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The Pittsburgh Sleep Quality Index: A New Instrument for Psychiatric Practice and Research

Daniel J. Buysse, Charles F. Reynolds III, Timothy H. Monk, Susan R. Berman, and David J. Kupfer

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Abstract. Despite the prevalence of sleep complaints among psychiatric patients, few questionnaires have been specifically designed to measure sleep quality in clinical populations. The Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire which assesses sleep quality and disturbances over a 1-month time interval. Nineteen individual items generate seven "component" scores: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The sum of scores for these seven components yields one global score. Clinical and clinimetric properties of the PSQI were assessed over an 18-month period with "good" sleepers (healthy subjects, $n = 52$) and "poor" sleepers (depressed patients, $n = 54$; sleep-disorder patients, $n = 62$). Acceptable measures of internal homogeneity, consistency (test-retest reliability), and validity were obtained. A global PSQI score > 5 yielded a diagnostic sensitivity of 89.6% and specificity of 86.5% (kappa $= 0.75$, $p < 0.001$) in distinguishing good and poor sleepers. The clinimetric and clinical properties of the PSQI suggest its utility both in psychiatric clinical practice and research activities.

Key Words. Sleep, sleep quality, depression, sleep disorders.

"Sleep quality" is an important clinical construct for two major reasons. First, complaints about sleep quality are common; epidemiological surveys indicate that 15-35% of the adult population complain of frequent sleep quality disturbance, such as difficulty falling asleep or difficulty maintaining sleep (Karacan et al., 1976, 1983; Bixler et al., 1979; Lugaresi et al., 1983; Welstein et al., 1983; Mellinger et al., 1985). Second, poor sleep quality can be an important symptom of many sleep and medical disorders. One frequently measured component of sleep quality, sleep duration, may even have a direct association with mortality (Kripke et al., 1979).

Sleep quality complaints are particularly relevant to psychiatry. Factors relating to anxiety and stress are one of the most important concomitants of sleep complaints in the general population (Karacan et al., 1983), and insomnia associated with psychiatric disorders is the most prevalent type of insomnia seen in sleep disorders centers, accounting for 35% of diagnoses (Coleman, 1983). Furthermore, sleep

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Daniel J. Buysse, M.D., is Assistant Professor; Charles F. Reynolds III, M.D., is Professor; Timothy H. Monk, Ph.D., is Associate Professor; Susan R. Berman is Research Associate; and David J. Kupfer, M.D., is Professor and Chairman, Department of Psychiatry, University of Pittsburgh School of Medicine. (Reprint requests to Dr. C.F. Reynolds III, Western Psychiatric Institute and Clinic, University of Pittsburgh, 3811 O'Hara St., Pittsburgh, PA 15213, USA.)

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quality disturbances are frequently reported in essentially all psychiatric disorders, including depression, schizophrenia, anxiety disorders, and psychoactive substance use disorders.

Although sleep quality is a readily accepted clinical construct, it represents a complex phenomenon that is difficult to define and measure objectively. "Sleep quality" includes quantitative aspects of sleep, such as sleep duration, sleep latency, or number of arousals, as well as more purely subjective aspects, such as "depth" or "restfulness" of sleep. However, the exact elements that compose sleep quality, and their relative importance, may vary between individuals. Furthermore, because sleep quality is largely subjective, sleep laboratory measures may correlate with perceived sleep quality, but they cannot define it. Finally, the measurement of sleep quality is affected by the type of study in which it is being examined. Large-scale population surveys generally focus on a few general questions about habitual sleep quality and types of sleep disturbances (e.g., Bixler et al., 1979; Karacan et al., 1983). Studies that examine the previous night's sleep (drug efficacy studies, for example) may focus on more subjective, comparative aspects of sleep quality, such as depth of sleep, restfulness, and feelings upon awakening (e.g., Frankel et al., 1976; Webb et al., 1976; Parrott and Hindmarch, 1978).

Given the importance of the construct and the inherent difficulties in its definition and quantification, it is important to have a clinical instrument that measures sleep quality. It is also necessary, however, to assess the "clinimetric" properties (i.e., properties such as sensibility, accuracy, comprehensibility, and reproducibility) of the instrument, all of which are essential to the description and valid measurement of complex clinical phenomena (Feinstein, 1987). Although many sleep questionnaires have been described in previous studies, they share several general difficulties. First, very few of them have used specified time intervals for assessment. Second, previous questionnaires have not been designed to yield a simple, global score to facilitate comparisons between groups or individuals. Third, few of these studies have directly assessed clinimetric properties of the questionnaires. Finally, previous questionnaires have been used primarily with unselected population samples or nonclinical control subjects.

The Pittsburgh Sleep Quality Index was developed with several goals: (1) to provide a reliable, valid, and standardized measure of sleep quality; (2) to discriminate between "good" and "poor" sleepers; (3) to provide an index that is easy for subjects to use and for clinicians and researchers to interpret; and (4) to provide a brief, clinically useful assessment of a variety of sleep disturbances that might affect sleep quality. This article describes the instrument and its clinimetric properties, including internal homogeneity, performance consistency, and validity.

Methods

Instrument Development and Description (Appendix). Items in the Pittsburgh Sleep Quality Index (PSQI) were derived from three sources: clinical intuition and experience with sleep disorder patients; a review of previous sleep quality questionnaires reported in the literature; and clinical experience with the instrument during 18 months of field testing.

The PSQI assesses sleep quality during the previous month. This is a time frame intermediate between postsleep inventories (which assess only the previous night's sleep) and

survey-type questionnaires (which assess difficulties over the previous year or more). A postsleep questionnaire may reflect more accurately the night-to-night variations that occur in sleep quality, but it does not provide information about the frequency or duration of specific problems that may lead a patient to seek help. On the other hand, survey-type questionnaires may not indicate the severity of a particular problem at the present time. In addition, a duration of 2-3 weeks is often used clinically to differentiate transient from persistent sleep-wake disorders (Consensus Conference on Insomnia, 1984). Therefore, administering the PSQI on two occasions separated by approximately 1 month allows for the discrimination of most transient and persistent disturbances.

The PSQI consists of 19 self-rated questions and five questions rated by the bedpartner or roommate. The latter five questions are used for clinical information only, are not tabulated in the scoring of the PSQI, and are not reported on in this article. The 19 self-rated questions assess a wide variety of factors relating to sleep quality, including estimates of sleep duration and latency and of the frequency and severity of specific sleep-related problems. These 19 items are grouped into seven component scores, each weighted equally on a 0-3 scale. The seven component scores are then summed to yield a global PSQI score, which has a range of 0-21; higher scores indicate worse sleep quality.

The seven components of the PSQI are standardized versions of areas routinely assessed in clinical interviews of patients with sleep/wake complaints. These components are subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction. Scoring of each component is illustrated in the Appendix. Subject instructions for the PSQI are contained in the text. The entire index requires 5-10 min for the subject to complete, and 5 min to score.

Subjects. The PSQI was administered to three groups of subjects during an 18-month study period. Group 1 consisted of "good" sleepers: 52 healthy control subjects without sleep complaints, recruited for participation in research studies of sleep and aging (MH-37869), nocturnal penile tumescence (MH-40023), and sleep in depression (MH-40023, MH-30915). Group 2 consisted of "poor" sleepers: 34 patients with major depressive disorder, who were again recruited for participation in research protocols relating to sleep, aging, depression, and nocturnal penile tumescence. This group included 24 outpatients and 10 inpatients at the Western Psychiatric Institute and Clinic. Group 3, also consisting of "poor" sleepers, was a clinical sample of 62 physician-referred outpatients at the Sleep Evaluation Center (SEC) of the Western Psychiatric Institute and Clinic. Patients are referred to the SEC for assessment of a variety of sleep/wake complaints, but only patients with Disorder of Initiating and Maintaining Sleep (DIMS, $n = 45$) or Disorders of Excessive Somnolence (DOES, $n = 17$) (Association of Sleep Disorders Centers-ASDC, 1979) were included in this study, since the number of patients with other disorders was too small to permit statistical analysis.

Subjects were not matched for age or sex ratio because of the different requirements for each research protocol, and the absence of any age criteria for the clinical sleep disorders sample. The mean ages for subject groups were as follows: controls 59.9 years (range: 24-83); depressives 50.9 years (range: 21-80); DIMS 44.8 years (range: 20-80); and DOES 42.2 years (range: 19-57). Analysis of variance (ANOVA) indicated a significant difference in age between groups ($F = 5.20, p < 0.001$), with post hoc differences between control subjects and DIMS and DOES patients. Male/female ratios were as follows: controls 40/12; depressives 25/9; DIMS 16/29; and DOES 8/9 ($\chi^2 = 21.2, p < 0.001$). Male subjects had a lower mean age (46.5 years; SD = 16.7) than female subjects (55.4 years; SD = 18.9) ($t = -3.01, p < 0.005$). Many of the male subjects were involved in studies of nocturnal penile tumescence in depression, while female subjects were participating mainly in studies of sleep, aging, and depression.

Evaluation for all subjects included a complete medical history and physical examination. Depressives and controls were excluded from research involvement (and therefore, from the current study) for any medical conditions that would prevent a 2-week medication-free interval, as well as for the presence of known central nervous system disease such as

seizure disorder, cerebrovascular disease, or dementia. No specific exclusion criteria were used for the clinic sample of sleep-disorder patients. All depressed patients and healthy controls were assessed with the Schedule for Affective Disorders and Schizophrenia-Lifetime version (SADS-L) (Endicott and Spitzer, 1978), and diagnosed according to Research Diagnostic Criteria (Spitzer et al., 1978); all depressed patients met criteria for definite or probable current major depressive disorder. Severity of depressive symptoms was assessed with the Hamilton Rating Scale for Depression (Hamilton, 1960); the mean Hamilton score for depressed patients was 21.3 (SD = 4.65). Sleep-disorder patients were evaluated as described elsewhere (Jacobs et al., 1988), and given preliminary diagnoses according to ASDC nosology (ASDC, 1979). Sleep-disorder patients meeting criteria for *DSM-III* (American Psychiatric Association, 1980) major depression were excluded from the current study. All subjects completed a 2-week sleep/wake diary and a sleep habits questionnaire.

All subjects were further evaluated with routine polysomnography following a medication-free interval of at least 2 weeks. For depressed and sleep-disorder patients, this interval followed withdrawal from psychotropic and sedative-hypnotic medications. All subjects were studied with a routine sleep montage, including electroencephalographic (C4, referenced to tied mastoids), electro-oculographic (EOG), and electromyographic (submental) leads. Most subjects had additional monitoring for sleep apnea, myoclonus, or nocturnal penile tumescence, dictated by clinical indications or research protocol involvement. All sleep records were scored in 1-min epochs according to standard criteria (Rechtschaffen and Kales, 1968), using Stage 2 sleep onset, and standard convention for definition of sleep efficiency (time spent asleep/total recording period).

Final diagnoses for depressed and sleep-disorder patients were based on results of clinical and structured interviews, sleep questionnaires, and diaries. In addition, polysomnographic findings were considered in the final diagnoses of the sleep-disorder patients (Jacobs et al., 1988).

All 148 subjects completed the PSQI on at least one occasion (T_1) during the course of their clinical and research evaluation. For the majority of subjects (n = 107), the PSQI was completed before sleep studies. For some subjects with stable sleep/wake complaints (n = 41), the PSQI was completed after sleep studies. A subgroup of 91 subjects (43 controls, 22 depressives, and 26 sleep-disorder patients) completed the index a second time (T_2), an average of 28.2 days later (range: 1-265 days). The second PSQI was completed before any pharmacological treatment began.

Statistical Analyses. Descriptive statistics and ANOVA were used to contrast clinical and demographic features of the patient groups.

Internal homogeneity of separate items was assessed using Cronbach's α statistic and corrected component-total correlation coefficients (Cronbach, 1951). Pearson product-moment correlations were also used to correlate component and item scores with the PSQI global score.

Test-retest reliability (consistency) was assessed with paired t tests and Pearson product-moment correlations for PSQI global score, component scores, and individual items, at Time 1 (T_1) versus Time 2 (T_2). This was done for the entire subject pool, as well as for separate subject groups (except DOES patients, since only five patients had complete questionnaires on two occasions).

As the primary analysis of *validity*, we assessed the degree to which the index detected differences between groups recognized clinically as distinct. This assumes that the index measures differences between groups at the same time point as a clinical "gold standard." In this case, the relevant "gold standard" diagnoses were based on a combination of clinical interviews, structured interviews, and polysomnographic data. For this analysis, an analysis of covariance (ANCOVA) was used to compare patient groups for PSQI global and component scores, and the Student-Neuman-Keul's procedure was used for pairwise comparisons. Age and sex were used as covariates because of group differences in age and sex ratio. A multiple ANCOVA (MANCOVA) was performed for the PSQI global score, again using age and sex as covariates.

As a secondary analysis of validity, we compared PSQI scores with polysomnographic results, being cognizant of the fact that PSQI scores reflect the experience of sleep during the previous month, while polysomnographic data were limited to 2 or 3 nights. PSQI estimates of sleep latency, sleep duration, and sleep efficiency were compared to their homologous polysomnographic measures, using both *t* tests and Pearson product-moment correlations. Global PSQI scores were also compared to polysomnographic variables selected a priori as being likely to correlate with overall sleep quality, again using Pearson correlations. The specific variables selected were REM %, delta %, sleep latency, sleep efficiency, and sleep duration. Finally, group differences for these polysomnographic variables were assessed using one-way ANOVAs.

Results

General Results. Subjects found the PSQI easy to use and understand. Ten subjects out of an original pool of 158 failed to give complete responses to all items, and were therefore omitted from any further analyses; nine of these 10 were DOES patients.

The PSQI global score has a possible range of 0-21 points. Actual scores ranged from 0 to 20 points, with an overall group mean of 7.4, median of 6.0, and SD of 5.1. For individual components, each with a possible range of 0-3, the observed ranges were 0-3.

Age was negatively correlated with the subjective sleep quality ($r = -0.22, p < 0.05$) and daytime dysfunction ($r = -0.29, p < 0.02$) component scores in the healthy controls. The PSQI global score and other component scores (sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, and use of sleeping medications) were not significantly correlated with age.

Internal Homogeneity. The seven *component* scores of the PSQI had an overall reliability coefficient (Cronbach's α) of 0.83, indicating a high degree of internal consistency. In other words, each of the seven components appears to measure a particular aspect of the same overall construct, viz., sleep quality. The largest component-total correlation coefficients were found for habitual sleep efficiency and subjective sleep quality (0.76 for each), and the smallest correlation coefficient was found for sleep disturbances (0.35). The mean component-total correlation coefficient was 0.58. Pearson product-moment correlations between component scores and the PSQI global score were also calculated for the entire group, as well as each group separately (Table 1). Once again, the strongest correlations were seen for habitual sleep efficiency and subjective sleep quality.

Individual *items* were also strongly correlated with each other, indicated by a reliability coefficient (Cronbach's α) of 0.83. Item-total correlation coefficients ranged from 0.66 for question #9 (enthusiasm to get things done) to 0.20 for item #8 (difficulty staying awake). Pearson product-moment correlations between individual items and the global score ranged from 0.83 (subjective sleep quality) to 0.07 (cough or snore during sleep) (Table 2).

Performance Consistency (Test-Retest Reliability). Ninety-one patients completed the PSQI on two separate occasions. Paired *t* tests for the global PSQI score, as well as the seven individual component scores, showed no significant

differences between T_1 and T_2. Two differences were noted for depressed patients, who showed a reduction in sleep disturbances ($t = 2.32$, $p = 0.03$) and daytime dysfunction ($t = 3.46$, $p = 0.002$) at T_2.

Table 1. Component-global Pittsburgh Sleep Quality Index (PSQI) score correlations[1]

	All groups ($n = 48$)		Controls ($n = 52$)		Depressives ($n = 34$)		DIMS[2] ($n = 45$)		DOES[3] ($n = 17$)	
Component	r	p	r	p	r	p	r	p	r	p
Sleep quality	0.83	0.001	0.64	0.001	0.71	0.001	0.68	0.001	0.57	0.01
Sleep latency	0.72	0.001	0.58	0.001	0.64	0.001	0.67	0.001	0.69	0.001
Sleep duration	0.80	0.001	0.44	0.001	0.68	0.001	0.79	0.001	0.60	0.01
Habitual sleep efficiency	0.85	0.001	0.57	0.001	0.83	0.001	0.75	0.001	0.76	0.001
Sleep disturbance	0.46	0.001	0.70	0.001	0.19	—	0.31	0.02	0.38	—
Use of sleeping medication	0.62	0.001	0.20	—	0.69	0.001	0.51	0.001	0.33	—
Daytime dysfunction	0.63	0.001	0.53	0.001	0.38	0.01	0.53	0.001	0.38	0.001

1. Pearson product-moment correlations.
2. DIMS = Disorders of Initiating and Maintaining Sleep.
3. DOES = Disorders of Excessive Somnolence.

Pearson product-moment correlations again demonstrated stability in global and component scores. For the entire subgroup in which T_1 and T_2 measures were obtained, the T_1-T_2 correlation coefficient for global PSQI scores was 0.85 ($p < 0.001$). Component scores had coefficients ranging from 0.84 (sleep latency) to 0.65 (medication use) ($p < 0.001$ for each component score). Global PSQI scores for each diagnostic group were also significantly correlated between the two testing times, with r's > 0.40 ($p < 0.005$) for each group. Component scores within each subject group showed more variability across time, but all of these scores were significantly correlated (r's > 0.35, $p < 0.05$). The single exception was medication use in control subjects, which showed no correlation between the two testing times.

Validity. (Table 3, Figs. 1, 2). Global PSQI scores differed significantly between subject groups, using an ANCOVA with age and sex as covariates (Table 3). Control subjects differed from all patient groups (Student-Neuman-Keul's procedure). Furthermore, DIMS and depressed patients had significantly higher scores than DOES patients. Control subjects differed from DIMS and depressed patients on all individual component scores; controls also differed from DOES patients on three components (sleep disturbances, daytime dysfunction, and sleep quality). DOES and DIMS patients had significantly different scores on all components except sleep disturbances, and DOES and depressives patients differed on all components except sleep disturbance and daytime dysfunction.

Group differences resulted in distinctive component and global score profiles, shown in Fig. 1. Depressed and DIMS patients showed similar profiles, which differed from those of DOES patients and control subjects. These differences were further substantiated with a significant MANCOVA for component scores across groups (Hotelling's $T^2 = 2.62$, $p < 0.001$).

Age was a significant covariate only for the daytime dysfunction component; but contrary to expectations, these factors were *inversely* correlated, i.e., reported severity of daytime dysfunction tended to be greater in younger than in older subjects. Sex was a significant covariate for use of sleeping medications and habitual sleep efficiency, with males showing higher scores for each of these components. Age and sex were *both* significant covariates for the PSQI global score, but group differences were highly statistically significant even after covarying for these factors.

The distribution of global PSQI scores also differed between groups (Fig. 2). A post hoc cutoff score of 5 correctly identified 88.5% (131/148) of all patients and controls (kappa = 0.75, $p < 0.001$). This represents a sensitivity of 89.6% and a specificity of 86.5%. The same cutoff score correctly identified 84.4% (38/45) of DIMS patients, 88% (15/17) of DOES patients, and 97% (33/34) of depressives.

Group differences in PSQI global scores were also substantiated by polysomnographic results, which showed significant group differences for sleep latency ($F = 4.53$, $p < 0.001$), sleep efficiency ($F = 5.78$, $p < 0.001$), sleep duration ($F = 4.82$, $p < 0.003$), and number of arousals ($F = 2.87$, $p < 0.04$). Significant group differences were not found for rapid eye movement (REM) % or delta sleep %.

Validity of the PSQI was further examined by comparing PSQI estimates of sleep variables with those obtained by polysomnography. *T* tests showed no differences between PSQI estimates and laboratory findings for sleep latency, but PSQI estimates of the past month's usual sleep duration and efficiency were greater than

Table 2. Item-global Pittsburgh Sleep Quality Index (PSQI) score correlations[1]

	All groups ($n = 148$)		Controls ($n = 52$)		Depressives ($n = 34$)		DIMS[3] ($n = 45$)		DOES[4] ($n = 17$)	
Item[2]	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*	*r*	*p*
Q5A	0.71	0.001	0.63	0.001	0.56	0.001	0.64	0.001	0.68	0.001
Q5B	0.52	0.001	0.52	0.001	0.38	0.01	0.49	0.001	0.55	0.01
Q5C	0.24	0.001	0.29	0.02	0.31	0.04	0.33	0.01	0.14	—
Q5D	0.17	0.02	0.12	—	0.07	—	0.08	—	-0.07	—
Q5E	0.07	—	0.34	0.007	-0.17	—	-0.10	—	0.29	—
Q5F	0.29	0.001	0.03	—	0.03	—	0.23	—	-0.03	—
Q5G	0.18	0.01	0.26	0.03	0.02	—	0.07	—	-0.00	—
Q5H	0.20	0.007	0.31	0.01	0.25	—	-0.21	—	-0.03	—
Q5I	0.24	0.002	0.54	0.001	0.06	—	-0.02	—	0.33	—
Q5J	0.32	0.001	0.37	0.004	0.17	—	0.22	—	-0.13	—
Q8	0.19	0.009	0.21	—	-0.08	—	0.28	0.03	0.14	—
Q6	0.83	0.001	0.37	0.003	0.71	0.001	0.69	0.001	0.57	0.008
Q2	0.66	0.001	0.64	0.001	0.56	0.001	0.64	0.001	0.72	0.001
Q4	0.80	0.001	0.44	0.001	0.68	0.001	0.79	0.001	0.57	0.008
Q7	0.62	0.001	0.19	—	0.69	0.001	0.49	0.001	0.31	—
Q9	0.69	0.001	0.55	0.001	0.44	0.005	0.53	0.001	0.30	—

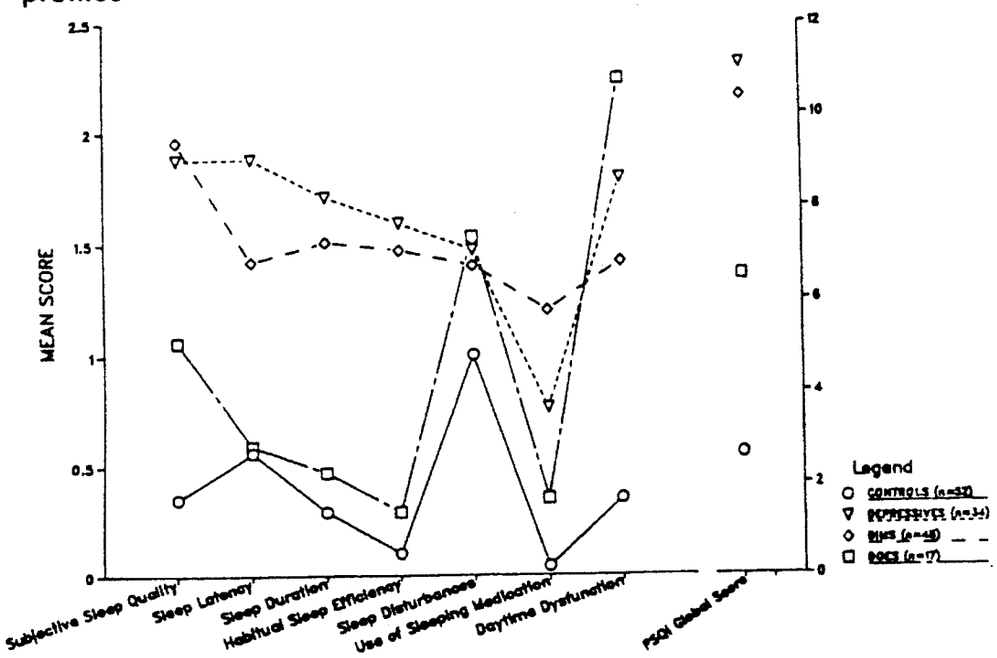
1. Pearson product-moment correlations.
2. Refer to questionnaire in Appendix.
3. DIMS = Disorders of Initiating and Maintaining Sleep.
4. DOES = Disorders of Excessive Somnolence.

Table 3. Pittsburgh Sleep Quality Index (PSQI) comparisons between diagnostic groups[1]

Component	Mean score ± SD (adjusted mean) Controls ($n = 52$)	Depressives ($n = 34$)	DIMS ($n = 45$)	DOES ($n = 17$)	ANCOVA F	ANCOVA p	Significant Student-Neuman-Keuls' comparisons
Subjective sleep quality	0.35 ± 0.48 (0.40)	1.88 ± 0.88 (1.92)	1.96 ± 0.93 (1.91)	1.06 ± 0.75 (1.02)	35.9	0.0001	Controls vs. depressives, DIMS, DOES; DOES vs. depressives, DIMS
Sleep latency	0.56 ± 0.73 (0.70)	1.88 ± 1.15 (1.96)	1.42 ± 1.01 (1.31)	0.59 ± 0.87 (0.49)	15.3	0.0001	Controls vs. depressives, DIMS; DOES vs. depressives, DIMS
Sleep duration	0.29 ± 0.50 (0.31)	1.71 ± 1.14 (1.74)	1.51 ± 1.20 (1.46)	0.47 ± 0.80 (0.46)	20.4	0.0001	Controls vs. depressives, DIMS; DOES vs. depressives, DIMS
Habitual sleep efficiency	0.10 ± 0.30 (0.11)	1.59 ± 1.18 (1.63)	1.47 ± 1.24 (1.41)	0.29 ± 0.77 (0.30)	25.2[2]	0.0001	Controls vs. depressives, DIMS; DOES vs. depressives, DIMS
Sleep disturbances	1.00 ± 0.40 (0.95)	1.47 ± 0.51 (1.45)	1.40 ± 0.62 (1.43)	1.53 ± 0.72 (1.56)	8.4	0.0001	Controls vs. depressives, DIMS, DOES
Use of sleeping medication	0.04 ± 0.28 (0.12)	0.76 ± 1.21 (0.84)	1.20 ± 1.31 (1.09)	0.35 ± 1.00 (0.31)	7.9[2]	0.0001	Controls vs. depressives, DIMS; DOES vs. depressives, DIMS
Daytime dysfunction	0.35 ± 0.48 (0.44)	1.79 ± 0.69 (1.83)	1.42 ± 0.94 (1.37)	2.24 ± 0.90 (2.16)	33.2[3]	0.0001	Controls vs. depressives, DIMS, DOES; DOES vs. DIMS
PSQI global score	2.67 ± 1.70	11.09 ± 4.31	10.38 ± 4.57	6.53 ± 2.98	45.1[4]	0.001	Controls vs. depressives, DIMS, DOES; DOES vs. depressives, DIMS

1. DIMS = Disorders of Initiating and Maintaining Sleep. DOES = Disorders of Excessive Somnolence.
2. Significant effect of sex as covariate.
3. Significant effect of age as covariate.
4. Significant effect of age and sex as covariates.

Fig. 1. Pittsburgh Sleep Quality Index (PSQI): Mean component score profiles



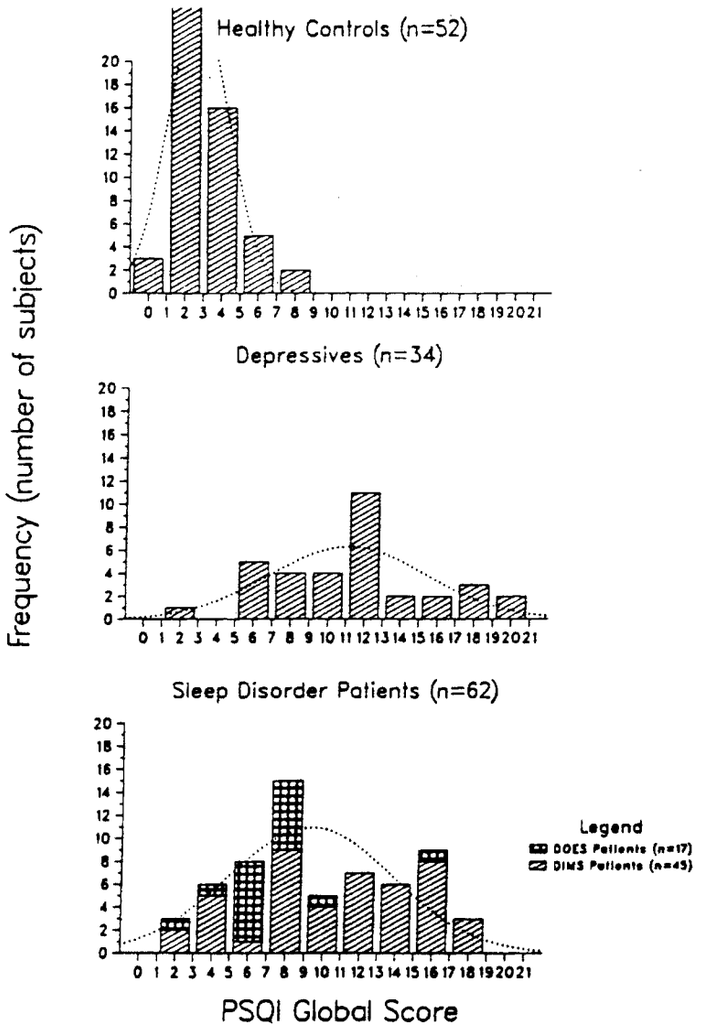
Depressed patients and patients with Disorders of Initiating and Maintaining Sleep (DIMS) have different components score profiles than do control subjects. Patients with Disorders of Excessive Somnolence (DOES) have a profile more similar to controls, but with expected elevations in subjective sleep quality, sleep disturbances, and daytme dysfunction. Significant group differences for individual components and overall profiles were substantiated with analyses of variance and multiple analyses of covariance (Table 3).

those obtained during polysomnography ($t = 9.98$ and 4.50, respectively; both p's < 0.001). This pattern was true for the total subject pool as well as individual subject groups. Pearson correlations demonstrated no significant positive correlations between PSQI estimates and polysomnographic results, except in sleep latency for the total subject pool ($r = 0.33$, $p < 0.001$) and for the depressive subgroup ($r = 0.37$, $p < 0.02$). Similarly, the global PSQI score was compared with several polysomnographic measures which we selected a priori as being likely to correlate with perceived sleep quality. For all subjects, the global score was weakly correlated only with objective sleep latency ($r = 0.20$, $p < 0.01$). For individual subject groups, the global PSQI score correlated only with REM % in controls ($r = 0.34$, $p < 0.006$) and number of arousals in depressives ($r = 0.47$, $p < 0.002$).

Discussion

Eighteen months of field testing with the PSQI have demonstrated that (1) subjects and patients find the index easy to use; (2) the seven major components of the index, as well as the 19 individual questions, are internally consistent; (3) the global scores, component scores, and individual question responses are stable across time; (4) the validity of the index is supported by its ability to discriminate patients from controls, and, to a more limited degree, by concurrent polysomnographic findings. We will

Fig. 2. Pittsburgh Sleep Quality Index (PSQI) global scores



PSQI global scores showed different distributions for control subjects, depressed patients, and sleep-disorder patients. A global score cutoff of > 5 correctly identified 88.5% of all controls and patients, yielding a sensitivity of 89.6% and a specificity of 86.5% (Kappa = 0.75, $p < 0.001$).

further discuss the format and clinimetric properties of the PSQI in relation to previous sleep questionnaires in the literature. We will also discuss possible applications for the PSQI in psychiatric clinical practice and research studies.

Questionnaire Format. A number of previous studies have reported on the use of self-rated or interviewer-administered sleep-quality questionnaires. In general, these instruments are of three types: habitual (i.e., "usual") sleep questionnaires for population surveys; habitual ("usual") sleep questionnaires for clinical investigations; and postsleep inventories.

The first type of questionnaire is used in epidemiological surveys of habitual or usual sleep habits, sleep difficulties, and sleep quality (e.g., McGhie and Russell,

1962; Karacan et al., 1976, 1983; Bixler et al., 1979; Johnson and Spinweber, 1983; Lugaresi et al., 1983; Welstein et al., 1983; Mellinger et al., 1985). The questions are usually few in number and general in scope, typically focusing on sleep duration, the presence of insomnia, and the use of medications for sleep. Habitual sleep questionnaires have also been used in clinical studies, most often to compare subjective reports with polysomnographic correlates (e.g., Monroe, 1969; Baekeland and Roy, 1971; Mendelson et al., 1984, 1986) or to examine differences between groups of subjects (McGhie, 1966; Beutler et al., 1978; Domino et al., 1984). These questionnaires are often more detailed than those used in large-scale surveys, and they include subjective estimates of sleep quality; however, their main focus is again on quantitative measures. The final type of questionnaire found in the literature is postsleep inventories (e.g., Samuel, 1964; Lewis, 1969; Frankel et al., 1973, 1976; Carskadon et al., 1976; Webb et al., 1976; Parrott and Hindmarch, 1978, 1980; Ellis et al., 1981; Mendelson et al., 1984). These instruments ask a variety of quantitative and qualitative questions about the previous night's sleep. They vary considerably in format, and in the number and type of questions. Postsleep inventories have been used to examine differences between subjective reports and objective polysomnographic findings, to study "good" and "bad" sleep, and to assess medication effects on sleep.

The PSQI has some similarities to these other questionnaires, but also has some important differences. The first comparison is in time interval of assessment. Most habitual sleep questionnaires do not specify a particular time frame, although there are some exceptions to this generalization (e.g., McGhie, 1966; Mendelson et al., 1986). The PSQI assesses a 1-month interval, which, as mentioned above, is clinically and scientifically useful. While postsleep inventories are unambiguous in their assessment of a single night's sleep, they are not as useful for detecting patterns of dysfunction, as noted previously.

A second comparison regards the type of questions included in the questionnaire. The PSQI is similar to many of the habitual sleep questionnaires in the type of questions included, e.g., estimates of sleep latency and duration, and frequency and severity estimates of problems. The PSQI's combination of quantitative and qualitative information is not found, however, in some of the more carefully studied questionnaires, such as those of Domino et al. (1984) and Webb et al. (1976).

The use of "component" scores in the PSQI is also similar to several other questionnaires, which have generated between 4 and 11 "factors" relating to sleep quality (Webb et al., 1976; Beutler et al., 1978; Parrott and Hindmarch, 1978; Domino et al., 1984). One major difference is that other questionnaires have more often included factors concerning mental activity before and during sleep. Another difference is that these other questionnaires have used factor analysis to generate specific factors, while the PSQI components are empirical and clinical in origin, rather than statistical.

A third comparison between the PSQI and other questionnaires regards scoring methods. The PSQI assigns ordinal scores to quantitative and qualitative information, allowing for the generation of component scores and a single global score. Except for McGhie (1966) and Beutler et al. (1978), previous questionnaires

do not use numerical scores for components or global scores. In the latter questionnaire, standard scores were determined by transforming the actual values of eight differently weighted "factors," and assigning an arbitrary value of "50" to the control mean. The PSQI global score has the advantages of giving a single overall assessment of sleep quality, being simple to calculate, and allowing for direct comparisons of individual patients or groups.

Finally, the PSQI was designed to assess clinical samples, while most previous questionnaires have been designed to assess normal sleep habits or entire populations. Although some questionnaires have been applied to patients with insomnia diagnosed by ASDC criteria (Mendelson et al., 1984, 1986), most have used patient samples that were not diagnosed according to current sleep disorders or psychiatric nomenclature.

Clinical Properties: Homogeneity and Consistency. The Cronbach's α of 0.83 obtained for PSQI components indicates a high degree of internal homogeneity (Feinstein, 1987). In other words, each of the components measures part of a coherent overall construct. Subjective sleep quality (item #6) showed one of the highest component-total correlation coefficients, which further supports this notion. The low component-total correlation coefficient seen for sleep disturbances may be the result of the large number of items that make up this component, as well as the fact that these items may be particularly susceptible to variation between individuals and over time. The sleep disturbance component also showed the least difference between diagnostic groups.

Data about internal homogeneity have been reported for three other sleep questionnaires, each of which used factor-analytic techniques. Domino et al. (1984) reported a factor analysis which yielded seven factors accounting for 71.7% of the total variance in the questionnaire. Cronbach's α was computed for these factors, with a median α of 0.82. Beutler et al. (1978) analyzed their 186-item questionnaire and found eight factors accounting for 59% of the total variance. The number of questions contributing to each factor ranged between 4 and 17. Finally, the postsleep inventory of Webb et al. (1976) had seven factors accounting for 54.5% of the total variance; specific questions with inter-item correlations higher than 0.65 were deliberately excluded. It is difficult to compare the PSQI with these questionnaires, due to differences in time frame of assessment, number of total questions, and subject populations tested. Most important, components of the PSQI were selected on purely clinical grounds, and not on the basis of factor analysis.

Overall consistency (test-retest reliability) of the PSQI was better for the entire subject pool than for any specific group. Of particular interest is the finding that DIMS patients had the highest correlations across time, while the control subjects had the lowest correlations. One possible explanation for the lower stability in the control subjects' scores is their low scores on all components, and particularly medication use. For both control subjects and DIMS patients, component correlations were highest for sleep latency and sleep duration, two "quantitative" variables. Correlation coefficients were lower for daytime dysfunction and sleep quality, two of the more "qualitative" components, as well as for the sleep disturbances component, which may include items that are variable between individuals and across time.

Consistency for the PSQI is lower than that reported by Domino et al. (1984), who administered their questionnaire on two occasions separated by 10 weeks, and found Pearson correlations for the seven factors of their questionnaire ranging from 0.68 to 0.79. However, this sample did not include patients with sleep or psychiatric disorders.

Clinimetric Properties: Validity. The identification of "good" and "poor" sleepers for research studies relies on subjective assessments of sleep quality, clinical interviews, and polysomnographic studies. The PSQI provides a standardized, quantitative measure of sleep quality that quickly identifies good and poor sleepers, and compares favorably with the "gold standard" of clinical and laboratory diagnosis. In the current study, good and poor sleepers consisted of healthy control subjects and depressed or sleep-disordered patients. A global PSQI score > 5 provided a sensitive and specific measure of poor sleep quality, relative to clinical and laboratory measures. Age and sex did not strongly correlate with PSQI component scores, but they were significant covariates for the global score. Given the differences in mean age and sex ratio between groups (with good sleepers being older than poor sleepers), the current results are likely to underestimate the PSQI's ability to identify good and poor sleepers.

Distinct component score profiles emerged for controls, DOES patients, and DIMS/depressed patients. The PSQI did *not* differentiate DIMS and depressed patients. This is not surprising, since the sleep disturbance of depressives is most often a sleep onset and maintenance insomnia. In fact, the current study lends validity to the classification of depressive sleep disturbance as a DIMS in the ASDC classification.

The PSQI is primarily intended to measure sleep quality and to identify good and bad sleepers, not to provide accurate clinical diagnoses. Nevertheless, responses to specific questions can point the clinician toward areas for further investigation. This is particularly true for the "sleep disturbances" component, which may guide clinical evaluations for specific patients, even though mean scores do not discriminate between groups. Furthermore, a PSQI global score > 5 indicates that a subject is having severe difficulties in at least two areas, or moderate difficulties in more than three areas. The global score is therefore "transparent," i.e., it conveys information about the severity of the subject's problem, and the number of problems present, through a single simple measure (Feinstein, 1987).

A number of other studies have also validated their sleep questionnaires by comparing different subject populations. For example, Domino et al. (1984) validated their scale by administering it to patients with and without complaints of sleep disturbance at a family physician's office, and to patients with and without depressive symptoms at a community mental health center. In each case, the patient groups differed significantly on a number of the questionnaire's scales. Beutler et al. (1978) used a stepwise discriminant function analysis to identify self-proclaimed insomniacs and controls. Their discriminant model, including subject age and three of the eight factors in their questionnaire, correctly identified 93% (86/92) of subjects. A separate discriminant analysis correctly identified 86% (37/43) of insomniacs who used or did not use medications. Mendelson et al. (1984, 1986)

found statistically significant differences on self-report sleep questionnaires for insomniacs versus controls. McGhie (1966) compared depressed and nondepressed psychiatric patients, and found no differences on the total sleep disturbance scale of his questionnaire. Finally, Webb et al. (1976) found differences between "good" and "bad" sleep episodes, and between high school and elderly subjects, with their postsleep inventory. Like these previous questionnaires, the PSQI separates patients with different diagnoses, but differs in that control subjects and patients in this study were diagnosed according to current research and clinical criteria. In addition, except for Beutler et al. (1978), previous reports have not indicated the sensitivity and specificity of their scales.

A number of other studies have reported on the use of polysomnography to validate subjective sleep reports (e.g., Lewis, 1969; Monroe, 1969; Baekeland and Hoy, 1971; Bixler et al., 1973; Frankel et al., 1973, 1976; Carskadon et al., 1976; Mendelson et al., 1984, 1986; Hoch et al., 1987). Several consistent findings emerge from these reports. First, subjects with and without insomnia are not "accurate" in their subjective report of variables such as sleep latency, sleep duration, and number of arousals. However, while control subjects tend to overestimate their ability to sleep, insomniacs tend to underestimate it, perhaps because they misperceive the experience of being asleep (W. Mendelson, personal communication, April 15, 1988). Second, while subjective estimates and objective measures of sleep differ in actual amount, they are often strongly and positively correlated. Finally, postsleep questionnaires yield more accurate subjective estimates that are more strongly correlated with polysomnographic findings. The current findings using the PSQI did not replicate these general findings, as PSQI responses were not found to correlate with polysomnographic measures. It is not surprising that subjects differed in subjective and polysomnographic variables, since the PSQI asks for a global estimate spanning 1 month, and is not sensitive to daily variability.

Applications. The PSQI's simplicity and its ability to identify different groups of patients suggest several clinical and research applications in psychiatry and general medical settings. Most fundamentally, it may be used as a simple screening measure to identify cases and controls, or "good" and "poor" sleepers. In a general clinical setting, the PSQI could be used to screen patients for the presence of significant sleep disturbance. In psychiatric settings, the PSQI may identify patients who are likely to have a sleep disturbance concomitant with their psychiatric symptoms. In addition, it may direct the clinican to specific areas of dysfunction that require further investigation. The PSQI could also be used in clinical research and epidemiological studies to identify groups that differ in the quality of their sleep.

The PSQI may also have several longitudinal applications in clinical practice and research. For example, it could be used to examine the course and natural history of sleep/wake disorders. It could also be used to monitor the progression of sleep disturbances and their interaction with other symptoms during the course of psychiatric illnesses such as depression. Rodin et al. (1988) recently published one of the few studies to examine the interaction between depressive symptoms and sleep disturbance longitudinally. The PSQI may be helpful in future studies of this type, providing more detailed information about types and severity of sleep disturbances

over time. Further, the PSQI could be useful in studying the relation between sleep quality and other variables, such as age, gender, health status, medical and psychiatric conditions, and performance on other psychological variables. Finally, the PSQI could be used to examine the longitudinal effects of specific therapeutic interventions for psychiatric disorders or sleep disorders. For example, sleep quality could be monitored during maintenance treatment of depression with medications or psychotherapy. Used in this way, the PSQI might also detect relapses heralded by the onset or reemergence of sleep disturbance.

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Appendix. Pittsburgh Sleep Quality Index (PSQI)

Name _____ ID # _____ Date _____ Age _____

Instructions:

The following questions relate to your usual sleep habits during the past month *only*. Your answers should indicate the most accurate reply for the *majority* of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?

   USUAL BED TIME _____

2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?

   NUMBER OF MINUTES _____

3. During the past month, when have you usually gotten up in the morning?

   USUAL GETTING UP TIME _____

4. During the past month, how many hours of *actual sleep* did you get at night? (This may be different than the number of hours you spend in bed.)

   HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions, check the one best response. Please answer *all* questions.

5. During the past month, how often have you had trouble sleeping because you...

   (a) Cannot get to sleep within 30 minutes

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (b) Wake up in the middle of the night or early morning

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (c) Have to get up to use the bathroom

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (d) Cannot breathe comfortably

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (e) Cough or snore loudly

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (f) Feel too cold

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (g) Feel too hot

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (h) Had bad dreams

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

   (i) Have pain

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

(j) Other reason(s), please describe _____

_____

How often during the past month have you had trouble sleeping because of this?

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

6. During the past month, how would you rate your sleep quality overall?

Very good _____
Fairly good _____
Fairly bad _____
Very bad _____

7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all _____
Only a very slight problem _____
Somewhat of a problem _____
A very big problem _____

10. Do you have a bed partner or roommate?

No bed partner or roommate _____
Partner/roommate in other room _____
Partner in same room, but not same bed _____
Partner in same bed _____

If you have a roommate or bed partner, ask him/her how often in the past month you have had...

(a) Loud snoring

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

(b) Long pauses between breaths while asleep

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

(c) Legs twitching or jerking while you sleep

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

(d) Episodes of disorientation or confusion during sleep

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

(e) Other restlessness while you sleep; please describe _____

_____

Not during the past month _____	Less than once a week _____	Once or twice a week _____	Three or more times a week _____

Scoring Instructions for the Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) contains 19 self-rated questions and 5 questions rated by the bed partner or roommate (if one is available). Only self-rated questions are included in the scoring. The 19 self-rated items are combined to form seven "component" scores, each of which has a range of 0-3 points. In all cases, a score of "0" indicates no difficulty, while a score of "3" indicates severe difficulty. The seven component scores are then added to yield one "global" score, with a range of 0-21 points, "0" indicating no difficulty and "21" indicating severe difficulties in all areas.

Scoring proceeds as follows:

Component 1: Subjective sleep quality

Examine question #6, and assign scores as follows:

Response	Component 1 score
"Very good"	0
"Fairly good"	1
"Fairly bad"	2
"Very bad"	3

Component 1 score: _____

Component 2: Sleep latency

1. Examine question #2, and assign scores as follows:

Response	Score
≤ 15 minutes	0
16-30 minutes	1
31-60 minutes	2
> 60 minutes	3

Question #2 score: _____

2. Examine question #5a, and assign scores as follows:

Response	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Question #5a score: _____

3. Add #2 score and #5a score

Sum of #2 and #5a: _____

4. Assign component 2 score as follows:

Sum of #2 and #5a	Component 2 score
0	0
1-2	1
3-4	2
5-6	3

Component 2 score: _____

Component 3: Sleep duration

Examine question #4, and assign scores as follows:

Response	Component 3 score
> 7 hours	0
6-7 hours	1
5-6 hours	2
< 5 hours	3

Component 3 score: _____

Component 4: Habitual sleep efficiency

(1) Write the number of hours slept (question # 4) here: _____

(2) Calculate the number of hours spent in bed:

Getting up time (question # 3): _____

– Bedtime (question # 1): _____

Number of hours spent in bed: _____

(3) Calculate habitual sleep efficiency as follows:

(Number of hours slept/Number of hours spent in bed) × 100 = Habitual sleep efficiency (%)

(_____/_____) × 100 = _____%

(4) Assign component 4 score as follows:

Habitual sleep efficiency %	Component 4 score
> 85%	0
75-84%	1
65-74%	2
< 65%	3

Component 4 score: _____

Component 5: Sleep disturbances

(1) Examine questions # 5b-5j, and assign scores for *each* question as follows:

Response	Score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

#5b score _____
c score _____
d score _____
e score _____
f score _____
g score _____
h score _____
i score _____
j score _____

(2) Add the scores for questions # 5b-5j:

Sum of # 5b-5j: _____

(3) Assign component 5 score as follows:

Sum of # 5b-5j	Component 5 score
0	0
1-9	1
10-18	2
19-27	3

Component 5 score: _____

Component 6: Use of sleeping medication

Examine question # 7 and assign scores as follows:

Response	Component 6 score
Not during the past month	0
Less than once a week	1
Once or twice a week	2
Three or more times a week	3

Component 6 score: _____

Component 7: Daytime dysfunction

(1) Examine question # 8, and assign scores as follows:

Response	Score
Never	0
Once or twice	1
Once or twice each week	2
Three or more times each week	3

Question # 8 score: _____

(2) Examine question # 9, and assign scores as follows:

Response	Score
No problem at all	0
Only a very slight problem	1
Somewhat of a problem	2
A very big problem	3

Question # 9 score: _____

(3) Add the scores for question # 8 and # 9:

Sum of #8 and #9: _____

(4) Assign component 7 score as follows:

Sum of # 8 and #9	Component 7 score
0	0
1-2	1
3-4	2
5-6	3

Component 7 score: _____

Global PSQI Score

Add the seven component scores together:

Global PSQI Score: _____