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Validation of the Pittsburgh Sleep Quality Index and the Epworth Sleepiness Scale in Older Black and White Women

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Abstract

Objectives

Despite routine use with older adults, the Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS) have not been adequately validated in older samples, particularly those from diverse racial backgrounds. The objective of this study was to determine the reliability and validity of and to provide normative data for these questionnaires in community-dwelling older women.

Methods

Participants were 306 black and 2,662 white women aged ≥70 from the Study of Osteoporotic Fractures. Participants completed the PSQI and ESS, and provided self-reported assessments of mood, cognition, and functioning, and underwent wrist actigraphy for sleep-wake estimation.

Results

Good internal consistency in both black and white women was demonstrated for the PSQI and ESS. Two PSQI subscales, however, were found to have inadequate reliability (Medications, Daytime Dysfunction). Both the PSQI and ESS were associated with theoretically similar measures in the expected directions. The PSQI also differentiated participants with no reported sleep disorder from those reporting at least one sleep disturbance, such as insomnia, sleep apnea, and restless legs. The ESS only differentiated women reporting no sleep disorder from those reporting insomnia.

Conclusions

In general, findings suggest that the PSQI and ESS are internally consistent, valid measures of self-reported sleep conditions problems in older women. Additional research is required to evaluate the impact of removing the Medications and Daytime Dysfunction PSQI subscales on this measure's internal consistency in older women.

Keywords: sleep, geriatric assessment, actigraphy, oldest old, women, aged

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Sleep disturbances are highly prevalent in older adults. Nearly 70% of elders report problems with their sleep, and 32% to 45% report difficulty falling asleep or maintaining sleep [1, 2]. Additionally, almost 40% of older adults have obstructive sleep apnea as defined by an apnea-hypopnea index ≥ 20 [3]. Research increasingly demonstrates associations between sleep disturbance and poor health outcomes, including falls [4], medical morbidity [5], psychiatric symptoms [6], and cognitive impairment [7]. To better understand the association between disturbed sleep and adverse outcomes, valid and easily administered measures of sleep quality and its daytime consequences are essential.

Questionnaires are available to measure sleep disturbances and sleep-related behavioral outcomes. Self-reported sleep quality is commonly measured with the Pittsburgh Sleep Quality Index (PSQI) [8], and the Epworth Sleepiness Scale (ESS) [9] is often used to quantify excessive daytime sleepiness. The PSQI [10] and ESS [11, 12], in particular, have been used as subjective measures of sleep in epidemiological studies with diverse, older racial or ethnic groups. Despite their routine use with older adults in both research and clinical settings, these measures have not been adequately validated in samples of older adults, particularly those of diverse race or ethnicity. Researchers have suggested that the sleep literature has primarily focused on middle-aged whites, and that normative data on both subjective and objective sleep measures are needed for other race/ethnic groups [13].

The aims of this study were to determine the internal consistency reliability and construct validity of these two self-report sleep measures (PSQI and ESS) and to provide normative data for these measures in black and white community-dwelling women 70 years of age and older. Norms are presented for the total sample and by age, education, and race. Internal-consistency reliability is presented for the total sample and by race. Strengths of using the Study of Osteoporotic Fractures (SOF) cohort for this purpose include the large sample of both black and white women, and the inclusion of two different sleep questionnaires and actigraphy.

METHOD

Participants

Participants were from a larger sample of community-dwelling women, 65 and older, enrolled between September 1986 and October 1988 in the Study of Osteoporotic Fractures (SOF), a prospective cohort study of older women assessed biannually [14, 15]. They were recruited at study sites in Baltimore, MD, Minneapolis, MN, Monongahela Valley (Pittsburgh area), PA, and Portland, OR. The original cohort (n = 9,704) was composed entirely of white women. A second cohort of 662 black women was recruited between February 1997 and February 1998. Of the these white and black participants, 4,111 died, 2,220 did not complete wrist actigraphy, 872 dropped out, 31 were lost to follow-up, and 4 were missing both sleep questionnaires. An additional 160 were excluded from analysis because someone other than participant completed the questionnaire. Participants in the present report were 2,968 women who, during the 8th clinic visit (January 2002–February 2004), completed at least one of the sleep questionnaires under study (i.e., PSQI or ESS) and wrist actigraphy to provide objective estimates of sleep patterns. The research protocol was approved by institutional review boards at all SOF study sites.

Measures

Subjective Sleep Measures

The Pittsburgh Sleep Quality Index (PSQI) [8] is a measure of sleep quality that takes 5-10 minutes to complete. It consists of 19 self-report items plus a 5-item rating made by a bed partner that is not included in scoring. On the self-report items, respondents indicate the amount of sleep they obtained and rate the extent to which various factors interfered with their sleep on a four-point Likert-type scale (0 = not at all, 3 = three or more times a week). These items yield scores on seven subscales: subjective sleep efficiency; sleep latency; sleep duration; sleep quality; sleep disturbance; sleep medication use; and daytime dysfunction due to sleepiness. Subscales yield a score from 0 to 3 and are summed to yield a total score ranging from 0 to 21 with higher total scores (referred to as global scores in the original PSQI validation study) [8], indicating poor sleep quality. A PSQI total score of >5 is indicative of poor sleep [8]. In predominantly middle-aged adults with and without poor sleep, the PSQI has good internal consistency, test-retest reliability, and diagnostic validity [8].

The Epworth Sleepiness Scale (ESS) is an 8-item self-report measure of excessive daytime sleepiness that takes several minutes to complete [9]. Respondents indicate on a four-point Likert-type scale (0 = never, 3 = high chance) the likelihood that they will “doze off or fall asleep” in eight different conditions (e.g., while sitting and reading, riding as a passenger in a car, sitting and talking to someone). Responses are summed to yield a total score from 0 to 24, with higher scores indicating greater sleepiness during common daily activities. The ESS distinguishes between good and poor sleepers in young to middle-aged adults—higher ESS scores are associated with polysomnography (PSG) derived sleep measures in patients with obstructive sleep apnea syndrome (OSAS), and differentiate patients who snore but do not have OSAS from those with OSAS [9]. High ESS scores are observed in patients with narcolepsy, idiopathic hypersomnia, and moderate to severe OSAS [9]. ESS total scores of >10 have been proposed to indicate excessive daytime sleepiness [16].

Participants also completed a questionnaire to indicate whether or not a healthcare provider had told them that they have insomnia, restless legs or periodic leg movements, sleep apnea, or narcolepsy.

Objective Sleep Measures

Actigraphy data were collected with the Sleepwatch-O actigraph (Ambulatory Monitoring, Inc., Ardsley, NY), which participants wore on their non-dominant wrists for ≥72 hours. The Sleepwatch-O contains a cantilevered beam that generates a voltage when moved. These voltages were recorded and summarized in 1-minute epochs. Data were analyzed in proportional integration mode (PIM) using the Action W-2 software (Ambulatory Monitoring, Inc.) and the University of California San Diego scoring algorithm [17, 18]. Further detail regarding the collection and analysis of wrist actigraphy data can be found elsewhere [19, 20]. Actigraphic sleep parameters were computed; those examined in current study were wake after sleep onset (WASO; total amount of time spent awake after initially falling asleep) and daytime inactivity, (i.e., the total amount of time spent asleep or inactive while out of bed). We did not study the associations of total sleep time with the sleep questionnaires as they have been previously examined in the Study for Osteoporotic Fractures (SOF) [21]. Sleep parameters were averaged across 24-hr periods.

Additional Measures

Demographic data, including age and education, were collected at the initial SOF visit. During SOF Visit 8, participants completed measures of general cognitive function (Mini-Mental State Exam, MMSE) [22], Functional Status (mobility and instrumental activities of daily living, IADLs) [23, 24], and depressive symptoms (Geriatric Depression Scale, GDS) [25]. They also reported their medical comorbidities, alcohol and nicotine use, caffeine intake, and the use of benzodiazepines, antidepressants, or psychotropic medications that can impact sleep (non-benzodiazepine sedative-hypnotics).

Statistical Analysis

Of the two sleep questionnaires, only the PSQI was normally distributed; the ESS was not. Thus we report results from parametric tests where appropriate for the PSQI and from non-parametric tests for the ESS.

We computed descriptive statistics for the total sample, separately for black and white women, and stratified by age and education levels. For the PSQI we computed the mean ± standard deviation (SD), or N (%), and for the ESS, we computed the median and the interquartile range (IQR). For each of the two sleep questionnaires (PSQI and ESS), we computed descriptive statistics (for total or subscale scores). A PSQI total score >5 and an ESS score >10 were used to define clinically significant abnormalities, as has been done in studies of young and middle-aged adults. We conducted pairwise comparisons by age group (70–79, 80–84, 85–89, and 90+), educational level (<high school, high school, some college, college, or graduate degree), and race (black or white). For continuous sleep variables we used independent samples t-tests for the PSQI total scores and Wilcoxon signed-rank tests for the ESS total scores, and for categorical sleep variables we conducted chi-square analyses (PSQI total score >5 vs. ≤ 5, and ESS >10 vs. ESS ≤ 10).

To evaluate the reliability of each measure, we calculated internal consistency using the standard raw Cronbach’s alpha = 0.70 as the minimum value for adequate internal consistency. To further evaluate item or subscale fit, we calculated the raw corrected item-total, subscale-total, and item-subscale correlations where appropriate. PSQI subscales are ordinal and the ESS was not normally distributed, thus we used Spearman's rank correlations for both questionnaires. We required item-total, subscale-total, or item-subcale correlations of $r \geq 0.30$ as our criterion for adequate fit.

To determine the construct validity of the PSQI and ESS, we examined their convergent validity—the extent to which each measure was associated with measures of theoretically similar constructs (i.e., Spearman's rank correlations with the other sleep questionnaire and objective sleep measures)—and their discriminant validity—the extent to which measures were associated with measures of theoretically divergent constructs (i.e., Spearman's rank correlations with dissimilar measures). In addition, we conducted Wilcoxon tests for pairwise comparisons of total PSQI and ESS scores between participants reporting ≥1 provider-diagnosed sleep disturbance versus no sleep diagnosis. Only three women reported a history of narcolepsy. Thus, comparisons between the two self-report sleep questionnaires and a diagnosis of narcolepsy were not examined. Many participants had two or more sleep diagnoses; to avoid confounding by another sleep disorder, we compared questionnaire results of participants with and without a self-reported specific sleep diagnoses.

RESULTS

The 2,968 women who completed ≥1 of the two sleep questionnaires (i.e., PSQI and ESS) and actigraphy had a mean ±standard deviation (SD) age of 83.4 ±3.7, and 12.9 ±2.7 years of education. Overall, 306 (10.3%) were black and 2,662 (89.7%) were white. Compared to white women, black women were younger, had fewer years of education, and used less caffeine. Black women were also more likely to have diabetes, hypertension, chronic obstructive pulmonary disease and less likely to report having used benzodiazepine or alcohol during the past 30 days (see Table 1).

Table 1

Participant characteristics (mean ±SD or N (%)) for the overall sample, black women, and white women.

	All women N = 2968	Black women n = 306	White women n = 2662	P-value
Age	83.4 ± 3.7	79.9 ± 4.6	83.8 ± 3.3	<0.001
Years of Education	12.9 ± 2.7	12.5 ± 3.0	12.9 ± 2.6	0.02
Alcohol past 30 days (# of drinks/day)	0.51 ± 0.70	0.34 ± 0.65	0.53 ± 0.71	<0.001
Alcohol past 30 days	1246 (42.0%)	80 (26.1%)	1166 (43.8%)	<0.001
Caffeine intake (mg/day)	150.5 ± 153.2	102.6 ± 112.7	156.0 ± 156.3	<0.001
Current Smoker	78 (2.6%)	19 (6.2%)	59 (2.2%)	<0.001
Benzodiazepine use	216 (7.3%)	14 (4.6%)	202 (7.6%)	0.05
Antidepressant use	386 (13.0%)	30 (9.8%)	356 (13.4%)	0.08
Diabetes	328 (11.1%)	78 (25.5%)	250 (9.4%)	<0.001

	All women N = 2968	Black women n = 306	White women n = 2662	P-value
Hypertension	1790 (60.3%)	238 (77.8%)	1552 (58.3%)	<0.001
Coronary artery disease	569 (19.2%)	65 (21.2%)	504 (18.9%)	0.33
Congestive heart failure	233 (7.9%)	30 (9.8%)	203 (7.6%)	0.18
Chronic obstructive pulmonary disease	359 (12.1%)	49 (16.0%)	310 (11.7%)	0.03

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Descriptive Statistics for PSQI and ESS

Tables 2 and 3 provide the distributions of the total scores and subscales of the PSQI and ESS by age, race, and education. The mean ±SD PSQI total score was 6.3 ±3.6, and 52.2% of the overall sample had a PSQI total score >5, indicating a significant disturbance in sleep quality (Table 2). Participants with less education reported worse sleep quality and were more likely to have a PSQI total score >5 than those with more education. Neither age nor race was significantly associated with PSQI total scores or PSQI total score >5.

Table 2

Descriptive statistics (mean ± SD, or %) for PSQI scores across demographic variables.

	PSQI Total Score	PSQI Quality	PSQI Latency	PSQI Duration	PSQI Efficiency	PSQI Disturbance	PSQI Medications	PSQI Dysfunction	PSQI Global Score >5
Total Sample (n = 2,968)	6.3±3.6	0.9±0.7	1.1±1.0	0.9±0.8	1.0±1.1	1.1±0.5	0.6±1.1	0.8±0.6	52.5%
Age*									
70–79 (n = 244)	6.6±3.9	0.9±0.7	1.0±1.0	1.1±0.8	1.2±1.2	1.2±0.6	0.6±1.1	0.7±0.7	54.9%
80–84 (n = 1,724)	6.3±3.6	0.9±0.7	1.1±1.0	0.9±0.7	0.9±1.1	1.1±0.5	0.5±1.1	0.8±0.6	51.2%
85–89 (n = 819)	6.4±3.7	0.9±0.8	1.2±1.0	0.8±0.8	1.0±1.1	1.1±0.5	0.6±1.1	0.8±0.6	53.0%
90+ (n = 181)	6.6±3.7	0.9±0.8	1.2±1.0	0.8±0.9	1.1±1.1	1.2±0.5	0.6±1.0	0.8±0.5	59.1%
Education**									
< High school (n = 512)	6.7±3.8	1.0±0.8	1.3±1.0	1.0±0.9	1.1±1.1	1.2±0.6	0.5±1.0	0.8±0.6	57.4%c
High school (n = 1,244)	6.4±3.6	0.9±0.7	1.1±1.0	0.9±0.7	1.0±1.1	1.2±0.5	0.6±1.1	0.8±0.6	53.5%
Some college (n = 634)	6.3±3.7a	0.8±0.7	1.1±1.0	0.9±0.7	0.9±1.1	1.1±0.5	0.6±1.1	0.8±0.6	51.0%
College (n = 254)	5.9±3.5 a,b	0.8±0.8	1.0±0.9	0.8±0.7	0.8±1.1	1.1±0.5	0.6±1.1	0.7±0.5	46.5%
Graduate education (n = 322)	6.0±3.5 a	0.8±0.7	1.0±1.0	0.9±0.7	0.8±1.1	1.1±0.5	0.6±1.1	0.8±0.6	47.8%
Race*									
White (n = 2,662)	6.3±3.6	0.9±0.7	1.1±1.0	0.9±0.7	0.9±1.1	1.1±0.5	0.6±1.1	0.8±0.6	52.2%
Black (n = 306)	6.6±3.9	0.8±0.8	1.1±1.0	1.0±0.9	1.2±1.2	1.2±0.6	0.4±1.0	0.7±0.7	54.6%

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Note: PSQI = Pittsburgh Sleep Quality Index; higher scores indicate worse sleep quality (total PSQI scores range from 0–21).

*No significant differences between age categories (p=0.39) or racial groups (p=0.13) for PSQI total score or for age categories (p=0.17) or racial groups (p=0.43) for PSQI >5.

**Significant differences between education categories for PSQI total score (p=0.02) or PSQI >5 (p=0.01).

ap <0.05 compared with < high school education,

bp<0.05 when compared with high school education.

cPSQI Global score>5 more likely to have < a high school education compared with PSQI Global score ≤5, p=0.01.

Table 3

Descriptive statistics (median (IQR), or %) for ESS scores across demographic variables.

	N	ESS	P-value	ESS>10	P-value
Total Sample	2,968	5 (3, 8)		10.8%	
Age			0.14		0.06
70–79	244	5 (3, 8)		11.5%	
80–84	1724	5 (3, 8)		11.8%	
85–89	819	5 (3, 8)		8.3%	
90+	181	5 (3, 8)		10.5%	
Education			< 0.001		0.005
< High school	512	4 (2, 7)		9.4%	
High school	1,244	5 (3, 8) a		10.5%	
Some college	634	5 (3, 8) a		9.9%	
College	254	5 (3, 8) a		8.7%	
Graduate education	322	6 (4, 9) a,b,c,d		16.8%	

	N	ESS	P-value	ESS>10	P-value
Race			0.01		0.003
White	2,662	5 (3, 8)		10.2%	
Black	306	6 (3, 9)		15.7%	

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Note: ESS = Epworth Sleepiness Scale; higher scores indicate greater sleepiness (ESS total scores range from 0 to 24).

ap<0.05 when compared with < high school education,

bp<0.05 when compared with high school education,

cp<0.05 when compared with some college education,

dp<0.05 when compared with college education.

eESS>10 more likely to have graduate education compared with ESS≤10, p<0.001.

As shown in Table 3, the sample had a median (IQR) ESS score of 5 (3, 8). Overall, 10.8% had an ESS score > 10, indicating excessive daytime sleepiness. Participants with the most education reported greater daytime sleepiness and were more likely to have an ESS score >10 compared with those with less education (Table 3 footnote). In addition, black participants reported higher scores on the ESS, indicating greater daytime sleepiness, compared with white participants (6 (3, 9) vs. 5 (3, 8). In addition, black participants were more likely to have an ESS score >10 (15.7% vs. 10.2%). There were no statistically significant differences in ESS score among age categories.

Internal Consistency

The 17 items of the PSQI yielded adequate internal consistency for the PSQI total score in the total sample (α = 0.78), in older white woman (α = 0.78), and in older black women (α = 0.80). The corrected item-total correlations ranged from 0.12 to 0.69. Items assessing “bad dreams” or “other reasons” as explanations for poor sleep, and an item assessing “trouble staying awake” during activities had correlations < 0.30 with the total score in the total sample and within each ethnic group. In the total sample and within the white, but not black group, corrected item-total correlations were < 0.30 for items assessing “trouble sleeping” due to having to use the bathroom, not breathing comfortably, coughing or snoring loudly, feeling too cold, and feeling too hot.

As in the original PSQI validation paper by Buysse et al. [8], we examined the internal consistency (Cronbach’s alpha) of, and corrected correlations between the seven subscales of the PSQI and the PSQI total score. When the seven subscales were treated as the unit of analysis (rather than individual items), they demonstrated adequate internal consistency in the total sample (Cronbach’s α = 0.72), for older white women (α = 0.72), and older black women (α = 0.74). In the total sample, the corrected subscale-total correlation coefficients ranged from 0.24 to 0.62 (see Table 4). These coefficients below 0.30 for the Sleep Medication and Daytime Dysfunction subscales in the total sample and the two racial groups.

Table 4

PSQI: Corrected subscale-total scale correlations.

	Full Sample (N = 2,965) Alpha = 0.72	White Women (n = 2,659) Alpha = 0.72	Black Women (n = 306) Alpha = 0.74
Sleep Subscales	Correlation with Total	Correlation with Total	Correlation with Total
Sleep Quality	0.62	0.63	0.59
Sleep Latency	0.53	0.53	0.51
Sleep Duration	0.47	0.47	0.51
Sleep Efficiency	0.53	0.53	0.51
Sleep Disturbances	0.38	0.37	0.45
Sleep Medications	0.28	0.28	0.29
Sleep Daytime	0.24	0.23	0.27
Dysfunction			

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Note: PSQI = Pittsburgh Sleep Quality Index

The ESS, which contains no subscales, demonstrated adequate internal consistency in the total sample ($\alpha = 0.76$) and in each racial group. Within black women, all corrected item-subscale correlations were ≥ 0.30, indicating adequate homogeneity of ESS items in this group (Table 5). For white participants and for the total sample, all but one corrected item-subscale correlation coefficients was ≥ 0.30—feeling sleepy in traffic ($r = 0.26$ for white women; $r = 0.27$ for the total sample); the other correlations for the white participants and for the total sample ranged from 0.31 to 0.54.

Table 5

ESS: Corrected item-total scale correlations.

	Full Sample (N = 2,968) Alpha = 0.76	White Women (n = 2,662) Alpha = 0.74	Black Women (n = 306) Alpha = 0.81
Sleep Items	Correlation with Total	Correlation with Total	Correlation with Total
Sit/Read	0.54	0.54	0.56
Watching TV	0.51	0.51	0.54
Public Place	0.50	0.50	0.52
Car Passenger	0.50	0.50	0.54
Afternoon	0.38	0.37	0.46
Sit/Talk to Someone	0.34	0.31	0.49
After Lunch	0.49	0.49	0.53
Traffic	0.27	0.26	0.40

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Note: ESS = Epworth Sleepiness Scale.

Construct Validity

Correlations between the two sleep questionnaires (PSQI and ESS) and theoretically relevant measures are presented in Table 6. Multiple measures were significantly associated with poorer sleep quality, as measured by the PSQI total score, such as greater daytime sleepiness on the ESS ($r = 0.11$); greater actigraphic wake after sleep onset ($r = 0.14$); and actigraphic daytime inactivity ($r = 0.05$). We also observed associations in the expected directions between the PSQI and non-sleep measures, including greater depressive symptoms (GDS; $r = 0.31$), a known correlate of sleep disturbance; and greater functional impairment due to mobility/IADL difficulties ($r = 0.18$).

Table 6

Correlations between sleep measures and theoretically relevant measures.

	ESS	Daytime inactivity (by actigraphy)	Total sleep time (by actigraphy)	Wake after sleep onset (by actigraphy)	Trails B	Apnea-hypopnea index	GDS	Mobility/ IADL
PSQI								
Spearman's r	0.11	0.05	−0.02	0.14	0.05	0.03	0.31	0.18
P-value	<0.001	0.01	0.34	<0.001	0.007	0.55	<0.001	<0.001
ESS								
Spearman's r	--	0.15	−0.19	0.05	−0.02	0.12	0.12	0.11
P-value		<0.001	<0.001	0.01	0.28	0.009	<0.001	<0.001

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Note: PSQI = Pittsburgh Sleep Quality Index; higher scores indicate worse sleep quality; ESS = Epworth Sleepiness Scale; higher scores indicate greater sleepiness. GDS = Geriatric Depression Scale; higher scores indicate more depressive symptoms; Mobility/IADL = Mobility/Instrumental Activities of Daily Living; higher scores indicate better functioning.

Like the PSQI, greater daytime sleepiness on the ESS was significantly associated in the expected direction with many theoretically related measures as shown in Table 7. We also examined the association between the ESS and PSQI Daytime Dysfunction subscale, which yielded a Spearman's rank correlation of 0.26, P < 0.001.

Table 7

Scores (mean±SD, median (IQR)) on sleep measures by categories of self-reported sleep disturbance*

	N	PSQI	P-value	ESS	P-value
No reported diagnosis	2688	6.0±3.4		5 (3, 8)	
Insomnia	108	12.1±3.5	<0.001	4 (2, 7)	0.01
Restless legs	129	9.1±3.8	<0.001	5 (3, 9)	0.24
Sleep apnea	26	8.5±3.9	<0.001	6.5 (3, 10)	0.22

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Note:

*All p-values refer to differences between diagnostic categories and no reported diagnosis based on t-tests (for PSQI) and Wilcoxon signed-rank tests (for ESS). PSQI = Pittsburgh Sleep Quality Index; higher scores indicate worse sleep quality; ESS = Epworth Sleepiness Scale; higher scores indicate greater sleepiness.

We also compared mean scores on the two questionnaires among individuals reporting provider-diagnosed insomnia, restless legs syndrome, or sleep apnea (Table 9). Participants reporting restless legs or sleep apnea reported significantly poorer sleep quality on the PSQI compared to those who did not report these diagnoses. Reports of daytime sleepiness on the ESS, however, did not differ between those reporting sleep apnea or restless legs versus those who did not report these diagnoses.

DISCUSSION

In the present study, we determined the internal consistency and construct validity of two self-report sleep assessment instruments—the Pittsburgh Sleep Quality Index (PSQI) and the Epworth Sleepiness Scale (ESS)—in a large sample of community-dwelling older black and white women. Although these measures are routinely used in research and clinical applications with older adults, their reliability and validity had not been established in prior studies in this population. Our findings indicate that, in general, the PSQI and ESS are appropriate for use with older women. In both racial groups, however, we found inadequate internal consistency of two PSQI subscales (Medications and Daytime Dysfunction); and in older white women we found inadequate internal consistency of one ESS item (sleepiness in traffic).

Reliability

We found that the PSQI items had adequate internal consistency in both white and black women, as measured by Cronbach's α. Alphas for the PSQI subscales were smaller than, but on the order of what

Buysse et al. reported in the original PSQI publication [8], and corrected subscale-total correlations for all but two subscales ranged from adequate to good in older white participants. The low subscale-total correlations we observed for the Medications and Daytime Dysfunction subscales suggest that, in both older white and black women, these two subscales fit poorly with the other variables comprising the total score, and should be excluded when using the PSQI to assess sleep quality in this population.

The ESS had good internal consistency and item-total correlations in both racial groups, suggesting it is appropriate to use the ESS total score in older black women; all but one item of the ESS had good item-total correlations in white women—sleepiness in traffic. Black participants reported more daytime sleepiness (higher ESS total scores) compared with white participants, which is consistent with prior research [12].

Overall, the internal consistency on the PSQI and ESS were slightly higher among black versus white participants. Better reliability and validity of these questionnaires among black participants may be related to the younger mean age of our black participants compared with white participants. Compared with white participants, black participants were more likely to have medical comorbidities, such as diabetes and hypertension, which are known correlates of sleep disturbance. Prior studies have found that racial and ethnic differences in sleep disturbance, such as sleep disordered breathing, may be eliminated when models adjust for health-related factors such as body mass index [26]. In addition, black participants in our study were using fewer psychotropic medications and consuming less caffeine and alcohol, which may also account for greater internal consistency of these sleep measures among black participants compared with white participants. Further research is needed to determine if between racial group differences in these measures are indeed better explained by age, medical burden, medication usage, or caffeine and alcohol intake.

Validity

We observed significant correlations between the two sleep questionnaires and theoretically related constructs, supporting each of the questionnaires' convergent validity. Indeed, we found numerous correlations of modest magnitude that were statistically significant, but likely are of modest clinical significance. Correlations between sleep questionnaires and objective sleep measured by actigraphy were small, whereas the correlation between depressive symptoms and the PSQI was moderate. This is consistent with other studies that have found subjective measures of sleep, such as the PSQI, to be more highly correlated with psychological states, such as depression, than objective ones, such as actigraphy [27, 28].

The ESS was associated with actigraphic daytime inactivity. A previous investigation with SOF participants also found an association between ESS and the apnea hyponea index (AHI) and total sleep time (TST) measured by actigraphy; these associations with AHI and TST were not significant for the PSQI [21]. In addition, the current study found a moderate association between the ESS and PSQI Daytime Dysfunction subscale, providing further validation of the ESS and this PSQI subscale.

The PSQI was correlated with participant report of clinician-identified sleep disorders versus no sleep diagnosis. Elevated ESS scores were associated with the report of the clinician diagnosed insomnia, but not with the presence of clinician-identified restless legs or periodic leg movements, or sleep apnea, although the latter association may have been limited by the small power of this analysis (only 26 participants reported a diagnosis of sleep apnea). Further, the ESS is not meant to be a measure of sleep apnea, but rather, of sleepiness that might be indicative of sleep apnea or some other sleep disorder.

The present study has certain limitations. Results from this study may not generalize to older men, other racial or ethnic groups, or to younger individuals. In addition, data were obtained from the eighth SOF study visit. Thus, selective attrition of participants due to medical morbidity or mortality may have produced a sample comprised of the healthiest SOF participants. Future studies of the validity and reliability of these measures are needed in a diverse population of older men. Further, the current study did not use a structured clinical interview or clinical assessment sleep disorders (e.g., by a sleep medicine specialist, or with PSG) to detect the presence of a clinical sleep disorder; participants reported provider diagnoses of sleep disturbance. Self-reported diagnoses provide an approximation of participants who may have current sleep disorders, but may in fact underestimate how many participants have clinical sleep disorders. Studies utilizing clinically validated measures of the presence of a sleep disorder may provide more robust associations of the significant associations found in this study. Finally, this study examined standard cut-points for clinical significance (>5 for the PSQI, >10 for the ESS). Future studies with sleep disorder diagnoses based on clinical evaluations should evaluate the senstivity and specificity of these cut-points and others for the valid assessment of clinically defined sleep disorders in older adults.

In summary, this study provides evidence to support use of the PSQI and ESS to assess sleep in older black or white women. In particular, the ESS total score is appropriate for both groups, with the exception of the item about sleepiness in traffic in white women. Our findings suggest that, while the PSQI global score and the majority of the PSQI subscales are reliable and valid in older black and white women, researchers should not interpret the Medications or Daytime Dysfunctions subscales of the PSQI in these populations. Items used to compute these two PSQI subscales should remain in the measure until further validation studies have been completed, as removal of these items could change the reliability and validity of the overall measure.

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Footnotes

Disclosure Statement

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