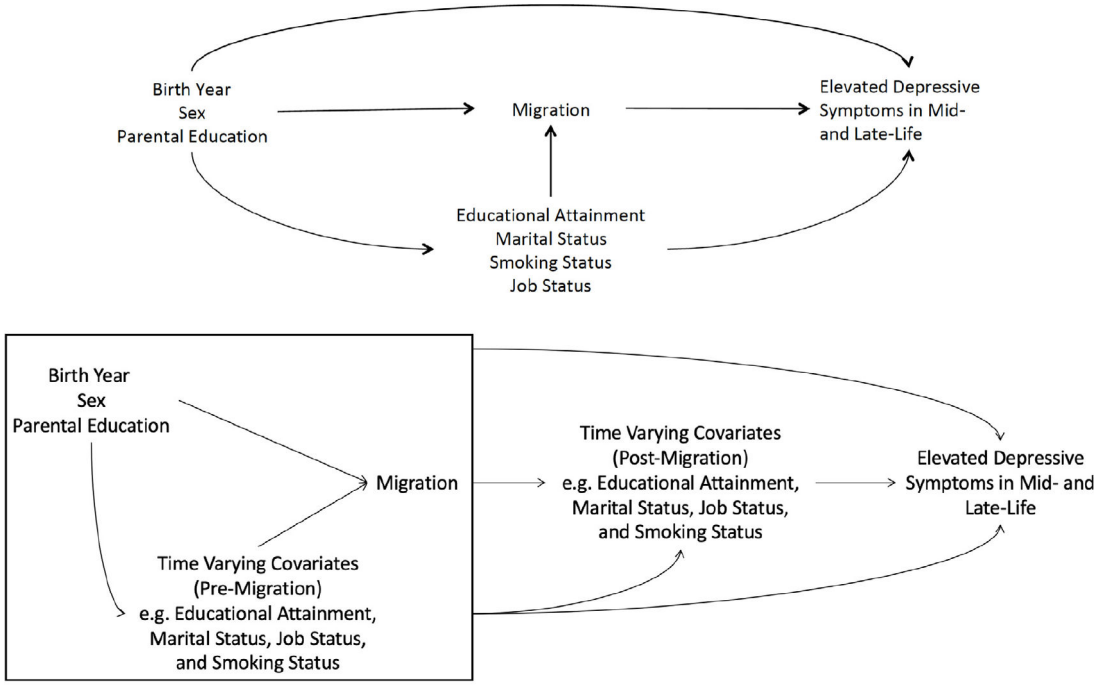


Fig. 1.

(A) Ideal conceptual diagram with time-constant confounders. (B) Realistic conceptual diagram displaying likely time-varying confounder-mediators. Note: age at evaluation is not represented in the figure, but we adjust for age at evaluation, although conceptually it is not an exposure-outcome confounder. The lifecourse nature of our study design (see Adina et al., 2020) enables us to accurately adjust for the time-varying values of those characteristics occurring up to the event of migration (i.e. the pre-migration characteristics displayed in the box). The box indicates conditioning and/or accounting for pre-treatment covariates to estimate the total effect of migration on elevated depressive symptoms in mid- and late-life.

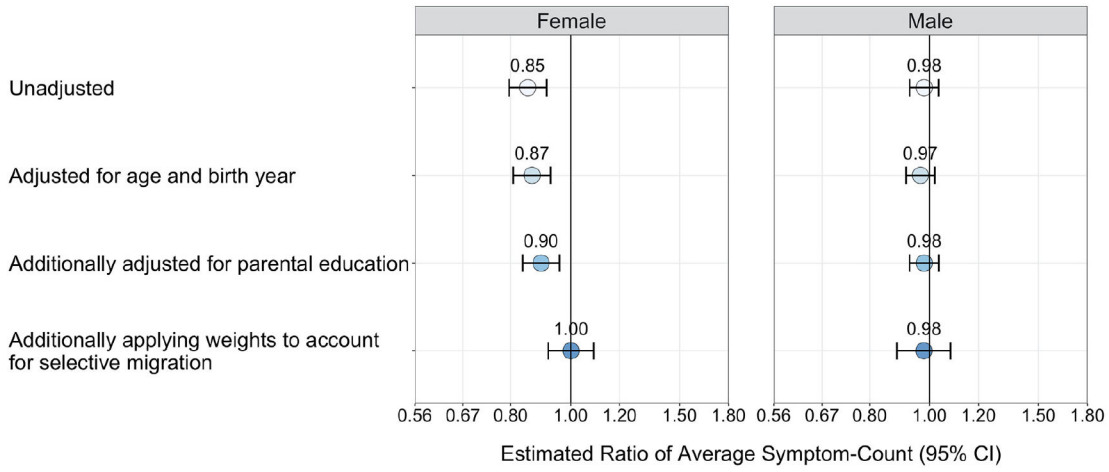


Fig. 2.

Estimated ratio of average symptom-count and 95% confidence intervals relating migration and depressive symptom-count from generalized estimating equations with log link, clustering by participant, pooling data from the Health and Retirement Study (2000–2012) and the Mexican Health and Aging Study (2001, 2003, 2012).

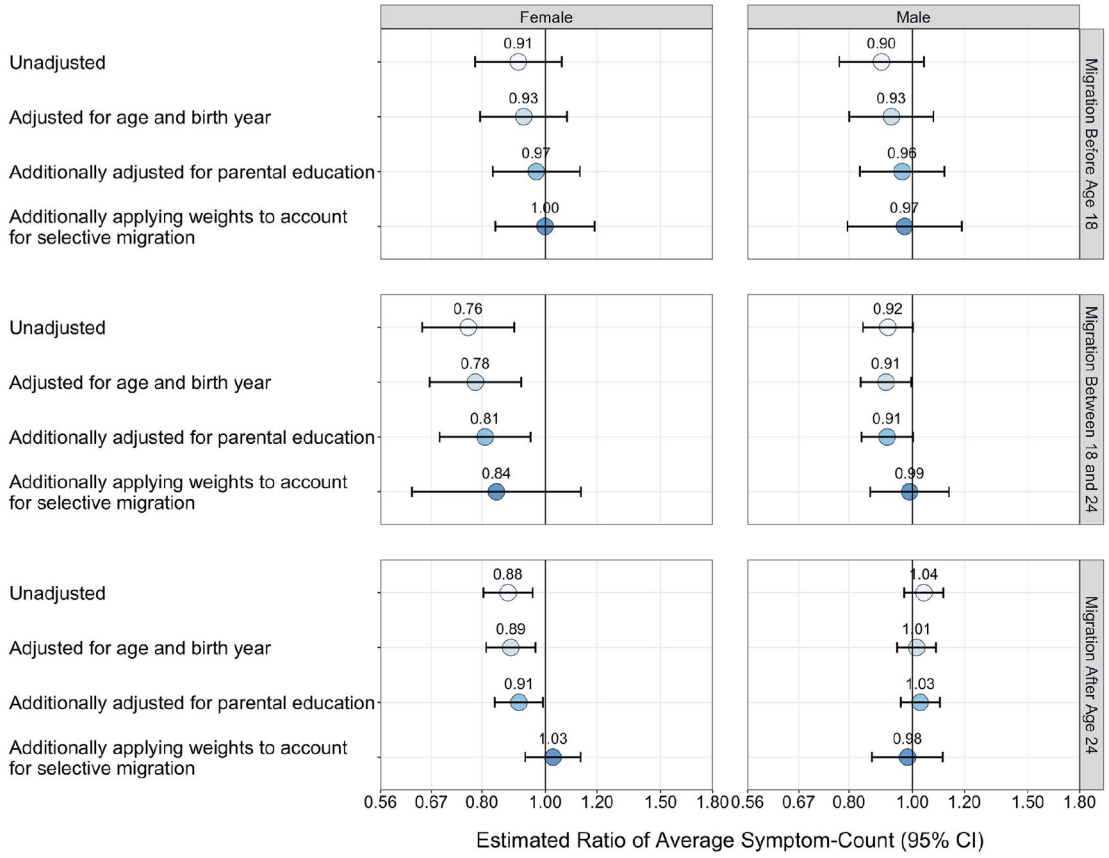


Fig. 3.

Estimated ratio of average symptom-count and 95% confidence intervals relating age-specific migration and depressive symptom-count from generalized estimating equations with log link, clustering by participant, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

Ann Epidemiol. Author manuscript; available in PMC 2024 September 27.

Table 1

Baseline characteristics (first evaluation) of the sample by migration status, Health and Retirement Study (2000–2012) and Mexican Health and Aging Study (2001, 2003, 2012).

	Males(*n* = 8,704)			Females(*n* = 16,230)		
	Migrant (*n* = 1,668)	Non-Migrant (*n* = 7,036)	*P*-value*	Migrant (*n* = 771)	Non-Migrant (*n* = 9,194)	*P*-value*
Baseline age (years), mean (SD)	62.3 (9.1)	61.4 (8.9)	<.001	59.3 (9.0)	61.0 (9.0)	<.001
Birth year, mean (SD)	1942 (12.1)	1943 (11.3)	.036	1946 (12.1)	1943 (11.5)	<.001
Age first married, mean (SD)	25.2 (7.8)	26.4 (10.7)	<.001	22.7 (7.7)	22.1 (9.7)	.048
Mother's education, %			.064			<.001
Missing and/or Do not know	12.3	13.0		10.8	11.7	
None	44.9	46.8		32.8	47.0	
Some primary	27.8	26.9		29.3	28.5	
Primary	9.2	9.0		14.4	8.9	
More than primary	5.9	4.3		12.7	3.9	
Father's education, %			.562			<.001
Missing and/or Do not know	13.8	14.6		19.8	14.7	
None	42.6	40.3		28.7	39.3	
Some primary	28.0	29.0		25.7	29.9	
Primary	9.2	9.4		12.6	9.7	
More than primary	6.4	6.6		13.2	6.4	
Own education (years), mean (SD)	5.2 (4.7)	5.9 (5.1)	<.001	6.1 (4.4)	4.8 (4.3)	<.001
Ever Smoke, %	75.6	72.6	.013	35.8	28.6	<.001
Age first smoked, mean (SD)	18.7 (9.4)	18.8 (8.1)	.778	22.6 (10.6)	24.1 (11.4)	.035
Ever worked, %	97.2	97.3	.962	80.5	64.9	<.001
Age at first job, mean (SD)	15.9 (8.1)	14.7 (7.0)	<.001	25.2 (10.6)	20.1 (12.0)	<.001
Age at initial migration, N (%)						
<18 y	217 (13.0)			149 (19.3)		
18–24 y	576 (34.5)			184 (23.9)		
>24 y	875 (52.5)			438 (56.8)		
Baseline Depressive Symptoms, %			0.319			<0.001
0	36.7	36.6		31.5	23.4	

	Males(*n* = 8,704)			Females(*n* = 16,230)		
	Migrant (*n* = 1,668)	**Non-Migrant (*n* = 7,036)**	***P*-value***	**Migrant (*n* = 771)**	**Non-Migrant (*n* = 9,194)**	***P*-value***
1	20.5	20.9		16.6	16.0	
2	13.3	13.9		10.5	12.4	
3	8.2	8.7		7.5	10.3	
4	8.0	7.1		7.5	10.9	
5	6.4	5.8		9.3	10.3	
6	3.4	4.2		9.3	9.1	
7	3.6	2.8		7.7	7.6	
Baseline Elevated Depressive Symptoms (>4/7), %	13.4	12.7	.476	12.7	27.0	.708

*P-values for means calculated using two-sample t-test; proportions using x^2.