Allostatic Load Among Non-Hispanic Whites, Non-Hispanic Blacks, and People of Mexican Origin: Effects of Ethnicity, Nativity, and Acculturation

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Adverse social circumstances, such as exposure to social and economic stressors, have been found to be associated with a variety of poor health outcomes in different ethnic and age groups, both internationally and in the United States.[1–6] However, the pathways through which these effects are transmitted have not been clearly elucidated. It has been postulated that persistent adversity over the long term leads to changes in the physiological stress response apparatus and that these physiological changes are responsible for deleterious health consequences.[7,8]

The capacity of individuals' physiological systems to adapt to challenges and stressors, or allostasis, is a necessary part of healthy functioning.[9–11] However, the accumulated consequences of repeated, frequent adaptation to stressors throughout the life course lead to dysregulation of these same physiological systems, referred to with a number of different terms, including *weathering*,[12,13] *allostatic load*,[7,8] *cumulative physiological dysregulation*,[14] and *biological risk profile*,[15] all measured in very similar ways. Here we refer to this phenomenon as allostatic load.

ETHNICITY AND ALLOSTATIC LOAD

Researchers initially operationalized allostatic load in the late 1990s using data from the MacArthur Studies of Successful Aging.[16] Seeman et al. assessed allostatic load as 10 biological markers focused on functioning in the hypothalamic–pituitary–adrenal axis, sympathetic nervous system, and cardiovascular and metabolic systems.[16] Since then, researchers have measured allostatic load in a variety of ways and have continued to use the MacArthur studies and other data, including data from the National Health and Nutrition Examination Survey (NHANES),[15,17] to examine the

Objectives. We investigated ethnic differences in allostatic load in a population-based sample of adults living in Texas City, TX, and assessed the effects of nativity and acculturation status on allostatic load among people of Mexican origin.

Methods. We used logistic regression models to examine ethnic variations in allostatic load scores among non-Hispanic Whites, non-Hispanic Blacks, and people of Mexican origin. We also examined associations between measures of acculturation and allostatic load scores among people of Mexican origin only.

Results. Foreign-born Mexicans were the least likely group to score in the higher allostatic load categories. Among individuals of Mexican origin, US-born Mexican Americans had higher allostatic load scores than foreign-born Mexicans, and acculturation measures did not account for the difference.

Conclusions. Our findings expand on recent research from the National Health and Nutrition Examination Survey with respect to ethnicity and allostatic load. Our results are consistent with the healthy immigrant hypothesis (i.e., newer immigrants are healthier) and the acculturation hypothesis, according to which the longer Mexican immigrants reside in the United States, the greater their likelihood of potentially losing culture-related health-protective effects. (*Am J Public Health.* 2010;100:940–946. doi:10.2105/AJPH.2007.129312)

concept of allostatic load. Results from multiple studies have indicated that higher allostatic load scores predict increased mortality, cognitive decline, and disability.[10,11,13,15–18]

Although allostatic load has been suggested as a potential factor in health declines, information is lacking on ethnic differences in allostatic load. In particular, the concept of allostatic load has the potential to aid in the understanding of health disparities.[18] Non-Hispanic Black (hereafter referred to as Black) and Hispanic individuals experience discrimination, institutionalized racism, and the strains of lower socioeconomic positions more often than do their non-Hispanic White (hereafter referred to as White) counterparts.[19] These adverse circumstances lead to an accumulation of stressful life events that may increase allostatic load, potentially resulting in poorer mid- to late-life health outcomes.

To our knowledge, only 2 studies have explicitly examined ethnic differences in

allostatic load. First, Geronimus et al.,[13] focusing on Black and White differences in what they termed "weathering," used a 10-item allostatic load measure from the 1999 to 2002 versions of NHANES. They found that Blacks had higher allostatic load scores across every age category. In the second study, Crimmins et al.[15] investigated ethnic differences in biological risk profiles, and the results suggested that Hispanics had more biological risk factors than do Whites but fewer risk factors than do Blacks.

In addition, stratified analyses by immigrant status have indicated that US-born Mexican Americans have more biological risk factors than do foreign-born Mexicans, consistent with evidence that foreign-born Hispanics have more favorable health profiles than US-born Hispanics, termed the healthy immigrant effect.[15,20–23] Whereas selective immigration is one explanation of why Mexican immigrants have healthier biological profiles, another explanation reflects acculturation mechanisms. These

factors point to cultural differences in health behaviors and support systems. For example, healthier diets,[24,25] lower rates of smoking and heavy drinking,[26] and strong family ties are hypothesized to be health protective, particularly among immigrant populations.[23]

We sought to expand on previous work focusing on ethnic differences in allostatic load by examining relationships between ethnicity, nativity, and acculturation in a sample of adults living in Texas. First, we estimated allostatic load scores among Whites, Blacks, and people of Mexican origin (both foreign and US born). Second, we examined adults of Mexican origin only in an attempt to determine the extent to which there are differences between foreign- and US-born individuals in allostatic load and whether measures of acculturation account for these differences.

METHODS

Our data were derived from the Texas City Stress and Health Study, conducted between 2004 and 2006. The original purpose of the study was to evaluate sources of sociobiological stress associated with living close to an environmental hazard (i.e., several oil refineries), with special attention to Hispanics. There are 2 advantages to this data set. First, it sampled every Hispanic household in the study area of Texas City, TX, which is located 37 mi (59.5 km) from Houston, TX. Because Houston is a gateway city and a port of entry for immigrants from Mexico, Texas City has a large foreign-born Mexican population as well as a substantial US-born Mexican American population. Second, this data set is one of the few containing blood test results and anthropometric and acculturation measures in a large sample of people of Mexican origin.

Study Design

The survey involved 3 stages. First, all households in an approximately 12-square mile study area that borders the oil refineries and comprises about 75% of the city population were approached and contacted to determine occupants' age and ethnicity. Prior to enumeration, 3 groups were identified: Hispanics aged 25 to 64 years, Hispanics 65 years or older, and non-Hispanics. In the second stage, all Hispanic housing units and 1 of every 8 non-Hispanic

housing units were selected. In the third stage, one adult per household among Hispanics aged 25 to 64 years and non-Hispanics was selected at random and considered eligible for interview. All Hispanics 65 years or older were also eligible for interview.

In summary, there were 3 strata: a 1-in-8 sample of all non-Hispanic households, with 1 adult eligible for interview; a census of Hispanic households, with 1 adult aged 25 to 64 years eligible for interview; and a census of Hispanic individuals 65 years or older. We accounted for stratification by including age and ethnicity in our multivariate models.

Selected and consenting residents were interviewed in their homes. The survey instrument covered a wide array of demographic, behavioral, social, and health indicators. The interview rate in the main study was 80%, yielding a sample size of 2706. A total of 102 respondents did not self-identify as White, Black, or being of Mexican descent, and these individuals were removed from the analyses. Thus, the final sample size was 2604. Blood samples were obtained from 54% of the participants (n=1410).

A trained phlebotomist drew blood in a clinic or in the respondent's home. Blood samples were centrifuged to obtain plasma, which was stored at −70°C until testing. Plasma cortisol was measured via enzyme immunoassay. Standard enzyme-linked immunosorbent assay methods were used to analyze plasma levels of interleukin-6 (IL-6), interleukin-10 (IL-10), C-reactive protein (CRP), and tumor necrosis factor α (TNF-α). Samples were batch analyzed to minimize interassay variation.

Measures

Allostatic load. Data based on 12 biomarkers were used to create the allostatic load summary score. For each biomarker, a dichotomous variable was constructed in which 1 reflected values in the high-risk quartile and 0 reflected values in the lower-risk range. We created gender-specific allostatic load scores by summing the risk factors in the high-risk quartile for each gender. Summative scores were then merged into 1 gender-specific score, consistent with previous research suggesting that gender-specific values should be used to refine the concept of allostatic load.[14]

In addition, we created 4 subsets of biomarkers reflecting cardiovascular, metabolic, inflammatory, and stress hormone parameters. The cardiovascular measurements included systolic and diastolic blood pressure, and the indicators of metabolic activity included high-density lipoprotein (HDL) cholesterol, total-to-HDL cholesterol ratio, glycated hemoglobin, body mass index (BMI), and triglycerides. The inflammatory markers were CRP, IL-6, IL-10, and TNF-α. One stress hormone measure was available: serum cortisol, adjusted for time of day. Risk factors were summed to produce a total allostatic load score and scores for each of the parameters; higher scores indicated higher allostatic load.[15,16,27,28]

Acculturation. On the basis of the work of Hazuda et al., we measured English-language use, social integration, and cultural assimilation.[29] The measure of English-language usage comprised 6 items focusing on the primary language spoken by respondents as adults and as children (Cronbach α=0.94). The childhood interaction measure was made up of 3 items that reflected the ethnicity of people with whom respondents had associated when they were children (Cronbach α=0.90), and the adult interaction measure was made up of 4 items that addressed the ethnicity of people with whom respondents associated as adults (Cronbach α=0.89). Finally, the preserving Mexican culture measure included 3 items addressing the importance of children knowing the history and customs of Mexico (Cronbach α=0.75). Higher scores reflected greater acculturation.

In addition, length of residence in the United States has been shown to be related to health behaviors, health status, and mortality.[30–34] Several researchers have used a cutoff of 10 years or less in the United States to denote a low level of exposure to US mainstream culture with respect to poor health behaviors (e.g., consuming a diet high in fats, not engaging in physical activity).[30,33] We compared foreign-born Mexicans who had lived in the United States for 10 years or less and those who had lived in the country for more than 10 years with US-born Mexican Americans.

Other covariates. Consistent with the research of Crimmins et al.,[15] we included age, education, income, health insurance, physical inactivity, and smoking status in our multivariate models. Respondents who had less than a high school

degree and those who had a high school degree were compared with respondents with more than a high school education. Income was divided into 4 categories; respondents earning less than $20000, those earning $20000 to $50000, and those with missing data on income were compared with respondents earning more than $50000. Current health insurance coverage was coded dichotomously (yes or no); lack of exercise was measured as no vigorous or moderate activity in the preceding week. Finally, respondents who were former and current smokers were compared with those who had never smoked.

Analysis Plan

Descriptive statistics were generated to illustrate allostatic load distributions and central tendencies by ethnicity and nativity. To examine the association of ethnicity with total allostatic load score and the 4 subscores, we evaluated a combination of ordered logistic and ordinary least squares models. We treated allostatic load as an ordinal variable and used ordered logistic models to examine the extent to which ethnicity and nativity were associated with low (0–1), medium-low (2), medium-high (3), or high (4 or higher) allostatic load scores.

Ordered logistic models assume that the coefficients that describe the relationship between each pair of outcome groups are the same.[35] The P value for the proportional odds model assumption was .67, indicating that the assumption was not violated and that ordered logistic regression was appropriate. In other words, the odds ratio (OR) was assumed to be constant for all categories. Therefore, odds ratios above 1 reflected an increased likelihood of being in a higher allostatic load category, and odds ratios below 1 reflected a reduced likelihood of being in such a category.

We used ordinary least squares models to evaluate the associations among ethnicity, nativity, and cardiovascular, metabolic, inflammatory, and stress hormone system markers. We used analyses identical to those just described to more closely examine the effects of acculturation on the relationship between nativity and allostatic load among people of Mexican origin only. In the analyses focusing on the overall sample, the 2 strata variables, age and ethnicity, were accounted for in all models.

RESULTS

Table 1 presents data on the sociodemographic, health behavior, and acculturation measures for the sample and the biomarkers used to calculate the allostatic load score. Approximately half of the respondents were former or current smokers, and 60% had health insurance coverage. Table 1 also indicates that 72% of respondents of Mexican origin were born in the United States. Finally, the average allostatic load score for the sample was 2.9.

Table 2 shows unadjusted total allostatic load score means, as well as score means for the cardiovascular, metabolic, inflammatory, and stress hormone components, by ethnicity and by nativity among people of Mexican origin. These results indicate that Blacks had the highest total allostatic load scores, although differences were statistically significant only in comparison with foreign-born Mexicans. In addition, there was variation across component scores, such that Blacks had higher cardiovascular and inflammatory system scores than both US-born Mexican Americans and Whites. Finally, US-born Mexican Americans had higher metabolic component scores than Whites and foreign-born Mexicans.

Table 3 shows the results of the regression models estimating the associations of ethnicity and nativity among people of Mexican origin with total allostatic load and component system scores. Each model was adjusted for sociodemographic and health behavior factors. The ordered logistic regression results indicate that foreign-born Mexicans were less likely than Whites to score in the higher allostatic load categories (OR=0.62; 95% confidence interval [CI]=0.43, 0.89). US-born Mexican Americans and Blacks were more likely to score in the higher allostatic load categories than were Whites, although the differences were not statistically significant (Ps=.081 and .059, respectively).

Table 3 also shows that Blacks had significantly higher cardiovascular and inflammatory subscores than Whites. Also, US-born Mexican Americans had higher metabolic function scores than Whites. There were no significant ethnic differences in stress hormones in our sample.

An additional way of exploring the relationship between nativity and allostatic load is to restrict the sample to people of Mexican origin and examine the links between measures of acculturation, nativity status, and allostatic load. Table 4 shows the ordered logistic regression results. Measures of acculturation included interaction with mainstream society both as an adult (model 2) and as a child (model 3), the importance of preserving Mexican culture (model 4), and English-language use (model 5).

Model 1, which focused on the association between nativity and total allostatic load score, indicates that US-born Mexican Americans were more likely than foreign-born Mexicans to score in higher allostatic load categories. Models 2 through 5 indicate that there were no significant associations between the acculturation measures used in this analysis and total allostatic load.

Finally, one additional variable that may shed light on the relationship between nativity and allostatic load is length of residence in the United States. Model 6, which incorporated length of residence, indicates that foreign-born Mexicans who had lived in the United States for 10 years or less had a 62% reduced likelihood of scoring in the higher allostatic load categories relative to US-born Mexican Americans. Foreign-born Mexicans who had lived in the United States for more than 10 years had a 42% reduced likelihood of scoring in the higher categories relative to US-born Mexican Americans.

DISCUSSION

Our intent in this research was to build on the preexisting evidence of ethnic differences in allostatic load. There are 2 key aspects of our study. First, the results are consistent with those of NHANES, such that we found that Blacks had higher total allostatic load scores and cardiovascular and inflammatory marker scores.[13,15] In addition, we found disadvantages among US-born Mexican American in metabolic system scores.

Second, we expanded the existing research by exploring relationships between acculturation, nativity, length of residence in the United States, and allostatic load. We found significant advantages in allostatic load among foreign-born Mexicans, even when we took acculturation into account. Also, foreign-born Mexicans

TABLE 1—Sample (n = 1410) Sociodemographic Characteristics, Health Behaviors, Acculturation Measures, and Biological Markers: Texas City Stress and Health Study, 2004–2006

	%	Mean (SD)	Range
Demographic characteristics			
Age, y		49.0 (16.1)	25–90
Female	58.6		
Education, y		11.5 (3.2)	0–29
Ethnicity			
Non-Hispanic White	35.5		
Non-Hispanic Black	12.5		
Mexican origin	52.0		
US born	72.1		
Foreign born	27.9		
Household income, $			
< 25 000	35.6		
25 000–49 000	32.1		
≥ 50 000	21.8		
Data missing	11.0		
Health behaviors			
Has health insurance	60.1		
Sedentary	27.2		
Smoking			
Former smoker	20.7		
Current smoker	29.7		
No history of smoking	49.4		
Acculturation			
Adult interaction		7.9 (1.9)	4–12
Childhood interaction		5.1 (1.9)	3–9
Preserving Mexican culture		5.1 (2.5)	3–15
English-language usage		18.1 (6.8)	6–28
% census tract Hispanic		23.1 (16.0)	0–100
No. years in the United States			
≤ 10	27.7		
> 10	72.2		
Biological markers			
Diastolic blood pressure, mmHg		75.6 (11.1)	40–130
Systolic blood pressure, mmHg		124.1 (19.1)	74–240
Glycated hemoglobin, %		6.1 (1.5)	4–16
HDL cholesterol, mg/dL		51.4 (15.1)	8–100
Total/HDL cholesterol ratio		4.3 (91.6)	0.5–26
BMI, kg/m^2		30.7 (7.3)	13–60
Interleukin-6, pg/mL		2.0 (4.8)	0.01–84
Interleukin-10, pg/mL		4.9 (16.0)	0.01–452
C-reactive protein, mg/dL		13.6 (16.5)	0.02–188
Tumor necrosis factor α, μg/L		5.7 (22.4)	0.01–551
Triglycerides, mg/dL		160.4 (125.8)	28–1420
Cortisol, μg/dL		22.9 (11.7)	0.01–180
Total allostatic load		2.9 (1.9)	0–11

Note. BMI = body mass index; HDL = high-density lipoprotein.

who had lived in the United States for 10 years or less were less likely than foreign-born Mexicans who had lived in the country for more than 10 years to have high allostatic load scores (62% vs 42%; Table 4). In the discussion to follow, we focus on how our findings fit into and inform healthy immigrant and acculturation arguments about why newer Mexican immigrants have better health profiles.

Healthy Immigrant and Acculturation Arguments

Our findings are consistent with research demonstrating health advantages for newer immigrants,[36,37] as well as with research suggesting that health declines are associated with increased time spent in the United States.[30,38] We included acculturation measures, length of residence in the United States, percentage of Hispanics living in the study census tract, and health behaviors to explain the newer immigrant advantage. Our results suggest that acculturation measures were not associated with allostatic load, and the association between US-born status and higher allostatic load scores remained significant among people of Mexican origin after available measures of acculturation had been taken into account.

What our study and NHANES[15] add to the general knowledge base on immigrant health is a potential explanation of this phenomenon in terms of allostatic load. In the NHANES study, foreign-born Hispanics had biological risk profiles similar to those of non-Hispanic Whites but had an advantage over their US-born Hispanic counterparts.[15] However, in our study, foreign-born Mexicans had lower allostatic load scores than Whites. An interesting aspect of this finding is that although overall allostatic load scores among foreign-born Mexicans were lower, not all component scores were significantly lower. In other words, the allostatic load advantage is a cumulative one that is based on slightly lower scores across the range of allostatic load components.

It is possible that our sample of foreign-born Mexicans taking part in the Texas City Stress and Health Study differed substantively from that of the NHANES study. Also, the Whites in Texas City could have differed from their NHANES counterparts. For example, 49.2% of White women in NHANES[39] had "healthy" BMIs (18.5–24.9 kg/m^2), as opposed to 29.6%

TABLE 2—Unadjusted Allostatic Load Score Means and Component Means, by Ethnicity: Texas City Stress and Health Study, 2004–2006 (n = 1410)

	White (n = 535)	Black (n = 150)	Mexican Origin All (n = 725)	Mexican Origin US Born (n = 544)	Mexican Origin Foreign Born (n = 181)
Total allostatic load score, mean (SD)	2.87 (1.91)	3.21 (1.83)[a]	2.94 (1.95)	3.07 (1.94)	2.55 (1.93)[b]
Component score, mean (SD)					
Cardiovascular	0.53 (0.71)	0.73 (0.81)[a,b,c]	0.48 (0.71)	0.50 (0.70)	0.40 (0.71)[c]
Metabolic	1.17 (1.27)	1.19 (1.21)	1.32 (1.35)[c]	1.40 (1.36)[a,c]	1.10 (1.31)
Inflammatory	0.99 (0.84)	1.15 (0.83)[a,c]	0.97 (0.84)	1.01 (0.85)	0.87 (0.80)
Stress hormone	23.3 (10.3)	23.1 (9.3)	22.1 (9.6)	22.0 (9.7)[c]	22.6 (9.4)

Note. Allostatic load scores ranged from 0–11. All differences were significant at P < .05.
[a]Significantly different from foreign-born Mexican respondents.
[b]Significantly different from US-born Mexican American respondents.
[c]Significantly different from White respondents.

in the Texas City sample. Likewise, 38.1% of White men in NHANES[39] were in the healthy weight range, as compared with 20.5% in the Texas City sample.

We expanded on the evidence established in NHANES[15] in that we attempted to determine possible explanations for higher allostatic load scores among US-born Mexican Americans by accounting for health behaviors and acculturation. There is a well-established pattern according to which, regardless of country of origin, the longer immigrants reside in the United States, the more likely they are to begin to adopt negative health behaviors such as smoking, drinking, and

eating diets high in fat and sugar.[33] If a protection effect with respect to acculturation factors were to exist, one would expect that adjusting for health behaviors such as smoking and physical activity would minimize the impact of nativity on allostatic load. However, when we compared models with and without health behaviors included (data not shown), there was no evidence of attenuation of the effects of nativity on allostatic load.

In addition, foreign-born Mexicans who had lived in the United States for shorter periods of time were less likely than were foreign-born Mexicans who had lived in the country for

longer periods to have high allostatic load scores. The findings just described are consistent with recent research suggesting that immigrants enter the United States in relatively good health but then converge with US residents' levels of health over time.[30,38] When combined with the lack of an acculturation effect, however, these findings are somewhat puzzling. It is possible that our acculturation measures did not capture significant aspects of the process in which, over time, allostatic load scores increase among people of Mexican origin. For example, an aspect of the immigrant assimilation experience is the stress of discrimination, which is arguably more intense for newer arrivals than for those who have lived in the United States for longer periods.[40,41]

In addition, a foreign-born advantage remained even among those who had lived in the country for longer periods, suggesting that certain characteristics of early life in the United States (e.g., cultural norms and habits) may be related to increased allostatic load scores in the US-born population. More complex research designs (e.g., longitudinal designs) are necessary to tease out the mechanisms through which ethnicity, nativity, and acculturation influence allostatic load.

Limitations

Although our findings shed light on the relationships among ethnicity, allostatic load, nativity, and acculturation, there are limitations to the interpretability of these results. First, measuring acculturation is complex, and critics argue that many of the current scales are not comprehensive and do not capture all of the facets of this complicated concept.[32] Many of the findings with respect to acculturation are mixed. It is possible that if we had assessed other dimensions, the results would have been different. Second, the study survey included questions about exercise and smoking behaviors but did not include questions about diet. Diet is a critical component of analyses, focusing on ethnicity and acculturation with respect to health outcomes.[32] If the health-protective nature of factors related to immigration and length of residence in the United States is to be more fully addressed, more detailed information is needed on generational status and support structures.

Third, we did not gather information on return migration. Researchers have suggested

TABLE 3—Results of Ordered Logistic and Ordinary Least Squares Regression Analyses Estimating Associations Between Ethnicity and Total Allostatic Load and Component Scores: Texas City Stress and Health Study, 2004–2006

Race/Ethnicity[a]	Allostatic Load Total,[b] OR (95% CI)	Cardiovascular,[c] b (SE)	Metabolic,[c] b (SE)	Inflammatory,[c] b (SE)	Stress Hormone,[c] b (SE)
Black	1.39 (0.99, 1.93)	0.21** (0.07)	−0.04 (0.12)	0.17* (0.08)	−0.83 (1.09)
US-born Mexican American	1.23 (0.97, 1.55)	−0.00 (0.04)	0.20* (0.08)	0.03 (0.05)	−1.12 (0.72)
Foreign-born Mexican	0.62 (0.43, 0.89)	−0.08 (0.07)	−0.16 (0.13)	−0.08 (0.08)	−0.82 (1.14)
Total no.	1405	1354	1405	1405	1070

Note. CI = confidence interval; OR = odds ratio. Models adjusted for age, education, income, health insurance, smoking, and physical activity.
[a]White is the reference category.
[b]Ordered logistic regression.
[c]Ordinary least squares regression.
*P < .05; **P < .01.

TABLE 4—Results of Ordered Logistic Regression Analyses Estimating Allostatic Load Among People of Mexican Origin: Texas City Stress and Health Study, 2004–2006

	OR (95% CI)					
	Model 1 (n = 723)	Model 2 (n = 389)	Model 3 (n = 697)	Model 4 (n = 666)	Model 5 (n = 714)	Model 6 (n = 723)
US born	1.99 (1.41, 2.80)	2.72 (1.64, 4.83)	1.92 (1.31, 2.84)	2.04 (1.43, 2.91)	2.37 (1.52, 3.71)	1.00
Adult interaction		0.90 (0.80, 1.02)				
Child interaction			1.03 (0.94, 1.12)			
Preserving Mexican culture				0.98 (0.93, 1.04)		
English-language usage					0.98 (0.95, 1.01)	
No. of years in US[a]						
≤ 10						0.38 (0.21, 0.68)
> 10						0.58 (0.39, 0.84)

Note. CI = confidence interval; OR = odds ratio. Analyses adjusted for age, education, income, health insurance, smoking, and physical activity.
[a]The comparison category is US born.

that an additional selection argument potentially reflecting immigrants' better health is the proclivity of unhealthy immigrants to return to their native country.[15,22,42] Finally, our sample is not generalizable. The participants in the Texas City Stress and Health Study lived near (within 4 mi) petrochemical activities, and these activities have been found to have complex associations with risk perception, stress, self-reported health, and ethnicity.[43–46] How this type of environment affected the relationships assessed in our study is not clear. Nevertheless, our sample, although not generalizable, yields important details on the relationships between nativity, acculturation, ethnicity, and allostatic load.

Conclusions

Future research should continue to replicate and expand on findings relating to ethnicity and allostatic load. One important area of expansion should focus on the relationships among Hispanics between other measures of acculturation and assimilation and biological risk factors. Health behaviors related to acculturation, such as diet, exercise, and use of preventive health care services, would be important to explore in the association of nativity and allostatic load. More detailed research on health behaviors will help to better answer the question of how nativity and acculturation influence biological risk factors.

Finally, studies of allostatic load should be used to inform the "Hispanic paradox," the finding that most Hispanic populations in the United States have mortality profiles comparable to those of non-Hispanic Whites, even though these populations are substantially disadvantaged with respect to income, education, and access to health care.[21–23,47] The pattern of lower allostatic load scores among Mexican immigrants found in our study and by Crimmins et al.[15] in their study is consistent with the concept that the Hispanic paradox is driven partially by the healthy immigrant effect. This pattern is consistent as well with the idea that Hispanic immigrants may be healthier at the time of their immigration and then converge to native population levels as a result of the erosion of culture-related protective factors such as diet and other health behaviors and social support mechanisms. ∎

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