

# An Exploration of Differences in Sleep Characteristics between Mexico-born US Immigrants and Other Americans to Address the Hispanic Paradox

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**Study Objectives:** Decreased sleep duration and quality are associated with poor health. Given that Mexico-born US immigrants (MI) often have favorable health status relative to the general US population (USALL), we tested the hypothesis that MI have better sleep as compared to USALL and to Mexican-Americans (MA) born in the US

**Research Design and Methods:** Cross-sectional analysis of a stratified multistage probability sample of 18 years and older civilian non-institutionalized USALL enrolled in NHANES during 2005-2006. Age-adjusted population prevalence rates and adjusted odd ratios of short habitual sleep time (SHST) and insomnia were calculated using weighted analyses.

**Setting:** Computer assisted personal bilingual (English/Spanish) interviews in the participants' home using a sleep questionnaire.

**Participants:** 5160 USALL participants, including 1046 MA, of whom 620 were MI.

**Results:** In logistic regression models unadjusted and adjusted for socioeconomic characteristics, health related behavior risk factors, health status, and depression, MI status was significantly associated with lower odds of SHST (OR = 0.7, 95%CI [0.6-0.9]), insomnia (OR = 0.3, 95%CI [0.2-0.5]), and sleep-associated functional impairments (OR = 0.4, 95%CI [0.2-0.8]). In MA males, MI status was associated with reduced odds of SHST < 7 h/weeknight and insomnia symptoms. Cultural changes measured by increased levels of English compared to Spanish language spoken at home were associated with an increased risk of poor sleep in MA men in univariate models, and may partially explain better sleep in MI men compared to their US-born counterparts.

**Conclusion:** Compared to the general US population, Mexican-born US immigrants have more favorable sleep, possibly contributing to their lower reported risk of diabetes, hypertension, CVD, and all-cause mortality (the "Hispanic Paradox").

**Keywords:** Mexican-American, immigrant, Mexico-born, US-born, sleep duration, insomnia, cultural changes, Centers for Disease Control and Prevention (CDC), National Health and Nutrition Examination Survey (NHANES)

**Citation:** Seicean S; Neuhauser D; Strohl K; Redline S. An exploration of differences in sleep characteristics between Mexico-born US immigrants and other Americans to address the Hispanic paradox. *SLEEP* 2011;34(8):1021-1031.

## INTRODUCTION

Sleep duration and quality have been reported to be associated with general health and subjective well-being. Short sleep duration has been linked to increased mortality risk,<sup>1-4</sup> obesity,<sup>5-7</sup> impaired glucose metabolism including incident diabetes,<sup>8</sup> hypertension,<sup>9</sup> coronary heart disease,<sup>10</sup> and altered metabolism and neuroendocrine profile.<sup>11-14</sup> Insomnia symptoms in individuals reporting short sleep duration also have been associated with an increased risk of hypertension.<sup>15</sup> Sleep quality is strongly related to mood and emotions in healthy adults and to psychiatric conditions including depression and anxiety<sup>16-18</sup> and suicide.<sup>19</sup> Insufficient/inadequate sleep impairs attention, alertness, reaction time, and overall social functioning.<sup>20,21</sup>

Mexico-born immigrants (MI) represent the largest segment of the US foreign-born population, rising from over 9 million non-institutionalized individuals in 2000<sup>22</sup> to 11.5 million in 2008.<sup>23</sup> Despite social and economic disadvantages including limited access to healthcare, this population has been reported as having significantly lower mortality and morbidity, includ-

ing a lower prevalence of hypertension, cardiovascular disease (CVD), and symptoms of serious psychological distress when compared to the US-born population or to their US-born ethnic counterparts.<sup>24,25</sup> The phenomenon is still poorly understood and often referred to as the "Hispanic Paradox." Several theories have been proposed to explain these observations, including: (a) the "Healthy Immigrant Effect," or self-selection of healthier individuals emigrating from Mexico to the US; (b) the "Salmon Effect," referring to MI returning to their homeland when older or when their health declines; and (c) the "Social Buffering Effect," referring to the positive health influences of strong social support and family ties among MI.<sup>26,27</sup> It is also plausible that reported differences in health status among ethnic and immigrant groups could reflect biases: (d) selection biases, if MI participating in epidemiological research studies represent a subgroup of healthier individuals, or (e) reporting biases, leading to misclassification.<sup>28,29</sup> Overall, the "Hispanic Paradox" conflicts with findings of some international immigrant health research. According to studies conducted in countries other than the US, except for the most recent arrivals, immigrants often experience worse health status across most dimensions when compared to the country of immigration native-born population.<sup>30-32</sup>

A recent brief communication proposed that compared to the MI, Mexican-Americans (MA) born in the US may be at an increased risk of short habitual sleep time (SHST).<sup>33</sup> The relationship was reported to be attenuated after adjusting for smoking status, body mass index, and self-reported stress level. However, no other sleep related outcomes were available to this study, and the authors did not further explore the extent to which other

A commentary on this article appears in this issue on page 981.

Submitted for publication September, 2009

Submitted in final revised form March, 2011

Accepted for publication April, 2011

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individual risk factors, including a cultural shift from Spanish to American culture, had any effect on the observed relationship between MI and SHST.

The present study attempts to further clarify potential influences of social, cultural, and behavioral risk factors, self-reported health, and depression on sleep outcomes in MA, and assess if the data support a “Hispanic Paradox” in relationship to sleep outcomes.

We propose that Mexican-immigrant status is associated with better sleep quantity and quality, and that such associations are positively influenced by Mexican culture. Our analyses are guided by a few previous studies of cross-cultural psychology<sup>34,35</sup> describing differences in sleep habits between adults living in Mexico and the US and/or England: Mexicans have been reported to have a tendency to sleep longer at night and during the day (siesta).<sup>35</sup> Cultural differences in attitudes related to sleep have been proposed as possible causative factors.<sup>35</sup> Hispanic culture may reinforce sleep as necessary and positive in contrast to cultures that perceive sleep as a factor that negatively influences work productivity.<sup>35</sup>

Furthermore, we hypothesize that transitions and assimilation of the Anglo-oriented US culture shape health beliefs and behaviors, adversely influencing sleep quality and quantity in MA born in the US. Thus, we propose that a measure of cultural change should be significantly associated with poor sleep outcomes in all MA.

We propose the following specific hypotheses:

1. Compared to a sample of nationally representative US individuals, including MA born in US, MI have lower age-adjusted population prevalence and lower odds of reporting short habitual sleep time (SHST) and/or insomnia. These differences will persist after adjusting for social determinants of health vulnerability, self-reported general health characteristics, and behavioral health risk factors.
2. Cultural change exhibited by MA from Mexican culture to American culture, measured by this study through language use at home (English vs. Spanish), is associated with an increased risk of poor sleep outcomes in MA individuals.

## METHODS

### Data Source

Data were derived from the 2005-2006 National Health and Nutrition Examination Surveys NHANES<sup>38</sup> which is a 2-year cycle of cross-sectional studies conducted by The National Center for Health Statistics, Center for Disease Control (NCHS/CDC) on civilian non-institutionalized individuals. Questionnaires that included assessment of sleep habits and sleep related problems were administered by interviewers in the homes of participants aged 16 years and older using computer-assisted personal interview (CAPI) technology, with help from trained bilingual interviewers. A physical examination generally occurred within 1 to 2 weeks after the in-home interview in a set of specially designed and equipped mobile examination centers (MEC), which travel to survey locations throughout the country. The survey team consisted of a physician, medical and health technicians, and dietary and health interviewers. Complete details on recruitment, design, and content of the used sur-

veys are described on the NHANES website <http://www.cdc.gov/nchs/nhanes.htm>.<sup>38</sup>

Sleep variables were obtained by merging the sleep related data collected with the questionnaire with other files, including the demographic, health insurance, acculturation, social support, current health status, medical conditions, depression screener questionnaire files, body measurements, physical activity, serum cotinine, alcohol use, food frequency questionnaire, and drug use, by respondent sequence number. The NHANES study received approval from a human subjects committee, and the proposed analysis, as de-identified data, were exempted from receiving approval by the University Hospitals Case Medical Center of Cleveland Institutional Review Board.

### Subjects

Sleep questionnaire data were available for a total of 6139 individuals  $\geq 16$  years. Exclusion criteria for these analyses were: age  $< 18$  years old (576 participants, due to our interest in an adult population), pregnancy status (364 participants, due to associated changes in sleep physiology), and incomplete data on immigration/naturalization status (39 participants), resulting in an analytic sample of 5160 individuals.

### Sleep Characteristics

Sleep duration was identified based on response to the question: “How much sleep do you usually get at night on weekdays or workdays?” Two different cutpoints for defining short habitual sleep time (dichotomized yes/no) were used:  $< 7$  h/weeknight and  $< 6$  h/weeknight.

Insomnia symptoms were based on following questions: “trouble falling asleep,” “waking up during the night and had trouble getting back to sleep,” “waking up too early in the morning and unable to get back to sleep,” “feeling unrested during the day, no matter how many hours of sleep had.” Responses to each sleep question were collapsed as follows: occurring  $\leq 2$ -4 times per month (considered a negligible symptom), 5-15 times per month (“some level of insomnia” or “mild/moderate insomnia”), and  $> 15$  times/month (“severe insomnia”). Insomnia (yes/no) was defined by using the National Heart, Lung, and Blood Institute (NHLBI) Working Group definition<sup>39</sup> as one of 4 sleep complaints plus at least one self-reported daytime functional impairment due to lack of sleep. Insomnia with short sleep duration (yes/no) was defined as any one of the insomnia symptoms reported as occurring 5-15 times per month with daytime functional impairments reported as moderate or extreme and sleep duration  $< 7$  h/weeknight. Additional dichotomized outcomes (yes/no) include self-reported perception of insufficient sleep during the past month, and “trouble sleeping” ever reported to a physician or other health professional. The study also collected data on functional impairments related to sleepiness, including difficulties carrying out specific regular daily activities in the last month in the following areas: “concentrating on the things,” “remembering things,” “getting things done because too sleepy or tired to drive or take public transportation,” “performing employed or volunteer work or attending school,” “working on a hobby, for example, sewing, collecting, gardening,” and “taking care of financial affairs and doing paperwork (for example, paying bills or keeping financial records).”

## Mexico-Born Status and Mexican-American Ethnicity Variables

MI status (dichotomized yes/no) was assigned based on the answer “born in Mexico” on the question “in what country were you born?”

MA (dichotomized yes/no) was considered based on the response to the self-reported ethnicity (i.e., Mexican American). Both were collected with the demographic questionnaire.

## Covariates

Covariates included self-reported demographics, health related variables, and substance use. Age was reported in years at the time of NHANES screening. Education was dichotomized with a cutoff set at high school graduation. Race was coded as Mexican American (MA), other Hispanic, Non-Hispanic White, Non-Hispanic Black, and other race including multi-racial. Financial strain was measured as a continuous variable by poverty income ratio (PIR), a variable obtained by dividing the family income by the poverty threshold. Marital status was defined based on living with a partner/married or other. Insurance status was dichotomized as covered by any type of health insurance vs. not insured. Data on social support was available for individuals  $\geq 40$  years. Social support was coded as “insufficient” if the participant reported the absence of someone to either: (a) “help paying any bills, housing costs, hospital visits, or providing with food or clothes”; or (b) provide emotional support “such as talking over problems or helping make a difficult decision”; or if the participant reported that they “have used more emotional support than received in the last year.” Spanish language preference was used as a proxy measure of cultural change of minority individuals (MA) to the majority culture (American).<sup>34,36</sup> It was determined based on the language the participant reported to use at home with 5 levels: “all Spanish,” primarily Spanish (“more Spanish than English”), about equal use of Spanish and English (“both equally”), primarily English (“more English than Spanish”), and nearly all English (“only English”).<sup>38</sup>

Self-reported “overall general health” was also dichotomized by collapsing “fair” and “poor health” groups into the newly created variable “unsatisfactory health” vs. “satisfactory health.” Depression was assessed by using the 9-item Patient Health Questionnaire (PHQ), and applying a diagnostic algorithm by using the PHQ score of  $> 10$  as indication of major depression.<sup>41</sup> Weight and height were collected by trained health technicians, and body mass index (BMI)<sup>42</sup> was computed as the ratio of weight to height squared. The daily average total number of hours of TV, video, computer usage, and computer games for entertainment was calculated by summing the number of hours per day that the participant reported engaging in these activities over the past 30 days, and used as continuous and categorical variable proxy for sedentary leisure time.

Substance use ascertained by the NHANES examinations which may influence sleep quality included nicotine use, caffeine intake, alcohol, and recreational drug use. Current smoking status was assessed using study collected serum cotinine, a biomarker of environmental tobacco smoke exposure. Participants with cotinine levels  $\leq 10$  ng/mL were considered non-smokers.<sup>43,44</sup> Caffeine consumption was defined as positive if respondents reported having  $\geq 1$  cup/day of a caffeinated drink. Self-report of any alcohol usage was available for participants  $\geq$

20 years and was defined as  $\geq 1$  alcohol drink per month. Illegal narcotics or stimulant drug use was coded as positive if past use of marijuana, hashish, cocaine, heroin, or methamphetamine was reported.

## Statistical Analysis

General and sleep characteristics of the US population were analyzed according to Mexican origin, immigrant status, and gender, by using sample weights analyses in SAS 9.2 (Proc Survey, SAS Institute, Inc., Cary, NC) and the Taylor Series Linearization approach.<sup>40</sup> Age-standardization to the US Census 2000 population estimates was performed by the direct method, to generate age-adjusted prevalence rates and standard errors, based on the CDC-NCHS recommendations.<sup>38</sup> Logistic regression modeling was performed to evaluate the relationship between MI status (exposure variable) and each sleep outcome. Models included adjustments for gender, age, education, PIR, marital status, caffeine, alcohol, smoking, recreational drug use, sedentary leisure time, self-reported general health, and depression. In addition, in the MA cohort, models also included adjustment for language preference at home. Weights were normalized (standardized) to the size of the subsamples.<sup>37</sup> Analyses were stratified by gender due to known sleep related gender differences and potential interactions between gender and other variables of interest.

To explore the extent to which the immigration from Mexico effect on sleep outcomes was mediated by covariates, single-mediator models were developed using Baron and Kenny’s 4-step approach.<sup>46,47</sup> Change  $\geq 15\%$  of the  $\beta$  coefficient values was considered as evidence of mediation.<sup>48</sup> Additionally, the mediated effects for binary sleep outcomes were estimated using the MacKinnon and Dwyer method of standardization.<sup>49,50</sup>

Sensitivity analyses were conducted within age-specific groups and by using alternative definitions for exposures, including alcohol and illegal drug use. The consistency of the presented weighted results was tested in unweighted analyses.<sup>1</sup> In additional sensitivity analyses, BMI was included as a covariate. However, since inclusion of BMI did not alter the relationships of interest, and because obesity may be a consequence of poor sleep,<sup>5-7</sup> the final models did not present the BMI-adjusted results. Health insurance status was found to be significantly co-linear with social support and cultural changes in the MA cohort, so this variable was excluded from the final models that included these variables.

Two-tailed P-values  $< 0.05$  were considered significant.

## RESULTS

General characteristics of MI, MA born in US, and the overall US samples are displayed in Table 1A, stratified by gender. Compared to their MA counterparts, MI males were on average significantly poorer, less educated, more likely to be married or living with a partner, not covered by any health insurance (including Medicaid and Medicare), and reported insufficient social support. Compared to MA born in US, they were significantly more likely to speak Spanish at home, reported less time spent watching TV or using a computer for entertainment, and had a lower prevalence of smoking and illegal drug use. Compared to their MA counterparts born in the US, MI men also showed a lower prevalence of depression and a lower mean BMI.

**Table 1A**—General characteristics<sup>‡</sup>: Mexico-born immigrants, Mexican-Americans, and all US individuals<sup>##</sup>, by gender

	Males			Females		
		US-born			US-born	
	Mexico-born immigrants (N = 352)	Mexican-American (N = 191)	All US <sup>##</sup> (N = 2654)	Mexico-born immigrants (N = 267)	Mexican-American (N = 232)	All US <sup>##</sup> (N = 2506)
<b>Mean age</b> (at screening, in years)	<b>36.5 (1.0)<sup>b</sup></b>	37.6 (0.8)	44.7 (0.8)	<b>40.1 (1.2)<sup>b</sup></b>	39.8 (1.5)	47.1 (0.8)
<b>Mean poverty income ratio</b> (family income/poverty threshold)	<b>1.6 (0.1)<sup>ab</sup></b>	2.9 (0.1)	3.2 (0.1)	<b>1.5 (0.1)<sup>ab</sup></b>	2.6 (0.1)	3.0 (0.1)
<b>Education</b> (% individuals reporting no high school graduation)	<b>71.5 (3.0)<sup>ab</sup></b>	26.6 (3.9)	17.8 (1.6)	<b>67.3 (3.2)<sup>ab</sup></b>	19.8 (2.8)	16.0 (1.1)
<b>Insurance status</b> (% individuals reporting not covered by any type of health insurance)	<b>67.4 (4.7)<sup>ab</sup></b>	31.7 (3.9)	21.2 (2.0)	<b>65.3 (4.3)<sup>ab</sup></b>	19.4 (5.4)	15.8 (1.8)
<b>Marital status</b> (% individuals reporting married or leaving with partner)	<b>74.6 (3.1)<sup>ab</sup></b>	51.3 (5.0)	66.9 (1.7)	<b>75.4 (2.5)<sup>ab</sup></b>	51.8 (2.8)	59.4 (1.6)
<b>Insufficient social support<sup>c</sup></b> (% individuals reporting lack of 1 or more categories of social support)	<b>23.9 (2.6)<sup>a</sup></b>	14.5 (2.3)	23.3 (1.3)	<b>29.7 (3.5)<sup>ab</sup></b>	16.9 (2.8)	22.1 (1.3)
<b>Language use at home</b> (% individuals)						
Only Spanish (0)	<b>70.0 (4.4)<sup>a</sup></b>	0.8 (0.5)		<b>70.8 (4.5)<sup>a</sup></b>	1.5 (0.7)	
Spanish > English (1)	<b>15.5 (3.1)<sup>a</sup></b>	5.1 (1.8)	N/A	<b>18.1 (4.0)<sup>a</sup></b>	4.5 (1.9)	N/A
Spanish = English (2)	<b>9.2 (1.8)<sup>a</sup></b>	17.1 (2.0)		<b>7.4 (2.0)<sup>a</sup></b>	27.2 (4.2)	
Spanish < English (3)	<b>3.5 (1.4)<sup>a</sup></b>	36.0 (3.3)		<b>2.8 (0.3)<sup>a</sup></b>	22.7 (4.3)	
Only English (4)	<b>1.8 (0.8)<sup>a</sup></b>	41.5 (3.8)		<b>0.9 (0.6)<sup>a</sup></b>	44.1 (3.9)	
<b>Mean sedentary leisure time</b> (number hours per day of TV watching and computer use past month for entertaining)	<b>2.3 (0.1)<sup>ab</sup></b>	3.4 (0.3)	3.3 (0.1)	<b>2.4 (0.1)<sup>ab</sup></b>	3.1 (0.1)	3.2 (0.1)
<b>Current smokers</b> (% individuals with serum cotinine levels > 10 ng/mL)	<b>18.1 (2.5)<sup>ab</sup></b>	30.5 (3.5)	31.4 (1.3)	<b>6.8 (1.6)<sup>ab</sup></b>	12.0 (3.0)	20.4 (1.1)
<b>Caffeine use</b> (% individuals reporting drinking ≥ 1 cup caffeinated drink/day)	<b>23.2 (3.0)<sup>b</sup></b>	26.2 (4.3)	29.1 (1.6)	<b>15.5 (2.7)<sup>ab</sup></b>	24.3 (3.7)	25.6 (1.8)
<b>Alcohol use<sup>d</sup></b> (% individuals reporting drinking alcohol ≥ 1 time/month)	<b>72.9 (4.6)</b>	69 (5.1)	72.7 (3.6)	<b>29.7 (2.8)<sup>ab</sup></b>	53.3 (2.6)	55.7 (2.0)
<b>Illegal drugs use</b> (% individuals reporting ever use of marijuana, hashish cocaine, heroin, methamphetamine)	<b>19 (2.8)<sup>a</sup></b>	30.8 (2.5)	21.1 (1.8)	<b>0.8 (0.6)<sup>ab</sup></b>	16.8 (3.0)	12.6 (1.9)
<b>Unsatisfactory health</b> (% individuals reporting fair/poor health)	<b>29.9 (2.5)<sup>b</sup></b>	24.9 (3.6)	14.1 (0.7)	<b>30.4 (2.3)<sup>ab</sup></b>	19.4 (2.7)	15.0 (1.0)
<b>Mean BMI</b> (at screening, kg/m <sup>2</sup> )	<b>27.3 (0.3)<sup>a</sup></b>	29.9 (0.7)	28.5 (0.2)	<b>29.3 (0.4)</b>	29.2 (0.6)	28.5 (0.3)
<b>Depression</b> (% individuals with PHQ-9 score ≥ 10)	<b>4.1 (1.3)<sup>a</sup></b>	7.2 (2.2)	4.8 (0.3)	<b>7.4 (2.6)</b>	7.9 (2.3)	7.1 (0.7)

<sup>‡</sup>Analyses conducted using survey analyses: mean or percentage (%) (standard deviation). <sup>##</sup>All US (male and female) cohorts include both Mexico-born immigrants and Mexican-Americans born in the US. <sup>a</sup>P-values < 0.05, comparing Mexico-born immigrants with US-born Mexican-Americans (calculated separately for each gender). <sup>b</sup>P-values < 0.05, comparing Mexico-born immigrants with the all-US cohort (calculated separately for the male and female groups). N/A, not calculated as Spanish at home not representative. <sup>c</sup>Data on social support was available only for ≥ 40 years. The proportion was calculated including 3 categories: yes, no, missing data. <sup>d</sup>Data on alcohol use was available only for ≥ 20 years. The proportion was calculated including 3 categories: yes, no, missing data.

Compared to the general sample of US males, MI males were significantly younger and had higher rates of poverty, lower rates of high school completion, lower rates of health insurance coverage, and higher rates of living with a partner. MI males also had lower prevalence of caffeine use and reported less time spent watching TV or using the computer for entertainment. A significantly higher proportion of MI males reported fair and poor health, compared to the overall US male cohort.

Among females the distributions of demographic, health status, and health behaviors among MI, US-born MA, and the general US sample were generally similar to those reported for males (above). Notable differences in the patterns of sample characteristics in the male and female cohorts were for alcohol

use, which was lower among MI females than their MA counterparts and the general US female sample (with no such differences seen by Mexican ethnicity observed in males), and for BMI and depression, which were comparable among all female subgroups (although differed among the male subgroups).

Sleep characteristics of the groups of interest are displayed in Table 1B, stratified by gender. Compared either to their US-born counterparts or the overall sample of US males, MI male immigrants had a lower unadjusted prevalence of SHST, insomnia (including insomnia with short sleep time, mild/moderate insomnia, and severe insomnia), self-perceived sleep deprivation, poor sleep quality reported to a physician, and daily sleep-related functional impairments. Although MI females also tended to report a lower



**Table 1B**—Sleep characteristics<sup>‡</sup>: Mexico-born immigrants, Mexican-Americans, and all US individuals, by gender

	Males			Females		
	Mexico-born immigrants (N = 352)	US-born Mexican-American (N = 191)	All US males <sup>††</sup> (N = 2654)	Mexico-born immigrants (N = 267)	US-born Mexican-American (N = 232)	All US females <sup>††</sup> (N = 2506)
<b>SHST &lt; 7 h/weeknight</b> (% individuals reporting short habitual sleep time < 7 h/night)	<b>28 (1.3)<sup>a,b</sup></b>	48.7 (5.7)	37.6 (0.9)	<b>36.5 (2.9)</b>	42.5 (2.7)	34.1 (1.8)
<b>SHST &lt; 6 h/weeknight</b> (% individuals reporting short habitual sleep time < 6 h/night)	<b>11.3 (1.9)<sup>a,b</sup></b>	16.8 (2.6)	14.7 (0.8)	<b>14.7 (2.6)</b>	13.6 (2.5)	12 (0.8)
<b>Sleep deprivation self-perception</b> (% individuals reporting insufficient sleep in the past month)	<b>14.0 (2.6)<sup>a,b</sup></b>	27.0 (5.6)	23.6 (1.2)	<b>20.2 (3.3)</b>	27.8 (4.6)	27.2 (1.0)
<b>Mild/moderate insomnia</b> (% individuals with insomnia symptoms > 5-15 times/month)	<b>9.3 (2.5)<sup>a,b</sup></b>	20.6 (3.9)	22.4(0.9)	<b>20.5 (3.1)<sup>a,b</sup></b>	27.9 (3.3)	29.7 (1.5)
<b>Severe insomnia</b> (% individuals with insomnia symptoms > 15 times/month)	<b>2.3 (0.8)<sup>a,b</sup></b>	9.2 (2.1)	6.0 (0.4)	<b>5.5 (2.1)</b>	9.1 (2.3)	8.2 (0.9)
<b>Insomnia with SHST &lt; 7 h/weeknight</b> (% individuals with insomnia symptoms > 5-15 times/month also reporting short habitual sleep time < 7 h/night)	<b>4.1 (1.2)<sup>a,b</sup></b>	14.5 (3.0)	12.6 (0.6)	<b>11.3 (2.6)</b>	15.7 (3.0)	14.6 (1.0)
<b>Poor sleep quality reported to a physician</b> (% individuals reporting talking to the physician about having poor sleep quality)	<b>4.4 (1.4)<sup>a,b</sup></b>	22.0 (3.2)	18.1 (0.9)	<b>10.3 (2.3)<sup>a,b</sup></b>	22.0 (3.0)	27.8 (1.3)
<b>Difficulty concentrating due to sleepiness</b> (% individuals reporting it)	<b>2.1 (0.8)<sup>a,b</sup></b>	4.2 (1.8)	4.4 (0.4)	<b>1.9 (0.9)<sup>a,b</sup></b>	8.4 (1.6)	4.7 (0.5)
<b>Memory impairment due to sleepiness</b> (% individuals reporting it)	<b>1.3 (0.4)<sup>a,b</sup></b>	8.4 (2.7)	3.0 (0.4)	<b>2.0 (1.0)</b>	3.9 (1.4)	4.1 (0.5)

<sup>†</sup>Analyses conducted using survey analyses: mean or percentage (%), (standard deviation). <sup>††</sup>All US (male and female) cohorts include both Mexico-born immigrants and Mexican-Americans born in the US. <sup>a</sup>P-values < 0.05, comparing Mexico-born immigrants with US-born Mexican-Americans (calculated separately for each gender). <sup>b</sup>P-value < 0.05, comparing Mexico-born immigrants with the All US cohort (calculated separately for each gender).

frequency of sleep symptoms than the comparison groups, the only significant differences in unadjusted prevalence ratios were for reports of mild/moderate insomnia, poor sleep quality reported to a physician, and difficulty concentrating due to sleepiness.

Further estimates of standardized (2000 Census data<sup>38</sup>) population age-adjusted prevalence of sleep characteristics and sleep-related impairments are shown in Table 2. Compared to the general US male cohort, MI men tended to have lower standardized age-adjusted prevalence population estimates for all sleep outcomes, and the differences attained significance for: SHST < 7/weeknight, self-perceived sleep-deprivation, poor sleep quality reported to a physician, mild/moderate insomnia with/without short sleeping hours, and daytime sleepiness. Compared to their MA counterparts, MI men had lower age-adjusted prevalence rates for SHST (< 6 or < 7 h/weeknight), self-perceived sleep deprivation, mild/moderate insomnia with and without short sleep, and daily sleepiness.

Compared to the general US female sample, MI women also tended to have lower age-adjusted prevalence rates of sleep problems or short sleep, with significant differences found for self-perceived sleep deprivation, poor sleep quality reported to a physician, some level of insomnia, daytime sleepiness, and memory impairments due to sleepiness.

Compared to their US-born MA counterparts, MI women had lower age-adjusted population prevalence rates for poor sleep quality reported to a physician and difficulty concentrating due to sleepiness.

Table 2 also shows the overall differences in sleep symptoms by gender within each sample. A lower proportion of MI men than MI women reported SHST < 7 h/weeknight, poor sleep reported to a physician, and mild/moderate insomnia with or without short sleep (all P values < 0.05). These gender differences generally paralleled what was observed in the general US sample with the exception of SHST, which was more common in men than women in the general sample.

Table 3 shows the results of multivariate logistic regression models, stratified by gender and adjusted for sociodemographic characteristics (age, race, marital status, income, education, health insurance), substance use (caffeine, alcohol, smoking, recreational drug use), sedentary leisure time (TV and computer use for recreational purposes), and health characteristics (self-reported general health and depression). Except for SHST < 6 h/weeknight, MI status was significantly associated with lower odds of sleep-related problems in the combined male and female sample. In both men and women, the odds of insomnia and poor sleep quality reported to a physician were > 40% lower in MI than all other US individuals. Significantly lower odds of SHST < 7 h/weeknight were found with MI status in men but not in women.

### Sleep, Mexico-born Status, Cultural Change, and other Risk Factors for Poor Sleep in Mexican-Americans

Additional statistical modeling was performed to further explore the role of language/culture change (using language preference as a proxy for changes from Mexican to American

**Table 2**—Age-adjusted population prevalence of poor sleep outcomes in US adults 20 years and older in Mexico-born US immigrants, US-born Mexican Americans, and the general US population sample, by gender<sup>†</sup>

	Males			Females		
	Mexico-born immigrants (N = 352)	US-born Mexican-American (N = 191)	All US (N = 2654)	Mexico-born immigrants (N = 267)	US-born Mexican-American (N = 232)	All US (N = 2506)
<b>Sleep related condition</b>						
<b>SHST &lt; 7 h/weeknight</b> (Short habitual sleep time < 7 h/night)	28.3 (2.2) <sup>a,b,c</sup>	51.4 (4.0)	38.9 (1.2) <sup>a</sup>	36.2 (3.0)	45.1 (3.3)	33.7 (2.0)
<b>SHST &lt; 6 h/weeknight</b> (Short habitual sleep time < 6 h/night)	12.3 (2.4) <sup>c</sup>	20.3 (3.0)	15.3 (0.8) <sup>a</sup>	15.4 (2.7)	14.2 (2.6)	11.7 (0.9) <sup>a</sup>
<b>Sleep deprivation self-perception</b> (past month)	15.8 (2.4) <sup>b,c</sup>	26.3 (5.0)	24.8 (1.3)	21.0 (3.0) <sup>b</sup>	29.2 (5.6)	28.6 (1.3)
<b>Poor sleep quality reported to a physician</b>	5.1 (1.5) <sup>a,b,c</sup>	23.6 (3.7)	20.2 (1.0) <sup>a</sup>	12.3 (2.3) <sup>b,c</sup>	24.5 (2.9)	29.6 (1.6)
<b>Mild/moderate insomnia</b> (insomnia symptoms > 5-15 times/month)	11.8 (2.2) <sup>a,b,c</sup>	21.8 (4.5)	24.3 (0.8) <sup>a</sup>	21.3 (3.4) <sup>b</sup>	28.5 (4.3)	30.8 (1.7)
<b>Severe insomnia</b> (insomnia symptoms > 15 times/month)	4.2 (1.4)	8.0 (1.7)	6.5 (0.5)	6.8 (2.5)	10.0 (2.3)	8.5 (1.0)
<b>Insomnia with SHST &lt; 7 h/weeknight</b> (insomnia symptoms > 5-15 times/month also reporting short habitual sleep time < 7 h/weeknight)	5.9 (1.6) <sup>a,b,c</sup>	17.6 (4.1)	13.8 (0.7)	12.2 (2.8)	17.7 (3.4)	15.1 (1.2)
<b>Daytime sleepiness</b>	11.0 (2.3) <sup>b</sup>	15.7 (3.6)	16.2 (1.0) <sup>a</sup>	12.9 (3.0) <sup>b</sup>	21.0 (3.0)	21.2 (1.3)
<b>Difficulty concentrating due to sleepiness</b>	2.7 (1.3)	4.6 (2.1) <sup>a</sup>	3.9 (0.4)	2.7 (1.2) <sup>c</sup>	8.6 (1.5)	4.8 (0.5)
<b>Memory impairment due to sleepiness</b>	2.9 (1.2) <sup>c</sup>	8.3 (2.6)	2.9 (0.4)	1.9 (1.0) <sup>b</sup>	4.4 (1.6)	4.3 (0.6)

<sup>†</sup>Age standardized to the 2000 Census population by the direct method proposed by CDC<sup>38</sup>; Prevalence showed as percentage % (standard deviation). <sup>a</sup>P-value < 0.05 between males and females (calculated separately for each cohort: Mexico-born immigrants, US-born Mexican-Americans, and all other US-born population). <sup>b</sup>P-value < 0.05 between Mexico-born Immigrants and all other US-born population (calculated separately for each gender). <sup>c</sup>P-value < 0.05 between Mexico-born immigrants and US-born Mexican-Americans (calculated separately for each gender).

culture), and other potential predictors of poor sleep characteristics in the MA sample.

In MA men, exclusively speaking Spanish at home was associated with an decreased prevalence of reporting most sleep outcomes in univariate models as compared to speaking exclusively English or both Spanish and English at home. In addition, significant univariate predictors of SHST < 6 h/weeknight in MA men were age and family income higher than poverty level (Table 4). Sedentary leisure time was also significantly associated with SHST < 7 h/weeknight. Insufficient social support, higher family income, higher education, and sedentary leisure time were significantly associated with sleep deprivation self-perception. Mild/moderate insomnia with and without SHST < 7 h/weeknight in MA men were also associated with insufficient social support, daily use of caffeinated drinks, self-reported fair/poor health, and depression.

In MA women, MI status and language use at home were not significant univariate predictors of SHST or self-perceived sleep deprivation. All sleep outcomes other than SHST < 7 h/weeknight were associated with self-reported fair/poor overall health and depression. In addition, insufficient social support was associated with severe insomnia, family income over poverty level; daily caffeine use was associated with mild/moderate insomnia with/without SHST < 7 h/weeknight; and current smoking was associated with sleep deprivation self-perception.

To further evaluate the potential independent correlates of poor sleep in MA men and women, and also to assess potential mediators in the relationships between sleep outcomes and MI status in MA men, multivariate models without and with inclusion of language use at home were performed (Table 5). In MA men, adjusted analyses showed both less consistent associations between MI status and all sleep outcomes, and between language preference and all sleep outcomes. SHST < 7 h/weeknight was associated with increased sedentary leisure time. Insufficient social support and self-reported poor general health status were significantly associated with sleep deprivation self-perception and mild/moderate insomnia. The latter was also associated with caffeine use and depression. Significant adjusted predictors of some insomnia with SHST in men included a low education level attainment, daily use of caffeinated drinks, sedentary leisure time, and depression. Depression was the only significant predictor of severe insomnia in adjusted models in MA men.

To further explore the extent to which the MI status effect on sleep outcomes in MA men could be mediated by covariates, we developed single and multiple mediators' models.<sup>50</sup> Both language use at home and a family income more than twice the poverty level reduced the parameter estimates for MI status by > 15% for SHST < 7 h/weeknight in the fully adjusted model. Sedentary leisure time and daily use of caffeinated drinks were associated with some sleep outcomes in men but did not mediate the relationship between MI status and sleep outcomes.

**Table 3**—Multivariate odds ratios (ORs) with 95% confidence intervals (95% CI) of poor sleep outcomes associated with Mexico-born status in the entire US analytic sample (including US-born Mexican-Americans), stratified by gender

Sleep related condition	Entire Sample Adjusted OR <sup>‡</sup> (95%CI) (N = 5160)	Males Adjusted OR <sup>‡</sup> (95%CI) (N = 2654)	Females Adjusted OR <sup>‡</sup> (95%CI) (N = 2506)
<b>SHST &lt; 7 h/weeknight</b> (Short habitual sleep time < 7 h/night)	0.7 (0.6-0.9)*	0.6 (0.5-0.8)*	1.0 (0.8-1.3)
<b>SHST &lt; 6 h/weeknight</b> (Short habitual sleep time < 6 h/night)	0.7 (0.5-1.1)	0.7 (0.4-1.1)	0.8 (0.5-1.3)
<b>Mild/moderate insomnia</b> (insomnia symptoms > 5-15 times/month)	0.4 (0.2-0.5)*	0.3 (0.1-0.5)*	0.5 (0.3-0.9)*
<b>Severe insomnia</b> (insomnia symptoms > 15 times/month)	0.3 (0.2-0.5)*	0.2 (0.1-0.5)*	0.3 (0.1-0.9)*
<b>Insomnia with SHST &lt; 7 h/weeknight</b> (insomnia symptoms > 5-15 times/month with short habitual sleep time < 7 h/night)	0.3 (0.2-0.5)*	0.2 (0.1-0.4)*	0.5 (0.3-0.9)*
<b>Poor sleep quality reported to a physician</b>	0.3 (0.2-0.5)*	0.2 (0.1-0.5)*	0.3 (0.1-0.5)*
<b>Difficulty concentrating due to sleepiness</b>	0.4 (0.2-0.8)*	0.5 (0.2-1.6)	0.3 (0.1-0.8)*
<b>Memory impairment due to sleepiness</b>	0.3 (0.1-0.5)*	0.2 (0.1-0.5)*	0.3 (0.1-1.0)*

\*P-value < 0.05. <sup>‡</sup>Adjusted for gender, age, race, education, marital status, poverty income ratio (a ratio of family income to poverty threshold), insurance status, caffeine, alcohol, smoking, recreational drug usage, number of hours used on TV and computer in the past month, self reported general health, and depression. <sup>‡‡</sup>Adjusted for age, race, education, marital status, poverty income ratio (a ratio of family income to poverty threshold), insurance status, caffeine, alcohol, smoking, recreational drug usage, number of hours used on TV and computer in the past month, self reported general health, and depression.

In adjusted models in MA women, language preference was not significantly associated with sleep outcomes nor operated as a mediator. In fully adjusted models, self-reported fair/poor overall general health was significantly associated with all poor sleep outcomes in MA women. Insufficient social support was associated with SHST < 7 h/weeknight and some insomnia with/without SHST in MA women. Depression was also a significant predictor in MA women for all insomnia outcomes in adjusted models.

## DISCUSSION

To our knowledge, this is the first study showing a significant overall lower prevalence of poor sleep and sleep-related outcomes in adult MI compared to the general US population, and/or to US-born MA. Several striking differences in self-reported short sleep duration, insomnia, and sleep-related daily impairments were observed when comparing the MI population both to the US population and to their US-born MA counterparts. In age-adjusted analyses, MI men were significantly less likely to report SHST < 7 h/weeknight, insomnia, sleep deprivation, and to report poor sleep to a physician as compared both to the US-born MA and the general sample of US men. Fewer differences were seen in women in age-adjusted analyses. Sleep duration did not differ between the MI women and other groups. However, compared to the general US female sample, MI women had a lower prevalence of perceived sleep deprivation, daytime sleepiness, and memory impairment due to sleepiness and were less likely to report sleep problems to a physician. Compared to their US-born MA counterparts, MI women had a lower prevalence of difficulty concentrating due to sleepiness and were less likely to report sleep problems to a physician. Focusing on the comparison between MI and the general US sample in multivariable adjusted models, MI men were significantly less likely to report SHST < 7 h/weeknight, insomnia, and sleep-related daily neuropsychological impairments. Similar trends were ob-

served among MI women when compared to the general sample of US women, although findings were not significant for differences in sleep duration.

Although poorer access to health care may partially explain the lower odds ratios for the outcome “poor sleep reported to a physician,” differences in access to care are unlikely to explain differences in the other sleep outcomes and suggest that sleep behaviors and sleep disorders differ in MI compared to the general US population. Better sleep-related outcomes despite significant socioeconomic disadvantages including limited access to health care in this segment of the US population are consistent with other previously reported health advantages in Mexico-born US immigrants (often referred to as “The Hispanic Paradox”).

In these analyses we also observed gender differences in sleep outcomes among MI that only partially paralleled what was observed in the general US population. A significantly lower prevalence of SHST < 7 h/weeknight in MI men compared to MI women was unexpected, since men have been reported to sleep less than women in a nationally representative study of the US.<sup>45</sup> This observation underscores the potential importance of cultural factors in influencing sleep behaviors.

In men, differences found in short sleep duration between MI and MA born in the US may reflect differences related to a shift in the cultural beliefs, value orientations, and attitudes regarding preferred life pace,<sup>51,52</sup> and/or importance of sleep<sup>35</sup> as MA men transition between Mexican culture and American culture. MI status was significantly associated with SHST < 7 h/weeknight and all insomnia outcomes after adjusting for all other health and demographic variables except for language used at home. In a behavioral study comparing MA with Anglo American students, relaxation as an adaptive daily coping strategy was described as a positive coping mechanism reflecting the influence of Mexican cultural values.<sup>52</sup>

The lower frequency of short sleep among MI men compared to MI women contrasted to the findings observed in the general

**Table 4—Univariate odds ratios (OR) with 95% confidence intervals (95% CI) of poor sleep outcomes, by gender in Mexican-Americans**

Risk Factors Unadjusted OR (95% CI)	Sleep Outcomes					
	SHST < 7 h/ weeknight (Short habitual sleep time < 7 h/night)	SHST < 6 h/ weeknight (Short habitual sleep time < 6 h/night)	Sleep Deprivation Self- Perception (past month)	Mild/Moderate Insomnia (insomnia symptoms > 5-15 times/ month)	Severe Insomnia (insomnia symptoms > 15 times/month)	Insomnia with SHST < 7 h/ weeknight (insomnia symptoms > 5-15 times/month with short habitual sleep time < 7 h/night)
	<b>Men (N = 543)</b>					
<b>Immigrant</b>	0.41 (0.26-0.64)*	0.63 (0.38-1.05)	0.44 (0.24-0.79)*	0.40 (0.24-0.66)*	0.24 (0.11-0.54)*	0.25 (0.14-0.47)*
<b>Language use at home</b>						
Only Spanish (0)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Spanish > English (1)	2.23 (1.41-3.54)*	1.73 (0.84-3.54)	1.32 (0.57-3.06)	1.93 (0.44-8.57)	0.95 (0.31-3.74)	2.51 (0.57-11.60)
Spanish = English (2)	1.65 (0.49-5.54)	1.59 (0.44-5.70)	2.54 (1.09-5.93)*	1.78 (0.93-3.38)	2.50 (1.20-5.32)*	2.95 (1.08-8.08)*
Spanish < English (3)	4.57 (3.06-6.81)*	3.43 (1.69-6.98)*	3.65 (1.74-7.68)*	1.92 (0.93-3.97)	1.74 (0.92-3.54)	4.35 (1.39-14.40)*
Only English (4)	2.54 (1.24-5.06)*	1.64 (0.63-4.24)	2.64 (1.30-5.38)*	3.15 (1.61-6.19)*	1.62 (0.81-3.22)	5.55 (2.18-13.91)*
<b>Insufficient social support</b>	0.76 (0.55-1.14)	0.99 (0.46-2.12)	2.60 (1.34-5.03)*	4.98 (2.54-9.78)*	3.81 (1.01-18.73)*	2.5 (1.3-4.7)*
<b>Age (5-year increments)</b>	1.04 (0.97-1.12)	1.10 (1.03-1.19)*	1.04 (0.96-1.13)	1.10 (1.004-1.04)*	1.07 (0.88-1.32)	1.17 (1.06-1.29)*
<b>Family income (≥ twice the poverty level)</b>	1.56 (0.84-3.10)	1.82 (1.09-2.90)*	1.59 (1.15-2.18)*	3.10 (1.32-7.40)*	2.11 (0.70-6.21)	2.34 (1.01-5.32)*
<b>No high school diploma</b>	0.54 (0.28-1.03)	0.58 (0.34-1.04)	0.38 (0.20-0.73)*	0.79 (0.40-1.59)	0.60 (0.26-1.42)	0.86 (0.46-1.63)
<b>Single</b>	0.98 (0.77-1.24)	0.55 (0.30-1.01)	1.55 (0.89-2.70)	1.27 (0.76-2.14)	1.07 (0.51-2.19)	1.33 (0.78-2.28)
<b>Sedentary leisure time (TV &amp; computer use ≥ 3 h/day)</b>	3.35 (1.49-7.50)*	1.91 (0.60-6.03)	2.08 (1.11-3.91)*	3.28 (1.27-8.49)*	2.87 (0.72-11.51)	3.61 (2.15-6.09)*
<b>Current smoker</b>	0.93 (0.49-1.77)	1.80 (0.81-4.00)	0.70 (0.32-1.54)	0.91 (0.51-1.60)	1.09 (0.31-3.79)	1.19 (0.47-3.04)
<b>Drinking caffeinated drink (≥ 1 cup/day)</b>	1.15 (0.69-1.93)	1.31 (0.61-2.80)	1.36 (0.80-2.31)	1.91 (1.27-2.86)*	2.10 (1.09-4.03)*	2.47 (1.58-3.87)*
<b>Drinking alcohol (≥ 1 time/month)</b>	0.69 (0.54-1.04)	0.93 (0.54-1.83)	0.73 (0.30-1.34)	0.89 (0.34-2.06)	0.61 (0.22-1.83)	0.58 (0.16-1.46)
<b>Ever use of illegal drugs</b>	1.06 (0.71-1.56)	1.12 (0.59-2.11)	1.09 (0.55-2.15)	1.28 (0.79-2.06)	0.44 (0.11-1.85)	1.36 (0.70-2.61)
<b>Self-reported fair or poor overall general health</b>	0.89 (0.69-1.15)	0.93 (0.59-1.44)	1.48 (0.94-2.34)	2.13 (1.16-3.91)*	1.73 (0.56-5.32)	2.12 (1.01-4.51)*
<b>Depression (PHQ-9 score ≥ 10)</b>	1.53 (0.48-4.78)	1.72 (0.39-7.50)	1.36 (0.61-3.02)	4.32 (1.41-13.23)*	4.84 (1.70-13.82)*	6.29 (2.29-17.25)*
	<b>Women (N = 499)</b>					
<b>Immigrant</b>	0.78 (0.53-1.15)	1.09 (0.54-2.18)	0.66 (0.29-1.45)	0.67 (0.43-1.03)	0.59 (0.25-1.40)	0.68 (0.39-1.19)
<b>Language use at home</b>						
Only Spanish (0)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Spanish > English (1)	0.95 (0.60-1.50)	0.37 (0.10-1.29)	1.45 (0.61-3.46)	0.83 (0.45-1.52)	1.0 (0.24-4.18)	0.63 (0.15-2.73)
Spanish = English (2)	1.27 (0.89-1.82)	0.51 (0.19-1.40)	1.47 (0.74-2.91)	1.54 (1.06-2.33)*	2.82 (1.21-6.55)*	1.08 (0.54-2.18)
Spanish < English (3)	1.5 (0.80-1.96)	0.76 (0.38-1.52)	1.00 (0.32-3.11)	1.33 (0.73-2.44)	0.77 (0.17-3.60)	1.14 (0.48-2.70)
Only English (4)	1.28 (0.91-1.79)	0.83 (0.36-1.90)	1.47 (0.70-3.09)	1.65 (1.06-2.56)*	1.41 (0.52-3.80)	1.33 (0.66-2.66)
<b>Insufficient social support</b>	0.99 (0.96-1.14)	1.09 (0.97-1.14)	1.02 (0.92-1.14)	1.73 (1.19-2.52)*	1.12 (1.03-1.24)*	1.09 (1.04-1.24)*
<b>Age (5-year increments)</b>	1.03 (0.64-1.56)	0.74 (0.24-2.01)	0.84 (0.43-1.71)	1.01 (0.99-1.02)	1.08 (1.002-1.18)*	0.48 (0.24-1.44)
<b>Family income (≥ twice the poverty level)</b>	1.46 (0.96-2.10)	1.84 (0.82-3.80)	1.20 (0.64-2.31)	1.70 (1.20-2.51)*	1.62 (0.62-4.51)	2.42 (1.14-5.12)*
<b>No high school diploma</b>	0.83 (0.50-1.36)	1.28 (0.50-3.24)	0.81 (0.48-1.35)	0.66 (0.46-0.94)*	0.78 (0.43-1.41)	0.75 (0.43-1.31)
<b>Single</b>	1.05 (0.74-1.48)	0.96 (0.56-1.64)	1.04 (0.64-1.60)	1.34 (0.88-2.06)	1.25 (0.56-2.81)	1.30 (0.75-2.24)
<b>Sedentary leisure time (TV &amp; computer use ≥ 3 h/day)</b>	1.39 (0.68-2.86)	1.65 (0.90-3.14)	1.16 (0.46-2.87)	1.00 (0.43-2.35)	0.73 (0.14-3.79)	1.22 (0.54-2.76)
<b>Current smoker</b>	1.69 (0.92-3.12)	1.56 (0.90-2.68)	1.88 (1.06-3.33)*	1.49 (0.86-2.59)	2.44 (0.85-7.06)	0.84 (0.29-2.41)
<b>Drinking caffeinated drink (≥ 1 cup/day)</b>	1.42 (0.61-3.28)	1.08 (0.52-2.27)	1.05 (0.64-1.76)	1.73 (1.17-2.54)*	1.49 (0.51-4.29)	1.98 (1.06-3.72)*
<b>Drinking alcohol (≥ 1 time/month)</b>	1.54 (0.94-2.51)	0.74 (0.43-1.34)	1.19 (0.63-2.35)	1.28 (0.64-2.46)	0.79 (0.46-1.11)	1.35 (0.84-2.07)
<b>Ever use of illegal drugs</b>	2.40 (0.77-7.47)	1.39 (0.60-3.19)	0.62 (0.20-1.94)	0.86 (0.39-1.91)	0.38 (0.07-2.08)	1.49 (0.66-3.34)
<b>Self-reported fair or poor overall general health</b>	1.67 (1.13-2.47)*	2.49 (1.48-4.20)*	1.94 (1.26-3.00)*	2.12 (1.27-3.52)*	4.60 (2.50-8.45)*	3.34 (2.02-5.52)*
<b>Depression (PHQ-9 score ≥ 10)</b>	2.46 (0.92-6.60)	2.63 (1.58-4.35)*	2.24 (1.18-4.26)*	5.83 (2.76-12.31)*	4.29 (1.94-9.48)*	7.16 (3.58-14.33)*

\*P-value < 0.05

US sample. Cultural gender-based norms and behaviors related to the division of the household labor may favorably influence the sleep of MI.

In MA women, all poor sleep outcomes, including SHST were significantly associated with self-reported fair/poor health status, a finding consistent with influence of health status on



**Table 5**—Multivariate odds ratios (ORs) with 95% confidence intervals (95% CI) of poor sleep outcomes by gender in Mexican-Americans, language adjusted and language unadjusted

Risk Factors Adjusted OR (95% CI)	Sleep Outcomes					
	SHST < 7 h/ weeknight (Short habitual sleep time < 7 h/ weeknight)	SHST < 6 h/ weeknight (Short habitual sleep time < 6 h/weeknight)	Sleep Deprivation Self-Perception (past month)	Mild/Moderate Insomnia (insomnia symptoms > 5-15 times/month)	Severe Insomnia (insomnia symptoms > 15 times/month)	Insomnia with SHST < 7 h/ weeknight (insomnia symptoms > 5-15 times/month with short habitual sleep time < 7 h/ weeknight)
	Men (N = 543)					
<b>Immigrant</b>	0.48 (0.26-0.87) <sup>‡</sup> 0.78 (0.36-1.61)	0.93 (0.57-1.49) <sup>‡</sup> 1.44 (0.67-3.09)	0.55 (0.26-1.16) <sup>‡</sup> 1.00 (0.41-2.42)	0.39 (0.19-0.81) <sup>‡</sup> 0.41 (0.14-1.17)	0.16 (0.06-0.40) <sup>‡</sup> 0.04 (0.002-1.44)	0.23 (0.09-0.51) <sup>‡</sup> 0.41 (0.11-1.49)
<b>Language use at home</b>						
Only Spanish (0)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Spanish > English (1)	2.12 (1.21-3.72) <sup>*</sup>	1.53 (0.73-3.20)	1.2 (0.54-2.73)	1.69 (0.37-7.75)	0.33 (0.03-3.44)	2.61 (0.44-15.24)
Spanish = English (2)	1.32 (0.46-3.78)	1.47 (0.42-5.16)	2.54 (0.84-7.71)	1.15 (0.33-3.94)	0.23 (0.02-30.14)	2.07 (0.41-10.92)
Spanish < English (3)	3.66 (1.71-7.85) <sup>*</sup>	3.23 (0.75-13.74)	3.41 (1.02-11.64) <sup>*</sup>	0.93 (0.34-2.68)	0.29 (0.01-15.40)	3.39 (0.54-22.2)
Only English (4)	1.91 (0.63-5.84)	1.50 (0.42-5.38)	2.23 (0.60-8.26)	1.34 (0.34-5.42)	0.11 (0.00-9.16)	3.45 (0.44-27.70)
<b>Insufficient social support</b>	0.86 (0.53-1.39)	1.11 (0.59-2.19)	4.22 (1.81-9.82) <sup>*</sup>	8.11 (2.23-20.34) <sup>*</sup>	6.64 (0.80-50.14)	3.77 (0.92-15.50)
<b>Age</b> (5 years increments)	0.96 (0.86-1.07)	1.07 (0.91-1.26)	0.92 (0.78-1.07)	1.08 (0.91-1.29)	0.95 (0.64-1.41)	1.10 (0.84-1.38)
<b>Family income</b> (twice or more over poverty level)	0.9 (0.6-1.4)	1.14 (0.67-1.94)	1.00 (0.74-1.36)	1.47 (0.90-2.43)	0.84 (0.34-2.22)	1.43 (0.81-2.53)
<b>No high school diploma</b>	0.9 (0.3-2.5)	0.68 (0.24-1.89)	0.46 (0.17-1.27)	1.17 (0.44-3.14)	0.63 (0.13-3.12)	2.30 (1.15-4.59) <sup>*</sup>
<b>Single</b>	0.9 (0.6-1.3)	0.49 (0.19-1.27)	1.28 (0.64-2.57)	0.82 (0.46-1.48)	0.72 (0.14-2.84)	0.96 (0.44-1.96)
<b>Sedentary leisure time</b> (TV & computer use ≥ 3 h/day)	2.7 (1.1-6.6) <sup>*</sup>	2.04 (0.67-6.15)	1.31 (0.55-3.15)	2.80 (0.89-8.76)	2.21 (0.39-12.34)	2.48 (1.08-5.67) <sup>*</sup>
<b>Current smoker</b>	0.88 (0.46-1.67)	2.01 (0.84-4.83)	0.60 (0.25-1.42)	0.58 (0.33-1.02)	0.77 (0.22-2.70)	0.66 (0.29-1.48)
<b>Drinking caffeinated drink</b> (≥ 1 cup/day)	1.09 (0.67-1.77)	1.15 (0.52-1.54)	1.55 (0.91-2.62)	1.88 (1.19-2.93) <sup>*</sup>	1.86 (0.72-4.81)	2.34 (1.34-4.14) <sup>*</sup>
<b>Drinking alcohol</b> (≥ 1 time/month)	0.70 (0.48-1.05)	0.83 (0.34-2.00)	0.63 (0.27-1.45)	0.71 (0.25-1.99)	0.78 (0.21-2.94)	0.56 (0.18-1.76)
<b>Ever use of illegal drugs</b>	0.78 (0.51-1.20)	0.93 (0.48-1.81)	0.96 (0.39-2.29)	1.32 (0.65-2.68)	0.29 (0.08-1.09)	1.16 (0.40-3.40)
<b>Self-reported fair or poor overall general health</b>	1.02 (0.68-1.51)	1.02 (0.63-1.65)	2.03 (1.19-3.45) <sup>*</sup>	2.04 (1.04-4.36) <sup>*</sup>	1.70 (0.40-7.23)	1.79 (0.60-5.79)
<b>Depression</b> (PHQ-9 score ≥ 10)	1.46 (0.37-5.84)	1.64 (0.34-7.84)	0.81 (0.38-1.73)	3.04 (1.05-8.84) <sup>*</sup>	2.61 (0.96-7.04)	4.84 (1.38-16.80) <sup>*</sup>
	Women (N = 499)					
<b>Immigrant</b>	0.94 (0.48-1.81) <sup>‡</sup> 0.90 (0.38-2.13)	1.08 (0.52-1.95) <sup>‡</sup> 0.75 (0.20-2.90)	0.52 (0.21-1.26) <sup>‡</sup> 0.37 (0.09-1.51)	0.67 (0.36-1.21) <sup>‡</sup> 1.03 (0.48-2.14)	0.53 (0.18-1.53) <sup>‡</sup> 0.81 (0.19-3.34)	0.68 (0.32-1.47) <sup>‡</sup> 0.66 (0.29-1.48)
<b>Language use at home</b>						
Only Spanish (0)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Spanish > English (1)	0.91 (0.54-1.51)	0.36 (0.09-1.53)	1.23 (0.44-3.44)	0.85 (0.40-1.78)	1.04 (0.28-3.90)	0.67 (0.15-2.94)
Spanish = English (2)	1.13 (0.56-2.25)	0.41 (0.08-2.16)	0.82 (0.21-3.11)	1.64 (0.78-3.48)	3.05 (0.84-11.29)	0.74 (0.19-2.91)
Spanish < English (3)	0.89 (0.3-2.41)	0.55 (0.13-2.29)	0.51 (0.09-2.74)	1.28 (0.66-2.48)	0.67 (0.21-2.15)	0.66 (0.24-1.78)
Only English (4)	0.87 (0.3-2.39)	0.68 (0.12-4.04)	0.71 (0.14-3.54)	2.44 (0.98-6.14)	1.60 (0.62-4.28)	1.26 (0.37-4.31)
<b>Insufficient social support</b>	1.53 (1.04-2.28) <sup>*</sup>	1.77 (0.86-3.70)	1.28 (0.65-2.52)	1.95 (1.4-2.73) <sup>*</sup>	1.44 (0.48-4.31)	2.83 (1.40-5.71) <sup>*</sup>
<b>Age</b> (5 years increments)	0.98 (0.87-1.10)	1.00 (0.82-1.25)	0.87 (0.72-1.04)	0.96 (0.82-1.12)	1.03 (0.83-1.27)	0.97 (0.78-1.19)
<b>Family income</b> (twice or more over poverty level)	1.19 (0.8-1.76)	1.21 (0.75-1.93)	0.87 (0.54-1.37)	0.64 (0.46-0.90) <sup>*</sup>	0.82 (0.45-1.51)	0.66 (0.38-1.08)
<b>No high school diploma</b>	0.85 (0.40-1.80)	0.86 (0.33-2.24)	0.70 (0.37-1.34)	0.44 (0.22-0.89) <sup>*</sup>	0.58 (0.33-0.99) <sup>*</sup>	0.39 (0.19-0.84) <sup>*</sup>
<b>Single</b>	1.01 (0.59-1.74)	1.04 (0.62-1.74)	0.91 (0.57-1.44)	1.12 (0.70-1.79)	1.08 (0.38-3.08)	1.31 (0.68-2.51)
<b>Sedentary leisure time</b> (TV & computer use ≥ 3 h/day)	1.36 (0.56-3.24)	2.22 (0.89-5.52)	1.21 (0.39-3.73)	0.86 (0.30-2.44)	0.85 (0.21-3.44)	1.39 (0.38-5.04)
<b>Current smoker</b>	1.49 (0.78-2.82)	1.62 (0.89-2.96)	1.84 (0.92-3.68)	1.04 (0.47-2.34)	2.69 (0.73-9.83)	0.44 (0.08-2.31)
<b>Drinking caffeinated drink</b> (≥ 1 cup/day)	1.29 (0.45-3.69)	0.98 (0.42-2.32)	0.89 (0.56-1.40)	1.31 (0.93-1.88)	1.24 (0.42-3.30)	1.58 (0.72-3.44)
<b>Drinking alcohol</b> (≥ 1 time/month)	1.40 (0.72-2.74)	0.67 (0.32-1.39)	1.37 (0.65-2.90)	1.43 (0.63-3.23)	0.99 (0.53-1.89)	1.43 (0.70-2.83)
<b>Ever use of illegal drugs</b>	1.57 (0.42-5.87)	1.10 (0.42-2.90)	0.29 (0.08-1.04)	0.36 (0.09-1.38)	0.25 (0.05-1.33)	0.67 (0.14-3.34)
<b>Self-reported fair or poor overall general health</b>	1.80 (1.17-2.78) <sup>*</sup>	2.46 (1.49-4.08) <sup>*</sup>	2.13 (1.26-3.60) <sup>*</sup>	2.31 (1.29-4.14) <sup>*</sup>	4.56 (2.06-10.11) <sup>*</sup>	3.28 (1.98-5.44) <sup>*</sup>
<b>Depression</b> (PHQ-9 score ≥ 10)	2.12 (0.63-7.08)	1.69 (0.76-3.78)	1.77 (0.86-3.64)	5.45 (2.07-14.24) <sup>*</sup>	3.37 (1.86-6.12) <sup>*</sup>	5.21 (2.05-13.21) <sup>*</sup>

All results are adjusted for age, education, income ratio ≥ twice the poverty income ratio, marital status, social support, ≥ 3 h daily use of TV and computer for recreational purposes in the past month, caffeine, alcohol, smoking, recreational drug usage, self reported general health, depression, and language use at home. <sup>‡</sup>Indicates results are not adjusted for language use at home. <sup>\*</sup>P-value < 0.05.

sleep observed generally.<sup>54</sup> Depression was associated with all insomnia outcomes in MA men and women, consistent with a large body of literature.<sup>16-18</sup> However, after adjusting for depression, the association between immigrant status and sleep disorders was only minimally affected. One potential explanation for this is possible ethnic differences in sleep related symptoms. Depressed Latinos previously have been reported to have higher REM density compared to other ethnic groups in the US.<sup>55</sup> Another study<sup>56</sup> reported significantly lower mean scores of abnormalities in sleep on the Patient Health Questionnaire 9-item depression scale in Latinos compared to other racial and ethnic groups of primary care patients with depression. Also, Hispanic PTSD patients were found to report elevated levels of symptoms of hypervigilance, intrusive thoughts, flashbacks, and emotional reactivity, but few negative symptoms reflecting low levels of difficulty sleeping, impaired concentration, emotional detachment, and restricted affect.<sup>57</sup> This could be indicative of different psychological mechanisms in Hispanics making them more susceptible to recurrent nightmares, but providing some protection against a broader pattern of sleep problems.

Our analyses did not replicate the mediator effect of smoking on the relationship between MI ethnicity and SHST in MA reported in a recent brief communication.<sup>33</sup> Alcohol and substance use were also not significantly associated with sleep outcomes. This may be due to misclassification of exposures using self-report data. However, current smoking status was carefully measured by this study by using serum cotinine, a biomarker of environmental tobacco smoke exposure. We also investigated the potential mediating effect of cultural changes, as measured by language preference at home. This marker was associated with sleep outcomes in MI men, but did not consistently attenuate the observed associations between MI status and all sleep outcomes.

The potential importance of the differences in sleep outcomes in this analysis is supported by a large body of literature that has consistently demonstrated that short sleep and insomnia are associated with increased risk of hypertension, obesity, coronary artery disease, and death.<sup>1-10</sup>

A strength of the study was use of data from a nationally representative and large sample (NHANES), which uses highly structured protocols and offers the advantage of community-based cohort recruitment, with balanced gender representation and geographic diversity, and likely to be free of the referral biases that may occur from studies of sleep clinic-based samples. Multiple sensitivity analyses were done to assess the consistency of the reported results.

Study limitations include the reliance on predominantly self-reported data. The insomnia definition used is modeled after established criteria. Since insomnia may be associated with sleep duration misperception, it is possible that those categorized as having insomnia and short sleep duration overlapped with the “mild/moderate insomnia” group. Differences between MI, US-born MA, and US general population may be partially attributed to differences in risk factors associated with poor sleep that was not completely accounted for by the measurements available. No data were available on psychological characteristics other than depression.

Systematic biases in self-reporting sleep related conditions among the groups cannot be excluded. Language barriers, including differences in meaning between the English and Spanish versions of the available questionnaires may also affect our conclusions.

There may be additional bias in the reported findings stemming from factors that have not yet been well explored in literature. This includes the possibility of some cultural component leading to underreporting of emotional problems<sup>58</sup> in MI men. Another reason as to why MI men have better sleep measures than their US-born counterparts may be related to differences in social perceptions and beliefs, including hope for better future economical well being due to immigration to the US or perhaps due to plans of return to their homeland in the future.<sup>59</sup> It has been speculated that such factors may reduce vulnerability to discrimination perception,<sup>56</sup> and thus possibly having a beneficial effect on sleep. Another potential explanation for our observations may be related to a “healthy immigrant effect,” whereby relatively healthy segments of a population emigrate.

In summary, our findings demonstrate that MI have more favorable sleep related outcomes than the general US population. For MI men, sleep patterns also were favorable than their US-born MA counterparts. Differences were not accounted for by measurable differences in gender, age, education, marital status, poverty income ratio, self-reported general health, insurance status, caffeine, alcohol, smoking, recreational drug usage and depression, or by differences in BMI.

## ACKNOWLEDGMENTS

This work was supported by National Institutes of Health grant HL007913.

## DISCLOSURE STATEMENT

This was not an industry supported study. Dr. Strohl has received research support from Inspire LLC and has participated in speaking engagements for Medscape, Up-To-Date, and American Thoracic Society. Dr. Redline has received research support from Dymedix Inc. The other authors have indicated no financial conflicts of interest.

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