HHS Public Access

Author manuscript

Sleep Med. Author manuscript; available in PMC 2017 February 01.

Published in final edited form as:

Sleep Med. 2016 February ; 18: 3–6. doi:10.1016/j.sleep.2015.01.007.

Reducing Health Disparities: The Role of Sleep Deficiency and Sleep Disorders

Aaron D. Laposky, PhD[a], **Eve Van Cauter, PhD**[b], and **Ana V. Diez-Roux, MD, PhD, MPH**[c]

Aaron D. Laposky: laposkya@nhlbi.nih.gov; Eve Van Cauter: evcauter@medicine.bsd.uchicago.edu; Ana V. Diez-Roux: avd37@drexel.edu

[a]National Institutes of Health, National Heart, Lung and Blood Institute, 6701 Rockledge Drive, Suite 10042, Bethesda, MD 20892-7952, Phone: 301-435-0193, FAX: 301-480-3451

[b]University of Chicago, Department of Medicine, 5841 South Maryland Ave, MC 6092, Chicago, IL 60637, Phone: 773-702-1234

[c]Drexel University, School of Public Health, 3215 Market St., Philadelphia, PA 19104, Phone: 267-359-6070

Abstract

Decrements in sleep health, including insufficient sleep duration, irregular timing of sleep, poor sleep quality, and sleep/circadian disorders are wide-spread in modern society and are associated with an array of disease risks and outcomes, including those contributing to health disparities (e.g. cardiovascular disease, obesity and diabetes, psychiatric illness and cancer). Recent findings have uncovered racial/ethnic and socioeconomic position differences in sleep health, however the contribution of sleep deficiency to health disparities remains largely unexplored, and understanding the underlying causes of disparities in sleep health is only beginning to emerge. In 2011, the National Heart Lung and Blood Institute convened a workshop, bringing together sleep and health disparities investigators, to identify research gaps and opportunities to advance sleep and health disparities science. This article provides a brief background and rationale for the workshop, and disseminates the research recommendations and priorities resulting from the working group discussions.

Keywords

sleep deficiency; obstructive sleep apnea; health disparities; socioeconomic position; cardiovascular disease; diabetes

1.1 Sleep and health disparities science: emerging opportunities

Eliminating disparities in health by race or ethnicity and socioeconomic position (SEP) remains a fundamental societal challenge. A more complete understanding of underlying

Correspondence to: Aaron D. Laposky, laposkya@nhlbi.nih.gov.

drivers of disparities in health is needed to inform prevention and intervention strategies. The determinants of health disparities include social, environmental, behavioral, and biological factors (1). Despite abundant research, there is still uncertainty regarding the underlying causes of many health disparities.

Sleep deficiency, which includes insufficient sleep duration, irregular timing of sleep, poor sleep quality, and sleep/circadian disorders is highly prevalent in modern society. Nearly 30% of men and women and 60% of adolescents fail to obtain sufficient amounts of sleep (2;3), 20% of adults experience excessive daytime sleepiness (4), 5–25% of adults meet objective criteria for sleep disordered breathing (SDB) (5), 20–30% report insomnia symptoms (6), and nearly 1/3 of the U.S. workforce is engaged in shift work (7). The significance of compromised sleep and undiagnosed sleep disorders is underscored by decades of scientific findings associating sleep deficiency with increased disease risk, including cardiovascular and metabolic disease (8–10), psychiatric illness (11), substance abuse (12), pregnancy complications (13) and impaired neurobehavioral and cognitive impairment (14). Sleep deficiency is also a well-recognized threat to public safety (15). These domains of health associated with sleep deficiency are also ones in which health disparities are well documented, raising important questions about the significance of sleep deficiency as a driver of health disparities.

Recent findings from population based surveys, including the National Health and Nutrition Examination Survey (NHANES), Behavioral Risk Factor Surveillance System (BRFSS), and National Health Interview Survey (NHIS) have uncovered disparities in habitual self-reported sleep duration, insufficient sleep and daytime sleepiness, and symptoms of SDB by race/ethnicity and a variety of SEP-related indicators (e.g. income, education, neighborhood factors, profession) (3;16–18). While the majority of research has focused on describing differences in sleep across racial/ethnic groups and SEP strata, the underlying factors contributing to disparities in sleep health are not well understood. This delineation will likely require consideration of interactions among multi-level factors, and will be critical in identifying modifiable factors for intervention strategies to reduce disparities in sleep health. For example, occupational and psychosocial stress, level of acculturation, neighborhood conditions, work-life balance, co-morbid medical conditions, and cultural beliefs and knowledge regarding sleep may all contribute to racial/ethnic differences in sleep(19–21). Most findings from population-based surveillance tools are based on self-reported sleep characteristics and symptoms, raising the possibility that cultural differences in reporting health information could account, in part, for some of the disparities identified in sleep health. A future direction for sleep and circadian science will be to develop biomarkers and point of care technologies for efficient and high throughput detection of sleep deficiency and sleep disorders. The application of mobile technologies in surveillance and cohort studies may provide a greater opportunity to obtain objective measurements of sleep duration, circadian alignment, and sleep disorders (e.g. sleep apnea) at the population-based level. The inclusion of objective measures of sleep duration, timing, quality, and sleep disorders in surveillance programs and diversity cohorts will provide another level of understanding of disparities in sleep phenotypes and the relationship to disparities in disease risk.

Shift work is consistently associated with multiple health risks (22), and discoveries in basic science have uncovered a direct interface between circadian clock genes and molecular pathways implicated in disease pathophysiology (23–26). Few studies have examined circadian phenotypes and circadian-related health risks across racial/ethnic groups. In one study, the endogenous circadian period and the phase advancing and delaying effects of light pulses were shown to differ between African American and non-Hispanic white participants (27). Racial/ethnic differences in the diurnal rhythm of cortisol were reported in a small sample of preadolescent boys and girls (28). Studies have shown a higher prevalence of non-dipping blood pressure in African Americans, which has been associated with an increased risk of cardiovascular morbidity (29;30). Delineating the cause of racial/ethnic differences in circadian rhythm perturbation represents a novel and potentially important domain for health disparities research.

In addition to characterizing racial/ethnic differences in sleep health and the underlying contributing factors, another opportunity for research is to examine sleep deficiency as a driver of health disparities (e.g. cardiovascular disease, obesity and diabetes, mental illness). Studies are needed that specifically identify the extent to which health disparities in various health outcomes are directly attributable to disparities in sleep health. It is also possible that the impact of sleep deficiencies on health outcomes is modified by race/ethnicity or SEP. Findings from the Coronary Artery Risk Development in Young Adults (CARDIA) cohort revealed an interaction between sleep duration measured by wrist actigraphy and race/ethnicity on blood pressure change over time (31). Racial/ethnic differences have been uncovered in the association between sleep duration and self-reported hypertension, hyperlipidemia, and diabetes mellitus, as well as objectively measured obesity and inflammatory C-reactive protein (CRP) levels (32;33). In the NHIS study, a stronger association between short and long sleep duration and diabetes, and short sleep duration and obesity was found in African American adults compared to non-Hispanic whites (34;35). Generally, more attention has been focused on short sleep duration as an adverse exposure, but long sleep duration has also been associated with race/ethnicity, cardiovascular and metabolic disease risk, and all-cause mortality, although these relationships are less well studied and understood (36–38). A recent study by Hale et al. found that fibrinogen partly mediated the association between long sleep duration and coronary heart disease and mortality in women, however, few studies have examined pathophysiology linking long sleep duration to disease risk or outcomes (39). Compared to short sleep, it may be less intuitive that long sleep could induce pathophysiology or modify disease risk, rather than representing a marker or consequence of an underlying or co-morbid condition. Nonetheless, the U-shaped association between sleep duration and disease risk deserves further consideration, including the interaction with race/ethnicity and health disparities. Sleep apnea is a serious medical condition associated with an array of cardiovascular and metabolic risk indicators and outcomes, and racial/ethnic differences in prevalence, severity, and knowledge of sleep apnea have been reported (40). The analysis of NHANES data revealed a stronger relationship between sleep apnea symptoms and hypertension in African American and Hispanic individuals than in non-Hispanic whites (41). Taken together, these observations indicate that future research will need not only to identify disparities in the prevalence of sleep deficiency, but also to more completely delineate the extent to which

susceptibility to the *effects* of sleep deficiency differ across racial/ethnic groups and/or SEP strata, and to identify the relevant mechanisms contributing to these differences. As sleep deficiency is emerging as a potential modifiable risk factor in a range of disease conditions, understanding the interactions between sleep and race/ethnicity in shaping disease risk may ultimately improve the delivery of effective health care for sleep disorders and sleep-related conditions in minority populations.

In recent years, the National Heart Lung, and Blood Institute (NHLBI) has supported objective assessments of sleep in cohorts including substantial minority populations, such as the Jackson Heart Study (42), the Multi-Ethnic Study of Atherosclerosis (MESA) (43) and the Hispanic Community Health Study (HCHS) (44). NHLBI supported continuous 24-hr actigraphy monitoring in a recent cycle of NHANES (2011–2012), providing surrogate measures of sleep duration, quality and timing in a representative sample of the US population. Furthermore, in 2014, an NHLBI-funded National Sleep Research Resource (NSRR) was launched for public use, representing an integrated resource of demographic, physiological, clinical and other data from sleep-related cohorts and clinical trials, providing a potential opportunity to examine novel questions about sleep-related health disparities (https://sleepdata.org/about). Therefore, in addition to the available self-reported sleep data from surveillance and cohort studies, an increasing amount of objective sleep data is being produced in cohorts amenable to systematic examination of health disparities. The impact of these resources will depend on their use by the research community, and on the significance and timeliness of the scientific questions that investigators propose to study.

2.1 Workshop design and objectives

A mission of the NIH is to identify domains of science where critical gaps in knowledge exist, and where strategic planning is needed to help close these gaps. In 2011, the NHLBI convened a workshop, entitled, “Reducing Health Disparities: The Role of Sleep Deficiency and Sleep Disorders”. The overarching objective of the workshop was to stimulate cross-disciplinary discussion between sleep and health disparities investigators, to elaborate a research agenda to reduce disparities in morbidity and mortality as they relate to sleep health and to advance our scientific understanding of the role of sleep in optimizing health outcomes. The working group was charged with (1) identifying critical gaps in knowledge that need to be overcome in understanding sleep-related health disparities (2) prioritizing opportunities for research to fundamentally improve our understanding of sleep-related health disparities (3) identifying strategies for translation, dissemination, and application to reduce sleep-related health disparities and (4) assessing the concept of “sleep” as a ‘fundamental requirement of daily living’ and potential implications for future disparities work. The 1.5 day workshop included sessions on (1) Disparities in Sleep Health (2) Etiology of Disparities in Sleep Health (3) Contributions of Sleep to Unexplained Health Disparities and (4) Diagnosis and Treatment of Sleep Disorders in Minority Populations. Based on these discussions, the working group produced a set of research recommendations and priorities for sleep and health disparities research, listed below. This special issue of Sleep Medicine originates, in part, from the scientific discussions that were catalyzed during the working group meeting, and many of the articles in this issue will provide more background and scientific evidence supporting the working group recommendations. An

accumulation of research has established sleep and circadian health as fundamental to health, highlighting the potential importance of these factors in understanding and eliminating heath disparities.

3.1 Working group research recommendations

- Advance epidemiology and clinical research to achieve a more complete understanding of disparities in domains of sleep health (i.e. prevalence and severity of sleep apnea, habitual sleep duration, sleep timing and regularity, insomnia complaints) across population subgroups (i.e. racial/ethnic, socioeconomic position, gender) for which cardiovascular and metabolic health disparities exist.
- Develop study designs and analytical approaches to investigate multilevel and life course determinants of sleep health (i.e. environmental, biological/genetic, psychosocial, societal, political/economic) and to elucidate the sleep-related causes of cardiovascular and metabolic health disparities across the age spectrum.
- Determine the contribution of sleep impairment (sleep apnea, insufficient sleep duration, irregular sleep schedules, insomnia complaints) to unexplained differences in cardiovascular and metabolic risk and disease outcomes, by race/ethnicity, socioeconomic position, gender, and age.
- Develop study designs, data sampling and collection tools, and analytical approaches to optimize our understanding of mediating and moderating factors, and feedback mechanisms coupling sleep to cardiovascular and metabolic health disparities.
- Advance research to understand barriers (i.e. person, provider, system) to medical diagnosis and treatment of sleep disorders in diverse population groups.
- Develop and test multi-level interventions to reduce disparities in sleep health that will impact our ability to improve disparities in cardiovascular and metabolic risk/disease.
- Create opportunities to integrate sleep and health disparity science by strategically utilizing resources (i.e. existing or anticipated cohorts), exchanging scientific data and ideas (i.e. cross-over into scientific meetings), and develop multi-disciplinary investigator-initiated grant applications.
- Enhance the diversity and foster career development of young investigators involved in sleep and health disparities science.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

We would like to acknowledge the contribution of each participant in the 2011 “Reducing Health Disparities: The Role of Sleep Deficiency and Sleep Disorders” workshop. Gary Bennett, PhD, Duke University; Carla Boutin-Foster, MD, Cornell University; Joseph Buckhalt, PhD, Auburn University; Orfeu Buxton, PhD, Harvard Medical School; Mercedes Carnethon, PhD, FAHA, Northwestern University; Lisa Cooper, MD, MPH, Johns Hopkins

University; Tiffany Gary-Webb, PhD, Columbia University; Maria Glymour, PhD, Harvard University; Michael Grandner, PhD, University of Pennsylvania; Lauren Hale, PhD, SUNY, Stony Brook, Girardin Jean-Louis, PhD, SUNY Downstate Medical Center; Kristen Knutson, PhD, University of Chicago; Nancy Kressin, PhD, Boston University; Kenneth Lichstein, PhD, University of Alabama; Karen Matthews, PhD, University of Pittsburgh School of Medicine; Carlos F. Mendes de Leon, PhD, University of Michigan; Sanjay Patel, MD, Harvard Medical School; David Takeuchi, PhD, University of Washington. The workshop was supported by the NHLBI Division of Lung Diseases and the Division for the Application of Research Discoveries.

Reference List

1. Diez Roux AV. Conceptual approaches to the study of health disparities. Annu Rev Public Health. 2012 Apr.33:41–58. [PubMed: 22224879]
2. McKnight-Eily LR, Eaton DK, Lowry R, Croft JB, Presley-Cantrell L, Perry GS. Relationships between hours of sleep and health-risk behaviors in US adolescent students. Prev Med. 2011 Oct; 53(4–5):271–3. [PubMed: 21843548]
3. Liu Y, Wheaton AG, Chapman DP, Croft JB. Sleep duration and chronic diseases among U.S. adults age 45 years and older: evidence from the 2010 Behavioral Risk Factor Surveillance System. Sleep. 2013 Oct; 36(10):1421–7. [PubMed: 24082301]
4. Ram S, Seirawan H, Kumar SK, Clark GT. Prevalence and impact of sleep disorders and sleep habits in the United States. Sleep Breath. 2010 Feb; 14(1):63–70. [PubMed: 19629554]
5. Peppard PE, Young T, Barnet JH, Palta M, Hagen EW, Hla KM. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol. 2013 May 1; 177(9):1006–14. [PubMed: 23589584]
6. Roth T. Insomnia: definition, prevalence, etiology, and consequences. J Clin Sleep Med. 2007 Aug 15; 3(5 Suppl):S7–10. [PubMed: 17824495]
7. Alterman T, Luckhaupt SE, Dahlhamer JM, Ward BW, Calvert GM. Prevalence rates of work organization characteristics among workers in the U.S.: data from the 2010 National Health Interview Survey. Am J Ind Med. 2013 Jun; 56(6):647–59. [PubMed: 22911666]
8. Aurora RN, Punjabi NM. Obstructive sleep apnoea and type 2 diabetes mellitus: a bidirectional association. Lancet Respir Med. 2013 Jun; 1(4):329–38. [PubMed: 24429158]
9. Dempsey JA, Veasey SC, Morgan BJ, O'Donnell CP. Pathophysiology of sleep apnea. Physiol Rev. 2010 Jan; 90(1):47–112. [PubMed: 20086074]
10. Depner CM, Stothard ER, Wright KP Jr. Metabolic consequences of sleep and circadian disorders. Curr Diab Rep. 2014 Jul.14(7):507. [PubMed: 24816752]
11. Sutton EL. Psychiatric Disorders and Sleep Issues. Med Clin North Am. 2014 Sep; 98(5):1123–43. [PubMed: 25134876]
12. Conroy DA, Arnedt JT. Sleep and substance use disorders: an update. Curr Psychiatry Rep. 2014 Oct.16(10):487. [PubMed: 25135784]
13. Oyiengo D, Louis M, Hott B, Bourjeily G. Sleep Disorders in Pregnancy. Clin Chest Med. 2014 Sep; 35(3):571–87. [PubMed: 25156772]
14. Goel N, Basner M, Rao H, Dinges DF. Circadian rhythms, sleep deprivation, and human performance. Prog Mol Biol Transl Sci. 2013; 119:155–90. [PubMed: 23899598]
15. Grandner MA, Pack AI. Sleep disorders, public health, and public safety. JAMA. 2011 Dec 21; 306(23):2616–7. [PubMed: 22187285]
16. Whinnery J, Jackson N, Rattanaumpawan P, Grandner MA. Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. Sleep. 2014 Mar; 37(3):601–11. [PubMed: 24587584]
17. Hale L, Do DP. Racial differences in self-reports of sleep duration in a population-based study. Sleep. 2007 Sep; 30(9):1096–103. [PubMed: 17910381]
18. Grandner MA, Petrov ME, Rattanaumpawan P, Jackson N, Platt A, Patel NP. Sleep symptoms, race/ethnicity, and socioeconomic position. J Clin Sleep Med. 2013 Sep; 9(9):897–905. [PubMed: 23997702]
19. Kingsbury JH, Buxton OM, Emmons KM. Sleep and its Relationship to Racial and Ethnic Disparities in Cardiovascular Disease. Curr Cardiovasc Risk Rep. 2013 Oct.7(5)

20. Knutson KL. Sociodemographic and cultural determinants of sleep deficiency: implications for cardiometabolic disease risk. Soc Sci Med. 2013 Feb.79:7–15. [PubMed: 22682665]
21. Hale L, Hill TD, Friedman E, et al. Perceived neighborhood quality, sleep quality, and health status: evidence from the Survey of the Health of Wisconsin. Soc Sci Med. 2013 Feb.79:16–22. [PubMed: 22901794]
22. Litinski M, Scheer FA, Shea SA. Influence of the Circadian System on Disease Severity. Sleep Med Clin. 2009 Jun 1; 4(2):143–63. [PubMed: 20161149]
23. Maury E, Hong HK, Bass J. Circadian disruption in the pathogenesis of metabolic syndrome. Diabetes Metab. 2014; 40(5):338–46. [PubMed: 24433933]
24. Durgan DJ, Young ME. The cardiomyocyte circadian clock: emerging roles in health and disease. Circ Res. 2010 Mar 5; 106(4):647–58. [PubMed: 20203314]
25. Landgraf D, McCarthy MJ, Welsh DK. Circadian clock and stress interactions in the molecular biology of psychiatric disorders. Curr Psychiatry Rep. 2014 Oct.16(10):483. [PubMed: 25135782]
26. Innominato PF, Roche VP, Palesh OG, Ulusakarya A, Spiegel D, Levi FA. The circadian timing system in clinical oncology. Ann Med. 2014 Jun; 46(4):191–207. [PubMed: 24915535]
27. Smith MR, Burgess HJ, Fogg LF, Eastman CI. Racial differences in the human endogenous circadian period. PLoS One. 2009; 4(6):e6014. [PubMed: 19564915]
28. DeSantis AS, Adam EK, Doane LD, Mineka S, Zinbarg RE, Craske MG. Racial/ethnic differences in cortisol diurnal rhythms in a community sample of adolescents. J Adolesc Health. 2007 Jul; 41(1):3–13. [PubMed: 17577528]
29. Jehn ML, Brotman DJ, Appel LJ. Racial differences in diurnal blood pressure and heart rate patterns: results from the Dietary Approaches to Stop Hypertension (DASH) trial. Arch Intern Med. 2008 May 12; 168(9):996–1002. [PubMed: 18474764]
30. Krakoff LR. Ambulatory blood pressure improves prediction of cardiovascular risk: implications for better antihypertensive management. Curr Atheroscler Rep. 2013 Apr.15(4):317. [PubMed: 23423525]
31. Knutson KL, Van CE, Rathouz PJ, et al. Association between sleep and blood pressure in midlife: the CARDIA sleep study. Arch Intern Med. 2009 Jun 8; 169(11):1055–61. [PubMed: 19506175]
32. Grandner MA, Sands-Lincoln MR, Pak VM, Garland SN. Sleep duration, cardiovascular disease, and proinflammatory biomarkers. Nat Sci Sleep. 2013; 5:93–107. [PubMed: 23901303]
33. Grandner MA, Chakravorty S, Perlis ML, Oliver L, Gurubhagavatula I. Habitual sleep duration associated with self-reported and objectively determined cardiometabolic risk factors. Sleep Med. 2014 Jan; 15(1):42–50. [PubMed: 24333222]
34. Zizi F, Pandey A, Murrray-Bachmann R, et al. Race/ethnicity, sleep duration, and diabetes mellitus: analysis of the National Health Interview Survey. Am J Med. 2012 Feb; 125(2):162–7. [PubMed: 22269619]
35. Donat M, Brown C, Williams N, et al. Linking sleep duration and obesity among black and white US adults. Clin Pract (Lond). 2013 Sep; 10(5):661–7.
36. Cappuccio FP, Cooper D, D'Elia L, Strazzullo P, Miller MA. Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. Eur Heart J. 2011 Jun; 32(12):1484–92. [PubMed: 21300732]
37. Gallicchio L, Kalesan B. Sleep duration and mortality: a systematic review and meta-analysis. J Sleep Res. 2009 Jun; 18(2):148–58. [PubMed: 19645960]
38. Pandey A, Williams N, Donat M, et al. Linking sleep to hypertension: greater risk for blacks. Int J Hypertens. 2013 Epub Apr 21.
39. Hale L, Parente V, Dowd JB, et al. Fibrinogen may mediate the association between long sleep duration and coronary heart disease. J Sleep Res. 2013 Jun; 22(3):305–14. [PubMed: 23217092]
40. Olafiranye O, Akinboboye O, Mitchell JE, Ogedegbe G, Jean-Louis G. Obstructive sleep apnea and cardiovascular disease in blacks: a call to action from the Association of Black Cardiologists. Am Heart J. 2013 Apr; 165(4):468–76. [PubMed: 23537962]
41. Sands-Lincoln M, Grandner M, Whinnery J, Keenan BT, Jackson N, Gurubhagavatula I. The association between obstructive sleep apnea and hypertension by race/ethnicity in a nationally representative sample. J Clin Hypertens (Greenwich). 2013 Aug; 15(8):593–9. [PubMed: 23889723]

42. Fulop T, Hickson DA, Wyatt SB, et al. Sleep-disordered breathing symptoms among African-Americans in the Jackson Heart Study. Sleep Med. 2012 Sep; 13(8):1039–49. [PubMed: 22841028]

43. Chen X, Wang R, Zee P, et al. Racial/Ethnic Differences in Sleep Disturbances: The Multi-Ethnic Study of Atherosclerosis (MESA). Sleep. 2014 Epub ahead of print Nov 20.

44. Redline S, Sotres-Alvarez D, Loredo J, et al. Sleep-disordered breathing in Hispanic/Latino individuals of diverse backgrounds. The Hispanic Community Health Study/Study of Latinos. Am J Respir Crit Care Med. 2014 Feb 1; 189(3):335–44. [PubMed: 24392863]

Highlights

- Sleep health measures differ by race/ethnicity and socioeconomic position.
- The multi-level etiology of disparities in sleep health is not well understood.
- Sleep deficiency is associated with conditions burdened by health disparities.
- Research is needed to elucidate the contribution of sleep to health disparities.
- Surveillance tools and cohorts are available to study sleep-related disparities.