Sleep Health 1 (2015) 214–220

Contents lists available at ScienceDirect

Sleep Health

Journal of the National Sleep Foundation

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

Accuracy of self-reported sleep parameters compared with actigraphy in young people with mental ill-health

Daniel J. Biddle, BSc (Hons) *, Rébecca Robillard, PhD, Daniel F. Hermens, PhD, Ian B. Hickie, MD, MBBS, FRANZCP, Nicholas Glozier, MA, MBBS, MSc, MRCPsych, FRANZCP, PhD

Brain and Mind Research Institute, The University of Sydney, Sydney, New South Wales, Australia

ARTICLE INFO

Article history:
Received 20 April 2015
Received in revised form 12 July 2015
Accepted 14 July 2015

Keywords:
Depression
Anxiety
Young people
Self-report
Actigraphy
Validation
Sleep assessment

ABSTRACT

Objectives: Validation of self-report assessment of habitual sleep duration and onset time in young people with mental ill-health.
Design: Validation sample.
Setting: Specialized early intervention centers for young people in Sydney, Australia.
Participants: One hundred and forty-six young people with mental ill-health.
Intervention: N/A.
Measurements: Self-reported habitual sleep duration and onset time were compared against at least 7 days of actigraphy monitoring. Average bias in and calibration of subjective measures were assessed, along with correlation of subjective and objective measures. Differences by age, sex, mental-disorder type, and reported insomnia were also explored.
Results: On average, subjective estimates of sleep were unbiased. Overall, each additional hour of objective habitual sleep duration predicted 41 minutes more subjective habitual sleep duration, and each hour later objective habitual sleep onset occurred predicted a 43-minute later subjective habitual sleep onset. There were subgroup differences: subjective habitual sleep duration in self-reported insomnia was shorter than objective duration by 30 minutes (SD = 119), on average. Calibration of habitual sleep duration was worse for those with mood disorders than with other primary diagnoses ($t = -2.39$, $P = .018$). Correlation between subjective and objective measures was strong for sleep onset time ($\rho = .667$, $P < .001$) and moderate for sleep duration ($r = .332$, $P < .001$). For the mood disorder group, subjective and objective sleep durations were uncorrelated.
Conclusions: Self-reports seem valid for large-scale studies of habitual sleep duration and onset in help-seeking young people, but assessment of habitual sleep duration requires objective measures where individual accuracy is important.

Introduction

Importance of sleep assessment for psychiatric research

The link between disturbed sleep and psychiatric conditions is well recognized. Sleep disturbance often precedes the onset of depression and is improved upon remission.[1,2] In young people, delayed sleep phase, characterized primarily by sleep onset routinely occurring much later than average, is associated with short sleep duration,[3] which in turn represents a risk factor for obesity, chronicity of mood disorders, and psychological distress.[4–6]

Clarifying the relationships between aspects of sleep, such as duration and scheduling (eg, sleep onset time, rise time), and psychiatric symptoms requires effective assessment of sleep parameters. Two main methods are used. The current criterion standard in sleep assessment is polysomnography (PSG),[7] although the typical few nights of measurement do not take into account the night-to-night variability in sleep commonly seen in psychiatric populations,[8] and the laboratory environment itself may alter sleep.[9] Actigraphy, another objective technique for sleep measurement, uses a wrist-worn accelerometer that tracks movement over multiple days. Although actigraphy is blind to the brain's electroencephalographic sleep and wake states, algorithms are used to estimate periods of sleep or wake based on activity patterns.

Unfortunately, despite their accuracy, objective sleep assessments involve significant costs, limiting feasibility in large-scale epidemiological studies and clinical practice. Conversely, subjective self-report measures such as questionnaires are affordable and easy to administer. They also assess subjective experience, which

* Corresponding author.
E-mail addresses: daniel.biddle@sydney.edu.au, djbiddle37@gmail.com (D.J. Biddle).

http://dx.doi.org/10.1016/j.sleh.2015.07.006
2352-7218/

has clinical relevance distinct from information they may provide about objective sleep.

Sleep questionnaires in healthy populations

Most self-report questionnaires require a once-off estimate of either usual or retrospective sleeping patterns over a given prior period, for example, 30 days,[10] as distinct from daily estimations commonly referred to as *sleep diaries*. At least 3 aspects of subjective estimate's accuracy compared with an objective measure are important to consider.[11] Firstly, *bias* is the degree to which the subjective measure over- or underestimates the objective measure. Secondly, *calibration* is the extent to which increases or decreases in an objective measure are associated with changes of similar magnitude in the subjective measure. Thirdly, *discrimination* is the degree to which greater or smaller values on the objective measures are associated with, respectively, greater or smaller values on the objective measure, as captured by the correlation between measures.

To date, few studies have compared self-reported habitual sleep duration (from questionnaires) with an objective measure of sleep duration in healthy adults. Those using PSG found that self-reports overestimated objective sleep duration,[1,12] whereas those using actigraphy either showed overestimation[11,13] or did not assess bias.[14] Calibration was considered in one study[11] and found to be relatively poor, with a 31-minute increase in subjective sleep duration for each additional hour of objective sleep. Across these studies, there was evidence of moderate,[11] mild,[14] or no[1] correlations between objective and subjective measures. To our knowledge, no study has compared habitual sleep onset time from questionnaires commonly used to estimate sleep phase to objective measures in adults.

One study has compared self-reported habitual sleep duration and actigraphy in healthy adolescents (mean age of 16 years, SD = 1.2), finding moderate to strong correlations overall.[15] This study, along with another in children aged 11.9 years on average (SD = 1.42), compared self-report and objective habitual sleep onset time, finding little bias and moderate to strong correlations.[15,16]

Sleep questionnaires in clinical and epidemiological research

Notwithstanding concerns about accuracy, questionnaires are commonly used in mental health research. For example, the Pittsburgh Sleep Quality Index (PSQI), a questionnaire initially created for psychiatric clinical and research use,[1] shows expected effects, for example, of concurrent improvement in PSQI sleep duration and depressive symptoms following treatment for depression.[17] However, mood disorders tend to be accompanied by cognitive biases. Thus, responses to questionnaires in these populations may to some degree reflect these cognitive biases instead of, or in addition to, actual sleep parameters.[18] In primary insomnia, consistent underestimation of PSG-measured sleep[19,20] is thought to reflect "sleep state misperception."[21] The possibility of inaccurate estimates, by either cause, may affect how questionnaires should be interpreted for such purposes as phenotyping, making long-term prognoses, or predicting treatment response.

Few studies to date have investigated, in clinical populations, the concordance between habitual sleep duration and/or sleep onset time from questionnaires and objective sleep assessments. In bipolar patients in remission,[22] sleep questionnaire duration subscales show moderate to strong correlations with actigraphy, but bias or calibration was not evaluated in this study. In a mixed clinical sample, Buysse et al[1] found that raw scores from self-reports overestimated and were weakly correlated with PSG. No studies to our knowledge have compared self-report and objective habitual sleep duration or onset time in young people with psychiatric disorders. Sleep assessment in this group is important because these disorders are associated with sleep and circadian disturbance,[23–25] and onset most commonly occurs early in life.[26] In addition, although agreement between sleep measures relates to sociodemographic and clinical characteristics in healthy samples,[11,27] this is untested in mentally unwell young people.

The current study aims to validate key items from the PSQI, a widely used sleep questionnaire, as a measure of habitual sleep duration and sleep scheduling compared with actigraphy in young people with psychiatric disturbance.

Specifically, the study aims to answer the following:

1. Do self-reported habitual sleep duration and onset time (from the PSQI) provide an *accurate* estimate of average objective habitual sleep onset time and duration, as estimated by actigraphy, in a sample of young people seeking help with mental ill-health? (ie, do they systematically over- or underestimate sleep variables?)
2. Are these estimates well *calibrated*? (ie, are increases and decreases in objective habitual sleep duration and onset time mirrored by increases and decreases in subjective habitual sleep duration and onset time that are of equal magnitude?)
3. Does self-report provide a valid estimate of the *relative* objective habitual sleep duration and onset time in this population? (ie, does it discriminate between short and long sleepers?)
4. Is bias, calibration, or discrimination related to clinical or sociodemographic characteristics (eg, age, sex, mood disorders, self-reported insomnia)?

Participants and methods

One hundred and fifty-four help-seeking adolescents and young adults aged 12 to 33 (34.4% male) were recruited from two *headspace* specialized assessment and early intervention centers in Camperdown and Campbellown, Sydney, Australia,[28] as part of an ongoing youth mental health follow-up study. Participants with a clinician-determined intellectual disability or acute suicidality, or insufficient English were not recruited. For most of the sample, psychiatric diagnoses were determined by a research psychologist or psychiatrist using Diagnostic and Statistical Manual of Mental Disorders, 4th Edition, Text Revision (DSM-IV-TR) criteria. In the case of comorbidity, primary diagnoses were assigned based on relative severity, time of illness onset, and possible interaction between underlying etiologies. For 15 participants (9.7% of sample), diagnoses were inferred from either clinician's notes or neuropsychology assessment reports detailing psychiatric history. Primary diagnoses were as follows: 69 unipolar depression, 40 bipolar disorder, 23 anxiety disorders, 11 psychotic disorder, 4 disruptive behavior disorder, 2 "at high risk of psychosis," and 5 "other" (eg, Asperger syndrome).

Measures

Objective habitual sleep duration and onset

Actigraphy (Actiwatch-64/L, 2, or Spectrum, Philips Respironics, USA) monitoring was conducted for periods ranging between 7 and 23 nights ($M = 17.19$, SD = 4.02), with at least 7 valid nights of measurement required for inclusion in the analysis.[29] To aid in interpreting actigraphy, participants were also requested to concurrently complete a sleep diary that included daily bedtimes and rise times. Data were collected for 1-minute epochs for Actiwatch-L (22.1% of sample) and 30-second epochs for Actiwatch-64 (66.9%), 2 (8.4%), and Spectrum (2.6%). These devices have been found to produce commensurable sleep statistic estimates.[30] Sleep-wake detection was conducted using Actiware 5.0 software (Philips Respironics) set to a medium sensitivity threshold and 10 minutes of immobility for sleep onset.[9,31,32]