pii: jc-00148-16 http://dx.doi.org/10.5664/jcsm.6486

JCSM
Journal of Clinical Sleep Medicine

SCIENTIFIC INVESTIGATIONS

Sleep Quality in an Adult American Indian Community Sample

Cindy L. Ehlers, PhD; Derek N. Wills, BS; Philip Lau, MA; David A. Gilder, MD

Molecular and Cellular Neurosciences Department, The Scripps Research Institute, La Jolla, CA

Study Objectives: Epidemiological studies have found that insufficient sleep (< 7 h/night) is more common among American Indians/Alaska Natives (AI/AN). In this study we sought to identify specific demographic, clinical, and cultural factors that may be associated with reduced sleep quality in an American Indian community sample.

Methods: Information on demography along with personal medical, psychiatric, and drinking history was obtained using the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA). Sleep quality was assessed by the Pittsburgh Sleep Quality Index (PSQI).

Results: The adult participants (n = 386, 54% women) had a mean ± standard deviation age of 31.35 ± 14.4 y. Higher degrees of AI ancestry, but not cultural identification, being older than 30 y, and having a high school diploma all were factors predictive of having a short sleep duration (< 6 h). The global score on the PSQI was significantly higher in those participants with a lifetime diagnosis of substance use disorders, anxiety disorders, and affective disorders. Alcohol use disorders and affective disorders were significant predictors of sleep latency whereas anxiety and affective disorders were correlated with waking more often in the night/early morning. Nicotine dependence was associated with having trouble breathing, and alcohol use disorders and anxiety disorders with bad dreams.

Conclusions: Alcohol use disorders are associated with poorer quality of sleep in this population and substance use disorders were associated with different aspects of sleep than anxiety and depressive disorders. These findings add to the understanding of the interactions between sleep and substance use, anxiety, and affective disorders in an understudied and underserved population.

Keywords: alcohol dependence, American Indians, anxiety disorders, BMI, drug dependence, major depressive disorders, PSQI, sleep

Citation: Ehlers CL, Wills DN, Lau P, Gilder DA. Sleep quality in an adult American Indian community sample. *J Clin Sleep Med.* 2017;13(3):385–391.

INTRODUCTION

Over the past decade there has been a growing body of literature that has explored the potential overlap between health disparities research and sleep medicine.[1] A number of epidemiological studies have reported poorer quality sleep and a higher prevalence of short and/or long sleep in non-White adults, particularly from lower socioeconomic status groups, in comparison with White adults.[2–5] This research has provided crucial information on disparities in such factors as self-reported sleep duration, daytime sleepiness, and symptoms of sleep disordered breathing across ethnic groups, geographical location, and socioeconomic status. However, the underlying racial/ethnic specific factors that may lead to these disparities in sleep health are less well understood.[6] It has been suggested that studies using a multilevel approach that includes examination of factors such as level of acculturation, comorbid medical and psychiatric conditions, neighborhood conditions, and cultural beliefs and practices will be crucial to the development of intervention and prevention strategies to reduce disparities in sleep health in minority populations.[6,7]

One minority population that has substantial health disparities and has been particularly understudied with respect to sleep medicine is American Indians/Alaska Natives (AI/AN). The Behavioral Risk Factor Surveillance System (BRFSS) found that healthy sleep (> 7 h) was lower among American Indians/Alaska Natives as compared with non-Hispanic Whites, Hispanics, and Asians.[8,9] AI/AN appear to experience more overall health disparities compared with other races and ethnicities in the United States. For instance, AI/AN have an average life expectancy of 5.2 y fewer than what has been reported for the general United States population[10] and receive worse health care and have worse access to health care than Whites.[11] A literature review on the prevalence of obesity, diabetes, metabolic syndrome, and cardiovascular disease found "clearly higher rates" in AI/AN compared to comparison groups.[12] Another health disparity that afflicts AI/AN is substance dependence. Data from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) demonstrates that the highest rates of 12-mo and lifetime prevalence of Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) alcohol use disorders are found in AI/AN (19.2% and 43.4, respectively) as compared to all other ethnic groups.[13]

BRIEF SUMMARY

Current Knowledge/Study Rationale: Although several large epidemiological studies have found that sleep insufficiency is more common among American Indians/Alaska Natives (AI/AN), what other aspects of sleep quality and what other comorbid conditions influence sleep in AI/AN is not clear.

Study Impact: This study shows that short sleep duration (< 6 h/night) was associated with the degree of AI ancestry but not cultural identification or body mass index. Substance use disorders, anxiety, and affective disorders influenced sleep as quantified by the Pittsburgh Sleep Quality Index.

Understanding the mechanisms mediating the effects of cardiovascular, metabolic and substance use and other mental health disorders on health outcomes, such as sleep patterns, in AI/AN, is a research topic of considerable importance in view of the evidence supporting a relationship between sleep disturbances and these disorders in the general population.[14] However, there have been few studies investigating AI/AN and sleep,[15–17] and none of these studies focused on the relationship between substance use and use disorders and sleep quality.

The current report is part of a larger study of mental health in a community sample of American Indians.[18] Using cross-sectional data from this sample, the current report extends previous studies to the assessment of sleep quality as indexed by the Pittsburgh Sleep Quality Index (PSQI). In this study we sought to determine if reduced sleep quality was associated with factors unique to being an American Indian, such as an individual's degree of American Indian ancestry and/or their identification with American Indian culture. We also sought to determine if select demographic variables might contribute to sleep quality such as age, education, sex, and body mass index (BMI). Finally, we evaluated the comorbidity of substance use disorders and affective and anxiety disorders and sleep quality, taking into consideration relevant demographic variables.

METHODS

Participants

American Indian participants were recruited from eight geographically contiguous rural Indian reservations with a total population of approximately 4,000 individuals. Participants were recruited using a combination of a venue-based method for sampling hard-to-reach populations[19,20] and a respondent-driven procedure[21] that has been described elsewhere.[22] Participants were recruited from tribal halls, health clinics, tribal libraries, and stores on the reservations. Flyers advertising the study were posted in each location with the telephone number of the tribal recruitment coordinator, who visited each location regularly and approached potential participants to offer information about and enrollment in the study. Individuals who elected to participate were encouraged to inform other individuals about the study. Approximately half of the participants were recruited with each method. Recruiters estimate equal numbers of participants learned of the study between the individual venues. A 10% to 25% rate of refusal with the venue method occurred, depending on venue. The refusal rate in the respondent-driven procedure is not known. To be included in the study, participants had to be of American Indian ancestry (AIA), be between the ages of 18 and 70 y, and be mobile enough to be transported from his or her home to the Scripps Research Institute. The protocol for the study was approved by the Institutional Review Board of the Scripps Research Institute, and the Indian Health Council, a tribal review group overseeing health issues for the reservations where recruitment was undertaken. Written informed consent was obtained from each participant after the study was fully explained.

Information on demography, personal medical and psychiatric history, and drinking history was obtained using a family history interview and the face-to-face Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA). There have been several studies that have evaluated the concurrent diagnostic validity of the SSAGA across alcohol and drug dependencies, major depression, anxiety disorders, and antisocial personality disorder.[23,24] These findings indicate that the SSAGA is a highly reliable and valid instrument for use in studies of psychiatric disorders, including substance dependence. BMI was calculated based on the participants' weight and height on the day of the interview.

Diagnoses of lifetime substance dependence and other psychiatric disorders were made on the basis of DSM-5 criteria generated by the SSAGA. Four anxiety disorders (panic disorder with or without agoraphobia, agoraphobia without panic, social phobia, and obsessive-compulsive disorder), posttraumatic stress disorder, and major depressive disorder were evaluated. Because of the difficulties in diagnosing hypomania using the SSAGA, it was not included and bipolar II disorder was instead included with major depressive disorder as a single major depressive disorder category. The presence of any of the four anxiety disorders was combined into a single variable "any anxiety disorder" (ANYAX) and the presence of any of the affective disorders was combined into a single variable "any affective disorder" (ANYAF).

Sleep quality was indexed by the PSQI. The PSQI consists of 19 items that produce a global sleep quality score as well as individual items such as usual bed time, wake time, actual hours slept, number of minutes to fall asleep, nightmares, and nighttime awakenings. Global PSQI score was estimated for each participant as described previously.[25] The psychometric properties of the PSQI have been described previously.[26] The amount of AIA was obtained from the subject's report of what they believed the percentage of their AIA that was reported to the Bureau of Indian Affairs based on their genealogy. American Indian cultural Identification was assessed using the Orthogonal Cultural Identification Scale (OCIS) developed by Oetting and Beauvais.[27,28] This scale's internal consistency for individual items was high and both concurrent and discriminant validity were demonstrated in this American Indian population.[29]

Data Analyses

Data analyses focused on specific aims generated based on previous research investigating alcohol use disorders and other psychiatric disorders in this population. Since the Centers for Disease Control and Prevention survey identified AIs as having the greatest prevalence of short sleep,[9] the first aim sought to determine if any general demographic variables were associated with short sleep (< 6 h) and/or five select items (sleep latency, sleep duration, wake up in the middle of the night or early morning, cannot breathe comfortably, had bad dreams) as well as the total score on the PSQI. Demographic variables tested included: age (> 30 y, ≤ 30 y), sex (male versus female), AIA (> 50%, ≤ 50%), education (no high school diploma versus high school diploma), economic status (more than or less than $20,000/y), being married (yes or no), current drinking frequency and quantity (median split), cultural identification (median split), and BMI (higher than 30 kg/m^2 or ≤ 30 kg/m^2).

Demographic variables were dichotomized to allow for the use of analysis of variance (ANOVA) to determine significant associations with the continuous items on the PSQI. Associations between sleep duration of 6 h or more or fewer than 6 h and demographic and clinical variables was evaluated using the Fisher exact test. Level of significance for these analyses was set at $p < 0.01$. Significant variables from the ANOVA were then entered into a regression to determine which variables were retained by the final model. Correlations between variables were estimated using the Cramér's V.

The second aim was to assess whether short sleep (< 6 h night), the PSQI total score and any of the five select items on the PSQI were associated with the psychiatric disorders of interest, taking into consideration any significant demographic variables. The psychiatric variables studied were lifetime diagnoses of DSM-5 alcohol use disorder (moderate or severe), nicotine dependence, cannabis dependence, stimulant dependence, and "any anxiety disorder," and "any affective disorder" as described previously. The five PSQI items evaluated were: sleep latency, number of hours asleep, waking up in night/early morning, cannot breathe comfortably and having bad dreams. ANOVA was used for these analyses and level of significance was set at $p < 0.01$. Any significant variables found in the univariate analyses were then entered all simultaneously into either a logistic regression for dichotomous variables or linear regression for continuous variables, along with any significant demographic variables for that item, in order to determine which variables were retained by the final model. To estimate whether there was sufficient power to conduct the analyses we identified the appropriate statistical model to be used (e.g., logistic regression, chi square, ANOVA, linear regression) and then we estimated the effect size for each variable for each question by evaluating our existing dataset. In the power analyses for logistic regression, sample size estimates for continuous independent variables were made using the Hsieh table for 0.80 power and alpha = 0.05 significance,[30] and for all logistic regression sample size estimates for dichotomous variables we used the Hosmer and Lemeshow equation 8.43 (2000) for 0.80 power at the 0.05 level of significance. For the power estimates for chi-square and ANOVA, we used G Power for Macintosh. For tests of partial independence in three-dimensional contingency tables we used Zar[31] and G Power. In all these analyses, adequate power is considered to be 0.80 power at the 0.05 level of significance. Power analyses indicated there was sufficient power (0.80) at alpha = 0.05 to detect differences in our primary analyses, for at least a medium effect size.

RESULTS

As shown in **Table 1**, participants in the study (n = 386) had a mean ± standard deviation age of 31.35 ± 14.4 y and women comprised 54% of the participants. There were no significant differences in age, number of years of education (11.64 ± 1.56 y), employment (26%), marital status (11%), nicotine dependence (35%), cannabis use disorders (24%), stimulant use disorders (23%), or alcohol use disorders (41%) between men and women. Women were more likely to have experienced a depressive disorder (men: n = 46, 26%; women: n = 92, 44%). or an anxiety disorder (men: n = 28, 16%; women: n = 62, 30%) than men. Some of the demographic variables were significantly correlated with other predictor variables. As would be predicted, age and BMI (Cramér's V = 0.2, $p < 0.01$), BMI, and AIA (Cramér's V = 0.15, $p < 0.01$), and AIA and cultural identification (Cramér's V = 0.15, $p < 0.01$), all were significantly correlated in the predicted direction. No significant correlations were found between demographic variables and the psychiatric diagnoses.

Table 1—Demographics.

Demographic (n = 386)	Result
Age	31.4 ± 14.4
Male	177 (45.9)
Female	209 (54.1)
Number of years of education	11.6 ± 1.6
High school diploma	194 (51.3)
Household income $20K or more	206 (60.6)
Married	44 (11.4)
Employed	99 (26.1)
American Indian ancestry > 50%	114 (29.5)
Cultural identification [a]	177 (46.2)
Body mass index	31.8 ± 7.5
Current drinking frequency [b]	4.0 ± 7.2
Current drinking quantity [c]	5.0 ± 6.4
Self-reported diabetes	27 (7.0)
Ever taken medication to sleep	125 (32.4)
Nicotine dependence [d]	137 (35.5)
Alcohol use disorder [e]	159 (41.2)
Cannabis use disorder [e]	91 (23.6)
Stimulant use disorder [e]	90 (23.3)
Any affective disorder [f]	138 (35.8)
Any anxiety disorder [f]	90 (23.3)

Data are provided as mean ± standard deviation or number (percentage). [a] = identifies "a lot," [b] = per month, [c] = per occasion, [d] = nicotine dependence by DSM-IV criteria, [e] = DSM-5 moderate or severe, [f] = DSM-5 diagnosis. DSM-IV = Diagnostic and Statistical Manual of Mental Diseases, Fourth Edition; DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition.

The first aim was to investigate whether some characteristics correlated with being an AI such as AIA, Cultural Identification on the OCIS and obesity (BMI > 30) explained any of the variance in the total score on the PSQI and/or any of the select items (short sleep (< 6 h), sleep latency, sleep duration, nighttime/early morning awakenings, bad dreams). None of the AI-related items (AIA, OCIS, BMI) were significantly associated with any significant variation in the total score on the PSQI. In fact, none of the other demographic variables (age, sex, economic status, being married, and current quantity and/or frequency of drinking) were significantly associated with the total score on the PSQI. Although the total score on the PSQI was not significant for any demographic variables, exploratory analyses revealed that some of these demographic variables (age, BMI, education, AIA) were found to be associated with

Table 2—Demographics of Pittsburgh Sleep Quality Index items.

	Age		American Indian Ancestry		Orthogonal Cultural Identification Scale		Body Mass Index	
PSQI items	**≤ 30**	**> 30**	**< 50**	**≥ 50**	**Low**	**High**	**≤ 30**	**> 30**
Short sleep (< 6 h)	11%	21%**	12%	23%*	14%	17%	11%	18%
Sleep latency (min)	34.3 ± 2.4	34.9 ± 4.0	35.2 ± 2.7	32.9 ± 3.5	31.1 ± 2.2	38.7 ± 4.1	32.3 ± 2.5	36.3 ± 3.4
Sleep duration (h)	7.8 ± 0.1	7.0** ± 0.2	7.6 ± 0.1	7.1* ± 0.2	7.5 ± 0.1	7.5 ± 0.2	7.8 ± 0.1	7.2** ± 0.1
Nighttime or early morning awakenings, approximate weekly occurrences	1.23 ± 0.1	1.46 ± 0.1	1.34 ± 0.07	1.29 ± 0.1	1.38 ± 0.08	1.26 ± 0.09	1.16 ± 0.08	1.46** ± 0.08
Cannot breathe comfortably, approximate weekly occurrences	0.23 ± 0.04	0.38 ± 0.07	0.31 ± 0.05	0.25 ± 0.06	0.28 ± 0.05	0.3 ± 0.06	0.21 ± 0.05	0.37* ± 0.06
Bad dreams, approximate weekly occurrences	0.58 ± 0.06	0.49 ± 0.06	0.56 ± 0.06	0.5 ± 0.08	0.51 ± 0.06	0.56 ± 0.07	0.47 ± 0.06	0.6 ± 0.06
PSQI total	4.82 ± 0.2	5.7* ± 0.4	5.15 ± 0.2	5.29 ± 0.4	5.17 ± 0.3	5.16 ± 0.3	4.79 ± 0.3	5.51 ± 0.3

Data are provided as mean ± standard error. * = $p < 0.05$. ** = $p < 0.01$. PSQI = Pittsburgh Sleep Quality Index.

select items on the PSQI. Short sleep duration (< 6 h) was associated with higher degrees of AIA ($F = 6.64$, $p < 0.01$), being older than 30 y ($F = 7.2$, $p < 0.009$), and having a high school diploma ($F = 6.91$, $p < 0.009$), and all three variables remained significant when entered into a logistic regression analysis (age: Wald = 5.0, $p < 0.025$; education: Wald = 3.85, $p < 0.05$; AIA: Wald = 4.0, $p < 0.05$) (see **Table 2**).

Evaluation of the PSQI item, sleep duration (as a continuous variable), revealed that age younger than 30 y was associated with a longer sleep duration (7.8 ± 0.12 h) than being older than 30 y (7.04 ± 0.15) ($F = 14.35$, df = 1,375, $p < 0.0001$) as was not being obese (BMI < 30) ($F = 9.5$, df = 1,375, $p < 0.002$) but only age was significant in the linear regression analysis (overall regression: $F = 10.39$, $p < 0.0001$; age, $t = -3.9$, $p < 0.0001$). Being obese made it significantly more likely to wake up in the middle of the night or early morning ($F = 6.67$, df = 1,378, $p < 0.01$). None of the other PSQI items (cannot breathe comfortably, had bad dreams) were significantly associated with any of the demographic variables (see **Table 2**).

The second aim was to assess the role of the selected psychiatric diagnoses in explaining variance in the PSQI total score or the individual items. The global score on the PSQI was significantly higher in those participants with a lifetime diagnosis of alcohol use disorders ($F = 7.72$, df = 1,357, $p < 0.006$), cannabis dependence ($F = 6.48$, df = 1,357, $p < 0.01$), nicotine dependence ($F = 10.71$, df = 1,356, $p < 0.001$), and the presence of "any anxiety disorder" ($F = 6.9$, df = 1,356, $p < 0.009$) and "any affective disorder" ($F = 17.17$, df = 1,356, $p < 0.0001$). A linear regression of all the diagnoses found significant in the univariate analyses revealed an overall significant model ($F = 6.9$, $p < 0.0001$), but only "any affective disorder" ($t = 3.47$, $p < 0.001$) and nicotine dependence ($t = 2.3$, $p < 0.02$) remained significant predictors in the final model (see **Table 3**).

An analysis of short sleep (< 6 h) and the five items of the PSQI and the select psychiatric disorders revealed that none of the disorders were significantly associated with short sleep. However, those with alcohol use disorders ($F = 11.16$, df = 1,377, $p < 0.001$) and "any affective disorders" ($F = 19.1$, df = 1,376, $p < 0.0001$) reported taking significantly longer to fall asleep. Linear regression of the sleep latency data resulted in an overall significant model ($F = 14.0$, $p < 0001$) and both alcohol use disorders ($t = 2.9$, $p < 0.004$) and "any affective disorder" ($t = 4.1$, $p < 0.0001$) remained significant predictors in the final model. Those with "any anxiety disorder" ($F = 7.96$, df = 1,377, $p < 0.005$) and "any affective disorder" ($F = 7.15$, df = 1,376, $p < 0.008$) also reported waking more often in the night/early morning. A regression analysis was performed entering "any affective disorder," "any anxiety disorder" and BMI and the overall model was significant ($F = 5.06$, $p < 0.002$), but only "any anxiety disorder" ($t = 2.4$, $p < 0.015$) and "any affective disorder" ($t = 2.2$, $p < 0.028$) remained significant predictors in the final model. Those participants with nicotine dependence reported having trouble with breathing during the night ($F = 6.8$, df = 1,376, $p < 0.009$). Participants with alcohol use disorders ($F = 6.15$, df = 380, $p < 0.01$) and "any anxiety disorder" ($F = 16.5$, df = 1,379, $p < 0.0001$) also reported having significantly more bad dreams than those without those disorders. A linear regression model was significant for bad dreams ($F = 11.27$, $p < 0.0001$), with both alcohol use disorders ($t = 2.4$, $p < 0.017$) and "any anxiety disorder" ($t = 4.1$, $p < 0.0001$) being significant predictors (see **Table 3**). As predicted by previous studies of patterns of comorbidity in this population,[22,32] some of the psychiatric variables were correlated with each other: Alcohol use disorders were correlated with both cannabis use disorders (Cramér's V = 0.29, $p < 0.01$) and nicotine dependence (Cramér's V = 0.34, $p < 0.01$), cannabis use disorders were correlated with nicotine dependence (Cramér's V = 0.24, $p < 0.01$) and "any anxiety disorder" (Cramér's V = 0.17, $p < 0.01$), and "any anxiety disorder" was correlated with "any affective disorder" (Cramér's V = 0.16, $p < 0.01$).

Table 3—Substance, anxiety and affective disorders with Pittsburgh Sleep Quality Index items.

	Alcohol Use DSM-5 Moderate or Severe		Cannabis Use DSM-5 Moderate or Severe		Nicotine Dependence by DSM-IV		Any DSM-5 Anxiety Disorder		Any DSM-5 Affective Disorder	
PSQI items	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Short sleep (< 6 h)	12%	20%	14%	18%	15%	16%	15%	16%	15%	16%
Sleep latency (min)	28.5 ± 2.4	43.2** ± 4.0	31.7 ± 2.3	43.9 ± 5.3*	31.3 ± 2.5	40.5* ± 4.1	31.9 ± 2.5	43.1* ± 4.4	27.6 ± 2.0	47.1** ± 4.8
Sleep duration (h)	7.4 ± 0.1	7.5 ± 0.2	7.5 ± 0.1	7.4 ± 0.2	7.5 ± 0.1	7.4 ± 0.2	7.5 ± 0.1	7.4 ± 0.2	7.6 ± 0.1	7.3 ± 0.2
Nighttime or early morning awakenings, approximate weekly occurrences	1.27 ± 0.1	1.42 ± 0.1	1.25 ± 0.1	1.57* ± 0.1	1.23 ± 0.1	1.51* ± 0.1	1.24 ± 0.07	1.63** ± 0.1	1.21 ± 0.1	1.54** ± 0.1
Cannot breathe comfortably, approximate weekly occurrences	0.24 ± 0.05	0.38 ± 0.06	0.25 ± 0.04	0.43* ± 0.09	0.22 ± 0.04	0.43** ± 0.07	0.26 ± 0.04	0.4 ± 0.09	0.25 ± 0.04	0.37 ± 0.07
Bad dreams, approximate weekly occurrences	0.45 ± 0.06	0.68** ± 0.08	0.48 ± 0.05	0.74* ± 0.1	0.48 ± 0.05	0.66* ± 0.09	0.44 ± 0.05	0.87** ± 0.1	0.48 ± 0.05	0.66 ± 0.09
PSQI total	4.72 ± 0.2	5.88 ± 0.4**	4.9 ± 0.2	6.13** ± 0.5	4.71 ± 0.2	6.10** ± 0.4	4.89 ± 0.2	6.17** ± 0.4	4.56 ± 0.2	6.29** ± 0.4

Data are provided as mean ± standard error. * = $p < 0.05$. ** = $p < 0.01$. PSQI = Pittsburgh Sleep Quality Index.

DISCUSSION

National behavioral surveys have found that the greatest percentage of short sleepers may be individuals identifying themselves as AI/AN in comparison with individuals of other ethnic groups.[8,9] Our study focused on evaluation of sleep quality and psychiatric comorbidity in one group of federally recognized AI/AN residing on eight contiguous reservations. In this study more detailed information on sleep and psychiatric covariates is available and may aid in informing the mechanisms underlying sleep disparities in AI/AN. Thirty percent of the participants in our study reported typically sleeping fewer than 7 h per night, and 15% reported sleeping fewer than 6 h per night. These percentages are very similar to national averages given for the general United States population by the Centers for Disease Control and Prevention (7 h = 29.5%, 6 h = 23%).[9] In our study, being a short sleeper (< 6 h) was also significantly associated with higher degrees of AIA but not with identification with AI culture. This implies that being of higher AI/AN ancestry may influence sleep duration more than cultural identification *per se*; however, more extensive measures of culture and the reservation environment could potentially uncover other equally important environmental/cultural factors. Two other factors that were significantly associated with short sleep were age and education, in that older adults with at least a high school education were more likely to be short sleepers. These results might suggest that these older, more educated individuals may be more occupied with work or family roles; however, short sleep was not significantly associated with employment, level of income, or being married.

It is interesting that we found no effect of sex on any of the sleep variables evaluated. These results are consistent with a study of sleep-related symptoms in an adult Indigenous population of North American Indians residing in Canada.[15] In that study no consistent effect of age or sex was found on insomnia complaints. It was speculated that perhaps cultural, ethnic, or socioeconomic factors may have modified the relationship between insomnia symptoms and sex or age in their population. They also noted that studies in other indigenous populations, such as the Maori in New Zealand, have also shown inconsistent effects of sex on insomnia symptoms.[33] In one other study of older American Indians (55 y or older) no significant differences were found between men and women on measures of sleep duration but women reported more difficulty falling asleep than men.[16] It is possible that sex/gender roles have less of an influence on sleep quality in indigenous populations than what is typically found in general population surveys.

An investigation of what factors may influence overall sleep quality in this AI/AN population revealed that substance use disorders (alcohol dependence, nicotine dependence, cannabis dependence) affective disorders, and anxiety disorders were all significantly associated with the total score on the PSQI, while none of the demographic variables (age, sex, employment, education, BMI, AIA, OCIS) contributed to any significant amounts of the variance in that variable. There is a growing literature demonstrating that sleep disturbances are associated with substance dependence.[14] Clinical studies have demonstrated that individuals with alcohol dependence are twice as likely to have insomnia,[34] which can last for several years, despite sobriety, even in the absence of mood disorders. Additionally, insomnia can compromise the efforts of alcohol-dependent patients to initiate and/or maintain sobriety.[35] The prevailing consensus of most studies is that there is a bidirectional relationship between sleep disturbances and substance dependence.[14,36] Although longitudinal studies of childhood and early adolescence substance use and sleep are limited, one study found that chronic insomnia predicted alcohol use in adolescents 12 mo after an initial assessment[37] and another

study found that mothers' rating of early childhood sleep disturbances was associated with an early onset of the use of substances in adolescence.[38] Thus it appears that etiological relationships between alcohol use disorders and sleep may not be easily disentangled. Similar problems have been found for the relationship between sleep and depression where the bidirectional associations between sleep disturbance and depression create difficulty in differentiating cause-and-effect relationships between them.[39,40] In the study of North American Indians in Canada, sleep-related symptoms such as insomnia, apneas, and restless legs symptoms were found to be independently associated with depression scores.[15] In our study the final regression model also confirmed that having "any affective disorder" was significantly associated with the total score on the PSQI along with nicotine dependence.

However, this study did find that substance use disorders, anxiety, and depression were all associated with an increase in select symptoms of sleep that were indexed on the PSQI. For instance, alcohol dependence and "any affective disorder" both contributed to an increase in sleep latency. However, only affective and anxiety disorders were associated with problems with waking up in the middle of the night or early morning. Nicotine dependence was the only variable found to be significantly associated with symptoms of not being able to breathe comfortably. These findings were partially confirmed in a study that evaluated sleep quality using the PSQI in a young adult Mexican American population.[41] In that study we also found that substance dependence was significantly correlated with how long it took to fall asleep, major depressive disorder with the number of hours spent sleeping a night, and anxiety disorders and major depressive disorder with waking up in the early morning or middle of the night. These findings, that substance use disorders are associated with reduced sleep quality in the early part of the night, also finds support from studies demonstrating that alcohol dependence is more likely to be associated with deficits in slow wave sleep, especially during the first half of the night, in human.[42,43]

Another aspect of sleep that was found to be significantly affected by substance dependence and anxiety disorders, in the current study, was having bad dreams. Dreams play an especially important cultural role in AIs. In AI veterans, trauma-related nightmares appear to be more common than what has been reported for other veteran populations.[44] It appears that use of substances, in addition to anxiety disorders, may also selectively affect the experience of having bad dreams in AI populations. These data suggest that assessing AI patients for bad dreams may be an important culturally appropriate screening mechanism for determining the presence of substance use and other psychiatric disorders.

The current results should be interpreted while considering several limitations. First, the findings may not generalize to other AI groups or represent all Indians within this population. Second, only retrospective and cross-sectional data on sleep, substance dependence, and other psychiatric disorders were assessed. Longitudinal studies will be necessary to better understand the direction of the relationships between these disorders. Sleep quality was assessed using a self-report instrument and no polysomnographic measures were obtained. Despite these limitations, this report represents an important step in the understanding of sleep quality in this high-risk and understudied ethnic group.

ABBREVIATIONS

AIA, American Indian Ancestry
AI/AN, American Indians/Alaska Natives
ANYAX, any anxiety disorder
ANYAF, any affective disorder
ANOVA, analysis of variance
BMI, body mass Index
BRFSS, Behavioral Risk Factor Surveillance System
CDC, Centers for Disease Control and Prevention
DSM, Diagnostic and Statistical Manual of Mental Disorders
NESARC, National Epidemiologic Survey on Alcohol and Related Conditions
OCIS, Orthogonal Cultural Identification Scale
PSQI, Pittsburgh Sleep Quality Index
SSAGA, Semi-Structured Assessment for the Genetics of Alcoholism

REFERENCES

1. Jean-Louis G, Grandner M. Importance of recognizing sleep health disparities and implementing innovative interventions to reduce these disparities. *Sleep Med.* 2016;18:1–2.
2. Hale L, Do DP. Racial differences in self-reports of sleep duration in a population-based study. *Sleep.* 2007;30(9):1096–1103.
3. Krueger PM, Friedman EM. Sleep duration in the United States: a cross-sectional population-based study. *Am J Epidemiol.* 2009;169(9):1052–1063.
4. Stamatakis KA, Kaplan GA, Roberts RE. Short sleep duration across income, education, and race/ethnic groups: population prevalence and growing disparities during 34 years of follow-up. *Ann Epidemiol.* 2007;17(12):948–955.
5. Carnethon MR, De Chavez PJ, Zee PC, et al. Disparities in sleep characteristics by race/ethnicity in a population-based sample: Chicago Area Sleep Study. *Sleep Med.* 2016;18:50–55.
6. Laposky AD, Van CE, Diez-Roux AV. Reducing health disparities: the role of sleep deficiency and sleep disorders. *Sleep Med.* 2016;18:3–6.
7. Airhihenbuwa CO, Iwelunmor JI, Ezepue CJ, Williams NJ, Jean-Louis G. I sleep, because we sleep: a synthesis on the role of culture in sleep behavior research. *Sleep Med.* 2016;18:67–73.
8. Chapman DP, Croft JB, Liu Y, Perry GS, Presley-Cantrell LR, Ford ES. Excess frequent insufficient sleep in American Indians/Alaska natives. *J Environ Public Health.* 2013;2013:259645.
9. Liu Y, Wheaton AG, Chapman DP, Cunningham TJ, Lu H, Croft JB. Prevalence of healthy sleep duration among adults - United States, 2014. *MMWR Morb Mortal Wkly Rep.* 2016;65(6):137–141.
10. Devi S. Native American health left out in the cold. *Lancet.* 2011;377(9776):1481–1482.
11. National Healthcare Quality & Disparities Reports. Agency for Healthcare Research and Quality Web site. http://www.ahrq.gov/research/findings/nhqrdr/index.html. Published May, 2013. Updated July, 2016. Accessed November 29, 2016.
12. Hutchinson RN, Shin S. Systematic review of health disparities for cardiovascular diseases and associated factors among American Indian and Alaska Native populations. *PLoS One.* 2014;9(1):e80973.
13. Grant BF, Goldstein RB, Saha TD, et al. Epidemiology of DSM-5 alcohol use disorder: results from the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry.* 2015;72(8):757–766.

14. Conroy DA, Arnedt JT. Sleep and substance use disorders: an update. *Curr Psychiatry Rep.* 2014;16(10):487.
15. Froese CL, Butt A, Mulgrew A, et al. Depression and sleep-related symptoms in an adult, indigenous, North American population. *J Clin Sleep Med.* 2008;4(4):356–361.
16. Sabanayagam C, Shankar A, Buchwald D, Goins RT. Insomnia symptoms and cardiovascular disease among older American Indians: the Native Elder Care Study. *J Environ Public Health.* 2011;2011:964617.
17. Nuyujukian DS, Beals J, Huang H, et al. Sleep duration and diabetes risk in American Indian and Alaska Native participants of a lifestyle intervention project. *Sleep.* 2016;39(11):1919–1926.
18. Ehlers CL, Gizer IR. Evidence for a genetic component for substance dependence in Native Americans. *Am J Psychiatry.* 2013;170(2):154–164.
19. Kalton G, Anderson DW. Sampling rare populations. *J Roy Stat Soc.* 1986;149:65–82.
20. Muhib FB, Lin LS, Stueve A, et al. A venue-based method for sampling hard-to-reach populations. *Public Health Rep.* 2001;116(Suppl 1):216–222.
21. Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. *Soc Probl.* 1997;44:174–199.
22. Gilder DA, Wall TL, Ehlers CL. Comorbidity of select anxiety and affective disorders with alcohol dependence in Southwest California Indians. *Alcohol Clin Exp Res.* 2004;28:1805–1813.
23. Bucholz KK, Cadoret R, Cloninger CR, et al. A new, semi-structured psychiatric interview for use in genetic linkage studies: a report on the reliability of the SSAGA. *J Stud Alcohol.* 1994;55(2):149–158.
24. Hesselbrock M, Easton C, Bucholz KK, Schuckit M, Hesselbrock V. A validity study of the SSAGA--a comparison with the SCAN. *Addiction.* 1999;94(9):1361–1370.
25. Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28(2):193–213.
26. Carpenter JS, Andrykowski MA. Psychometric evaluation of the Pittsburgh Sleep Quality Index. *J Psychosom Res.* 1998;45(1):5–13.
27. Oetting ER, Beauvais F. Orthogonal cultural identification theory: the cultural identification of minority adolescents. *Int J Addict.* 1990;25(5A-6A):655–685.
28. Oetting ER, Beauvais F. Critical incidents: failure in prevention. *Int J Addict.* 1991;26(7):797–820.
29. Venner KL, Wall TL, Lau P, Ehlers CL. Testing of an orthogonal measure of cultural identification with adult mission Indians. *Cultur Divers Ethnic Minor Psychol.* 2006;12(4):632–643.
30. Hsieh FY. Sample size tables for logistic regression. *Stat Med.* 1989;8(7):795–802.
31. Zar JH. *Biostatistical Analysis*. Upper Saddle River, NJ: Prentice-Hall, Inc; 1996:507–509.
32. Gilder DA, Stouffer GM, Lau P, Ehlers CL. Clinical characteristics of alcohol combined with other substance use disorders in an American Indian community sample. *Drug Alcohol Depend.* 2016;161:222–229.
33. Paine SJ, Gander PH, Harris R, Reid P. Who reports insomnia? Relationships with age, sex, ethnicity, and socioeconomic deprivation. *Sleep.* 2004;27(6):1163–1169.
34. Brower KJ, Perron BE. Prevalence and correlates of withdrawal-related insomnia among adults with alcohol dependence: results from a national survey. *Am J Addict.* 2010;19(3):238–244.
35. Brower KJ. Insomnia, alcoholism and relapse. *Sleep Med Rev.* 2003;7(6):523–539.
36. Pasch KE, Latimer LA, Cance JD, Moe SG, Lytle LA. Longitudinal bi-directional relationships between sleep and youth substance use. *J Youth Adolesc.* 2012;41(9):1184–1196.
37. Roberts RE, Roberts CR, Duong HT. Chronic insomnia and its negative consequences for health and functioning of adolescents: a 12-month prospective study. *J Adolesc Health.* 2008;42(3):294–302.
38. Wong MM, Brower KJ, Nigg JT, Zucker RA. Childhood sleep problems, response inhibition, and alcohol and drug outcomes in adolescence and young adulthood. *Alcohol Clin Exp Res.* 2010;34(6):1033–1044.
39. Franzen PL, Buysse DJ. Sleep disturbances and depression: risk relationships for subsequent depression and therapeutic implications. *Dialogues Clin Neurosci.* 2008;10(4):473–481.
40. Alvaro PK, Roberts RM, Harris JK. A systematic review assessing bidirectionality between sleep disturbances, anxiety, and depression. *Sleep.* 2013;36(7):1059–1068.
41. Ehlers CL, Gilder DA, Criado JR, Caetano R. Sleep quality and alcohol-use disorders in a select population of young-adult Mexican Americans. *J Stud Alcohol Drugs.* 2010;71(6):879–884.
42. Irwin M, Miller C, Gillin JC, Demodena A, Ehlers CL. Polysomnographic and spectral sleep EEG in primary alcoholics: an interaction between alcohol dependence and African-American ethnicity. *Alcohol Clin Exp Res.* 2000;24(9):1376–1384.
43. Irwin M, Gillin JC, Dang J, Weissman J, Phillips E, Ehlers CL. Sleep deprivation as a probe of homeostatic sleep regulation in primary alcoholics. *Biol Psychiatry.* 2002;51(8):632–641.
44. Shore JH, Orton H, Manson SM. Trauma-related nightmares among American Indian veterans: views from the dream catcher. *Am Indian Alsk Native Ment Health Res.* 2009;16(1):25–38.

ACKNOWLEDGEMENTS

The authors thank Phil Lau and Gina Stouffer for assistance in data analyses and Shirley Sanchez for editing the manuscript.

SUBMISSION & CORRESPONDENCE INFORMATION

Submitted for publication April 11, 2016
Submitted in final revised form October 7, 2016
Accepted for publication October 31, 2016
Address correspondence to: Dr. Cindy L. Ehlers, The Scripps Research Institute, 10550 North Torrey Pines Road, SP30-1501, La Jolla, CA 92037; Tel: (858) 784-7058; Fax: (858) 784-7409; Email: cindye@scripps.edu

DISCLOSURE STATEMENT

This study was supported in part by the National Institute of Alcoholism and Alcohol Abuse Grants: AA006420, AA010201, the National Center on Minority Health and Health Disparities (NCMHD) and the Stein Endowment fund. The authors have indicated no financial conflicts of interest.