INTRODUCTION

SUBJECTIVE JUDGMENTS ABOUT SLEEP LATENCY and total sleep time are of central importance to the diagnosis and treatment of insomnia and related sleep disorders. However, it is widely recognized that subjective recollections of sleep experience provide only a partial, and often inaccurate, portrayal of the nature and severity of objective sleep difficulties. Whereas many normal sleepers provide estimates of total sleep time and sleep latency that agree with polysomnographic (PSG) measures, insomnia patients often report greater sleep disruption than is evidenced by objective laboratory data. Indeed, as many as 10% to 25% of insomniacs meet diagnostic criteria for sleep state misperception, a classification assigned to individuals who complain of marked insomnia but show relatively normal sleep on PSG. Other reports indicate that less extreme sleep misperceptions are common among insomnia patients generally, leading some to argue that patients with sleep state misperception may simply represent the outer end of a normal sleep misperception continuum.

Yet, while several investigators have argued that sleep time underestimation and sleep latency overestimation is...
common to many insomnia patients, at least two studies suggest considerable variability in sleep time perception among sleep disorder patients. One recent report showed, for example, that while group-based averages indicate a general tendency for patients with complaints of insomnia to underestimate total sleep time, a substantial number of patients produced estimates of sleep time that were congruent with PSG-observed sleep time, and nearly 20% overestimated total sleep. Carskadon and colleagues reported similarly that, as a group, insomnia patients produced overestimates of total sleep time and underestimates of sleep latency, but also noted that nearly 20% of the sample produced estimates of total sleep time that were congruent with PSG readings and 12% of the sample produced substantial overestimates of total sleep time.

Despite the obvious clinical importance of subjective perceptions of sleep disturbance, research has provided relatively little insight into patient factors potentially affecting sleep time perceptions. Laboratory work suggests that sleep time underestimation may be due in part to physiologic or perceptual deficits that limit insomniacs' capacity to differentiate between sleep and wakefulness. Upon being awakened from PSG-defined sleep, poor sleepers are more likely than good sleepers to report that they were actually awake, an effect attenuated by triazolam and zolpidem. In addition, there is some evidence suggesting that alterations in perceptions of wakefulness vary as a function of time of night. In a laboratory study of patients with sleep state misperception, expected alterations in perceptions of wakefulness were observed for stage 2 sleep during the first sleep cycle, whereas when awakened during stage 2 of the third sleep cycle, patients were more likely to report that they were asleep after being awakened. Finally, Edinger and Fins found evidence suggesting that sleep time perception varies by sleep disorder and specific sleep self-report factors. That is, psychophysiological insomniacs tended to underestimate total sleep time whereas PLM patients tended to overestimate sleep time. Overestimation was also associated with a complaint of non-restorative sleep and the conviction that one's sleep difficulty is organically based.

We hypothesized that psychological factors may also play a role in distorting the self-reported severity of sleep disturbance, since psychological distress tends to be associated with the magnification of somatic complaints in general. The most common psychiatric syndromes (i.e., mood and anxiety disorders) might be exacerbated by, as well as contribute to, sleep deprivation, and psychiatric symptoms (such as fatigue, poor concentration, panic, and irritability) could readily be misattributed by patients to poor sleep. Psychologically distressed patients may furthermore enhance the severity of sleep disturbance reports, which could serve to elicit a more aggressive medical treatment of their sleep difficulties, psychological difficulties, or both. Indirect support for this possibility is provided by data documenting elevated MMPI psychopathology and neuroticism among sleep state misperception patients.

In the present study we have sought to characterize the extent to which a diagnostically diverse group of sleep disorder patients misperceive total sleep time and sleep latency. Furthermore, we aimed to identify diagnostic, polysomnographic, and psychological factors associated with the overestimation and underestimation of total sleep time and sleep latency. Our goal was to broaden the inquiry to include sleep-disordered patients representing a variety of diagnostic subgroups.

**METHODS**

**Subjects**

Subjects were drawn from an initial pool of 592 consecutive patients who underwent diagnostic PSG following clinical referral to a university based sleep disorders center. Selection criteria consisted of: 1) a completed overnight polysomnography evaluation; 2) a completed MMPI; and 3) self-reported sleep initiation and/or sleep maintenance difficulties or a complaint of non-restorative sleep. Four-hundred twenty eight participants underwent an overnight PSG and had a completed MMPI, among whom 350 (82%) reported sleep initiation/maintenance difficulties or complained of non-restorative sleep. From this pool of eligible participants, we then selected patients meeting criteria for one of five sleep disorder diagnoses of primary interest to this investigation: psychophysiological insomnia; insomnia associated with depressive disorder; insomnia secondary to an Axis I psychiatric disorder other than depression; sleep state misperception (SSM, n=8); and periodic limb movement in sleep disorder (PLMD, n=24). Finally, to arrange for approximately equivalent cell sizes relative to other diagnostic subgroups, we randomly selected 21 of the 152 eligible obstructive sleep apnea patients (14%) who met inclusion criteria. Patients whose primary sleep disorder diagnosis was poor sleep hygiene (n=11), or central apnea (n=7) were excluded from the study, as were several patient groups with too few cases to analyze (e.g., insomnia secondary to a medical condition).

The final study N was 104 (37% female; M age=45, SD=11.4). Men and women were equally represented across sleep diagnosis categories, χ² (5)=7.47, ns. There were no age differences across diagnostic groups, with one exception: patients with PLMD were older than other diagnostic groups (M=54.3 vs. 42.2), t (97)=−4.75, p<.001. With regard to medical comorbidity, 26% had hypertension, 14% had cardiac disease, 9% had pulmonary disease,
11% had neurological disease, and 54% had other medical diseases (primarily endocrine, hematologic, and gastrointestinal). Mean periodic limb movement arousal index for PLMD patients was 27.4 (SD=20.0). OSA patients had a mean apnea-hypopnea index of 74.4 (SD=35.2), a mean oxygen saturation of 92% (SD=4.3), and a mean minimum oxygen saturation of 80% (SD=6.5).

Procedure

During their initial visit, patients underwent an extensive interview and examination by a board certified psychiatrist and sleep physician (WBM). The clinical interview included screening for current or past psychiatric disturbance and for evidence of a conditioned element to the sleep disturbance. Patients also completed the MMPI26 and the sleep habit questionnaire.27 The MMPI consists of 550 true/false format items covering a wide variety of behaviors, thoughts, and attitudes, somatic difficulties, and emotions. Responses reduce to 10 empirically derived clinical scales with reasonably good test-retest reliability, adequate internal consistency, and meaningful correlations with behavior and scores on related psychological tests. Scale scores are represented as t-scores, with a mean of 50 and standard deviation of 10, and are referenced against the responses of a large "Minnesota normal" sample; more detailed description of instrument development and psychometric properties is published elsewhere.26 The Sleep Habit Questionnaire is a self-administered clinic form developed for research purposes. The questionnaire consists of 16 items assessing a range of sleep-related experiences, including the nature and duration of the presenting sleep complaint, usual bedtime on weeknights and weekends, past use of prescription and non-prescription hypnotics, and patient perceptions of their habitual (usual) sleep latency and total sleep time. Items from the sleep habit questionnaire used in this study were: patient estimates of usual total sleep time and sleep latency (e.g., "How many hours, on average, do you think you sleep?").

Sleep disorders were diagnosed using the International Classification of Sleep Disorders (ICSD).3 In determining the presence of psychiatric disorder, the interviewer applied DSM-III-R criteria29 to interview data, but was blind to MMPI results. Following overnight PSG, patients completed an additional brief questionnaire including items assessing perceived (estimated) total sleep time and sleep latency.

Variable Computation and Data Analysis Overview

Congruence between subjective estimates of total sleep time and sleep latency and PSG derived times was computed using a ratio score approach, as described by Edinger and colleagues13 (also see Mendelson21,22). Sleep time and sleep latency ratio scores were computed for each patient using the formulas:

1) subjective sleep ratio = (estimated sleep time/ PSG sleep time) x 100
2) subjective sleep latency ratio = (estimated sleep latency/ PSG sleep latency) x 100

Using this approach, a value of 100% indicates perfect congruence between the subjective (patient-based) estimate and objective findings. A value of 0% indicates no correspondence between the subjective and objective estimates.

Table 1—Subjective estimates of total sleep time and sleep latency versus objective findings (complete sample).

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
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<td>Total Sleep Time (in minutes)</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Estimate (patient)</td>
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<td>311.9a</td>
<td>128.0</td>
<td>1 - 599</td>
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<td>328.8</td>
<td>89.0</td>
<td>75 - 555</td>
</tr>
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<td>Subjective sleep ratio: % (estimated / observed)</td>
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<td>96.0</td>
<td>37.1</td>
<td>.3 - 234</td>
</tr>
<tr>
<td>Sleep Latency (minutes)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimated (patient)</td>
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<td>44.4b</td>
<td>44.9</td>
<td>.5 - 239</td>
</tr>
<tr>
<td>Observed (PSG)</td>
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<td>31.2</td>
<td>.5 - 161</td>
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<tr>
<td>Subjective sleep latency ratio: % (estimated / observed)</td>
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<td>22.1</td>
<td>80 - 187</td>
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<td>Sleep Habit Questionnaire Data</td>
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<td></td>
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<tr>
<td>Habitual total sleep time estimate</td>
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<td>167.4</td>
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<tr>
<td>Habitual sleep latency estimate</td>
<td>97</td>
<td>28.3</td>
<td>45.6</td>
<td>0 - 300</td>
</tr>
</tbody>
</table>

a Subjective estimates of total sleep time did not differ significantly from observed total sleep time, t (103) = 1.56, p = .11.

b Subjective estimates of sleep latency significantly differed from observed sleep latency, t (91) = -6.01, p < .0001.
and the observed (PSG) data, values <100% reflect relative underestimation, and values >100% reflect relative overestimation. Because both the estimated and observed sleep latency distributions were positively skewed, both variables were transformed to their logarithm value using the formula Log10(x + 10) prior to computation of subjective sleep latency ratio scores, to reduce the influence of extreme outliers. This transformation resulted in substantial improvement in the normality of the distribution (skewness=.74, kurtosis=.78).

By combing subjective estimates and PSG-based sleep times into a single measurement unit, ratio scores can fully characterize the distribution of sleep time over- and under-estimations. Moreover, ratio scores can readily be analyzed to identify patient variables of relevance to sleep time misestimation. However, because ratio scores do not indicate the absolute magnitude of differences between subjective and objective indices (i.e., the number of minutes by which estimates diverge from PSG observed times), we also report some descriptive data concerning the range of sleep time misestimations, expressed in minutes. Primary study hypotheses are tested using ratio scores.

To facilitate the interpretation of group effects for several analyses, participants were also categorized into one of three subjective sleep ratio groups, based on equal cut-points in the distribution. Subjective sleep ratio scores were normally distributed around the 100% midpoint; patients were grouped according to their subjective sleep ratio scores as follows: those with scores below 86% were placed in the "low" subjective sleep ratio group (relative underestimators of sleep time), those with scores between 86% and 112% were placed in the "middle" sleep ratio group (relatively accurate estimators of sleep time), and those with scores above 112% were categorized in the "high" sleep ratio group (relative overestimators of sleep time). A similar grouping scheme was applied to sleep latency ratio scores, with the following tertile-based cut-points: "low" (<110%), "middle" (110% to 127%), and "high" (>127%).

Statistical analyses for continuous outcome measures and categorical independent variables were performed using independent and paired sample t-tests and one way analysis of variance (ANOVA). Analyses involving continuous predictor and outcome measures are reported using the Pearson R correlation. Our sample included relatively few patients diagnosed with SSM (n=8) and insomnia with a depressive disorder (n=11), relative to other diagnostic categories. Such cell size differences potentially violate assumptions of homogeneity of variance for comparisons involving group means, and could restrict our ability to detect group differences. We therefore assessed for heterogeneity of within-cell variance for comparisons of subjective sleep and sleep latency ratio data among each sleep disorder group using the Levene test, a robust diagnostic procedure developed to detect unequal variances. Results showed no differences in variance across diagnostic categories, both for subjective sleep ratio scores, F (5, 98) = .87, ns and subjective sleep latency ratio scores, F (5, 86) = .93, ns, indicating that the homogeneity of variance assumption was not violated for the two analyses involving mean comparisons of subjective sleep ratio data by sleep disorder diagnosis.

RESULTS

Sleep Time Estimation Across the Entire Sample

Table 1 lists descriptive data for key PSG and self-report measures. Estimated total sleep time was moderately correlated with observed total sleep time (r=.56, p<.0001) and, similarly, estimated sleep latency was moderately correlated with observed sleep latency (r=.59, p<.0001). Paired t-tests showed, however, that mean estimated sleep latency was significantly higher than observed sleep latency, (M's= 44.4 vs. 21.5 minutes), t (91)=-6.01, p < .0001. In contrast, estimated total sleep time did not differ from observed total sleep time, t (103)=-1.56, p = .11, although examination of the raw means suggests a possible trend for patients to underestimate total sleep time (see Table 1).

The distributions for subjective sleep ratio and subjective sleep latency ratio scores are shown in Figures 1 and 2. As Figure 1 illustrates, congruence between sleep time estimates and observed total sleep time varied widely across the sample (M=96.0%, SD=37.1). The median subjective sleep ratio score was 100.3, indicating that many participants provided accurate sleep time estimates, and a roughly equal proportion of patients overestimated and underestimated total sleep time.
underestimated total sleep time. Expressed in minutes, findings showed that 24% of the sample provided estimates that were within ± 30 minutes of the PSG-observed total sleep time. In addition, while a full 30% of patients underestimated their sleep time by 60 minutes or greater, a similar percentage (26%) overestimated total sleep time by more than 60 minutes. Whereas subjective sleep ratio scores were normally distributed around the 100% mark, both mean and median subjective sleep latency ratio scores fell well above 100% (M=119.0, SD=22.1, Median=117.3), with the majority of patients overestimating sleep latency (see Figure 2). Expressed in minutes, nearly half of the sample (49%) overestimated sleep latency by 15 minutes or greater, whereas only 8% underestimated sleep latency times by 15 minutes or more. A significant minority of patients (22%) provided estimates of sleep latency that were within ± 5 minutes of PSG-observed sleep latency duration.

**Sleep Time Estimation by ICSD Diagnosis**

Table 2 lists subjective sleep ratio and subjective sleep latency ratio data, stratified by sleep disorder diagnosis. Subjective sleep ratios varied by diagnostic group, F (5, 98) =3.99, p<.005. Planned comparisons showed that psychophysiological insomniacs overestimated total sleep time relative to the other groups combined, t (102)=2.84, p< .01. Expressed in minutes, the average difference between subjective estimates of sleep time and PSG determined total sleep time was +33 minutes (SD=73.8) among patients with psychophysiological insomnia, as compared to -28 minutes (SD = 111.4) among the other diagnostic groups combined. Only sleep state misperception patients tended to underestimate total sleep time relative to all other diagnostic groups, t (102)=3.53, p<.005, a finding that was expected based on the criteria used to assign patients to this diagnostic group. Subjective sleep latency ratio scores did not differ across ICSD diagnostic groups, F (5, 86) =.75, ns.

**Sleep Parameter and Patient History Influences on Sleep Time Perceptions**

Next, we examined the relationship between several sleep parameter measures and sleep time perception. Using continuous outcome measures, subjective sleep ratio and sleep latency ratios were not correlated with sleep efficiency, wake time after sleep onset, latency of REM onset, or time in each sleep stage. However, when PSG parameters were analyzed using three level groupings of sleep ratio data (i.e., low, middle, and high), several noteworthy differences emerged. In particular, wake time after sleep onset, F (2, 99) = 4.24, p<.02, and sleep efficiency, F (2, 99)=5.50, p<.005, varied by subjective sleep ratio grouping. Planned comparisons revealed a non-linear relationship between wake time after sleep onset and subjective sleep ratios, indicating that patients in the "middle" subjective sleep ratio group (those producing "accurate" estimations of total sleep time) had shorter durations of wakefulness after sleep onset (M=51.9, SD=44.0) as compared to patients in the sleep time overestimation group (M=92.4, SD=60.5; t (65)=-3.15, p < .001), and (at trend level) the sleep time underestimation group (M=74.1, SD=64.6; t (68)=1.68, p<.10). Similarly, patients in the "middle" group whose sleep time estimates were relatively congruent with PSG measures had higher sleep efficiency (M=82.2, SD=14.2) as compared to the combined means for sleep time underestimators (M=77.6, SD=17.5) and sleep time overestimators (M=68.9, SD=18.2), t (102)=2.38, p< .02.

We also examined the relationship between habitual sleep time estimation (i.e., average time slept at home) and sleep estimation ratio scores during PSG monitoring. Habitual total sleep time estimation was positively correlated with subjective sleep ratio scores (r=.38, p < .0001) and negatively correlated with subjective sleep latency ratio scores (r=-.31, p<.005), suggesting that as reported habitual sleep time decreased (i.e., fewer average hours slept at home), patients were more likely to produce underestimates of sleep time and overestimates of sleep latency in the lab during the overnight study. These findings were further characterized by examining mean habitual sleep time for low, middle, and high sleep ratio groupings. There were clear differences in reported habitual sleep time across both subjective sleep ratio, F (2, 99)=8.04, p<.005, and subjective sleep latency subgroups, F (2, 89) = 4.01, p< .05. Planned comparisons showed that habitual sleep times reported by patients who underestimated total sleep time in the lab were significantly lower than were the habitual
times provided by sleep time overestimators, (M's = 260.6 vs. 415.3), t(65)=-3.87, p<.0001. Similarly, habitual sleep times reported by patients grouped in the high subjective sleep latency ratio group (i.e., those producing large overestimates of sleep latency in the lab) were significantly lower than habitual sleep times reported by patients in the low subjective sleep latency ratio group (M's=276.6 vs. 386.0), t (60)=2.46, p<.05.

In terms of demographic characteristics, men had significantly higher subjective sleep latency ratio scores relative to women, indicating a greater tendency among men to overestimate the time it took them to get to sleep (M's=123.6 vs. 109.5 minutes), t(90)=2.99, p<.005. Subjective sleep ratio and sleep latency ratios were not related to age, years of sleep complaint, or presenting sleep complaint (all p's>.30).

Sleep Time Estimation as a function of MMPI Scores and Psychiatric History

To test the hypothesis that psychological factors would relate to sleep time misperceptions, we compared MMPI subscale scores across the three subjective sleep ratio and sleep latency ratio subgroups. Our prediction was that patients reporting significantly greater sleep disturbance than found via objective measures would have higher MMPI elevations relative to patients whose subjective reports of sleep time were more congruent with PSG-based times. An analysis of variance showed that Psychasthenia (Pt) scores differed as a function of subjective sleep ratio subgroup, F (2, 99)=3.24, p<.05. Planned comparisons showed that sleep time underestimators had higher scores on the Pt scale relative to patients in the middle and high subjective sleep ratio groups combined (M's=67.7 vs. 81.9), t (102)=2.29, p<.03. Subjective sleep ratio subgroups did not differ on any additional MMPI subscales and there were no MMPI differences across the three subjective sleep latency ratio subgroups. Likewise, patients with current and/or past history of either depressive disorder (n=28) or other psychiatric disorders (n=41) did not differ from the remainder of the sample in the degree of sleep time or sleep latency misestimation.

We also tested the hypothesis that psychological factors would be more predictive of sleep time misperception for patients with a current or past history of depressive disorder or other psychiatric illness, as compared to patients with no psychiatric history. Contrary to expectations, when the sample was limited first to patients with a history of depression, and second, to only those with a history of psychiatric problems other than depression, no MMPI clinical scale scores differed by either subjective sleep or sleep latency ratio group. However, several MMPI associations were detected among patients without current or past treatment for depression (n=76). As can be seen in Table 3, among patients without current or past depression, total sleep time underestimators had more overall MMPI elevations and higher Hypochondriasis (Hs), Hysteria (Hy), and Pt scores (all p's<.05). Sleep time underestimators also demonstrated a possible trend towards higher Depression (D) and Psychopathic deviate (Pd) scores (p's<.06).

DISCUSSION

This study investigated discrepancies between patients' subjective perceptions of sleep time and sleep latency and PSG-based measures, testing the potential roles played by several diagnostic, sleep history, and psychological factors in influencing these judgments. In a diagnostically diverse sample, we confirmed and extended prior research showing wide variability in the degree of congruence between subjective sleep time estimation and PSG derived sleep time. Whereas earlier studies indicated a clear tendency for insomnia patients to underestimate total sleep time and overestimate sleep latency, patients in this diverse clinical sample were in fact just as likely to overestimate as to underestimate total sleep time, but showed a tendency to

| Table 2—Total sleep time and sleep latency estimation accuracy by ICSD diagnosis. |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| **ICSD diagnosis** | **Subjective Sleep Ratio** | **Subjective Sleep Latency Ratio** |
|                  | n    | M    | SD   | n    | M    | SD   |
| Sleep state misperception | 8    | 53.7 | 23.6 | 7    | 131.8| 19.8 |
| Psychophysiological insomnia | 19   | 117.1 | 35.5 | 17   | 119.6| 21.7 |
| Insomnia with psychiatric disorder, not depression | 21   | 90.2 | 40.4 | 19   | 115.0| 24.8 |
| Insomnia with depressive disorder | 11   | 92.3 | 43.5 | 8    | 119.0| 27.3 |
| Obstructive sleep apnea | 21   | 100.1| 24.0 | 20   | 115.4| 14.7 |
| PLMD | 23   | 96.4 | 35.1 | 21   | 121.5| 25.0 |

Note. Subjective sleep ratio scores varied across diagnostic subgroups, F (103) = 3.98, p < .005.

*a Sleep state misperception patients significantly underestimated total sleep time relative to combined subjective sleep ratio averages across the other patient subgroups, t (102) = 3.53, p < .01. *bPsychophysiological insomnia patients overestimated total sleep time relative to the combined subjective sleep ratio average across the other patient subgroups, t (102) = -2.84, p < .01.
overestimate sleep latency. Indeed, both sleep latency and total sleep time estimation were moderately correlated with PSG-determined time, suggesting that the estimation of sleep quality provided by this diverse sample of sleep disorder patients provided a reasonably accurate, albeit incomplete, portrayal of the nature and severity of their sleep difficulties.

Several interesting findings emerged with regard to the relation between PSG-derived sleep parameters, patient sleep history, and subjective perceptions of sleep time. Patients whose total sleep time estimates were congruent with PSG-observed total sleep time experienced fewer minutes of wake time after initial sleep onset and demonstrated better sleep efficiency. Although prior research suggests that sleep time underestimation may be related to frequent nocturnal arousals, 6 patients who experienced more prolonged periods of wakefulness did not uniformly underestimate their sleep time, as might be expected. Rather, there was a trend for patients in both the sleep time underestimation and overestimation group to experience longer periods of wakefulness and poorer sleep efficiency, relative to those whose estimates were congruent with PSG-observed times. One hypothesis which might be tested in further studies would be that longer periods of wakefulness may simply limit patients’ capacity to gauge the passing of time, resulting in either over- or underestimates of total sleep time.

Estimates of habitual sleep time and sleep latency at home were related to sleep time perceptions in a more linear fashion. That is, those who underestimated total sleep time during overnight PSG reported sleeping fewer hours at home compared to patients whose estimates were consistent with PSG-observed sleep time or who overestimated sleep time in the lab in all diagnostic groups. Similarly, patients who produced overestimates of sleep latency in the lab also reported sleeping the fewest hours at home. These findings suggest that patients who present with the most severe subjective sleep complaints during an initial clinical interview are also more likely to misperceive, or possibly exaggerate, the extent to which they struggle to initiate and maintain sleep. Taken together, these findings underscore the possibility that, in addition to standard pharmacological and behavioral treatments, patients with relatively severe insomnia complaints may benefit from additional intervention aimed at improving discrimination between sleep and wakeful states.32

The finding that psychophysiological insomnia patients produced modest overestimates of total sleep time relative to other diagnostic subgroups was unexpected, especially given other reports in the literature.13 Given the conditioned element of their sleep disturbance, it may be that psychophysiological insomnia patients experienced some unexpected improvement in their sleep during their overnight stay in the lab. Consequently, a portion of these patients may have awakened with the perception that they had slept even longer than indicated via PSG-measured sleep. However, this finding should be interpreted with some caution, since the magnitude of sleep time overestimation among psychophysiological insomniacs in this sample was relatively small. Apart from clear and substantial total sleep time underestimation among patients with sleep state misperception, we found no other differences in the accuracy of sleep time or sleep latency estimation across other sleep disorder diagnoses. Additional research is needed to clarify the extent to which etiologic factors underlying different sleep disorders contribute to sleep time

Table 3—Mean MMPI Scores by subjective sleep ratio subgroup.1

<table>
<thead>
<tr>
<th>MMPI variable</th>
<th>Low (Underestimators)</th>
<th>Middle</th>
<th>High (Overestimators)</th>
<th>F</th>
<th>p</th>
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<tr>
<td>Total</td>
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<td>1.4</td>
<td>4.03</td>
<td>.02</td>
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<td>elevationsb</td>
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<td>61.6</td>
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Analysis excludes patients with a history of depression, resulting in n = 74. b Mean MMPI score for the low subjective sleep ratio group was significantly higher than the mean MMPI score for middle and high subjective sleep ratio groups combined, all t’s >2.3, p’s < .03.
While recent research emphasizes the potential role of physiological and cognitive factors in influencing perceptions of sleep time, findings from our study suggest that psychological factors also may influence patients’ subjective reports of sleep quality. Consistent with the hypothesis that psychologically distressed patients would be more prone to overestimates of sleep disturbance, we found that the MMPI scale Pt (Scale 7, or "Psychasthenia") was positively associated with sleep time underestimation. This finding suggests that cognitive rumination, physiological symptoms of tension/anxiety, and catastrophic expectations about the impact of poor sleep may play an important role in the exaggeration of sleep disturbance self-reports. This hypothesis is certainly well represented in clinical observation, and raises the possibility that behavioral approaches aimed at improving anxiety management skills might improve the accuracy of subjective reports of sleep. This finding also raises the possibility that self-reported sleep improvement (e.g., following behavioral or pharmacological insomnia treatment) might be partially accounted for by alterations in perceived sleep quality and duration.

We also found preliminary evidence suggesting that personality variables have a greater impact on sleep misperceptions among non-depressed patients relative to patients with a current or past history of depression. When the sample was limited to those patients with no history of depression, sleep time underestimators had more clinical elevations and scored higher on the HS, HY, and PT subscales of the MMPI relative to patients who were either accurate or provided overestimations of total sleep time. Although requiring replication, these initial findings suggest that frequent somatic complaints, rumination, and a preference for medically-oriented explanations of psychological distress may be most strongly associated with exaggerated estimates of sleep disturbance among patients without comorbid depressive symptomatology that has required treatment.

Important study limitations include the reliance upon a single-night sleep study, which may be associated with a first-night effect and other alterations in sleep architecture. Second, although the MMPI is widely used and well validated as a psychopathology measure, MMPI responses, particularly those involving somatic complaints, may be influenced by the presence of a medical disorder. In this respect, comorbid medical diseases (e.g., hypertension, cardiac disease) were relatively common in our sample and may have had some influence on MMPI responding. Finally, while our utilization of ratio scores provided a useful means of characterizing subjective versus objective indices of sleep, ratio scores provide less information about the absolute magnitude of differences between subjective and objective measures, and could therefore lead to an attenuation of between group differences. Although not a focus in the present study, it would be worthwhile in future studies to more fully explore the relative strengths and weaknesses of different methodological approaches to characterizing the congruence between sleep time estimates and PSG-observed sleep times.

In most clinical settings, it is the nature and severity of patients’ subjective complaints of sleep disturbance, rather than PSG-derived indices, that guide treatment decisions. As such, this study represents an initial attempt to identify factors that lead some patients to perceive greater sleep disturbance than is indicated by PSG. Whereas psychological factors may lead to over reporting or even exaggeration of sleep disturbance among a subset of patients, finding also suggest that sleep quality itself may influence the degree of congruence between subjective and objective indices of sleep time. Thus, for patients with pre-existing or newly emerging psychopathology, self-reports of sleep disturbance may be indicative of more global distress or interpersonal difficulties. For others (e.g., those with relatively severe sleep impairment), sleep misperception may be related in part to the inherent difficulties associated with estimating sleep time following a night of fitful sleep. Finally, while our results confirm that a majority of patients presenting with insomnia overestimate how long it takes for them to fall asleep, findings also caution against the routine assumption that patients’ judgements of total sleep duration represent an overestimation of the severity of their sleep disturbance, since many patients in this sample were reasonably accurate in estimating how long they slept.

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