Published in final edited form as:

J Clin Psychol. 2020 October ; 76(10): 1972–1983. doi:10.1002/jclp.22974.

Mental Health and Sleep Disparities in an Urban College Sample: A Longitudinal Examination of White and Black Students

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Abstract

Objective: Racial disparities in sleep may be consequential among college students given high rates of dysfunctional sleep among this population. The present study sought to investigate whether disparities in sleep explain existing mental health disparities.

Method: Data included secondary analysis of a college risk behaviors and health study (n=1242, mean age= 18.5). Race was dichotomized as White or Black, excluding all others, with participants completing measures of sleep at baseline and measures of depression and anxiety at follow-up one to two years later.

Results: Compared to White students, Black students were more likely to report lower rates of depression and anxiety, but poorer sleep outcomes. Mediation analyses revealed that sleep partially mediated (suppressed) the association between race and depressive and anxiety symptoms.

Conclusions: Results indicate that disparities in sleep may play an important role in the association between race and mental health symptoms among college students. Future health disparity research would benefit from exploring the potentially bidirectional relationship between sleep and mental health symptoms among college students.

Keywords

Sleep disparities; health disparities; race; depression; anxiety

Healthy sleep, as characterized by sleep regularity, subjective satisfaction, alertness during the day, timing of sleep, sleep efficiency, and sleep duration, is increasingly recognized as an important determinant of overall health, as important as a healthy diet or adequate physical activity (Buysse, 2014; Luyster, Strollo, Zee, & Walsh, 2012). Yet, short sleep duration is common in the general population with 28.3% of adults sleeping 6 hours or fewer (Krueger

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& Friedman, 2009). Efforts to address sleep disturbance are warranted given that poor sleep is associated with a range of adverse mental health symptoms including depression (Zhai, Zhang, & Zhang, 2015), suicidal ideation (Pigeon, Piquart, & Conner, 2012), and anxiety (Alvaro, Roberts, & Harris, 2013).

Black-White Disparities in Sleep

A growing body of research suggests that Black individuals are disproportionately prone to inadequate sleep (Krueger & Friedman, 2009). For example, Black individuals report significantly higher rates of very short (i.e., less than five hours) and short (i.e., between five and six hours) sleep durations compared to White individuals (Krueger & Friedman, 2009; Whinnery, Jackson, Rattanaumpawan, & Grandner, 2014). These sleep disparities often emerge at a young age and persist over time (Stamatakis, Kaplan, & Roberts, 2007). A review of 23 studies found that Black youth between the ages of 6 and 19 report greater levels of insufficient sleep compared to their White peers (Guglielmo, Gazmararian, Chung, Rogers, & Hale, 2018).

College students are particularly susceptible to experiencing sleep disturbance and report high rates of difficulty falling or staying asleep, poor sleep quality, and excessive daytime sleepiness (Nyer et al., 2013; Williams et al., 2019). For example, one study found that over 60% of college students are categorized as poor sleepers, with 70.6% obtaining less than 8 hours of sleep per night (Lund, Reider, Whiting, & Prichard, 2010). These sleep outcomes may disproportionately impact Black college students, with 62% reporting very short sleep durations (< 6.5 hours), 61% reporting high levels of daytime sleepiness, and 63% reporting poor sleep quality (Billings & Berg-Cross, 2014).

Black-White Disparities in Mental Health

In contrast to differences in sleep, evidence regarding disparities in mental health are more incongruous. Some evidence supports the existence of racial disparities in mental health (McGuire & Miranda, 2008). Specifically, mental health symptoms among Black individuals may be more severe and disabling, and have been shown to persist over time (Breslau et al., 2006; Williams et al., 2007). In contrast, other studies support the existence of a Black-White paradox, with Blacks experiencing lower rates of mental health disorders than their White counterparts despite facing disproportionately more risk factors for mental illness including higher rates of physical morbidity, social inequity, and discrimination (Keyes, 2009; Erving, Thomas, & Frazier, 2018).

Mental health disorders are common among college students (Auerbach et al., 2016; Pedrelli, Nyer, Yeung, Zulauf, & Wilens, 2015), with some evidence suggesting that mental health problems are more prevalent among racial minority college students. A large multi-campus study found that compared to White college students, Black students had a higher likelihood of screening positive for depression (Eisenberg, Hunt, & Speer, 2013). Rates of anxiety disorders are more nuanced, with several studies indicating similar rates between White and racial minority students (Eisenberg, Gollust, Golberstein, & Hefner, 2007; Eisenberg et al., 2013). Nevertheless, mental health prevention efforts may be particularly

relevant for racial minority college students since they are more likely to have unmet mental health needs compared to White students (Lipson, Kern, Eisenberg, & Breland-Noble, 2018).

The Association Between Sleep and Mental Health Disparities Among College Students

Poor sleep among college students is associated with several mental health outcomes including depression (Nyer et al., 2013; Williams et al., 2019), anxiety (Becker et al., 2018; Hershner & Chervin, 2014) and substance use (Boehm, Lei, Lloyd, & Prichard, 2016). Importantly, anxiety and depression, two of the most common mental health conditions experienced by college students (Pedrelli et al., 2015), are associated with poor sleep quality, sleep latency, sleep duration, and sleep efficiency (Becker et al., 2018). Estimates of global sleep quality have revealed similar outcomes, with poorer global sleep quality being associated with increased depressive and anxiety symptoms (Pensuksan et al., 2016). Although the connection between inadequate sleep and poor mental health is well-established, it remains unclear whether Black college students' susceptibility to adverse mental health outcomes is related to existing disparities in sleep. This gap in knowledge is particularly relevant considering evidence suggesting that poor sleep interferes with academic outcomes (Gaultney, 2010).

Present Study

The purpose of present study was to investigate whether sleep disparities explain mental health disparities among a racially diverse sample of college undergraduates. A better understanding of the association between sleep and mental health symptoms among a diverse sample of college students could help to decrease inequities in health later in life. Thus, the first aim of the study was to examine the longitudinal associations between racial identity (i.e., Black vs White), sleep, and mental health symptoms. Consistent with the existing literature, we hypothesized that Black students would report poorer sleep, as well as greater rates of depressive and anxious symptoms, and that poorer sleep would be associated with greater rates of depressive and anxious symptoms. The second aim of the study was to assess whether sleep serves as a mechanism through which racial identity is associated with adverse mental health symptoms. Specifically, we hypothesized that the association between racial minority status and mental health symptoms would be mediated by sleep.

Methods

The present study consisted of secondary data analysis from a university-wide longitudinal study called Spit for Science (S4S). The primary aim of S4S is to examine the genetic and environmental influences of emotional and physical health among college students at a large urban university in the southeast (Dick et al., 2014). All incoming freshmen who are at least 18 years of age are invited to participate in S4S by completing an online survey. Baseline information for all participants is collected during each cohort's freshman year, with follow-up data collected during the spring of each subsequent academic year. Nearly 70% of eligible freshman have participated in S4S each year since its inception, with demographic

makeup of study participants mirroring the gender and racial makeup of students attending the university.

Participants

Questions about participants' sleep were first added to the survey in 2014. Accordingly, the present study consisted of participants from the fourth (2014) S4S cohort. In order to be included in the present study, participants had to identify as being either Black or White and must have participated in S4S during the fall of their freshman year. The final analytic sample consisted of 1242 students.

Procedure

Participants' demographic information, sleep duration, and sleep quality was assessed during the fall of their freshman year. Sleep health was assessed during the spring of participants' sophomore year. Additionally, information regarding participants' anxiety and depressive symptoms were assessed during the spring of participants' sophomore and junior years. All data were collected via online surveys administered using Research Electronic Data Capture (REDCap; Harris et al., 2009). Participants were reimbursed \$10 per survey completed. The study was approved by the Institutional Review Board of the affiliated university.

Measures

Gender and Race.—Participants' self-identified their gender as either “male” or “female.” Race was also self-identified. In order to be included in the present study, participants had to either identify as “Black/African American” or “White.”

Depression and Anxiety.—Depression and anxiety were assessed using a subset of items from the Symptom Checklist-90-R (Derogatis, Lipman, & Covi, 1973). The primary aim of the SCL-90-R is to assess a broad range of psychological problems and symptoms of psychopathology. Four self-reported items were respectively used to assess depression and anxiety over the past week. Depression was assessed by examining the degree to which participants endorsed the following items: “feeling blue”, “worrying too much about things”, “feeling no interest in things”, and “feeling hopeless about the future”. Similarly, anxiety was items assessed by examining the degree to which participants endorsed the following items: “nervousness or shakiness inside”, “suddenly scared for no reason”, “feeling fearful” and “spells of terror”. All items were rated on a 5-point Likert scale ranging from 1 (not at all) to 5 (extremely). Cronbach's alpha for depression and anxiety items of the SCL-90-R at baseline was .86 and .84 respectively.

Sleep.—Sleep duration and sleep quality were assessed using two items from the Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). Specifically, total sleep time was measured using a single item which asked participants how long they typically sleep per night. Similarly, sleep quality, (“how would you rate your sleep quality overall?”), was rated using a single item on a 4-point Likert item from 1 (Very Bad) to 4 (Very Good).

Sleep health was measured using the RU SATED questionnaire (Buysse, 2014). This self-report scale evaluates six facets of sleep which have been consistently tied with relevant physical and mental health outcomes including: (a) sleep regularity, (b) subjective satisfaction, (c) alertness during the day, (d) timing, (e) efficiency, and (f) duration. Scores on this 6-item scale range from 0 (poor sleep health) to 12 (good sleep health). Preliminary evidence suggests that the scale is a valid and reliable measure for the assessment of sleep health indicators (Ravyts, Dzierzewski, Perez, Donovan, & Dautovich, 2019). Cronbach's alpha for sleep health in the present study was .66.

Data Analyses

In order to assess whether sleep mediated the association between race and mental health symptoms, mediation analyses with an asymptotic bootstrapping approach were conducted (Preacher & Hayes, 2008). Specifically, mediation models were conducted using PROCESS macro (Hayes, 2013), with Model 4 and $N = 5,000$ resamples. Six mediation models assessed the longitudinal associations between race, sleep, and mental health symptoms. Race was included as the predictor variables in all models. Total sleep time (year 1), sleep quality (year 1), and sleep health (year 2) were each entered as the respective mediators for two models each. Depression (year 3) and anxiety (year 3) were entered as the respective criterion variables for three mediation models, one for each of the above-mentioned sleep variables. All models controlled for gender. Confidence intervals which did not include zero were considered statistically significant (i.e., $p < .05$). Published reports indicate that our sample size of 1242 is more than adequate to detect mediation via bootstrapping techniques (Fritz & MacKinnon, 2007). Figure 1 displays the conceptual mediation models. Missing data was handled using list-wise deletion.

Results

Descriptive Statistics

Of the 1242 participants included in the present study, 35.67% identified as female and 25.28% identified as Black. Participants' ages ranged from 18 to 22, with a mean age of 18.50. At baseline, Black students reported significantly lower depressive ($p < .001$) and anxiety ($p < .001$) symptoms compared to their White peers. In contrast, White students reported significantly better sleep including higher total sleep time ($p < .001$), as well as better sleep quality ($p < .01$), and sleep health ($p < .001$) than their Black peers. Complete participant demographic and clinical characteristics are provided in Table 1.

Longitudinal Mediation Analyses

The positive total effects of race on depression and anxiety was significant. The direct associations between race and mental health symptoms remained positive, suggesting that being White was associated with greater mental health symptoms. The associations between race and mental health symptoms were suppressed by significant negative indirect effects of total sleep time, sleep quality, and sleep health respectively. Overall, between 7 and 25% of the association between race and mental health symptoms was found to be suppressed by sleep parameters. Only total sleep time failed to mediate the association between race and

depression. The complete results of the longitudinal mediation analyses are presented in Table 2.

Discussion

The purpose of the present study was to examine whether Black-White disparities in sleep may explain disparities in mental health commonly found among college undergraduates. Contrary to our expectations, our findings indicate that compared to White students, Black students were more likely to report lower levels of anxiety and depressive symptoms. In contrast, Black students were more likely to report worse sleep including shorter total sleep time, poorer sleep quality, and worse sleep health than their White peers. These sleep parameters were, in turn, negatively associated with depressive and anxiety symptoms. Finally, our mediation analyses indicated that the association between race and mental health symptoms became stronger when sleep was included as a mediator (i.e. suppression was present).

Our finding that Black college students report worse sleep compared to White students is consistent with existing research. Several studies investigating racial differences in sleep found that Black individuals are at higher risk for negative sleep outcomes including shorter sleep duration and poorer sleep quality compared to their White peers (Nam et al., 2018; Owens, Hunte, Sterkel, Johnson, & Johnson-Lawrence, 2017; Whinnery et al., 2014). Although college students in general report insufficient sleep, [irregular sleep–wake patterns](#), and are greater risk for sleep disorders (Forquer, Camden, Gabriela, & Johnson, 2008; Lund et al., 2010), few studies have examined racial differences in sleep among college students. Given that poor sleep is associated with adverse academic outcomes, and that educational attainment protects against future negative health consequences, knowledge regarding sleep disparities in college is informative. Such findings suggest that assessing and developing interventions to decrease sleep disparities in college students may be warranted.

Several factors have been posited to explain the presence of sleep disparities. For example, research examining community-dwelling adults suggest that socioeconomic status, living in disadvantaged neighborhoods, and discrimination, may each partially account for racial differences in objective and subjective sleep outcomes (Mezick et al., 2008; Owens et al., 2017). Though our findings do not shed light on the mechanisms leading to sleep disparities, they do suggest racial disparities in sleep occur at a young age and are connected to mental health symptoms. Further research is needed to elucidate which mechanisms contribute to disparities in sleep among college students.

Contrary to our hypothesis, Black students reported less anxiety and depressive symptoms compared to their White peers. Several reasons may elucidate these findings. First, results from this study can be explained by the Black White paradox, where despite greater exposure to risk factors for mental illness, Black Americans report relatively lower or similar rates of mental health disorders than Whites (Keyes, 2009). Second, several factors have been posited to protect against the onset and exacerbation of mental health issues among racial minorities. For example, using a student and community sample, one study found that African Americans with higher ethnic identity reported lower levels of anxiety and

depression (Williams, Chapman, Wong, & Turkheimer, 2012). Other factors including religiosity and resiliency have also been implicated as potential buffers against adverse mental health outcomes in Black populations (Keyes, 2009; Levin, Chatters, & Taylor, 2005). Finally, the diverse racial composition of the school from which participants were sampled might buffer against mental health symptoms for Black students. Prior research has shown that Black students are more likely to experience more depressive and somatic symptoms as the percentage of White students at their school increases (Walsemann, Bell, & Maitra, 2011).

The current study also found evidence indicating that inadequate sleep is associated with more symptoms of depression and anxiety. Adjustment to college life is a stressful experience that is frequently associated with the development of depressive symptoms (Acharya, Jin, & Collins, 2018). Changes in sleeping habits, social activities, class workload, and living environment may all contribute to depressive symptoms among college students (Acharya et al., 2018). The association between sleep and mental health symptoms in college students supports the cognitive-energy model of sleep, which posits that sleep serves as a resource for managing emotional reactions to stress (Zohar, Tzischinsky, Epstein, & Lavie, 2005). Improving sleep among college students may therefore increase internal resources to cope appropriately with stress and reduce the risk of adverse mental health outcomes. Consistent with this theory, preliminary evidence indicates that sleep interventions not only improve college students' sleep but also decrease their depressive and anxiety symptoms (Baroni, Bruzzese, Di Bartolo, Ciarleglio, & Shatkin, 2018).

Implications

The results from this work have implications on both theoretical and practical levels. Theoretically, the current study highlights the role of sleep for mental health symptoms in college students. Specifically, the magnitude of the association between race and mental health symptoms was strengthened with the inclusion of sleep. In addition to suppressing the mental health disparity between Black and White students, the current study additionally highlighted that better sleep was associated with fewer mental health symptoms in this population regardless of racial status. Practically, the finding that sleep was associated with better mental health functioning in this population provides important evidence that sleep is a potential target to enhance mental health in college students from diverse racial groups and indicates a potential intervention target for healthcare providers. Future work should further disentangle this relation by examining potential pathways leading to negative sleep outcomes in college students, with a particular emphasis on prevention of racial differences in the obtainment of adequate sleep.

Limitations

Although the current study contains many strengths including the use of a large, diverse sample of college students and longitudinal data analyses, it should be interpreted in the context of a few limitations. First, the current study utilized brief self-report, retrospective measures of sleep and mental health symptoms. Relatedly, at least one self-report questionnaire for sleep, RU-SATED, revealed a low Cronbach's Alpha (i.e., .66). As such, results may differ if investigated using alternative measurements of sleep and health such as

actigraphy or daily diary methodology. In addition, although the current study highlighted that Black students had worse sleep in comparison to White students, both samples endorsed adequate sleep in terms in total sleep time, sleep quality, and sleep health. The overall adequate level of sleep endorsed by this sample does not align with past research, which instead indicated that college students, especially Black college students, report significant sleep disturbance (Billings & Berg-Cross, 2014). Whether this discrepancy is a characteristic of the specific sample studied or a result of measurement artifact, where measurement error or scale specific factors skew results, should be investigated in future studies. Associations between race, sleep, and mental health might differ among those with clinical sleep disorders. The study sample was also limited to one college campus. It is possible that the incorporation of participants from multiple colleges, particularly among campuses where minority students are less well represented might alter the study's findings. Finally, although sleep was found to mediate the association between race and mental health symptoms, other relationships among these factors may exist. For example, future research may wish to assess whether mental health symptoms also mediate the relationship between race and sleep.

Summary

In summary, the present study provides compelling evidence on the connection among race, sleep, and mental health symptoms in a diverse college student population. We examined the association between race and mental health using longitudinal data from a large multi-cohort study. We found evidence for both mental health and sleep disparities among Black and White college students. Furthermore, sleep suppressed the influence of race on mental health symptoms, that is, the magnitude of the relationship between race became larger when sleep was included. These results underscore the importance of sleep in college students. Future work should further disentangle the relation between sleep and health outcomes in racially diverse college students.

Acknowledgements

Dr. Dzierzewski was supported by a grant from the National Institute on Aging (K23AG049955). Spit for Science has been supported by Virginia Commonwealth University, P20 AA017828, R37AA011408, K02AA018755, and P50 AA022537 from the National Institute on Alcohol Abuse and Alcoholism, and UL1RR031990 from the National Center for Research Resources and National Institutes of Health Roadmap for Medical Research. Data from this study are available to qualified researchers via dbGaP (phs001754). We would like to thank the Spit for Science participants for making this study a success, as well as the many University faculty, students, and staff who contributed to the design and implementation of the project.

References

- Acharya L, Jin L, & Collins W (2018). College life is stressful today: Emerging stressors and depressive symptoms in college students. *Journal of American College Health*, 1–10. 10.1080/07448481.2018.1451869
- Alvaro PK, Roberts RM, & Harris JK (2013). A Systematic Review Assessing Bidirectionality between Sleep Disturbances, Anxiety, and Depression. *Sleep*, 36(7), 1059–1068. 10.5665/sleep.2810 [PubMed: 23814343]
- Assari S (2017). Combined Racial and Gender Differences in the Long-Term Predictive Role of Education on Depressive Symptoms and Chronic Medical Conditions. *Journal of Racial and Ethnic Health Disparities*, 4(3), 385–396. 10.1007/s40615-016-0239-7 [PubMed: 27270925]

- Auerbach RP, Alonso J, Axinn WG, Cuijpers P, Ebert DD, Green JG, ... Bruffaerts R (2016). Mental disorders among college students in the WHO World Mental Health Surveys. *Psychological Medicine*, 46(14), 2955–2970. 10.1017/S0033291716001665 [PubMed: 27484622]
- Baroni A, Bruzzese J-M, Di Bartolo CA, Ciarleglio A, & Shatkin JP (2018). Impact of a sleep course on sleep, mood and anxiety symptoms in college students: A pilot study. *Journal of American College Health*, 66(1), 41–50. 10.1080/07448481.2017.1369091 [PubMed: 28820661]
- Becker SP, Jarrett MA, Luebke AM, Garner AA, Burns GL, & Kofler MJ (2018). Sleep in a large, multi-university sample of college students: Sleep problem prevalence, sex differences, and mental health correlates. *Sleep Health*, 4(2), 174–181. 10.1016/j.sleh.2018.01.001 [PubMed: 29555131]
- Billings T, & Berg-Cross L (2014). Sleep competing activities and sleep problems in minority college students. *Journal of Racial and Ethnic Health Disparities*, 1(4), 300–308. 10.1007/s40615-014-0037-z
- Boehm MA, Lei QM, Lloyd RM, & Prichard JR (2016). Depression, anxiety, and tobacco use: Overlapping impediments to sleep in a national sample of college students. *Journal of American College Health*, 64(7), 565–574. 10.1080/07448481.2016.1205073 [PubMed: 27347758]
- Brandolim Becker N, Martins RIS, Jesus S. de N., Chiodelli R, & Stephen Rieber M (2018). Sleep health assessment: A scale validation. *Psychiatry Research*, 259, 51–55. 10.1016/j.psychres.2017.10.014 [PubMed: 29028524]
- Breslau J, Aguilar-Gaxiola S, Kendler KS, Su M, Williams D, & Kessler RC (2006). Specifying race-ethnic differences in risk for psychiatric disorder in a USA national sample. *Psychological Medicine*, 36(1), 57–68. 10.1017/S0033291705006161 [PubMed: 16202191]
- Buyse DJ (2014). Sleep Health: Can We Define It? Does It Matter? *Sleep*, 37(1), 9–17. 10.5665/sleep.3298 [PubMed: 24470692]
- Buyse DJ, Reynolds CF, Monk TH, Berman SR, & Kupfer DJ (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193–213. [PubMed: 2748771]
- Curcio G, Ferrara M, & De Gennaro L (2006). Sleep loss, learning capacity and academic performance. *Sleep Medicine Reviews*, 10(5), 323–337. 10.1016/j.smrv.2005.11.001 [PubMed: 16564189]
- Derogatis LR, Lipman RS, & Covi L (1973). SCL-90: An outpatient psychiatric rating scale--preliminary report. *Psychopharmacology Bulletin*, 9(1), 13–28. [PubMed: 4682398]
- Dick DM, Nasim A, Edwards AC, Salvatore JE, Cho SB, Adkins A, ... Kendler KS (2014). Spit for Science: Launching a longitudinal study of genetic and environmental influences on substance use and emotional health at a large US university. *Frontiers in Genetics*, 5 10.3389/fgene.2014.00047
- Eisenberg D, Gollust SE, Golberstein E, & Hefner JL (2007). Prevalence and Correlates of Depression, Anxiety, and Suicidality Among University Students. *American Journal of Orthopsychiatry*, 77(4), 534–542. 10.1037/0002-9432.77.4.534 [PubMed: 18194033]
- Eisenberg D, Hunt J, & Speer N (2013). Mental health in American colleges and universities: Variation across student subgroups and across campuses. *The Journal of Nervous and Mental Disease*, 201(1), 60–67. 10.1097/NMD.0b013e31827ab077 [PubMed: 23274298]
- Eliasson AH, Kashani M, Mayhew M, Ude A, Hoffman J, & Vernalis M (2010). Reducing Perceived Stress Improves Sleep Quality: A Longitudinal Outcomes Study. *Chest*, 138(4, Supplement), 913A 10.1378/chest.10417 [PubMed: 20472861]
- Erving CL, Thomas CS, & Frazier C (2018). Is the Black-White Mental Health Paradox Consistent Across Gender and Psychiatric Disorders?. *American Journal of Epidemiology*, 188(2), 314–322.
- Forquer LM, Camden AE, Gabriau KM, & Johnson CM (2008). Sleep patterns of college students at a public university. *Journal of American College Health*, 56(5), 563–565. 10.3200/JACH.56.5.563-565 [PubMed: 18400669]
- Fritz MS, & MacKinnon DP (2007). Required sample size to detect the mediated effect. *Psychological science*, 18(3), 233–239. [PubMed: 17444920]
- Gaultney JF (2010). The prevalence of sleep disorders in college students: Impact on academic performance. *Journal of American College Health*, 59(2), 91–97. 10.1080/07448481.2010.483708 [PubMed: 20864434]

- Gilman SE, Breslau J, Conron KJ, Koenen KC, Subramanian SV, & Zaslavsky AM (2008). Education and race-ethnicity differences in the lifetime risk of alcohol dependence. *Journal of Epidemiology and Community Health*, 62(3), 224–230. 10.1136/jech.2006.059022 [PubMed: 18272737]
- Guglielmo D, Gazmararian JA, Chung J, Rogers AE, & Hale L (2018). Racial/ethnic sleep disparities in US school-aged children and adolescents: A review of the literature. *Sleep Health*, 4(1), 68–80. 10.1016/j.sleh.2017.09.005 [PubMed: 29332684]
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, & Conde JG (2009). Research Electronic Data Capture (REDCap): A metadata-driven methodology and workflow process for providing translational research informatics support. *Journal of Biomedical Informatics*, 42(2), 377–381. 10.1016/j.jbi.2008.08.010 [PubMed: 18929686]
- Hayes AF (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.
- Hayley AC, Sivertsen B, Hysing M, Vedaa Ø, & Øverland S (2017). Sleep difficulties and academic performance in Norwegian higher education students. *British Journal of Educational Psychology*, 87(4), 722–737. [PubMed: 28861896]
- Hershner SD, & Chervin RD (2014). Causes and consequences of sleepiness among college students. *Nature and Science of Sleep*, 6, 73–84. 10.2147/NSS.S62907
- Kelly WE, Kelly KE, & Clanton RC (2001). The relationship between sleep length and grade-point average among college students. *College Student Journal*, 35(1), 84–86.
- Keyes CLM (2009). The Black-White paradox in health: Flourishing in the face of social inequality and discrimination. *Journal of Personality*, 77(6), 1677–1706. 10.1111/j.1467-6494.2009.00597.x [PubMed: 19796064]
- Krueger PM, & Friedman EM (2009). Sleep duration in the United States: A cross-sectional population-based study. *American Journal of Epidemiology*, 169(9), 1052–1063. 10.1093/aje/kwp023 [PubMed: 19299406]
- Levin J, Chatters LM, & Taylor RJ (2005). Religion, health and medicine in African Americans: Implications for physicians. *Journal of the National Medical Association*, 97(2), 237. [PubMed: 15712787]
- Lipson SK, Kern A, Eisenberg D, & Breland-Noble AM (2018). Mental Health Disparities Among College Students of Color. *The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine*, 63(3), 348–356. 10.1016/j.jadohealth.2018.04.014 [PubMed: 30237000]
- Lund HG, Reider BD, Whiting AB, & Prichard JR (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health*, 46(2), 124–132. 10.1016/j.jadohealth.2009.06.016 [PubMed: 20113918]
- Luyster FS, Strollo PJ, Zee PC, & Walsh JK (2012). Sleep: A Health Imperative. *Sleep*, 35(6), 727–734. 10.5665/sleep.1846 [PubMed: 22654183]
- McGuire TG, & Miranda J (2008). Racial and Ethnic Disparities in Mental Health Care: Evidence and Policy Implications. *Health Affairs (Project Hope)*, 27(2), 393–403. 10.1377/hlthaff.27.2.393 [PubMed: 18332495]
- Mezick EJ, Matthews KA, Hall M, Strollo PJ, Buysse DJ, Kamarck TW, ... Reis SE (2008). Influence of race and socioeconomic status on sleep: Pittsburgh SleepSCORE project. *Psychosomatic Medicine*, 70(4), 410–416. 10.1097/PSY.0b013e31816fdf21 [PubMed: 18480189]
- Montez JK, Hummer RA, Hayward MD, Woo H, & Rogers RG (2011). Trends in the Educational Gradient of U.S. Adult Mortality From 1986 Through 2006 by Race, Gender, and Age Group. *Research on Aging*, 33(2), 145–171. 10.1177/0164027510392388 [PubMed: 21897495]
- Nam S, Whittemore R, Jung S, Latkin C, Kershaw T, & Redeker NS (2018). Physical neighborhood and social environment, beliefs about sleep, sleep hygiene behaviors, and sleep quality among African Americans. *Sleep Health*, 4(3), 258–264. 10.1016/j.sleh.2018.03.002 [PubMed: 29776620]
- Nyer M, Farabaugh A, Fehling K, Soskin D, Holt D, Papakostas GI, ... Mischoulon D (2013a). Relationship between sleep disturbance and depression, anxiety, and functioning in college students. *Depression and Anxiety*, 30(9). 10.1002/da.22064

- Nyer M, Farabaugh A, Fehling K, Soskin D, Holt D, Papakostas GI, ... Mischoulon D (2013b). Relationship between sleep disturbance and depression, anxiety, and functioning in college students. *Depression and Anxiety*, 30(9). 10.1002/da.22064
- Owens SL, Hunte HER, Sterkel A, Johnson DA, & Johnson-Lawrence V (2017). Association between discrimination and objective and subjective sleep measures in the Midlife in the United States study adult sample. *Psychosomatic Medicine*, 79(4), 469–478. 10.1097/PSY.0000000000000428 [PubMed: 28114149]
- Park S, Cho MJ, Chang SM, Bae JN, Jeon HJ, Cho S-J, ... Hong JP (2010). Relationships of sleep duration with sociodemographic and health-related factors, psychiatric disorders and sleep disturbances in a community sample of Korean adults. *Journal of Sleep Research*, 19(4), 567–577. 10.1111/j.1365-2869.2010.00841.x [PubMed: 20477953]
- Pedrelli P, Nyer M, Yeung A, Zulauf C, & Wilens T (2015). College Students: Mental Health Problems and Treatment Considerations. *Academic Psychiatry : The Journal of the American Association of Directors of Psychiatric Residency Training and the Association for Academic Psychiatry*, 39(5), 503–511. 10.1007/s40596-014-0205-9
- Pensuksan WC, Lertmaharit S, Lohsoonthorn V, Rattananupong T, Sonkprasert T, Gelaye B, & Williams MA (2016). Relationship between Poor Sleep Quality and Psychological Problems among Undergraduate Students in the Southern Thailand. *Walailak Journal of Science and Technology*, 13(4), 235–242. [PubMed: 27152114]
- Pigeon WR, Pinquart M, & Conner K (2012). Meta-analysis of sleep disturbance and suicidal thoughts and behaviors. *The Journal of Clinical Psychiatry*.
- Preacher KJ, & Hayes AF (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, 40(3), 879–891. [PubMed: 18697684]
- Ravyts SG Dzierzewski JM, Perez E, Donovan EK & Dautovich N (2019). Psychometric Properties of a Sleep Health Scale: RU-SATED. *Behavioral Sleep Medicine*. doi:10.1080/15402002.2019.1701474
- Stamatakis KA, Kaplan GA, & Roberts RE (2007). Short sleep duration across income, education, and race/ethnic groups: population prevalence and growing disparities during 34 years of follow-up. *Annals of epidemiology*, 17(12), 948–955. [PubMed: 17855122]
- Walsemann KM, Bell BA, & Maitra D (2011). The intersection of school racial composition and student race/ethnicity on adolescent depressive and somatic symptoms. *Social Science & Medicine* (1982), 72(11), 1873–1883. 10.1016/j.socscimed.2011.03.033 [PubMed: 21531493]
- Whinnery J, Jackson N, Rattanaupawan P, & Grandner MA (2014). Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. *Sleep*, 37(3), 601–611. 10.5665/sleep.3508 [PubMed: 24587584]
- Williams AB, Dzierzewski JM, Griffin SC, Lind MJ, Dick D, & Rybarczyk BD (2019). Insomnia Disorder and Behaviorally Induced Insufficient Sleep Syndrome: Prevalence and Relationship to Depression in College Students. *Behavioral Sleep Medicine*, 1–12. 10.1080/15402002.2019.1578772
- Williams DR, González HM, Neighbors H, Nesse R, Abelson JM, Sweetman J, & Jackson JS (2007). Prevalence and distribution of major depressive disorder in African Americans, Caribbean blacks, and non-Hispanic whites: Results from the National Survey of American Life. *Archives of General Psychiatry*, 64(3), 305–315. 10.1001/archpsyc.64.3.305 [PubMed: 17339519]
- Williams MT, Chapman LK, Wong J, & Turkheimer E (2012). The role of ethnic identity in symptoms of anxiety and depression in African Americans. *Psychiatry Research*, 199(1), 31–36. 10.1016/j.psychres.2012.03.049 [PubMed: 22513043]
- Zhai L, Zhang H, & Zhang D (2015). Sleep duration and depression among adults: A meta-analysis of prospective studies. *Depression and Anxiety*, 32(9), 664–670. 10.1002/da.22386 [PubMed: 26047492]
- Zohar D, Tzischinsky O, Epstein R, & Lavie P (2005). The effects of sleep loss on medical residents' emotional reactions to work events: A cognitive-energy model. *Sleep*, 28(1), 47–54. [PubMed: 15700720]

Figure 1.
Conceptual models for race/ethnicity and mental health symptoms as mediated by sleep

Table 1

Participant demographic information and clinical characteristics at baseline

	Total Sample	Black Students	White Students
Number of Students	1242	314	928
Age	18.50 (.38)	18.45 (.35) *	18.51 (.39)
Gender (% Male)	64.33	70.38	62.22
Depressive symptoms	9.02 (.3.83)	8.42 (3.59) **	9.22 (3.89)
Anxiety symptoms	6.96 (3.30)	6.18 (2.79) **	7.22 (3.42)
Total sleep time	491.71 (87.87)	468.74 (95.75) **	499.49 (83.69)
Sleep quality	3.00 (.66)	2.90 (.68) *	3.04 (.65)
Sleep health	7.74 (2.52)	7.02 (2.52) **	8.07 (2.44)

Note. Group comparisons were completed using independent sample t-tests.

* $p < .01$,

** $p < .001$, total sleep time measured in minutes.

Table 2

Longitudinal association between Race/Ethnicity and Depression and Anxiety Mediated by Sleep

	Total Association	Direct Association	Indirect Association Via Sleep	Sleep-Mental Health Path	Percent of Total Association Suppressed
Mediator: Total Sleep Time					
Depression	$\beta = 1.54$ (CI: .75, 2.33) *	$\beta = 1.64$ (CI: .84, 2.44) *	$\beta = -.10$ (CI: -.32, .02)	$\beta = -.003$ (CI: -.01, .001)	--
Anxiety	$\beta = 1.58$ (CI: .85, 2.30) *	$\beta = 1.69$ (CI: .10, 2.42) *	$\beta = -.11$ (CI: -.33, -.01) *	$\beta = -.004$ (CI: -.01, .0001)	7%
Mediator: Sleep Quality					
Depression	$\beta = 1.49$ (CI: .70, 2.28) *	$\beta = 1.60$ (CI: .82, 2.39) *	$\beta = -.11$ (CI: -.30, -.02) *	$\beta = -.80$ (CI: -1.42, -.19) *	8%
Anxiety	$\beta = 1.58$ (CI: .84, 2.31) *	$\beta = 1.71$ (CI: .98, 2.44) *	$\beta = -.13$ (CI: -.33, -.01) *	$\beta = -.96$ (CI: -1.53, -.40) *	9%
Mediator: Sleep Health					
Depression	$\beta = 1.47$ (CI: .67, 2.27) *	$\beta = 1.75$ (CI: .93, 2.58) *	$\beta = -.28$ (CI: -.58, -.10) *	$\beta = -.20$ (CI: -.35, -.05) *	19%
Anxiety	$\beta = 1.57$ (CI: .83, 2.31) *	$\beta = 1.95$ (CI: 1.21, 2.70) *	$\beta = -.38$ (CI: -.67, -.19) *	$\beta = -.28$ (CI: -.41, -.14) *	25%

Note.

* $p < .05$. Analyses included gender as a covariate. Confidence intervals not including zero are considered significant.