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SCIENTIFIC INVESTIGATIONS

Sleep Hygiene Index: Psychometric Characteristics and Usefulness as a Screening Tool in a Sample of Nigerian Undergraduate Students

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Study Objectives: The objectives of this study were to investigate the psychometric properties of the Sleep Hygiene Index (SHI) and determine its capacity to screen for poor sleep quality in a nonclinical sample of Nigerian university students.
Methods: A total of 348 students appropriately completed the SHI, the Morningness-Eveningness Questionnaire (MEQ), the Pittsburgh Sleep Quality Index (PSQI), and the Epworth Sleepiness Scale (ESS).
Results: The internal consistency (Cronbach alpha) of the SHI was .64 and its construct validity was modestly satisfactory. It had a significant negative correlation with the MEQ ($r = -.170$, $P < .001$) and positive correlations with global PSQI ($r = .289$, $P < .001$) and ESS ($r = .219$, $P < .001$) scores. Prior to the factor analysis, our sample was randomly divided into two. In one half of the sample (sample 1), exploratory factor analysis of the SHI items yielded a three-factor model. Confirmatory factor analysis on the other half (sample 2) corroborated this model with satisfactory indices of fitness ($c^2 = 67.805$; $df = 55$; $c^2/df = 1.233$; $P = .115$; goodness of fit index = .943; Tucker-Lewis index = .958; incremental fit index = .972; comparative fit index = .970; root mean square error of approximation = .037). A cutoff total score of 16 on the SHI had the best sensitivity (77.0%) and specificity (47.5%) to identify students who were categorized as experiencing poor sleep quality, according to the PSQI (area under the curve = 0.65, 95% confidence interval = 0.59–0.71).
Conclusions: The SHI exhibited satisfactory psychometric properties as a self-rated assessment instrument in the evaluation of sleep hygiene and as a screening instrument for poor sleep quality among Nigerian undergraduate students.
Keywords: Nigerian students, reliability, sleep hygiene, validity
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BRIEF SUMMARY
Current Knowledge/Study Rationale: Although the Sleep Hygiene Index (SHI) had been validated in some population in the developed countries, an extensive electronic literature search revealed no validation study or application of the instrument among the undergraduate student populations in Nigeria or Sub-Saharan Africa.
Study Impact: This study advanced the frontiers of knowledge of sleep medicine, especially in the developing world, by demonstrating the validity of the SHI for assessing sleep hygiene among the university undergraduate student population in Nigeria by performing exploratory and confirmatory factor analyses on the factors extracted in the SHI, which has not been previously done. We also demonstrated the usefulness of the SHI in identifying poor sleep quality in this population.

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INTRODUCTION

Sleep plays a vital role in life and is known to significantly contribute to the physical, emotional, cognitive, and overall psychological growth and development of an individual.[1] Disruptions in the sleep-wake cycle, duration of sleep, or sleep quality are associated with potentially severe negative consequences on physical and mental health.[2,3]

Sleep-related problems are now posing public health concerns globally as insufficient sleep is on the rise, and this is especially worse among university students.[4] In recent times, there has been interest in sleep hygiene as a target of intervention to stem this rise.[5] Sleep hygiene has been defined as behaviors that improve the quality and quantity of sleep.[6] An optimal sleep hygiene includes behavioral and environmental practices such as maintaining consistent bed-on and bed-off times, encouraging a comfortable bed and sleeping environment, regular exercise, minimizing daytime napping, avoiding caffeinated beverages or stimulants prior to bedtime, and avoiding emotionally and cognitively stimulating activities before bedtime.[6,7] Inadequate sleep hygiene is presumed to result from the daily living activities that are inconsistent with the maintenance of good-quality sleep and normal daytime alertness.[8] Although the effect of sleep hygiene has been reported to be questionable in older adults,[9] better effectiveness has been reported in adolescents and young adults, probably because they have a poorer knowledge about healthy sleep behavior.[10] In a developing country such as Nigeria, where there are inadequate

personnel to evaluate sleep problems among students, limited socioeconomic resources restrict access to proper and effective treatment. Improving sleep hygiene may thus provide a cheap, safe, and easily accessible option of intervention. The concept of sleep hygiene in terms of its construct and correlates has not been explored in Nigeria, especially among undergraduate students. Exploration of the psychometric properties of a scale to rate sleep hygiene in this population might be the first step in this process. Of the commonly used instruments assessing sleep hygiene, the Sleep Hygiene Awareness and Practice Scale (SHAPS),[11] the Sleep Hygiene Self-Test (SHST),[12] the Sleep Hygiene Index (SHI),[13] and the Adolescent Sleep Hygiene Scale (ASHS),[5] only the 13-item SHI was developed based on the diagnostic criteria for inadequate sleep hygiene as described in the International Classification of Sleep Disorders (ICSD).[12] In contrast, the SHAPS and SHST appeared not to have been developed with a clear rationale for item selection, which may explain their lower internal inconsistencies (Cronbach alpha = .47 and .54 respectively) when compared to that for the SHI (Cronbach alpha = .89).[13,14] Furthermore, the ASHS was designed for use among adolescents and may not be useful among older individuals. Its length (32 items) may also make it less appealing when compared to the shorter SHI. The SHI thus appears superior and more respondent-friendly compared to the other instruments. The authors of the SHI reported moderate internal consistency (Cronbach alpha = .66) and satisfactory 2-week test-retest reliability (r = .71), and was significantly associated with sleep quality and daytime sleepiness in a nonclinical sample.[13] Similar findings have been reported in a hospital-based sample. Using a sample of 161 patients seeking treatment for chronic pain in Seoul, South Korea, the SHI was reported to have satisfactory reliability (Cronbach alpha = .75) and 2-week test-retest stability (r = .83).[15] The SHI has also been reported to have adequate internal reliability (Cronbach alpha = .89) and a good test-retest internal consistency (r = .89) in a nonclinical sample in Iran.[14]

There is a dearth of research regarding studies exploring the psychometric properties of the SHI and these studies were all conducted in the developed countries.[13,14] An extensive literature search revealed that the validity, reliability, and factor structure of the SHI has not been examined among the undergraduate student populations in Nigeria or Sub-Saharan Africa. The objectives of this study were to (1) examine the internal consistency (reliability) and validity of the SHI in relation to other measures of sleep among the Nigerian undergraduate student population; (2) explore the underlying latent factors in SHI using exploratory factor analysis (EFA); (3) evaluate the adequacy of the indices of fitness of the model obtained with EFA applying confirmatory factor analysis (CFA); and (4) explore the characteristics of the SHI as a screening instrument for poor sleep quality among Nigerian undergraduate students.

METHODS

Study Design and Participants

This cross-sectional descriptive study was carried out among the undergraduate students of the Obafemi Awolowo University, Ile-Ife, in Southwestern Nigeria during the midsemester period of an academic year. We calculated the sample size using the subject-to-item ratio of 10:1, which is considered acceptable.[16] This yielded a sample size of 130, because the SHI consists of 13 items; however, we increased the sample size to 370 in order to increase the reliability of the study. The participants were recruited from the eight undergraduate halls of residence located within the school premises using a multistage stratified sampling method. Each hall consists of 6 to 8 blocks, each of which contains 30 rooms, and has 6 occupants. The halls of residence were stratified into two according to sex (four halls each for male and female) and the number of participants per hall was determined by proportionate sampling from the odd-numbered blocks in the halls. Participants were then selected until the sample from each hall was complete. Only students residing within the school premises, those who had no current or lifetime diagnoses of medical or psychiatric disorder, and those who were not regularly using psychoactive substances (alcohol, nicotine, etc.) were included in the study. These were ascertained after the study objectives had been explained and informed consent obtained from potential participants as follows: single questions were asked about current and lifetime diagnoses of medical and psychiatric conditions and responses were either "yes" or "no." A list of psychoactive substances was also provided and they were asked to indicate how frequently they used the substances. Responses ranged from "daily" to "occasionally" to "never." Only potential participants who responded "never" and "occasionally" to all the psychoactive substances were included in the study.

The study protocol was approved by the Health Research Ethics Committee, Institute of Public Health, Obafemi Awolowo University, Ile-Ife.

Measurements

Sociodemographic Questionnaire

A semistructured sociodemographic data schedule was designed to elicit information on variables such as age, sex, relationship status, and cumulative grade point average (CGPA), which is a measure of the participants' academic performance. Socioeconomic status was assessed by the participants' need to engage in part-time employment to supplement their allowances.

Sleep Hygiene Index

The SHI is a 13-item self-report index designed from the ICSD to assess the presence of sleep hygiene behaviors.[13] Each of the item is rated on a five-point Likert scale (ranging from 0 [never] to 4 [always]). The total scores ranged from 0 to 52, with higher scores indicating poorer sleep hygiene status. The scale's developers reported it to have an internal consistency of Cronbach alpha of .66, and good test-retest reliability of 0.71.[13] We did not adapt the SHI for two main reasons. First, our respondents were university undergraduate students, which is similar to the study population (undergraduate students from a university in the Midwest United States) in which Mastin et al.,[13] the developers of the index, originally examined its psychometric characteristics. Second, the SHI was originally

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developed in the English language, which is the language of communication in Nigerian universities.

Morningness-Eveningness Questionnaire

The Morningness-Eveningness Questionnaire (MEQ), developed by Horne and Ostberg,[17] was used to assess the study participants' preference for activity in the morning or evening (sleep chronotype). It consists of 19 items and the global score varies from 16 to 86. Individuals with values below 42 were classified as evening type; those with values above 58, as morning type, and those with values between 42 and 58 were regarded as having the intermediate type. The MEQ has high internal consistency reliability (Cronbach alpha = .86) and high test-retest reliability (r = .89).[18]

Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a self-report instrument that measures sleep quality, and is applicable for use in both clinical and nonclinical populations.[19] The index comprises 19 items, which are variously summed to form 7 component scores. These components include sleep duration, sleep latency, habitual sleep efficiency, subjective sleep quality, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component was scored within a range of 0 (no difficulty) to 3 (severe difficulty). The 7 component scores were added to yield a global score, which ranged from 0 to 21. A global score greater than 5 is considered to represent poor sleep quality.[19] This instrument has demonstrated satisfactory validity among the Nigerian student population.[20] In the study by Aloba et al.,[20] the PSQI significantly (t = 4.88, df = 518, P < .001) identified students with the fourth edition of the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV)-diagnosed insomnia.

Epworth Sleepiness Scale

The Epworth Sleepiness Scale (ESS) is a self-administered eight-item questionnaire, which subjectively measures an individual's tendency to fall asleep during regularly encountered situations.[21] Each item was scored on a Likert scale of 0 to 3. The total scores ranged from 0 to 24, with higher scores suggesting a greater likelihood of sleepiness. A score of 10 or higher was considered to suggest significant daytime sleepiness.[21] The ESS showed adequate internal consistency (Cronbach alpha = .88) and test-retest reliability (r = .82) in a nonclinical sample.[22]

Analysis

Of the 370 students who consented to participate in the study, responses from only 348 participants were included in analysis (representing a response rate of 94.1%). Four potential participants did not meet the inclusion criteria (two had current medical conditions, and two drank alcohol regularly), and 18 questionnaires were not appropriately completed. The variable that evaluated the respondents' academic performance (CGPA) was excluded from analysis because only 35% of the students responded to this question. Data were analyzed using the Statistical Package for Social Sciences version 21 (IBM Corp., Armonk, New York, United States). The reliability of the SHI was determined by calculating the Cronbach alpha while its construct validity was examined through correlational analyses with MEQ, PSQI, and ESS. Before subjecting the data to factor analysis, the total sample (n = 348) was randomly divided into equal halves (n = 174 each).[23–25] In order to explore the factor structure of the SHI, we performed EFA using principal component analysis with Oblimin rotation and Kaiser normalization[26] on half of the sample (sample 1). Kaiser-Meyer-Olkin test and Bartlett test of sphericity were performed to ensure that our sample 1 data were suitable for EFA. Items with factor loading of at least 0.40 were retained. We conducted CFA on the second half (sample 2) using the maximum likelihood method to examine the factor structure yielded by the EFA in sample 1. The CFA was performed with the Analysis of Moment Structure (AMOS) software, 20th version. Satisfactory indices of fitness of the CFA model were based on the criteria described by Hu and Bentler[27] in which the goodness of fit index (GFI), comparative fit index (CFI), incremental fit index (IFI) and Tucker-Lewis index (TLI) values will be approximate to or exceed 0.95; root mean square error of approximation (RMSEA) less than 0.06; c^2/degree of freedom (CMIN/df) ratio less than 2, and a nonsignificant P value (> .05).

We also examined the screening quality of the SHI in order to determine the total cutoff score that will optimally identify students with poor sleep quality as measured by the PSQI. This was done by analyzing the receiver operating characteristic (ROC) curve by calculating the area under the ROC curve (AUC). The best combination of sensitivity and specificity will be reflected by the highest Youden index.[28] Other parameters evaluated include the positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (LR+) and negative likelihood ratio (LR−). An AUC value nearer to 1 will indicate a more satisfactory discriminatory ability of the SHI.[29]

RESULTS

Sociodemographic and Sleep-Related Characteristics of the Respondents (n = 348)

Table 1 shows the sociodemographic characteristics of the participants. The mean age (standard deviation [SD]) was 21.60 (2.87), with male students making up 44.8% of the total sample. Approximately two-thirds of the students (64.9%) were single, whereas approximately one-fourth (26.4 %) were engaged in part-time employment. The SHI score ranged between 0–39 with the mean (SD) score being 19.0 (6.31), whereas the mean (SD) score of MEQ was 55.5 (6.62). The mean (SD) scores of PSQI and ESS were 5.2 (2.56) and 9.0 (4.25), respectively.

Reliability and Validity

The Cronbach alpha for the SHI was .64. The construct validity of the SHI is reported in **Table 2**. The SHI had modest positive correlations with global PSQI score (r = .29, P < .001) and ESS score (r = .22, P < .001), whereas it had a negative correlation with MEQ score (r = −.17, P = .001).

Exploratory (sample 1, n = 174) and Confirmatory (sample 2, n = 174) Factor Analyses of the SHI

Table 3 shows that the Kaiser-Meyer-Olkin (KMO) measure of the sampling adequacy was 0.66 and Bartlett test of sphericity

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Table 1—Sociodemographic and sleep-related characteristics of the respondents.

Age, years, mean ± SD	21.6 ± 2.87
Sex, n (%)	
Male	156 (44.8)
Female	192 (55.2)
Relationship status, n (%)	
Single	226 (64.9)
In a relationship	122 (35.1)
Part-time employment, n (%)	
Yes	92 (26.4)
No	256 (73.6)
PSQI score, mean ± SD	5.2 ± 2.56
Good sleep quality (score ≤ 5), n (%)	200 (57.5)
Poor sleep quality (score > 5), n (%)	148 (42.5)
ESS score, mean ± SD	9.0 ± 4.25
Normal (score < 9), n (%)	202 (58.0)
Excessive daytime sleepiness (score ≥ 10), n (%)	144 (42.0)
MEQ, mean ± SD	55.5 ± 6.62
Morning (score > 58), n (%)	119 (34.2)
Intermediate (score 42–58), n (%)	215 (61.8)
Evening (score < 42), n (%)	14 (4.0)
SHI, mean ± SD	19.0 ± 6.31

ESS = Epworth Sleepiness Scale, MEQ = Morningness-Eveningness Questionnaire, PSQI = Pittsburgh Sleep Quality Index, SD = standard deviation, SHI = Sleep Hygiene Index.

was statistically significant ($P < .001$). The KMO value greater than 0.50[30] and significant value of Bartlett test of sphericity[31] were considered satisfactory indicators of the appropriateness of the data for subjection to factor analysis. Initially, the exploratory factor analysis of the SHI using principal component analysis extracted three factors with eigenvalues greater than 1. These three factors cumulatively accounted for 50% of the total sample variance (Factor 1 = 21.71%, Factor 2 = 17.71% and Factor 3 = 10.93%). Items 4, 5, 6, 7, 8, 10, and 11 loaded on Factor 1 (subsequently labeled "bed-related behavior"); items 1, 9, 12, and 13 loaded on Factor 2 (labeled "bed-related cognition-activity"), whereas items 2 and 3 loaded on Factor 3 (labeled "sleep-wake timing"). The internal consistencies (Cronbach alpha) of Factors 1, 2, and 3 were .71, .65, and .81, respectively.

Figure 1 shows the CFA path analysis diagram on sample 2 indicating satisfactory indices of fitness of the three factors of the SHI extracted in sample 1: $c^2 = 67.805$; $df = 55$; $c^2/df = 1.233$; $P = .115$; GFI = 0.943; CFI = 0.970; IFI = 0.972; TLI = 0.958, and RMSEA = 0.037.

Psychometric Details of the SHI at Different Cutoff Scores

Table 4 shows that the best SHI cutoff score that best identifies participants with poor sleep quality was 16, with sensitivity of 77.0%, specificity of 47.5% and an accuracy of 62.3%. The PPV, NPV, LR+, and LR− were 59.5%, 67.4%, 1.467, and 0.484, respectively. The AUC at this cutoff score is 0.650 (**Figure 2**).

Table 2—Correlation between SHI and sleep chronotype, sleep quality, and daytime sleepiness.

	SHI	MEQ	PSQI	ESS
SHI	1	−.170**	.289*	.219*
MEQ		1	−.166**	.019
PSQI			1	.112**
ESS				1

* = $P < .001$, ** = $P < .05$. ESS = Epworth Sleepiness Scale, MEQ = Morningness-Eveningness Questionnaire, PSQI = Pittsburgh Sleep Quality Index, SHI = Sleep Hygiene Index.

Table 5 also shows that there were significant differences ($P < .05$) between subjects with good sleep quality and those with poor sleep quality on all the extracted three factors of the SHI.

DISCUSSION

The aim of this study was to examine the psychometric properties of the SHI and its ability to identify those with poor sleep quality in a nonclinical sample of undergraduate students in a multiethnic federal university in south- western Nigeria. The internal consistency (reliability) of SHI in this study (Cronbach alpha = .64) is similar to what was reported by Mastin et al. (Cronbach alpha = .66).[13] However, it is lower than the reliability coefficients of 0.89[14] and 0.75[15] reported in Iran and South Korea, respectively. The reliability value of the SHI items in our study lends credence to the suitability and reliability of the SHI as a measure of sleep hygiene behavior among a nonclinical sample of Nigerian university undergraduate students.

We examined the construct validity of the SHI using correlational analysis with the PSQI, the ESS, and the MEQ. The construct validity of the SHI was also observed to be modestly satisfactory. The directions of the associations between the SHI and the other study measures were all as expected. Higher SHI scores, indicating poorer sleep hygiene behavior, correlated positively with higher global PSQI scores, which indicates poor sleep quality. This finding is consistent with previous studies reporting that poor sleep hygiene is strongly associated with poorer sleep quality.[14,32] In addition, poor sleep hygiene was found to modestly correlate with excessive daytime sleepiness in this study, which is consistent with the findings reported in previous studies.[13,14] Higher scores on the SHI were also significantly associated with lower MEQ scores, which indicates a preference for evening activities, an observation that has been previously reported.[33] A plausible explanation for this observation between the SHI and the MEQ could be due to poor sleep hygiene leading to poor night sleep, which might result in compensatory sleep during the early part of the following day. Such individuals may thus be more alert in the evenings and prefer to engage in activities around this time.

The factor analysis of the SHI in our study extracted a three-factor structure, which accounted for 50% of the total sample variance. This is similar to the finding by Chehri et al.[14] in a

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Table 3—PCA of the SHI items, showing the factors and their item loading (sample 1, n = 174).

Item Content	Factor 1 (BRB)	Factor 2 (BDC-A)	Factor 3 (SWT)
8. I go to bed feeling stressed, angry, upset, or nervous.	0.733	–	–
10. I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).	0.724	–	–
6. I use alcohol, tobacco, or caffeine within 4hrs of going to bed or after going to bed.	0.640	–	–
7. I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).	0.621	–	–
11. I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).	0.518	–	–
5. I stay in bed longer than I should two or three times a week.	0.515	–	–
4. I exercise to the point of sweating within 1 hour of going to bed.	0.425	–	–
13. I think, plan, or worry when I am in bed.	–	0.693	–
9. I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study).	–	0.675	–
12. I do important work before bedtime (for example: pay bills, schedule, or study).	–	0.636	–
1. I take daytime naps lasting two or more hours.	–	0.479	–
2. I go to bed at different times from day to day.	–	–	0.860
3. I get out of bed at different times from day to day.	–	–	0.769
Eigenvalue	2.822	2.303	1.421
% Variance explained	21.708	17.713	10.932
Cronbach alpha	.708	.652	.814
Kaiser-Meyer-Olkin test of sampling adequacy	0.66		
Bartlett test of sphericity	494.268, *df* = 78, *P* < .001		

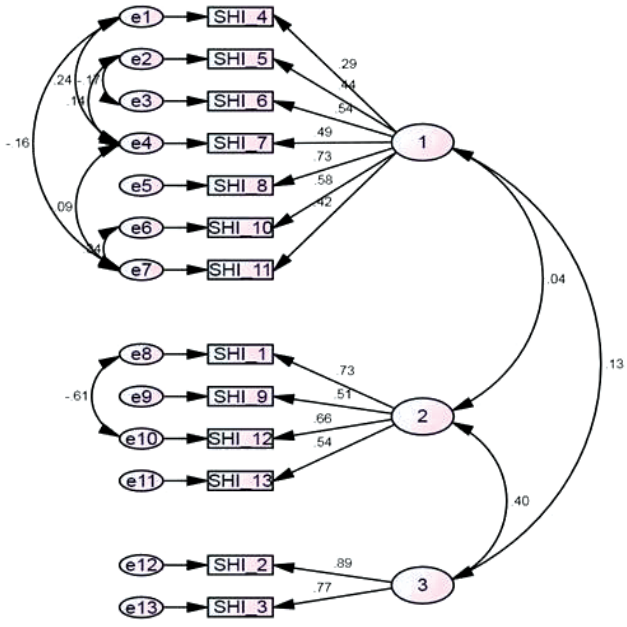
BRB = bed-related behavior, BRC-A = bed-related cognition-activity, PCA = principal component analysis, SHI = Sleep Hygiene Index, SWT = sleep-wake timing.

nonclinical Iranian sample, although we noted that some of the items loaded differently in both studies. The study by Chehri et al. translated the original scale, which was developed in English, to the Persian language. This semantic and cultural adaptation could have accounted for the differences in the factorial item loading between the Iranian study and ours. It is also plausible that the cultural adaptation of the SHI could have influenced the responses to the items in their study. Furthermore, the variation could be due to different study populations in both studies. Our study was carried out in the university undergraduate student population, whereas Chehri et al. used the general population, which comprised older participants. Future studies may compare the psychometric properties of the SHI in different age groups within the same culture.

In the current study, we observed that Factor 3 consisted of only two components—item 2 "I go to bed at different times from day to day" and 3 "I get out of bed at different times from day to day"—with a high internal consistency coefficient. A plausible reason for this is that bed-on and bed-off times highly correlated with sleep hygiene behavior among our undergraduate student populations. The CFA of the 3-factor model also exhibited satisfactory indices of fitness, an observation that further strongly supports the 3-factor structure of the SHI among the Nigerian students.

To the best of our knowledge, this is the first study to evaluate the suitability of SHI as a screening instrument to identify poor sleep quality among the Nigerian undergraduate student population. Because there is no gold standard for sleep hygiene,

Figure 1—Confirmatory factor analysis path diagram indicating the item loadings and residual error covariations of the three SHI factors among the students.



Sample 2 (n = 174). Indices of fitness: c^2 = 67.805; *df* = 55; c^2/df = 1.233; *P* = .115; goodness of fit index = 0.943; comparative fit index = 0.970; incremental fit index = 0.972; Tucker-Lewis index = 0.958; root mean square error of approximation = 0.037 (90% confidence interval = 0.000–0.063). SHI = Sleep Hygiene Index.

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Table 4—Psychometric details of SHI at different cutoff scores.

SHI Cutoff	Sensitivity	Specificity	PPV	NPV	LR+	LR−	Youden Index	Accuracy
14	0.858	0.275	0.533	0.659	1.183	0.516	0.133	0.567
15	0.824	0.325	0.550	0.649	1.221	0.542	0.149	0.575
16	0.770	0.475	0.595	0.674	1.467	0.484	0.245	0.623
17	0.730	0.521	0.596	0.659	1.475	0.518	0.220	0.621
18	0.655	0.565	0.601	0.621	1.506	0.611	0.220	0.610

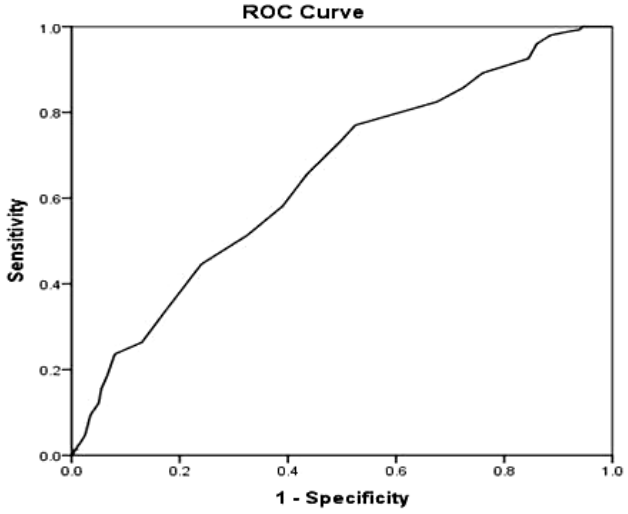
LR = likelihood ratio, NPV = negative predictive value, PPV = positive predictive value, SHI = Sleep Hygiene Index.

Table 5—Differences of the 3-factor components of SHI between students with poor sleep quality and those with good sleep quality.

	Sleep Quality (PSQI)		Statistics		
	Good Sleep Quality	Poor Sleep Quality	*t* test	*df*	*P*
Factor 1 (BRB)	6.97 ± 3.88	8.40 ± 4.18	3.30	346	.001
Factor 2 (BRC-A)	7.35 ± 3.13	8.35 ± 3.13	2.90	346	.004
Factor 3 (SWT)	3.23 ± 1.88	4.14 ± 2.02	4.323	346	< .001

BRB = bed-related behavior, BRC-A = bed-related cognition-activity, PSQI = Pittsburgh Sleep Quality Index, SHI = Sleep Hygiene Index, SWT = sleep-wake timing.

Figure 2—ROC curve of the SHI at a cutoff of 16 against PSQI.



AUC = 0.650; 95% confidence interval = 0.593–0.708; standard error = 0.029. AUC = area under the curve, PSQI = Pittsburgh Sleep Quality Index, ROC = receiver operating characteristic, SHI = Sleep Hygiene Index.

we evaluated the screening characteristics of the SHI against the students' sleep quality measured with the PSQI. Although it is not a diagnostic instrument, the PSQI has been reported to correlate with clinician-diagnosed sleep disorders.[34] In this study, we found the SHI to be of moderate use as a screening tool to discriminate the students with poor sleep quality. The AUC of 0.650 found in our study is lower than 0.800, which is the recommended value for instruments with good screening potential.[29] At a cutoff of 16, the ROC of the SHI had the highest Youden index, which is regarded as the most optimal tradeoff points between the sensitivity and specificity of an instrument.[28] An AUC of 0.65 implies that 65% of the time, a student who is randomly selected from those categorized as having poor sleep quality will have a total SHI score greater than 16 compared to a student randomly selected from those with good sleep quality. Among the respondents in this study, this cut-off could identify 77% of students with poor sleep quality (sensitivity) and 47.5% of those without poor sleep quality (specificity), with an accuracy of 62.3%. This sensitivity is above the threshold of 70% that is regarded as the acceptable minimal requirement for a screening instrument.[35] However, the specificity is lower than the minimum requirement of 80%[35] whereas the accuracy is moderate. A possible explanation for the low specificity of the instrument as a screening tool for poor sleep quality among the undergraduate students may be the erratic bed-on and bed-off schedules,[32] which may be related to the demands of academic study and the desire for excellent academic performance. In this study, strict bed-on and bed-off times were only maintained by 11.8% and 8% of the student population, respectively. Erratic bedtimes are a strong contributor and a major factor in the SHI, regardless of the cause. Another possible reason may be that this study was carried out in a nonclinical sample. Poor sleep hygiene may be due to a deliberate effort to increase study times rather than an underlying sleep pathology, which would be more likely in a clinical sample. However, considering its ease of administration and the limited resources for sleep assessment in Nigeria, the SHI may serve as an initial screening instrument that would indicate the need for further evaluation by specialists for related physical and psychological health problems.[3,36] We also noted that there were significant differences between the mean score of each extracted factor in the students with good sleep quality compared to those with poor sleep quality. This further support the validity of the three-factor model of SHI.

The strength of this study is that it is the first study in Nigeria and Sub-Saharan Africa to evaluate the psychometric properties of the SHI, and its appropriateness to identify poor sleep

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quality among undergraduate students. However, in interpreting our findings, the following limitations need to be considered. First, generalization of our findings might be difficult because this study was conducted using a subset of the population (undergraduate students). Second, although the sample size appeared adequate for EFA, future studies should utilize a larger and more diverse sample size. This could provide more robust and stable results. Third, we only examined the internal reliability of the SHI and not the test-retest reliability. Fourth, subjective measures were used to assess sleep quality and may be subject to recall bias. Subsequent studies can include objective measures such as actigraphy. Future research should investigate the effect of sociodemographic characteristics on the association between sleep hygiene practices, and sleep and other health outcomes.

CONCLUSIONS

This study demonstrated modest reliability and validity for the SHI. In addition, it has modest utility as a screening tool for poor sleep quality among Nigerian undergraduate students. The SHI can function as an inexpensive and accessible baseline assessment in the identification and overall management of poor sleep quality in undergraduate students. This is important considering the adverse effects of poor sleep quality on their academic, physical, and psychological functioning; however, more studies are needed to further establish its usefulness among other non-clinical and clinical Nigerian populations.

ABBREVIATIONS

AUC, area under the curve
CFA, confirmatory factor analysis
CFI, comparative fit index
CMIN/*df*, minimum discrepancy/degree of freedom
EFA, exploratory factor analysis
ESS, Epworth Sleepiness Scale
GFI, goodness-of-fit index
IFI, incremental fit index
LR+, positive likelihood ratio
LR−, negative likelihood ratio
MEQ, Morningness-Eveningness Questionnaire
NPV, negative predictive value
PPV, positive predictive value
PSQI, Pittsburgh Sleep Quality Index
RMSEA, root mean square error of approximation
ROC, receiver operating characteristic
SHI, Sleep Hygiene Index
TLI, Tucker-Lewis index

REFERENCES

1. Brand S, Kirov R. Sleep and its importance in adolescence and in common adolescent somatic and psychiatric conditions. *Int J Gen Med.* 2011;4:425–442.
2. Lee SA, Paek JH, Han SH. Sleep hygiene and its association with daytime sleepiness, depressive symptoms, and quality of life in patients with mild obstructive sleep apnea. *J Neurol Sci.* 2015;359(1-2):445–449.
3. Seun-Fadipe CT, Mosaku KS. Sleep quality and psychological distress among undergraduate students of a Nigerian university. *Sleep Health.* 2017;3(3):190–194.
4. Ahrberg K, Dresler M, Niedermaier S, Steiger A, Genzel L. The interaction between sleep quality and academic performance. *J Psychiatr Res.* 2012;46(12):1618–1622.
5. Storfer-Isser A, LeBourgeois MK, Harsh J, Tompsett CJ, Redline S. Psychometric Properties of the Adolescent Sleep Hygiene Scale (ASHS). *J Sleep Res.* 2013;22(6):707–716.
6. Stepanski EJ, Wyatt JK. Use of sleep hygiene in the treatment of insomnia. *Sleep Med Rev.* 2003;7(3):215–225.
7. LeBourgeois MK, Giannotti F, Cortesi F, Wolfson AR, Harsh J. The relationship between reported sleep quality and sleep hygiene in Italian and American adolescents. *Pediatrics.* 2005;115(1 Suppl):257–265.
8. American Academy of Sleep Medicine. *International Classification of Sleep Disorders.* 3rd ed. Darien, IL: American Academy of Sleep Medicine; 2014.
9. McCrae CS, Rowe MA, Dautovich ND, et al. Sleep hygiene practices in two community dwelling samples of older adults. *Sleep.* 2006;29(12):1551–1560.
10. Voinescu BL, Szentagotai-Tatar A. Sleep hygiene awareness: its relation to sleep quality and diurnal preference. *J Mol Psychiatry.* 2015;3(1):1.
11. Lacks P, Rotert M. Knowledge and practice of sleep hygiene techniques in insomniacs and good sleepers. *Behav Res Ther.* 1986;24(3):365–368.
12. Blake DD, Gomez MH. A scale for assessing sleep hygiene: preliminary data. *Psychol Rep.* 1998;83(3 Pt 2):1175–1178.
13. Mastin DF, Bryson J, Corwyn R. Assessment of sleep hygiene using the sleep hygiene index. *J Behav Med.* 2006;29(3):223–227.
14. Chehri A, Kiamanesh A, Ahadi H, Khazaie H. Psychometric properties of the Persian version of Sleep Hygiene Index in the general population. *Iran J Psychiatry Behav Sci.* 2016;10(3):e5268.
15. Cho S, Kim GS, Lee JH. Psychometric evaluation of the sleep hygiene index: a sample of patients with chronic pain. *Health Qual Life Outcomes.* 2013;11:213.
16. Cabrera-Nguyen P. Author guidelines for reporting scales development and validation results in the Journal of the Social Work and Research. *Soc Work Res.* 2010;1:99–103.
17. Horne JA, Ostberg O. A self-assessment questionnaire to determine morningness-eveningness in human circadian rhythms. *Int J Chronobiol.* 1976;4(2):97–110.
18. Neubauer AC. Psychometric comparison of two circadian rhythm questionnaires and their relationship with personality. *Pers Individ Dif.* 1992;13:125–131.
19. Buysse D, Reynolds CR, Monk T, Berman S, Kupfer D. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 1989;28(2):193–213.
20. Aloba OO, Adewuya AO, Ola BA, Mapayi BM. Validity of the Pittsburgh Sleep Quality Index (PSQI) among Nigerian university students. *Sleep Med.* 2007;8(3):266–270.
21. Johns M. A new method for measuring daytime sleepiness: the Epworth Sleepiness Scale. *Sleep.* 1991;14(6):540–545.
22. Johns M. Reliability and factor analysis of the Epworth Sleepiness Scale. *Sleep.* 1992;15(4):376–381.
23. Aloba O, Adefemi S, Aloba T. Positive and Negative Suicide Ideation (PANSI) Inventory: initial psychometric properties as a suicide risk screening tool among Nigerian university students. *Clinical Medicine Insights: Psychiatry.* 2018;9:1–9.
24. Browne MW, Cudeck R. Alternative ways of assessing model fit. In: *Testing Structural Equation Models.* Thousand Oaks, CA: SAGE; 1993.
25. Robida A. Hospital Survey on Patient Safety Culture in Slovenia: a psychometric evaluation. *Int J Qual Health Care.* 2013;2(4)5:469–475.
26. Kaiser HF. A second generation little jiffy. *Psychometrika.* 1970;35:401–416.
27. Hu L, Bentler PM. Cutoff criteria for indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Modeling.* 1999;6:1–55.

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28. Youden WJ. Index for rating diagnostic tests. *Cancer Nur.* 1950;3(1):32–35.
29. Hanley JA, McNeil BJ. The meaning and use of the area under a receiver operating characteristics (ROC) curve. *Radiology.* 1982;143(1):23–36.
30. Kaiser HF, Rice J. Little Jiffy, Mark IV. *Educ Psychol Meas.* 1974;34:111–117.
31. Bartlett MS. The Effect of Standardization on a chi square Approximation in Factor Analysis. *Biometrika.* 1951;38:337–344.
32. Brown FC, Buboltz WCJ, Soper B. Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in university students. *Behav Med.* 2002;28(1):33–38.
33. Urbán R, Magyaródi T, Rigó A. Morningness-eveningness, chronotypes and health-impairing behaviors in adolescents. *Chronobiol Int.* 2011;28(3):1–11.
34. Beaudreau SA, Spira AP, Stewart A, et al. Validation of the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale in older black and white women. *Sleep Med* 2012;13(1):36–42.
35. Glascoe FP. Screening for developmental and behavioral problems. *Ment Retard Develop Disabil Res Rev.* 2005;11(3):173–179.
36. Lund GH, Reider DB, Whiting BA, Prichard JR. Sleep patterns and predictors of disturbed sleep in a large population of college students. *J Adolesc Health.* 2010 46(2):124–132.

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DISCLOSURE STATEMENT

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