

Sleep-Related Functioning in Euthymic Patients With Bipolar Disorder, Patients With Insomnia, and Subjects Without Sleep Problems

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Objective: The authors investigated sleep-related functioning in euthymic patients with bipolar disorder.

Method: Euthymic patients with bipolar disorder (N=20), patients with insomnia (N=20), and subjects with good sleep (N=20) were compared on data from interviews and questionnaires and on findings from eight consecutive days and nights of sleep diary keeping (subjective sleep estimate) and actigraphy (objective sleep estimate).

Results: Seventy percent of the euthymic patients with bipolar disorder exhibited a clinically significant sleep disturbance. Compared with the other groups, the bi-

polar disorder group exhibited impaired sleep efficiency, higher levels of anxiety and fear about poor sleep, lower daytime activity levels, and a tendency to misperceive sleep. The bipolar disorder group held a level of dysfunctional beliefs about sleep that was comparable to that in the insomnia group and significantly higher than that in the good sleeper group.

Conclusions: Insomnia is a significant problem among euthymic patients with bipolar disorder. Components of cognitive behavior therapy for insomnia, especially stimulus control and cognitive therapy, may be a helpful adjunct to treatment for patients with bipolar disorder.

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Bipolar disorder is a common, severe, chronic, and often life-threatening condition. The lifetime prevalences of bipolar I disorder and bipolar II disorder are 0.8% and 0.5%, respectively (DSM-IV), although more liberal definitions of hypomania identify many more patients with bipolar spectrum disorders (1). Treatment of bipolar I disorder typically involves pharmacotherapy. However, even in patients with continued adherence to medication regimens, the risk of relapse over a 5-year period has been estimated to be as high as 73% (2). The risk of relapse is similar in both bipolar I disorder and bipolar II disorder, is higher in bipolar disorder than in unipolar depression, and persists across the lifespan in patients with bipolar disorder (1).

Three lines of evidence point to the importance of sleep in bipolar disorder. First, experimentally induced sleep deprivation is associated with the onset of hypomania or mania in a considerable proportion of patients (e.g., reference 3). Second, in a systematic review of 11 studies involving 631 patients with bipolar disorder, sleep disturbance was the most common prodrome of mania (reported by 77% of patients) and the sixth most common prodrome of bipolar depression (reported by 24% of patients) (4). Third, the sleep/wake cycle has been a core component of theoretical conceptualizations of bipolar disorder. It has been hypothesized that bipolar disorder patients have a genetic diathesis that may take the form of circadian rhythm instability. Psychosocial stresses are pro-

posed to cause disrupted routine and sleep, which, in turn, disrupts the vulnerable circadian rhythm and triggers an episode (5, 6).

As a result of these findings, psychosocial treatments for bipolar disorder, such as cognitive behavior therapy and interpersonal and social rhythm therapy, include education and monitoring of the sleep/wake cycle and include the aim of promoting regularity in daily activities. Although these interventions have been shown to be efficacious adjuncts to pharmacotherapy (7, 8), they focus on a wide variety of behaviors, making them potentially time-consuming, and have not yet drawn on the large and impressive literature documenting the effectiveness of cognitive behavior therapy in the treatment of insomnia (9).

In the present study, we sought to establish whether core components of cognitive behavior therapy for insomnia have the potential to enhance interventions for bipolar disorder patients by providing a specific emphasis on sleep. Three components were investigated: 1) stimulus control to reverse maladaptive conditioning between the bed/bedroom and not sleeping by limiting sleep-incompatible behaviors within the bedroom environment, 2) sleep hygiene to provide education about behaviors that interfere with sleep, and 3) cognitive therapy to alter unhelpful beliefs about sleep. An additional aim of this study was to observe the sleep-related functioning of bipolar disorder patients in the nonacute, so-called euthymic or interepisode phase of the disorder. Although it is recog-

nized that patients with bipolar disorder often continue to be symptomatic between episodes (10), to our knowledge the research to date on sleep disturbance has often focused exclusively on sleep just prior to and during episodes of mania or depression.

Method

Participants

Twenty individuals who met the DSM-IV criteria for bipolar I disorder, as assessed by the Structured Clinical Interview for DSM-IV (SCID) (11), and 20 individuals who met the DSM-IV criteria for primary insomnia, as assessed by the Insomnia Diagnostic Interview (unpublished 2004 manuscript of A.G. Harvey et al.), were recruited for this study, along with 20 volunteers without sleep problems. The insomnia and good sleeper groups provided a baseline index of poor sleep and good sleep, respectively. The bipolar disorder patients were recruited from a group of outpatients who met the DSM-IV diagnostic criteria for bipolar I disorder but were currently euthymic. The 20 patients with a diagnosis of primary insomnia were recruited from a group of outpatients seeking treatment for insomnia. The 20 volunteers in the good sleeper group were recruited from the subject pool in the Department of Experimental Psychology, University of Oxford. Inclusion criteria for the good sleeper group were an indication of sleeping "very well" on the Insomnia Diagnostic Interview, no difficulties with sleep in the past month, and no current use of medication for sleep.

For the bipolar disorder group, the average age at onset of the disorder was 22.3 years ($SD=10.1$), the average number of manic episodes was 4.5 ($SD=2.2$), and the average number of depressive episodes was 4.7 ($SD=1.6$). At the time of the study, all participants were being treated with two to three pharmacological agents, including lithium (700–1500 mg/day), carbamazepine (400–800 mg/day), sodium valproate (500–800 mg/day), venlafaxine (225–400 mg/day), fluoxetine (20–70 mg/day), and lamotrigine (50–100 mg/day). In addition, ten patients were taking medication to help them sleep (eight were taking benzodiazepine receptor agonists, and two were taking over-the-counter medications). It is noteworthy that a drug-free group of bipolar disorder patients would likely be unfeasible or unrepresentative. The bipolar disorder patients were confirmed to be euthymic according to their average scores on the Hamilton Depression Rating Scale (mean=1.4, $SD=1.9$) (12) and the Young Mania Rating Scale (mean=2.3, $SD=2.8$) (13). For the insomnia group, the average length of sleep disturbance was 10.55 years ($SD=7.13$). Six patients with insomnia were taking medication to help them sleep (two were taking sedative antidepressants, and four were taking over-the-counter medications).

As for most psychiatric disorders (14), both bipolar disorder and insomnia are known to commonly co-occur with one or more other disorders (15, 16). As such, we did not select "pure" cases, because this selection criterion would reduce the representativeness of the study groups (17, 18). However, we ensured that bipolar disorder was the primary diagnosis of the patients in the bipolar disorder group and that insomnia was the primary diagnosis for the insomnia group. The primary diagnosis was defined as the disorder that was reported to be currently most distressing and disabling (19). Current comorbid axis I disorders, assessed with the SCID, included problem alcohol/drug/medication dependence ($N=4$), specific phobia ($N=1$), generalized anxiety disorder ($N=2$), and posttraumatic stress disorder ($N=2$) for the bipolar disorder group; social phobia ($N=1$), specific phobia ($N=3$), and generalized anxiety disorder ($N=1$) for the insomnia group; and specific phobia ($N=3$) for the good sleeper group.

TABLE 1. Characteristics of Patients With Bipolar Disorder, Patients With Insomnia, and Subjects With Good Sleep in a Study of Sleep-Related Functioning in Euthymic Patients With Bipolar Disorder

Characteristic	Patients With Bipolar Disorder (N=20)		Patients With Insomnia (N=20)		Subjects With Good Sleep (N=20) ^a		Analysis
	N	%	N	%	N	%	
Sex							χ^2 (df=3)
Male	10	50	9	45	7	35	0.95
Female	10	50	11	55	13	65	
Employed							5.84
Yes	7	35	14	70	13	65	
No	13	65	6	30	7	35	
	Mean ^c	SD	Mean ^c	SD	Mean ^c	SD	F (df=2, 57)
Age (years)	39.6	15.2	39.6	10.6	35.0	13.4	0.79
Mood rating ^b	0.4 _a	2.1	1.6 _a	4.2	5.2 _b	2.1	14.39*

^a Subjects who reported on the Insomnia Diagnostic Interview that they slept "very well," reported no difficulties with their sleep in the past month, and were not currently taking any medication for sleep.

^b Rated on a scale from -10, "depressed," to 10, "elated."

^c Different subscripts indicate significant differences between groups (Tukey's test).

* $p<0.02$.

The three groups did not differ in sex, age, or employment status, although the difference between groups for the latter variable approached significance ($p=0.06$). It is unsurprising that bipolar disorder subjects may be less likely to be in employment appropriate to their education. At the time of the interview, the good sleeper group rated their mood as more positive, relative to the bipolar disorder and insomnia groups, who did not differ from each other in their mood ratings (Table 1).

Procedure

After written informed consent was obtained from the participants, as required by the ethics committee that approved this study, the SCID and Insomnia Diagnostic Interview were administered, demographic data were recorded, and a current mood rating was made (on a scale from -10, "depressed," to 10, "elated").

Measures of the sleep/wake cycle. In view of the complex issues involved in accurately assessing sleep (20), the sleep/wake cycle was indexed by using three different methods.

Retrospective self-report. Three measures were taken. First, the Insomnia Diagnostic Interview was administered, as described earlier. Second, the Pittsburgh Sleep Quality Index (21) was administered. This 19-item questionnaire comprises seven component scores, including 1) subjective sleep quality, 2) sleep onset latency, 3) sleep duration, 4) habitual sleep efficiency, 5) sleep disturbance, 6) use of sleep medications, and 7) daytime functioning. The Pittsburgh Sleep Quality Index refers to the majority of days and nights over the previous month. The seven component scores are summed to provide a global score that ranges from 0 to 21, with higher scores indicating worse sleep. The Pittsburgh Sleep Quality Index has good internal consistency ($\alpha=0.83$) and test-retest reliability ($r=0.85$) (22). A total score >5 identifies a clinically significant sleep disturbance with 89.6% sensitivity and 86.5% specificity (21). Third, the participants were asked to report the number of nights in the past week that they had trouble falling asleep and staying asleep and were asked to provide a rating of

their sleep quality on a scale from 1, "very restless," to 10, "very sound."

Retrospective self-report measures have the advantages of being quick and easy to complete and of capturing the individual's subjective global impression of his/her sleep. The disadvantages of these measures include 1) that subjects must understand the concept of an average, as they are asked to report their "typical sleep;" 2) that their answers rely on long-term memory, which can be subject to inaccuracy (23, 24); and 3) that the answers are open to reasoning biases, such as answering on the basis of saliency (the worst night) or recency (the last night) (20). To compensate for the disadvantages of the self-report measures, we also included two prospective measures.

Prospective self-report. The participants were asked to keep a sleep diary (subjective estimate of the sleep/wake cycle) over 8 consecutive days. They were asked to record, in the morning immediately on waking, how long it took them to get to sleep (sleep onset latency), the number of times they woke during the night and the duration of these awakenings (wake after sleep onset), and the length of time they slept in total (total sleep time).

One advantage of this measure is that it constitutes an index of the considerable night-to-night variability in sleep (25). In addition, it retains the advantages associated with retrospective self-report measures while overcoming several of the disadvantages. However, a disadvantage of prospective self-reports of sleep is that sleep is very difficult to estimate accurately; it is defined by the absence of memories (26, 27). Accordingly, an objective estimate of sleep that did not require memory, perception, or judgment was also included.

Prospective actigraphy estimate. While keeping the sleep diary, the participants were asked to wear an Actigraph for 8 consecutive days and nights. The Actigraph (Ambulatory Monitoring Inc., Ardsley, N.Y.) is a small wristwatch-like device worn continuously on the nondominant wrist. Embedded within the device is a miniaturized piezoelectric acceleration sensor that detects and stores information about physical motion. This information is downloaded into compatible software to generate an estimation of the sleep/wake cycle. For adults without sleep complaints, there is strong agreement between sleep estimates generated by actigraphy and those generated by polysomnography, which is the "gold standard" sleep assessment technique. The epoch-by-epoch agreement rate for sleep and wakefulness detection ranges from 74% to 98% (28–30). However, the rate of agreement is lower in individuals who lie immobile for long periods (e.g., clinically depressed patients and insomnia patients), as actigraphy is less accurate in differentiating quiet presleep wakefulness from sleep. Data were collected in the Actigraph's Zero-Crossing Mode, which allowed for the recording of a daytime activity count for each 60-second epoch. This count reflects the number of times movement was recorded above the preset threshold within each epoch and has previously been found to provide an effective measure of daytime activity level (31). It is noteworthy that six individuals in the bipolar disorder group did not complete the 8-day prospective monitoring task. Thus, the analysis was based on data for 14 patients with bipolar disorder. There were no significant differences in the Pittsburgh Sleep Quality Index global score between the 14 completers and the six noncompleters ($t=-1.42$, $df=18$, $n.s.$).

Sleep-related cognitive and behavioral processes. A semi-structured interview (32) was administered to assess the constructs that underpin the stimulus control and sleep hygiene intervention. The topics covered were those listed in previous research as indicators of poor sleep hygiene and poor stimulus control (e.g., references 33–36). As an index of the need for a cognitive intervention, the Sleep Disturbance Questionnaire (37, 38) and the Dysfunctional Attitudes and Beliefs About Sleep Questionnaire (36) were administered. The Sleep Disturbance Ques-

tionnaire requires participants to rate the extent to which 12 attributions for inability to sleep are true for them on a scale from "never true" to "very often true." The items assess several potential causes of sleep disturbance, including physical tension (average of three items), sleep pattern problem (average of three items), cognitive arousal (average of three items), and sleep effort (average of three items) (37). Because the Sleep Disturbance Questionnaire is used to inquire about sleep disturbance, it was not considered meaningful to administer it to the good sleeper group. The Dysfunctional Attitudes and Beliefs About Sleep Questionnaire is a 30-item questionnaire designed to assess beliefs and attitudes relating to sleep. For each item the participant is asked to mark his/her extent of agreement on a Likert-type scale from 0, "strongly disagree," to 10, "strongly agree." The Dysfunctional Attitudes and Beliefs About Sleep Questionnaire generates a total score and scores on five subscales (39): 1) unhelpful beliefs about the consequences of insomnia (average of six items), 2) unhelpful beliefs about the control and predictability of sleep (average of nine items), 3) unhelpful beliefs about sleep requirements (average of three items), 4) unhelpful causal attributions for insomnia (average of two items), and 5) unhelpful sleep promoting practices (average of eight items).

Immediately after this session, the Hamilton Rating Scale for Depression and the Young Mania Rating Scale were completed for the participants in the bipolar disorder group. The participants returned for a second session to hand in the sleep diary and Actigraph and to receive a debriefing about the aims of the study.

Data Analytic Plan

For continuous variables, data analysis comparing all three groups was based on one-way analysis of variance with post hoc Tukey's tests to explore significant effects. Data analysis comparing two groups was based on t tests for independent samples. For categorical variables, chi-square analyses were conducted. For analyses involving multiple comparisons, a Bonferroni adjustment was conducted to control for the possibility of inflated error (0.05/number of comparisons).

Both the bipolar disorder group and the insomnia group reported experiencing more nights of difficulty falling asleep and staying asleep over the past week, relative to the good sleepers, but the two patient groups did not differ on these variables. The insomnia patients rated their sleep quality as poorer, compared to the bipolar disorder patients, whose ratings of sleep quality were poorer than those of the good sleeper subjects (Table 2).

Results

Measures of Sleep/Wake Cycle

Retrospective self-report. Based on the Insomnia Diagnostic Interview, the percentage of participants who met the full diagnostic criteria for primary insomnia was 55% in the bipolar disorder group, 100% in the insomnia group, and 0% in the good sleeper group. Criterion D for primary insomnia, which specifies that insomnia must not occur exclusively because of another psychiatric disorder, was not used in making the diagnosis of primary insomnia in the bipolar disorder group.

The percentage of participants scoring >5 on the Pittsburgh Sleep Quality Index, a level indicative of a clinically significant sleep disturbance (21), was 70% for the bipolar disorder group, 100% for the insomnia group, and 0% for the good sleeper group. The mean values for the Pittsburgh Sleep Quality Index variables are summarized in Ta-

TABLE 2. Sleep/Wake Cycle Characteristics of Euthymic Patients With Bipolar Disorder, Patients With Insomnia, and Subjects With Good Sleep

Characteristic	Patients With Bipolar Disorder (N=20)		Patients With Insomnia (N=20)		Subjects With Good Sleep (N=20) ^a		Analysis	
	Mean ^b	SD	Mean ^b	SD	Mean ^b	SD	F (df=2, 57)	p
Pittsburgh Sleep Quality Index score								
Global	7.9 _b	5.3	11.5 _a	2.5	2.3 _c	1.3	36.06	<0.007
Subjective sleep quality	1.2 _b	0.8	1.9 _a	0.6	0.2 _c	0.5	33.19	<0.007
Sleep onset latency	1.6 _a	1.6	1.8 _a	0.9	0.4 _b	0.5	9.88	<0.007
Sleep duration	0.9 _b	1.0	1.9 _a	0.8	0.4 _c	0.5	20.12	<0.007
Habitual sleep efficiency	1.1 _b	1.1	2.0 _a	1.0	0.1 _c	0.2	23.65	<0.007
Sleep disturbances	1.1	0.6	1.4	0.5	0.9	0.4	5.28	n.s.
Use of sleep medications	0.7	1.2	0.9	1.2	0.0	0.0	4.36	n.s.
Daytime dysfunction	1.4 _a	0.9	1.5 _a	0.6	0.5 _b	0.5	13.17	<0.007
Self-reported problems falling asleep (number of nights over the past week)	3.1 _a	3.9	2.8 _a	2.2	0.2 _b	0.3	7.60	<0.02
Self-reported problems staying asleep (number of nights over the past week)	3.8 _a	5.0	5.2 _a	1.8	0.5 _b	1.4	11.65	<0.02
Subjective sleep quality ^c	6.0 _b	2.5	4.1 _a	1.9	8.5 _c	1.8	22.52	<0.02
	Mean ^b	SD	Mean ^b	SD	Mean ^b	SD	F (df=2, 52)	p
Subjective estimates of sleep/wake cycle ^d								
Sleep onset latency (minutes)	49.1 _a	46.2	33.9	22.5	9.6 _b	5.1	5.81	<0.02
Wake after sleep onset (minutes)	36.4	36.6	41.5 _a	20.8	10.4 _b	8.8	5.95	<0.02
Total sleep time (hours)	7.1	1.6	6.2 _a	0.9	7.5 _b	0.9	5.35	<0.02
	Mean ^b	SD	Mean ^b	SD	Mean ^b	SD	F (df=2, 52)	p
Objective estimates of sleep/wake cycle ^d								
Sleep onset latency (minutes)	18.5	17.8	19.4	29.5	13.9	8.3	0.41	n.s.
Wake after sleep onset (minutes)	37.5	30.2	27.6	24.2	29.6	24.5	0.69	n.s.
Total sleep time (hours)	8.4 _a	1.3	7.0 _b	0.9	7.0 _b	1.0	9.58	<0.02
Daytime activity (number of movements above threshold/60-second epoch) ^e	171.6 _a	38.0	195.2 _b	23.5	208.9 _b	22.7	8.05	<0.02

^a Subjects who reported on the Insomnia Diagnostic Interview that they slept "very well," reported no difficulties with their sleep in the past month, and were not currently taking any medication for sleep.

^b Different subscripts indicate significant differences between groups (Tukey's test).

^c Rated on a scale from 1, "very restless," to 10, "very sound."

^d Data were missing for six participants in the bipolar disorder group.

^e Measured with actigraphy.

ble 2. The mean global score on the Pittsburgh Sleep Quality Index was higher for the insomnia group than for the bipolar disorder group, which scored higher than the good sleeper group. On the sleep onset latency and daytime dysfunction subscales, the insomnia group and the bipolar disorder group did not differ from each other, but both scored higher than the good sleeper group. For the subjective sleep quality, sleep duration, and habitual sleep efficiency subscales, the insomnia group scored higher than the bipolar disorder group, which scored higher than the good sleeper group.

Prospective self-report. Over 8 consecutive days and nights, the bipolar disorder group reported longer sleep onset latency, relative to the good sleeper group. The insomnia group's subjective rating of time awake after sleep onset was longer and of total sleep time was shorter, relative to the good sleeper group.

Prospective actigraphy estimate. For the bipolar disorder group, the objective estimate of total sleep time was longer and the daytime activity mean lower, relative to both the insomnia and good sleeper groups (Table 2). Sleep onset latency and wake after sleep onset did not differ significantly across the groups.

Sleep-Related Cognitive and Behavioral Processes

The bipolar disorder and insomnia groups had lower sleep efficiency scores, relative to the good sleeper group; otherwise, the three groups scored similarly on the sleep hygiene and stimulus control variables (Table 3).

As for the Sleep Disturbance Questionnaire subscales (Table 3), the highest scores for both patient groups were obtained on the cognitive arousal subscale. Comparisons of the bipolar disorder group and the insomnia group on each of the subscales indicated that the insomnia group scored higher on both the physical tension and cognitive arousal subscales, relative to the bipolar disorder group. The three Sleep Disturbance Questionnaire items endorsed most frequently by the bipolar disorder group were "I can't get into a proper routine" (40% endorsed either "often true" or "always true"), "My mind keeps turning things over" (45% endorsed either "often true" or "always true"), and "I am unable to empty my mind" (30% endorsed either "often true" or "always true"). The three Sleep Disturbance Questionnaire items endorsed most frequently by the insomnia group were "My mind keeps turning things over" (75% endorsed either "often true" or "always true"), "My thinking

TABLE 3. Sleep-Related Cognitive and Behavioral Processes of Euthymic Patients With Bipolar Disorder, Patients With Insomnia, and Subjects With Good Sleep

Sleep-Related Process	Patients With Bipolar Disorder (N=20)		Patients With Insomnia (N=20)		Subjects With Good Sleep (N=20) ^a		Analysis	
	N		N		N		χ^2 (df=2)	p
Sleep hygiene								
Quiet bedroom	19		18		18		0.44	n.s.
Mattress comfortable	19		18		17		1.11	n.s.
Alcohol as a sleep aid	4		5		0		9.02	n.s.
Exercise within 4 hours of going to bed	0		4		3		3.31	n.s.
Reading while in bed	15		14		14		0.16	n.s.
Watching television while in bed	5		5		7		0.66	n.s.
Using telephone while in bed	6		10		10		2.17	n.s.
Playing radio while in bed	12		9		11		0.94	n.s.
Desk with paper work in bedroom	5		3		7		2.13	n.s.
Tea/coffee/cafeinated soft drink after 5:00 p.m.	10		14		13		1.83	n.s.
Cigarettes after 5:00 p.m.	9		2		2		9.62	n.s.
	Mean	SD	Mean	SD	Mean	SD	F (df=2, 57)	p
Standard cups of tea/day	3.2	3.7	2.3	2.0	1.3	1.7	2.54	n.s.
Standard cups of coffee/day	0.8	1.3	0.5	1.0	1.8	2.5	2.72	n.s.
Standard cups of caffeinated soft drinks/day	0.3	0.7	0.1	0.2	0.2	0.5	0.76	n.s.
Number of cigarettes/day	13.8	7.8	9.0	1.4	10.8	13.1	0.72	n.s.
	N		N		N		χ^2 (df=2)	p
Stimulus control variables								
Napping	9		11		12		0.94	n.s.
Variable sleep scheduling	10		7		15		6.56	n.s.
Response to inability to fall asleep							2.26	n.s.
Stay in bed	16		19		18			
Get out of bed	4		1		2			
	Mean ^b	SD	Mean ^b	SD	Mean ^b	SD	F (df=2, 58)	p
Sleep efficiency ^c	77.7 _a	16.0	74.2 _a	10.7	92.6 _b	5.5	14.6	<0.02
	Mean ^b	SD	Mean ^b	SD	Mean ^b	SD	t (df=39)	p
Sleep Disturbance Questionnaire score								
Physical tension	2.3 _b	0.6	2.9 _a	0.8			2.93	<0.02
Sleep pattern problem	2.7	0.9	2.8	0.8			0.30	n.s.
Cognitive arousal	3.0 _b	1.1	4.1 _a	0.7			3.65	<0.02
Sleep effort	2.4	0.9	2.9	1.0			1.53	n.s.
Dysfunctional Attitudes and Beliefs About Sleep Questionnaire score								
Total	108.1 _a	39.7	121.0 _a	30.8	74.0 _b	32.7	7.59	<0.008
Consequences of insomnia	4.7	2.4	5.7	1.4	3.7	2.0	4.70	n.s.
Control and predictability of sleep	4.3 _a	2.4	5.2 _a	1.5	2.0 _b	1.2	15.51	<0.008
Sleep requirements	3.4	1.8	4.4	1.8	3.5	1.5	1.73	n.s.
Causal attributions	3.2	2.2	2.0	1.5	2.3	1.7	2.01	n.s.
Sleep-promoting practices	3.0	1.7	2.9	1.2	2.7	1.4	0.34	n.s.

^a Subjects who reported on the Insomnia Diagnostic Interview that they slept "very well," reported no difficulties with their sleep in the past month, and were not currently taking any medication for sleep.

^b Different subscripts indicate significant differences (Tukey's test).

^c (Total sleep time/time in bed)/100.

takes a long time to unwind" (75% endorsed either "often true" or "always true"), and "I am unable to empty my mind" (75% endorsed either "often true" or "always true").

For the total score on the Dysfunctional Attitudes and Beliefs About Sleep Questionnaire, the insomnia and bipolar disorder groups did not differ from each other but both scored higher than the good sleeper group. The differences for only one of the five subscales of the Dysfunctional Attitudes and Beliefs About Sleep Questionnaire reached significance (Table 3). For the subscale measuring control and predictability of sleep, the insomnia and bipolar disorder groups did not differ from each other, but both

scored significantly higher than the good sleeper group. The correlation between the total score on the Dysfunctional Attitudes and Beliefs About Sleep Questionnaire and the Pittsburgh Sleep Quality Index global score was significant for the bipolar disorder group ($r=0.76$, $N=20$, $p<0.001$) but not for the insomnia group ($r=0.35$, $N=20$, n.s.) or the good sleeper group ($r=0.004$, $N=20$, n.s.).

Discussion

One aim of the present study was to investigate the sleep-related functioning of euthymic bipolar disorder pa-

tients. The rationale was that while patients with bipolar disorder are known to be symptomatic even when euthymic (10), to our knowledge there are no published data documenting their sleep/wake cycle during nonacute periods, despite the importance of sleep in theories about bipolar disorder (e.g., references 5, 6). Taken together, the sleep estimates from the retrospective, prospective, subjective, and objective sources in the current study indicate that sleep disturbance was, indeed, a significant problem in the bipolar disorder group, even when the patients were euthymic. Seventy percent of the bipolar disorder group had a clinically significant sleep problem, and 55% met the strict diagnostic criteria for insomnia (excluding criterion D). These findings add to previous evidence indicating that bipolar disorder patients may experience considerable symptoms during periods when their illness is nonacute (10). Furthermore, the sleep of the bipolar disorder patients, as a group, was more similar to that of the insomnia patients than to that of the good sleeper group on most measures. This pattern was even more evident in analyses comparing the 11 patients with bipolar disorder plus insomnia with the patients who had insomnia only. However, we make these observations cautiously, as the number of subjects was small; hence the study may have lacked sufficient statistical power to detect minor but important differences.

The bipolar disorder and insomnia groups were heterogeneous in 1) their sleep characteristics (see standard deviations in Table 2), 2) the medications they were taking, and 3) their patterns of comorbidity. However, correlations between the Pittsburgh Sleep Quality Index global score and demographic variables were not significant, suggesting that baseline differences in demographic characteristics were unrelated to sleep problems.

Previous research has established a discrepancy between subjective and objective sleep estimates in patients with insomnia, who tend to overestimate the time it takes them to get to sleep (sleep onset latency) and underestimate how much sleep they obtain overall (total sleep time) (e.g., references 40, 41). In the present study, the bipolar disorder group showed a similar pattern of results: they overestimated how long it took them to fall asleep (by an average of 40.6 minutes [Table 2]) and they underestimated how much sleep they obtained overall (by an average of 1.3 hours [Table 2]). Although these findings should be verified by using polysomnography as the objective sleep measure, we offer several tentative interpretations. First, research on insomnia has highlighted that cognitive arousal is a mechanism that underpins the tendency to misperceive sleep in insomnia (42). Given the results for the Sleep Disturbance Questionnaire and Dysfunctional Attitudes and Beliefs About Sleep Questionnaire in the present study, it is possible that this mechanism also operates to distort the perception of sleep in patients with bipolar disorder. Second, misperception of sleep may contribute to anxiety because it leads the person to believe

that the sleep he/she is getting is inadequate. Because anxiety is antithetical to sleep, this difficulty may then serve to maintain the insomnia (43). A behavioral intervention can reduce the tendency to underestimate the amount of sleep obtained and reduce sleep-related anxiety in insomnia patients (44); similar results from use of such interventions would be predicted in euthymic bipolar disorder patients.

Finally, the bipolar disorder group had lower daytime activity levels, relative to both the insomnia group and the good sleeper group. The lower activity level in the bipolar disorder group may be related to their use of medication and may not be important for sleep. On the other hand, it could also be relevant to their insomnia. For example, lower activity levels might serve to maintain nighttime sleep problems, as the patients may not be sufficiently tired to get to sleep. The latter finding raises the possibility that components from the behavioral activation intervention (45) may be worth considering as an adjunct to psychosocial treatment for bipolar disorder.

An additional aim of this study was to assess the constructs that underpin three components of cognitive behavior therapy for insomnia. The finding that the insomnia group had poorer sleep efficiency is consistent with previous findings (see reference 25). Sleep efficiency was the only stimulus control variable to reach significance in the comparison of bipolar disorder patients and good sleepers. This finding raises the possibility that improved sleep efficiency, by means of a stimulus control intervention, may be a useful objective for patients with bipolar disorder (46, 47). By contrast, the bipolar disorder group did not have poor sleep hygiene. This finding brings into question the value of sleep hygiene training in the treatment of insomnia in bipolar disorder patients. By analogy with behavioral approaches to primary insomnia (32), our analysis represents a first step in the process of empirically deriving appropriate interventions for the treatment of sleep disturbance in patients with bipolar disorder.

The results from the Sleep Disturbance Questionnaire and Dysfunctional Attitudes and Beliefs About Sleep Questionnaire were striking. The most commonly endorsed item on the Sleep Disturbance Questionnaire—"I can't get in a proper routine"—confirms the importance of regularizing the sleep/wake cycle, a treatment component that is already included in cognitive behavior therapy and interpersonal and social rhythm therapy for bipolar disorder (7, 8). The other most frequently endorsed items ("My mind keeps turning things over" and "I am unable to empty my mind"), along with the relatively high score on the cognitive arousal subscale of the Sleep Disturbance Questionnaire, parallel results found in the insomnia groups in this study and in previous research (32, 37). These findings raise the possibility that excessive cognitive arousal while trying to get to sleep may be one process that maintains the sleep disturbances experienced by euthymic bipolar patients.

The bipolar disorder group held a level of dysfunctional beliefs about sleep that was comparable to that of the insomnia group and significantly higher than that of the good sleepers. Although these findings need to be confirmed with a larger group of subjects, we found that holding more dysfunctional beliefs about sleep was associated with more severe sleep disturbance ($r=0.76$). This association is consistent with previous research findings (48) and suggests that dysfunctional beliefs about sleep may be important in the maintenance of insomnia in patients with bipolar disorder. In addition, relative to the good sleeper group, both the bipolar disorder group and the insomnia group scored higher on the control and predictability of sleep subscale of the Dysfunctional Attitudes and Beliefs About Sleep Questionnaire. The highly scored items of this subscale for the bipolar disorder group were "I am worried that I may lose control over my abilities to sleep," "I can't ever predict whether I'll have a good or poor night's sleep," and "I get overwhelmed by my thoughts at night and often feel I have no control over this racing mind." In addition to confirming the Sleep Disturbance Questionnaire findings just discussed, these items suggest that the bipolar disorder subjects are anxious and fearful about their sleep. Informally, most of the patients in the bipolar disorder group reported that the cause of their anxiety about sleep was the awareness that sleep loss can herald an episode of mania or depression.

The clinical implications of these findings are threefold. First, they raise the possibility that interventions designed to reduce cognitive arousal while trying to get to sleep may be warranted (49). Second, as anxiety and fear are antithetical to sleep onset, they are worthy targets for intervention. Future studies should explore the utility of education (25, 50) and behavioral experiments (51) designed to alter dysfunctional beliefs. Finally, when working with patients to enhance their ability to recognize prodromes and develop effective coping strategies for prodromes (8), care should be taken not to increase anxiety about sleep.

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