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The effect of age at migration on cardiovascular mortality among elderly Mexican immigrants

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Abstract

Purpose—This study evaluated the influence of age at migration on cardiovascular mortality among older Mexican Americans immigrants.

Methods—A population-based cohort of Mexican-origin (N=907) participants aged 60+ was followed up to 8 years. The association between migration before age 20 compared to after age 20 and mortality was analyzed using multivariate Cox proportional models.

Results—Compared to those who migrated later, those who migrated before age 20 had higher incomes and education, were more likely to speak English, were culturally more Anglo, and more likely to be male. Immigration before age 20 was associated with higher rates of cardiovascular mortality (HR=2.39 95%CI [1.16,4.94]) compared to those migrating at older ages, even after adjustment for age, sex, education, income and baseline cardiovascular health. No age at migration differences were observed for non-cardiovascular deaths.

Conclusions—Mexican Americans who migrated in early life experienced higher cardiovascular disease death rates than later migrants. Early experiences related to migration may have consequences for late-life disease that are not mitigated by the higher socioeconomic status achieved by early migrants. Health or economic selection related to migration may play a role although accounting for health and socioeconomic status actually increased differences between early and later migrants.

Keywords

Migration; Mexican; elderly; cardiovascular mortality

INTRODUCTION

The continuously rising flow of international migration has made the topic of health and migration increasingly important worldwide (1). In the US, forty percent of Hispanics are foreign-born and 65% of those are of Mexican origin (2). Adverse socioeconomic

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circumstances, limited upward mobility (3) and higher exposures to occupational hazards characterize the Mexican immigrant population. The majority of epidemiological research on immigration and health has been concern with assessing the degree to which specific health behaviors such as smoking (4–6) and higher fat diets (7) account for morbidity and mortality patterns (8).

However, the effects of immigration on health among the elderly should also be evaluated from a life-course perspective (9); duration since migration can been seen as a marker of cumulative exposure to new social, cultural and physical environment. The effects of selection on migrant health may also diminish over time and the current environment may exert comparatively more influence on health.

Reasons for migration differ by life stage (10); for example, late-life immigrants often do so to rejoin their families (11,12) but health status may influence this decision either by increasing the likelihood (so families can care for ill parents) or decreasing it (the person is too ill to move). Those who migrate in middle life are most likely to be motivated by economic conditions. Those who migrate during their childhood or adolescence generally have less choice and accompany their families who may migrate seeking better economic circumstances. All immigrants face socioeconomic and cultural challenges, including differences in cultural norms and learning a new language. Those migrating earlier may have greater opportunities for education and, therefore, a higher income as adults than older migrants. In the process of education, they are more likely to become more acculturated and learn English. However, at least initially, most immigrants from Mexico experience poverty, discrimination and hazardous work. Even if they experience later socioeconomic improvements, the economic and social disadvantages that they encounter at an early age might be detrimental to their health later in life. Several studies have linked early deprivation to late life disease and shown that migration plays a role as a lifecourse risk factor (13–17). Adaptation to a new cultural environment may occur more rapidly and readily at younger ages, and the effects of selection on late life disease could diminish over time. In short, early migration may reflect exposure to a major change in a vulnerable stage of life and longer cumulative exposure with diminishing effects of selection. Late life migration may be more subject to recent selection and related to less cultural change. We hypothesized that those who migrated at an earlier age will have higher cardiovascular mortality rates than later migrants that would not be accounted for by socioeconomic factors.

METHODS

Sacramento Area Latino Study on Aging (SALSA) study design and population

SALSA is a longitudinal study designed to study health status, especially mortality, cognitive decline and dementia in older people of Mexican origin living in the US (18). Study participants were residents of the Sacramento Metropolitan Statistical Area. An eligible person was aged 60 or older in 1998 and self-designated as Latino. The first stage of the sampling involved identifying Census tracts in five contiguous counties and characterizing them by the percentage of eligible residents. These tracts were ranked in order of percentage eligible, and all tracts in which the percentage eligible was at least 5% were selected for the target population. A total of 1,789 participants were enrolled in the study. Fifty-one percent (n=907) reported being born in Mexico (95%). We limited our analysis to immigrants with complete information on age at migration.

Age at Migration

Age at migration was calculated by subtracting the age of the participant at study baseline from the number of years the participant reported being in the US. Participants were divided into three lifecourse stages: respondents who arrived in the US during their childhood or

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adolescence (prior to age 20), those who arrived between ages 20–49 and those who arrived at or after age 50. An identical analytical approach has been used previously (19).

Mortality Ascertainment and Cardiovascular Mortality

Mortality ascertainment included online obituary surveillance, family telephone interviews, search of the California vital records and the National Death Index. During 8 years of follow-up, 158 participants died. Death certificates were obtained for 87.0% (n=137) of the deceased. Death certificates for 15.3% were not found. Of those known to be deceased but lacking death certificates, 42.9% (n=9) died in Mexico or another Latin American country.

Causes of death were abstracted from the death certificates and coded according to the 10th revision of the International Classification of Diseases and defined as a cause with a mention anywhere on the death certificate. There were 90 cardiovascular deaths; nine (9) of them were excluded due to missing values on age at migration. Codes for acute rheumatic fever, chronic rheumatic heart disease (I00–I09.9); hypertensive heart and renal diseases (I11,I13.9); ischemic heart disease, pulmonary heart disease, other cardiovascular diseases (I20–I51.9) and stroke (I60,I69.9) were recorded as cardiovascular death.

Other Covariates

Measures of socioeconomic status included education, self-reported household gross income, sources of entitlement income, home ownership and lifetime occupation. The distribution of years of education was strongly skewed toward lower values, so education was dichotomized using the median value of years of education (±4 years). Income was categorized a dichotomous variable (1) <$1,500 or (2) ≥$1,500. Sources of income from pensions and social security were also dichotomized. Occupation was combined in four groups: 1) managerial, professional, technical, or administrative 2) sales, clerical service 3) craftsman, machine operators, farm workers and 4) homemakers (20). Hispanic neighborhood composition was categorized as those who answered that at least 50% in their neighborhood were Latino. Living arrangements were measured as the total number of family members living in the household. Cultural orientation was derived from the Acculturation Rating Scale for Mexican Americans (ARSMA-II) in which higher acculturation scores indicates greater adherence to the Anglo culture (21).

Medical history—History of cardiovascular disease at baseline was defined by a composite measure of self-reported physician diagnoses of coronary heart disease, stroke or congestive heart failure. Subjects were hypertensive if they had systolic blood pressure equal to or greater than 140mmHg and diastolic blood pressure equal to or greater than 90mmHg or were taking antihypertensive medications. Participants were diabetic if they had fasting glucose ≥126 mg/dL or were taking diabetes medications at baseline or reported that a physician had diagnosed them with diabetes. *Lifestyle factors.* Smoking status was defined as current, former or never smoker. Body Mass Index (BMI) was calculated as weight in kg/height in meters squared.

Statistical Analysis

Differences in participant characteristics by age at migration were compared by using chi-square tests for categorical variables and analysis of variance for continuous variables. Death rates were age-adjusted to the year 2000 US standard population (22).

Survival time was calculated as the time from enrollment into the study until date of death or last contact (through March 1, 2006). For those lost to follow-up or refused and not known to be dead, the last date of contact was used in these calculations.

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Variables found in the bivariate analysis to be significantly associated with age at migration and those suggested in the literature to be related with cardiovascular mortality were considered for inclusion in the Cox proportional hazards model. Evaluation for potential confounding variables was further examined as follows: (1) association between the predictor and cardiovascular mortality and (2) the confounder was added to the model with age at migration indicators variables. If addition of the covariate changed the coefficient of age at migration indicator variables by more than 10% the covariate was included in further analyses.

Age at migration was included in proportional hazards models as 2 indicator variables (<20 years, 20–49 years), for which age 50+ was the reference category. For the multivariate analysis, a series of four sequential models was used; in which Model 1 evaluate the effect of age at migration without taking into account other variables in the model. Model 2 includes age at migration indicator variables and demographics (age and sex). Model 3 includes those variables that were included in model 2 in addition to education and income. Finally, Model 4 takes into account all the variables included in model 3 plus chronic diseases at baseline, which were independent predictors of CVD mortality (cardiovascular disease, diabetes and hypertension). For each of the models, the significance of the effect of age at migration in predicting mortality was further evaluated with the calculation of the likelihood ratio test (LRT). LRT was estimated by using the difference between the −2 log likelihood ratio comparing 2 models, one that included all covariates and a second model, which included all covariates, except age at migration. Deaths attributable to non-cardiovascular causes were treated as censored at the time of death. The assumption of proportionality was evaluated graphically for age at migration as the main exposure variable and met model assumptions.

RESULTS

Demographic and baseline characteristics

Table 1 compares baseline characteristics of the cohort by age at migration. Compared to later migrants, those who immigrated early in life were more likely to be male and were younger. Early migrants had more education, income sources and higher income than later migrants. They were less likely to be living with family members and a lower proportion reported living in a Latino neighborhood than later migrants. All of the participants (100%) who migrated after age 50 reported to be Spanish speakers and more likely to be culturally more Mexican. There were no significant differences in smoking status or obesity by age at migration. Baseline prevalence of cardiovascular disease was significantly higher in the earlier migration group. No differences were observed for diabetes and hypertension by age at migration.

Age at Migration and Cardiovascular Mortality

There were 158 deaths among the 789 participants of which 52.6% was attributable to cardiovascular disease. Those who migrated in the first two decades of life had the highest age-adjusted cardiovascular mortality rate (26.5 per 1,000 person-years, n=25), followed by middle life migrants (23.5 per 1,000, n=44) and by oldest migrants (12.33 per 1,000, n=12).

Covariates and cardiovascular mortality

Table 2 shows associations of each covariate with cardiovascular mortality unadjusted and adjusted for age at migration in order to test each of these as a potential confounder. Older age, male gender and lower education were significantly associated with higher risk of CVD mortality. Baseline CVD, diabetes and hypertension were also associated with higher risk of CVD mortality. Cultural orientation, income, income sources, health insurance, home ownership, number of family members, percent Latino in neighborhood, BMI, and current smoking were not associated. Adjustment for age at migration had no important effects on any of these associations.

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Table 3 presents the results of Cox proportional hazards analyses predicting cardiovascular mortality by age at migration groups. In the unadjusted model, earlier age at migration was associated with a nearly two fold increased risk of cardiovascular mortality compared to migration after age 50. Compared to those migrating after age 50, immigration before age 20 was associated with more than twice the rate of cardiovascular mortality (model 2) after taking into account age and sex. This association increased to nearly threefold, after adjustment for education and income (model 3). In the final model which included all covariates, the magnitude of the association of age at migration (<20 years) with cardiovascular mortality was attenuated by 20% compared to model 3 but remained statistically significant. No age at migration differences were observed for non-cardiovascular deaths (data not shown).

CONCLUSIONS

This study highlights the complex relationship between migration, socioeconomic position and cardiovascular mortality in a cohort of largely Mexican-origin elderly. Migration in childhood or adolescence was associated with better socioeconomic conditions than migration after age 50. Despite this, early age at migration was significantly associated with a higher rate of CVD mortality compared to migration in midlife and older ages, even after taking into account socioeconomic position and baseline health. Although late-life immigrants may experience greater health selection than early migrants, adjustment for chronic diseases at baseline found that these did not influence the association between age at migration and mortality. Late life migrants were predominantly less educated women who were more culturally Mexican and more likely to be living with their family. Once we accounted for the confounding effects of gender, education and income, the early migrant group still had poorer mortality outcomes than the late life migrant group. There were no significant differences between the early or late group compared to the middle-aged migrant group. However, the hazard ratio fell midway between these two groups, giving an indication of a trend in risk by age at migration.

Although there is no other study that has evaluated the effect of age at migration on cardiovascular mortality among elderly Mexican-origin immigrants, a study performed in Asia points out similar results. In this study, the authors reported that people who migrated from mainland China to Hong Kong during childhood or adolescence had an increased risk of diabetes and ischemic heart disease as compared to those who were born in Hong Kong (13). From these results, the authors inferred that there may be life-stage-specific vulnerabilities to environmental change that might be detrimental for cardiovascular health later in life. Research comparing Japanese migrants suggests the role of the environmental factors in chronic disease etiology (6). Other studies have documented that earlier immigrants are more obese, have higher levels of cholesterol, were less physically active and smoked more cigarettes than those with less duration of residence (23,4). This relationship has been shown in Japanese Americans (6), Mexican Americans (24,25), Asians (26) and in studies performed in Sweden (27). Evidence for a differential adoption of high-risk behaviors among early migrants is not supported by this study. Risk factors often change with age (28,29), due to selection and to behavioral modifications adopted by older people and their effects on health outcomes may be diminished (30).

The observation that those who migrated earlier in life have higher income and education than later migrants is likely to be a consequence of their longer duration of residence in the US. Earlier migration is associated with a greater opportunity for higher education that leads to the accumulation of material benefits such as social security and other retirement benefits. It may seem paradoxical that early migrants face higher mortality risks although they have higher socioeconomic status that should be protective against mortality. However, this finding implies that, although migration may improve socioeconomic conditions, in the long run, cumulative exposure to residence in the US appears to contribute to increasing risk of cardiovascular

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mortality. It also indicates that improved socioeconomic status may not overcome the long-term effects of early deprivation on late life chronic disease.

Those who migrate early might also face higher levels of psychosocial stressors and chronic strains that they have to overcome in order to succeed in a higher income economy. These stressors might include moving from a rural to urban environment (31), discrimination (32), the need to master a new language and social customs during early years. The fact that a higher proportion of later age migrants are female and had an extended number of family members in the household, might suggest that this group migrated later in life to the US to care for their grandchildren or other family members. As other studies point out (10,33) those who immigrated later were more likely to be living with their children and to be receiving money from them. Extended family living arrangements are clearly one way in which those that migrate late in life can cope not only with the emotional stresses of migration, but also with economic hardship and costly living in the US.

The study sample was fairly representative of the eligible target population when comparing the SALSA study and California census data (Mexican-born, age 60+) for indicators such as sex, education, and age at migration (34). The prevalence of diabetes was similar to that published in NHANES-II (35) -- 32% vs. 25% for Mexican Americans aged 60+. The prevalence of hypertension in our sample (52% overall) was slightly lower than reported for NHANES-II for older Mexican Americans (68%) (36).

There are some limitations which should be considered in this study. Thirteen percent of the sample had missing values on age at migration and could not be included. However, further analysis showed that those individuals who were excluded did not differ significantly on demographic factors such as age, sex and years of education ($p \geq 0.05$) when compared with subjects included in our analyses. Return migration and differential loss to follow-up could also lead to under-estimation of the relationship between age at migration and mortality. If migrants who return to their country of origin -particularly those who immigrated after 50 years of age -are those who are less healthy, the observed death rates may be lower merely by the process of selection (37), which, in turn, can result in overestimation of the rate of death in those that migrate before 20 years. In this study, however, no significant differences were observed after comparing active and lost to follow-up/refusal participants within age at migration strata ($p=0.13$); thus lost to follow-up is probably not a major threat to validity. Is important to mention that the number of CVD deaths within each age at migration strata was relatively small, resulting in wider confidence limits. Finally, we cannot exclude the possibility of residual confounding as might occur due to unmeasured covariates (e.g. physical activity).

In this study, we documented that, among Mexican-origin migrants, early migration may have lasting consequences for risk of cardiovascular mortality later in life. Our evidence suggests that improved economic circumstances gained by migration do not mitigate the effects of early experiences related to migration. There is little question that early life experiences influence health and survival across the life span. Migration at any age can be a profound change; at younger ages it may result in lasting effects on cardiovascular health.

Acknowledgements

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List of Abbreviations and Acronyms

SALSA
: Sacramento Area Latino Study on Aging

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CI
: Confidence Intervals

LRT
: Log Likelihood Test

ARSMA-II
: Acculturation Rating Scale for Mexican Americans

NHANES-II
: National Health and Nutrition Examination Survey

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Table 1

Descriptive means or percents of the study population stratified by age at migration in the US, the Sacramento Area Latino Study on Aging (N=789).

	Age at Migration		
Covariates	**<20 years (n=164)**	**20–49 years (n=456)**	**50 years and older (n=169)**
Duration of US residence(mean± std)**	62.21 (12.32)	38.39 (10.70)	12.24 (8.58)
Demographic and Cultural Factors			
Age at baseline (mean± std)**	71.70 (8.09)	70.36 (6.97)	72.92 (8.50)
Sex (% male)*	45.12 (74)	42.76 (195)	30.77 (52)
Years of education (mean± std)***	6.60 (4.67)	5.17 (4.69)	3.40 (4.01)
Cultural orientation score (mean/std)***	37.54 (11.18)	27.55 (7.06)	23.54 (4.33)
Economic Factors			
Monthly household income (%≤$1,500)***	62.96 (102)	81.07 (364)	95.00 (152)
Pension retirement (% yes)***	56.79 (92)	48.34 (219)	13.86 (23)
Social Security (% yes)***	79.88 (131)	80.04 (361)	41.57 (69)
Medical insurance (% yes)***	91.46 (150)	89.89 (409)	65.48 (110)
Own a house (% yes)***	78.66 (129)	69.30 (316)	13.69 (23)
Lifetime Occupation (%)			
Professional, technical, managers*	8.54 (14)	3.74 (17)	6.59 (11)
Sales, clerical, services*	7.93 (13)	4.84 (22)	11.38 (19)
Craftsmen, machine operators, farming, forestry***	69.51 (114)	74.29 (338)	42.51 (71)
Homemaker***	14.02 (23)	17.14 (78)	39.52 (66)
Social Networks/Neighborhood Composition			
Number of family members in the house(mean± std)***	2.43 (1.43)	2.77 (1.54)	4.20 (2.41)
Neighborhood 50% or more Latino(% yes)**	27.83 (32)	47.06 (160)	38.46 (35)
Lifestyle Factors			
Body Mass Index (mean± std)	28.82 (4.86)	29.35 (5.46)	29.12 (5.54)
Current smoker (% yes)	11.59 (19)	11.43 (52)	10.71 (18)
Chronic Disease at Baseline			
Cardiovascular disease (% yes)*	25.00 (41)	16.23 (74)	18.34 (31)
Diabetes (% yes)	24.39 (40)	30.48 (139)	27.98 (47)
Hypertension (% yes)	65.85 (108)	59.21 (270)	60.95 (103)

Values in the table are proportions % (n) unless otherwise specified

* $p < 0.05$

** $p < 0.01$

*** $p < 0.0001$

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Table 2

Association between covariates and cardiovascular mortality unadjusted and adjusted for age at migration.

	Unadjusted		Adjusted for age at migration	
Covariates	**HR**	**95%CI**	**HR**	**95%CI**
Age at baseline (years)	1.12	1.10, 1.15	1.20	1.09, 1.15
Sex (0=female, 1=male)	1.96	1.30, 2.98	2.11	1.35, 3.28
Years of education (0=≥4 years, 1=<4 years)	1.72	1.10, 2.67	2.04	1.27, 3.29
Cultural orientation score	1.01	0.99, 1.03	1.00	0.97, 1.02
Monthly household income (0=>$1,500, 1= ≤ $1,500)	1.46	0.82, 2.58	1.67	0.91, 3.08
Pension retirement (0=no; 1=yes)	0.76	0.51, 1.15	0.82	0.52, 1.30
Social Security (0=no, 1=yes)	0.78	0.48, 1.27	0.70	0.40, 1.23
Medical insurance (0=no; 1=yes)	0.35	0.14, 0.84	0.41	0.16, 1.03
Own a house (0=rent, 1=own)	0.91	0.66, 1.26	0.91	0.64, 1.31
Number of family members in the house (#)	0.97	0.86, 1.09	1.02	0.90. 1.16
Neighborhood 50% or more Latino (0=less than 50%, 1=>50%)	0.71	0.39, 1.29	0.73	0.40, 1.34
Body Mass Index (weight in kg/m^2)	0.98	0.94, 1.02	0.98	0.93, 1.02
Current smoker (0=no; 1=yes)	1.18	0.63, 2.21	1.07	0.54, 2.14
Cardiovascular disease (0=no; 1=yes)	3.62	2.38, 5.49	3.94	2.54, 6.11
Diabetes (0=no; 1=yes)	2.64	1.75, 4.00	2.88	1.86, 4.45
Hypertension (0=no; 1=yes)	1.68	1.07, 2.65	1.86	1.13, 3.06

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Table 3

Adjusted hazard ratios for age at migration (reference: 50 and older) predicting cardiovascular mortality as measured by Cox proportional hazard models; The Sacramento Area Latino Study on Aging (SALSA); 1998–2006.

Age at migration	Model 1	Model 2	Model 3	Model 4
CVD Mortality	**Hazard Ratio (95% CI)**			
<20 years	1.90 (0.95, 3.78)	2.08 (1.04, 4.16)	2.97 (1.44, 6.16)	2.39 (1.16, 4.94)
20–49	1.55 (0.61, 2.19)	1.45 (0.76, 2.79)	1.60 (0.83, 3.10)	1.35 (0.70, 2.60)
50 and older	1.00	1.00	1.00	1.00
Age		1.12 (1.09, 1.15)	1.12 (1.09, 1.15)	1.11 (1.08, 1.14)
Sex		2.05 (1.31, 3.21)	2.17 (1.36, 3.44)	1.91 (1.19, 3.04)
Education			1.75 (1.05, 2.92)	1.57 (0.93, 2.66)
Income			1.53 (0.81, 2.88)	1.43 (0.76, 2.71)
CVD				2.39(1.50, 3.80)
Diabetes				2.11 (1.32, 3.36)
Hypertension				0.89 (0.51, 1.48)
−2log	1033.20	952.10	927.37	901.90
LRT (df)	-	81.10	105.82	131.29
p-value		<0.0001	<0.0001	<0.0001

Model 1: unadjusted including only age at migration indicator variables

Model 2: Model 1 + age (continuous) and sex (1=male)

Model 3: Model 2+ education (<4 years) and income (≤$1,500)

Model 4: Model 3 + prevalent chronic disease at baseline (cardiovascular disease, diabetes and hypertension)

*Likelihood Ratio Test. Calculated as difference in the −2log likelihood for the reduced and full models to evaluate if adding age at migration categories result in a significant improvement in the model. Referent model refers to (−2Log L) after excluding age at migration categories. LRT> χ^2 (2) =5.99.

†LRT statistic associated two-tailed p-value.