Examining Racial/Ethnic Disparities in the Association between Adolescent Sleep and Alcohol or Marijuana Use

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Abstract

Objectives—The current study examines the association between self-reported measures of trouble sleeping, total sleep time (TST), and bedtimes and odds of past month alcohol and marijuana (AM) use in a racially/ethnically diverse sample of adolescents.

Design—Web-based cross-sectional survey.

Setting—Los Angeles (LA) County, California.

Participants—The sample is comprised of 2539 youth representing four distinct racial/ethnic categories (Non-Hispanic White, Hispanic, Asian, and "Other"; mean age= 15.54; 54.23% female) from Los Angeles.

Measurements—The survey assessed TST and bedtimes (weekdays and weekends), trouble sleeping, and past month AM use, as well as relevant covariates (sociodemographics and mental health symptoms).

Results—Although there were significant racial/ethnic differences in the prevalence of sleep problems and AM use, the associations between sleep problems and AM use were consistent across racial/ethnic groups. Specifically, shorter TST, later bedtimes, and trouble sleeping, were each associated with significantly higher odds of past month alcohol use, whereas later bedtimes and shorter TST were also associated with increased odds of past month marijuana use, even after adjusting for other known risk factors.

Conclusions—Sleep problems are associated with increased AM use in teens, even after controlling for sociodemographics and mental health symptoms. Further longitudinal research on sleep and AM use is critical to identify novel prevention and intervention efforts to reduce disparities in the relationship between sleep and AM use.

Keywords

Adolescents; alcohol; marijuana; substance use; ethnic differences; disparities

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Adolescence is a developmental period marked by dramatic increases in sleep problems,(1) as well as alcohol and marijuana use (AM).(2, 3) Adolescent AM use, in turn is associated

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with worse health outcomes,(4) neurocognitive deficits(5) and an increased likelihood of receiving a diagnosis of abuse or dependence disorder in adulthood.(6) Similarly, adolescent sleep problems are associated with a wide variety of adverse consequences, including increased risk of mood disorders,(7) poorer academic functioning,(8) obesity,(9) cardiovascular risk factors(10) and motor vehicle accidents.(1)

Previous research suggests that sleep problems are associated with increased risk of AM use both cross-sectionally(11–13) and longitudinally(14–17); however, to our knowledge, there have been no studies that have examined racial/ethnic differences in sleep-AM use associations, despite known racial/ethnic differences in each of these behaviors. For example, whites and Hispanics are more likely than blacks and Asians to be in heavier using classes for drinking(18, 19), smoking cigarettes(20), and marijuana use(21, 22), but non-whites tend to experience more social and health consequences from alcohol and drug use (23, 24) compared to whites. There are also well-recognized differences in sleep according to racial/ethnic category with non-whites tending to report more sleep problems than whites(25); however, most of these studies have focused on white-black comparisons, rather than including a broader representation of racial/ethnic groups (26). Due to the expected increase in non-white populations in the U.S., and the fact that non-whites tend to experience more social and health consequences from both sleep problems and alcohol or other substance use that may endure into adulthood, it is crucial to evaluate the prevalence of sleep problems and AM use among white as well as non-white adolescents, and assess how associations between sleep, and AM use may differ across racial/ethnic groups.

Previous research has also tended to utilize single sleep measures, focused either on sleep duration or insomnia-related symptoms. However, it is important to capture multiple dimensions of sleep simultaneously including duration, sleep patterns (e.g., bedtimes), and insomnia-related symptoms (e.g., trouble sleeping) to provide a more thorough understanding of the links between sleep and AM use. In addition, given that there are known sociodemographic (27) (e.g., family structure, parent education) and psychosocial risk factors(28) (e.g., mental health symptoms) that may explain associations between sleep and AM use, it is critical to examine the independent contribution of sleep to AM use, after statistically adjusting for these other co-occurring risk factors.

The present study extends the current literature by examining the association between several dimensions of sleep (duration, quality, and bedtimes) and AM use and the degree to which associations differ across four different racial/ethnic groups (white, Hispanic, Asian, or "Other") in a large sample of adolescents in Southern California. This large and diverse sample and inclusion of other risk factors, offers an important opportunity to examine racial/ethnic differences, while controlling for key covariates, in order to determine the independent risk for alcohol or marijuana use associated with sleep.

Methods

Youth from this study originated from 16 middle schools across three school districts in southern California that were part of a large, ongoing longitudinal study with a school-based intervention that occurred in 2008 (29). Across all schools, 92% of parents returned a

consent form at the baseline, and approximately 71% of parents gave permission for their child to participate in the original study. Ninety-four percent of consented students completed the baseline survey, which is higher or comparable to other school-based survey completion rates with this population (30). We continued to follow two cohorts of youth (the original 6th grade cohort, and the original 7th grade cohort) as they transitioned into high school. Questionnaires for the current study were administered from May 2013 to April 2014 via a web survey when the sleep measures were added to the survey and youth were on average 15 ½ years old (n=2,539). For all variables except mother's education missingness was less than 0.5% (mother's education missingness was 7%).

Race/Ethnicity and covariates

Youth self-reported their racial/ethnic category. Based on the distribution of racial/ethnic categories, the following four categories were used in the current analyses: non-Hispanic white (20.99%), Hispanic (43.91%), Asian (20.95%), and "Other" (14.4%; which was comprised of the following categories: African American 2.32%, American Indian 0.83%, Native Hawaiian 0.79%, Multi-ethnic 10.20%). In addition to examining racial/ethnic differences in observed associations, we included covariates known to covary with race/ethnicity, sleep, and/or AM: self-reported age, gender, educational attainment of mother (less than high school high school versus greater than high school), family structure (i.e., 2-parent household versus single-parent household), and an indicator for whether the student had attended one of the intervention schools. We also included mental health as a covariate. Five-items assessed mental health symptoms (Mental Health Inventory, MHI-5;(31), focusing mostly on anxiety and depression symptoms in the past month. Scores were scaled such that they ranged from 0 to 100, with higher scores indicating better mental health ($\alpha=0.75$).

Sleep measures

Self-reported sleep items were added to the ongoing CHOICE survey in 2013. The primary outcomes for the current study were past month bedtimes (weekdays and weekends), total sleep time (TST; derived from reported bedtimes and waketimes), and a single-item assessing "trouble sleeping" is taken from the Patient Health Questionnaire (PHQ) Somatic Symptom Severity Scale measure (32). Specifically, the "trouble sleeping" is 1 of 4 response choices for a question which asks "During the past 4 weeks, how much have you been bothered by any of the following problems?" Given the considerable variability in adolescent sleep patterns during the school week and on the weekends, we analyzed weekday and weekend bedtimes and TST separately.

Past month alcohol and marijuana use were assessed using measures well-established with adolescents (e.g., CHKS;(33), Project ALERT(34). Past month use was assessed with the item: "During the past month, how many days did you drink at least one full drink of alcohol or use marijuana?" ("0 days" to "20–30 days"). We constructed two dichotomous measures to indicate any drinking or marijuana use in the past month. Consistency and reliability of these measures have been shown in numerous studies.(30, 35)

Analytic Strategy

Sample descriptives and ANOVAs or cross-tabs were conducted for age, sex, sociodemographic characteristics as well as sleep and AM use. Given the unique opportunity to explore racial/ethnic differences, which is critical to inform targeted intervention efforts, we conducted logistic regressions models for the total sample and separately by each racial/ethnic category were conducted, controlling for age, sex, sociodemographics, an intervention school indicator (0/1) and mental health symptoms. We conducted race/ethnicity by sleep interactions for all models, and the omnibus test for the interaction term was non-significant in all models (analyses available upon request). However, given the unique opportunity with this diverse sample to describe sleep-AM associations in distinct racial/ethnic groups, we report race/stratified models although results should be considered exploratory and descriptive in nature.

Results

Descriptives for the total sample and for each racial/ethnic category are reported in Table 1. Rates of alcohol use (17% overall) and marijuana use (12% overall) in the past month differed significantly by the different racial/ethnic categories. Non-Hispanic white respondents reported the most drinking (26%) and marijuana use (18%), whereas Asian respondents reported the least amount of past month alcohol or marijuana use (9% and 5%, respectively). On average, teens' self-reported bedtime was 11:00 pm during the week; however, Asian teens stayed up the latest during the week and Hispanic teens went to bed the earliest. On the weekends, the average bedtime was midnight with Asian and "Other" racial/ethnic respondents reporting the latest bedtime (12:15am). Overall a majority of respondents reported "not being bothered" by trouble sleeping (53%); however, teens in the "Other" racial/ethnic category were the most likely to report being bothered a lot by trouble sleeping (21%).

Sleep Problems and Alcohol Use

In the total sample, later bedtimes (weekdays and weekends) and shorter TST (weekdays and weekends) were independently associated with increased risk for alcohol use in the past month (Table 2), even after controlling for covariates. For every 10 minutes later that respondents went to bed, there was a 4% (weekday) or 6% (weekend) increase in the odds of past month alcohol use. Similar associations held across all race/ethnic categories for weekend bedtimes, but for weekday bedtimes the exploratory stratified models indicated that this association was not statistically significant for Asians. In the total sample, longer TST on either the weekends or weekdays was significantly associated with a lower likelihood of past month alcohol use. In the exploratory stratified models, however, longer weekend TST for those reporting "Other" race/ethnicity and weekday TST for non-Hispanic Whites were significantly associated with a lower likelihood of past month alcohol use. Finally, in the overall sample, we found that trouble sleeping was significantly associated with greater past month alcohol use. Teens who were bothered by trouble sleeping "a little" or "a lot", were 28% or 55%, respectively, more likely to have used alcohol in the past month, compared to those who were not bothered by trouble sleeping. In the Asian subgroup, the odds were of considerably greater magnitude than in the total sample. Of note,

these results should be interpreted with caution, given the overall low prevalence of alcohol use in the Asian subgroup and given that there was not a significant race/ethnicity interaction for trouble sleeping on alcohol use.

Sleep Problems and Marijuana Use

Similar to past month alcohol use, we found that later weekday and weekend bedtimes and shorter TST on weekdays and weekends were risk factors for marijuana use in the past month (Table 3). Similar to the findings with alcohol use, for every 10 minutes later that respondents went to bed, there was a 4% (weekday) or 6% (weekend) increase in the odds of past month marijuana use. Similar associations were evident across all racial/ethnic categories except for Asians, for whom the association was not significant in the stratified models. Longer TST on either the weekends or weekdays was significantly associated with a lower likelihood of past month marijuana use. In the stratified analyses there was only a statistically significant association between TST and marijuana use for the 'other' racial category. We found no statistically significant associations between being bothered by trouble sleeping and past month marijuana use in the total sample or in the stratified analyses.

Discussion

This is the first study to examine the effects of several dimensions of sleep (duration, quality, and bedtimes) on alcohol and marijuana in a large, racially/ethnically diverse sample of adolescents and to explore racial/ethnic differences in observed associations. Consistent with prior reports from teens in other parts of the U.S.(1), we found high rates of insufficient sleep duration in this population, particularly among Asian youth, who slept on average 7 hours and 17 minutes per night during the school week. These findings are consistent with some of the limited prior research that has included Asian adolescents (36). We also found considerable variability in weekday and weekend TST, with adolescents sleeping approximately one hour and 45 minutes longer on weekends. These findings suggest that on the weekends, adolescents attempt to "catch-up" on sleep debt accumulated during the week, in part due to conflicting demands between early school start times, as well as teen social pressures, and neurobiological changes which favor later bedtimes. Although the majority (53%) of adolescents did not report trouble sleeping, approximately 15% overall reported being "bothered a lot" by trouble sleeping, and nearly 1 in 5 adolescents in the "Other" racial/ethnic category reported significant trouble sleeping. Also consistent with racial/ethnic differences in both the prevalence and consequences of AM use(37, 38), we found that Asians were the least likely to use either of these substances.

There have been several recent reports, including a handful of longitudinal studies showing that sleep problems can predict the onset of alcohol or other drug use and associated problems(14, 16). Although our findings are cross-sectional, they make a unique contribution to the current knowledge base by assessing several dimensions of sleep and adding to the dearth of evidence on racial/ethnic differences in the associations between sleep and AM use.

Despite racial/ethnic differences in the prevalence of specific sleep problems and AM use, we found that the associations between sleep duration, timing, and quality and AM use were consistent across racial/ethnic categories, as evidenced by the absence of statistically significant interaction effects. Given that no prior studies have investigated racial/ethnic differences in sleep-AOD associations among teens, for descriptive purposes, we reported race/ethnicity stratified models, which demonstrated a few differences in the observed associations across groups. For example, for the association between trouble sleeping and alcohol use was only statistically significant for Asians. However, given the low overall base rate for drinking among Asian youth; these findings could reflect the small cell size for this group and should be interpreted with caution. Nevertheless, findings suggest that insomnia-related symptoms may heighten risk for alcohol use among Asian youth. In contrast, later bedtimes were significantly associated with increased likelihood of past month marijuana use in all racial/ethnic groups except for Asians, perhaps because marijuana use was rare in the Asian group. Shorter sleep duration on weekends was associated with increased risk of marijuana use for teens reporting "Other" racial/ethnic category, whereas shorter weekday sleep duration was associated with increased risk of marijuana use in Non-Hispanic Whites. Although we did not find statistically significant race/ethnicity*sleep interactions for AM use, it is still critical to consider the role of race/ethnicity in order to inform targeted intervention efforts for this age group, given that there are racial/ethnic differences in both sleep and AM use.

Findings must be interpreted within the context of study limitations. Most notably, findings were based on cross-sectional data; therefore temporality or causal relationships cannot be inferred. Nevertheless, findings are consistent with a growing body of longitudinal data suggesting that sleep problems predict the onset of subsequent alcohol and other drug use and disorders in teens and young adults (14, 16). Moreover, data from neuroimaging studies provides solid mechanistic evidence that sleep and circadian disruptions may be causally related to the development and exacerbation of alcohol and other drug use disorders (39). An additional limitation is the reliance on self-reported sleep and AM use, which may have introduced bias or common method variance. Although we included a broader assessment of sleep than has been used in prior studies, our sleep assessment was still limited to a small number of items, and only a single item on insomnia-related symptoms. Future research that utilizes both objective measures of sleep (e.g., via actigraphy) as well as broader self-report instruments that assess multiple domains of subjective sleep disturbances and circadian preferences, is necessary to provide a more comprehensive understanding of the links between sleep and AM use. Although this study was unique in evaluating sleep-AM use associations in four distinct racial/ethnic groups, based on the distribution in the sample, the "Other" racial/ethnic group was a heterogeneous group consisting of African Americans, American Indians, Native Hawaiians, and Multi-ethnic respondents.

Not with standing these limitations, the current study provides an important contribution to the literature in this area by analyzing associations across four racially/ethnically distinct ethnic groups, analyzing multiple dimensions of sleep, including duration and timing on weekends and weekdays, and subjective sleep quality, and controlling for a host of risk factors that are known to covary with race/ethnicity, as well as sleep and AM use. As such, findings suggest that sleep is an independent correlate of AM use, rather than a proxy for

other co-occurring risk factors. Understanding racial/ethnic differences in sleep problems and AM use, as well as the associations between sleep and AM use is critical to inform prevention efforts by helping parents, schools, communities and providers know how and when to intervene. Further research is needed in this area to address potential differences and disparities. Finally, this research has important policy implications, particularly as more and more states consider marijuana legalization, and also given the ongoing policy debate about high school start times, which are in direct conflict with teens internal biological clocks(40). Finding ways to improve adolescent sleep at both the individual level and societal level is critical to improve adolescent health, including reducing the risk of alcohol and marijuana use.

Acknowledgments

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Table 1

Sample Descriptives Overall and by Race/Ethnicity

	Overall Sample (n=2539)		Non-Hispanic White (n=533)		Hispanic (n=1115)		Asian (n=532)		Other (n=359)		P-Value[a]
	Mean/%	SD	Mean/%	SD	Mean/%	SD	Mean/%	SD	Mean/%	SD	
DEMOGRAPHICS											
Age in Years (range 14–19)	15.5	0.68	15.6	0.67	15.6	0.69	15.5	0.66	15.5	0.7	<.0001
Female (%)	54.2		49.0		57.0		53.0		55.2		0.019
Mother's Highest Education (%)											<.0001
< High School	13.6		2.1		28.1		2.6		5.6		
High School	18.0		10.9		26.		11.6		13.8		
> High School	68.4		87.0		45.3		85.8		80.6		
Two Parent Household (%)	66.6		74.1		63.0		68.0		64.8		0.000
Mental Health Score (MHI-5, 0–100)	66.0	19.6	66.9	20.0	66.7	19.6	64.3	18.6	64.9	20.6	0.054
Past Month Alcohol Use (%)	17.1		26.3		16.4		9.2		17.3		<.0001
Past Month Marijuana Use (%)	11.8		17.8		11.8		4.9		13.1		<.0001
Weekday Bedtime[b]	11pm		11pm		10:45pm		11:20pm		11pm		<.0001
Weekend Bedtime[b]	midnight		midnight		midnight		12:15am		12:15am		0.000
Total Sleep Time Hours, Weekend	9.4	1.8	9.3	1.7	9.5	1.8	9.2	1.9	9.3	1.9	0.066
Total Sleep Time Hours, Weekday	7.6	1.2	7.7	1.1	7.7	1.1	7.3	1.3	7.6	1.31	<.0001
Bothered by Trouble Sleeping											0.011
Bothered a Little	30.7		32.9		30.7		28.4		31.2		
Bothered a Lot	15.9		13.9		16.7		12.8		20.6		
Not Bothered	53.4		53.2		52.7		58.8		48.2		

[a]P-values reported from Chi-square tests for categorical variables and ANOVAs for continuous variables.

Table 2

Results of Logistic Regression Predicting Alcohol Use in the Past Month both overall and stratified by Race/Ethnicity.

	Overall Sample (n=2539)[a]		Non-Hispanic White (n=533)[b]		Hispanic (n=1115)[b]		Asian (n=532)[b]		Other (n=359)[b]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Weekday Bedtime										
10 minutes	1.04	1.03 – 1.06 ***	1.07	1.03 – 1.10 ***	1.04	1.01 – 1.06 **	1.03	0.99 – 1.07	1.04	1.01 – 1.08 *
Weekend Bedtime										
10 minutes	1.06	1.05 – 1.07 ***	1.08	1.05 – 1.11 ***	1.05	1.03 – 1.07 ***	1.05	1.02 – 1.09 **	1.06	1.03 – 1.10 ***
Total Sleep Time Hours										
Weekend	0.88	0.83 – 0.95 ***	0.88	0.77 – 1.00	0.93	0.84 – 1.02	0.93	0.77 – 1.11	0.77	0.66 – 0.91 **
Weekday	0.85	0.78 – 0.93 ***	0.78	0.65 – 0.93 **	0.90	0.78 – 1.04	0.83	0.66 – 1.05	0.90	0.73 – 1.12
Bothered by Trouble Sleeping										
Bothered a Little	1.28	1.00 – 1.65 *	0.73	0.46 – 1.16	1.42	0.97 – 2.10	2.19	1.09 – 4.39 *	1.75	0.88 – 3.50
Bothered a Lot	1.55	1.13 – 2.12 **	1.32	0.72 – 2.40	1.40	0.87 – 2.26	2.55	1.02 – 6.36 *	1.84	0.83 – 4.08
Not Bothered (reference)										

*
p<.05,

**
p<.01,

***
p<.001

[a] The overall model controls for age, gender, race/ethnicity (White, Hispanic, Asian, Other), mother's highest education (<HS, HS, >HS), family structure (two-parent versus single-parent household), mental health symptoms (MHI-5 score), and an indicator for whether or not the respondent attended an intervention school; n's for each model differ slightly due to item missingness.

[b] All stratified models control for the same covariates as in total sample, with the exception of race/ethnicity; n's for each model differ slightly due to item missingness.

Note: In the models including the sleep by race/ethnicity interactions, the omnibus interaction term was non-significant in all models.

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Table 3

Results of Logistic Regression Predicting Marijuana Use in the Past Month both overall and stratified by Race/Ethnicity.

	Overall Sample (n=2539)[a]		Non-Hispanic White (n=533)[b]		Hispanic (n=1115)[b]		Asian (n=532)[b]		Other (n=359)[b]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Weekday Bedtime										
10 minutes	1.04	1.02 – 1.06***	1.05	1.02 – 1.09**	1.04	1.01 – 1.06*	0.99	0.93 – 1.04	1.05	1.01 – 1.09*
Weekend Bedtime										
10 minutes	1.06	1.05 – 1.08***	1.07	1.03 – 1.10***	1.07	1.05 – 1.09***	1.01	0.97 – 1.06	1.08	1.05 – 1.12***
Total Sleep Time Hours										
Weekend	0.87	0.80 – 0.94***	0.91	0.78 – 1.06	0.89	0.79 – 1.00	0.98	0.79 – 1.21	0.71	0.59 – 0.85***
Weekday	0.89	0.81 – 0.99*	0.85	0.71 – 1.03	0.97	0.82 – 1.15	1.01	0.72 – 1.41	0.78	0.62 – 0.99*
Bothered by Trouble Sleeping										
Bothered a Little	1.17	0.87 – 1.57	0.89	0.52 – 1.51	1.26	0.80 – 1.98	1.53	0.62 – 3.77	1.32	0.62 – 2.81
Bothered a Lot	1.40	0.98 – 2.01	1.37	0.70 – 2.70	1.39	0.81 – 2.38	1.01	0.25 – 4.11	1.60	0.67 – 3.82
Not Bothered (reference)										

*
p<.05,

**
p<.01,

***
p<.001

[a] The overall model controls for age, gender, race/ethnicity (White, Hispanic, Asian, Other), mother's highest education (<HS, HS, >HS), family structure (two-parent versus single-parent household), mental health symptoms (MHI-5 score), and an indicator for whether or not the respondent attended an intervention school; n's for each model differ slightly due to item missingness.

[b] All stratified models control for the same covariates as in total sample, with the exception of race/ethnicity; n's for each model differ slightly due to item missingness.

Note: In the models including the sleep by race/ethnicity interactions, the omnibus interaction term was non-significant in all models.