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ORIGINAL ARTICLE

The association of acculturative stress with self-reported sleep disturbance and sleep duration among Asian Americans

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Abstract

Study Objectives: This study aims to examine associations between acculturative stress—defined as the psychological impact, or stress reaction, of adapting to a new cultural context—and self-reported sleep outcomes among Chinese and Korean immigrants in the United States.

Methods: In this cross-sectional study, acculturative stress was assessed using a 9-item scale, and sleep disturbance was measured using the 8-item scale. Sleep duration was self-reported. Poisson and linear regression analyses were conducted to examine the associations between acculturative stress, sleep disturbance, and sleep duration.

Results: Our sample consists of 400 participants (females: 52%, Chinese: 50%, Koreans: 50%, the mean of age = 58.4). 81.8% of them were classified as having no sleep disturbance, whereas 18.2% were classified as having sleep disturbance. Poisson models revealed that greater acculturative stress was associated with a higher prevalence of sleep disturbance (Prevalence Ratio (PR): 1.18, 95% confidence interval (CI): 1.06% to 1.31%). In linear models, a one-unit increase in acculturative stress was associated with 0.08 hr less sleep ($p < .05$). Interaction tests indicated effect modification for sleep disturbance by sex and ethnic identity: only women had a significant association between acculturative stress and sleep disturbance (PR: 1.30; 95% CI: 1.13 to 1.49), while the association was significant for individuals identifying as "very Asian" (PR: 1.21; 95% CI: 1.08 to 1.35), but not for those identifying as "mostly Asian" or "bicultural/western".

Conclusions: If findings are replicated, we suggest developing intervention programs for Asian immigrants to minimize acculturative stress and bolster protective factors that decrease the risk for poor sleep outcomes.

Information on Clinical Trial:

Name: Screening To Prevent ColoRectal Cancer (STOP CRC) among At-Risk Asian American Primary Care Patients

NCT Number: NCT03481296

URL: https://clinicaltrials.gov/ct2/show/NCT03481296?term=Sunmin+Lee&draw=2&rank=1

Statement of Significance

The research presented in the manuscript focuses on the association of acculturative stress with sleep disturbance and sleep duration among Asian Americans in the United States. Although Asian Americans are the fastest-growing racial/ethnic group in the United States, few sleep studies have been dedicated to Asian Americans. Moreover, there has been increasing attention to the potential role acculturative stress may play in the development of racial/ethnic and immigrant disparities in sleep. To the best of our knowledge, our study is one of the first to examine an association of acculturative stress with sleep disturbance and sleep duration among Asian Americans. Also, this is the first to examine ethnic identity as an effect modifier in the relationship between acculturative stress and sleep disturbance.

Key words: Asian Americans; sleep; acculturative stress; emigrants and immigrants

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Introduction

Racial and ethnic minorities experience worse sleep across multiple domains, including duration and quality [1, 2], with 45.8% of Black adults, 34.5% of Hispanic adults, and 37.5% of Asian adults reporting sleeping for inadequate durations compared to just 33.4% of White adults [3]. Moreover, many racial/ethnic minority and immigrant groups are disproportionately affected by health conditions associated with poor sleep outcomes—including obesity [4, 5], diabetes [6, 7], and mental health-related issues [8–10]—while frequently underdiagnosed for sleep disorders compared to their White counterparts [11].

Asian Americans are the fastest-growing racial/ethnic group in the United States (U.S.), from less than a million in 1960 to over 20 million in 2019 [12]. Among them, 59% are foreign-born [13]. However, Asians are consistently less represented in sleep health studies than their Black and Latino/Hispanic counterparts [14]. This underrepresentation is often compounded by data insufficiency and inconsistencies in the definition of "Asian American" [15, 16], often treating Asian Americans as a single, monolithic "Asian" group [17]. Few studies regarding sleep patterns or risk factors for poor sleep have been dedicated to Asian Americans as a whole in the U.S. According to the 2007–2008 National Health and Nutrition Examination Survey data, Asians/others are two times as likely as non-Hispanic Whites to sleep less than 6 hours a night, and four times as likely to sleep less than 5 hours a night—rates greater than or equal to that of both Black and Mexican Americans in the same study [18, 19]. Studies from 2014 and 2016 confirm higher rates of short sleepers in Asians compared to Whites [20, 21], with this trend persisting for both US-born and foreign-born Asian Americans. Age-adjusted analyses revealed differences in short-sleep prevalence depending on nativity, with an age-adjusted prevalence of short sleep of 38.2% for US-born Asian Americans compared to only 26.7% for foreign-born Asian Americans [22]. While sleep studies have primarily used sleep duration as an outcome and limited data are available on racial/ethnic variation in sleep disturbance, existing studies show that racial/ethnic minorities consistently report higher rates of sleep disturbances and less restful sleep [2, 23].

This paper focuses on associations between acculturative stress and sleep outcomes among foreign-born Asian Americans. Acculturative stress is defined as the psychological impact, or stress reaction, of adapting to a new cultural context [24, 25]. Herein, we present a framework for understanding structural drivers of poor sleep health amongst Asian immigrants [26]. First, immigrants are more likely to work shift work, placing them at higher risk of disturbed sleep. According to an analysis of the 2015 American Community Survey and the American Time Use Survey data, immigrants nationwide are 15.6% more likely than US-born workers to be employed in occupations involving shift work—defined as working outside the traditional work hours of 7 am to 6 pm—and working nontraditional shift work hours has been extensively studied as a risk factor for more disturbed sleep/wakefulness patterns and less restful sleep [27–30]. Second, immigrants are more likely to be in housing conditions that are not conducive to high-quality sleep. Asians are more likely to live in multiperson, multigenerational households. A recent Pew Research Center analysis of the 2016 American Community Survey reported that Asians were the most likely out of all studied ethnic/racial groups to live in these multigenerational households, with nearly 30% of all Asians in the US residing in homes with at least two generations [31]. A study conducted in 2020 reveals that living in a crowded household of over five people was associated with a 40% increased risk of poor sleep health [32]. Third, neighborhood-level factors may also come into play, such as higher levels of light and noise disrupting circadian rhythms of residents in neighborhoods with higher proportions of ethnic/racial minorities [33–35]. An analysis of 216 331 neighborhood census-defined block groups across the US in 2010 revealed that block groups with higher proportions of Asian residents had consistently higher levels of exposure to nighttime noise than those with higher proportions of White residents [36].

Fourth, Asian immigrants experiencing racial microaggressions motivated by individual-level racism and xenophobia may experience poorer sleep quality and shorter sleep duration due to these subtle discriminatory experiences [37]. Anti-Asian microaggressions and more overt discriminatory experiences have been recently brought to national attention through the rise in hate crimes during the COVID-19 era [38, 39]. However, these cases do not exist in isolation as Asians have a long history of being scapegoated during public health crises. Examples include the 1990 quarantine of San Francisco Chinatown due to fear of the spread of the bubonic plague through "foreign" Asian bodies, and the similar widespread blaming of Asians during the 2003 SARS pandemic [39, 40]. Fifth, Asian immigrants may face high levels of acculturative stress [41, 42], defined as the psychological impact, or stress reaction, of adapting to a new cultural context [24, 43], which has been recently identified as a risk factor for poorer sleep outcomes in Korean American immigrants [41, 44]. Acculturative stress might cause sleep disturbances via disruption of the sleep-wake cycle [45], disrupting sleep by activating two response pathways common in both wakefulness maintenance and stress response bodily mechanisms: (1) stimulation of the hypothalamic–pituitary–adrenal (HPA) axis and the sympathetic nervous system's "fight-or-flight" response; and (2) increased release of attention and arousal associated hormones including corticotrophin-releasing hormone, adrenocorticotropic hormone, cortisol, noradrenaline and adrenaline [46].

Few studies exist exploring the relationship between acculturative stress and sleep outcomes in immigrant communities in the US or elsewhere. We identified only five prior studies examining the relationship between acculturative stress and sleep outcomes in racial/ethnic minorities within the US, with three conducted in Latino populations and two in Asian populations. Among the three studies conducted in Latino populations, greater acculturative stress was associated with significantly greater insomnia symptoms [47], and greater daytime sleepiness [48]; however, acculturative stress was not significantly associated with sleep duration [48, 49].

Considering the two studies examining the relationship between acculturative stress and sleep outcomes in Asians, there are conflicting findings. The first study was an exploratory investigation of 30 healthy Korean American women recruited from churches in the southeast United States. This study found that there was not a significant association between acculturative stress and global sleep quality, as assessed by a 25-item version of the Revised Social, Attitudinal, Familial and Environmental Acculturative Stress Scale (R-SAFE) [50], and a 15-item version of the Pittsburgh Sleep Quality Index [51]. However, the study's

small sample size (n = 30) limits the study's power and generalizability [41]. The second study involved 343 Korean immigrants and examined the association between various dimensions of acculturative stress and sleep duration. The study found significant gender-specific associations between measured acculturative stress subscales and sleep duration, only after adjustment for covariates such as age and orientation to American cultural values [44]. In women only, higher scores for homesickness and lower civic engagement were associated with shorter sleep duration after accounting for sociodemographic and acculturation covariates. In men only, higher scores for social isolation were associated with shorter sleep duration, after accounting for the same covariates [44]. These findings suggest that there may be sex differences in the association between acculturative stress and sleep among Asian American immigrants.

As shown earlier in the second Korean American study, sex may be a potential effect modifier of the association between acculturative stress and sleep outcomes. Asian American women may be at higher risk of experiencing the negative health impacts of acculturative stress than their male counterparts due to their double marginalized status [52, 53]. Additionally, ethnic identity may be another potential effect modifier as the association between acculturative stress and sleep outcomes may vary by different levels of ethnic identity. Previous studies have indicated that certain individual and contextual factors may increase one's vulnerability to stressful experiences by accentuating appraisal of the stress [54]. The salience of identity might function in this way for acculturative stress and lead to decreased ability to cope with acculturative stress [55–59]. A recent 2019 meta-analysis showed mixed findings, demonstrating that different aspects of ethnic/racial identity can function to exacerbate or protect against the negative impact of discrimination on health-related outcomes including mental health, risky health behaviors, and physical health [60].

The current study fills gaps in sleep health disparities research by focusing on understudied Asian American immigrants—specifically, Chinese and Korean immigrants—groups that consistently report poor outcomes on sleep measures, including sleep duration and sleep disturbance [1, 21, 22]. This study builds upon previous studies by focusing its analysis on the impact of acculturative stress—a critical component of the immigrant experience. We hypothesize that acculturative stress is positively associated with self-reported sleep disturbance (Hypothesis 1). In addition, we expect that acculturative stress is negatively associated with self-reported sleep duration (Hypothesis 2). Finally, we hypothesize that sex and ethnic identity modify the associations between acculturative stress and self-reported sleep outcomes: we hypothesize that women and individuals with higher Asian ethnic identity will have stronger associations between acculturative stress and adverse sleep outcomes compared to men and bicultural/westernized individuals (Hypothesis 3).

Methods

Data and study sample

The current study examined baseline data from a randomized controlled trial to increase colorectal cancer screening among 400 Chinese and Korean Americans (200 Chinese and 200 Korean Americans) living in the Washington, DC. Metropolitan Area. Study participants were between the ages of 50 and 75, and they were recruited from primary care physicians' clinics. To recruit eligible participants, we used two major recruitment strategies: (1) Referral of potential participants by participating primary care physicians (PCPs) or their clinical staff. This was usually done when patients visited the PCP clinics; and (2) Medical record review of PCP's patient pools by trained research assistants. Once the research assistants identified eligible participants, invitation letters and flyers were sent to potential participants by mail. Two weeks later, we contacted potential participants to screen for eligibility and invited them to the study. Inclusion criteria were: (1) self-identified Chinese or Korean; (2) age between 50 and 75 years; (3) not completed stool blood test (e.g., Fecal Immunochemical Test (FIT)) within the past year; and (4) not completed a colonoscopy within past 10 years. Exclusion criteria were as follows: (1) family history of colorectal cancer (parents and siblings); (2) history of removing polyps; (3) history of inflammatory bowel disease; and (4) history of diagnosis of colorectal cancer.

We used the baseline survey data collected from August 2018 to June 2020. Ninety-two percent of data collection was completed in-person, and the remaining 8% was collected by phone due to the restriction on in-person research activities with the COVID-19 outbreak in March 2020. After signing informed consent forms, participants completed a self-administered questionnaire (for in-person data collection) or a research assistant-led phone survey (for phone-based data collection) in their preferred language (Mandarin (49.5%), Korean (50%), or English (0.5%)). English version of the informed consent forms and all measures in the questionnaire were translated into Chinese or Korean by a bilingual research assistant and reviewed by the second bilingual research assistant. If there were disagreements between the two bilingual research assistants, the disagreements were resolved by further discussion or review by the third bilingual research staff. The translated documents and measures were pilot-tested by Chinese- and Korean-speaking lay people in the community for clarity and ease of understanding. There were no missing data. This study was approved by the Institutional Review Boards of the University of Maryland, College Park, and University of California, Irvine.

Variables

Dependent variables Our dependent variables were self-reported sleep disturbance and sleep duration. Sleep disturbance was assessed using validated questionnaires from the Patient Reported Outcomes Measurement Information System (PROMIS) [61], which were tested in population-based sample in the US with good reliability and construct validity [62]. We used the short-form Sleep Disturbance questionnaires that contained eight items to measure self-reported perceptions of sleep quality, depth, and restoration within the past seven days [63]. The 8-item PROMIS sleep disturbance was selected based on psychometric (Cronbach's alpha: 0.92) [64] clinical input, and it provided precision and efficiency compared with their corresponding full scales and other commonly used scales [63, 64]. Each item was rated on a 5-point Likert scale, and ratings were summed to obtain a total raw score ranging from 8 to 40. In our study, Cronbach's alpha was 0.89 for the overall sample and also for each ethnic group. The total raw score was converted to a standardized T-score using conversion tables, with higher

scores indicating greater sleep disturbances [65]. The *T*-scores were classified into four categories (none to slight, mild, moderate, and severe) based on the guidelines suggested by the PROMIS website (nihpromis.org). In our study, 327 participants (81.8%) were classified into "none to slight" category, 41 (10.3%) were "mild", 30 (7.5%) were "moderate" and 2 (0.5%) were in "severe" category. Based on this distribution, we further categorized sleep disturbance into a binary variable (0 = none to slight, 1 = mild, moderate, or severe) [66]. For the rest of the paper, we will refer to respondents as either having sleep disturbance (mild, moderate, or severe) or not (none to slight).

For sleep duration, we calculated sleep duration using the participants' responses to the question, "What is your usual sleep and wake time? (hours and minutes)." This variable was treated as a continuous value in the analysis, ranging from 4 to 11 hours/day in the sample.

Independent variable Our independent variable of interest was acculturative stress. This was a commonly used scale adapted from the Mexican American Prevalence and Services Survey [67, 68], and included in the Occupational/Emotional Stress subscale of the Hispanic Stress Inventory for use among Asians in the National Latino and Asian American Longitudinal Survey (NLAAS) [69, 70]. It was a 9-item scale with dichotomous responses (yes = 1 or no/not applicable = 0) to the following items: (1) feeling guilty for leaving the family in a home country, (2) receiving the same level of respect in the US as in a home country, (3) limited contact with family or friends in a home country, (4) difficulty in interactions with others because of English proficiency, (5) being treated badly because of speaking English with an accent, (6) difficulty in finding work because of Asian descent, (7) being questioned about legal status, (8) concern about being deported if one were to go to a social or government agency, and (9) avoiding seeking health services due to fear of immigration officials. Item 2 was reverse-coded. All items were summed to create one measure of acculturative stress, resulting in a score ranging from 0 to 9, with higher values indicating higher acculturative stress. Cronbach's alpha was 0.57 for the overall sample, while it was 0.56 for Chinese participants and 0.69 for Korean participants. Previous papers that used the NLAAS measure of acculturative stress also had similar Cronbach's alphas [71–73]. Given that there is no established clinically significant cutoff for this scale, we used the variable as a continuous variable in the analysis following previously published studies [74–78].

Covariates We included sociodemographic characteristics of age, sex, Asian subgroup, education, income, and employment status, and marital status, which could be potential confounders of the associations of interest. Age was a continuous variable in years, and sex was reported as male and female. Asian subgroup was classified as Chinese and Korean. Education was categorized as follows: less than high school, high school graduate/GED, some college/vocational school, college graduate, and higher than a college degree. Household income was classified as <$20 000, $20 000–$39 999, $40 000–$59 999, $60 000–$79 999, $80 000–$99 999, and ≥$100 000. Employment status was recoded into three categories: full-time, part-time, and not employed (which includes going to school, keeping house, and retired). Marital status was recoded into a binary variable: married or cohabiting, and not currently married (which includes divorce, separated, widowed, and never married). Number of chronic conditions was constructed using a question where participants were asked if they had ever been told by a doctor or health care provider in the past year that they had following 10 conditions: (1) high blood pressure, (2) high cholesterol, (3) heart attack, or any other heart disease, (4) cancer, (5) stroke, (6) diabetes, (7) anxiety or depression, (8) obesity, (9) breathing problem (asthma or emphysema), and (10) any other health problems. Response option for each of 10 conditions was: "have been told" (score of 1) or "have not been told" (score of 0). Responses to the 10 items were summed to generate a measure of multimorbidity, ranging from 0 to 10.

Potential effect modifiers We considered sex (male or female) and ethnic identity as potential effect modifiers. Ethnic identity was assessed by asking whether participants rated themselves as "very Asian," "mostly Asian," "bicultural," "mostly westernized," or "very westernized." This is a single item from the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA) [79, 80], which is a good instrument for acculturation with strong psychometric properties [81]. Since only a few participants identified as mostly or very westernized, the ethnic identity variable was recoded into three categories: "very Asian," "mostly Asian," or "bicultural/westernized."

Statistical analysis

First, we calculated descriptive statistics for the overall sample and stratified them by presence of sleep disturbance. Second, we conducted regression models. We used Poisson regressions to examine acculturative stress in relation to sleep disturbance as a binary outcome (i.e., estimating sleep disturbance (mild/moderate/severe sleep disturbance) compared to no sleep disturbance (none/slight sleep disturbance), and linear regression to examine acculturative stress in relation to sleep duration as a continuous outcome. We additionally compared the prevalence of sleep disturbances and hours of sleep duration by quartile of acculturative stress (lowest and highest). Furthermore, we also included sensitivity analyses which adjusted for depression, living situation, number of chronic conditions and year living in the US. We used Poisson regression because the prevalence of sleep disturbance exceeded 10%. For each outcome variable, we estimated three regression models. Model 1 estimated how sleep outcomes were associated with acculturative stress without any covariates. Model 2 added the demographic variables age, sex, Asian subgroup to Model 1. Model 3 added the socioeconomic variables such as education, household income, employment status, and marital status to Model 2. Model 4 added the number of chronic conditions to Model 3. Finally, we examined interaction terms to test for effect modification by (1) sex and (2) ethnic identity, for the associations between acculturative stress and sleep outcomes. When interaction terms were statistically significant at $p < .05$, we examined the separate associations between acculturative stress and the sleep outcome, stratified by different levels of sex and ethnic identity. We conducted effect modification by retirement and number of health conditions as sensitivity analyses to consider that our sample consists of the participants aged 50–75 years. All statistical analyses were computed using Stata, version 15.1.

Results

The average sleep duration and sociodemographic characteristics for the entire sample and stratified by self-reported sleep

disturbance are presented in Table 1. Of the 400 participants, 327 (81.8%) respondents were classified as having no sleep disturbance, while 73 (18.2%) were classified as having sleep disturbance. Participants in the two sleep disturbance groups displayed differences in sleep duration, acculturative stress, sex, Asian subgroup, and marital status. Individuals categorized as having sleep disturbance had a shorter sleep duration (6.76 hours) compared to those who did not have sleep disturbance (7.36 hours). Only nine participants (2.3%) were short sleepers (<5 hours), and four of them were classified as having sleep disturbance. Twelve people (3%) were longer sleepers (>9 hours); among them, one person had sleep disturbance. People who had sleep disturbance had higher acculturative stress (2.15) than those who did not have sleep disturbance (1.52). A higher proportion of females (22.8%) were classified as having a sleep disturbance, compared to males (13.2%). Individuals with sleep disturbance were more likely to be Korean (23.0%) than Chinese (13.5%) and not married (30.5%) than married or cohabitating (16.1%). Fifty-three percent of the study population was female. All of our participants were foreign-born, with an average of 23.1 years of residence in the US. A total of 9 (2.25%) participants were shorter sleepers (<5 hours), while 12 participants were longer sleepers (>9 hours).

Table 2 reports the adjusted prevalence ratios (aPR) and 95% confidence intervals (CI) for Poisson regression models to estimate associations between acculturative stress and self-reported sleep disturbance. Across all models, higher acculturative stress was associated with sleep disturbance. In Model 1, without adjusting any potential confounders, individuals who experienced a one-unit increase in acculturative stress scale (range 0–9) had 1.21 (95% CI: 1.08 to 1.35) times the prevalence of sleep disturbance. The association was maintained in Model 2 (aPR: 1.19; 95% CI: 1.07 to 1.33), which adjusted for age, sex, Asian subgroup, in Model 3 (aPR: 1.18; 95% CI: 1.06 to 1.31), which added covariates of education, income, employment status, and marital status to Model 2, and in Model 4 (aPR: 1.18; 95% CI: 1.06 to 1.31), which added the number of chronic conditions to Model 3. Furthermore, in this fully adjusted model (Model 4), females had 1.74 times the prevalence of sleep disturbance compared to

Table 1. Characteristics of the study participants (n = 400)

		Sleep disturbance		
	Total	None/slight	Mild/moderate/severe	p-value
	(100%)	n = 327 (81.8%)	n = 73 (18.2%)	
Sleep duration (SE)	7.25 (0.06)	7.36 (0.06)	6.76 (0.16)	0.0001
<5 hours	9	5 (55.56)	4 (44.44)	0.040
>9 hours	12	11 (91.67)	1 (8.33)	0.367
Acculturative stress (SE)	1.64 (0.08)	1.52 (0.08)	2.15 (0.21)	0.002
Age (SE)	58.39 (0.32)	58.38 (0.36)	58.45 (0.67)	0.930
Sex				
Male	189	164 (86.8)	25 (13.2)	0.014
Female	211	163 (77.3)	48 (22.8)	
Asian subgroup				
Korean	200	154 (77.0)	46 (23.0)	0.014
Chinese	200	173 (86.5)	27 (13.5)	
Education (Years)				
< HS	43	35 (81.4)	8 (18.6)	0.224
HS grad/GED	91	73 (80.2)	18 (19.8)	
Some college/vocational school	68	59 (86.8)	9 (13.2)	
College grad	101	76 (75.3)	25 (24.8)	
> College	97	84 (86.6)	13 (13.4)	
Income				
< $20	62	46 (74.2)	16 (25.8)	0.517
$20K–39,999	64	54 (84.4)	10 (15.63)	
$40K–59,999	85	68 (80.0)	17 (20.0)	
$60K–79,999	49	40 (81.6)	9 (18.4)	
$80K–99,999	32	26 (81.3)	6 (18.8)	
≥ $100K	108	93 (86.1)	15 (13.9)	
Employment				
Full-time	231	190 (82.3)	41 (17.8)	0.674
Part-time	84	66 (78.6)	18 (21.4)	
Not employed	85	71 (83.5)	14 (16.5)	
Marital status				
Married or lived with partner	341	286 (83.9)	55 (16.1)	0.008
Not currently married	59	41 (69.5)	18 (30.5)	
Num of chronic conditions				
0	130	112 (86.2)	18 (13.9)	0.131
1–2	185	151 (81.6)	34 (18.4)	
3	85	64 (75.3)	21 (24.7)	

Notes: The mean and standard error were presented for continuous variables (sleep duration and age), while frequencies and percentages were reported for categorical variables. The chronic conditions include the following 10 conditions: (1) high blood pressure, (2) high cholesterol, (3) heart attack, or any other heart disease, (4) cancer, (5) stroke, (6) diabetes, (7) anxiety or depression, (8) obesity, (9) breathing problem (asthma or emphysema), (10) any other health problems.

males, and the Chinese had 0.59 times the prevalence of sleep disturbance compared to Koreans. We observed an 18% increase in the likelihood of sleep disturbance with a small increase in acculturative stress, showing a substantial association between acculturative stress and sleep disturbance. This association was robust when years in the US was additionally adjusted (Model 2 in Table C, Supplementary Material). If we compared the highest quartile of acculturative stress to the lowest quartile, individuals in the highest quartile had 2.60 times (95% CI: 1.38 to 4.90) the prevalence of sleep disturbance compared to those in the lowest quartile (Table A, Supplementary Material).

Table 3 displays the results from linear regression models for acculturative stress and self-reported sleep duration, adjusting for potential confounders. Without any covariates, a one-unit increase in acculturative stress (range 0–9) was associated with 0.07 hours less sleep in Model 1 ($p < .10$). This amounts to about four minutes less sleep for every unit increase in acculturative stress. The negative association between acculturative stress and sleep duration was attenuated when age, sex, and Asian subgroup were adjusted for (Model 2). However, the association was strongest in Model 3 and Model 4, which further adjusted for the covariates of education, income, employment status, marital status, and the number of chronic conditions. In these models, each one-unit increase in reported acculturative stress (a small increase in acculturative stress) was associated with 0.08 fewer hours of sleep (about 5 fewer minutes of sleep) ($p < .05$), which was a moderate association. This association was robust when we adjusted for years in the US (Model 2 in Table D, Supplementary Material). If we compared the highest quartile of acculturative stress to the lowest quartile, individuals in the highest quartile had 0.35 fewer hours of sleep (equivalent to 21 min) compared to those in the lowest quartile (Table B, Supplementary Material). Compared to Korean participants, Chinese participants reported sleeping longer by 0.30 hours. Moreover, compared to participants with an educational level higher than a college degree, those less than high school had

Table 2. Association between acculturative stress and sleep disturbance: Poisson regression analysis ($n = 400$)

	Model 1 PR (95% CI)	Model 2 PR (95% CI)	Model 3 PR (95% CI)	Model 4 PR (95% CI)
Acculturative stress	1.21*** (1.08–1.35)	1.19*** (1.07–1.33)	1.18*** (1.06–1.31)	1.18*** (1.06–1.31)
Age		0.99 (0.95–1.02)	0.98 (0.95–1.02)	0.97 (0.94–1.01)
Sex				
Female		1.70** (1.10–2.64)	1.77*** (1.14–2.75)	1.74**(1.13–2.68)
Male (reference)		1.00	1.00	1.00
Asian subgroup				
Chinese		0.60** (0.37–0.97)	0.58** (0.34–0.98)	0.59**(0.35–1.00)
Korean (reference)		1.00	1.00	1.00
Education				
<HS			0.99 (0.42–2.32)	0.89 (0.38–2.09)
HS grad/GED			0.98 (0.46–2.08)	0.91 (0.43–1.93)
Some college/vocational school			0.83 (0.37–1.86)	0.80 (0.36–1.78)
College grad			1.41 (0.72–2.77)	1.34 (0.68–2.65)
> College (reference)			1.00	1.00
Income				
< $20			2.02* (0.94–4.34)	2.09* (0.98–4.43)
$20K–39,999			0.78 (0.36–1.70)	0.80 (0.37–1.75)
$40K–59,999			1.02 (0.49–2.11)	1.04 (0.51–2.15)
$60K–79,999			0.99 (0.44–2.21)	1.07 (0.48–2.39)
$80K–99,999			1.09 (0.45–2.63)	1.16 (0.48–2.80)
≥ $100K (reference)			1.00	1.00
Employment status				
Part-time			0.85 (0.51–1.40)	0.84 (0.51–1.38)
Not employed			0.70 (0.40–1.02)	0.68 (0.40–1.17)
Full-time (reference)			1.00	1.00
Marital status				
Not currently married			1.57* (0.99–2.49)	1.58*(0.99–2.51)
Married/cohabit (reference)			1.00	1.00
Num of chronic conditions				
1-2				1.24 (0.74–2.06)
3				1.81** (1.03–3.19)
0 (reference)				1.00
Constant	0.13*** (0.09–0.18)	0.23 (0.02–2.18)	0.33 (0.03–3.31)	0.40 (0.04–4.02)

Model 1: Acculturative stress.
Model 2: Model 1 + age, sex, ethnicity.
Model 3: Model 2 + education, income, employment status, marital status.
Model 4: Model 3 + number of chronic conditions.
Notes: The chronic conditions include the following 10 conditions: (1) high blood pressure, (2) high cholesterol, (3) heart attack, or any other heart disease, (4) cancer, (5) stroke, (6) diabetes, (7) anxiety or depression, (8) obesity, (9) breathing problem (asthma or emphysema), and (10) any other health problems.
PR = prevalence ratio; CI = confidence interval
*$p < .10$; **$p < .05$; ***$p < .01$.

Table 3. Association between acculturative stress and sleep duration (hours): OLS regression analysis (n = 400)

	Model 1 β (SE)	Model 2 β (SE)	Model 3 β (SE)	Model 4 β (SE)
Acculturative stress	−0.07* (0.04)	−0.06 (0.04)	−0.08** (0.04)	−0.08** (0.04)
Age		0.01 (0.01)	−0.01 (0.01)	−0.01 (0.01)
Sex				
Female		−0.06 (0.12)	−0.16 (0.12)	−0.16 (0.12)
Male (reference)				
Asian Subgroup				
Chinese		0.33*** (0.12)	0.30*** (0.13)	0.30** (0.13)
Korean (reference)				
Education				
<HS			0.44* (0.24)	0.45* (0.25)
HS grad/GED			0.32 (0.20)	0.33 (0.20)
Some college/vocational school			−0.01 (0.20)	−0.01 (0.21)
College grad			0.17 (0.19)	0.17 (0.19)
> College (reference)				
Income				
< $20			0.09 (0.23)	0.09 (0.23)
$20K–39,999			0.21 (0.22)	0.21 (0.22)
$40K–59,999			−0.21 (0.19)	−0.21 (0.19)
$60K–79,999			−0.13 (0.22)	−0.14 (0.22)
$80K–99,999			0.11 (0.25)	0.10 (0.25)
≥ $100K (reference)				
Employment status				
Part-time			0.36** (0.16)	0.36** (0.16)
Not employed			0.33** (0.17)	0.34** (0.17)
Full-time (reference)				
Marital status				
Not currently married			−0.08 (0.17)	−0.08 (0.17)
Married/cohabit (reference)				
Num of chronic conditions				
1–2				0.01 (0.13)
3				−0.07 (0.17)
0 (reference)				
Constant	7.36*** (0.08)	6.78*** (0.59)	7.47*** (0.65)	7.43*** (0.66)

Model 1: Acculturative stress.
Model 2: Model 1 + age, sex, Asian subgroup.
Model 3: Model 2 + education, income, employment status, marital status.
Model 4: Model 3 + number of chronic conditions.
Notes: The chronic conditions include the following 10 conditions: (1) high blood pressure, (2) high cholesterol, (3) heart attack, or any other heart disease, (4) cancer, (5) stroke, (6) diabetes, (7) anxiety or depression, (8) obesity, (9) breathing problem (asthma or emphysema), and (10) any other health problems.
SE = standard errors.
*p < .10; **p < .05; ***p < .01.

longer sleep duration by 0.45 hours. Additionally, compared to full-time employees, participants who were part-time employees or not employed were sleeping longer by 0.36 hours and 0.34 hours, respectively.

We tested sex and ethnic identity as potential effect modifiers of the association between acculturative stress and self-reported sleep outcomes with all covariates. The effect modification analyses by sex and ethnic identity for sleep disturbance were significant at p < .05, but not for sleep duration (results not shown). Thus, stratified analysis results for sleep disturbance are presented in Table 4. Stratified results by sex show that females had 1.30 (95% CI: 1.13 to 1.49) times the prevalence of mild, moderate, or severe sleep disturbance when experiencing one point higher on the higher acculturative stress scale, but we did not find a similar association in males. Results stratified by ethnic identity indicated a significant association between acculturative stress and sleep disturbance for those respondents identifying as "very Asian": a one-unit increase in acculturative stress was associated with 1.21 (95% CI: 1.08 to 1.35) times the prevalence of sleep disturbance. On the other hand, for respondents identifying as "mostly Asian" or "bicultural/western", acculturative stress was not significantly associated with sleep disturbance.

Discussion

This study is among the first to analyze acculturative stress and sleep outcomes, particularly for both Korean and Chinese American immigrants in the US in a relatively large sample. This study affirms previous findings in Korean Americans of a significant negative association between acculturative stress and sleep duration [44], and it is the first to explore this relationship in Chinese Americans, with both Asian subgroups demonstrating that higher levels of acculturative stress are associated with shorter sleep durations. Furthermore, the present study advances the current understanding of immigrant and minority sleep health by documenting a positive relationship of acculturative stress and sleep disturbance in Asian Americans, with variation in this relationship based on sex and ethnic identity.

Table 4. Association between acculturative stress and sleep disturbance stratified by sex and ethnic identity: Poisson regression analysis (n = 400)

	Sex		
	Men (n = 189)		Women (n = 211)
	PR (95% CI)		PR (95% CI)
Acculturative stress	0.98 (0.82–1.16)		1.30 (1.13–1.49)***
	Ethnic identity		
	Bicultural/ Western (n = 96)	Mostly Asian (n = 62)	Very Asian (n = 242)
	PR (95% CI)	PR (95% CI)	PR (95% CI)
Acculturative Stress	1.00 (0.63–1.57)	1.93 (0.52–7.18)	1.21 (1.08–1.35)***

Notes: Models adjusted for age, Asian subgroup, education, income, employment status, marital status, and number of chronic conditions. The chronic conditions include the following 10 conditions: (1) high blood pressure, (2) high cholesterol, (3) heart attack, or any other heart disease, (4) cancer, (5) stroke, (6) diabetes, (7) anxiety or depression, (8) obesity, (9) breathing problem (asthma or emphysema), and (10) any other health problems.
PR = prevalence ratio; CI = confidence interval.
*p < .10; **p < .05; ***p < .01.

Our results describing a statistically significant substantial association between acculturative stress and self-reported sleep disturbance among Asian Americans advances on studies that have examined this association in other immigrant groups in the US. For example, in a study of 1 192 self-identified Hispanic/Latino adults who participated in both the Hispanic Community Health Study/Study of Latinos Sueño and Sociocultural Ancillary studies [47], a one standard deviation increase in acculturative stress severity (measured using the 17-item Hispanic Stress Inventory scale) was associated with 1.45 unit increases in an insomnia symptoms score [47]. These results align with research showing that other forms of chronic stressors such as upsetting life events are associated with sleep disturbance outcomes in Black, White, and Chinese American women [82], as well as job-related stress in multiethnic Australian and Swedish adult populations [83, 84]. Moreover, several systematic reviews have established sleep disturbances are one of the hallmark indicators of stress-related issues such as posttraumatic stress disorder [85–87]. On a physiological level, acculturative stress might cause sleep disturbances via disruption of the sleep-wake cycle [45], disrupting sleep by activating two response pathways common in both wakefulness maintenance and stress response bodily mechanisms: (1) stimulation of the hypothalamic–pituitary–adrenal (HPA) axis and the sympathetic nervous system's "fight-or-flight" response; and (2) increased release of attention and arousal associated hormones including corticotropin-releasing hormone, adrenocorticotropic hormone, cortisol, noradrenaline, and adrenaline [46]. Therefore, this study indicates that acculturative stress—the psychological impact of adapting to a new cultural context—especially in a context that systematically marginalizes immigrants of color, functions similar to other chronic stressors for disrupting sleep health for Asian American immigrants [88]. There may also be structural factors related to acculturative stress that contribute to the observed associations; for example, immigrants with a high level of acculturative stress may be more likely to work in multiple jobs, shift work, or jobs that require commuting long distances which influence opportunities for sleep [27–30].

Additionally, our study of a moderate negative association between acculturative stress and sleep duration is consistent with recent findings of a negative relationship between acculturative stress and self-reported sleep duration in Korean Americans even after adjustment for sociodemographic characteristics [44], and it is the first to extend this finding for Chinese American immigrants. Notably, Chinese and Korean immigrants experiencing the highest level of acculturative stress may sleep on average 40 fewer minutes than those with no acculturative stress. Acculturative stress may lead to shorter sleep durations in a similar stress response pathway as it does for sleep disturbance [46], and via sympathetic nervous system "fight-or flight", HPA axis, and/or attention and arousal related hormone mechanisms [89].

We found an interesting association between levels of education and sleep duration. Compared to participants with an educational level higher than a college degree, those with a high school degree and less than high school had *longer* sleep duration (0.35 and 0.49 hours, respectively). This is similar to findings among African Americans reported by Jackson and colleagues where the increasing prevalence of short sleep was observed among professionals, a phenomenon referred to as John Henryism (more educated Black Americans strive harder to succeed (often to the detriment of their health status)) [90, 91]. Interestingly, in the same study, White professionals slept more than White nonprofessionals [90].

Notably, we draw attention to the significant effect modification of the relationship between acculturative stress and sleep disturbance by sex and ethnic identity. Our study is partly consistent with a previous study that demonstrated that the relationship between specific subdomains of acculturative stress—such as homesickness and civil engagement—and sleep duration in Korean American immigrants differed in men compared to women [44]. The present study expands on these findings by revealing significant effect modification of the relationship between a single global measure of acculturative stress and sleep disturbance by sex. Specifically, women had 1.31 times the prevalence of mild, moderate, or severe sleep disturbance for every one-point increase on the acculturative stress scale, with no such association existing for men. Previous studies suggest that Asian American women are more vulnerable to the health effects of discrimination-related stressors such as acculturative stress due to their double marginalized status [52, 53]. Moreover, women in general had higher risk of sleep disturbance than men in our study, suggesting that clinicians should pay particular attention to the roles of stress for sleep health among Asian immigrant women. Furthermore, our study reveals that ethnic identity modifies the effect of acculturative stress on sleep disturbances. We found that the association between acculturative stress and sleep disturbance was significant only among those who described their ethnic identity as "very Asian". However, the association was not evident among those who rated their ethnic identity as "bicultural/western" or "mostly Asian". This may be because a strong ethnic identity may increase one's vulnerability to stressful experiences by accentuating appraisal of the stress [54]. Individuals with strong ethnic identity may feel greater threat when they experience acculturative stress because their identity with their cultural roots is strong and thus acculturative stress is more disturbing, resulting in sleep disturbance.

Furthermore, a recent meta-analysis paper had a mixed finding for the role of ethnic identity, which differentiated between ethnic identity "exploration"—defined as "search activities and behaviors related to understanding the role of ethnicity/race in one's overall identity"— and "commitment"—defined as "clarity about the role of ethnicity/race in one's self-concept" [60]. The ethnic identity "exploration" increased vulnerabilities associated with discrimination and exacerbated mental health and risky health behaviors, whereas, ERI "commitment" had a buffering effect, conferring protection against discrimination. The buffering effect was stronger in Latinx but weaker among Asians. Our study result was consistent with the "exploration" of ethnic identity, but not with "commitment" of ethnic identity. The measure of ethnic identity in this study cannot be classified as either "exploration" or "commitment"; in future research, it may be valuable to include more detailed assessments of ethnic identity in relation to sleep outcomes among Asian Americans [60].

The level of acculturative stress in this sample was low (the mean = 1.64) considering the range was from 0 to 9. This could be because the scale was originally developed for Mexican Americans [67, 68], which might not reflect the acculturative stress that Asian Americans experience. In previous studies, the mean of the scale was higher among Latino populations (the mean = 2.20 [77]; 2.6 [78]), but lower among Asian Americans (the mean = 1.76 [77]; 1.8 [78]; 0.93–2.38 [92]). Additionally, cronbach's alpha was low (0.57 for the overall sample, 0.56 for Chinese participants and 0.69 for Korean), which means that the scale might not capture acculturative stress well. Future studies should use acculturative stress measures specific to Asian Americans. Given that our sample consists of participants 50–75 years of age, we conducted sensitivity analyses to consider factors specific to this phase of the life course, including retirement and health conditions. When we examined effect modification by retirement and number of health conditions, we did not find significant effect modification.

Our study has several limitations. First, we used self-reported data on sleep outcomes, which may not be accurate. We asked about usual sleep and wake times, which might have been the time when they get into and get out of bed rather than the times when they fell asleep and woke up in the morning. This might have overestimated the sleep duration. Additionally, studies have found that individuals overestimate sleep duration compared to objectively measured sleep duration [93–95], and also that individuals with insomnia tend to underestimate self-reported duration compared to when objectively measured [96, 97]. However, for our measure of sleep disturbance, we used the gold-standard PROMIS scale—a widely used, valid, and reliable self-reported measure of sleep disturbance in diverse populations [63]. Future studies need to assess both subjective and objective sleep data. Second, the study was limited to the Chinese and Korean participants aged 50–75 living in the Washington D.C. Metropolitan Area. Our results may not be generalized to those who (1) are outside the age range, (2) originate from Asian countries other than China and Korea, or (3) reside elsewhere in the US. Third, the cross-sectional study design does not provide information on temporal ordering or allow us to examine causal mechanisms between acculturative stress and sleep outcomes. A future prospective study is needed to investigate mechanisms for the observed associations. Fourth, sleep disturbance information was obtained in a retrospective manner (i.e., during the past 7 days), and it may not be accurate information. Last, we did not have information on access to Chinese/Korean resources (e.g., easy access to translators, shops that use native language), which might have contributed to a reduction in acculturative stress or enhanced stress coping.

Nonetheless, the study has several important implications, as sleep health plays a crucial role in physical and mental health outcomes [98–110]. We found that Asian immigrants with higher acculturative stress were more likely to experience sleep disturbance and to sleep for a shorter period of time. We also found that the positive association between acculturative stress and sleep disturbance was more pronounced for females and individuals with a strong Asian identity. There is a need to conduct further replication studies using nationally representative samples. Further research also should identify mechanisms underlying these observed associations—and the stronger association for females and individuals with a strong Asian identity—as this can inform clinical approaches and the development of prevention-oriented interventions. It may be possible to develop intervention programs and social policies for Asian immigrants to minimize acculturative stress experiences and bolster protective factors that decrease the risk for poor sleep outcomes. For example, educational programs, counseling services, and community programs in Chinese or Korean language may provide an opportunity to develop coping strategies or facilitate strong community connections that could reduce acculturative stress. Our research highlights the need for future studies exploring the efficacy of such programs and policies to reduce acculturative stress in Asian immigrants.

Supplementary material

Supplementary material is available at *SLEEP* online.

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Disclosure Statement

None declared.

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