Psychometric Evaluation of the Pittsburgh Sleep Quality Index in Cancer Patients

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Abstract:
This report summarizes findings related to the psychometric properties (internal consistency and construct validity) of the Pittsburgh Sleep Quality Index (PSQI) and discusses issues related to its use based on data from two clinical studies with diverse samples of cancer patients. Subjects completed a questionnaire that included the PSQI, the Schwartz Cancer Fatigue Scale, and specific demographic, disease, and treatment variables. There were complete data on 170 (of 214) cases in Study 1 and 249 (of 259) cases in Study 2. The Cronbach's alpha for the Global Sleep Quality scale was 0.81 in Study 1 and 0.77 in Study 2. A comparison of Global Sleep Quality in two contrasting groups with low and high fatigue yielded statistically significant differences in both samples. Psychometric evaluation supports its internal consistency reliability and construct validity. However, the scoring is rather cumbersome and raises questions regarding level of measurement and appropriate analysis techniques.
Key Words: Cancer, sleep, insomnia, measurement, psychometrics, medical oncology, neoplasm

Article:
INTRODUCTION
Sleep disturbances can seriously influence physical and mental well-being as well as quality of life. These effects are often more pronounced in individuals who are facing the multiple consequences of a serious and life- threatening illness such as cancer. There is some evidence that cancer patients have more problems sleeping than healthy individuals and that the degree of difficulty in initiating and maintaining sleep for cancer patients may even be as high as in suicidal patients or known insomniacs.[1] Sleep deprivation can have profound physical effects including fatigability, pain intolerance, and decreased immune functioning as well as emotional consequences such as irritability, depression, and decreased pleasure in work and social activities.[2]

Research on sleep in cancer patients has been limited by the lack of an effective measurement tool for clinical trials. There are few empirical data using psychometrically sound measures about the real prevalence and nature of sleep[s] disturbances in cancer patients. [4] It is not known which types of patients are more likely to have significant problems and whether there is a relationship between sleep disturbances and demographic characteristics, type of cancer, extent of disease, or type of treatment. It has been proposed that other common symptoms in cancer

patients such as pain, fatigue, anxiety, and depression may be associated with sleep disturbances but the strength and significance of these relationships is not known. Advancing the science in this area, including clinical trials of interventions to improve sleep, will require consistent use of measures with established reliability and validity in cancer patients. The purpose of this report is to summarize findings related to the psychometric properties of a self- report tool, the Pittsburgh Sleep Quality Index (PSQI), and to discuss issues related to its use based on data from two clinical studies with diverse samples of cancer patients.

Sleep Measurement: Polysomnography and Actigraphy

There are numerous approaches to sleep measurement that range in expense and ease of use. Tools that measure various aspects of sleep include polysomnography, actigraphy, and self-reports including sleep logs and questionnaires. Polysomnography, or all-night sleep recordings, is considered the most accurate measure of sleep and yields measures of specific sleep stages. Polysomnography monitors sleep-related physiologic parameters such as respiratory, neuromuscular, cardiac, gastrointestinal, and endocrine functions.[5] Parameters may be measured by electroencephalogram (EEG) (the core of polysomnography), electrooculogram (EOG), electrocardiogram (ECG), or electromyogram (EMG) readings. Although polysomnography is the physiologic "gold standard" to monitor sleep, it is most often utilized in a sleep lab that can be expensive, inconvenient, cumbersome, or uncomfortable. These reasons may explain why no clinical studies in cancer patients have used polysomnography.

An alternative but less inexpensive approach is the use of actigraphy, an instrument that records a patient's movement pattern over a period of time. The wrist actigraph is a small device that can be worn on the wrist or leg.[6] Movement data from internal motion sensors is transferred to a computer for an analysis of standard descriptors of sleep and wake periods. Each actigraphy wristwatch costs about US$ 1,000 and data management and interpretation can be time-intensive, thus its applicability in large-scale clinical trials may be limited.

Recent research with cancer patients has used actigraphy. Miaskowski and Lee reported that cancer patients (n = 24) receiving radiation therapy experienced significant sleep disturbances as measured by actigraphy. Furthermore, those who were given a higher proportion of their radiation treatment dose reported more sleep problems.[7] Berger and Farr used actigraphy to study 72 women receiving chemotherapy. They reported an increased number of nighttime awakenings that were associated with increased fatigue.[8]

Sleep Measurement: Self-Report

Self-report measures are the most common approach to measuring sleep and include sleep diaries, sleep logs, and questionnaires. These non-physiologic measures of sleep have multiple utility and can allow comparison between sleep parameters, monitor adherence to therapy, facilitate longitudinal data collection, evaluate treatment progress, monitor symptoms, and promote self management.[9] Sleep logs can be used to give a day-to-day account of sleep activities 24 hours per day over a period of time. The advantages of self reports include their ease of use, convenience, low expense, reflection of the natural setting, relative non- obtrusiveness, and recording of the person's perceived sleep experience. Disadvantages of self-reports consist of their subjectivity; they may also be burdensome if used daily. They are subject to reporting-

bias and may yield missing data when respondents do not answer all items or inaccurate data if participants fail to complete them in a timely way.[9,10]

Numerous clinical studies on side effects of cancer treatment, cancer pain, and quality of life in cancer patients use self-report measures. In a recent review of 15 prevalence studies in diverse cancer populations, most reported findings from a single question embedded in another instrument. Between 30–50% of patients reported sleep difficulties of some type.[3] In a more comprehensive, 82-item, investigator- designed survey of 150 patients with breast and lung cancer, Engstrom et al. found that 44% reported "a problem with sleep disturbances" during the past month. In a follow-up interview with those experiencing problems, 57% reported the severity of the sleep disturbance as at least moderate in intensity.[11] In a small comparative study of subjective reports of sleep patterns of cancer patients to a control group, cancer patients were three times more likely to experience sleep difficulties; specifically, many faced increased difficulty with sleep onset.[12]

The Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a self-report questionnaire that assesses sleep quality and quantity. The original version was designed to measure sleep reports over a one-month interval. [13] The19-item self-report questionnaire yields 7 component scores: subjective sleep quality, sleep latency, duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. There are five additional questions that are completed by a bed partner if there is one. These are not used in the scoring. A Cronbach's alpha of 0.83 was reported for the *Global Sleep Quality* scale. A *Global Sleep Quality* score greater than 5 discriminated between good and poor sleepers and yielded a diagnostic sensitivity of 89.6% and specificity of 86.5%.[13,14] There is evidence of the reliability and validity of the PSQI in the elderly, [14,15] bereaved spouses, [16] patients with AIDS,[1 7] panic disorder,[18] and phobias.[19] Additionally, the PSQI has demonstrated sensitivity in measuring the effectiveness of drugs [20] and exercise. [21]

There is limited research on the use of the PSQI with cancer patients: one study with 15 patients and a historical control and one study limited to women with breast cancer following treatment. Owen et al. used the PSQI to compare a small sample of 15 cancer patients to 52 healthy individuals. [22] They found that the cancer patients had significantly poorer overall sleep quality and scored significantly worse on 5 of the 7 component scores. Carpenter and Andrykowski found in their research of the psychometric evaluation of the PSQI that it demonstrated utility for self-administration, internal consistency reliability (alpha = 0.80 across all diagnostic groups), and construct validity across a variety of clinical populations, including a group of 102 women with breast cancer receiving routine follow-up care. [23] They recommended that a cut-off score of >8 (vs. 5 as recommended by the tool developers) may be more appropriate to determine poor sleep in clinical populations.

Evidence to support the reliability, validity, and sensitivity of the PSQI in patients with diverse types of cancer and undergoing active treatment is lacking and essential to support its use as an outcome measure in future clinical studies. This report summarizes an analysis of two clinical studies and includes: 1) discussion of missing data and issues related to scoring and feasibility; 2) an evaluation of reliability using an item analysis and reliability analysis to determine internal

consistency; and 3) an assessment of construct validity by contrasting sleep quality in two groups—one with low and one with high fatigue using independent group *t*-tests. Data for these analyses come from two clinical studies with diverse samples of cancer patients with a variety of primary diagnoses and including patients receiving radiation therapy and chemotherapy. Both studies were approved by the Institutional Review Boards at their respective institutions.

METHODS

Study One

This cross-sectional study was designed to evaluate the psychometric properties (i.e., internal consistency and construct validity) of the PSQI (adapted for a one-week time interval) in a heterogeneous sample of cancer patients. The study used a prospective, consecutive sampling approach. All patients who were receiving care in three settings (outpatient oncology, radiation therapy, and inpatient oncology) at the University of Utah (UU) in Salt Lake City, Utah, during a designated time period were screened for study eligibility and invited to complete a questionnaire. Completion of the questionnaire implied voluntary consent to participate. The symptom questionnaire included several tools but those reported here include the PSQI[13] and the Schwartz Cancer Fatigue Scale (SCFS).[24] The SCFS is a short, 6-item instrument that asks the respondent to rate "how much has fatigue made you feel (e.g. tired)?" on a five-point verbal numeric scale with 1 being not at all and 5 being extremely. Two subscales can be computed that measure physical and perceptual fatigue. The reliability and validity [24.25] of this tool have been established. Both tools were framed within the context of "the past week."

Of those who were eligible, 214 patients consented to participate (radiation therapy $n = 81$, outpatient oncology clinic $n = 86$, and inpatient oncology unit $n = 47$). The study demographic characteristics are summarized in Table 1. Forty-nine percent were female and age ranged from 14 to 88 years, with a mean age of 53 years. Racial/ethnic diversity was limited; 92.3% were Caucasian, reflective of the state's population at that time. The patients had multiple types of cancer as a primary diagnosis (see Table 2); 19.6% had breast cancer and 47.1% of the patients had advanced disease.

Study 2

The second longitudinal study addressed similar aims by a secondary analysis using data from a randomized clinical trial to compare an energy conservation/activity management

Table 1
Demographic Characteristics of the Two Study Samples

Characteristic	Study 1 (n = 214)		Study 2 (n = 259)	
	n	%	*n*	%
Sex				
Female	103	49.0	231	89.2
Male	107	51.0	28	10.8
Race/Ethnicity				
White	193	92.3	235	90.7
African American	1	0.5	15	5.8
Hispanic	7	3.3	5	1.9
Native American	5	2.4	–	–
Asian/Pacific Islander	3	1.4	–	–
Other			2	<1
Marital Status				
Married/Living with Partner	142	67.9	182	70.8
Single	28	13.4	20	7.8
Separated or Divorced	21	10.1	29	19.1
Widowed	18	8.6	26	29.2
Education				
Less than High School	19	9.2	7	2.7
High School or GED	57	27.4	74	28.4
Some college/technical	57	27.4	89	34.6
Associate Degree plus	75	36.1	88	34.2
Income				
Less than 15,000/year	42	22.9	–	–
15,000 to 35,000/year	46	25.1	–	–
35,000 to 50,000/year	31	16.9	–	–
50,000 to 70,000/year	28	15.3	–	–
More than 70,000	36	19.7	–	–

Table 2
Number and Percent of Individuals with a Cancer Primary Site in Each Sample

Site	Study 1 (n = 214)		Study 2 (n = 259)	
	n	%	*n*	%
Breast	41	19.6	204	78.8
Lymphoma/Leukemia	41	19.6	16	6.2
Prostate/Testicular	25	11.9	–	–
Lung	14	6.5	30	11.6
Melanoma	11	5.3	–	–
Cervical/Ovarian	9	4.3	5	1.9
Colorectal	4	1.9	4	1.5

(ECAM) intervention with an attentional control group for the management of cancer treatment-related fatigue. [26] The intervention consisted of structured information about energy conservation and activity management combined with training in skills for coping with fatigue in an emotionally supportive context. The attentional control group received nutrition information unrelated to fatigue or treatment and was designed to provide the amount of instruction equivalent to the ECAM intervention. The intervention was delivered by telephone by a nurse counselor. Participants received three phone calls to discuss educational materials sent in the mail and consequently developed and implemented an action plan.

The sample included men and women, over age 18, who were initiating treatment for breast, lung, colorectal, cervical, testicular, prostate, and lymphoma cancers. The treatment was for cure or local control and involved at least three cycles of chemotherapy, 5–6 weeks of radiation therapy treatments, or concurrent radiation and chemotherapy. This study was implemented at two clinical sites; Fox Chase Cancer Center (FCCC) in Philadelphia, Pennsylvania and the Huntsman Cancer Institute at the University of Utah (UU) in Salt Lake City, Utah. In addition to the PSQI, eight other instruments were utilized in this study, including the Schwartz Cancer Fatigue Scale. [24] The PSQI questions were framed within the context of the sleep experience during the past month, which is the original version. Data were collected at three time points, which varied by treatment regimen. In the chemotherapy and concurrent group, measures were at baseline and 48 hours following the second and third chemotherapy administrations. In the radiation therapy group, measures were at baseline, during the last week of treatment, and one month following treatment. Time 3 data were utilized in this analysis.

Research staff initially screened individuals who were diagnosed with eligible cancers and scheduled for initial evaluations. They then explained the study objectives and procedures to eligible individuals; those interested provided written consent to participate. The individual then completed the baseline questionnaires. If contact was made by phone, questionnaires and consent forms were mailed to participants. After reviewing returned questionnaires, research staff called participants if responses were not complete.

The sample at Time 3 included 259 cancer patients aged 26 to 83 years, with a mean age of 56.6 years. One hundred twenty-nine (49.8%) were receiving radiation therapy and 130 (50.2%) were receiving chemotherapy or concurrent therapy. The study demographic characteristics are summarized in Table 1. More (89.2%) were female and 90.7% were Caucasian. Although all target cancer diagnoses were represented (see Table 2), the majority (78.8%) had breast cancer.

RESULTS

There are 19 individual questions in the PSQI. The scoring of these questions transforms them into seven components, each ranging from 0 to 3, with a higher score representing poorer sleep quality. Some questions are simply re- coded and others combine 2–9 questions and then recode responses to yield a 0 to 3 scale. 13 The sum of these 7 components yields a *Global Sleep Quality* score ranging from 0 to 21. The scoring is prescribed in the original methodological paper but has several glitches, such as overlapping categories. Clarifications to the scoring as used in these analyses are detailed in Appendix 1.

In order to compare the psychometric properties of the PSQI with reports in other populations, each of the seven component scores is treated as an "item" in the analysis. In addition, the results from several of the original questionnaire variables are reported as they may be more clinically relevant and sensitive to change in the cancer patient population.

Analysis of Missing Data

The first step in the analysis was to evaluate individual questions to identify the pattern of missing data. Unless corrected in the analysis, each missing question can result in a missing item and a missing *Global Sleep Quality* score. A large amount of missing data can influence the

reliability of the tool and bias the findings. The number and percent missing for each component are summarized in Table 3. The cumulative effect in the ability to compute the *Global Sleep Quality* score was marked in Study 1, as 21% of cases were lost. This was decreased to 4.2% in Study 2, as participants were called to follow-up on missing questions.

Item and Reliability Analysis

The second step in the analysis was to evaluate the range and variance of responses to each item, that is, component score, following the recoding to 0–3. Responses included the range of all possible scores for each of the seven items. The *Global Sleep Quality* score ranged from 0 to 21 in Study 1 and 1 to 19 in Study 2. The highest possible score would be 21. The means and standard deviations for each sample are summarized in Table 4. In Study 1, the mean component scores ranged from 0.99–1.48; in Study 2, the means ranged from 0.85–1.47. The item-to-item correlation matrix was examined to identify items with low (less than 0.30, indicating minimal contribution) or high (greater than 0.70, indicating redundancy) correlations. There were no item–item correlations greater than 0.70, indicating little redundancy in the items. In Study 1, six correlations were less than 0.30; three were for component 6, *Use of Sleeping Medication*, and three were with component 7, *Daytime Dysfunction*. These

Table 3
Percent of Missing Data for Each Component Score

	Study 1 (n = 214)		Study 2 (n = 259)	
Component Scores (0–3)	n	%	n	%
1. Subjective sleep quality	4	2	1	<1
2. Sleep latency	11	5	3	1
3. Hours of actual sleep	6	3	0	0
4. Sleep efficiency	21	10	6	2
5. Sleep disturbances	14	7	8	3
6. Use of sleeping medication	4	2	0	0
7. Daytime dysfunction	7	3	0	0
Global Sleep Quality (1–21)	44	21	11	4

Table 4
Mean and Standard Deviation for Each Component Score and Other Key Variables

	Study 1 (n = 214)		Study 2 (n = 259)	
Component Scores (0–3)	Mean	SD	Mean	SD
1. Subjective sleep quality	1.18	0.83	1.10	0.73
2. Sleep latency	1.25	1.05	1.06	0.95
3. Sleep duration	1.00	1.05	0.90	0.91
4. Habitual sleep efficiency	0.99	1.18	0.87	1.11
5. Sleep disturbances	1.48	0.58	1.47	1.62
6. Use of sleeping medication	1.07	1.35	0.85	1.23
7. Daytime dysfunction	1.18	0.85	1.04	0.70
Global Sleep Quality (1–21)	8.15	4.70	7.31	4.03
Total sleep disturbance (0–30 possible)	10.60	5.31	8.33	4.28
Minutes to fall asleep	27.76	30.60	22.44	25.48
Sleep efficiency in percent	0.81	0.17	0.82	0.14

may represent distinct concepts, but it would be difficult to factor analyze as these are only single questions. In Study 2, the pattern was similar except there were also three low correlations with component 5, *Sleep Disturbances*.

A reliability analysis of the 7 component score items was conducted using SPSS 11.0. The corrected item-to-total (i.e., Component-toGlobal) correlations and Cronbach alpha coefficients if the item were deleted are summarized for each sample in Table 5. In Study 1, the Component-to-Global correlations ranged from 0.38–0.64. In Study 2, the Component-to-Global correlations ranged from 0.32–0.63. In both, components 6 and 7 were lowest. The overall scale alpha was 0.804 in Study 1 and 0.770 in Study 2. The alpha increased minimally by deleting component 6 (*Use of Sleeping Medication*) in Study 2.

Validity Analysis

The construct validity was examined by comparing the *Global Sleep Quality* scores in two contrasting groups: low fatigue and high fatigue. The mean score on the SCFS (possible 1 low to 5 high) was categorized into two groups. Those with a fatigue score from 1 to 3 were categorized as low and from 3.1 to 5 as high. Scores on the PSQI *Global Sleep Quality* were compared using independent *t*-tests (Table 6). The findings indicate that the *Global Sleep Quality* score was significantly higher (indicating poorer sleep) in the high fatigue groups. This was true in both samples and supports the construct validity of the PSQI.

DISCUSSION

In order to effectively study the sleep problems that cancer patients experience, it is necessary to identify valid and reliable tools to measure sleep that can be easily administered in the clinical or home setting. The PSQI is a self-administered questionnaire that collects data regarding multiple facets of sleep quality. It takes 5–10 minutes to complete.

Table 5
Reliability Analysis of PSQI in Two Samples

	Study 1 (n = 214)		Study 2 (n = 259)	
Component Scores	Corrected Item-Total Correlation	Alpha if Item Deleted	Corrected Item-Total Correlation	Alpha if Item Deleted
1. Subjective sleep quality	0.63	0.744	0.63	0.695
2. Sleep latency	0.55	0.753	0.56	0.699
3. Sleep duration	0.62	0.739	0.53	0.707
4. Habitual sleep efficiency	0.64	0.735	0.57	0.695
5. Sleep disturbances	0.53	0.771	0.40	0.736
6. Use of sleeping medication	0.39	0.801	0.32	0.772
7. Daytime dysfunction	0.40	0.781	0.37	0.741
Total Standardized Alpha		0.808		0.770

Table 6
Comparison of Global PSQI in Groups with Low and High Fatigue

Group	Global Sleep Quality Mean	SD
Study 1		
Low fatigue ($n = 104$)	6.82	4.57
High Fatigue ($n = 56$)	10.20	4.28
t	−4.556	
Significance	$P < 0.001$	
Study 2		
Low fatigue ($n = 214$)	6.88	3.77
High Fatigue ($n = 42$)	9.50	4.52
t	−3.52	
Significance	$P < 0.001$	

When self-administered, there can be a significant amount of missing data unless the questionnaire is reviewed for completion and missing items are revisited with the respondent. In Study 1, the question about "usual bed time" had a high percent missing. Many people would write in yes versus indicating a time. This resulted in an inability to accurately compute *Sleep Efficiency*. Several analytic strategies can be applied to not lose cases in the scoring. For example, in computing the *Sleep Disturbances*, the sum was computed by recoding missing items as 0 so all subjects with at least one response would have a score. In computing the *Global Sleep Quality*, several approaches can be applied. It is possible to impute a mean score for a missing component based on the other components. An alternate approach was used in Study 2. A *Global Sleep Quality* computation was allowed if at least 5 of the 7 components were present. A mean of the non-missing components was computed and the result multiplied by 7 to give a comparable score. The mean sum in using this approach was 7.308 with 259 cases, as compared to 7.297 with 249 cases when only complete cases were included.

There are a few other practical points of interest. Because patients report time data (e.g., time that you usually go to bed), it is wise to determine the type of time and format that will be used to enter the data a priori. Military time is recommended. In addition, it is useful to establish a system to cross check the multiple computerized calculations. For example, importing data into an Excel spread sheet can allow for cross-checking the hours in bed and sleep efficiency calculations. This approach allows easier detection of problems that may be formulaic or unusual cases in which original data should be verified.

The evidence from these two studies supports the internal consistency (reliability) of the PSQI in these two samples of cancer patients. These findings are similar to those reported in the tool development in which the Cronbach's alpha was 0.83[13] and in two other studies in which the alpha ranged from 0.80 to 0.83.[22,23] Each of the seven components contributes to the measurement of the overall construct of sleep quality. Another similar finding is that the largest item-total (Component-to-Global) coefficients were found for habitual sleep efficiency and sleep quality. In these studies, *Use of Sleeping Medication* and *Daytime Dysfunction* had the lowest Component-to-Global correlations, while in the original study, *Sleep Disturbances* had the lowest item-total (Component-to-Global) correlation. Additional research to replicate these findings and to test sensitivity and test–retest reliability in cancer patients is recommended.

The findings from these two studies also support the construct validity of the PSQI. Using a contrasting groups approach, there were significant and clinically relevant differences in *Global Sleep Quality* between groups with low and high fatigue in both samples. This finding is similar to the significant difference in sleep quality found by Buysse et al between controls and patients with depression. [13] Additional research might consider factor analysis to evaluate whether the PSQI only measures one construct or has subscales. This approach seems reasonable conceptually (e.g., is *Sleep Efficiency* different than *Sleep Latency*?), but is limited mathematically by the 7 component scores that are built into the scoring of tool and limited number of total questions (n = 19). Most components, except *Sleep Disturbances*, are based on one or two questions.

One limitation of the scoring approach used in the PSQI is that the level of measurement and potential variance are decreased as questions are combined and rescored. This is true in particular with *Minutes to Fall Asleep* and *Sleep Efficiency* (a computed percent: hours asleep/ hours in bed), which are interval level data. Another problem with *Sleep Efficiency* is that the computed percent may be greater than 100%. This was true for 10 cases (3.9%) in Study 2. This phenomena is explainable as subjects answer individual questions (e.g., what time do you usually go to bed) that are used to compute sleep efficiency with an average for a week or month. This does not really pose a problem in the scoring as all *Sleep Efficiency* ratings greater than 85% received a score of "0". However, if *Sleep Efficiency* is used as a percentage variable, these scores will inflate the mean. One approach is to recode values greater than 100% to equal to 100%. The scoring scheme also yields a loss of data in regards to *Sleep Disturbances*. This item could range from 0 to 27 and is reduced to 0–3 in the scoring, thus losing sensitivity. In cancer patients, specific causes of sleep disturbance, such as pain, are relevant clinically and as a confounding variable in research. An alternative approach is to evaluate these items as outcomes independent of the components or scoring instructions.

In conclusion, the PSQI is a relatively easy-to-administer tool that can measure sleep quality over a period of time. Psychometric evaluation supports its internal consistency (reliability) and construct validity in cancer patients. The scoring is rather cumbersome and raises questions regarding level of measurement and appropriate analysis techniques. Additional research should examine the test-retest reliability of the PSQI and sensitivity to change, and further evaluate its construct validity. Research in cancer patients with greater ethnic and racial diversity is recommended to further support its use as an outcome measure in clinical studies.

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Appendix 1
Scoring the PSQI

Original Scoring		Revised Scoring	
Component 3 Sleep Duration		Component 3 Sleep Duration	
>7 hours	0	>7 hours	0
6–7 hours	1	>6 and ≤7 hours	1
5–6 hours	2	≥5 and ≤6 hours	2
<5 hours	3	<5 hours	3
Component 4 Sleep Efficiency		Component 4 Sleep Efficiency	
>85%	0	>85%	0
75–84%	1	75–85%	1
65–74%	2	65–74%	2
<65%	3	<65%	3