



Acculturation and depression are associated with short and long sleep duration among Mexican Americans in NHANES 2005–2018

Cameron K. Ormiston^{a,*}, Diana Lopez^a, Francisco A. Montiel Ishino^a, Timothy S. McNeel^b, Faustine Williams^a

^a Division of Intramural Research, National Institute on Minority Health and Health Disparities, Bethesda, MD, USA

^b Information Management Services, Inc., Calverton, MD, USA

ARTICLE INFO

Keywords:

Acculturation
Depression
Health disparities
Hispanics/Latinos
Mexican Americans
Sleep duration

ABSTRACT

Acculturation and depression are linked to poor sleep quality and sleep problems that may explain ongoing health disparities for Hispanics/Latinos. We examined the associations of acculturation, depression, and sleep duration among the Mexican American population. We used a multinomial logistic regression model on cross-sectional data from the 2005–2018 National Health and Nutrition Examination Survey on 4,700 Mexican American adults aged ≥ 18 years old. The outcome of sleep duration was operationalized as short (≤ 6 h), optimal (7–8 h), and long (≥ 9 h). Acculturation was constructed using years living in the U.S. and language(s) spoken at home (majority Spanish, English and Spanish equally, majority English). Depression severity was assessed using the 9-item Patient Health Questionnaire. Covariates included gender, age, marital status, income, and U.S. citizenship. Speaking majority English (Adjusted Odds Ratio (AOR) = 1.23; 95% Confidence Interval (CI) = 1.00–1.52) and mild (AOR = 1.63; 95%CI = 1.32–2.01), moderate (AOR = 1.94; 95%CI = 1.43–2.63), and moderately severe/severe (AOR = 2.58; 95%CI = 1.72–3.88) levels of depression were significantly associated with short sleep duration. Living in the U.S. for ≥ 10 years (AOR = 1.61; 95%CI = 1.17–2.23) and moderately severe/severe depression (AOR = 2.30; 95%CI = 1.34–3.93) were significantly associated with long sleep duration. Our results provide additional evidence of a link between acculturation, depression, and short and long sleep duration among the Mexican American population. Understanding the sleep health of this population is important for informing future public health interventions and research. Additional investigation into the relationship between acculturation/depression and other sleep health measures among this population is warranted.

1. Introduction

Sleep plays an important role in metabolism, cognition, memory, attention, mental health, cardiovascular health, and other vital functions (Mukherjee et al., 2015). As such, numerous studies have highlighted the benefits of sufficient and quality sleep, such as improving learning and maintaining good health and quality of life (Mukherjee et al., 2015). Over one-third of the United States (U.S.) reports getting < 7 h of sleep per day and 50–70 million U.S. adults report having a sleep disorder (Sheehan et al., 2019; Whinnery et al., 2014; Martinez-Miller et al., 2019). Also, research suggests inadequate sleep prevalence may

increase over time, with non-Hispanic Black and Hispanic/Latino populations being disproportionately affected (Sheehan et al., 2019; Whinnery et al., 2014; Martinez-Miller et al., 2019). Furthering our understanding of sleep and its disproportionate burden on Hispanic/Latino populations is therefore increasingly urgent. Additionally, short sleep duration (≤ 6 h per day) is strongly linked to inflammation, weight gain, heart disease, depression, diabetes, breast cancer, erratic eating times, and all-cause mortality (Itani et al., Apr 2017; Malhotra and Loscalzo, 2009). At the other end of the spectrum, getting too much sleep (≥ 9 h per day) may also have deleterious effects on health. Several studies, including a recent cross-sectional analysis of the 2013–2016

Abbreviations: HCHS/SOL, Hispanic Community Health Study/Study of Latinos; NHANES, National Health and Nutrition Examination Survey; NHIS, National Health Interview Survey; U.S., United States.

* Corresponding author at: Division of Intramural Research, National Institute on Minority Health and Health Disparities, 7201 Wisconsin Avenue, Room 533N, Bethesda, MD 20814, USA.

E-mail address: cam.ormiston@nih.gov (C.K. Ormiston).

<https://doi.org/10.1016/j.pmedr.2022.101918>

Received 11 January 2022; Received in revised form 8 July 2022; Accepted 18 July 2022

Available online 21 July 2022

2211-3355/Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

National Health and Nutrition Examination Survey (NHANES), have shown long sleep duration is linked to worse heart health, increased mortality, cardiovascular disease, and other adverse health outcomes (Cash et al., 2020; Hale and Rivero-Fuentes, 2011).

Black and Hispanic/Latino individuals consistently report shorter sleep duration, poorer sleep quality, and greater difficulty falling asleep compared to White individuals (Jackson et al., 2015; Chattu et al., 2019; Billings et al., 2021). In fact, insufficient sleep duration among racial and ethnic minorities has been noted as a possible fundamental contributor to racial and socioeconomic health disparities (Jackson et al., 2015). These disparities arise due to structural, environmental, and social issues, such as racism, discrimination, housing and occupational stress, and financial and food insecurity—all of which are barriers to getting good sleep and making adequate sleep a priority.

Among the Hispanic/Latino population, an analysis of the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) found sleep insufficiency (short sleep duration) was exceedingly common among all Hispanic/Latino heritage groups (Dudley et al., 2017). Mexican Americans born in the U.S. are more likely than Mexican-born immigrants to report sleep symptoms (e.g., difficulty falling asleep, daytime sleepiness, snoring, difficulty staying asleep) and shorter sleep duration (Hale and Rivero-Fuentes, 2011; Chattu et al., 2019; Grandner et al., 2013). Seicean et al.'s (Seicean et al., 2011) cross-sectional study on 2005–2006 NHANES data showed Mexican-born immigrants had significantly lower odds of short sleep duration, sleep-related functional problems, and insomnia. A cross-sectional analysis of the 2004–2017 National Health and Interview Survey (NHIS) found all Latino heritages, apart from U.S.-born Cubans, reported shorter sleep compared to non-Hispanic/Latino White respondents (García et al., 2020). The same study, however, reported that short sleep duration risk differed by country of origin, with foreign-born Mexicans having the least elevated risk for short sleep duration and U.S.-born respondents having a higher short sleep duration risk than their foreign-born counterparts (García et al., 2020). As such, these trends may suggest the “healthy immigrant effect” and acculturation—the adoption or borrowing of a host culture’s values, beliefs, and practices—may affect sleep duration and quality (Grandner et al., 2013; García et al., 2020; Patel et al., 2015).

Higher levels of acculturation defined by birthplace and language spoken at home (Seicean et al., 2011) and language of interview (Gaston et al., 2021) are associated with insufficient sleep duration, sleep disturbances, depression, and poorer quality sleep in both U.S.-born and foreign-born Hispanic/Latino immigrants (Billings et al., 2021; Seicean et al., 2011; Gaston et al., 2021). Among Mexican-born men, higher rates of acculturation are associated with an elevated risk for insufficient sleep (Seicean et al., 2011). Acculturation (defined as years living in the U.S.) has also shown to be positively associated with a higher risk for anxiety and mood disorders among Mexican-born immigrants (Breslau et al., 2007). Depression has in turn been linked with poor sleep among Hispanics/Latinos and U.S.-born Mexican Americans (Manber et al., 2013; Heilemann et al., 2012). For example, greater depressive symptoms and acculturation (indicated by early socialization in the U.S. during childhood, birthplace, and language) have been associated with sleep troubles in low-income women of Mexican heritage (U.S.-born Mexican American and Mexican-born women) (Heilemann et al., 2012).

We examined the association between acculturation, depression, and short (≤ 6 h per day) and long (≥ 9 h per day) sleep duration in a nationally representative sample of Mexican American adults using the NHANES from 2005 to 2018. Although NHANES sleep duration data on Mexican Americans have been analyzed before, most have examined a small number of survey years, focused only on short sleep duration, or generalized the Hispanic/Latino population. Previous research on Hispanic/Latino heritage groups has also shown heterogeneity in health outcomes (García et al., 2020; Patel et al., 2015). Learning about the sleep health of Mexican Americans is therefore important because Mexican Americans are the largest Hispanic/Latino heritage group and they may have different sleep patterns than other groups (Patel et al.,

2015; Gaston et al., 2021). We hypothesized that higher levels of acculturation and depression would confer greater odds for short or long sleep duration. Our study contributes to the growing body of work on acculturation and sleep within the Hispanic/Latino population by further elucidating how acculturation and depression influence both short and long sleep duration among Mexican Americans.

2. Methods

Data from the 2005–2018 NHANES were collected in August 2020 and were analyzed from August 2020 to September 2020. The NHANES combines interviews and physical examinations, and it is designed to produce estimates that are representative of the noninstitutionalized civilian U.S. population. The sample was selected using a multiyear, stratified, clustered four-stage design [more information can be found at https://www.cdc.gov/nchs/data/series/sr_02/sr02-184-508.pdf]. Analyses were limited to Mexican Americans aged ≥ 18 years old who received the physical examination ($n = 6532$). Subjects whose answers were provided by a proxy ($n = 31$) or who had missing data for any variable used in the model ($n = 1801$) were excluded, for a final sample size of 4,700. Complete information on the recruitment, design, and survey questions and responses for the NHANES can be found at the Centers for Disease Control and Prevention – National Center for Health Statistics [<https://www.cdc.gov/nchs/nhanes/default.aspx>]. The Institutional Review Board was not required as the data for this study were secondary, as such no human subjects were involved.

2.1. Measures

2.1.1. Sleep duration outcome

From 2005 to 2014, sleep duration came from responses to the question “How much sleep do you usually get at night on weekdays or workdays?” From 2015 to 2018, sleep duration came from responses to the question “What time do you usually go to sleep on weekdays or workdays?” and the question “What time do you usually wake up on weekdays or workdays?” Responses were categorized into short (≤ 6 h), optimal (7–8 h), and long (≥ 9 h). Our sleep duration cutoffs were based on the American Academy of Sleep Medicine and Sleep Research Society’s recommendations for adult sleep duration and available clinical and epidemiological literature (García et al., 2020; Redline et al., 2019; Grandner et al., 2010; Grandner and Drummond, 2007). These cut points have also been shown to be associated with significant morbidity and mortality (García et al., 2020; Redline et al., 2019; Grandner et al., 2010; Grandner and Drummond, 2007; Beunza et al., 2007; Kripke et al., 2002; Gottlieb et al., 2006; Burazeri et al., 2003; Grandner et al., 2010).

2.1.2. Acculturation

Length of time in the U.S. was categorized as < 10 years or ≥ 10 years based on the following response choices: < 1 year, 1 to < 5 years, 5 to < 10 years, 10 to < 15 years, 15 to < 20 years, 20 to < 30 years, 30 to < 40 years, 40 to < 50 years, and ≥ 50 years. Language(s) spoken at home came from responses to the question “What language(s) do you usually speak at home? Do you speak only Spanish, more Spanish than English, both equally, more English than Spanish, or only English?” Responses were categorized as majority Spanish (Only Spanish; More Spanish than English), English and Spanish equally, and majority English (More English than Spanish; Only English).

2.1.3. Depression

Depression was assessed using the 9-item Patient Health Questionnaire. (Kroenke et al., 2001) Depression severity is found by summing the 9 items, each of which are scored from 0 to 3, for a total score of 0–27. Depression levels were defined by item scores as minimal (0–4), mild (5–9), moderate (10–14), and moderately severe (15–19) to severe (20–27).

2.2. Covariates and controls

The model adjusted for sociodemographic variables, which included age (18–44, 45–54, 55–64, 65–74, ≥75 years old), gender (male, female), marital status (married/living with partner, widowed, divorced/separated, never married), family income (at or below poverty level, above poverty level), and U.S. citizenship status (dichotomized yes/no).

2.3. Analytic plan

A multinomial logistic regression model was used to examine the association between acculturation, depression, and sleep duration. Sleep duration was the response variable, and 7–8 h was the reference category to short and long sleep (≤6 h and ≥9 h, respectively). Subjects with missing values for any variable used in the model were excluded, resulting in a sample size of 4,700. Analyses were weighted, and Taylor series linearization methods were used to account for the stratified, multistage, cluster sample design of NHANES. Analyses were conducted using SUDAAN 11.0.1. To address the study’s missing data, models were fit and parameter estimates were summarized using multiple imputation methods implemented in SUDAAN 11.0.1. Multiple imputation analysis yielded results that were very similar to the main findings.

3. Results

3.1. Descriptive characteristics of sample

Table 1 shows the characteristics of the sample (N = 4700) overall and stratified by sleep duration (short, optimal, and long). The majority of the sample was 18–44 years old (65.0%), male (52.8%), married/living with a partner (67.5%), and had an income above the poverty level (70.8%). For the acculturation variables, 85.7% of the sample had lived in the U.S. for ≥10 years and 50.6% spoke majority Spanish. Regarding depression, 77.1% reported minimal levels, 15.7% mild, 4.8% moderate, and 2.4% moderately severe/severe.

For people living in the U.S. for ≥10 years, 30.8% were short sleepers, 54.3% had optimal sleep duration, and 14.9% were long sleepers. More participants reported short sleep duration relative to long sleep duration across all levels of depression. Among those who experienced moderately severe/severe depression levels, 43.5% reported short sleep duration, 33.4% had optimal sleep duration, and 23.1% reported long sleep duration. See Table 1 for more details.

3.2. Multinomial logistic regression

3.2.1. Acculturation

Living in the U.S. for ≥10 years was significantly associated with long sleep duration compared to living in the U.S. for <10 years (adjusted odds ratio [AOR] = 1.61; 95% CI = 1.17–2.23). Speaking majority English was associated with short sleep duration compared to speaking majority Spanish (AOR = 1.23; 95% CI = 1.00–1.52). This finding should be interpreted with caution, however, given the 95% CI lower limit is 1.00. See Table 2 for more details.

3.2.2. Depression

Mild (AOR = 1.63; 95% CI = 1.32–2.01), moderate (AOR = 1.94; 95% CI = 1.43–2.63), and moderately severe/severe (AOR = 2.58; 95% CI = 1.72–3.88) levels of depression were significantly associated with short sleep duration odds compared to minimal levels. Similarly, moderately severe/severe depression was associated with long sleep duration (AOR = 2.30; 95% CI = 1.34–3.93). In a sensitivity analysis using depression as a continuous variable, it was found that for every one-point increase in the PHQ-9, odds of short (AOR = 1.07; 95% CI = 1.05–1.09) and long (AOR = 1.04; 95% CI = 1.02–1.07) sleep duration increased. See Table 2 for more details.

Table 1

Characteristics of the sample, overall and stratified by sleep duration category in 2005–2018 NHANES sample (N = 4700).

	Overall Sample N [% ^a]	Stratified by Sleep Duration Category		
		Short (≤6 h) n [% ^b]	Optimal (7–8 h) n [% ^b]	Long (≥9 h) n [% ^b]
Age				
18–44	2424 [65.0]	685 [28.7]	1436 [57.9]	303 [13.4]
45–54	768 [16.9]	259 [32.4]	428 [56.3]	81 [11.3]
55–64	813 [10.5]	267 [32.9]	422 [50.3]	124 [16.8]
65–74	507 [5.3]	145 [28.3]	262 [50.4]	100 [21.3]
≥75	188 [2.3]	56 [28.0]	83 [45.0]	49 [27.0]
Gender				
Female	2410 [47.2]	700 [28.5]	1317 [53.9]	393 [17.7]
Male	2290 [52.8]	712 [30.8]	1314 [58.2]	264 [11.0]
Marital Status				
Divorced/Separated	559 [10.5]	227 [41.4]	263 [46.8]	69 [11.8]
Married/Living with partner	3104 [67.5]	891 [28.5]	1798 [58.1]	415 [13.4]
Never Married	764 [18.4]	210 [27.6]	428 [55.0]	126 [17.5]
Widowed	273 [3.5]	84 [30.0]	142 [52.3]	47 [17.6]
Poverty Level				
At or below poverty level	1464 [29.2]	393 [28.0]	827 [56.1]	244 [15.9]
Above poverty level	3236 [70.8]	1019 [30.4]	1804 [56.2]	413 [13.4]
U.S. Citizen				
Yes	2786 [58.9]	922 [32.8]	1458 [51.9]	406 [15.3]
No	1914 [41.1]	490 [25.3]	1173 [62.3]	251 [12.4]
Length of time in U.S.				
<10 years	658 [14.3]	164 [23.1]	424 [67.5]	70 [9.5]
10 years or more	4042 [85.7]	1248 [30.8]	2207 [54.3]	587 [14.9]
Language(s) spoken at home				
Majority Spanish	2496 [50.6]	673 [26.7]	1482 [60.5]	341 [12.8]
English and Spanish equally	689 [14.2]	205 [28.5]	380 [56.6]	104 [14.8]
Majority English	1515 [35.2]	534 [34.5]	769 [49.7]	212 [15.8]
Depression Severity				
Minimal	3560 [77.1]	970 [27.2]	2114 [59.1]	476 [13.7]
Mild	746 [15.7]	275 [36.4]	357 [48.3]	114 [15.3]
Moderate	258 [4.8]	111 [41.1]	111 [45.3]	36 [13.7]
Moderately severe/severe	136 [2.4]	56 [43.5]	49 [33.4]	31 [23.1]

Weighted prevalence shown as percentage.

^a weighted column percentage.

^b weighted row percentage.

Table 2
Associations between acculturation, depression, and sleep duration (adjusted).

	Short Sleep (≤ 6 h)		Long Sleep (≥ 9 h)	
	AOR	95% CI	AOR	95% CI
Years Lived in the U.S.				
<10 Years	1.00	ref	1.00	ref
≥ 10 Years	1.25	(0.94,1.66)	1.61	(1.17,2.23)
Language(s) Spoken at Home				
Majority Spanish	1.00	ref	1.00	ref
English and Spanish equally	0.95	(0.74,1.21)	1.06	(0.80,1.40)
Majority English	1.23	(1.00,1.52)	1.29	(0.89,1.89)
Depression severity				
Minimal	1.00	ref	1.00	ref
Mild	1.63	(1.32, 2.01)	1.23	(0.97,1.57)
Moderate	1.94	(1.43,2.63)	1.11	(0.73,1.69)
Moderately severe/severe	2.58	(1.72,3.88)	2.30	(1.34,3.93)

Optimal sleep (7–8 h) is the reference variable for short and long sleep. Bolded adjusted odds ratios indicate $p < 0.05$.

4. Discussion

The present study found that a greater degree of acculturation was associated with a higher prevalence and likelihood of insufficient sleep and over-sleeping. We also found depression was associated with short (mild, moderate, and moderately severe/severe depression) and long sleep (moderately severe/severe depression) duration.

It has been suggested that the association between adverse sleep duration and acculturation may be due to the adverse impact acculturation has on health behaviors, which in turn can negatively affect sleep duration (Hale and Rivero-Fuentes, 2011; García et al., 2020). For instance, acculturation has previously been associated with poor diet, substance use, smoking during pregnancy, and chronic disease (Lara et al., 2005). Presently, there are limited studies on the associations between acculturation and sleep duration, and findings are mixed. An analysis of the HCHS/SOL by Patel et al. (2015) found a dose–response relationship between years in the U.S. and both short and long sleep duration, although their findings were non-significant while we found a significant relationship for long sleep duration. Using language spoken at home as a proxy for acculturation among a nationally representative sample in the 2007–2008 NHANES, Whinnery et al. (2014) found Spanish-only households were significantly less likely to report sleeping <5 h per day compared to English-only households (OR = 0.32, $P = 0.030$). Also consistent with our results, they did not find any significant associations between language(s) spoken at home and long sleep duration (Whinnery et al., 2014).

Furthermore, Seicean et al. (2011) reported that speaking English-only was associated with greater odds of sleeping <7 h per day compared to speaking Spanish-only among male Mexican Americans (OR = 2.54; 95% CI = 1.24–5.06). Seicean et al. (2011), however, did not analyze the association between acculturation and long sleep duration. A cross-sectional analysis of the 2004–2017 NHIS by Gaston et al. (2021) also found the prevalence of short sleep duration among Mexican adults to be higher in those with English-only interviews compared to Spanish-only interviews. Our study yielded comparable results, with English-only households having 23% greater odds of sleeping ≤ 6 h per day. Similarly, a cross-sectional analysis of the 2004–2017 NHIS reported acculturation (defined by citizenship status, language of interview, and years living in the U.S.) was associated with greater odds of sleeping ≤ 6 h per day (OR = 1.11; 95% CI = 1.04–1.18) and sleeping ≥ 9 h per day (OR = 1.27; 95% CI = 1.16–1.40) for foreign-born Mexicans (García et al., 2020). The authors, however, found no significant difference in long sleep duration among individuals who speak Spanish only at home and individuals who speak English only at home.

We also found a dose-dependent relationship between depression and odds of having short or long sleep duration. Depression has been previously associated with shorter sleep duration in female Hispanics/Latinos and with long sleep duration in the general population (Seicean et al., 2011; Dong et al., 2022). Our study yielded comparable results among a nationally representative sample of Mexican Americans. Our findings may be explained by a third variable that could hinder achieving optimal sleep, such as job stress, psychosocial stress, discrimination, and neighborhood factors (Alcántara et al., 2017).

In fact, given that poor sleep may be influenced by one's psychosocial and environmental context (Hale and Rivero-Fuentes, 2011), and extensive evidence indicates a link between depression and acculturative stress among Hispanics/Latinos (Hovey, 2000; Bekteshi et al., 2015; Gomez et al., 2011; Kim et al., 2014), acculturative stress may be the mechanism through which depression is associated with sub-optimal sleep duration (Hale and Rivero-Fuentes, 2011; García et al., 2020). Indeed, there is evidence of a direct relationship between acculturative stress and self-reported poor sleep quality (Alcántara et al., 2017; Gonzalez-Guarda et al., 2021). In addition, García et al. (2020) found short and long sleep duration risk to increase significantly after adjusting for acculturation measures for foreign-born Mexicans. The authors posited this finding may illustrate the negative effects of acculturative stress on a variety of health behaviors (e.g., smoking, poor diet, and drinking), including sleep (García et al., 2020).

Furthermore, Alcántara et al. (2019) suggested that elevated levels of acculturative stress (defined by the 17-item Hispanic Stress Inventory) may increase hypervigilance and worry—possible maladaptive coping behaviors that can increase the amount of time spent in bed. In the context of our study, the hypothalamic–pituitary–adrenal axis may be the mechanism underlying the link between unideal sleep duration and depression (Sun et al., 2018; Kim and Dimsdale, 2007). Individuals with depression can experience frequent circadian rhythm disruption, leading to adverse sleep duration (short and long) (Landgraf et al., 2014; Nader et al., 2010). Unhealthy sleep duration has, in turn, been implicated in worsening depression risk and symptoms (Sun et al., 2018; Vargas and Lopez-Duran, 2017). This may create a vicious cycle of stress, depression, and poor sleep (Pillai et al., 2014; Han et al., 2012). In fact, continual activation of the stress response has been shown to increase sleep duration, and studies have indicated a bidirectional relationship between depression and short sleep duration (Sun et al., 2018; Johnson et al., 2016). Understanding the effect of acculturative stress on the sleep health of Mexican American adults is important given a study that examined acculturative stress in six Hispanic/Latino heritage groups (i.e., Mexican, Cuban, Central American, Dominican, Mexican, Puerto Rican, and South American), reported Mexican immigrants had the highest level of acculturative stress (Cervantes et al., 2019). This is likely due to strict immigration policies and discrimination (Cervantes et al., 2019). Mexican Americans and immigrants therefore may be a particularly vulnerable group to acculturative stress.

In a follow-up study, Alcántara et al. (2019) examined the relationship between psychosocial stress and sleep in Hispanics/Latinos but did not find significant associations between acculturative stress and objective measures of sleep duration. This may be due to the use of a general Hispanic/Latino sample, which obscures differences between heritage groups (García et al., 2020). The authors also mentioned their study results were underpowered and limited by small sample size for some effect modification analyses (Alcántara et al., 2019).

There are a few limitations to consider for our study. First, given that this is a cross-sectional study, a causal relationship between sleep duration and acculturation or depression cannot be determined. Additionally, the acculturation-related variables used in our study do not fully capture the multi-dimensional nature of acculturation: acculturation involves factors such as diet, relationships, values, and beliefs. We were only able to use the variables available in the NHANES as proxies for acculturation (i.e., time spent in the U.S. and language(s) spoken at home). Finally, to increase our sample size we used pooled data from

NHANES 2005–2018 survey cycles. A limitation of pooling data is that social contexts across survey years may be inconsistent and thus affect survey responses. A final limitation is that sleep duration and depression have a bidirectional relationship, meaning more research is needed to elucidate how sleep duration influences or is influenced by depression (Dong et al., 2022). However, our study strengths—the use of a large amount of survey years and a nationally representative sample of Mexican Americans—should also be noted.

5. Conclusions

We found acculturation and depression to be associated with short and long sleep duration. Our results provide additional evidence of a link between acculturation/depression and short and long sleep duration among the Mexican American population. This area of research remains under-studied and further work should be done to elucidate the relationship between acculturation/depression and sleep among this population. For example, future studies should examine the association between acculturation and other sleep health measures (e.g., trouble falling asleep, sleep disorders, etc.). Moreover, since Mexican immigrants have been shown to be at a higher risk for acculturative stress and health consequences due to acculturation, improving health practitioner knowledge on how sleep duration and quality are influenced by these psychosocial and cultural processes is vital to ameliorating sleep health disparities.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

CKO, DL, FAMI, and FW efforts were supported by the Division of Intramural Research, National Institute on Minority Health and Health Disparities, National Institutes of Health (ZIA MD000015). The content is solely the responsibility of the authors and does not necessarily reflect the views of the National Institutes of Health. We would also like to acknowledge and thank Dennis W. Buckman of Information Management Services Inc. for his invaluable guidance and assistance in the data analysis for this study.

References

- Alcántara, C., Gallo, L.C., Wen, J., Dudley, K.A., Wallace, D.M., Mossavar-Rahmani, Y., Sotres-Alvarez, D., Zee, P.C., Ramos, A.R., Petrov, M.E., Casement, M.D., Hall, M.H., Redline, S., Patel, S.R., 2019. Employment status and the association of sociocultural stress with sleep in the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). *Sleep* 42 (4). <https://doi.org/10.1093/sleep/zsz002>.
- Alcántara, C., Patel, S.R., Carnethon, M., Castañeda, S.F., Isasi, C.R., Davis, S., Ramos, A.R., Arredondo, E., Redline, S., Zee, P.C., Gallo, L.C., 2017. Stress and Sleep: Results from the Hispanic Community Health Study/Study of Latinos Sociocultural Ancillary Study. *SSM Popul. Health* 3, 713–721.
- Bekteshi, V., Xu, Q., Van Tran, T., 2015. Psychological distress among low-income U.S.-and foreign-born women of Mexican descent: impact of acculturation. *Womens Health Issues* 25 (2), 185–192. <https://doi.org/10.1016/j.whi.2014.11.001>.
- Beunza, J.J., Martínez-González, M.Á., Ebrahim, S., et al., 2007. Sedentary behaviors and the risk of incident hypertension*: the SUN cohort. *Am. J. Hypertens.* 20 (11), 1156–1162. <https://doi.org/10.1016/j.amjhyper.2007.06.007>.
- Billings, M.E., Cohen, R.T., Baldwin, C.M., Johnson, D.A., Palen, B.N., Parthasarathy, S., Patel, S.R., Russell, M., Tapia, I.E., Williamson, A.A., Sharma, S., 2021. Disparities in sleep health and potential intervention models: A focused review. *Chest* 159 (3), 1232–1240.
- Breslau, J., Aguilar-Gaxiola, S., Borges, G., Castilla-Puentes, R.C., Kendler, K.S., Medina-Mora, M.-E., Su, M., Kessler, R.C., 2007. Mental disorders among English-speaking Mexican immigrants to the US compared to a national sample of Mexicans. *Psychiatry Res.* 151 (1–2), 115–122.
- Burazeri, G., Gofin, J., Kark, J.D., 2003. Over 8 hours of sleep—marker of increased mortality in Mediterranean population: follow-up population study. *Croat. Med. J.* 44 (2), 193–198.

- Cash RE, Beverly Hery CM, Panchal AR, Bower JK. Association between sleep duration and ideal cardiovascular health among US Adults, National Health and Nutrition Examination Survey, 2013–2016. *Prev Chronic Dis.* Jun 11 2020;17:E43. doi: 10.5888/pcd17.190424.
- Cervantes, R.C., Gattamorta, K.A., Berger-Cardoso, J., 2019. Examining difference in immigration stress, acculturation stress and mental health outcomes in Six Hispanic/Latino Nativity and Regional Groups. *J. Immigr. Minor. Health* 21 (1), 14–20. <https://doi.org/10.1007/s10903-018-0714-9>.
- Chattu, V.K., Chattu, S.K., Spence, D.W., Manzar, M.D., Burman, D., Pandi-Perumal, S.R., 2019. Do disparities in sleep duration among racial and ethnic minorities contribute to differences in disease prevalence? *J Racial Ethn Health Disparities* 6 (6), 1053–1061. <https://doi.org/10.1007/s40615-019-00607-7>.
- Dong, L., Xie, Y., Zou, X., 2022. Association between sleep duration and depression in US adults: A cross-sectional study. *J. Affect. Disord.* 296, 183–188. <https://doi.org/10.1016/j.jad.2021.09.075>.
- Dudley, K.A., Weng, J., Sotres-Alvarez, D., Simonelli, G., Cespedes Feliciano, E., Ramirez, M., Ramos, A.R., Loreda, J.S., Reid, K.J., Mossavar-Rahmani, Y., Zee, P.C., Chirinos, D.A., Gallo, L.C., Wang, R., Patel, S.R., 2017. Actigraphic Sleep Patterns of U.S. Hispanics: The Hispanic Community Health Study/Study of Latinos. *Sleep* 40 (2). <https://doi.org/10.1093/sleep/zsw049>.
- García, C., Sheehan, C.M., Flores-Gonzalez, N., Ailshire, J.A., 2020. Sleep Patterns among US Latinos by Nativity and Country of Origin: Results from the National Health Interview Survey. *Ethn. Dis.* 30 (1), 119–128. <https://doi.org/10.18865/ed.30.1.119>.
- Gaston, S.A., Martinez-Miller, E.E., McGrath, J., et al., 2021. Disparities in multiple sleep characteristics among non-Hispanic White and Hispanic/Latino adults by birthplace and language preference: cross-sectional results from the US National Health Interview Survey. *BMJ Open.* 11 (9) <https://doi.org/10.1136/bmjopen-2020-047834>.
- Gomez, J., Miranda, R., Polanco, L., 2011. Acculturative stress, perceived discrimination, and vulnerability to suicide attempts among emerging adults. *J. Youth Adolesc.* 40 (11), 1465–1476. <https://doi.org/10.1007/s10964-011-9688-9>.
- Gonzalez-Guarda, R.M., Stafford, A.M., Nagy, G.A., Befus, D.R., Conklin, J.L., 2021. A systematic review of physical health consequences and acculturation stress among Latinx individuals in the United States. *Biol. Res. Nurs.* 23 (3), 362–374. <https://doi.org/10.1177/1099800420968889>.
- Gottlieb, D.J., Redline, S., Nieto, F.J., Baldwin, C.M., Newman, A.B., Resnick, H.E., Punjabi, N.M., 2006. Association of usual sleep duration with hypertension: the Sleep Heart Health Study. *Sleep* 29 (8), 1009–1014.
- Grandner, M.A., Drummond, S.P.A., 2007. Who are the long sleepers? Towards an understanding of the mortality relationship. *Sleep Med. Rev.* 11 (5), 341–360. <https://doi.org/10.1016/j.smrv.2007.03.010>.
- Grandner MA, Petrov ME, Rattanaumpawan P, Jackson N, Platt A, Patel NP. Sleep symptoms, race/ethnicity, and socioeconomic position. *J. Clin. Sleep Med.* 2013;9 (9):897-905; 905a-905d. doi:10.5664/jcsm.2990.
- Grandner, M.A., Hale, L., Moore, M., Patel, N.P., 2010. Mortality associated with short sleep duration: The evidence, the possible mechanisms, and the future. *Sleep Med. Rev.* 14 (3), 191–203. <https://doi.org/10.1016/j.smrv.2009.07.006>.
- Grandner, M.A., Patel, N.P., Gehrman, P.R., Perlis, M.L., Pack, A.I., 2010. Problems associated with short sleep: bridging the gap between laboratory and epidemiological studies. *Sleep Med. Rev.* 14 (4), 239–247. <https://doi.org/10.1016/j.smrv.2009.08.001>.
- Hale, L., Rivero-Fuentes, E., 2011. Negative acculturation in sleep duration Among Mexican immigrants and Mexican Americans. *J. Immigr. Minor. Health* 13 (2), 402–407. <https://doi.org/10.1007/s10903-009-9284-1>.
- Han, K.S., Kim, L., Shim, I., 2012. Stress and sleep disorder. *Exp. Neurobiol.* 21 (4), 141–150. <https://doi.org/10.5607/en.2012.21.4.141>.
- Heilemann, M.V., Choudhury, S.M., Kury, F.S., Lee, K.A., 2012. Factors associated with sleep disturbance in women of Mexican descent. *J. Adv. Nurs.* 68 (10), 2256–2266. <https://doi.org/10.1111/j.1365-2648.2011.05918.x>.
- Hovey, J.D., 2000. Acculturative stress, depression, and suicidal ideation in Mexican immigrants. *Cult. Divers. Ethnic Minority Psychol.* 6 (2), 134–151. <https://doi.org/10.1037/1099-9809.6.2.134>.
- Itani, O., Jike, M., Watanabe, N., Kaneita, Y., 2017. Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. *Sleep Med.* 32, 246–256. <https://doi.org/10.1016/j.sleep.2016.08.006>.
- Jackson, C.L., Redline, S., Emmons, K.M., 2015. Sleep as a potential fundamental contributor to disparities in cardiovascular health. *Annu. Rev. Public Health* 36, 417–440. <https://doi.org/10.1146/annurev-publhealth-031914-122838>.
- Johnson, D.A., Lisabeth, L., Lewis, T.T., Sims, M., Hickson, D.A., Samdarshi, T., Taylor, H., Roux, A.V.D., 2016. The contribution of psychosocial stressors to sleep among African Americans in the Jackson Heart Study. *Sleep* 39 (7), 1411–1419.
- Kim, E.J., Dimsdale, J.E., 2007. The effect of psychosocial stress on sleep: a review of polysomnographic evidence. *Behav. Sleep Med.* 5 (4), 256–278. <https://doi.org/10.1080/15402000701557383>.
- Kim, E., Hogge, I., Salvisberg, C., 2014. Effects of self-esteem and ethnic identity: acculturative stress and psychological well-being among Mexican immigrants. *Hispanic J. Behav. Sci.* 36 (2), 144–163. <https://doi.org/10.1177/0739986314527733>.
- Kripke, D.F., Garfinkel, L., Wingard, D.L., Klauber, M.R., Marler, M.R., 2002. Mortality associated with sleep duration and insomnia. *Arch. Gen. Psychiatry* 59 (2), 131–136. <https://doi.org/10.1001/archpsyc.59.2.131>.
- Kroenke, K., Spitzer, R.L., Williams, J.B., 2001. The PHQ-9: validity of a brief depression severity measure. *J. Gen. Intern. Med.* 16 (9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>.

- Landgraf, D., McCarthy, M.J., Welsh, D.K., 2014. Circadian clock and stress interactions in the molecular biology of psychiatric disorders. *Curr. Psychiatry Rep.* 16 (10), 483. <https://doi.org/10.1007/s11920-014-0483-7>.
- Lara, M., Gamboa, C., Kahramanian, M.I., Morales, L.S., Bautista, D.E., 2005. Acculturation and Latino health in the United States: a review of the literature and its sociopolitical context. *Annu. Rev. Public Health* 26, 367–397. <https://doi.org/10.1146/annurev.publhealth.26.021304.144615>.
- Malhotra, A., Loscalzo, J., 2009. Sleep and cardiovascular disease: an overview. *Prog. Cardiovasc. Dis.* 51 (4), 279–284. <https://doi.org/10.1016/j.pcad.2008.10.004>.
- Manber, R., Steidtmann, D., Chambers, A.S., Ganger, W., Horwitz, S., Connelly, C.D., 2013. Factors associated with clinically significant insomnia among pregnant low-income Latinas. *J. Women's Health* 22 (8), 694–701. <https://doi.org/10.1089/jwh.2012.4039>.
- Martinez-Miller, E.E., Prather, A.A., Robinson, W.R., Avery, C.L., Yang, Y.C., Haan, M.N., Aiello, A.E., 2019. US acculturation and poor sleep among an intergenerational cohort of adult Latinos in Sacramento, California. *Sleep* 42 (3). <https://doi.org/10.1093/sleep/zsy246>.
- Mukherjee, S., Patel, S.R., Kales, S.N., Ayas, N.T., Strohl, K.P., Gozal, D., Malhotra, A., 2015. An official American thoracic society statement: the importance of healthy sleep. Recommendations and future priorities. *Am. J. Respir. Crit. Care Med.* 191 (12), 1450–1458.
- Nader, N., Chrousos, G.P., Kino, T., 2010. Interactions of the circadian CLOCK system and the HPA axis. *Trends Endocrinol. Metab.* 21 (5), 277–286. <https://doi.org/10.1016/j.tem.2009.12.011>.
- Patel, S.R., Sotres-Alvarez, D., Castañeda, S.F., Dudley, K.A., Gallo, L.C., Hernandez, R., Medeiros, E.A., Penedo, F.J., Mossavar-Rahmani, Y., Ramos, A.R., Redline, S., Reid, K.J., Zee, P.C., 2015. Social and health correlates of sleep duration in a US hispanic population: results from the hispanic community health study/study of latinos. *Sleep* 38 (10), 1515–1522.
- Pillai, V., Roth, T., Mullins, H.M., Drake, C.L., 2014. Moderators and mediators of the relationship between stress and insomnia: stressor chronicity, cognitive intrusion, and coping. *Sleep* 37 (7), 1199–1208. <https://doi.org/10.5665/sleep.3838>.
- Redline, S., Redline, B., James, P., 2019. Sleep epidemiology: an introduction. In: Redline, S., Redline, B., James, P. (Eds.), *The Social Epidemiology of Sleep*. Oxford University Press, pp. 11–46.
- Seicean, S., Neuhauser, D., Strohl, K., Redline, S., 2011. An exploration of differences in sleep characteristics between Mexico-born US immigrants and other Americans to address the Hispanic Paradox. *Sleep* 34 (8), 1021–1031. <https://doi.org/10.5665/sleep.1154>.
- Sheehan, C.M., Frochen, S.E., Walsemann, K.M., Ailshire, J.A., Are, U.S., 2018. adults reporting less sleep?: Findings from sleep duration trends in the National Health Interview Survey, 2004–2017. *Sleep* 42 (2). <https://doi.org/10.1093/sleep/zsy221>.
- Sun, Y., Shi, L., Bao, Y., Sun, Y., Shi, J., Lu, L., 2018. The bidirectional relationship between sleep duration and depression in community-dwelling middle-aged and elderly individuals: evidence from a longitudinal study. *Sleep Med.* 52, 221–229. <https://doi.org/10.1016/j.sleep.2018.03.011>.
- Vargas, I., Lopez-Duran, N., 2017. Investigating the effect of acute sleep deprivation on hypothalamic-pituitary-adrenal-axis response to a psychosocial stressor. *Psychoneuroendocrinology* 79, 1–8. <https://doi.org/10.1016/j.psyneuen.2017.01.030>.
- Whinnery, J., Jackson, N., Rattanaumpawan, P., Grandner, M.A., 2014. Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. *Sleep* 37 (3), 601–611. <https://doi.org/10.5665/sleep.3508>.