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Acculturation And Diabetes Risk Among Mexican Americans

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Abstract

Mexican Americans experience a disproportionate burden of type 2 diabetes in the United States, but it is unclear how acculturation influences diabetes risk in this Hispanic subgroup. We studied the influence of acculturation on diabetes risk in a large cohort of Mexican Americans. Acculturation was assessed at baseline by means of language use, birth country, and duration of residence in the U.S. (among Mexico-born participants). Self-reported diabetes status was ascertained during annual follow-up interviews. Cox proportional hazards regression was used to model the influence of each acculturation proxy variable on incident diabetes. Interactions with each acculturation measure were also tested for gender and education level. In bivariate analyses, greater acculturation was associated with older age, higher education, higher BMI, lower physical activity levels, and a greater likelihood of current/former smoking and alcohol consumption. In multivariate adjusted analyses, diabetes risk was higher among immigrants with 15-19 years (HR=1.40; 95% CI 1.01, 1.93) and 20+ years (HR=1.55; 95% CI 1.15, 2.09) of U.S. residence, relative to those with less than 5 years. Diabetes risk was not significantly associated with either language use or birth country overall, but gender was found to modify these relationships. A greater risk was observed among English-dominant males relative to Spanish-dominant males (HR= 5.67, 95% CI=1.63-19.69) and U.S.-born males relative to Mexico-born males (HR=4.01, 95% CI=1.53-10.49). Future studies of acculturation and health should examine multiple proxy measures or use multi-dimensional acculturation scales. Gender-specific relationships should also be considered in future studies of acculturation as a risk factor for diabetes.

Table of Contents

List of Tables

Introduction

As with other racial and ethnic minority groups in the U.S., the likelihood of developing type 2 diabetes is elevated among Hispanics relative to non-Hispanic whites. For Mexican Americans, who comprise the largest Hispanic subgroup, the prevalence is nearly twice as high compared to non-Hispanic whites (13.9% vs 7.6%).[1] Along with higher diabetes rates, Hispanics also exhibit poorer glycemic control,[2,3] greater risk of diabetes-related complications,[4] and greater diabetes mortality.[5] Given rapid increases in both the size of the Hispanic population[6] and the diabetes prevalence among Hispanics,[7] this represents a growing challenge for the U.S. healthcare system. In order to improve diabetes prevention and screening efforts, it is critical to understand the basis for the disproportionate diabetes burden in the Hispanic population.

Genetic predisposition has been proposed as one reason for the disparity, though it is generally agreed that environmental influences also play a role,[8] and may interact with genetics to drive diabetes development. Previous comparisons of genetically similar Mexican and Mexican-American populations have demonstrated the importance of culture, with higher diabetes prevalence exhibited among the latter group.[9-11] This suggests that assimilation into U.S. culture may contribute to the diabetes burden among Hispanics. Acculturation, or the adoption of the attitudes, values, customs, beliefs, and behaviors of the host culture,[12] has indeed been associated with some unhealthy behaviors[13] and poor health conditions[14] among Hispanics. Importantly for diabetes risk, greater acculturation has been associated with increases in BMI[13] and adoption of poor dietary habits[15] among both men and women.

Previous studies have investigated acculturation and diabetes risk among Hispanics, but results have been inconsistent.[16-26] However, few studies have used prospective data from a large cohort of Hispanic individuals, and few have investigated potential modifiers of the relationship. Additionally, while a number of studies have focused on elderly Hispanics, the relationship among adults of all ages has not been well documented in longitudinal studies. The purpose of this study was to examine diabetes risk in relation to acculturation in a large population-based cohort of Mexican Americans, as well as to identify potential effect modifiers.

Methods

Participants

Data for these analyses came from an ongoing population-based cohort study of Mexican Americans in the Houston area. The study was initiated by the Department of Epidemiology at The University of Texas M.D. Anderson Cancer Center in 2001 and now includes over 23,000 adult participants. The aim of this cohort is to better understand risk factors and protective factors for chronic diseases in the Mexican American population.[27] Thus comprehensive data pertaining to lifestyle and environmental factors and disease outcomes have been collected.

Details of eligibility and recruitment procedures can be found elsewhere.[27] Briefly, participants are self-identified Mexican Americans who have resided in the Houston, Texas area for at least 1 year. Participants were recruited from locations such as community centers, health clinics, and other neighborhood facilities. Following enrollment, participants in the cohort completed an interview, which included an assessment of self-reported diabetes status, acculturation-related variables, demographic information, and lifestyle characteristics. Participants were then re-contacted annually following enrollment, and self-reported diabetes status was ascertained during each follow-up. To validate self-reported diabetes status, medical records were reviewed for a subset of participants (n=235). Agreement between self-reported status and medical records was 98%. For this analysis, all adult participants (aged 21 and older) with demographic data and at least one annual follow-up who were diabetes-free at baseline were included (n=15,647).

Acculturation Measures

Two four-item scales assessing language use were used to assess level of language acculturation. Derived from the Bidimensional Acculturation Scale,[28] one scale pertained to frequency/ability of English usage, while the other pertained to frequency/ability of Spanish usage. Three items on each scale addressed frequency of speaking, watching television, or listening to radio programs in the given language. For these items, responses were scored from 1 to 4, with a higher score reflecting a higher frequency. The fourth item on each scale addressed reading ability in the given language and was also scored from 1 to 4, with a higher score reflecting a greater ability. For each of the two scales individually, scores from the four items were averaged. Thus each participant received two scores, one reflecting English frequency/ability and one reflecting Spanish frequency/ability. Similar to previously used methods,[28,29] scores were then used to place participants into one of three acculturation groups: (1)Spanish-dominant (≥2.5 on the Spanish scale only); (2)Bilingual (≥2.5 on both the English and Spanish scales); and (3)English-dominant (≥2.5 on the English scale only). Participants scoring <2.5 on both the English and the Spanish scales were excluded from analyses involving language acculturation (n=137).

Birth country and number of years lived in the US were also used to assess acculturation. Participants were categorized as Mexico-born or U.S.-born based on self-reported country of birth. Among participants born in Mexico, years of U.S. residence was categorized as a five level variable (<5 yrs, 5-9 yrs, 10-14 yrs, 15-19 yrs, 20+ yrs).

Statistical Analysis

Baseline participant characteristics were compared across language acculturation groups. Chi-square analyses were used for categorical variables and ANOVA was used for continuous variables.

Cox proportional hazards regression models were fit to investigate the relationship between language acculturation and time to incident diabetes. Similar analyses were performed using birth country and years in the US (among Mexico-born) as measures of acculturation. For participants with incident diabetes, follow-up time in years was calculated using age at enrollment and age at diagnosis. For participants who remained diabetes-free, follow-up time was calculated using age at enrollment and age at most recent follow-up. Deceased participants were censored using age at death. For each independent variable, the proportional hazards assumption was first checked by visual inspection of log-log plots. If the hazards appeared to be non-proportional, a time-interaction term was created as the product of the independent variable and follow-up time in years. This time-interaction term was then added to the proportional hazards model. If the time-interaction term was significant ($p<0.05$), this term was retained in all final models to account for the interaction of the independent variable with follow-up time.

For each acculturation measure, the group presumed to be least acculturated (Spanish-dominant, Mexico-born, <5 years in the US) was used as the reference group. Multivariate adjustments were performed for sex, age (continuous), alcohol consumption (current/former or never), smoking status (current/former or never), BMI (<25.0, 25.0-29.9, ≥30.0), physical activity (continuous, MET min/week), and education level (some high school or less, high school graduate, some college, or college graduate).

Sex and education level were evaluated as potential effect modifiers. This was done by testing the interaction of each variable separately with language, birth country, and years in the US in the proportional hazards models. For significant interactions, stratified analyses were performed for the modifying covariate, in both unadjusted and multivariate-adjusted models. All analyses were performed using SAS software (version 9.3; SAS Institute, Cary, NC).

Results

Baseline participant characteristics are presented in Table 1. The sample was predominantly female (78.4%), and the mean age among all participants was approximately 40 years. The majority of participants was born in Mexico (76.7%), did not graduate from high school (58%), was married (80.0%), had never smoked (74.6%), and did not consume alcohol (67.5%). Most participants were either overweight (36.4%) or obese (45.6%) and most reported moderate/high physical activity (70.6%).

The majority of participants were Spanish dominant (n=9258), followed by Bilingual (n=4862), and English-dominant (n=1527). For every characteristic assessed at baseline, significant differences were observed among language acculturation groups. English-dominant participants were older than the other two groups. Spanish-dominant participants were more likely to be female and more likely to be married. English-dominant and bilingual participants were more educated and more likely to be current/former smokers and alcohol consumers. English-dominant persons were more likely to be obese, while Spanish-dominant persons were more likely to be overweight. Spanish-dominant and bilingual participants were more likely to report moderate/high physical activity levels than English-dominant participants.

In unadjusted regression analyses (Table 2), language acculturation was not associated with diabetes risk. For birth country, findings were suggestive of a greater risk among U.S.-born relative to Mexico-born participants, but the difference was not significant (HR=1.32; 95% CI: 0.99, 1.76). Further adjustment for education, BMI, physical activity, smoking, and alcohol consumption also produced no significant associations for either language acculturation or birth country.

Among Mexico-born participants, there was evidence of an increase in diabetes risk with increasing years lived in the US in both unadjusted and adjusted models. Relative to those living in the US for <5 years, the risk was significantly elevated among those living 15 to 19 years (HR= 1.40; 95% CI 1.01, 1.93) and 20 or more years (HR=1.55; 95% CI 1.15, 2.09) in the adjusted model.

Interactions with education level were not significant for any of the acculturation measures. For sex, significant interactions were observed with language acculturation and birth country, but not with years lived in the US. Results for language acculturation and birth country, stratified by sex, are shown in Table 3. Among females, neither language acculturation nor birth country was associated with diabetes risk. For males, risk of diabetes increased with increasing acculturation. Relative to Spanish-dominant males, the risk was significantly higher among English-dominant males in the unadjusted model (HR=6.07; 95% CI: 1.84, 20.08). Though some attenuation was observed in the fully-adjusted model, the risk was still significantly higher among males who were English-dominant (HR=5.67; 95% CI: 1.63, 19.69). Similar relationships were observed for the association between birth country and diabetes risk. Relative to Mexico-born males, U.S.-born males were at a significantly greater risk of developing diabetes in both the unadjusted model (HR=5.29; 95% CI: 2.11, 13.23) and the fully-adjusted model (HR=4.01; 95% CI: 1.53, 10.49).

Discussion

In this large prospective study, three proxy measures were used to investigate the relationship between acculturation and type 2 diabetes risk among Mexican Americans. Overall we found that language acculturation and birth country were not associated with type 2 diabetes risk in this population. On the other hand, among Mexico-born participants, an increase in risk was observed with increasing years lived in the U.S. Secondary analyses suggest that gender modified the association with diabetes risk for language and birth country, but not for years lived in the US. These findings highlight the complexity of assessing acculturation and suggest that different proxy measures may capture different aspects of the multidimensional acculturation process. Furthermore, they demonstrate the importance of considering gender-specific associations, as they suggest that acculturation and migration may differentially affect the health of men and women.

Our finding of an increase in diabetes risk with increasing years in the US is consistent with results from previous cross-sectional studies among Hispanic immigrants[18] and among immigrants in general.[19,30] It is hypothesized that greater exposure to the US food environment and sedentary lifestyle leads to increases in body weight, which thereby explains much of the increase in diabetes risk with longer duration of residence. Prior work among Hispanics has shown that immigrants typically arrive with BMI levels below those of U.S. natives, but over time, BMIs converge to native levels.[31] In our sample, longer U.S. residence among immigrants was associated with higher baseline BMIs, independent of age (data not shown). Yet even with adjustment for baseline BMI, the increase in risk with longer duration of residence was still apparent. This suggests that other factors are involved, beyond simply increases in body weight with greater acculturation. One of these factors may be changes in diet composition. A systematic review found that more acculturated Latinos consumed more sugar, sugar-sweetened beverages, fast food, snacks, and added fats than less-acculturated Latinos.[15] Adoption of these unhealthy dietary preferences over time may lead to an increase in diabetes risk. Dietary data were not available for use in these analyses, so we were unable to assess this possibility.

The lack of an association with either language acculturation or birth country has also been found in previous cross-sectional studies. In a recent study using data from the National Health and Nutrition Examination Survey (NHANES), birth country and predominate language were not associated with diabetes prevalence among Mexican Americans.[25] Likewise, neither English ability nor citizenship status were significant predictors of diabetes in results from the California Health Interview Survey (CHIS).[18] Similar to our findings, however, results from CHIS did demonstrate an increase in diabetes prevalence with increasing years lived in the US. The disparate relationships observed with various acculturation proxies may appear to be an inconsistency in our findings. However, given that acculturation is a complex and dynamic process, it is likely that different proxy measures may reflect different aspects of acculturation. Thus the use of a single proxy measure may be inadequate to account for acculturation in studies of Latino health. Alternatively, it is possible that such proxy measures are unable to fully explain the complex relationship between the acculturation process and health outcomes such as diabetes risk.[12] Multidimensional measures may be needed to effectively evaluate such associations.

Ours is not the first study to demonstrate that men and women may be differentially affected by the acculturation process. Evidence suggests that acculturation exerts a stronger influence on diabetes risk factors, such as weight gain, among women compared to men.[13,32] Yet prior research has found that the positive association between acculturation and diabetes is stronger among males than among females. In their work, Gorman et al. propose that this may be explained by a gender gap in health conditions among the least acculturated. They report that less acculturated women have poorer health than less acculturated men, but this gap diminishes as men become more acculturated and their health deteriorates over time.[32] This could contribute to the differences between men and women observed in our study.

Alternatively, it is possible that less acculturated men are more likely to have undiagnosed diabetes, which could account for their lower self-report of diabetes relative to more acculturated men. Men who are recent immigrants may be less aware of health conditions such as diabetes, but this may change as they assimilate and increase their use of medical care.[32] A recent survey of Latino adults found that being male and being less assimilated are two characteristics associated with lack of access to a usual health care provider.[33] We were unable to assess health care utilization or access to care, so we could not confirm these relationships in our population. However, this could account for the observed increase in diabetes risk with acculturation among males. Further studies are needed to examine gender-specific predictors of diabetes among Mexican Americans, including those that account for a potential relationship between acculturation and healthcare utilization.

This study has several key strengths. Participants were drawn from a large cohort of solely Mexican American persons. Thus even after restriction to diabetes-free individuals with complete demographic and follow-up data, there were over 15,000 participants included in our analyses. Because participants were all of Mexican origin, this excluded the possibility of differing relationships between acculturation and diabetes among various Latino American subgroups. Furthermore, the average length of follow-up among participants was over 5 years, with some participants followed for as long as 13 years. Thus we were able to prospectively assess the relationships between acculturation and risk of developing diabetes. Finally, baseline interviews addressed a number of risk factors and demographic characteristics, which allowed us to adjust for a number of potentially confounding variables in our analyses.

This study also has several limitations. First, our study sample was comprised of fewer men than women. Thus the number of incident diabetes cases among males was relatively small, resulting in wide confidence intervals in analyses restricted to males. It is also possible that the significant relationship observed among males may be attributed to a decreased likelihood of reporting incident diabetes among the less acculturated males. Because blood measures were not used to assess diabetes status, we could not detect unreported diabetes outcomes. Additionally, some important risk factors for diabetes, including family history and diet, could not be adjusted for in this study. Thus we were unable to assess how these factors may influence the relationship between acculturation and diabetes risk. Finally, because more complete measures of acculturation were not available for this study, our assessment of acculturation was limited to proxy measures of acculturation. However, years of U.S. residence, language use, and birth country have been widely used to assess acculturation among Hispanics, and thus our use of these measures facilitates comparisons with the relevant literature.

In this study, number of years in the U.S. was positively associated with diabetes risk among immigrants from Mexico. Though language use and birth country were not associated with risk in the primary analyses, significant interactions with sex for these proxy measures suggested an increase in diabetes risk with acculturation among males. English-dominant males and U.S.-born males were at increased risk of diabetes relative to their Spanish-dominant and Mexico-born counterparts. To better understand these relationships, further studies are needed to examine which aspects of acculturation may be directly affecting diabetes risk. Relationships with health outcomes may vary for different proxy measures, so understanding the influence of acculturation may require the use of multiple proxy measures or multidimensional acculturation scales. Our findings also suggest that acculturation may have differential influences on the health of men and women, and thus future studies of acculturation should consider how gender may modify observed relationships. Overall, a better understanding of the acculturative influences on health may help in targeting high-risk groups for prevention and screening efforts.

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Table 1. Characteristics of baseline participants by acculturation group

	Total (N=15647)	Spanish Dominant (N=9258)	Bilingual (N=4862)	English Dominant (N=1527)	p-value*
Age	39.74 ± 12.84	39.9 ± 12.3	38.7 ± 13.1	41.2 ± 14.5	<0.001
Length of Follow-up	5.5±3.1	5.5±3.0	5.4±3.1	5.8±3.1	<0.001
Gender					<0.001
Male	3375 (21.6)	1613 (17.4)	1359 (28.0)	403 (26.4)	
Female	12272 (78.4)	7645 (82.6)	3503 (72.1)	1124 (73.6)	
Birth Country					
Mexico	11991 (76.7)	8971 (97.0)	2900 (59.7)	120 (7.9)	
U.S.	3636 (23.3)	277 (3.0)	1954 (40.3)	1405 (92.1)	
Education					<0.001
Less than high school	9063 (58.0)	6651 (71.9)	1867 (38.4)	545 (35.7)	
High school graduate	3507 (22.4)	1416 (15.3)	1550 (31.9)	541 (35.5)	
Some college	2593 (16.6)	1021 (11.0)	1182 (24.3)	390 (25.6)	
College graduate	476 (3.0)	165 (1.8)	261 (5.4)	50 (3.3)	
Marital Status					<0.001
Married	12500 (80.0)	7932 (85.8)	3656 (75.3)	912 (59.8)	
Never Married	1111 (7.1)	350 (3.8)	516 (10.6)	245 (16.1)	
Separated/widowed/divorced	2013 (12.9)	959 (10.4)	685 (14.1)	369 (24.2)	
BMI					<0.001
Normal (<25 kg/m^{2})	2712 (18.0)	1631 (18.2)	835 (18.0)	246 (17.0)	
Overweight (25-<30 kg/m^2)	5489 (36.4)	3371 (37.6)	1663 (35.8)	455 (31.4)	
Obese (30+ kg/m^2)	6875 (45.6)	3975 (44.3)	2153 (46.3)	747 (51.6)	
Smoking Status					<0.001
Never	11671 (74.6)	7410 (80.0)	3301 (67.9)	960 (62.9)	
Current/former	3973 (25.4)	1848 (20.0)	1558 (32.1)	567 (37.1)	
Alcohol Consumption					<0.001
Never	10545 (67.5)	7045 (76.2)	2792 (57.6)	708 (46.6)	
Current/former	5075 (32.5)	2204 (23.8)	2058 (42.4)	813 (53.5)	
Physical Activity					<0.001
Low (<600 MET-min/week)	4600 (29.4)	2734 (29.5)	1348 (27.7)	518 (34.0)	
Moderate/High (≥600 MET-min/week)	11038 (70.6)	6521 (70.5)	3511 (72.3)	1006 (66.0)	

Data are expressed as mean ± SD or n (%)
*P-values are from X^2

Table 2. Risk of developing diabetes by language acculturation, birth country, and years in the US

	Cases/ Non-cases	HR (95% CI) Unadjusted	HR (95% CI) Adjusted**
Language Acculturation*			
Spanish Dominant	589/8669	1	1
Bilingual	241/4621	0.94 (0.71, 1.26)	0.99 (0.72, 1.35)
English Dominant	95/1432	1.40 (0.93, 2.11)	1.18 (0.74, 1.88)
Birth Country*			
Mexico	708/11379	1	1
U.S.	223/3454	1.32 (0.99, 1.76)	1.05 (0.76, 1.45)
Years in the US among Mexico-born			
<5	62/1377	1	1
5-9	117/2570	1.11 (0.81, 1.51)	1.09 (0.80, 1.49)
10-14	142/2586	1.34 (0.99, 1.81)	1.21 (0.89, 1.64)
15-19	96/1593	1.59 (1.15, 2.19)	1.40 (1.01, 1.93)
20+	289/3236	1.94 (1.48, 2.56)	1.55 (1.15, 2.09)

*Models include time-interaction term

**Adjusted for age, sex, education, BMI, physical activity, smoking, alcohol

Table 3. Risk of developing diabetes by language acculturation and birth country, stratified by sex

	Males			Females		
	Cases/Non-cases	**Unadjusted HR (95% CI)**	**Adjusted HR (95% CI)****	**Cases/Non-cases**	**Unadjusted HR (95% CI)**	**Adjusted HR (95% CI)****
Language Acculturation*						
Spanish Dominant	25/1588	1	1	564/7081	1	1
Bilingual	30/1329	2.02 (0.73, 5.55)	1.48 (0.51, 4.31)	211/3292	0.96 (0.71, 1.30)	0.95 (0.68, 1.33)
English Dominant	15/388	6.07 (1.84, 20.08)	5.67 (1.63, 19.69)	80/1044	1.23 (0.79, 1.94)	0.91 (0.54, 1.52)
Birth Country*						
Mexico	38/2445	1	1	670/8934	1	1
U.S.	31/881	5.29 (2.11, 13.23)	4.01 (1.53, 10.49)	192/2573	1.15 (0.84, 1.57)	0.87 (0.61, 1.23)

*Models include time-interaction term
**Adjusted for age, education, BMI, physical activity, smoking, alcohol consumption