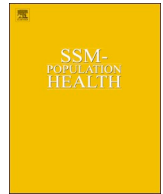




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Article

Internal migration and the health of Indigenous Mexicans: A longitudinal study

Gabriela León-Pérez

Department of Sociology, Virginia Commonwealth University, 827 West Franklin Street, Richmond, VA, 23284-2040, USA

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ABSTRACT

Rationale: Indigenous peoples have historically comprised a substantial part of migration streams around the world, yet our understanding of the effects of migration on indigenous health is limited.

Objective: To explore the migration-indigenous health relationship by assessing the impact of internal migration on the self-rated health trajectories of indigenous Mexicans.

Data and method: Using three waves of data (2002–2012) from the Mexican Family Life Survey, I estimated linear growth curves to examine differences in initial self-rated health and changes in self-rated health between indigenous and non-indigenous respondents (N = 12,533). Then, I investigated whether migrating domestically during the study period shaped indigenous health trajectories.

Results: At the baseline interview (before migration), indigenous migrants reported significantly better self-rated health than indigenous non-migrants and than all non-indigenous respondents. In spite of their better initial health, indigenous migrants' health deteriorated substantially after migration, such that by the time of the last interview they reported the worst health. The self-rated health of all other groups improved during the same period.

Conclusion: Findings provide evidence of pre-migration health selection and post-migration health deterioration among Mexican indigenous migrants. These results suggest that internal migration is a risk factor that has an independent effect on indigenous health even after adjusting for personal, family, socioeconomic, and health care factors.

1. Introduction

There are over 370 million indigenous peoples living in approximately 90 countries around the world (Gracey & King, 2009). Defining “indigenous” is sometimes contentious because it can carry political and social connotations. Still, there is agreement that indigeneity is inherently social and encompasses major components of cultural identity (King, Smith, & Gracey, 2009; Nettleton, Napolitano, & Stephens, 2007; Vaggia & Snodgrass, 2015). Based on Martínez Cobo's (1981) definition for the United Nations, indigenous status involves self-identification as descendants of pre-invasion and pre-colonial societies and the desire to preserve and transmit their culture and traditions to future generations.

While their health has improved over the last century, indigenous peoples are still highly disenfranchised and experience wide health disparities relative to non-indigenous populations within the same country (Anderson et al., 2016; Vaggia & Snodgrass, 2015). Compared to their non-indigenous counterparts, indigenous groups around the world have lower life expectancies; higher rates of infant, child, and

maternal mortality; and higher rates of infectious and chronic diseases, alcohol and drug abuse, and depression (Anderson et al., 2016; Vaggia & Snodgrass, 2015). Some scholars have suggested that the high prevalence of migration among indigenous peoples may contribute to their health disparities (King et al., 2009; Nettleton et al., 2007). However, there is little empirical research about whether and how migration shapes the health of indigenous populations.

Indigenous migrants are substantially underrepresented in the migrant health literature. Indigenous peoples have historically comprised a considerable part of migration streams around the world, yet their experiences are often lost in the data because they are usually aggregated into larger groups. For example, in the case of internal migration, indigenous migrants are often grouped within the rural migrant category; in the case of international migration, they are rarely separated from others from the same country of origin despite their distinct linguistic and cultural characteristics (Yescas, 2010).

In this study, I use three waves of data from the Mexican Family Life Survey to examine the health trajectories of indigenous Mexicans and assess if internal migration has an impact on indigenous health

E-mail address: gleonperez@vcu.edu.

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disparities. Most of what we know about the health of indigenous peoples is based on research from Australia, Canada, and the US. Indigenous populations make up 2.8% of the population in Australia (Australian Bureau of Statistics, 2017), 4.9% in Canada (Statistics Canada, 2016), and 1.7% in the US (Norris, Vine, and Hoeffel 2012). Comparatively, in Mexico there are 68 indigenous groups with over 12 million individuals comprising over 10% of the national population (CDI 2014). This makes Mexico the country with the largest indigenous population in the Western Hemisphere and an adequate case study.

The paper is organized as follows. First, I provide an overview of the determinants of indigenous health worldwide. Then, I focus on the specific case of indigenous Mexicans, describing the health disparities they experience and patterns of internal migration. Having reviewed the existing literature, I present my hypotheses, describe the data and methods, and compare the baseline characteristics of indigenous and non-indigenous survey participants. Next, I describe the results from linear growth curves assessing health disparities over time between indigenous and non-indigenous individuals and whether the relationship between indigenous status and health is moderated by internal migration. I conclude with a summary of findings and policy implications.

1.1. Determinants of indigenous health

Similar to other disadvantaged groups, indigenous health is impacted by low socioeconomic status, discrimination, poverty, and marginalization (Maxwell et al., 2015; Montenegro and Stephens 2006; Nettleton et al., 2007). However, indigenous communities tend to experience a greater burden of disease, disability, and death than other poor, marginalized groups (Gracey & King, 2009; Vallenggia & Snodgrass, 2015). What makes the experiences and health outcomes of indigenous populations different?

Prior scholarship suggests that the unique socio-historical experiences of indigenous peoples place additional burdens on their health. First, the legacy of colonialism still manifests itself both ideologically (i.e., in the belief that indigenous peoples are inferior) and structurally (i.e., through institutions such as the health care system that may not respect traditional health practices) (Cea Herrera 2004; Stephens, Porter, Willis, Clark, & Nettleton, 2005). Second, the loss of land and traditional subsistence patterns can be directly related to changes in diet and physical activity levels (Gracey & King, 2009). Along the same lines, loss of cultural practices and historical trauma may impact mental health across generations (Torres Stone et al., 2006; Whitbeck et al., 2004). Third, many indigenous peoples, particularly older generations and those living in remote areas, are monolingual in their native languages, which limits their access to health care services (Flood & Rohloff, 2018).

In addition, King et al. (2009) and Nettleton et al. (2007) suggest that migration is another social determinant of indigenous health. Specifically, the high prevalence of migration among indigenous populations may be a risk factor that negatively impacts their health. While indigenous peoples migrate looking to improve their living conditions, they are among the most vulnerable and marginalized migrants. Compared to their non-indigenous counterparts, indigenous migrants receive lower wages, occupy lower status jobs, are exposed to poorer living conditions, and experience discrimination in access to the labor market, housing, and health care (Gamlin & Hawkes, 2015; Holmes, 2006; Montenegro and Stephens 2006). Migration may also affect indigenous health through residential instability, stress, and loss of social networks and support (King et al., 2009; Nettleton et al., 2007). These negative conditions and experiences at the destination are potential risk factors that may lead to post-migration health deterioration.

1.2. The case of indigenous Mexicans

In Mexico, indigenous status is based on self-identification as a member of an Amerindian ethnic group and/or speaking an indigenous language (INEGI, 2010). Mexico is one of several countries that have revised their Constitutions to legally recognize indigenous peoples' right to self-determination and to preserve their cultural, linguistic, and territorial integrity (de la Peña, 2005; Vallenggia & Snodgrass, 2015). In spite of this political recognition, the indigenous population in Mexico has been historically disenfranchised and has consistently lagged in most social, economic, and health indicators.

Indigenous Mexicans face stark inequalities from birth to old age in morbidity and mortality relative to their non-indigenous counterparts. Indigenous communities are afflicted by communicable diseases, such as respiratory infections and gastrointestinal diseases, with prevalence rates that are in some cases double the national rates (Almaguer González, Vargas Vite, & García Ramírez, 2014; UNDP, 2010). Chronic malnutrition and stunting are endemic problems among indigenous children ages 0–5 (Almaguer González et al., 2014; Rivera et al., 2003). Additionally, indigenous populations have higher rates of mortality in all age groups, especially the most vulnerable. For example, infant and maternal mortality rates for some indigenous groups are two to eight times the national rates (Gamlin & Hawkes, 2015; Montenegro and Stephens 2006).

Recent studies have assessed changes in the health of indigenous Mexicans over the past twenty years. Similar to patterns observed among indigenous populations worldwide (Vallenggia & Snodgrass, 2015), prior longitudinal studies suggest that the health status of Mexican indigenous peoples has improved in recent years. For example, Servan-Mori, Torres-Pereda, Orozco, and Sosa-Rubí (2014) found that the prevalence of stunting in indigenous children decreased by 42% between 1988 and 2012 and the rate of infant mortality decreased by 34% between 2000 and 2010. Leyva-Flores et al. (2013) found that indigenous Mexicans' health insurance coverage through the program *Seguro Popular*¹ rose from 14% in 2006 to 62% in 2012, and that their use of hospital services for childbirth increased from 64% to 76% during the same period. Although these are important health achievements, they have not been enough to close the inequalities between the indigenous and non-indigenous populations; rather, health disparities still persist in stunting, infant mortality, health insurance coverage, and health care utilization (Leyva-Flores, Servan-Mori, Infante-Xibille, Pelcastre-Villafuerte, & Gonzalez, 2014; Servan-Mori et al., 2014).

1.3. Indigenous migration within Mexico

Migration is an important element—sometimes even a rite of passage—for many Mexican indigenous communities (Anguiano, 1993; Arizpe, 1976). Indigenous groups tend to live in underserved rural communities with the highest rates of poverty, illiteracy, and lack of potable water and public services (CDI 2014; UNDP, 2010). Poverty, subpar living conditions, loss of lands, social unrest, and changing economic landscapes motivate indigenous peoples to leave their communities, crossing municipal, state, and national boundaries in search of a better life.

While some indigenous groups have traditionally migrated to the US, indigenous Mexicans are more likely to migrate domestically and have historically constituted a substantial part of internal migration streams in Mexico (Arizpe, 1976; Davis, Stecklov, and Winters 2002). Indigenous migrants comprise the overwhelming majority of agricultural workers in Mexico (Anguiano, 1993; Juárez-Sánchez, 2015;

¹ The Mexican federal government established *Seguro Popular* in 2004. The goal of this universal health insurance program is to expand access to health care, particularly among the most vulnerable groups such as indigenous communities (Chemor Ruiz et al., 2018).

Zabin & Hughes, 1995). Interestingly, indigenous migrants sometimes fill the jobs that are left behind by farmworkers who emigrated to the US (Juárez-Sánchez, 2015). Agricultural migrant workers, in general, tend to work in precarious conditions and their subsistence is based on seasonal jobs (Anguiano, 1993; Juárez-Sánchez, 2015; Velasco-Ortiz, 2014). There are also important indigenous migration streams to urban destinations. When they move to urban centers, indigenous migrants tend to work as construction workers, domestic workers, or vendors in the informal sector (Anguiano, 1993; Pérez Ruiz, 2007; UNDP, 2010). Rural-to-urban migration often serves as a step prior to US migration, providing individuals with skills that are valuable in the US labor market. It is also a first step toward acculturation to an urban environment given that, for example, many indigenous migrants do not speak Spanish and do not know how to drive a car. Thus, a first internal migration, especially to northern border states, serves as a “school for *el Norte*” (Zabin & Hughes, 1995, p. 413).

Even though domestic migration is more prevalent than international migration among indigenous Mexicans, existing scholarship on the health of indigenous migrants has focused almost exclusively on US migration. This research provides insights into the relationship between migration and indigenous health. For instance, indigenous migration to the US is associated with a higher risk for sexually transmitted illnesses (Espinoza et al., 2014; Maier, 2007), increased alcohol and drug use (Pinedo et al., 2014, 2016), poor self-rated health (Holmes, 2006), and higher depressive symptoms (Salgado et al., 2014). These findings are based on cross-sectional research and, thus, it is not possible to establish if their health was directly and negatively impacted by migration or if they experienced poor health before migrating.

To my knowledge, most prior studies on the health of Mexican indigenous migrants are based on research collected at the destination or after they have returned to their origin community. While we do not know about indigenous peoples’ pre-migration health, individuals who migrate domestically from more deprived to less deprived areas (as is usually the case for indigenous migrants) tend to be healthier than non-migrants in the sending community (Norman, Boyle, and Rees 2005; Shackleton, Darlington-Pollock, Norman, Jackson, & Exeter, 2018). Research on indigenous residential mobility provides additional evidence of potential health selection. In a study of ethnic groups in New Zealand, Darlington-Pollock, Shackleton, Norman, Lee, and Exeter (2018) found that Māori movers had a lower risk of cardiovascular disease than their counterparts who remained in the original census block. This suggests that there may be a healthy migrant effect whereby indigenous migrants are selected based on certain traits, including better health (Jasso, Massey, Rosenzweig, & Smith, 2004; Palloni & Ewbank, 2004).

1.4. Current study

This study uses prospective data to investigate indigenous health disparities over time and examine whether the health of indigenous Mexicans varies by internal migration experience. First, I use baseline, pre-migration data to identify health selection effects among indigenous migrants. Then, I compare their pre- and post-migration health to examine if there were changes over time. I evaluate this in light of any changes experienced by non-migrant indigenous respondents during the same period, as well as changes experienced by their non-indigenous counterparts. Using non-migrants as a reference group enables an assessment of whether and how migration produces similar or diverging trajectories from those who stayed behind (Shackleton et al., 2018). In addition, it allows us to infer what the health status of migrants would be had they not left the origin (Ginsburg et al., 2016; Jasso et al., 2004). Moreover, comparing indigenous and non-indigenous individuals sheds light on whether migration contributes to indigenous health disparities. Drawing from previous research on internal migration and on indigenous health, I expect that:

Hypothesis 1. Indigenous respondents will have worse initial health than their non-indigenous counterparts.

Hypothesis 2. Indigenous migrants will have better initial health than indigenous non-migrants.

Hypothesis 3. Health trajectories will vary across groups based on indigenous and migration status, with indigenous migrants having the worst health over time.

2. Methods

2.1. Data

Data came from the Mexican Family Life Survey (MxFLS), a nationally representative longitudinal survey of the well-being of individuals and families in Mexico (Rubalcava & Teruel, 2006a). The MxFLS collected data on social, economic, and demographic indicators at three time points, as well as information on internal and international migration trips done between interview waves. The study used a probabilistic, stratified, and multi-staged cluster design and is representative at the national, regional, and urban-rural levels. The baseline survey (MxFLS-1) was conducted in 2002 and sampled over 8400 households in 150 urban and rural communities throughout Mexico (Rubalcava & Teruel, 2006a). Localities were randomly chosen from the regions identified in Mexico's National Development Plan 2000–2006. Households within these localities were sampled randomly. Within sampled households, all members ages 15 and older were included in the adult sample (a household member was defined as anyone who usually lives in the household, regardless of familial or blood relations). Approximately 19,800 adult interviews were conducted in the first wave of data collection. The second (MxFLS-2) and third (MxFLS-3) waves of the survey were fielded during 2005–2006 and 2009–2012 and achieved a 90 and 85 percent re-contact rate at the household level, respectively (Rubalcava & Teruel, 2006b, 2013).

The analytical sample includes data on 12,533 panel members. All analyses were restricted to individuals ages 15 to 50 given that internal migration was concentrated within this age range. In addition, individuals who were missing all migration history data (N = 2485) and those who migrated internationally between interviews (N = 581) were excluded from the sample.

2.2. Dependent variable

The dependent variable was self-rated health. Respondents were asked: “Currently, could you say that your health is very good, good, regular, poor, or very poor?” Responses were reverse coded such that higher scores indicate better health. An advantage of self-rated health is that, when measured over time, it is able to capture continuous and underlying changes in health that may occur before the emergence of a disease or a functional loss (Shaw & Krause, 2002). In addition, it can be especially useful when studying populations that do not have widespread access to health care services (Wong, Peláez, and Palloni 2005), as is the case of indigenous Mexicans. Prior studies confirm that this measure is positively associated with mobility, physical health, and emotional well-being among indigenous populations (Bombak & Bruce, 2012; Díaz et al., 2008; Herman, Solomons, Mendoza, & Qureshi, 2001).

2.3. Independent variables

The key independent variables were indigenous status and internal migration between interviews. The survey asked the following question to capture indigeneity: “Do you consider yourself part of an indigenous group?” Respondents were coded as 1 = indigenous if they answered yes. This operationalization is consistent with the criteria used by the

Mexican census to identify indigenous populations (INEGI, 2010). Internal migration captures whether respondents made any domestic migration trips that lasted more than a year at any time between the first and last interviews. To code for internal migration experience, I used the migration history data collected at each follow-up interview: “Since [year of last interview] have you moved for a year or longer outside of the locality/neighborhood where you used to live?” If they answered “yes”, respondents were then asked to list all the places where they lived, both within the country and internationally. Using this data, I created two dichotomous variables: internal migrants include respondents who relocated domestically at any time between interviews; non-migrants stayed in their communities of origin during the entire study period.

2.4. Control variables

Models controlled for personal characteristics, socioeconomic status, migration capital, and health care factors, all of which could be related to observed disparities in self-rated health. Personal characteristics include age, gender, marital status, and children in the household. Age captures life course position and was measured in years. Gender was coded as 1 = female and 0 = male. Marital status was coded as 1 = currently married or in a civil union and 0 = else. I also included a variable measuring the number of children ages 0–14 living in the household.

Socioeconomic status is an important predictor of both health (Preston and Taubman 1994) and internal migration (Quinn & Stephen, 2005). Educational attainment was drawn from the first interview and coded as 1 = middle school education or more and 0 = elementary school or no formal education. Employment status was coded as 1 = employed for pay and 0 = else.

Migration capital adjusts for out-migration selectivity and was measured with individual- and community-level indicators. Following other longitudinal studies of internal migration (e.g., Lu, 2010; Tong & Martin, 2012), I controlled for previous migration experience which is a dichotomous variable that captures whether an individual ever moved between age 12 and the time of the first interview. Because migration decisions are influenced by the place of origin (Davis, Guy, & Paul, 2002), I included variables capturing rural/urban community and state of origin. Following the definition used by the Mexican National Institute of Statistics and Geography, rural origin was coded as 1 = community of origin had a population of less than 2500 and 0 = else. Migrant sending state was coded as 1 if the respondent was from a state with high rates of domestic out-migration (as identified by Chávez Galindo (2001)).

Finally, models adjusted for variables that capture access to health care as this may contribute to health disparities. Health insurance was coded as 1 = had public or private health insurance and 0 = uninsured. Health care utilization was coded as 1 = visited a doctor, health care professional, hospital, or clinic in the four weeks prior to the interview and 0 = else.

2.5. Analytic strategy

First, I estimated baseline descriptive statistics and computed two-tailed t-tests and chi-square tests to assess significant differences between indigenous and non-indigenous respondents. Next, I computed a series of individual growth curves within a linear mixed model (i.e., multilevel) framework. Growth curves allow the modeling of within-person change and between-person differences in outcomes across various measurement waves (Singer & Willet, 2003). The goal was to assess if indigenous status was related to the initial level of self-rated health and to change in self-rated health over time (from the first to the last interview), and if internal migration between interviews moderated the relationship.

The outcome captured changes in self-rated health scores over time.

Analyses included a time measurement that captured changes in health since the initial assessment, with values of “0” for the first interview, “1” for the second interview, and “2” for the third interview. Therefore, the intercept represents the value of self-rated health at occasion 0 (baseline) and the linear slope represents the rate of change in self-rated health across occasions (Singer & Willet, 2003). Models allowed both the intercept and time trend to vary for individuals, therefore subjects were allowed to have starting points and rates of change that differed from the group (Hedeker & Gibbons, 2006; Singer & Willet, 2003).

Repeated measures can be considered as having a hierarchical structure in which observations are nested within individuals. Therefore, each subject is his or her own control. In the models presented here, the level-1 was organized around the observation and captured intra-individual patterns of change in self-rated health associated with the passage of time (Singer & Willet, 2003). The level-1 equation for individual i at occasion j is the following:

$$Y_{ij} = \pi_{0i} + \pi_{1i} \text{TIME}_{ij} + \varepsilon_{ij}$$

where π_{0i} represents the initial self-rated health for individual i at occasion j , π_{1i} represents the mean linear rate of change for individual i at occasion j , and ε_{ij} is an error term representing the deviation of individual i from the average level of self-rated health at occasion j .

The level-2 model was organized around the individual. It captured between-person differences in initial status and growth rate by adding random effects to the level-1 parameters for the intercept and the time variable (Hedeker & Gibbons, 2006). To assess whether initial health and the rate of change vary by indigenous status and internal migration experience, I included both variables as predictors of the intercept and the slope parameter. Further, I added an interaction between indigenous status and internal migration to the growth parameters to assess if the effect of indigenous status on initial health and on the rate of change varied by internal migration experience. The level-2 equations are the following:

$$\pi_{0i} = \gamma_{00} + \gamma_{01} \text{Indigenous}_i + \gamma_{02} \text{Migration}_{ij} + \gamma_{03} \text{Indigenous} * \text{Migration}_{ij} + \zeta_{0i}$$

$$\pi_{1i} = \gamma_{10} + \gamma_{11} \text{Indigenous}_i + \gamma_{12} \text{Migration}_{ij} + \gamma_{13} \text{Indigenous} * \text{Migration}_{ij} + \zeta_{1i}$$

where the initial level of self-rated health for individual i (π_{0i}) is the product of an intercept γ_{00} representing the population-level average of self-rated health, the main effects and interaction effects of indigenous status and internal migration (γ_{01} , γ_{02} , γ_{03}), and a random error term for the deviation of individual i from the average level of self-rated health (ζ_{0i}). The linear rate of change in self-rated health for individual i (π_{1i}) is the product of an intercept corresponding to the average rate of change (γ_{10}), parameters representing the indigenous status of individual i (γ_{11}), the migration status of individual i at occasion j (γ_{12}), an interaction effect between indigenous status and internal migration (γ_{13}), and a random error term for the deviation of individual i from the average rates of linear change (ζ_{1i}).

To test if personal characteristics, socioeconomic status, migration capital, and health care variables were related to initial health and to the rate of change in health, subsequent models introduced covariates to the growth parameters. Time-variant control variables include marital status, children living in the household, employment status, and health care variables. Remaining covariates are time-invariant and reflect the status characteristics of subjects. Appendix 1 provides a summary of how variables were coded.

An advantage of multilevel models is their robustness to missing or incomplete data across time (due to attrition or missing data only in some data points) because they are computed using any information available for each subject (Hedeker & Gibbons, 2006). Nevertheless, panel attrition is of concern as it may be related to observed disparities in health. Therefore, following prior longitudinal studies on racial/ethnic and health disparities (e.g., Gubernskaya, 2015; Warner and Brown 2011), models also adjusted for biases related to attrition and mortality by controlling for the number of waves a respondent

Table 1
Baseline descriptive statistics for complete sample and by indigenous status.

	Complete Sample (N = 12,533) ^a	Indigenous (N = 1500) ^a	Non-Indigenous (N = 11,033) ^a	Sig. ^b
Indigenous status	11.8% (0.4)	–	–	
Self-rated health (mean score)	3.5 (0.0)	3.4 (0.3)	3.6 (0.1)	***
Good or very good	53.3% (0.8)	42.7% (2.0)	54.8% (0.8)	***
Regular	43.6% (0.8)	52.3% (2.1)	42.4% (0.8)	***
Poor or very poor	3.1% (0.3)	5.0% (1.1)	2.8% (0.2)	*
Internal migration between interviews	11.6% (0.5)	8.0% (1.1)	12.1% (0.5)	**
<i>Personal characteristics</i>				
Female	55.9% (0.8)	53.3% (2.1)	56.3% (0.8)	
Age (mean years)	31.5 (0.2)	32.8 (0.4)	31.3 (0.2)	**
Married	64.6% (0.7)	69.4% (1.9)	64.0% (0.8)	*
Children in household (mean number)	1.6 (0.0)	2.0 (0.1)	1.6 (0.0)	***
<i>Socioeconomic status</i>				
Secondary education or more	59.4% (0.7)	40.6% (2.0)	61.9% (0.8)	***
Employed	59.9% (0.8)	57.3% (2.1)	60.2% (0.8)	
<i>Migration capital</i>				
Prior internal migration experience	24.7% (0.7)	22.4% (1.9)	25.0% (0.7)	
Rural origin	25.3% (0.5)	52.3% (2.1)	21.7% (0.5)	***
Migrant sending state	40.0% (0.8)	55.9% (2.0)	37.9% (0.8)	***
<i>Health care access and utilization</i>				
Health care utilization	16.9% (0.6)	15.7% (1.4)	16.9% (0.6)	
Health insurance status	43.6% (0.8)	28.1% (1.8)	45.7% (0.8)	***

Note: Percentages and mean scores presented, standard errors in parentheses.

a. Unweighted sample sizes.

b. Asterisks indicate significant differences between the indigenous and non-indigenous samples, where *p < 0.05, **p < 0.01, and ***p < 0.001.

completed and whether the respondent died during the observation period. Analyses were weighted to take into account unequal probabilities of selection and household non-response.

3. Results

3.1. Characteristics of the sample

Table 1 presents baseline descriptive statistics for the complete sample and for the indigenous and non-indigenous subsamples. Twelve percent of respondents self-identified as members of an indigenous group. Indigenous respondents reported slightly worse initial health than their non-indigenous counterparts. Almost 12% of the sample migrated internally between interviews. The proportion of indigenous migrants was smaller than that of non-indigenous migrants (8% vs. 12%, respectively).

Over half of both subsamples were female. The indigenous sample was slightly older, had a larger proportion of married individuals, more children living in the household, and substantially lower educational attainment. Almost 60% of both groups were employed and about a quarter had prior internal migration experience. Over half of indigenous respondents were from rural communities and from states with high rates of domestic out-migration. Approximately 16% of both groups visited a doctor in the four weeks before the interview, but less than a third of the indigenous sample had health insurance compared to almost half of the non-indigenous sample.

3.2. Indigenous and non-indigenous health trajectories

Table 2 presents the results from linear growth curves modeling self-rated health trajectories across interview waves. Following the equations presented earlier, each model includes coefficients predicting initial levels of self-rated health (i.e., the intercept) and change in self-rated health over time (i.e., the linear slope).

Model 1 examines the independent effects of indigenous status and internal migration on self-rated health trajectories across the study period, net of the effects of all covariates. We begin by describing Panel A, which includes the effects of the independent and control variables

on initial or baseline self-rated health (i.e., at the time of the first interview). As expected in Hypothesis 1, the coefficient for indigenous status is significant and negative, indicating that indigenous respondents reported worse initial health than non-indigenous respondents. Internal migrants did not differ significantly from non-migrants in baseline health. Consistent with findings in the health literature, women and older individuals had worse initial health than men and younger individuals. Initial self-rated health decreased for every additional child living in the household. Having higher levels of education was associated with better initial health, but employment status was not a significant predictor. Although prior migration experience was not related to initial health, the community-level migration capital variables were significant predictors: those from rural origin communities and from migrant sending states reported worse baseline health than their counterparts from urban communities and from states with lower levels of emigration. Visiting a doctor prior to the interview was related to worse initial health, while having health insurance was related to better initial health.

Next, Panel B in Model 1 (Table 2) shows results from the growth parameters predicting changes in health. The significant and positive coefficient for the linear slope indicates that, on average, there was a positive change in self-rated health over time across the sample. Interestingly, the self-rated health of indigenous respondents improved more than that of their non-indigenous counterparts, as indicated by the significant and positive coefficient. Internal migration between interviews did not have an impact on the rate of change. Of the covariates, being female, older, married, and having health insurance were significantly related to worse health over time.

3.3. The impact of internal migration on indigenous health

Model 2 in Table 2 includes an interaction term between indigenous status and internal migration. The interaction is a significant predictor of both the intercept and the slope, which suggests that internal migration does shape indigenous health trajectories. To facilitate interpretation of the interaction effects, Fig. 1 presents self-rated health trajectories by indigenous and migration status calculated using the coefficients from Model 2. At the first interview (before migration),

Table 2
Linear growth curves modeling association between internal migration and self-rated health across three waves, 2000–2012.

	Model 1		Model 2	
	B	SE	B	SE
Fixed Effects				
A. Intercept				
Indigenous status	3.851***	0.028	3.850***	0.028
Indigenous status	-0.038*	0.018	-0.044*	0.018
Internal migration	-0.059	0.052	-0.162**	0.057
Indigenous × Internal migration	-	-	1.131***	0.180
Female	-0.084***	0.012	-0.084***	0.012
Age	-0.008***	0.001	-0.008***	0.001
Married	-0.012	0.013	-0.012	0.013
Children living in household	-0.009*	0.004	-0.009*	0.004
Secondary education or higher	0.189***	0.013	0.189***	0.013
Employed	0.008	0.012	0.0075	0.012
Prior migration experience	-0.002	0.014	-0.003	0.014
Rural origin	-0.088***	0.013	-0.088***	0.013
Migrant sending state	-0.064***	0.012	-0.064***	0.012
Health care utilization	-0.197***	0.014	-0.197***	0.014
Health insurance status	0.066***	0.011	0.066***	0.011
B. Linear slope				
Indigenous status	0.164***	0.036	0.164***	0.036
Indigenous status	0.042**	0.013	0.045**	0.013
Internal migration	-0.011	0.031	0.072*	0.030
Indigenous × Internal migration	-	-	-0.597***	0.100
Female	-0.019*	0.009	-0.019*	0.009
Age	-0.002***	0.000	-0.002***	0.000
Married	-0.018**	0.010	-0.017	0.010
Children living in household	0.006	0.003	0.005	0.003
Secondary education or higher	0.004	0.010	0.004	0.009
Employed	-0.007	0.010	-0.006	0.009
Prior migration experience	-0.003	0.010	-0.004	0.010
Rural origin	0.001	0.009	0.001	0.009
Migrant sending state	0.006	0.008	0.006	0.008
Health care utilization	-0.004	0.012	-0.005	0.012
Health insurance status	-0.038***	0.010	-0.038***	0.009
Panel attrition controls				
Number of waves completed	-0.007	0.010	-0.007	0.010
Died during study period	-0.001	2.560	-0.001	2.560
Random Effects				
Level 1 residual	0.212***	0.002	0.210***	0.002
Level 2 intercept	0.113***	0.003	0.113***	0.003
Level 2 slope	0.049***	0.002	0.049***	0.002
-2 log likelihood	103,818.0		103,778.4	

Unweighted $N = 12,533$ individuals; 33,410 observations. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Notes: Fixed effects coefficients capture *within-person* change over time: panel A includes parameters predicting initial levels of self-rated health (i.e., the intercept); panel B includes growth parameters predicting changes in health (i.e., the slope). Random effects coefficients capture *between-person* differences in outcomes.

indigenous migrants reported substantially better self-rated health than all non-indigenous respondents and than indigenous non-migrants, thus providing support for [Hypothesis 2](#). There is no evidence of positive health selection among non-indigenous migrants—in fact, they reported worse initial health than their non-migrant counterparts.

Over time, there was a consistent improvement in self-rated health among indigenous non-migrants and the non-indigenous population, but especially among indigenous non-migrants such that by the time of the last interview they reported slightly better health than their non-indigenous counterparts. In contrast, indigenous migrants experienced a steep decline in health and by the time of the last interview they reported substantially worse health than all other groups. These findings provide support for [Hypothesis 3](#), which expected health trajectories to vary by indigenous and migration status and that indigenous migrants would have the worst health over time. In sum, results indicate that internal migration is a risk factor that has an independent effect on Mexican indigenous health even after adjusting for personal, family, socioeconomic, and health care factors.

4. Discussion

This study used longitudinal data from the MxFLS to examine the health trajectories of indigenous and non-indigenous Mexicans and to investigate if migrating domestically shapes indigenous health. Overall, results from linear growth curves revealed that the self-rated health of indigenous peoples varied significantly based on internal migration experience.

Indigenous respondents as a whole reported worse initial self-rated health than their non-indigenous counterparts. In Mexico, indigenous background is related to poorer morbidity and mortality outcomes ([Gamlin & Hawkes, 2015](#); [Montenegro and Stephens 2006](#); [UNDP, 2010](#)). Therefore, indigenous respondents' poor perception of their health is consistent with poor health outcomes (relative to non-indigenous peoples) and with research on indigenous populations in the US, Canada, Australia, and New Zealand ([Bombak & Bruce, 2012](#)). However, disaggregation of the data revealed different health patterns among indigenous respondents depending on migration experience. Consistent with the healthy migrant hypothesis, indigenous migrants reported significantly better initial health than non-migrants. Notably, the initial health of indigenous migrants was better than that of non-indigenous migrants. A possible reason could be the types of jobs held by internal migrants. Indigenous migrants tend to work in physically intensive occupations, such as agriculture and construction, that require good health ([Anguiano, 1993](#); [Velasco-Ortiz, 2014](#); [Zabin & Hughes, 1995](#)), whereas non-indigenous migrants are employed primarily in the trade, service, and manufacturing sectors ([Pérez-Campuzano & Santos-Cerquera, 2013](#)).

Despite their better initial health, indigenous migrants experienced health deterioration after migration and, by the time of the last interview, reported worse health than their non-migrant counterparts. Migration did not impact the health of non-indigenous migrants; rather, their health improved and followed a similar (positive) trajectory to that of non-migrants. These findings highlight the importance of disaggregated analyses. Migrants are not a homogenous group and distinct patterns emerge when the experiences of vulnerable and under-represented migrants are acknowledged. [Fig. 2](#) graphically summarizes the findings on the relationship between indigenous health and internal migration.

Prior research sheds light on why indigenous health might worsen after migration. Some potential explanations include the physical demands of their occupations and poor working conditions ([Gamlin & Hawkes, 2015](#); [Juárez-Sánchez, 2015](#); [Melesio Nolasco, 2006](#)), poverty and marginalization ([Holmes, 2006](#); [Pérez Ruiz, 2007](#)), changing diets and food insecurity ([Maxwell et al., 2015](#)), increased substance use ([Pinedo et al., 2014, 2016](#)), and discrimination ([Pérez Ruiz, 2007](#); [Salgado et al., 2014](#)). Health deterioration could also be related to the characteristics of the destination community, such as the levels of urbanization and deprivation ([Darlington-Pollock et al., 2016, 2018](#)). The extent to which these conjectures are true warrants further investigation.

An unexpected finding was that the self-rated health of indigenous non-migrants improved slightly more than that of their non-indigenous counterparts. Prior studies that found improvements in Mexican indigenous health examined almost the same period (e.g., [Leyva-Flores et al., 2013](#); [Servan-Mori et al., 2014](#)), so findings presented here provide additional evidence that indigenous health disparities in Mexico have narrowed in recent years. This improvement could be related to increased access to health care through the universal health insurance program *Seguro Popular* and a subsequent reduction in the health insurance gap ([Chemor Ruiz, Ratsch, & AlamillaMartínez, 2018](#); [Leyva-Flores et al., 2013, 2014](#)). To illustrate, in this study, health insurance coverage increased from 28% in 2002 to 49% in 2012 among indigenous respondents, and from 46% to 60% among non-indigenous respondents. More research is needed to assess the effect of *Seguro Popular* on indigenous health and whether the narrowing of the health

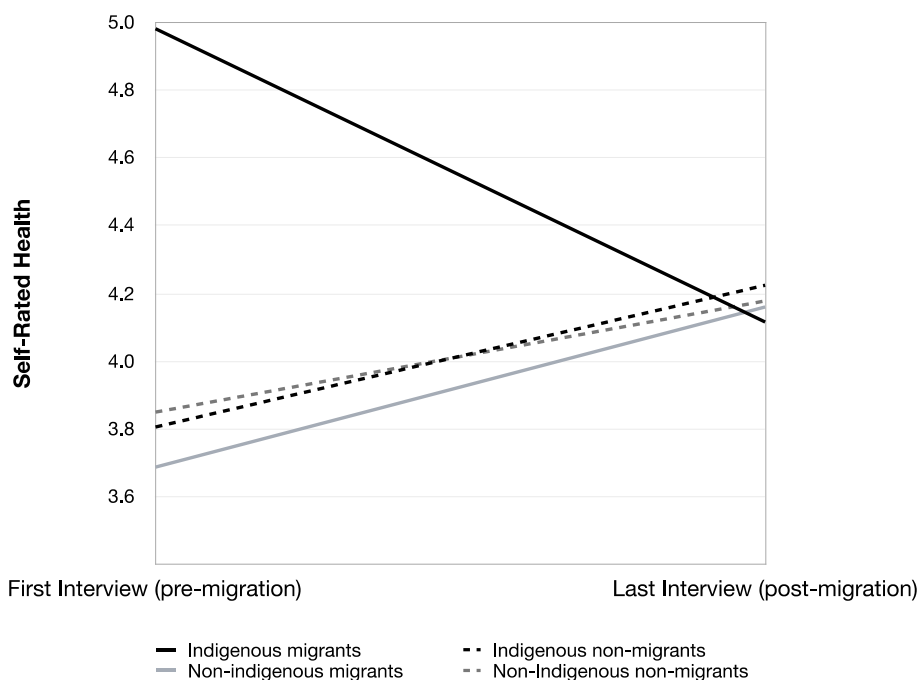


Fig. 1. Self-rated health trajectories by indigenous and migration status.

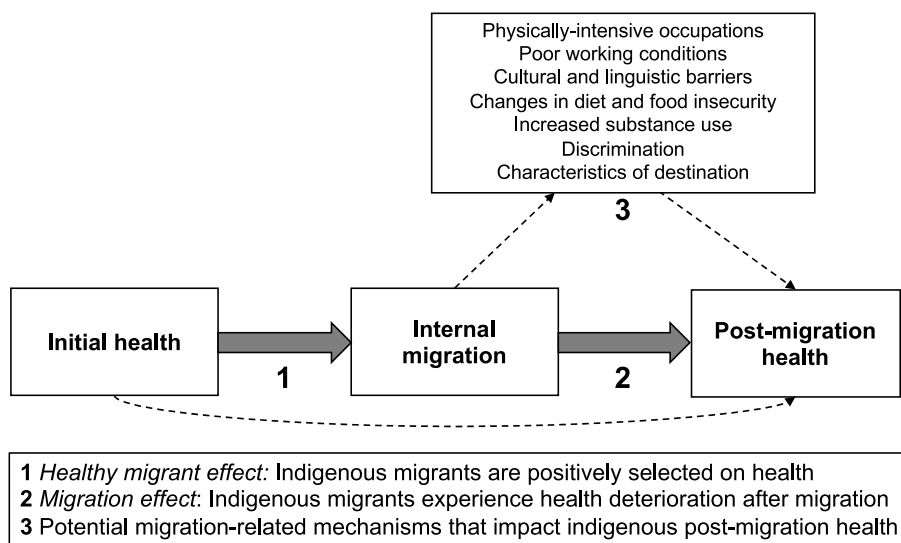
insurance gap has fostered a reduction in health disparities. Future studies should also explore whether remittances to the origin community contribute to health improvements among indigenous non-migrants. The economies of many indigenous communities are sustained in part by remittances sent from the US and from other parts of Mexico. Indigenous families that receive remittances may experience improved standards of living, increased utilization of health services, and, consequently, better health (Lu, Hu, & Treiman, 2012).

There are several limitations to this research. First, results may not apply equally across indigenous groups. Mexico has 68 indigenous groups who live across a range of social and economic contexts. There are also language variations: some only speak Spanish and do not speak their indigenous language, others are bilingual, and others do not speak Spanish at all (CDI 2014). Spanish-speaking ability and proficiency may influence health as those who do not speak Spanish experience additional barriers in accessing health care services and discrimination in health care settings (Flood & Rohloff, 2018). Future studies should

compare indigenous individuals by ethnic group and language spoken and examine if there are different outcomes.

Another limitation is that findings may not be generalizable to all indigenous populations. Indigenous groups around the world are not only very diverse, but also live in extremely different local environments and national contexts (de la Peña, 2005). Despite their poor health outcomes and marginalization, indigenous peoples in Mexico have political recognition and have been afforded some linguistic, cultural, and territorial rights. Thus, their experiences and outcomes will differ from those of indigenous peoples in other countries who have little or no recognition from their governments and/or who experience active suppression of their political aspirations and cultures (Kirmayer & Brass, 2016). More research is needed on the effects of migration on the health of indigenous groups across different social and political contexts.

Findings about the impact of migration on indigenous health have policy implications. For example, public health policies in Mexico



1 Healthy migrant effect: Indigenous migrants are positively selected on health
 2 Migration effect: Indigenous migrants experience health deterioration after migration
 3 Potential migration-related mechanisms that impact indigenous post-migration health

should take into account the high mobility of indigenous populations and the consequences of migration on their health. Prevention programs could focus on reducing health risks at the origin community, with special attention to residents who have intentions to migrate in order to mitigate the potential negative health risks of migration (Ginsburg et al. 2016). Investments in indigenous communities could improve overall health, reduce health disparities, and potentially diminish the need to migrate. In addition, gathering information about the health of indigenous migrants at their destination may help inform policies to address health risks upon arrival and prevent rapid health deterioration.

To my knowledge, this is the first longitudinal study to investigate the healthy migrant hypothesis among indigenous migrants and the impact of migration on indigenous health trajectories. While this research focused on indigenous Mexicans, it fits within a larger global conversation about indigenous populations. Migration plays an important part in the lives of indigenous groups, yet our understanding of the effects of migration on indigenous health is limited. This research sheds light on the migration-indigenous health relationship by comparing pre- and post-migration self-rated health and its impact on indigenous health disparities. Using prospective data, I uncovered evidence of positive health selection and post-migration health deterioration among indigenous migrants, thus finding support for the argument that migration is a social determinant of indigenous health (King et al., 2009; Nettleton et al., 2007). Specifically, internal

migration is a risk factor that has an independent effect on indigenous health even after adjusting for personal, family, socioeconomic, and health care factors.

Declarations of interest

None.

Ethics statement

Ethics approval was not required for this research given that I used de-identified, publicly available data. As per the Institutional Review Board at my institution, approval is not needed when “data are obtained by the investigator in a completely anonymous state when the investigator will have no access to the ability to re-identify individuals.”

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Appendix 1. . Coding of Variables Used in the Analyses

Variable	Coding	Time-Variant*
<i>Key Variables of Interest</i>		
Indigenous	1 = self-identified as member of an indigenous group, 0 = otherwise	No
Self-rated health	Ranges from 1 = very bad to 5 = very good	Yes
Migration status	1 = internal migrant; 0 = non-migrant	Yes
<i>Personal Characteristics</i>		
Female	1 = female; 0 = male	No
Age	Years	Yes
Married	1 = married or in a civil union; 0 = otherwise	Yes
Children in household	Number of children ages 0-14 living in the household	Yes
<i>Socioeconomic status</i>		
Education	1 = secondary education or more; 0 = otherwise	No
Employed	1 = employed for pay; 0 = otherwise	Yes
<i>Migration capital</i>		
Prior migration experience	1 = migrated internally at any time between age 12 and first interview; 0 = otherwise	No
Rural origin	1 = origin community with 2,500 inhabitants or less; 0 = otherwise	No
Migrant sending state	1 = high internal migration sending state; 0 = otherwise	No
<i>Health care access and utilization</i>		
Doctor visit	1 = visited doctor, health care provider, hospital, or clinic in last 4 weeks; 0 = otherwise	Yes
Health insurance	1 = had public or private health insurance; 0 = uninsured	Yes

*Yes = Time-variant variable in growth curve models; No = Time-invariant variable in growth curve models (measured at the first interview).

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