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Foreign-born Hispanic Women's Health Patterns in Allostatic Load Converge to U.S.-born Hispanic Women at a Slower Tempo Compared to Men

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Abstract

Objectives: We investigated the patterns of foreign-born Hispanic health convergence to U.S.-born Hispanics using an allostatic load index, a subjective biological risk health profile; and we explored whether the health convergence patterns differ by sex.

Methods: The analytic sample consisted of 3,347 Hispanics from the pooled 2005–2010 National Health and Nutrition Examination Survey. We used negative binomial regression models to investigate the association between duration in the United States and the allostatic load index, while controlling for potential covariates.

Results: Foreign-born Hispanics who had lived in the United States for 0–9 years and 10–19 years had lower levels of allostatic load than U.S.-born Hispanics; however, those who had lived in the United States for 20 or more years had a level of allostatic load similar to their U.S.-born counterparts. The pattern of immigrant health convergence shows a clear sex difference. In the sex-stratified models, we found that foreign-born Hispanic men converged to the level of allostatic load of U.S.-born Hispanic men after having lived in the United States for about 10 years. The health convergence pattern qualitatively differed for foreign-born Hispanic women, who remained healthier than U.S.-born Hispanic women regardless of duration in the United States.

Conclusion: Foreign-born Hispanics are healthier than their U.S.-born counterparts, providing support for the healthy migrant hypothesis. This relatively better health of foreign-born Hispanics disappears with longer duration in the United States, providing support for the health convergence hypothesis, but is most noticeable for men. Foreign-born Hispanic women converge to U.S.-born Hispanic women health status at a slower tempo, compared with foreign-born Hispanic men.

Keywords

Immigrant health; allostatic load; stress; assimilation; biomarkers

Introduction

In 2015, 57 million U.S. Hispanics accounted for approximately 18% of the total U.S. population and approximately 54% of the total U.S. population growth since 2000 (Krogstad, 2016). Given such demographic significance, understanding the health of U.S.

Hispanics has critical implications for the current state and future health trajectories of the total U.S. population (Jasso, Massey, Rosenzweig, & Smith, 2004). Health advantages for Hispanics, particularly foreign-born Hispanics, despite their lower socioeconomic profiles (referred to as the Hispanic paradox) have received considerable research attention in the past few decades (Burnam, Hough, Karno, Escobar, & Telles, 1987; Franzini, Ribble, & Keddie, 2001; Markides & Eschbach, 2005). However, Hispanic women's health issues have been largely unstudied outside of the realms of prenatal health and health behaviors. The need for sex-specific examinations of Hispanic health is imperative, given that sex and gender are the core organizing principles influencing all aspects of the immigration experience for foreign-born Hispanics (Herrera, 2013) and health inequalities for all (Arber & Ginn, 1993).

In addition to challenging our understanding of the conventional relationship between socioeconomic status and health, Hispanic health is complex, involving substantial heterogeneities within the panethnic Hispanic identity based on race, class, sex/gender, country of origin, nativity, and citizenship status (Virell-Fuentes, 2007; Virell-Fuentes, Miranda, & Abdulrahim, 2012). The key domains of Hispanic health research are intertwined with immigration. Hispanic immigrant health research has predominantly focused on the initial relative health advantages and subsequent health deterioration among foreign-born Hispanics (Jasso et al., 2004; Virell-Fuentes et al., 2012). Simply stated, foreign-born Hispanics are healthier than U.S.-born Hispanics when they first enter the United States (i.e., healthy migrant hypothesis), but their health deteriorates as they spend more time in the United States (i.e., health convergence hypothesis). However, debate surrounds questions of whether such health advantages truly exist or instead are artificially generated by positive health selection (Akresh & Frank, 2008), attrition due to return immigration (i.e., "salmon bias") (Abraido-Lanza, Dohrenwend, Ng-Mak, & Turner, 1999), or to data quality issues, such as including misclassification of race and ethnicities (Arias, 2010) and misreporting because of language barriers (Virell-Fuentes, Morenoff, Williams, & House, 2011). Empirical evidence has largely and consistently documented the initial relative health advantages of Hispanic immigrants (e.g., Markides & Eschbach, 2005), and health convergence of foreign-born Hispanics to U.S.-born Hispanics over time (Markides & Eschbach, 2005).

Although acculturation and language-related misreporting have been used to explain the specific mechanisms of health convergence of foreign-born Hispanics to U.S.-born Hispanics (Bzostek, Goldman, & Pebley, 2007; Virell-Fuentes et al., 2011), the explicit inclusion of biomarkers can provide a unique method for testing the health convergence hypothesis with the minimal risk of reporting bias (Crimmins & Seeman, 2004; Green & Darity, 2010). For example, allostatic load—an index of biological parameters—has been used to measure the cumulative physiological toll of stressors on the body (Crimmins & Seeman, 2004), and such physiological measures reduce the probability of misreporting due to cultural and language differences. A few pioneering studies investigating allostatic load for Hispanics have documented the differences in biological risk profiles within Hispanics. First, foreign-born Hispanics have lower levels of allostatic load compared with U.S.-born Hispanics (Crimmins, Kim, Alley, Karlamangla, & Seeman, 2007; Peek et al., 2010; Salazar et al., 2016), supporting the healthy migrant hypothesis that foreign-born individuals are

healthier than U.S.-born individuals (Jasso et al., 2004). Second, this observed health advantage of foreign-born Hispanics in allostatic load is attenuated with duration of residence in the United States (Kaestner, Pearson, Keene, & Geronimus, 2009), supporting the health convergence hypothesis, which posits that health of foreign-born Hispanics becomes more similar to U.S.-born Hispanics health over time (Lara, Gamboa, Kahramanian, Morales, & Hayes Bautista, 2005). Despite the limitations of these studies (e.g., not using the clinically determined thresholds for allostatic load, using a non-generalizable sample), they have articulated and testified to the critical need for investigating biomarkers for Hispanics, particularly for Hispanic immigrants (Salazar et al., 2016).

A critical missing component of this emerging literature on Hispanic health and biological risk profiles is the understanding of Hispanic women's health through a systematic sex-specific perspective. That is, rather than merely including women's immigration experiences as a control variable, a more systematic approach is called for to incorporate women's experiences using sex-specific analyses (Heidari, Babor, De Castro, Tort, & Curno, 2016). Specifically, given documented sex differences in allostatic load for all racial/ethnic groups (Yang & Kozloski, 2011), whether and how Hispanic women's allostatic load and convergence patterns qualitatively differ from Hispanic men's is important for our understanding of women's health issues. Both sex and gender factors are likely at work in this emerging area of scholarship, as such references to "sex" in this article refer to both. To fill this gap, we used pooled, nationally representative data to investigate the sex-specific health convergence patterns of allostatic load for Hispanic adults in a multivariate framework using the sex-stratified analyses.

Data and Methods

Sample

Data for this study come from the 2005–2010 National Health and Nutrition Examination Survey (NHANES). The NHANES is a nationally representative survey designed to assess the health and nutritional status of adults and children in the United States (Centers for Disease Control Prevention, 2013). It is collected through both interviews and physical examinations and includes detailed information on demographic, socioeconomic, dietary, and health profiles. The physical examination component includes medical, dental, physiological measurements, as well as laboratory tests administered by medical personnel. Starting with all adults in the United States in the pooled 2005–2010 data ($n = 31,034$), we first restricted our analytic sample to individuals who reported being Hispanic ($n = 10,071$) and then to individuals aged 25 years or older ($n = 4,109$). We further restricted our sample to those who participated in the medical examination component of the survey ($n = 4,000$). We employed listwise deletion to account for missing values (i.e., complete case analysis) by using the most restrictive assumption that variables are missing completely at random (MCAR) given the large number of missing values for income (Allison, 2002; Kim, Egerter, Cubbin, Takahashi, & Braveman, 2007). We discuss the issue of missing values for biomarkers in the *Measures* section in detail. In sensitivity analyses, we found that using multiple imputation yields substantively consistent results. The final analytical sample contained 3,347 observations.

Measures

Dependent Variables: Allostatic Load Scores—Consistent with previous literature (Green & Darity, 2010), we used a set of 10 biomarkers, including those derived from the physical examinations and laboratory components of NHANES, to calculate allostatic load scores for each participant. These included (1) systolic and (2) diastolic blood pressure, (3) body mass index (BMI), (4) glycosylated hemoglobin, (5) albumin, (6) creatinine clearance, (7) triglycerides, (8) C-reactive protein, (9) HDL cholesterol, and (10) total cholesterol.

Our exploratory analysis revealed that a small number of individuals had missing values for one or more biomarkers. Based on the assumption that missing values on one or more biomarkers do not depend on missing values for another (i.e., that they are missing at random (MAR)), we followed previous studies in using regression-based multiple imputation to account for missing data on allostatic load (Allison, 2002; Shrive, Stuart, Quan, & Ghali, 2006; van der Heijden, Donders, Stijnen, & Moons, 2006). Our regression-based approach has been used in previous research to address missing values on biomarker information using NHANES (Howard & Sparks, 2015, 2016a, 2016b). Typically, less than 4% of the sample had missing cases for each measure except for triglycerides (mg/dL), for which 51.06% had missing values. We used the GLM procedure in SAS 9.4 to estimate these regression models (SAS Institute, 2013).

Table 1 presents descriptive statistics for all biomarkers. We specified a regression formula wherein each biomarker acted as the dependent variable and a value was predicted using age, sex, marital status, years of education, and income level as independent variables. The following formula illustrates the regression approach for each biomarker. In this formula, y represents the particular biomarker. The intercept and coefficients are represented by β_0 and β_i , respectively. Each independent variable for the regression formula used in the multiple imputation algorithms is represented by x_i , and the error term is represented by e_i .

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_{n-1} x_{n-1} + \beta_n x_n + e_i$$

We compared the results of the imputed means and standard deviations with results of the nonimputed ones for each element and found that they were similar.

Table 1 also presents clinical incidence of each biomarker for men and women, which was determined based on exceeding clinically determined thresholds, consistent with previous literature (Howard & Sparks, 2016a). Among the 10 biomarkers considered in our study consistent with previous studies (e.g., Juster, McEwen, & Lupien, 2010; Santos-Lozada & Daw, 2018), only four exceeded an incidence of 20% (i.e., HDL cholesterol (mg/dL), triglycerides (mg/dL), BMI (kg/m²), and C-reactive protein (mg/dL)). Three exceeded an incidence of 10%: systolic blood pressure (mmHg), total cholesterol (mg/dL), and glycosylated hemoglobin (%). Diastolic blood pressure (mmHg), pulse rate at 60 seconds, and albumin (g/dL) had incidence rates below 10%. We incorporated allostatic load in our models by assigning individuals the count of biomarkers that exceeded the clinically determined thresholds (see Table 1), as discussed in previous research (Howard & Sparks, 2016a). The potential range of the allostatic load score is 0 to 10 (Duong, Bingham, Aldana,

Chung, & Sumner, 2017; Geronimus, Hicken, Keene, & Bound, 2006; Howard & Sparks, 2016a). For descriptive statistics of biomarkers with and without imputations, see the Appendix Table 1,

Independent Variable: Time in the United States—In exploring the patterns of convergence in allostatic load scores of foreign-born Hispanics toward that of U.S.-born Hispanics, the key independent variable of interest is time in the United States. Using information on nativity and years spent in the United States, we coded this time in the United States as a set of dichotomous variables indicating whether the respondent was (1) a U.S.-born Hispanic (reference), or was an immigrant who had lived in the United States for (2) 0–9 years, (3) 10–19 years, or (4) 20 or more years.

Covariates—We included several covariates in the models. First, we included three demographic characteristics: age, sex, and marital status. *Age* was included as a set of dichotomous variables: (1) 25–40 years (reference), (2) 41–60 years, and (3) 61 years or older. *Sex* was measured as dichotomous variable that was coded 1 for female. *Marital status* was measured as (1) single (reference), (2) married, (3) cohabitating, or (4) divorced, separated, widowed.

Next, we included three socioeconomic characteristics: education, family income and employment status as previous studies have demonstrated the relationship between low socioeconomic status -measures as education, income and employment- to be associated with higher allostatic load (Szanton, Gill, & Allen, 2005). *Education* was also measured as a set of binary variables: (1) less than a high school education (reference), (2) high school or some college, and (3) college degree or higher. *Employment Status* was measured as a binary variable: (1) currently employed (reference) and (2) unemployed. *Family income* was measured as (1) less than \$20,000 (reference), (2) \$20,000–\$64,999, (3) \$65,000 or more, or (4) don't know/refused.

Lastly, we included two health behavior characteristics: smoking and drinking. These health behavior characteristics are important behavior determinants of allostatic load (Petrovic et al., 2016) that can influence allostatic load by either decelerating the reactivity of the physiological stress system or attenuating stress response (Wiggert, Wilhelm, Nakajima, & al' Absi, 2016). *Smoking* was measured as (1) nonsmoker (reference), (2) current smoker, and (3) former smoker. *Drinking* was measured as (1) nondrinker (reference), (2) one drink per week, or (3) more than one drink per week.

Analytic Approach

We incorporated survey weights, strata, and clustering to account for complex sample design and to adjust for probability of selection of respondents, subgroup selection, and unit nonresponse. Specifically, we followed NHANES guidelines for the incorporation of survey weights, strata, and clustering in our analysis of the subsample who participated in the physical examination component of the study (Johnson et al., 2013). Following previous modeling approaches, we used negative binomial regression models to examine the relationship between duration in the United States and allostatic load levels (Howard & Sparks, 2015). We fit three regression models in a nested structure to assess the association

between duration in the United States and allostatic load levels. We specified our two final models to explore the differences in the patterns of health convergence between Hispanic men and Hispanic women by using the sex-stratified analyses.

Results

Descriptive Results

Table 2 present the descriptive statistics by duration in the United States for the overall sample and by sex. The average allostatic load scores were 2.03 for the overall population, 2.14 for U.S.-born Hispanics, 1.69 for Hispanics who had lived in the United States for 0–9 years, 1.93 for those who had live in the United States for 10–19 years and 2.20 for those who had lived in the United States 20 or more years. The average allostatic load scores were 2.13 for men and 1.92 for women. In addition, women were more likely to be nonsmokers and nondrinkers.

Figure 1 displays the descriptive relationship between the average allostatic load and duration in the United States. Panel A presents the average allostatic load scores based on the time in the United States for all Hispanics, regardless of sex. A clear pattern of convergence is observed: whereas the most recent Hispanic immigrants have the lowest allostatic load level, those in the group with longest duration in the United States have the highest allostatic load level compared with U.S.-born Hispanics. This pattern indicates that more-recent immigrants (i.e., who have been in the United States for less than 20 years) are healthier than U.S.-born Hispanics. Notably, the average allostatic load score for the Hispanic immigrant group with the longest duration in the United States (i.e., 20 or more years) is even higher than that of U.S.-born Hispanics. Panel B presents the mean allostatic load scores based on duration in the United States by sex. Overall, women are healthier than men in every group. The trends presented in Panel B suggest that health of foreign-born Hispanic women converges toward that of U.S.-born Hispanic women *more slowly* compared with the convergence of health among foreign-born and U.S.-born men.

Multivariate Results

Table 3 presents the results from the negative binomial regression models. In the first model, we included only the duration in the United States to provide an unadjusted estimate of this association (Model 1). The second model incorporates various demographic (i.e., age, sex, and marital status) and socioeconomic (i.e., education, family income, and employment status) characteristics (Model 2). The third model adds two health behavior characteristics: smoking and drinking (Model 3). The fourth and fifth models are the sex-specific stratified models used to ascertain whether differences in health convergence patterns are different for Hispanic men (Model 4) and Hispanic women (Model 5). We present the results from the negative binomial regression models as coefficients (β) with corresponding significance levels, 95% confidence intervals (95% CI), and exponentiated coefficients (i.e., incidence rate ratios). Incidence rate ratios (IRR) greater than 1 indicate an increased risk of that outcome in the exposed group when compared to the reference group.

The dispersion indicator points to unobserved heterogeneity for each model regarding allostatic load, but this indicator is close to zero. Reductions in the Akaike information criterion (AIC) from the initial model to the subsequent model indicate that the set of covariates in Model 2 increases the level of explanation beyond the much simpler model. The modest reductions in the AIC from Model 2 to Model 3 indicate that the inclusion of health behaviors does not improve model fit significantly. We explored potential collinearity through an examination of the variance inflation factor (VIF) for each covariate and found no multicollinearity.

The results from Model 1 indicate that foreign-born Hispanics who have been in the United States for 0–9 years and 10–19 years have significantly lower allostatic load levels than U.S.-born Hispanics ($\beta = -0.22$ and $\beta = -0.11$, respectively). No difference was found for those who have lived in the United States for 20 or more years in comparison to their U.S. born counterparts. The results from Model 2 indicate that these differences by duration in the United States remain significant even after individuals' demographic and socioeconomic characteristics are controlled for, when these controls are incorporated those who have live in the United States for 20 years or more have marginally significant lower levels of allostatic load in comparison to their U.S. born counterparts ($\beta = -0.05$, $p = 0.10$). Age is positively associated with allostatic load scores across all categories. In general, women have significantly lower allostatic load scores than men. Divorced, separated, and/or widowed individuals have higher allostatic load levels than those who had never been married, but this is only at the lowest level of significance. In addition, individuals with higher income have significantly lower allostatic load levels than those with low income. Higher educational attainment is associated with lower allostatic load scores, but only for those with a college degree or more. Individuals who report being unemployed have higher levels of allostatic load than employed ones ($\beta = 0.16$, $p = 0.001$).

Model 3, the fully specified model, adds the health behavior characteristics to previous models. Significant differences by duration in the United States remain salient. Consistent with previous models, foreign-born Hispanics living in the United States for 0–9 years and 10–19 years have lower allostatic load levels than U.S.-born Hispanics ($\beta = -0.15$ and $\beta = -0.14$, respectively). The difference found for foreign-born Hispanics living in the United States for 20 or more years from U.S.-born Hispanics in allostatic load level strengthens in this model ($\beta = -0.05$, $p = 0.05$). The results from demographic and socioeconomic characteristics are consistent across models. *Ceteris paribus*, no difference was found by smoking status. Finally, compared with nondrinkers, those who reported having one drink per week ($p = 0.01$) and those who reported having more than one drink per week ($p = 0.001$) have lower allostatic load levels.

Model 4 shows the fully specified sex-specific model for Hispanic men. The results show that foreign-born Hispanic men living 0–9 years in the United States have lower levels of allostatic load than U.S.-born Hispanic men, but this difference is not present for those living 10–19 years and 20 or more years in the United States. In Model 5, which displays the fully specified sex-specific model for only Hispanic women, all foreign-born Hispanic women have significantly lower levels of allostatic load than U.S.-born Hispanic women. This is

indicative of differential tempos of health convergence toward U.S.-born levels for foreign-born Hispanic women compared with that experienced by foreign-born Hispanic men.

Discussion

Given the profound sex differences in all aspects of immigration for foreign-born Hispanics (Herrera, 2013) and health inequalities for all (Arber & Ginn, 1993; Heidari et al., 2016), we investigated the health convergence patterns of foreign-born Hispanics to U.S.-born Hispanics using an allostatic load index as well as whether and how the health convergence patterns differ by sex. The explicit use of biomarkers in our study instead of self-reported health indicators provides unique advantages in testing the health convergence hypothesis with minimal risk of reporting bias (Crimmins & Seeman, 2004; Green & Darity, 2010).

Our findings are consistent with the immigrant health literature, which has largely documented the initial health advantages and subsequent health deterioration of foreign-born Hispanics compared to U.S.-born Hispanics. However, the allostatic load scores for Hispanics (2.14) was significantly higher than non-Hispanic whites (1.77) and non-Hispanic blacks (1.96). Consistent with the healthy migrant hypothesis, we observed initial health advantages of foreign-born Hispanics: foreign-born Hispanics—men and women—healthier than their U.S.-born counterparts, as indicated by lower allostatic loads. Furthermore, the nativity differences in allostatic loads are explained by the time foreign-born Hispanics have spent in the United States. Foreign-born Hispanics who had lived in the United States between 0–9 years and 10–19 years had lower allostatic loads than U.S.-born Hispanics. However, those living in the United States for 20 or more years had allostatic loads scores closer to their U.S.-born counterparts, providing empirical support for the health convergence hypothesis.

We further demonstrated that the health convergence patterns of foreign-born Hispanics to U.S.-born Hispanics substantially differ by sex: health convergence of Hispanic women differs from that of Hispanic men in terms of the initial onset and tempo. First, consistent with previous findings of sex differences in allostatic loads for all racial/ethnic groups (Yang & Kozloski, 2011), we also found the profound sex differences in allostatic loads for Hispanics. Hispanic women are healthier than Hispanic men regardless of nativity and duration in the United States. In addition to the sex differences in allostatic loads for Hispanics, we found a stark sex difference in the health convergence patterns among foreign-born Hispanics: health of foreign-born Hispanic women converges toward that of U.S.-born Hispanic women at a much slower pace compared to the of Hispanic men, which converges after 10 years of living in the United States. Although the health of foreign-born Hispanics has a trend of convergence to that of U.S.-born Hispanics living 20 or more years in the United States for both women and men, foreign-born Hispanic women show a slower tempo and later onset of health convergence toward U.S.-born levels compared with foreign-born Hispanic men. That is, the trend for women is not linear in which the foreign-born Hispanic women who had lived in the US for 10–19 years (1.52) have the relatively same level of allostatic load compared to those who had lived for 0–9 years (1.51). Due to the cross-sectional design of our study, we suggest cautious interpretation for the initial onset and tempo of health convergence. For example, the patterns of health convergence may be

the product of cohort effects and future studies utilizing longitudinal data should investigate the mechanism in which the health convergence patterns are generated. In short, this key finding of qualitative and substantive differences in health by sex provides empirical evidence for the need for more research through a systematic sex-specific perspective for Hispanics.

Additionally, our results are consistent with previous scholarship regarding demographic and socioeconomic characteristics (Howard & Sparks, 2015). We did not find differences by smoking status, which should be explored in future scholarship. Finally, the effects found by drinking behavior for the overall sample, are only found for women.

Despite the advantages in using biomarkers in testing the health convergence hypothesis with the minimal risk of reporting bias (Crimmins & Seeman, 2004; Green & Darity, 2010), the results of this study should be interpreted in the context of several limitations. First, because of the use of pooled cross-sectional data, a causal relationship between duration in the United States and the health convergence of foreign-born Hispanics cannot be established. Future studies should utilize longitudinal data to address the issue of causal inference. Furthermore, due to the use of pooled cross-sectional data, the relationships between health behavior variables (i.e., smoking and drinking) and allostatic load should be interpreted with caution. Second, the use of panethnic Hispanic identification may mask important within-group heterogeneity among Hispanics (Waters & Jiménez, 2005). Third, several measures that may be associated with allostatic load are not included due to data constraints (e.g., information on current medications); and inclusion of such variables may be appropriate for future research. Fourth, because we wanted to use a previously validated index of allostatic load we choose data from the 2005–2010 period, future studies should replicate the study with newer data as they become available. Two notable social stratification aspects of potential heterogeneity among Hispanics worthy of further research are foreign-born Hispanics' documentation status and context of reception (e.g., neighborhoods) (Glick, 2010; Massey & Bartley, 2005). Finally, future research should investigate the specific mechanisms by which the health of foreign-born Hispanic women converges to that of U.S.-born Hispanic women more slowly compared with the convergence among their male counterparts.

Implications for Practice and Policy

The finding of different health convergence patterns for foreign-born Hispanic women compared with foreign-born Hispanic men warrant more nuanced health policies. These policies must explicitly acknowledge the systematic sex differences in the health changes among Hispanic immigrants.

Appendix

Appendix Table 1.

Descriptive Statistics for 10 Allostatic Load Biomarkers with and without Imputation

Biomarker	Without Imputation			With Imputation			Clinically Based Allostatic Load Prevalence		
	<i>n</i>	Mean	SE	<i>n</i>	Mean	SE	Clinical Threshold	Without Imputation (%)	With Imputation (%)
Cardiovascular markers									
Diastolic blood pressure (mmHg)	3,293	70.4	0.38	3,347	70.4	0.37	90	4.5	4.4
Systolic blood pressure (mmHg)	3,293	121.2	0.58	3,347	121.1	0.55	140	12.2	12
Pulse rate at 60 seconds	3,297	72.4	0.29	3,347	72.4	0.28	90	8.7	8.6
Metabolic markers									
Total cholesterol (mg/dL)	3,229	202.1	1.01	3,347	202	0.97	240	15.6	15.1
HDL cholesterol (mg/dL)	3,239	49.7	0.41	3,347	49.6	0.39	<40	25	24.1
Triglycerides (mg/dL)	1,587	151.8	4.37	3,347	151.5	2.08	150	35.9	45.5
Glycosylated hemoglobin (%)	3,246	5.8	0.04	3,347	5.8	0.04	6.4	11	10.8
Body mass index (kg/m ²)	3,322	29.4	0.16	3,347	29.4	0.16	30	38	38
Inflammation markers									
Albumin (g/dL)	3,229	4.3	0.01	3,347	4.3	0.01	<3.8	4.8	4.6
C-reactive protein (mg/dL)	3,243	0.4	0.02	3,347	0.4	0.02	0.30	37.9	39.1

Source: 2005–2010 National Health and Nutrition Examination Survey.

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Panel A **Panel B**

Figure 1. Average Allostatic Load by Nativity/Duration in the United States (Panel A) and by Sex (Panel B), with 95% Confidence Intervals (Panel A)

Table 1.

Descriptive Statistics for 10 Allostatic Load Biomarkers by Sex

Biomarker	Men			Women			Clinically Based Allostatic Load Prevalence		
	<i>n</i>	Mean	SE	<i>n</i>	Mean	SE	Clinical Threshold	Men (%)	Women (%)
Cardiovascular markers									
Diastolic blood pressure (mmHg)	1,650	71.98	0.39	1,697	68.62	0.51	90	5.5	3.18
Systolic blood pressure (mmHg)	1,650	123.07	0.52	1,697	118.97	0.73	140	11.61	12.41
Pulse rate at 60 seconds	1,650	71.34	0.35	1,697	73.62	0.39	90	9.2	7.9
Metabolic markers									
Total cholesterol (mg/dL)	1,650	204.83	1.25	1,697	198.89	1.25	240	16.9	13.0
HDL cholesterol (mg/dL)	1,650	45.48	0.37	1,697	54.29	0.65	<40	34.4	12.5
Triglycerides (mg/dL)	1,650	215.21	5.04	1,697	145.45	2.51	150	56.3	37.1
Glycosylated hemoglobin (%)	1,650	5.75	0.04	1,697	5.75	0.05	6.4	10.6	11.0
Body mass index (kg/m ²)	1,650	29.13	0.21	1,697	29.69	0.19	30	34.1	42.4
Inflammation markers									
Albumin (g/dL)	1,650	4.35	0.02	1,697	4.15	0.03	<3.8	2.33	7.2
C-reactive protein (mg/dL)	1,650	0.36	0.06	1,697	0.50	0.05	0.30	32.8	47.1

Source: 2005–2010 National Health and Nutrition Examination Survey.

Table 2.

Descriptive Statistics for Hispanic Adults by Nativity, Duration in the United States, and Sex

	Duration in the United States						Sex		
	All	U.S. Born	0–9 years	10–19 years	20+ years	p-value	Men	Women	p-value
Allostatic load	2.03	2.14	1.69	1.93	2.20	< 0.001	2.13	1.92	< 0.001
Demographic characteristics									
<i>Age</i>									
25–40 years (reference)	0.48	0.50	0.70	0.62	0.23	< 0.001	0.53	0.43	< 0.001
41–60 years	0.38	0.34	0.25	0.33	0.54		0.35	0.41	
61 + years	0.14	0.16	0.05	0.05	0.23		0.12	0.16	
<i>Female</i>	0.47	0.52	0.41	0.47	0.56	< 0.001			
<i>Marital status</i>									
Single (reference)	0.13	0.15	0.17	0.12	0.07	< 0.001	0.15	0.11	< 0.001
Married	0.59	0.53	0.57	0.65	0.64		0.62	0.56	
Cohabiting	0.10	0.09	0.15	0.11	0.06		0.12	0.80	
Divorced/ separated/ widowed	0.18	0.22	0.11	0.11	0.22		0.12	0.25	
Socioeconomic characteristics									
<i>Income level</i>									
< \$20,000 (reference)	0.25	0.20	0.35	0.27	0.22	< 0.001	0.25	0.25	0.49
\$20,000 – \$64,999	0.51	0.44	0.51	0.58	0.55		0.52	0.50	
\$65,000 +	0.19	0.32	0.05	0.10	0.17		0.18	0.20	
Income missing	0.05	0.03	0.09	0.05	0.06		0.06	0.05	
Employment Status									
Employed (reference)	0.68	0.65	0.76	0.72	0.65	< 0.001	0.80	0.56	< 0.001
Unemployed	0.32	0.35	0.24	0.28	0.35		0.20	0.44	
<i>Education</i>									
Less than high school (reference)	0.48	0.27	0.61	0.62	0.56	< 0.001	0.49	0.46	0.48
High school/some college	0.41	0.57	0.32	0.31	0.34		0.40	0.42	
College or more	0.11	0.16	0.07	0.07	0.11		0.11	0.12	
Health behavior characteristics									
<i>Smoking</i>									
Non-smoker (reference)	0.62	0.58	0.68	0.66	0.61	< 0.001	0.52	0.74	< 0.001
Current smoker	0.18	0.22	0.16	0.15	0.16		0.23	0.13	
Former smoker	0.20	0.19	0.16	0.18	0.23		0.25	0.13	
<i>Drinking</i>									
Non-drinker (reference)	0.33	0.27	0.31	0.39	0.37	< 0.001	0.23	0.43	< 0.001
One drink per week	0.52	0.54	0.58	0.47	0.47		0.53	0.50	
More than one drinks per week	0.16	0.19	0.11	0.13	0.15		0.23	0.07	
Unweighted N	3,347	1,169	543	535	1,100		1,650	1,697	
Weighted Percentage	--	34.80	19.34	18.28	27.57		52.90	47.10	

Note: Allostatic load score differences were assessed using *t* tests through univariate OLS regression model.

Source: 2005–2010 National Health and Nutrition Examination Survey.

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Table 3.

Negative binomial regression results on allostatic load

Variable	Model 1			Model 2			Model 3			Model 4 (Men)			Model 5 (Women)		
	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR
Duration in the United States (ref: U.S. Born)															
0–9 years	-0.22***	-0.21, -0.08	0.80	-0.17***	-0.25, -0.09	0.84	-0.17***	-0.25, -0.10	0.84	-0.20***	-0.31, -0.08	0.82	-0.15**	-0.26, -0.04	0.86
10–19 years	-0.11**	-0.15, -0.02	0.90	-0.08***	-0.16, -0.01	0.92	-0.09***	-0.17, -0.01	0.91	-0.03	-0.14, 0.08	0.91	-0.16**	-0.21, -0.07	0.80
20 years or more	0.04	-0.02, 0.09	1.04	-0.05†	-0.10, 0.02	0.95	-0.05*	-0.11, 0.00	0.95	-0.03	-0.11, 0.05	0.97	-0.09*	-0.17, -0.01	0.90
Demographic characteristics															
Age (ref: 25–40 years)															
41–60 years				0.27***	0.21, 0.33	1.31	0.26***	0.20, 0.32	1.30	0.17***	0.08, 0.25	1.19	0.36***	0.27, 0.46	1.43
61 + years				0.28***	0.21, 0.36	1.32	0.28***	0.18, 0.33	1.32	0.09†	-0.02, 0.20	1.09	0.40***	0.30, 0.51	1.49
Women				-0.11***	-0.16, -0.06	0.89	-0.12***	-0.17, -0.07	0.89						
Marital status (ref: single)															
Married				0.05	-0.03, 0.14	1.05	0.05	-0.04, 0.19	1.05	0.11†	0.00, 0.23	1.12	-0.00	-0.13, 0.12	1.00
Cohabiting				0.07	-0.04, 0.17	1.07	0.07	-0.05, -0.00	1.07	0.11	0.05, 0.35	1.12	0.06	-0.11, 0.24	1.06
Divorced/separated/ widowed				0.09†	-0.00, 0.19	1.09	-0.09†	0.00, 0.19	0.91	0.11	-0.04, 0.25	1.12	0.03	-0.10, 0.16	1.03
Socioeconomic characteristics															
Income level (ref: < \$20,000)															
\$20,000 – \$64,999				-0.05†	-0.11, 0.01	0.95	-0.04	-0.10, -0.01	0.96	-0.02	-0.06, 0.10	0.98	-0.10*	-0.18, -0.02	0.90
\$65,000 +				-0.10***	-0.18, -0.02	0.90	-0.09*	-0.17, -0.01	0.91	0.06	-0.05, 0.18	1.06	-0.23***	-0.34, -0.11	0.79
Income missing				-0.09	-0.20, 0.02	0.91	-0.09	-0.20, 0.02	0.93	-0.07	-0.23, 0.09	0.93	-0.09	0.24, 0.06	0.91
Education (ref: less than HS)															
High school/some college				-0.03	-0.08, 0.03	0.97	-0.02	-0.07, 0.04	0.98	-0.03	-0.11, 0.04	0.97	0.00	-0.08, 0.07	1.00

Variable	Model 1			Model 2			Model 3			Model 4 (Men)			Model 5 (Women)		
	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR	Coeff(β)	95% CI	IRR
College or more				-0.23 *** -0.32, -0.14		0.79	-0.21 *** -0.31, 0.12		0.81	-0.21 ** -0.33, -0.08		0.81	-0.22 * -0.35, -0.09		0.80
Employment Status (ref: Employed)															
Unemployed				0.16 ***	0.10, 0.21	1.17	0.15 ***	0.10, 0.21	1.16	0.21 ***	0.13, 0.30	1.23	0.14 ***	0.06, 0.21	1.15
Health behavior characteristics															
<i>Smoking</i> (ref: non-smoker)															
Current smoker							0.02	-0.05, 0.08	1.02	0.00	-0.09, 0.09	1.00	0.04	-0.07, 0.14	1.04
Former smoker							0.05	-0.01, 0.11	1.05	0.00	-0.07, 0.08	1.00	0.13	0.04, 0.22	1.14
<i>Drinking</i> (ref: non-drinker)															
One drink per week							-0.07 ** -0.13, -0.02		0.93	-0.02	-0.10, 0.05	0.98	-0.12 *** -0.19, -0.05		0.88
More than one drinks per week							-0.12 *** -0.20, -0.05		0.89	-0.07	-0.13, 0.03	0.93	-0.22 *** -0.38, -0.07		0.80
Intercept	0.82 ***	0.78, 0.85		0.64 ***	0.55, 0.75		0.87 ***	0.76, -0.98		0.63 ***	0.47, 0.78		0.61 ***	0.45, 0.77	
AIC		12,237			11,993			11,987			--			--	

Note:

†
p 0.10,*
p 0.05,**
p 0.01,***
p 0.001