BEHAVIORAL SLEEP MEDICINE, *1*(3), 155–170

Role of Nocturnal Cognitive Arousal in the Complaint of Insomnia Among Older Adults

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Self-reported cognitive activity has been hypothesized to contribute directly to problematic sleep. We evaluated this formulation by examining nocturnal sleep parameters, daytime functioning and psychological adjustment cross-sectionally (N = 183) in four groups of older adults: good and poor sleepers with high and low cognitive arousal. Results indicate that when sleep quality was controlled for, individuals with high and low nocturnal cognitive arousal did not differ on either nocturnal or daytime aspects of the insomnia complaint. They were, however, less well adjusted psychologically. The pattern of findings suggests that high cognitive arousal contributes indirectly to the overall insomnia experience through its association with psychological maladjustment, rather than interfering with sleep per se. Treatment of late-life insomnia should include assessment and, possibly, clinical management of psychological adjustment.

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Cognitive factors such as negative thoughts during nocturnal wake times and dysfunctional beliefs and attitudes about sleep have recently been integrated into the conceptualization and clinical management of late-life insomnia (e.g., Creti, 1996; Fichten, Libman, Bailes, & Alapin, 2000; Morin, Savard, & Blais, 2000). Nevertheless, there is little information available about the nature, role, and impact of negative thinking in the complaint of insomnia. Is negative nocturnal cognitive activity a cause, a consequence or simply a correlate of insomnia? In the present study we compared the characteristics of older adults who reported sleeping well or poorly and evaluated the role of nocturnal cognitive arousal in the complaint of insomnia. We did this by examining nocturnal sleep parameters, daytime functioning and psychological adjustment in relation to nocturnal cognitive activity and experienced sleep quality in four groups of older adults: good and poor sleepers with high and low nocturnal cognitive arousal.

Poor sleepers are not homogeneous and it appears that different subgroups may present very different psychological profiles (Chambers & Keller, 1993; Fichten et al., 1995; Ohayon, Caulet, Priest, & Guilleminault, 1997; Zorick, Roth, Hartze, Piccione, & Stepanski, 1981). Also, a diagnosis of insomnia requires not only poor sleep but also distress about the problem (American Psychiatric Association [APA], 1994).

People with insomnia have been shown to be more maladjusted, anxious, depressed, neurotic and worried than people without insomnia (e.g., Brabbins et al., 1993; Dorsey & Bootzin, 1997; Fuller, Waters, Binks, & Anderson, 1997; Lundh, Broman, & Hetta, 1995; Morin & Gramling, 1989). They have also been shown to have lower self-esteem and greater difficulty in interpersonal relationships than normal sleepers (Healey et al., 1981). In addition, they are predisposed to cognitive hyperarousal (Coren, 1988; Nicassio, Mendlowitz, Fussell, & Petras, 1985). Yet, the cause-effect and mediator-moderator relationships between psychological factors and insomnia are not well defined.

The important role of cognitions in the insomnia complaint has been underscored by several investigators (e.g., Borkovec, Lane, & Van Oot, 1981; Coyle & Watts, 1991; Morin, Kowatch, Barry, & Walton, 1993). Some hypothesized that cognitive activity prior to sleep, particularly when it involves anxious and negative thoughts, contributes directly to the etiology and to the maintenance of sleep onset problems (e.g., Borkovec, 1979; Lichstein & Rosenthal, 1980; Youkilis & Bootzin, 1981). Others (e.g., White & Nicassio, 1990) proposed that cognitions serve as a mediating factor between stress and sleep. Cognitive arousal has been found consistently characteristic of poor sleepers rather than good sleepers and those with sleep onset insomnia have been shown to report greater nocturnal cognitive activity than good sleepers (Coates et al., 1983; Harvey, 2000; Kuisk, Bertelson & Walsh, 1989). In older adults, negative thought frequency is closely related to poor sleep, distress about insomnia, and poor psychological adjustment (Fichten et al., 1995). Intrusive thoughts in older adults suffering from bereave-

ment are associated with longer sleep latency, altered delta sleep ratios, depression severity, and poorer subjective sleep quality (Hall et al., 1997). All these findings suggest a central role for thoughts in the experience of insomnia and support the hypothesis that thoughts, negative thoughts in particular, play a significant role in the insomnia experience of older adults (cf. Fichten et al., 2001). The cause-effect / mediator-moderator role of thoughts is not, however, resolved by these studies.

Physiological hyperarousal has been proposed not only as an explanation of poor sleep but also of difficulties related to personality and psychological adjustment, including negative affect and self reports of daytime impairments (Bonnet & Arand, 1997). This suggests that physiological hyperarousal and cognitive arousal, together, might account for delayed sleep onset both at night and during daytime naps and form the physiological basis for certain personality characteristics, aspects of psychological adjustment, as well as perceived impairments in daytime functioning and negative cognitions at night. This line of evidence suggests a mediating, but not a causal or moderating, role for nocturnal cognitive activity in the complaint of insomnia.

The aim was to evaluate the role of cognitive factors in insomnia by (a) carrying out a cross-sectional evaluation of cognitive arousal during nocturnal wake times, and (b) investigating the relationship of cognitive arousal to sleep and wake parameters as well as to personality and psychological adjustment. Individuals with high nocturnal cognitive arousal, regardless of sleep status, were expected to report poorer sleep quality (Hypothesis 1), more daytime impairments (Hypothesis 2), and higher scores on psychological and personality measures (Hypothesis 3) than individuals with low cognitive arousal.

METHOD

Participants

One hundred eighty-three older community dwelling volunteers (60 men and 123 women; *M* age = 69.57 years, range = 55–87 years) participated in this investigation. They were predominantly married and living with a spouse. Although socio-economic background varied, most participants were well educated, not currently employed, had an income equal or greater to $30,000 in the early 1990s, and were reasonably satisfied with their income. They were volunteers who had taken part in a larger ongoing study conducted by the Sleep and Aging Project of the Jewish General Hospital in Montreal (Creti, 1996; Fichten et al., 1995; Libman et al., 1998). Both good and poor sleepers were recruited through media publicity consisting of press releases, presentations and mailings to seniors' groups, as well as notices in community clinics and residences for older adults. Those interested in participating were first screened using the Telephone Screening Interview and sub-

sequently in person using the Structured Sleep History Interview. Selection criteria were: (a) age 55 and over; (b) ability to read and write English well enough to complete the measures; (c) prescription sleep medications, if taken, currently taken no more than 3 times weekly (this criterion is consistent with sample selection in published studies on psychological intervention for insomnia and allows for the selection of a reasonably "typical" sample of older adults with insomnia; Fichten, et al., 2000); (d) psychological status: currently not receiving psychiatric or psychological care and no evidence of psychopathology and / or clinical depression; (e) physical status: absence of major illness or drug use directly associated with sleep disturbance (cf. Lacks, 1987); (f) no evidence of physiologically based sleep disturbance such as sleep apnea or restless leg syndrome/periodic limb movements during sleep (APA, 1994; American Sleep Disorders Association, 1990) and (g) no evidence of parasomnias or circadian rhythm sleep disorders (e.g., phase delay, phase advance, or deregulation of circadian cycle).

Measures

Telephone Screening Interview. (Creti, 1996). A standardized telephone interview, which included an introduction to the research project and evaluated selection criteria.

Background Information Form. This is a modified version of a short questionnaire used in previous studies on aging (e.g., Libman et al., 1989). It has nine items and provides information on socioeconomic, personal, and demographic variables.

Structured Sleep History Interview. A modified version of the clinical instrument developed by Lacks (1987) was used to provide information on exclusion criteria.

Sleep Questionnaire. This brief questionnaire was designed for a larger study on sleep and aging and inquires about typical sleep experiences. Scores from this measure have acceptable psychometric properties for research use: test-retest correlations indicate reasonable temporal stability (*r* ranges from .58 to .92 for test retest intervals between 2 weeks and 15 months) and the pattern of correlations among variables shows logical highly significant relationships (Fichten et al., 1995). Correlations ranging from .72 to .83 have been found between corresponding scores on this questionnaire and on a daily sleep diary (Libman, Fichten, Bailes, & Amsel, 2000).

Of interest to this investigation are the following items: duration of insomnia problem (years); presence or absence of a diagnosable difficulty of initiating or maintaining sleep (DIMS); frequency of sleep medication use (nights/week); sleep

onset latency (SOL; hr); wake after sleep onset (WASO; hr); total sleep time (TST; hr); sleep efficiency (SE; %) — defined as total sleep time / total time in bed; frequency of self reported insomnia (1 = *very rarely*, 10 = *very often*); distress associated with an insomnia problem (1 = *not at all*, 10 = *very much*); and frequency of daytime fatigue attributed to sleep problem (days per week).

Stanford Sleepiness Scale (Hoddes, Zarcone, Smythe, Phillips, & Dement, 1973). This frequently used measure of daytime sleepiness/alertness consists of a 7-point Guttman scaled item where responses range from 1 (*feeling active and vital, alert, wide-awake*) to 7 (*lost struggle to remain awake*). This scale was modified to allow respondents to select the one option which best describes how sleepy they feel on most days. The scale's authors report that alternate forms reliability yielded an agreement of 88%.

Pre-Sleep Arousal Scale (Nicassio, Mendlowitz, Fussell, & Petras, 1985). Sixteen items using a 5-point rating scale assess pre-sleep somatic and cognitive aspects of arousal. Higher scores indicate greater arousal. Somatic and Cognitive subscales were shown to be internally consistent and stable over time (Cronbach alphas ranged from .68 to .88; 3-week test-retest correlations ranged from .72 on the Cognitive subscale to .76 on the Somatic subscale). Mean scores of people with insomnia were significantly higher than those of normal sleepers on scores for both subscales. On the Cognitive subscale means for those with and without insomnia were $M = 15.12$ (5.3) and $M = 11.34$ (3.4), respectively. For the present investigation, the measure was modified to reflect all nocturnal arousals, not only pre-sleep arousal (i.e., WASO as well as SOL). A cut-off point determined by median split was used to classify participants as "High" and "Low" Cognitive Arousal individuals. Participants with scores equal to or greater than 13 were categorized as "High Arousal" individuals and those whose scores on this subscale were below 13 were classified as "Low Arousal" individuals.

Eysenck Personality Inventory (Eysenck & Eysenck, 1968). This reliable and valid empirically based questionnaire is among the most frequently used measures of personality. It evaluates the dimensions of Neuroticism, Extraversion-Introversion, and the tendency to respond in a socially desirable direction. Only the Neuroticism subscale is of interest in the present investigation.

Sleep Self-Efficacy Scale (Lacks, 1987, 1988). This 9-item scale evaluates individuals' beliefs about their ability to influence their own sleep related motivation and behavior. Stronger sleep efficacy expectations after behavioral treatment for insomnia constitute evidence for the scale's validity (Lacks, 1988).

Anxious Self Statement Questionnaire (Kendall & Hollon, 1989). This 32 item self-report measure evaluates cognitions in the form of anxious self-talk. It

shows acceptable reliability and validity: split-half reliability was .92; item total correlations ranged from .45 to .79; the scale's authors demonstrated that the measure is sensitive to stressful events. The measure was modified to reflect anxious self-talk during periods of nocturnal wakefulness. Older poor sleepers have been found to have significantly more anxious self-talk than good sleepers on this modified measure (Fichten et al., 1995).

Penn State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990). This 16 item self-report instrument was designed to measure frequency and intensity of worrying in general. Respondents indicate, using a 5-point scale, how typical of them each statement is. Internal consistency evaluations obtained in the eight validation studies conducted by the scale's authors ranged from coefficient alpha scores of .91 to .95. Test retest reliability coefficients (after 8 to 10 weeks) ranged from .74 to .92. Validity studies have been carried out with older individuals (Beck, Stanley, & Zebb, 1995).

Brief Symptom Inventory (BSI; Derogatis, Rickels, & Rock, 1976). A 53 item self-report psychological symptom inventory, the BSI has subscales for nine symptom dimensions (e.g., depression, anxiety) and three global indexes. It is a brief version of the SCL–90 (Derogatis, 1977)—a frequently used instrument with acceptable reliability and validity. Validation data indicate correlations from .92 to .98 between the symptom dimensions and global indexes of the BSI and the SCL–90 (Derogatis et al., 1976). Lower scores indicate better adjustment.

Satisfaction with Life (Diener, Emmons, Larson, & Griffen, 1985). This scale evaluates the cognitive, judgmental aspect of subjective well-being. It consists of five items that use a 7-point Likert scale. Data reported by the scale's authors indicate good psychometric properties for this measure: Item total correlations vary between .55 and .70; items loaded on a single factor and scores were found to be highly correlated with scores on other life satisfaction measures. It assesses the presence of good psychological adjustment, rather than absence of psychological maladjustment.

Grouping Participants Into Four Sleep Status Groups: Good and Poor Sleepers With High and Low Nocturnal Cognitive Arousal

Poor Sleepers were those 106 individuals who met usual research criteria for the diagnosis of DIMS (i.e., 30 min of undesired awake time at least 3 times per week, problem duration at last 6 months). Good Sleepers were those 77 individuals who failed to meet the criteria for diagnosis of DIMS. A cut-off determined by median split was used to classify participants as "High" or "Low" on nocturnal cognitive arousal. This permitted a sufficient number of participants in the four categories of

interest: Good/Poor Sleepers, High/Low Arousal. Low Arousal corresponded to a score lower than 13 on Cognitive subscale of the Pre-Sleep Arousal Scale (Nicassio et al., 1985) and High Arousal corresponded to a score of 13 or more. Appropriateness for using this value for grouping is supported by the fact that it falls between the means for individuals with (M = 15) and without insomnia (M = 11) in general (White, 1983). In older adults, it is similar to the mean value (M = 14) found in two mixed samples of older Good and Poor Sleepers (Fichten et al., 2001).

Among the 183 individuals, there were 54 Low Arousal Good Sleepers, 23 High Arousal Good Sleepers, 34 Low Arousal Poor Sleepers, and 72 High Arousal Poor Sleepers. Poor Sleep and High Cognitive Arousal were significantly related, $\chi^2(1) = 25.87$, $p < .001$, with Poor Sleepers more likely to have High Cognitive Arousal. To examine similarities and differences between these four groups on demographic characteristics a series of two-way analyses of variance (ANOVA) comparisons (2 Sleep Status [Good/Poor] × 2 Arousal [High/Low]) was performed. None of the comparisons were statistically significant.

Poor Sleepers had experienced insomnia for a mean of 15.40 (SD = 14.37) years, suggesting that they were experiencing a chronic, rather than an acute sleep problem. There was no significant difference between Low and High Arousal Poor Sleepers on this variable. Most Poor Sleepers in this investigation experienced difficulties maintaining sleep (N = 49) or a combination of both initiating and maintaining sleep (N = 43). Only 14 participants experienced solely difficulties initiating sleep. Participants reported using few sleep medications (M = .50 times per week; SD = .89; range: 0–3).

Procedure

Individuals who met the selection criteria were administered a battery of questionnaires which took approximately 1½ hr to complete in either 1 or 2 sessions. Some participants failed to complete all measures. Therefore, sample sizes can vary among comparisons.

RESULTS

The objective was to evaluate the role of cognitive arousal in insomnia by comparing the 4 groups on psychological adjustment, personality, nighttime indexes of negative, anxious, and worried self-talk, as well as nocturnal sleep parameters and daytime sleep-related variables such as fatigue and sleepiness.

Comparison Among The Four Groups: Sleep Characteristics

The overall data analysis followed a 2 × 2 factorial design (2 Sleep Status [Good/Poor] × 2 Nocturnal Cognitive Arousal [High/Low]). Significant two-way

multivariate analyses of variance (MANOVA) were followed by a series of two-way ANOVA comparisons as well as post hoc analyses when appropriate.

Sleep related characteristics. Table 1 shows that Good Sleepers experienced significantly better sleep than Poor Sleepers. The significant MANOVA, $F_{\text{Sleep Status}}(7, 172) = 24.96$, $p < .001$, was followed by a series of two-way ANOVA comparisons on nighttime functioning variables (2 Sleep Status [Good /Poor] × 2 Arousal [High/Low]). Means, standard deviations and univariate *F* tests showed significant main effects for Sleep Status ($p < .005$) on all nighttime and daytime functioning variables evaluated with the exception of number of naps per week. All comparisons remained significant after a Bonferroni adjustment to the alpha level. Notably, the only sleep-related variable on which individuals with different levels of Cognitive Arousal could be distinguished was self-reported Insomnia Frequency ($p < .01$). This result should, however, be viewed with caution, as the MANOVA Arousal main effect was not significant.

Psychological adjustment, personality, and cognitive factors. To evaluate the relative contributions of sleep parameters and pre-sleep cognitive arousal to the complaints of insomnia in older adults, the four groups were compared on psychological adjustment, personality measures, and nighttime indexes of negative, anxious, and worried self-talk as well as on distress about sleep. Because both main effects were statistically significant on the MANOVA, $F_{\text{Sleep Status}}(11, 167) = 10.71$, $p < .001$, and, $F_{\text{Arousal}}(11, 167) = 15.45$, $p < .001$, and because the Sleep by Arousal interaction effect approached significance, $F_{\text{Sleep} \times \text{Arousal}}(11, 167) = 1.60$, $p < .10$, a series of 2 × 2 ANOVA comparisons were performed.

Tables 2 and 3, which display the means, show significant main effects for all Nocturnal Cognitive Arousal variables. After a Bonferroni adjustment to the alpha level, all comparisons remained significant. These results indicate that individuals experiencing High levels of Cognitive Arousal during nocturnal awakenings were more poorly adjusted than individuals with Low Cognitive Arousal. Regardless of sleep status, they entertained significantly more worried, anxious, and negative thoughts, as well as higher levels of somatic arousal during the night than individuals with lower levels of Cognitive Arousal. They also displayed a more neurotic personality style, reported significantly lower satisfaction with their lives, and greater distress about their sleep impairments than individuals with Low levels of Cognitive Arousal.

Results in Tables 2 and 3 also show significant main effects for Sleep Status on 6 of the 11 measures examined. Poor Sleepers displayed significantly more Neuroticism, obtained higher scores on the Penn State Worry Questionnaire, experienced greater sleep-related distress, had higher Cognitive and Somatic Arousal and lower Sleep Self-Efficacy than Good Sleepers. Following a Bonferroni adjustment to the alpha level, comparisons of Good and Poor Sleepers on the measures of Cognitive and Somatic Arousal were no longer significant.

TABLE 1
Sleep Related Characteristics: Means and Standard Deviations on Nighttime and Daytime Functioning Variables as a Function of Sleep Status and Levels of Nocturnal Cognitive Arousal

	Good Sleepers				*Poor Sleepers*					
	Low Arousal (n = 54)		*High Arousal (n = 23)*		*Low Arousal (n = 34)*		*High Arousal (n = 72)*			
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p <*
Nighttime functioning										
Total sleep time (hours)	6.86	1.00	6.76	0.96	5.30	1.66	5.14	1.30	F(Sleep: Good/Poor) = 60.55	.001
									F(Arousal: High/Low) = .39	*ns*
									F(Sleep*Arousal) = .03	*ns*
Total wake time (hours)[b]	0.09	0.18	0.16	0.21	2.44	2.01	2.60	1.56	F(Sleep: Good/Poor) = 126.27	.001
									F(Arousal: High/Low) = .29	*ns*
									F(Sleep*Arousal) = .04	*ns*
Sleep efficiency (%)	0.98	0.21	0.97	0.20	0.69	0.20	0.66	0.18	F(Sleep: Good/Poor) = 62.57	.001
									F(Arousal: High/Low) = .30	*ns*
									F(Sleep*Arousal) = 2.76	*ns*
Insomnia frequency (1–10)[a]	1.91	1.77	3.04	3.03	6.20	3.18	7.30	2.44	F(Sleep: Good/Poor) = 110.60	.001
									F(Arousal: High/Low) = 7.54	.010
									F(Sleep*Arousal) = .002	*ns*
Daytime functioning										
Fatigue due to lack of sleep (days/week)	1.00	1.85	0.96	1.96	2.59	2.81	2.49	1.97	F(Sleep: Good/Poor) = 20.69	.001
									F(Arousal: High/Low) = .04	*ns*
									F(Sleep*Arousal) = .006	*ns*
Stanford Sleepiness Scale (1–7)[a]	1.90	1.18	1.67	1.01	2.23	1.41	2.49	1.21	F(Sleep: Good/Poor) = 8.35	.005
									F(Arousal: High/Low) = .007	*ns*
									F(Sleep*Arousal) = 1.48	*ns*
Naps (per week)	2.00	2.35	1.93	2.13	2.73	2.87	1.62	2.17	F(Sleep: Good/Poor) = .28	*ns*
									F(Arousal: High/Low) = 2.41	*ns*
									F(Sleep*Arousal) = 1.85	*ns*

Note. Univariate *F* tests with (3, 179) degrees of freedom.
[a]Higher scores indicate higher insomnia frequency, fatigue, or sleepiness. [b]Total Wake Time = sum of Sleep Onset Latency and Wake After Sleep Onset.

TABLE 2
Psychological Adjustment and Personality: Means and Standard Deviations for Daytime Measures as a Function of Sleep Status and Level of Nocturnal Cognitive Arousal

	Good Sleepers				*Poor Sleepers*					
	Low Arousal (n = 54)		*High Arousal (n = 23)*		*Low Arousal (n = 34)*		*High Arousal (n = 72)*			
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p <*
Poor adjustment: BSI Global Severity Index	0.35[a]	0.34	0.50	0.40	0.31[b]	0.22	0.66[a,b]	0.48	F(Sleep: Good/Poor) = 0.93	*ns*
									F(Arousal: High/Low) = 14.88	.001
									F(Sleep*Arousal) = 2.42	*ns*
Poor adjustment: BSI Depression	0.39[a]	0.49	0.43[b]	0.50	0.29[c]	0.39	0.75[a,b]	0.74	F(Sleep: Good/Poor) = 1.27	*ns*
									F(Arousal: High/Low) = 6.73	.006
									F(Sleep*Arousal) = 4.78	.050
Good adjustment: Satisfaction With Life	23.19	6.70	22.16	6.97	24.79	6.60	20.54	6.93	F(Sleep: Good/Poor) = 1.27	*ns*
									F(Arousal: High/Low) = 5.71	.006
									F(Sleep*Arousal) = 2.13	*ns*
Eysenck Personality Inventory: Neuroticism	5.45	4.12	8.08	3.80	8.45	4.43	11.62	4.60	F(Sleep: Good/Poor) = 21.49	.001
									F(Arousal: High/Low) = 16.99	.001
									F(Sleep*Arousal) = 0.15	*ns*
Penn State Worry Questionnaire	35.41	10.54	44.13	10.71	43.96	12.76	52.20	13.77	F(Sleep: Good/Poor) = 17.25	.001
									F(Arousal: High/Low) = 17.95	.001
									F(Sleep*Arousal) = 0.01	*ns*
Poor adjustment: BSI Anxiety	0.29[b]	0.44	0.46	0.47	0.27[a]	0.41	0.68[a,b]	0.55	F(Sleep: Good/Poor) = 1.51	*ns*
									F(Arousal: High/Low) = 13.59	.001
									F(Sleep*Arousal) = 2.27	*ns*

Note. Univariate *F* tests with (3, 179) degrees of freedom. Means in a row sharing subscripts are significantly different at $p < .05$. With the exception of the Satisfaction With Life scale, higher scores indicate poorer adjustment. BSI = Brief Symptom Inventory.

TABLE 3
Psychological Adjustment and Personality: Means and Standard Deviations for Nocturnal Measures as a Function of Sleep Status and Level of Nocturnal Cognitive Arousal

	Good Sleepers				*Poor Sleepers*					
	Low Arousal (n = 54)		*High Arousal (n = 23)*		*Low Arousal (n = 34)*		*High Arousal (n = 72)*			
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p <*
Anxious self-statement	13.32	14.57	54.11	16.06	47.13	19.83	53.65	22.25	F(Sleep: Good/Poor) = 1.05	*ns*
									F(Arousal: High/Low) = 10.50	.001
									F(Sleep*Arousal) = 0.04	*ns*
Presleep Arousal Scale: Cognitive subscale	9.24[a,d]	1.44	16.74[b,d]	4.06	9.97	1.42	8.82[a,b]	5.06	F(Sleep: Good/Poor) = 5.70	.050
									F(Arousal: High/Low) = 19.20	.001
									F(Sleep*Arousal) = 1.32	*ns*
Presleep Arousal Scale: Somatic subscale	8.34	0.69	10.22	3.00	9.29	1.70	10.78	2.99	F(Sleep: Good/Poor) = 4.08	.050
									F(Arousal: High/Low) = 20.10	.001
									F(Sleep*Arousal) = 0.27	*ns*
Sleep related distress: Sleep questionnaire	1.33[a,d]	1.10	1.49[b]	1.27	3.26[c,d]	2.73	5.48[a,b,c]	2.48	F(Sleep: Good/Poor) = 65.10	.001
									F(Arousal: High/Low) = 16.00	.001
									F(Sleep*Arousal) = 5.98	.010
Sleep self-efficacy	39.26	4.63	34.43	6.73	31.73	7.08	23.80	5.37	F(Sleep: Good/Poor) = 95.99	.001
									F(Arousal: High/Low) = 47.30	.001
									F(Sleep*Arousal) = 2.81	*ns*

Note. Univariate *F* tests with (3, 179) degrees of freedom. Means in a row sharing subscripts are significantly different at $p < .05$. Higher scores indicate poorer adjustment.

Significant Sleep Status × Arousal interactions were found on two of the variables assessed: depression and sleep-related distress. Tukey honestly significant difference tests show that, in general, individuals who have both Poor Sleep and High levels of nocturnal Cognitive Arousal tended to fare worse than all others and that Poor Sleepers with Low Cognitive Arousal during nocturnal awakenings did not differ significantly from either group of Good Sleepers on measures of psychological adjustment and personality. Notably, after a Bonferroni adjustment to the alpha level, neither interaction remained significant.

DISCUSSION

Before proceeding to interpreting the findings, some of the limitations of this investigation should be discussed. First, our sample consisted of healthy, well-educated and well-functioning older individuals, which may limit generalizability to other, less well-functioning samples. In addition, with respect to our grouping of individuals with High and Low Arousal, we are aware that excluding individuals with scores around the median would have been preferable to using a median split. Unfortunately, this method would not have left us with enough subjects in the four categories of interest.

In general, the present findings indicate that (a) Good and Poor Sleepers differed on most nocturnal, daytime and psychological variables; (b) nocturnal cognitive arousal was strongly associated with personality and psychological adjustment variables, but not with sleep or daytime functioning parameters; and (c) interaction between sleep status and cognitive arousal was minimal.

There were, as expected, more highly cognitively aroused individuals among poor sleepers. However, contrary to Hypothesis 1, cognitive arousal was not related to sleep parameters, per se, suggesting that it may be related to the perception of poor sleep quality rather than to actual sleep deficits.

We expected that individuals displaying more cognitive activity during the night would also report greater daytime difficulties than individuals with lower levels of nocturnal cognitive arousal (Hypothesis 2). Contrary to Hypothesis 2, we found that poor daytime functioning was not associated with high levels of cognitive arousal during nocturnal awakenings, and that individuals with high and low levels of nocturnal cognitive arousal did not differ on daytime fatigue or sleepiness. Daytime impairments were related solely to sleep status, with Poor Sleepers reporting greater fatigue and sleepiness than good sleepers.

Consistent with the findings of others, Poor Sleepers in this investigation displayed somewhat worse psychological adjustment than Good Sleepers (e.g., Morin & Gramling, 1989). Overall, they were more neurotic, had higher somatic and cognitive arousal and worried more during nocturnal wakefulness than Good Sleepers. Predictably, Poor Sleepers were also more distressed about their sleep and reported lower sleep self-efficacy.

These findings raise the following questions: (a) are these findings due to poor sleep, (b) does psychological maladjustment cause sleep problems, or (c) is the relationship due to other variables? Our data suggest that the third possibility is most likely although poor sleep, per se, may also have an impact on selected indices of psychological adjustment. For example, consistent with Hypothesis 3, regardless of sleep status, people reporting elevated nocturnal cognitive arousal differed from those with low arousal on virtually all personality and psychological functioning indexes examined: They entertained more anxious, worried and negative thoughts and had higher neuroticism scores and lower satisfaction with their lives than individuals with low cognitive arousal.

Our findings demonstrate the separate, as well as combined, effects of both sleep parameters and nocturnal cognitive arousal on the complaint of insomnia and on poor psychological adaptation among older adults. Contrary to others' findings, we failed to find that Poor Sleepers are also more depressed and anxious during the day than good sleepers (for a review, see Benca et al., 1997). Moreover, Low Arousal Poor Sleepers were similar to Good Sleepers on most measures of psychological adjustment. Thus, these findings indicate that when effects of sleep quality and cognitive arousal were separated, poor sleep, per se, appears to be unrelated to higher levels of depression, anxiety or psychopathology. Rather, poor sleep quality is associated with sleep-related preoccupations, such as sleep self-efficacy and sleep related distress.

Though individuals with High Cognitive Arousal were likely to be Poor Sleepers, there were sufficient numbers of Poor Sleepers with Low levels of nocturnal Cognitive Arousal and Good Sleepers with High Cognitive Arousal to separate the effects of sleep quality and cognitive arousal. Data from these groups show that High Cognitive Arousal was not a necessary feature of poor sleep. These findings support suggestions in the literature that Poor Sleepers do not represent a homogeneous group and that there are subgroups with different psychological profiles (cf. Chambers & Keller, 1993; Fichten et al., 1995; Ohayon et al., 1997; Watts, Coyle, & East, 1994). Since the majority of Poor Sleepers in this investigation also reported High levels of Cognitive Arousal, it would seem that the two variables have an additive effect.

Future studies should address the question of whether high levels of cognitive arousal pose a significant risk for developing or maintaining sleep difficulties longitudinally. The pattern of these findings suggest that cognitive arousal, rather than being directly associated with poor sleep, may be a perpetuating and perhaps a predisposing expression of psychological maladjustment and/or personality traits which, in turn, are related to the overall insomnia experience.

ACKNOWLEDGMENTS

This article was prepared with Grants from the Conseil Québécois de la recherche sociale, the Canadian Institutes of Health, Dawson College, and FCAR, respectively. We are grateful for the generous support of these organizations.

We thank the dedicated members of our research team.

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