Sleep Health 1 (2015) 285–292

Contents lists available at ScienceDirect

Sleep Health

Journal of the National Sleep Foundation

journal homepage: http://www.elsevier.com/locate/sleh

Actigraphic sleep characteristics among older Americans☆

Lianne M. Kurina, PhD [a,*], Ronald A. Thisted, PhD [b,c], Jen-Hao Chen, PhD [d], Martha K. McClintock, PhD [e], Linda J. Waite, PhD [f], Diane S. Lauderdale, PhD [b]

[a] Department of Medicine, Section of General Medical Disciplines, Stanford University School of Medicine, 450 Serra Mall, Bldg 20, Stanford, CA 94305-2160
[b] Department of Public Health Sciences, University of Chicago, 5841 S Maryland Ave, MC 2000, Chicago, IL 60637
[c] Department of Statistics, University of Chicago, 5734 S University Ave, Chicago, IL 60637
[d] Department of Health Sciences, University of Missouri, 537 Clark Hall, Columbia, MO 65211
[e] Institute of Mind and Biology and Departments of Comparative Human Development and Psychology, University of Chicago, 940 E 57th St, Chicago, IL 60637
[f] Department of Sociology, University of Chicago, 1126 E 59th St, Chicago, IL 60637

ARTICLE INFO

Article history:
Received 28 July 2015
Received in revised form 7 September 2015
Accepted 11 September 2015

Keywords:
Sleep
Actigraphy
Epidemiology
Older adults

ABSTRACT

Objectives: To date, there has been no evidence about objectively measured sleep characteristics from a representative national probability sample of adults in the United States. We used actigraphy to measure the sleep characteristics of older Americans.
Design: Cross-sectional study.
Setting: Sleep substudy within Wave 2 (2010-2011) of the ongoing National Social Life, Health, and Aging Project.
Participants: Seven hundred and thirty-nine National Social Life, Health, and Aging Project participants aged 62-90 years.
Intervention: Not applicable.
Measurements: Study participants wore a wrist actigraph for 72 hours, and sleep properties were compared across demographic, socioeconomic, and health-behavior–related lines.
Results: Actigraph-estimated sleep time averaged 7.2 hours (SE, 0.06 hour) each night; the majority of the sample (80%) slept between 5.8 and 8.6 hours per night. Average time spent awake after sleep onset (WASO) was 39 minutes (SE, 1.2 minutes). Women had significantly more total sleep time and lower sleep fragmentation compared with men. Total sleep time increased significantly with age, although sleep percentage decreased with age. Compared with white participants, African American participants had significantly more WASO (9.2 minutes, $P < .01$) and greater sleep fragmentation (2.3 percentage points, $P < .001$). WASO was significantly higher and sleep percentage significantly lower among those with less education.
Conclusions: Both *short sleepers* and *long sleepers*—often conventionally defined as obtaining <6 and >9 hours per night, respectively—are relatively rare among older Americans when sleep is estimated by actigraphy. Sleep quality is significantly poorer among men, African Americans, and those with less education.

Introduction

Sleep characteristics including sleep duration and quality are of increasing interest to epidemiologists for their potential etiologic roles in a number of adverse health outcomes, including obesity, cardiovascular disease, and mortality.[1–3] However, assessing sleep characteristics for community-based populations is complicated. The criterion standard, polysomnography (PSG), is expensive, and even home-based PSG is likely to disrupt routines, limiting its utility for understanding the sleep patterns of large numbers of individuals in natural settings. The most commonly used method for measuring sleep in large studies is through survey questions. However, a number of studies have demonstrated generally low correlations between self-reported and objective sleep measures of both duration and quality,[4–8] suggesting that survey-based sleep measures may tap into different aspects of the experience or perception of sleep and do not simply reflect the sleep characteristic they appear to reference.

Wrist actigraphy is a practical method of estimating sleep objectively in large, free-living populations because it does not disrupt routines and is reasonably low cost; estimates of sleep parameters from actigraphy have been shown to correspond reasonably well to those from PSG.[9–11] The use of wrist actigraphy in large epidemiologic

☆ The work for this article was performed at the University of Chicago and at Stanford University.

* Corresponding author at: Stanford University, 450 Serra Mall, Bldg 20, Stanford, CA 94305-2160. Tel.: +1 650 725 7531; fax: +1 650 723 8596.
E-mail address: lkurina@stanford.edu (L.M. Kurina).

http://dx.doi.org/10.1016/j.sleh.2015.09.004
2352-7218/

studies has yielded estimated sleep properties in several cohorts.[11–14] However, previous cohorts with actigraphy have been geographically defined (both single-site and multisite studies) and not drawn from a national probability sample and, therefore, the generalizability of sleep characteristics derived from these studies to the national population is unknown. Consequently, we do not have good answers to the following very basic question: How much and how well do Americans sleep?

Here we use nationally representative, actigraph-estimated sleep data in the United States to answer basic questions about sleep for older Americans aged 62 to 90 years and to explore the relationship between sleep properties and sociodemographic factors and health behaviors.

Participants and methods

Study design and subjects

This study used a randomly-selected subsample of participants in the second wave of the National Social Life, Health, and Aging Project (NSHAP), a nationally representative longitudinal study of older Americans with in-home interviews.[15,16] The first NSHAP data collection wave was in 2005-2006 and focused on individuals 57-85 years of age. Wave 2 of NSHAP data collection took place in 2010-2011 and retained the excellent level of representativeness achieved in Wave 1.[17]

A randomly selected one-third of NSHAP participants in Wave 2 (2010-2011) were invited to participate in the sleep substudy.[18] Of the 808 individuals in the Wave 2 sample and 309 spouses (or coresident partners) invited, 80% (n = 897) agreed to participate. The actigraphs were distributed from the central NSHAP office, and potential participants had to be recontacted after the in-home interview to arrange device delivery. Ninety-five percent (n = 849) of those who agreed to participate were successfully recontacted and received the packet of materials for the sleep substudy, including the wrist actigraph. Actiwatches were received back from 823 individuals. Of these, further exclusions occurred because of: errors uploading data (n = 4); blank data records indicating that the watch was not worn (n = 26); and, despite careful review, an absence of discernable rest intervals (n = 13). We further restricted our analyses to participants aged 62-90 years at the time of data collection (N = 739) by excluding spouses outside the target age range.

Demographic and socioeconomic data, as well as data on health behaviors, were collected by trained interviewers during face-to-face interviews at study participants' homes using Computer-Assisted Personal Interviews.[15] Respondents who agreed to participate in the sleep substudy were subsequently telephoned and then mailed wrist actiwatches and instructions on how to complete the actigraphy study, usually a few days following the in-home interview.[18]

These analyses used a deidentified data set prepared for public release by the parent study. The University of Chicago Institutional Review Board considers studies that use previously collected and deidentified data to be exempt from review.

Interview data

Interviewers used structured questionnaires to identify study participants' sex, race/ethnicity, marital status, completed education, household income, household wealth, alcohol consumption, and tobacco use.

Race/ethnicity

Respondents were asked the following 2 questions to elicit race and ethnicity: (1) "Do you consider yourself primarily white or Caucasian, Black or African American, American Indian, Asian, or something else?" and (2) "Do you consider yourself Hispanic or Latino?" Using the answers to these questions, study participants were categorized into 4 race/ethnicity categories: white/Caucasian; black/African American; nonblack Hispanic; and other.

Marital status

Respondents' current marital status was categorized for analysis as follows: married or living with a partner; divorced, separated, or never married; and widowed.

Socioeconomic status

We used 3 measures of socioeconomic status: educational attainment, household income, and household assets.

Educational attainment was categorized as less than high school degree, high school degree or some college, and bachelor's degree or more.

Household income was first queried with a global question asking respondents to approximate their household income before taxes or deductions. For those respondents who did not answer the global question, an unfolding bracket method of questions was used. For example, respondents would be asked, "Would you say your household income was more than $50,000 or less than $50,000?" followed by more precise categories conditional on the first answer. Estimation of household income was then done using a multiple imputation technique that included the answers to the folding bracket questions and all predictors for each relevant regression model.

Household assets were assessed similarly to income. Respondents were first asked a global question about their total household assets: "Now I'd like you to think about all of the assets of your household. These are things like your house (if you own it), your cars, other rental properties and businesses you own, and financial assets like savings accounts, stocks, bonds, mutual funds, and pensions. Altogether, how much would you say that amounted to, approximately, after accounting for the loans you might have to pay off?" Again, those respondents who did not answer the question were then asked a set of questions to bracket their household assets. Multiple imputation was then used to estimate household assets using the answers to the bracketing questions and the predictors in the relevant regression models.

Models predicting the sleep properties were fit first with the 3 socioeconomic measures (education, income, and assets) separately and then together. In all of these models, only education was significantly associated with the sleep properties and, thus, this was the only socioeconomic measure retained in the final models, presented below.

Body mass index

Height and weight were measured in the participants' homes by the trained interviewers.[19] Participants were asked to stand against a wall, and then the interviewer placed a clipboard on top of the participant's head followed by a post-it note to mark the clipboard's place on the wall. Height was then measured with a tape measure from the floor to the post-it note. Weight was measured with clothes on using a Health-o-Meter digital scale (model HDL111DQ-60).

Body mass index (BMI) was calculated as weight per height squared (kg/m^2). Body mass index was divided into categories using the standard definitions for underweight (<18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), obese (30.0-34.9 kg/m^2), and morbidly obese (≥ 35.0 kg/m^2).[20,21] Only 2 individuals were classified as underweight, one of whom had a BMI of 18.47 and the second a BMI of 18.0. Given the paucity of individuals in the underweight category and their BMIs, the 2 underweight individuals were included in the normal-weight category for the main analyses.