

Quantifying subjective assessment of sleep and life-quality in antidepressant-treated depressed patients

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This study sought to establish a method of quantifying subjective perceptions of sleep against perceptions of life-quality and mood, using amended versions of the Pittsburgh sleep diary (PghSD) and quality of life of insomniacs (QOLI) questionnaire. Diaries and questionnaires were self-completed in participants' homes. Outpatients with a DSM-IV diagnosis of major depressive disorder were compared with a healthy control group (with no history, or family history, of depression). Poorer sleepers, as determined by the sleep diary, were significantly more likely to report poorer life-quality and mood perceptions on the subsequent questionnaire. Furthermore, the depressed group reported significantly poorer perceptions of sleep quality and poorer perceptions of life-quality and mood than the control group, even though estimates of sleep disturbance were similar. This may indicate that depressed individuals experience more 'sleep distress' than healthy individuals. These results confirm the extent of subjectively reported sleep disruption in depression and demonstrate the merit of combining the amended PghSD and QOLI to quantify sleep perceptions. Copyright © 2002 John Wiley & Sons, Ltd.

KEY WORDS — subjective sleep quality; Pittsburgh sleep diary; depression; quality of life of insomniacs questionnaire

INTRODUCTION

Previous researchers have used various techniques, such as diaries and questionnaires to measure subjective ratings of sleep and life-quality. The objective of the current study was to combine these methods to get a clearer picture of the relationship between reported sleep disturbance and depression. Previous research indicates that sleep disturbances are particularly pronounced for individuals with depression and anxiety (Breslau *et al.*, 1996; Kupfer, 1995). Depressed subjects have longer sleep latency, increased awakenings and earlier waking compared with non-depressed individuals (Sandor and Shapiro, 1994; Van Moffaert, 1994). Whether depression causes, or is caused by, sleep disturbances is still unclear (Van Moffaert, 1994) but there appears to be a significantly higher

risk of major depression in individuals with a history of insomnia (Breslau *et al.*, 1996; Ford and Kamerow, 1989). Most data appear to confirm that insomnia is a risk factor for the first episode of depression, and increases the risk of recurrence (Chang *et al.*, 1997; Dryman and Eaton, 1991; Livingston *et al.*, 1993; Roberts *et al.*, 2000).

A significant aspect in depression may be self-appraisal of sleep-quality and subsequent mood. An important attribute of depression is the patient's negative cognitive evaluation of their ability to perform normal daily tasks (Beck, 1967), including sleep. Fichten and colleagues (Alapin *et al.*, 2001) reported that the level of distress related to self-evaluation of sleep is related to levels of reported daytime functioning (including depression). From this, it could follow that 'poor sleepers', who report least satisfaction with their sleep, may be at greater risk for future depression than those who are less distressed by sleep perceptions. Furthermore, the depressed patient's perception of sleep-quality is particularly pessimistic and this may result in imprecise evaluations (Armitage *et al.*, 1997), particularly when compared with objective

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measures such as sleep EEG (Åkerstedt *et al.*, 1994; Baker *et al.*, 1999). However, whether individuals are able to accurately perceive sleep timings may be less important than how they actually feel about their sleep, and about changes to their normal sleep pattern. It has been suggested that subjective sleep-reporting of insomnia may be preferable to objective measures (Fichten *et al.*, 2000), an assertion supported by the American Sleep Disorders Association (Standards of Practice Committee of the American Sleep Disorders Association, 1995). Consequently, subjective reports of sleep remain important and may reveal vital aspects regarding the extent of negative cognition demonstrated by the patient.

Previous researchers have used various techniques to measure subjective reports of sleep. Some have used sleep logs (Wohlgemuth *et al.*, 1999) or diaries (Keklund and Åkerstedt, 1997; McCall *et al.*, 1995; Monk *et al.*, 1994), whilst others prefer questionnaires. There is much debate about which is the best method for measuring sleep (Libman *et al.*, 2000). Monk *et al.* (1994) employed the Pittsburgh Sleep Diary (PghSD) to study aspects of sleep disturbance in patients with insomnia and hypersomnia. Patients were found to report significantly more, and longer, nocturnal awakenings and reported poorer perceptions of sleep-quality, mood on awakening and alertness on awakening than controls. Monk *et al.* (1994) did not disclose whether there were any differences in sleep-lateness between the groups. Although significant differences were found, a potential weakness of the study was that the groups were not matched for age or gender. To our knowledge, there appears to be no published research that demonstrates the use of the PghSD specifically on a depressed population. However, other instruments, such as the Leeds Sleep Evaluation Questionnaire, have been successfully used to measure the effect on antidepressants on sleep (Stephenson *et al.*, 2000).

To measure perceptions of life-quality and mood, researchers have used questionnaires (Cartwright *et al.*, 1998; Pires de Souza, 1996; Rombaut *et al.*, 1990) or self-completed depression scales (Bliwise *et al.*, 1993). For example, Pires de Souza (1996) used the Quality of Life of Insomniacs (QOLI) questionnaire to investigate the effect of insomnia on various life-quality perceptions, in a cohort of Brazilian undergraduate students, who were rated as 'insomniac' or 'non-insomniac' on the basis of four criteria. Those rated as insomniac reported significantly poorer perceptions of life-quality. However, it should be noted that from the cohort of 226 students, only six were rated as insomniac, and it was not reported

whether any of the students had been previously diagnosed with any primary sleep disorder. Furthermore only 20 of the cohort were male. Research suggests that women have a greater tendency for insomnia than men (Breslau *et al.*, 1996).

The QOLI also measures sub-categories of reported life-quality, focusing on sleep-quality, daytime sleepiness, physical well-being, mental well-being and quality of relationships. Pires de Souza (1996) found a moderate to high correlation between these sub-categories, suggesting that these themes reliably measured aspects of life-quality in relation to overall life-quality. The QOLI has also been used to specifically discriminate between insomniacs and non-insomniacs in respect of reported life-quality (Rombaut *et al.*, 1990). Fifty-two insomniac patients were compared with 61 non-insomniac controls. The patients reported significantly poorer perceptions of life-quality than the control group, across the sub-categories and overall life-quality. The correlation between sub-categories was high. However, although 'patients' were rated as insomniac via a number of criteria, they were described as 'untreated' and may not have been clinically assessed for insomnia. To our knowledge there appears to be no published research that demonstrates the use of the QOLI specifically on a depressed population.

We administered amended versions of the PghSD and QOLI (in combination) on a cohort of depressed patients and controls to examine how well they measured potential differences in sleep reporting and subsequent mood reporting. Previously, researchers have used these methods independently. The PghSD measures self-reported aspects of sleep, including the timing and quality of sleep, over a 2-week period. The QOLI reveals perceptions of life-quality, at one specific time. These are important perceptions and need to be measured together within the same individuals, to examine how sleep perception may reflect later evaluation of daytime functioning, particularly in depression.

Responses from the amended PghSD (the 'diary') were used to predict responses on the QOLI (the 'questionnaire'). It was predicted that participants who reported poorer sleep-quality on the diary would exhibit significantly poorer life-quality responses on the questionnaire, than those who reported better sleep-quality. It was further hypothesized that the depressed group would describe significantly poorer subjective sleep (on the diary) and poorer life-quality perceptions (on the questionnaire), than the control group. Finally, the degree of correlation between the diary and questionnaire, and within each instrument, was assessed.

METHOD

Participants

Twenty depressed patients were recruited from among current psychiatric outpatients within the Mood Disorders Service in Southampton (UK).[†] The patients had received a DSM-IV diagnosis of major depressive disorder from their consultant psychiatrist. All 20 depressed patients were taking psychotropic drugs; seven were receiving tricyclics, three were receiving SSRI treatment and nine patients were taking newer antidepressants; one patient was receiving a combination of phenelzine and tryptophan. Two of the patients were also taking lithium, and only one patient was receiving any form of hypnotic drug. Twelve of the depressed group were women and eight were men. The average age (years) of the depressed group was 42.05 (standard deviation 11.43), and ranged from 19 to 62. A control group of 20 matched participants was also recruited, who were questioned regarding current and past history of depression. Only those without a history, or family history, of depression were included. The average age of the control group was 39.75 (standard deviation 11.81) and ages ranged from 19 to 58. All participants gave full informed consent.

MATERIALS

Sleep diary

The diary consisted of 14 pages, one for each day of the study period, and was an amended version of the PghSD (Monk *et al.*, 1994). The aim of the diary was to measure subjective estimates of sleep length, the degree of sleep disruption and the participants' evaluation of their sleep-episodes. Each diary consisted of six items: the first three related to participants' estimations of sleep patterns; sleep latency (SL), the number of awakenings after sleep onset (WASO) and the length of these (WMINS). Participants were required to write down their estimates for these items. The second three items concerned participants' sleep evaluation regarding sleep-quality (SQUAL), mood on awakening (SMOOD) and alertness on awakening (SALERT). Here, participants had to mark their response along a 100 mm analogue linear scale (where 0 = 'very good' and 100 = 'very bad').

[†]Ethical approval, in accordance with the Declaration of Helsinki, was granted by the Southampton and South West Hants Local Research Ethics Committee (Submission 012/98).

Questionnaire

The questionnaire contained 39 questions relating to life-quality and was an amended version of the QOLI (Rombaut *et al.*, 1990). The questionnaire was categorized into five themes: Quality of sleep ('Sleep', five questions) elicited responses about how well the participant had slept recently. Daytime sleepiness ('Awake', five questions) probed the participant for perceptions of sluggishness or vitality during the day. Physical well-being ('Physical', ten questions) included health-related questions, such as perceptions of somatic complaints. Mental well-being ('Mood', twelve questions) investigated feelings of anxiety, despair and depression. Finally, relationships ('Relate', seven questions) elicited responses related to perceptions of personal and social interactions. The original QOLI (Pires de Souza, 1996) had consisted of 52 questions, however, 13 of these were removed for the current questionnaire, as they referred specifically to drug taking behaviours and consequently were beyond the focus of the current study. The questionnaire required two types of response; one involving choosing a response from six alternatives and another that required a mark on a 100 mm linear rating scale (similar to that used on the diary). The sub-themes were represented in each of these response types.

Procedure and scoring

The depressed group was informed of the study during an outpatient appointment, and asked whether they wished to participate. The procedure was explained and the diaries and questionnaires were dispensed. The control group was invited to participate and, following consent, participants were given the diaries and questionnaires. Participants were asked to complete the sleep diaries every morning for 2 weeks. After 2 weeks, participants were instructed to complete the questionnaires. Once both instruments were completed they were returned to the investigators. The diaries and questionnaires were then scored for analysis. 'Sleep patterns' on the diary were scored by averaging the items (SL, WASO, WMINS) for the 2-week period. 'Sleep evaluation' responses (SQUAL, SMOOD, SALERT) were scored according to the mark on the linear rating scale (e.g. 75 mm received a score of 75) and averaged for the fortnight. Higher scores represented poorer perceptions. The diary scores were then used to separate the participants into 'sleep inefficient' and 'sleep efficient' groups, on the basis of each participant's score compared to

Table 1. Mean scores for diary items ($n = 40$)

Category	Mean \pm SD ^a
Sleep latency (min) (SL)	24.5 \pm 21.3
No. of nocturnal awakenings (WASO)	1.7 \pm 1.0
Length of WASO (min) (WMINS)	18.9 \pm 24.3
Evaluation of sleep-quality (SQUAL)	40.9 \pm 18.2
Evaluation of mood on awakening (SMOOD)	44.0 \pm 18.6
Evaluation of alertness on awakening (SALERT)	50.7 \pm 19.1

^aHigher scores indicate poorer sleep perceptions.

the overall mean scores. The linear rating scales on the questionnaire were scored in the same way as the diary. Questions with the six alternative responses were rated 0–100, according to a scoring manual. Again, higher scores represented poorer perceptions. This was conducted for each of the sub-categories, and for the overall questionnaire.

RESULTS

Table 1 shows the mean diary scores for all participants. These were used to assess participants' sleep efficiency. Each participant was rated according to the degree to which their individual responses deviated from the overall mean scores, based on the percentage variation of that deviation. Participants whose own perceptions were poorer than those mean scores were categorized as 'sleep inefficient'; otherwise they were categorized as 'sleep efficient'. From this, 16 participants were rated as 'sleep inefficient' and 24 were assessed as 'sleep efficient'. These groups were used to predict responses on the subsequent questionnaire. Within the 'sleep inefficient' group 13 participants were from the depressed cohort and three were healthy controls. In the 'sleep efficient' group seven were depressed and 17 controls.

Diary responses versus questionnaire responses

Between-group differences were analysed using a two-way analysis of variance (ANOVA). There were significant main effects for both diagnosis (depressed vs control; $F = 3.07$, $p < 0.05$) and sleep efficiency rating (inefficient vs efficient; $F = 2.88$, $p < 0.01$) but no interaction effect. This was further examined for the various sub-sections of the diary and questionnaire, by diagnosis and sleep efficiency, the results of which are displayed in Table 2.

Table 2 shows that the depressed group did not differ significantly from controls in respect of individual diary items. However, they did differ significantly on the questionnaire items, except for the daytime sleepiness category. Depressed individuals returned poorer questionnaire responses than controls. Although Table 2 does show a trend for the depressed group to report generally poorer diary responses than controls, this was not significant. The remaining results were as predicted. Analysis by sleep efficiency demonstrated that those categorized as 'sleep inefficient' reported significantly poorer diary and questionnaire responses than their counterparts. It would seem that, while the depressed and control groups were fairly similar in their reporting of sleep, the degree to which this affected their later perceptions of life-quality and mood was quite different.

Correlation within, and between, the diary and questionnaire

Correlations between the items on the diary and questionnaire were assessed using Pearson's correlation coefficient. These were conducted to examine how the items were correlated within the diary and questionnaire individually, and between the two instruments.

Table 2. Mean scores and (SD) for diary and questionnaire items by diagnosis and sleep efficiency

Diary items	Max	Depressed		Healthy controls		Difference p	
		SI ($n = 13$)	SE ($n = 7$)	SI ($n = 3$)	SE ($n = 17$)	D/C	SI/SE
Latency	N/A	42.3 (25.4)	22.5 (11.0)	33.7 (15.9)	10.1 (6.9)	ns	<0.01
WASO	N/A	2.1 (1.3)	1.7 (1.3)	1.5 (0.5)	1.4 (0.7)	ns	ns
WMINS	N/A	35.1 (35.7)	12.3 (10.0)	23.2 (9.0)	8.4 (9.1)	ns	<0.05
SQUAL	100	57.6 (15.1)	29.0 (11.8)	53.1 (8.0)	30.9 (12.4)	ns	<0.001
SMOOD	100	61.7 (15.3)	35.9 (11.5)	50.0 (1.1)	32.7 (14.0)	ns	<0.001
SALERT	100	67.8 (14.7)	40.2 (8.5)	55.7 (3.8)	41.1 (17.5)	ns	<0.001
Questionnaire items							
Sleep	500	227.9 (97.3)	179.6 (115.0)	217.3 (45.0)	116.7 (71.9)	ns	<0.05
Awake	500	355.0 (82.9)	241.1 (121.9)	273.7 (32.9)	192.4 (86.0)	<0.05	<0.01
Physical	1000	623.2 (148.1)	399.1 (236.8)	321.3 (128.2)	262.0 (141.7)	<0.01	<0.05
Mood	1200	783.1 (253.1)	482.9 (364.0)	473.3 (115.5)	313.5 (157.5)	<0.05	<0.05
Relate	700	488.9 (145.6)	327.9 (150.9)	168.3 (73.7)	137.1 (91.5)	<0.001	<0.05

Table 3. Correlation of diary and questionnaire items

Within-instrument analysis					
All participants (n = 40)					
Diary items	WASO	WMINS	SQUAL	SMOOD	SALERT
Latency	0.62	0.79	0.67	0.59	0.41
WASO		0.71	0.44	0.24	0.13
WMINS			0.56	0.46	0.24
SQUAL				0.89	0.61
SMOOD					0.63
Q're items	Awake	Physical	Mood	Relate	
Sleep	0.47	0.51	0.54	0.79	
Awake		0.74	0.79	0.73	
Physical			0.86	0.92	
Mood				0.86	
Between-instrument analysis					
All participants (n = 40)					
	Sleep	Awake	Physical	Mood	Relate
Sleep pattern					
Latency	0.62	0.52	0.48	0.55	0.55
WASO	0.66	0.28	0.18	0.29	0.25
WMINS	0.60	0.31	0.34	0.32	0.39
Sleep evaluation					
SQUAL	0.64	0.57	0.55	0.63	0.53
SMOOD	0.44	0.59	0.60	0.64	0.59
SALERT	0.33	0.75	0.53	0.52	0.53

Table 3 reflects these correlations and shows that most of the diary items were highly correlated to each other, in accordance with original predictions. This was demonstrated within the 'sleep patterns' section (SL, WASO, WMINS) and within the 'sleep evaluation' section (SQUAL, SMOOD, SALERT). There was also a strong correlation between these sections. However, the correlation within each diary section was generally higher than it was between those sections. In particular, the number of nocturnal awakenings (WASO) was not correlated with either mood or alertness on awakening, and the length of awakenings (WMINS) was not correlated with alertness on awakening. Table 3 also shows that all questionnaire items were highly correlated to each other, with the exception of the daytime sleepiness item, which correlated less well with other questionnaire items.

Table 3 shows that most of the diary items were significantly correlated with the questionnaire items, in accordance with original predictions. All categories within the 'sleep evaluation' section of the diary were significantly correlated with the questionnaire items. The 'sleep patterns' section of the diary was less consistent and had generally lower correlations with the questionnaire items, especially the WASO and WMINS. However, whilst these high correlations

may indicate the degree to which the two instruments could be tapping the same variables, they represent the overall sample. Consequently, further analyses were conducted to assess whether the pattern of correlation differed when considering group comparisons.

Table 4 shows the degree to which correlation within the diary and questionnaire differed in respect of sleep efficiency and diagnosis. Correlation of diary items was higher for those rated as sleep inefficient than for those reporting better sleep, and for depressed group when compared with controls. This would suggest that for those whom sleep is perceived to be problem, there is greater consistency in that sleep reporting, than for those who find less of a problem with their sleep. This is largely repeated for the questionnaire items except, again notably, the perceptions of daytime sleepiness.

DISCUSSION

In summary, the results largely supported the original predictions. Sleep-inefficient participants reported significantly poorer life-quality perceptions than sleep-efficient participants, which accords with previous research on the relationship between insomnia and depression (Breslau *et al.*, 1996; Ford and Kamerow, 1989). The depressed group consistently reported poorer sleep-quality and life-quality/mood perceptions than the control group, although only significantly so for the latter. Whilst this appears to contradict previous research that demonstrated that depressed individuals exhibit poorer sleep patterns (Sandor and Shapiro, 1994; Van Moffaert, 1994) those studies referred to direct observation and not subjective measures; self-evaluations may reflect the way the individual feels about sleep quality. The aims and objectives of this study were met in that the diary was clearly able to detect poorer sleepers, who subsequently reported poorer life-quality and mood. Combining the amended PghSD and QOLI presented a clear overall picture of subjective self-evaluations in depression, confirming widespread negative cognition (Beck, 1967). These findings provide support for the decision to combine the amended PghSD and QOLI. The correlation within the diary and questionnaire, and between these instruments, was moderate to high, although there were notable exceptions for the number, and length, of nocturnal awakenings.

It would appear that the number, and length, of nocturnal awakenings are weaker predictors of subsequent perceptions of life-quality and mood. Lower correlations were observed for these variables against 'sleep evaluations' on the diary, and most

Table 4. Correlation of diary and questionnaire items by groups

Sleep efficiency										
Diary items	Sleep inefficient (<i>n</i> = 16)					Sleep efficient (<i>n</i> = 24)				
	WASO	WMINS	SQUAL	SMOOD	SALERT	WASO	WMINS	SQUAL	SMOOD	SALERT
Latency	0.78	0.79	0.56	0.50	0.05	0.42	0.38	0.19	0.05	0.02
WASO		0.87	0.47	0.32	0.04		0.46	0.36	0.07	0.08
WMINS			0.42	0.31	0.09			0.34	0.05	0.53
SQUAL				0.87	0.30				0.72	0.26
SMOOD					0.23					0.42
Q're items	Awake	Physical	Mood	Relate		Awake	Physical	Mood	Relate	
Sleep	0.02	0.03	0.03	0.06		0.43	0.57	0.63	0.57	
Awake		0.77	0.68	0.78			0.50	0.68	0.46	
Physical			0.82	0.93				0.76	0.84	
Mood				0.81					0.77	
Diagnosis										
Diary items	Depressed (<i>n</i> = 20)					Healthy controls (<i>n</i> = 20)				
	WASO	WMINS	SQUAL	SMOOD	SALERT	WASO	WMINS	SQUAL	SMOOD	SALERT
Latency	0.77	0.85	0.63	0.50	0.25	0.02	0.31	0.54	0.38	0.34
WASO		0.78	0.45	0.16	0.01		0.25	0.24	0.13	0.12
WMINS			0.52	0.37	0.24			0.50	0.41	0.20
SQUAL				0.86	0.63				0.90	0.43
SMOOD					0.63					0.44
Q're items	Awake	Physical	Mood	Relate		Awake	Physical	Mood	Relate	
Sleep	0.21	0.29	0.38	0.34		0.55	0.49	0.52	0.35	
Awake		0.77	0.77	0.80			0.35	0.61	0.19	
Physical			0.88	0.92				0.53	0.76	
Mood				0.88					0.53	

questionnaire items. They also displayed the least significant difference between the groups, and greater variation than other items. This did not correspond with previous applications of the PghSD (Monk *et al.*, 1994) where significant differences for these variables were observed between sleep-disorder patients and controls. Also, the daytime sleepiness item on the questionnaire demonstrated generally lower correlation, the least significant difference between the groups and wider variation than other questionnaire categories. This may indicate that individuals do vary in their perception of how often they wake during the night and how long for. How important these timings are to the individual may also vary, but may be crucial in their perception of sleep-quality, and subsequent life-quality and mood.

These results provide further evidence to support the findings of Fichten and her colleagues (Alapin *et al.*, 2001) in respect of personal distress towards sleep perceptions, and suggest that there is a difference between being sleepy and feeling sleepy. The difference between the depressed group and controls regarding sleep perceptions was less marked and yet

the former proceeded to report significantly poorer daytime functioning perceptions. The 'sleep inefficient' participants, however, did report poorer sleep and life-quality/mood than the 'sleep efficient' individuals. This may appear obvious for sleep perceptions, since the sleep efficiency groups were categorized that way. However, the correlational analyses also showed that those with a self-perceived sleep problem reported their sleep perceptions more consistently than for those who sleep was less of a problem. Even within the depressed group, there may be individuals who do not perceive their sleep as a problem.

There were a number of limitations in the current study, most notably the method of selection. No account was taken for total sleep time, an important variable in any sleep analysis. It might have been useful to examine questionnaire responses on a daily basis, alongside the sleep diary perceptions. Future studies might also extend the focus of the relationship beyond depression, and examine other psychiatric conditions.

Nevertheless, this study provided some intriguing preliminary data. The method of quantifying

subjective reports of sleep and mood was justified. This technique can now be used to examine other factors of subjective sleep reporting in depression. We are presently conducting a number of these studies, such as examining the similarity between depressed individuals and their non-depressed first-degree relatives in the way that they report sleep. Additionally, the subjective measuring techniques introduced here will be examined alongside objective measures, such as sleep EEG.

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