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Assessment of Sleep Hygiene Using the Sleep Hygiene Index

David F. Mastin,[1,5] Jeff Bryson,[2,3,4] and Robert Corwyn[1]

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The Sleep Hygiene Index was developed to assess the practice of sleep hygiene behaviors. The Sleep Hygiene Index was delivered to 632 subjects and a subset of the subjects participated in a readministration of the instrument. Test–retest reliability analyses suggested that sleep hygiene behaviors are relatively stable over time for a nonclinical population. Results confirmed that sleep hygiene is strongly related to sleep quality and modestly related to perceptions of daytime sleepiness. As predicted, support of the sleep hygiene construct was also provided by strong correlations with the associated features of a diagnosis of inadequate sleep hygiene. The Sleep Hygiene Index, a much shorter sleep hygiene instrument than previously published, demonstrated comparable psychometric properties with additional evidence of validity and a clear item selection rationale.

KEY WORDS: sleep; hygiene; quality; sleepiness; causal indicators.

In recent years there has been increased attention and interest in poor sleep habits. A steady decline in the time adults in the United States spend asleep (National Sleep Foundation, 2002) and an estimated yearly cost to society of sleep problems ranging in the tens of billions of US dollars (i.e. Leger, 1994) has created an interest in sleep quality and sleep habits (also known as sleep hygiene). Sleep hygiene may be described as practicing behaviors that facilitate sleep and avoiding behaviors that interfere with sleep (Riedel, 2000). *Inadequate* sleep hygiene is defined in the International Classification of Sleep Disorders (American Sleep Disorders Association, 1990) as a "sleep disorder due to the performance of daily living activities that are inconsistent with the maintenance of good quality sleep and full daytime alertness" (p. 73).

[1]University of Arkansas at Little Rock, Little Rock, Arkansas.
[2]Jacksonville State University, Jacksonville, Alabama.
[3]Fielding Graduate University, Santa Barbara, California.
[4]Behavioral Health Associates of North Alabama, P.C., Gadsden, Alabama.
[5]To whom correspondence should be addressed at Department of Psychology, University of Arkansas at Little Rock, 2801 South University Avenue, Little Rock, Arkansas; e-mail: dfmastin@ualr.edu.

The current authors are aware of two existing instruments intended to assess adult sleep hygiene: the Sleep Hygiene Awareness and Practice Scale (Lacks and Rotert, 1986) and the Sleep Hygiene Self-Test (Blake and Gomez, 1998). These instruments have been found to have only fair internal consistency as measured by Cronbach's α (Sleep Hygiene Awareness and Practice Scale $= 0.47$; Sleep Hygiene Self-Test $= 0.54$). The Sleep Hygiene Self-Test has not been shown to correlate with any external measure of sleep quality and a reported correlation (Brown *et al.*, 2002) between the Pittsburgh Sleep Quality Index and the Sleep Hygiene Awareness and Practice Scale is questionable due to overlapping instrument items. Further, authors of these instruments failed to provide a clear rationale for item selection or present data relating these instruments to subjective experiences of sleepiness.

The objectives of the current paper are to (a) describe the psychometric assumptions relevant to the measurement of sleep hygiene; (b) introduce and report on the psychometric properties and construction of a new instrument, the Sleep Hygiene Index (see Appendix), an instrument with 13 items derived from the diagnostic criteria for a diagnosis of inadequate sleep hygiene as defined in the International Classification of Sleep Disorders (American Sleep Disorders

Association, 1990); (c) report on the relationship between sleep hygiene, subjective sleepiness, and sleep quality in a nonclinical population; and (d) discuss the utility of the construct of sleep hygiene and implications for clinical practice and research.

Sleep hygiene is assessed by measuring behaviors and environmental variables thought to cause or lead to relatively poor sleep quality rather than measuring outcomes. For example, a typical sleep hygiene item would query the subject as to caffeine intake before bedtime. This use of items thought to have a causal impact on the variable being measured (causal items) necessitates a different set of assumptions and design processes than is typical in classical test theory (Bollen and Lennox, 1991; Diamantopoulos and Winklhofer, 2001; MacCallum and Browne, 1993; Streiner, 2003). For example, one does not necessarily expect causal indicators to be highly related with one another. Therefore, Cronbach α should not be the only measure to report in assessing the reliability of instruments that consist of causal items. Following the guidelines of classical test theory, authors of previous sleep hygiene instruments may have discarded indicators with evidence that items reduced overall or subscale coefficient α, exhibited poor item-total correlations, or failed to fit a factor analysis. Alternately, items with questionable selection rationale may have been retained due to their contributions to a favorable coefficient α. Instead, especially in the case of the use of causal items, authors are urged to look toward additional indices of reliability relevant to the instrument being designed (Bollen and Lennox, 1991). Test–retest reliability is reported for the Sleep Hygiene Index as an indicator of reliability over time as well as Cronbach's α as a measure of internal reliability.

It should also be understood that an instrument that consists primarily of causal items is defining the variable of interest by these items (Bollen and Lennox, 1991; Diamantopoulos and Winklhofer, 2001). It is understandable then that possessing a clear rationale for item selection is critical. Although the diagnosis of inadequate sleep hygiene has been met with some criticism (Reynolds *et al.*, 1991), the current authors believe the International Classification of Sleep Disorders diagnostic criteria for this disorder provides a suitable reference for agreement as to what poor sleep hygiene is and therefore how sleep hygiene as a construct may be defined.

The model proposed in Fig. 1 presents the causal items derived from the diagnostic criteria for inadequate sleep hygiene as x_1 through x_{13}. The variable of interest, sleep hygiene, is identified by η_1. It should be noted that the arrows point *from* the causal indicators *to* the latent construct. Effect indicators derived from the associated features of inadequate sleep hygiene (American Sleep Disorders Association, 1990) are identified by y_1 through y_5. Here, arrows representing the relation between latent construct and indicators for these effect indicators point *from* the latent construct *to* the indicators. Bollen and Lennox (1991) have suggested that some measurement of effect is necessary for adequate latent variable identification. Two linked constructs, sleep quality and subjective sleepiness, are identified by η_2 and η_3, respectively, measured here with the Pittsburgh Sleep Quality Index (Buysse *et al.*, 1989) and the Epworth Sleepiness Scale (Johns, 1991).

METHOD

Participants

Subjects were recruited from a midsized university in the Midwest United States. Data were collected from 632 volunteering psychology university students over two academic semesters: alpha and beta (alpha set: 103 males and 205 females, mean age 21.6; beta set: 125 males and 199 females, mean age 22.7). Less than 5% of the data was spoiled due to skipped items or illegible handwriting. Students were offered extra points upon completing the research during class. No student rejected the opportunity. A subset of group beta 141 (55 males and 86 females, mean age 23.9) retook the Sleep Hygiene Index after a 4–5-week interval to measure test–retest reliability. Subset beta was comprised of attending students who had participated in the first research opportunity earlier in the semester. The research was reviewed and approved by a university institutional review board and participants gave informed consent to participate.

Procedure

All subjects completed the assessment in a classroom setting in one sitting of less than 1 h. All participants completed the Sleep Hygiene Index and Epworth Sleepiness Scale (ESS). Group alpha also completed the Pittsburgh Sleep Quality Index. Participants were debriefed in an effort to answer any questions regarding the study and

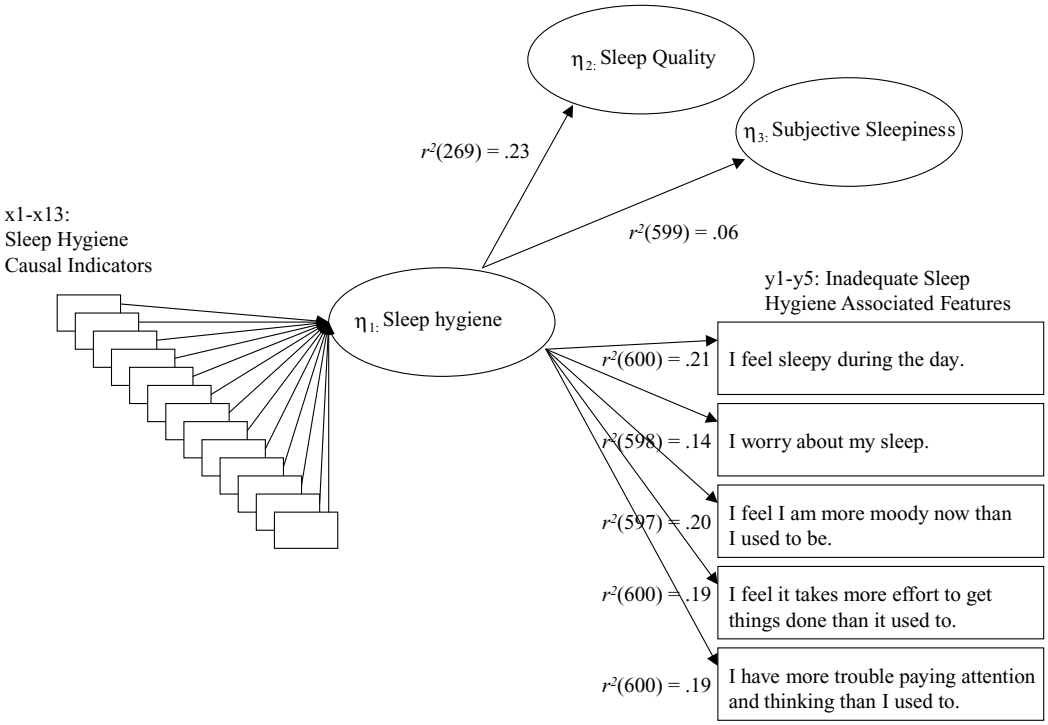

Fig. 1. Diagnostic criteria for inadequate sleep hygiene are x_1 through x_{11}. Variable of interest, sleep hygiene, is identified by η_1. Associated features of inadequate sleep hygiene are identified by y_1 through y_5. Two linked constructs, sleep quality and subjective sleepiness, are identified by η_2 and η_3, respectively. All correlations in this figure were significant at the 0.05 level or less.

were provided an educative handout of sleep hygiene guidelines. Participants were offered access to the results of the research upon completion of the study.

Instruments

Sleep Hygiene Index

The Sleep Hygiene Index, first presented here, is a 13-item self-administered index intended to assess the presence of behaviors thought to comprise sleep hygiene. Participants were asked to indicate how frequently they engage in specific behaviors (always, frequently, sometimes, rarely, never). Items constructing the Sleep Hygiene Index were derived from the diagnostic criteria for inadequate sleep hygiene in the International Classification of Sleep Disorders (American Sleep Disorders Association, 1990). Item scores were summed providing a global assessment of sleep hygiene. Higher scores are indicative of more maladaptive sleep hygiene status.

Epworth Sleepiness Scale

The Epworth Sleepiness Scale is a self-report 8-item questionnaire producing scores from 0 to 24. Scores greater than 10 suggest significant daytime sleepiness (Johns, 1991). The Epworth Sleepiness Scale has good psychometric properties (Johns, 1991), correlates with objective measures of sleepiness (Chervin *et al.*, 1997), and has been shown to differentiate between individuals with and without sleep disorders (Chervin *et al.*, 1997) and those who are and are not sleep deprived (Johnson, 1997).

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index is a self-rated 19-item instrument intended to assess sleep quality and sleep disturbance over a 1-month period in clinical and nonclinical populations (Buysse *et al.*, 1989). Scores range from 0 to 21 with the higher scores indicating poorer sleep quality. The Pittsburgh Sleep Quality Index has been demonstrated to have

good internal reliability, stability over time, evidence of validity (Buysse *et al.*, 1989), and is well regarded in the sleep research community.

RESULTS

Descriptives

There were 603 complete data sets for the Sleep Hygiene Index resulting in $M = 34.66$ (SD = 6.6) and a range of 17–55.

Reliability

Although Cronbach's α for the Sleep Hygiene Index ($\alpha = 0.66$) was found to be superior to previously published sleep hygiene instruments, we only report it to give a general idea of internal consistency. More importantly, the Sleep Hygiene Index was found to have good test–retest reliability ($r(139) = 0.71, p < 0.01$).

Validity

The Sleep Hygiene Index was positively correlated ($p < 0.01$) with all associated features of inadequate sleep hygiene (American Sleep Disorders Association, 1990) (y_1 through y_5; Pearson r values ranged from 0.371 to 0.458). The Sleep Hygiene Index correlated positively with the Epworth Sleepiness Scale ($r(599) = 0.244$, $p < 0.01$) and the Pittsburgh Sleep Quality Index total score ($r(269) = 0.481, p < 0.01$). The Sleep Hygiene Index also positively correlated ($p < 0.05$ or less) with all the Pittsburgh Sleep Quality Index component scores (this is noteworthy in that some subcomponents are more clearly independent from the sleep hygiene construct in item design than others).

DISCUSSION

Our results support the sleep hygiene model proposed in Fig. 1. Reliability analyses suggested that sleep hygiene behaviors as measured by the Sleep Hygiene Index are relatively stable over time for a nonclinical population. Results confirmed the finding by Brown *et al.* (2002) that sleep hygiene is strongly related to sleep quality. For the first time, we are able to report that sleep hygiene is modestly related to perceptions of daytime sleepiness as would be expected in that poor sleep hygiene is thought to be related to poor sleep quality. As predicted, support of the sleep hygiene construct, as measured by the Sleep Hygiene Index, was also provided by strong correlations with the associated features of a diagnosis of inadequate sleep hygiene. The Sleep Hygiene Index, a much shorter sleep hygiene instrument than previously published, demonstrated comparable psychometric properties with additional evidence of validity and a clear item selection rationale. This study was limited in that a nonprobability sample was used. The extent to which the Sleep Hygiene Index results could be generalized across age groups for example, is unknown.

Possessing a valid and reliable instrument may be necessary, but may not be sufficient in understanding and modifying sleep hygiene behaviors. An incongruity between sleep hygiene knowledge and practices in clinical (Lacks and Rotert, 1986) and non-clinical populations (Brown *et al.*, 2002) suggests that an understanding of sleep hygiene in context may be important. We suggest that clinically it is important to understand that sleep hygiene does not exist in isolation and may be better understood when considering the psychosocial context of the patient (e.g., precipitation and/or maintenance of maladaptive sleep hygiene behaviors may not be addressed by education alone). Further, it is likely to be unnecessary to create a core, or alternately, a comprehensive list of sleep hygiene behaviors in the pursuit of a quantitative assessment of sleep hygiene. With regard to research it is important to (a) understand the psychometric implications of the use of causal variables in the assessment of sleep hygiene (Bollen and Lennox, 1991), (b) create more complete models of sleep hygiene in an effort to understand and explain the precipitation and maintenance of sleep hygiene related behaviors, and (c) examine sleep hygiene behaviors independently in an effort to understand the relative contribution of each to constructs of interest (as suggested by Stepanski and Wyatt, 2003).

APPENDIX

Sleep Hygiene Index Items

1. I take daytime naps lasting two or more hours.
2. I go to bed at different times from day to day.

3. I get out of bed at different times from day to day.
4. I exercise to the point of sweating within 1 h of going to bed.
5. I stay in bed longer than I should two or three times a week.
6. I use alcohol, tobacco, or caffeine within 4 h of going to bed or after going to bed.
7. I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).
8. I go to bed feeling stressed, angry, upset, or nervous.
9. I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study).
10. I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).
11. I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).
12. I do important work before bedtime (for example: pay bills, schedule, or study).
13. I think, plan, or worry when I am in bed.

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