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Examining sleep duration and sleep health among sexual minority and heterosexual adults: Findings from NHANES (2005-2014)

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Abstract

Objectives: To examine sexual identity differences in sleep duration and sleep health (use of sleep medications and/or sedatives, trouble sleeping and diagnosis of sleeping disorders) among American adults.

Methods: Data from the National Health and Nutrition Examination Survey (2005–2014) were used. Sex-stratified multiple logistic regression models were used to compare sleep duration and sleep health between sexual minority (gay/lesbian, bisexual, not sure) and heterosexual participants, adjusted for pre-determined covariates. Heterosexual participants were the reference group.

Results: The analytic sample included 16,332 participants. No differences in sleep duration or sleep health were detected when we compared gay and bisexual men to heterosexual men. Not sure men had significantly higher rates of adequate sleep duration than heterosexual men (aOR 2.35 [1.16–4.79]. Compared to heterosexual women, bisexual women reported higher rates of short sleep duration (aOR 1.29 [95% CI=1.01–1.65]). Bisexual women were also more likely than heterosexual women to use sleep medication and/or sedatives (aOR 1.85 [95% CI=1.19–2.88]), to have ever told a health professional they had trouble sleeping (aOR 1.64 [95% CI=1.15–2.34) and to have been told by a health professional they had a sleeping disorder (aOR 2.38 [95% CI=1.50–3.80). Lesbian and not sure women exhibited no differences in sleep duration or sleep health compared to heterosexual women.

Conclusions: Findings suggest there is an urgent need to promote sleep health and further investigate sleeping disorders among bisexual women. Additional research should incorporate objective measures of sleep health and examine whether sleep health is associated with chronic disease in sexual minorities.

Keywords

normal sleep; epidemiology; normal sleep adult < normal sleep; women-s sleep

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Introduction

There is growing evidence that indicates social stressors (e.g., discrimination, victimization) negatively impact the health of sexual minorities (e.g., lesbian/gay, bisexual, other non-heterosexual) in the United States (Institute of Medicine, 2011). Although significant disparities in mental health (Plöderl & Tremblay, 2015), tobacco use (Blosnich, Lee, & Horn, 2013; Conron, Mimiaga, & Landers, 2010; Garland-Forshee, Fiala, Ngo, & Moseley, 2014), alcohol consumption (Dermody et al., 2014; Hughes, McCabe, Wilsnack, West, & Boyd, 2010), and illicit drug use (Goldbach, Mereish, & Burgess, 2017) are well documented, less research has examined physical health conditions (Caceres et al., 2017). Recent data suggest that sexual minority women (Caceres et al., 2018a; Corliss et al., 2018; Kinsky, Stall, Hawk, & Markovic, 2016) and bisexual men (Caceres et al., 2018b; Fredriksen-Goldsen, Kim, Barkan, Muraco, & Hoy-Ellis, 2013) also have higher rates of obesity and diabetes compared to their heterosexual peers. However, the study of sleep health among sexual minorities remains an emerging area of research.

Sleep health is increasingly recognized as a public health concern (Office of Disease Prevention and Health Promotion, 2018). Between 1985–2012 the percent of Americans reporting short sleep duration rose by 31% (Ford, Cunningham, & Croft, 2015). Data from several studies suggest that short sleep duration is associated with higher rates of obesity, hypertension, diabetes, and cancer (St-Onge et al., 2016; Yin et al., 2017). However, long sleep duration might be more prevalent than short sleep duration (Bin, Marshall, & Glozier, 2013). As sleep has a critical role in regulating physiological activities, sleep disturbances are associated with multisystem dysfunction (Hurtado-Alvarado, Dominguez-Salazar, Pavon, Velazquez-Moctezum, & Gomez-Gonzalez, 2016; Stamatakis & Punjabi, 2010; Watson, Badr, Belenk, & Bliwise, 2015). Studies have consistently found that sleep duration has a U-shaped association with elevated blood pressure (Kim & Jo, 2010; Ramos et al., 2013), stroke (Liu, Wheaton, Chapman, & Croft, 2013; Sabanayagam & Shankar, 2010), and cardiovascular mortality (Kim et al., 2013).

Given that sexual minorities report higher rates of risk factors associated with poor sleep quality (e.g., heavy drinking, substance use, and exposure to violence) (Hughes et al., 2010; Katz-Wise & Hyde, 2012; Mustanski, Andrews, & Puckett, 2016) we hypothesized that sexual minorities may be at increased risk for poor sleep health compared to their heterosexual counterparts. Recently, there has been increased attention to sleep as a health concern in sexual minorities. Three recent studies that used data from the National Health Interview Survey identified no sexual identity differences in sleep duration among men and women (Chen & Shiu, 2017; Galinsky, Ward, Joestl, & Dahlhamer, 2018; Jackson, Agénor, Johnson, Austin, & Kawachi, 2016). However, a separate study found that young adult sexual minorities (including bisexual men and “mostly lesbian” women) reported higher rates of short sleep duration than heterosexuals (Fricke & Sironi, 2017). Compared to their heterosexual peers, sexual minority women appear more likely to have trouble falling asleep and staying asleep throughout the night (Chen & Shiu, 2017; Fricke & Sironi, 2017; Galinsky et al., 2018). Gay men have also reported higher rates of trouble falling asleep, waking up feeling not rested, and using prescription sleep medications than heterosexual men (Galinsky et al., 2018). Further, an analysis of data from the New York City Health and

Nutrition Examination Survey identified higher rates of sleep problems (e.g., trouble falling asleep, staying sleep, or sleeping too much) among bisexual individuals compared to their heterosexual counterparts (Duncan et al., 2018).

The limited and conflicting evidence regarding sleep health in sexual minorities and the significant health implications of poor sleep health warrant further investigation. Therefore, the purpose of this study was to examine sexual identity differences in sleep duration and sleep health among American adults. To address significant gaps in the literature we conducted an analysis of data from the 2005–2014 National Health and Nutrition Examination Survey (NHANES). We hypothesized that sexual minority men and women (gay/lesbian, bisexual, and not sure) would report worse sleep health (including sleep duration, use of sleep medications and/or sedatives, trouble sleeping, diagnosis of sleeping disorders) than their heterosexual peers.

Methods

Data

NHANES uses a complex multi-stage probability sampling design to achieve a representative sample of individuals from across the United States (Johnson et al., 2014). We did not include data from the 2015–2016 NHANES cycle as data were not fully available when analyses were conducted.

Inclusion criteria.—Sexual identity was assessed in NHANES in participants between the ages of 18–59 (n = 20,866). All adult participants with complete and sufficient data for sexual identity were considered for inclusion in the present study (n = 16,697).

Exclusion criteria.—The total NHANES (2005–2014) sample was 50,965. After excluding participants under the age of 18 (n = 20,670) and those over the age of 59 (n = 9,429), 20,866 remained. We excluded any participant who responded “something else” (men=43, women=62), “don’t know” (men=43, women=48), or “refused” (men=23, women=36) to the sexual identity item due to insufficient sample sizes for multivariable analyses. We also excluded 1,784 men and 2,130 women that had no recorded response for sexual identity. Next, we excluded participants that answered “don’t know” or “refused” to any measure of sleep health (n=37). Lastly, we excluded participants that responded “don’t know” or “refused” for covariates (n=328).

Measures

Sexual identity.—Participants were categorized as heterosexual, gay/lesbian, bisexual, or not sure based on the following item: “Do you think of yourself as heterosexual or straight, homosexual or lesbian, bisexual, something else, or not sure?”

Demographic characteristics.—*Age* (range 18–59 years) was continuous. *Race/ethnicity* was coded as: Non-Hispanic White, Non-Hispanic Black, Hispanic, and other race. The *income to poverty ratio* (range 0–5), provided by NHANES, was calculated by dividing the total household income by the poverty threshold for that specific survey year with a higher income to poverty ratio indicating a higher income. *Education* was categorized as less

than high school, graduated high school, attended college/technical college, or graduated college/technical college. *Relationship status* (married/partnered vs. not partnered) and *employment status* (employed; student; unemployed looking; unemployed, not looking) were examined. We also assessed *household size* (range 1–7).

Healthcare utilization.—In addition to assessing current *health insurance coverage*, we examined whether participants had a *routine place* to go to for healthcare and the number of times they received healthcare in the past year.

Perceived health.—Participants rated their general health condition as excellent, very good, good, fair, or poor.

Health behaviors.—Participants who reported *current tobacco use* (on some days or everyday) were considered current smokers. *Alcohol use* was measured based on participants' reported average number of alcoholic drinks per day in the past year. Next, we calculated the average number of minutes of moderate- and vigorous-intensity aerobic activity in the past week from participants' self-report. A binary measure of *physical activity* was created by determining whether participants met physical activity recommendations for adults (either ≥ 150 minutes of moderate-intensity aerobic activity per week, ≥ 75 minutes of vigorous-intensity aerobic activity per week, or an equivalent combination of moderate- and vigorous-intensity aerobic activity per week) (Centers for Disease Control and Prevention, 2015).

Health conditions.—Depression was measured using the 9-item Patient Health Questionnaire (PHQ-9) (Kroenke, Spitzer, & Williams, 2001). Participants with PHQ-9 scores greater than or equal to 10 were categorized as meeting criteria for depression. Cronbach's alpha for the PHQ-9 was 0.87 in the present sample. Obesity (body mass index ≥ 30.0 kg/m^2) was calculated from objectively measured height and weight defined based on established criteria (Centers for Disease Control and Prevention, 2016). We then created a count of 17 health conditions including depression and obesity (as described above) and self-reported diagnosis of hypertension, diabetes, high cholesterol, heart failure, angina, coronary artery disease, myocardial infarction, stroke, chronic obstructive pulmonary disease, asthma, cancer, liver disease, chronic kidney disease, arthritis, and anemia (range = 0–12).

Measures of sleep health.—*Sleep duration* was assessed by asking participants: "How much sleep do you usually get at night on weekdays or workdays?" Sleep duration was then categorized as short sleep duration (≤6 hours), adequate sleep duration (7–8 hours), or long sleep duration (≥ 9 hours) based on previous work (Grandner, Chakravorty, Perlis, Oliver, & Gurubhagavatula, 2014). Additional sleep measures included: 1) whether participants had a ever *told a health professional they had trouble sleeping* and 2) whether they had ever been told by a health professional they *had a sleeping disorder*. Both measures were coded dichotomously (0= "No"; 1 = "Yes"). In addition, we assessed *use of prescription sleep medications* in the past month including selected benzodiazepines and barbiturates, doxepin, quitiapine, ramelteon, and trazodone (Bertisch, Herzig, Winkelman, & Buettner, 2014). *Use of prescription and over the counter sedative medications* (e.g., muscle relaxants, opioids,

sedating anti-depressants), defined as medications not commonly prescribed for sleeping disorders but that can have sedating effects, was assessed (Bertisch et al., 2014). Since few participants reported taking more than one sleep or sedative medication we combined these variables and created a dichotomous item (0=No sleep or sedative medication; 1=Any sleep or sedative medication).

Statistical Analysis

Analyses were conducted in Stata version 15. Survey weights were constructed for survey years (2005–2014) as recommended by NHANES (Centers for Disease Control and Prevention, 2013). First we conducted chi-square and Student's *t* tests for categorical and continuous variables, respectively, to examine sexual identity differences across study variables. For all analyses we compared gay/lesbian, bisexual, and not sure participants, separately, to heterosexual participants of the same sex (reference group). Missing data were handled using multiple imputation with chained equations using appropriate imputation commands in Stata and following previously described methods (Buuren Van, Boshuizen, & Knook, 1999; Kenward & Carpenter, 2007). Multiple imputation with chained equations is recommended for imputation of categorical data because it does not assume data are normally distributed. We used the standard multiple imputation methodology to impute missing values for all covariates and for the five participants with missing data for sleep duration (Sullivan, Salter, Ryan, & Lee, 2015). A total of 50 imputations were run as this has been found to improve the precision of multiple imputation (Sullivan et al., 2015). Prior to conducting analyses on the imputed data we examined imputation diagnostics.

Given that significant sex differences in health disparities have been noted among sexual minorities, we ran sex-stratified multiple logistic regression models with measures of sleep health as outcomes in separate models. For use of sleep medications and/or sedatives Model 1 was unadjusted, Model 2 added survey year, demographic characteristics, healthcare utilization, self-rated health, and health behaviors, and Model 3 added health conditions. For the remaining measures of sleep health (sleep duration, reporting trouble sleeping, and diagnosis of sleeping disorder) Model 3 was adjusted for health conditions and use of sleep medications and/or sedatives. A significance level of $p < .05$ was determined a priori for all analyses.

Results

The final sample consisted of 16,332 participants. As shown in Table 1, 8,030 male participants were included, of which 7,682 (95.6%) were heterosexual, 166 (2.5%) were gay, 118 (1.3%) were bisexual, and 64 (0.6%) were not sure of their sexual identity. Several sexual identity differences in demographic characteristics were identified. Compared to heterosexual men, not sure men were less likely to identify as Non-Hispanic White. Both bisexual and not sure men had a lower family income to poverty ratio than heterosexual men. Not sure men were also more likely than heterosexual men to report they had not graduated high school, whereas gay men were more likely than heterosexual men to have graduated college or technical college. Gay and bisexual men were less likely to be married or living with a partner and reported a lower household size relative to heterosexual men.

However, not sure men had a higher household size compared to heterosexual men. Next, we examined sexual identity differences for healthcare utilization, perceived health, health behaviors, health conditions, and sleep health among men (Supplementary Table 1). Compared to heterosexual men, gay men reported higher rates of health insurance coverage. Gay men also reported consuming a lower number of alcoholic drinks per day and were less likely to report short sleep duration than heterosexual men. Further, bisexual men reported a higher number of health conditions, whereas not sure men had a lower number of health conditions relative to heterosexual men. Not sure men were also less likely to report current tobacco use, having health insurance coverage, or having been told they had a sleeping disorder than heterosexual men.

As shown in Table 2, 8,032 female participants were included, of which 7,699 (93.4%) were heterosexual, 107 (1.2%) were lesbian, 342 (4.1%) were bisexual, and 154 (1.3%) were not sure of their sexual identity. Bisexual women were younger than heterosexual women. Bisexual and not sure women had a lower family income to poverty ratio and were less likely to have graduated college or technical college than heterosexual women. Lesbian, bisexual, and not sure women were all less likely to be married or living with a partner relative to heterosexual women. Compared to heterosexual women, not sure women were less likely to be currently employed, but had a higher household size. Next, we examined sexual identity differences for healthcare utilization, perceived health, health behaviors, health conditions, and sleep health among women (Supplementary Table 2). Lesbian, bisexual, and not sure women were less likely to have health insurance coverage than heterosexual women. Not sure women were also less likely than heterosexual women to report having a routine place of care or to have received any healthcare in the past year. Lesbian and bisexual women reported higher rates of current tobacco use, a higher number of alcoholic drinks per day, and having more health conditions than heterosexual women. Lesbian and bisexual women were also more likely to report higher rates of using prescription sleep medications and/or sedatives than heterosexual women. Bisexual women were more likely than heterosexual women to report higher rates of short sleep duration, having told a health professional they had trouble sleeping, and having been told by a health professional had a sleeping disorder.

Results of multivariable analyses examining sexual identity differences in sleep health among men are shown in Table 3. Although gay men had lower odds of short sleep duration (OR 0.68 [95% CI=0.47–0.98]) and higher odds of long sleep duration in unadjusted analyses (OR 1.79 [95% CI=1.01–3.20]), these associations were attenuated after covariate adjustment. Not sure men were less likely than heterosexual men to report short sleep duration (aOR 0.44 [95% CI=0.21–0.92]) and more likely to report adequate sleep duration (aOR 2.35 [95% CI=1.16–4.79]). No differences in sleep health were noted when gay and bisexual were compared to heterosexual men in full adjusted models.

Results of multivariable analyses examining sexual identity differences in sleep health among women are shown in Table 4. In fully adjusted models, bisexual women were significantly more likely to use sleep medications and/or sedatives (aOR 1.86 [95% CI=1.20–2.89]) than heterosexual women. In addition, bisexual women reported higher rates of short sleep duration (aOR 1.29 [95% CI=1.01–1.65]) and were less likely to have

adequate sleep duration (aOR 0.76 [95% CI=0.60–0.97]) relative to their heterosexual counterparts. Bisexual women were also more likely to have ever told a health professional they had trouble sleeping (aOR 1.63 [95% CI=1.16–2.29), and to have been told by a health professional they had a sleeping disorder (aOR 2.37 [95% CI=1.49–3.76) than heterosexual women. No differences in sleep health were observed when lesbian and not sure women were compared to heterosexual women.

Discussion

In this study we examined sexual identity differences in sleep duration and sleep health in a nationally representative sample of adults in the United States (ages 18–59). Although we hypothesized that, based on higher rates of risk factors for poor sleep quality, gay and bisexual men would report higher rates of inadequate sleep duration and worse sleep health than heterosexual men, no differences were detected. Our findings are consistent with previous evidence from other national surveys including the National Health Interview Survey (Galinsky et al., 2018; Jackson et al., 2016) and the Behavioral Risk Factor Surveillance System (Dai & Hao, 2017) that identified few differences in sleep health between sexual minority and heterosexual men. On the other hand, Fricke and Sironi (2017) identified that sexual minority men, particularly bisexual men, reported higher rates of short sleep duration than heterosexual men. Previous data suggests that men attracted to both sexes were also more likely to have trouble falling asleep (Fricke & Sironi, 2017). Although we used different sleep measures than Fricke and Sironi (2017) we found no differences in sleep health between bisexual and heterosexual men. We also posited gay and bisexual men would report higher rates of use of sleep medications and/or sedatives, but no differences were identified. This contradicts previous evidence from one study that identified gay men reported greater use of medication to fall asleep in the past month than their heterosexual counterparts (Galinsky et al., 2018).

Our findings for bisexual women corroborate previous work, which found they reported higher rates of inadequate sleep duration and worse sleep health than heterosexual women. Bisexual, not lesbian women, in the present study had higher rates of short sleep duration, use of sleep medications and/or sedatives, having told a health professional they had trouble sleeping, and being told by a health professional they had a sleeping disorder. The higher rates of short sleep duration observed in bisexual women is consistent with evidence from two previous studies (Chen & Shiu, 2017; Fricke & Sironi, 2017). Further, bisexual women in two previous studies also reported higher rates of trouble falling asleep and trouble staying asleep (Fricke & Sironi, 2017; Galinsky et al., 2018). Lesbian and bisexual women in Chen and Shiu (2017) reported higher rates of disturbed sleep (i.e., feeling unrested, having difficulty falling asleep, and waking up during the night). However, a significant limitation of that study was the lack of sex-stratified analyses as all sexual minorities, regardless of their gender, were compared to heterosexual men. On the other hand, our findings contradict the work of Galinsky et al. (2018), who using data from the National Health Interview Survey, identified that lesbian women, not bisexual women, had significantly higher rates of use of medications to fall asleep than heterosexual women. As evidence regarding which subgroup of sexual minority women have higher use of sleep medications and/or sedatives is contradictory, there is a need to further examine correlates of

use of sleep medications and/or sedatives in this population and potential differences between sexual minority subgroups. Further, we were unable to identify any previous studies that have described similar trends in the diagnosis of sleeping disorders among sexual minority women as the present study. Therefore, it is important for future work to investigate which particular sleeping disorders might be elevated in sexual minority women.

A notable strength of the present study was the inclusion of not sure men and women, an understudied group within the sexual minority population. Contrary to our hypothesis, we found that not sure men reported lower rates of short sleep duration and higher rates of adequate sleep duration than heterosexual men. This has not been previously described in the literature. Our findings contradict several studies that have found no difference in sleep health between not sure and heterosexual men (Chen & Shiu, 2017; Duncan et al., 2018; Jackson et al., 2016). However, it is important to note that the limited number of not sure men (n=64) in the present study limits confidence in these findings. Therefore, findings for not sure men should be interpreted with caution. Although we hypothesized that not sure women would report worse sleep health than heterosexual women, we identified few differences between them. This is consistent with previous research (Duncan et al., 2018; Jackson et al., 2016). These data suggest that additional research with larger samples of not sure individuals is needed to examine whether our findings are consistent in other samples.

There are two possible explanations for the lack of differences in sleep health between some sexual minority subgroups (particularly gay/bisexual men and lesbian/not sure women) and their same-sex heterosexual counterparts in the present study. First, we comprehensively adjusted for potential confounders (i.e., health behaviors, health conditions, and use of prescription sleep medications), which could explain why our findings for bisexual men and lesbian women, in particular, differed from the work of Fricke and Sironi (2017) and Galinsky et al. (2018) for some measures of sleep health. In addition, we may have lacked statistical power to detect these differences when comparing gay/bisexual men and lesbian/not sure women to their same-sex heterosexual peers separately. With the exception of the work of Fricke and Sironi (2017) and Galinsky et al. (2018) our findings are consistent with most studies that have examined sleep health in sexual minorities. Therefore, we recommend that the present study be replicated with larger samples of sexual minorities without neglecting to incorporate the confounders examined in this analysis.

These data highlight important areas of future research. It is important to note that few of the previous studies comprehensively adjusted for potential confounders of the association between sexual identity and sleep health. In particular, minority stressors (e.g., victimization, discrimination, internalized homophobia) are posited to contribute to negative health outcomes among sexual minorities (Meyer, 2003). Future research is needed that explores the association of minority stressors and sleep health in this population. The higher rates of sleep problems among bisexual women warrants further research to examine potential contributors to poor sleep health in this group. Our data are consistent with a recent study that found that bisexual individuals reported more sleep problems than heterosexuals (Duncan et al., 2018). However, the previous study combined bisexual men and women so we are unable to adequately compare findings. A concern regarding our findings is the lack of specificity about sleep diagnoses as it is unclear which types of sleeping disorders were

present in bisexual women. Given sample size constraints of the sexual minority participants (particularly lesbian women [n = 107]; bisexual men [n = 118]; not sure [n = 64]) in the present study we were unable to examine whether there was heterogeneity in sleep health across racial/ethnic minorities or socioeconomic status. This is particularly important as several previous studies have identified significant racial/ethnic differences in sleep duration among sexual minority adults (Chen & Shiu, 2017; Trinh, Agénor, Austin, & Jackson, 2017).

As inadequate sleep duration has been associated with a number of chronic conditions and sexual minority women demonstrate higher rates of obesity and diabetes (Caceres et al., 2018a; Corliss et al., 2018; Jun et al., 2012; Kinsky et al., 2016), poor sleep health might be a potential mechanism by which sexual minority women exhibit excess chronic disease risk. In addition to future research examining the possible links between sleep health and chronic conditions in this population, we recommend that clinicians screen sexual minority women, particularly bisexual women, for inadequate sleep duration and other sleep problems. Given that few studies have investigated this association, at this time, it is difficult to tailor prevention efforts to reduce inadequate sleep in this population. However, it is likely that initiatives to promote sleep that do not account for the heterogeneity observed across sexual identity, particularly for women, may miss an important opportunity to address contributors to poor sleep quality.

Limitations

A limitation of the present study was the small sample size of sexual minorities, which might decrease confidence in our findings. Further, we excluded participants who identified as “something else” and those who responded “refused” or “don’t know” to the sexual identity item for this reason. Important differences in sleep health between these individuals and heterosexual participants may exist. This is an area that should be explored in future studies. Although these data are nationally representative, we were unable to examine the potential impact of geographic region on the association between sexual identity and sleep health. NHANES data are cross-sectional and causality cannot be inferred from these findings. Also, we were unable to examine all relevant variables including minority stressors, hours of sleep during weekends, whether participants worked more than one job, etc. These are all factors that could potentially impact sleep health. The measures of sleep health included in this study were based on self-report and likely did not comprehensively capture sleep quality in participants (e.g., sleep efficiency, sleep latency). As discussed above, participants were asked if they had ever been diagnosed with a sleeping disorder by a health professional, but no data were provided about specific diagnoses (e.g., insomnia, obstructive sleep apnea). Future studies should examine sexual identity disparities across different sleeping disorders and use validated instruments to assess sleep quality. Moreover, additional studies that use objective measures of sleep health (e.g., actigraphy, polysomnography, confirmation of sleeping disorders with electronic health records) are needed to strengthen this area of inquiry. Given that NHANES does not assess sexual identity in adults over the age of 60 and few studies have examined sleep health among older sexual minorities, there remains a significant gap in knowledge of sleep health disparities among sexual minority older adults.

Conclusions

The link between sleep health and chronic conditions warrants increased attention to sleep health as a potential contributor to chronic disease disparities among sexual minorities. This study represents an important contribution to the extant literature. With the exception of higher rates of adequate sleep duration in not sure men, we identified few sexual identity differences in sleep health among men. Bisexual women, however, demonstrated significantly worse outcomes for several measures of sleep health. These findings have significant implications for future research and promotion of sleep health among sexual minorities. Culturally tailored sleep interventions may be needed to adequately address sleep problems observed in bisexual women.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Sexual identity differences in demographic characteristics in men (ages 18–59), National Health and Nutrition Examination Survey 2005–2014 (N=8,030)

		Heterosexual (n=7,682)	Gay (n=166)	p-value Heterosexual vs. Gay men	Bisexual (n=118)	p-value Heterosexual vs. Bisexual men	Not sure (n=64)	p-value Heterosexual vs. Not sure men
Demographic characteristics	**Sample size**	**weighted %/mean (SE)**						
Age (mean)	8,030	38.5 (0.21)	38.9 (1.23)	0.77	38.8 (1.46)	0.87	39.0 (1.84)	0.82
Race	8,030			0.21		0.11		<0.001 *
Non-Hispanic		66.6%	72.9%		68.0%		32.6%	
White		10.8%	10.0%		15.7%		8.9%	
Non-Hispanic		15.9%	10.7%		13.0%		35.4%	
Black		6.7%	6.4%		3.3%		23.2%	
Hispanic								
Other race								
Family income to poverty ratio	7,470	3.1 (0.04)	3.2 (0.18)	0.51	2.7 (0.19)	0.03 *	1.8 (0.23)	<0.001 *
Education	7,601			<0.001 *		0.75		<0.001 *
Did not graduate high school		16.3%	3.5%		17.7%		53.4%	
Graduated high school		24.4%	14.5%		28.1%		20.0%	
Attended college/technical college		31.3%	33.9%		31.7%		9.3%	
Graduated college/technical college		28.0%	48.1%		22.5%		17.3%	
Relationship status	7,601			<0.001 *		<0.001 *		0.27
Married/living with partner		65.7%	35.8%		32.5%		56.8%	
Employment status	8,030			0.55		0.24		0.14
Employed		81.6%	79.7%		73.2%		78.0%	
Student		3.0%	4.4%		5.7%		1.4%	
Unemployed, looking		4.2%	2.9%		5.6%		0.4%	

		Heterosexual (n=7,682)	Gay (n=166)	p-value Heterosexual vs. Gay men	Bisexual (n=118)	p-value Heterosexual vs. Bisexual men	Not sure (n=64)	p-value Heterosexual vs. Not sure men
Demographic characteristics	**Sample size**	**weighted %/mean (SE)**						
Unemployed, not looking		11.2%	13.0%		15.5%		20.2%	
Household size (mean)	8,030	3.4 (0.04)	2.3 (0.20)	<0.001 *	2.9 (0.20)	0.02 *	3.9 (0.25)	0.04 *

Note. Reference group = same-sex heterosexual participants

* denotes p <0.05

Table 2.

Sexual identity differences in demographic characteristics in women (ages 18–59), National Health and Nutrition Examination Survey 2005–2014 (N=8,302)

		Heterosexual (n=7,699)	Lesbian (n=107)	p-value Heterosexual vs. Lesbian women	Bisexual (n=342)	p-value Heterosexual vs. Bisexual women	Not sure (n=154)	p-value Heterosexual vs. Not sure women
Demographic characteristics	**Sample size**	**weighted %/mean (SE)**						
Age (mean)	8,302	39.3 (0.23)	37.9 (1.33)	0.28	32.1 (0.65)	<0.001 *	38.7 (1.25)	0.60
Race	8,302			0.10		0.02 *		<0.001 *
Non-Hispanic		66.5%	67.8%		68.5%		36.1%	
White		12.5%	18.9%		15.9%		23.3%	
Non-Hispanic		14.4%	8.6%		9.3%		21.8%	
Black		6.6%	4.7%		6.3%		18.8%	
Hispanic								
Other race								
Family income to poverty ratio	7,763	3.0 (0.05)	2.7 (0.20)	0.11	2.3 (0.13)	<0.001 *	2.1 (0.18)	<0.001 *
Education	7,891			0.61		0.01 *		<0.001 *
Did not graduate high school		13.2%	15.8%		17.0%		33.1%	
Graduated high school		19.9%	15.3%		23.7%		26.1%	
Attended college/technical college		35.3%	31.5%		40.0%		23.0%	
Graduated college/technical college		31.6%	37.4%		19.4%		17.8%	
Relationship status	7,891			<0.001 *		<0.001 *		0.01 *
Married/living with partner		64.8%	35.8%		44.1%		48.8%	
Employment status	8,300			0.20		0.09		<0.001 *
Employed		69.4%	64.1%		67.4%		57.9%	
Student		2.9%	7.1%		5.2%		3.9%	

		Heterosexual (n=7,699)	Lesbian (n=107)	p-value Heterosexual vs. Lesbian women	Bisexual (n=342)	p-value Heterosexual vs. Bisexual women	Not sure (n=154)	p-value Heterosexual vs. Not sure women
Demographic characteristics	**Sample size**	**weighted %/mean (SE)**						
Unemployed, looking		2.9%	2.4%		4.3%		9.9%	
Unemployed, not looking		24.8%	26.4%		23.1%		28.3%	
Household size (mean)	8,302	3.3 (0.03)	2.6 (0.14)	<0.001 *	3.2 (0.09)	0.22	3.7 (0.16)	0.01 *

Note. Reference group = same-sex heterosexual participants

* denotes $p < 0.05$

Table 3.

Results of multivariable analyses examining sexual orientation differences in sleep health in men (ages 18–59), National Health and Nutrition Examination Survey 2005–2014 (n=8,030)

	OR (95% CI)	aOR (95% CI)	aOR (95% CI)
Medication use	**Model 1**	**Model 2**	**Model 3**
Use of sleep medications and/or sedatives			
Heterosexual	Ref	Ref	Ref
Gay	1.34 (0.69–2.62)	1.07 (0.54–2.15)	1.07 (0.54–2.14)
Bisexual	0.99 (0.43–2.29)	0.63 (0.27–1.47)	0.63 (0.27–1.47)
Not sure	1.06 (0.23–4.81)	1.25 (0.36–4.35)	1.23 (0.36–4.29)
Sleep duration			
Short sleep duration [a]			
Heterosexual	Ref	Ref	Ref
Gay	0.68 (0.48–0.98) *	0.72 (0.50–1.05)	0.71 (0.49–1.04)
Bisexual	1.07 (0.71–1.63)	0.97 (0.64–1.46)	0.95 (0.63–1.43)
Not sure	0.44 (0.22–0.88) *	0.42 (0.20–0.88) *	0.44 (0.21–0.92) *
Adequate sleep duration [a]			
Heterosexual	Ref	Ref	Ref
Gay	1.24 (0.89–1.74)	1.21 (0.83–1.76)	1.22 (0.84–1.80)
Bisexual	0.89 (0.60–1.33)	1.02 (0.69–1.52)	1.04 (0.70–1.55)
Not sure	2.27 (1.15–4.46) *	2.50 (1.21–5.15) *	2.35 (1.16–4.79) *
Long sleep duration [a]			
Heterosexual	Ref	Ref	Ref
Gay	1.79 (1.01–3.20) *	1.68 (0.94–2.99)	1.67 (0.92–3.01)
Bisexual	1.24 (0.61–2.55)	1.03 (0.49–2.20)	1.03 (0.48–2.22)
Not sure	0.78 (0.13–4.59)	0.67 (0.11–4.23)	0.68 (0.11–4.26)
Sleep health			
Ever told a health professional you had trouble sleeping [a]			
Heterosexual	Ref	Ref	Ref
Gay	1.59 (0.98–2.59)	1.10 (0.69–1.78)	1.08 (0.67–1.73)
Bisexual	1.25 (0.77–2.05)	0.86 (0.53–1.40)	0.81 (0.49–1.35)
Not sure	0.53 (0.17–1.69)	0.55 (0.21–1.43)	0.59 (0.22–1.55)
Ever told by a health professional you have a sleeping disorder [a]			
Heterosexual	Ref	Ref	Ref
Gay	1.11 (0.60–2.06)	1.06 (0.54–2.09)	1.02 (0.52–1.99)

	OR (95% CI)	aOR (95% CI)	aOR (95% CI)
Medication use	**Model 1**	**Model 2**	**Model 3**
Bisexual	1.56 (0.75–3.26)	1.39 (0.69–2.80)	1.18 (0.59–2.35)
Not sure	0.23 (0.05–0.96) *	0.22 (0.05–1.04)	0.30 (0.07–1.30)

Note.

*denotes $p < 0.05$

Model 1 = Unadjusted; Model 2 = Adjusted for survey year, demographic characteristics, self-rated health, healthcare utilization, and health behaviors; Model 3= Added health conditions

[a]Model 3 added use of sleep medications and/or sedatives.

Table 4.

Results of multivariable analyses examining sexual orientation differences in sleep health in women (ages 18–59), National Health and Nutrition Examination Survey 2005–2014 (n=8,302)

	OR (95% CI)	aOR (95% CI)	aOR (95% CI)
Medication use	**Model 1**	**Model 2**	**Model 3**
Use of sleep medications and/or sedatives [a]			
Heterosexual	Ref	Ref	Ref
Lesbian	1.95 (1.04–3.64) *	1.72 (0.78–3.78)	1.68 (0.77–3.70)
Bisexual	2.11 (1.42–3.12) *	1.89 (1.21–2.94) *	1.86 (1.20–2.89) *
Not sure	1.31 (0.63–2.73)	1.50 (0.73–3.06)	1.46 (0.71–3.01)
Sleep duration			
Short sleep duration [a]			
Heterosexual	Ref	Ref	Ref
Lesbian	1.16 (0.73–1.86)	0.97 (0.59–1.58)	0.93 (0.58–1.51)
Bisexual	1.52 (1.23–1.87) *	1.34 (1.04–1.72) *	1.29 (1.01–1.65) *
Not sure	1.16 (0.80–1.69)	0.92 (0.65–1.30)	0.89 (0.63–1.25)
Adequate sleep duration [a]			
Heterosexual	Ref	Ref	Ref
Lesbian	0.83 (0.52–1.34)	1.04 (0.63–1.72)	1.08 (0.66–1.77)
Bisexual	0.60 (0.49–0.75) *	0.73 (0.57–0.94) *	0.76 (0.60–0.97) *
Not sure	0.73 (0.51–1.05)	0.90 (0.64–1.24)	0.92 (0.66–1.29)
Long sleep duration [a]			
Heterosexual	Ref	Ref	Ref
Lesbian	1.16 (0.55–2.44)	1.01 (0.49–2.06)	0.99 (0.49–2.04)
Bisexual	1.39 (0.91–2.13)	1.09 (0.71–1.69)	1.09 (0.70–1.69)
Not sure	1.70 (0.94–3.08)	1.70 (0.95–3.07)	1.70 (0.95–3.03)
Sleep problems			
Ever told a health professional you had trouble sleeping [a]			
Heterosexual	Ref	Ref	Ref
Lesbian	1.61 (0.99–2.65)	1.25 (0.73–2.18)	1.10 (0.62–1.95)
Bisexual	1.73 (1.30–2.31) *	1.79 (1.29–2.49) *	1.63 (1.16–2.29) *
Not sure	0.66 (0.41–1.06)	0.73 (0.41–1.30)	0.63 (0.33–1.19)
Ever told by a health professional you have a sleeping disorder [a]			
Heterosexual	Ref	Ref	Ref
Lesbian	2.06 (0.90–4.74)	1.76 (0.79–3.92)	1.69 (0.75–3.82)

	OR (95% CI)	aOR (95% CI)	aOR (95% CI)
Medication use	**Model 1**	**Model 2**	**Model 3**
Bisexual	2.30 (1.51–3.49) *	2.50 (1.56–4.00) *	2.37 (1.49–3.76) *
Not sure	1.09 (0.59–2.01)	1.08 (0.52–2.26)	0.94 (0.44–2.05)

Note.

* denotes $p < 0.05$

Model 1 = Unadjusted; Model 2 = Adjusted for survey year, demographic characteristics, self-rated health, healthcare utilization, and health behaviors; Model 3= Added health conditions

[a] Model 3 added use of sleep medications and/or sedatives