Cognitive-Emotional Hyperarousal as a Premorbid Characteristic of Individuals Vulnerable to Insomnia

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Objective: To examine whether cognitive-emotional hyperarousal is a premorbid characteristic of middle-aged and young good sleepers vulnerable to stress-related insomnia. **Methods:** Self-reported information was collected from two samples of 305 middle-aged and 196 young adults. From those adults, 149 middle-aged (50.34 ± 4.47 years) and 85 young (20.19 ± 1.31 years) good sleepers were selected for the present study. The Ford Insomnia Response to Stress Test (FIRST) was used to measure vulnerability to stress-related insomnia. Trait measures of personality, arousability, rumination, presleep arousal, and coping skills were entered as predictors in the linear regression models, at the same time controlling for gender, depression, and anxiety. **Results:** The regression models showed that arousability ($\beta = 0.546$), neuroticism ($\beta = 0.413$), perceived stress ($\beta = 0.375$), and rumination ($\beta = 0.214$) were associated with FIRST scores in middle-aged adults. Among young adults, the regression models revealed that presleep cognitive arousal ($\beta = 0.448$), arousability ($\beta = 0.426$), neuroticism ($\beta = 0.320$), presleep somatic arousal ($\beta = 0.290$), emotion-oriented coping ($\beta = 0.220$), and rumination ($\beta = 0.212$) were associated with FIRST scores. Finally, individuals with high FIRST scores did not show lower scores in measures of cognitive-emotional hyperarousal compared with chronic insomniacs. **Conclusions:** These data suggest that cognitive-emotional hyperarousal may be a premorbid characteristic of subjects vulnerable to insomnia. It seems that maladaptive coping stress strategies and cognitive-emotional hyperarousal predispose to the development of insomnia and that interventions targeting these characteristics may be important in the prevention and treatment of chronic insomnia. **Key words:** insomnia, predisposition, hyperarousal, emotion, personality, coping.

BMI = body mass index; **DSM-IV-TR** = Diagnostic and Statistical Manual for Mental Disorders, Fourth Edition, Text Revised; **FIRST** = Ford Insomnia Response to Stress Test; **ISI** = Insomnia Severity Index; **PSQI** = Pittsburgh Sleep Quality Index.

INTRODUCTION

Insomnia is the most common sleep disorder. Yet, little is known about the mechanisms that cause chronic insomnia (1). Several, not mutually exclusive, models have been proposed in the last two decades to understand the etiology and pathophysiology of insomnia (2–9). Some of these models suggest that predisposing factors (i.e., trait-like characteristics) are involved in the etiology of this prevalent disorder (2–4,9).

One of the major questions in regard to chronic insomnia is whether hyperarousal (both physiological and cognitive-emotional) preexists the development of the disorder or is a consequence of it (5,10–12). The characteristic psychological profile found in chronic insomniacs, which consists of obsessive-ruminative personality traits, inadequate stress-coping strategies, and cognitive-emotional hyperarousal, has been documented in many studies (2,12,13). Based on these findings, most investigators have inferred that the above-mentioned psychological characteristics are present premorbidly and play a key role in the etiology of chronic insomnia (2–4,9).

Several studies (2,12,14,15) have examined risk factors of insomnia (e.g., gender, age, depression). However, only one study to date (16) has examined whether the above-mentioned psychological characteristics are premorbid conditions of subjects at risk for future development of chronic insomnia. In addition, whether cognitive-emotional hyperarousal is associated with vulnerability to transient insomnia has not yet been examined. As has been previously proposed, studies on predisposed, yet unaffected, individuals may improve our understanding of the etiology of insomnia, as it is difficult to separate the underlying causes of the disorder from its morbidity when assessing subjects who have already developed insomnia (10,17), especially in middle-aged and older adults where various conditions coexist (17). Such information on the psychological premorbid characteristics of insomniacs would be important in the prevention and treatment of this very prevalent sleep disorder. Drake et al. (18) have developed a reliable measure to identify individuals predisposed to insomnia before the onset of the condition (18,19). The Ford Insomnia Response to Stress Test (FIRST) assesses vulnerability to stress-related insomnia by requiring the individual to rate the likelihood of having sleep disturbances in association with specific and common stressful events (18).

The present study's objective was thus to examine whether psychological trait-like factors that typically characterize chronic insomniacs (i.e., ruminative personality traits, inadequate stress-coping strategies, and cognitive-emotional hyperarousal) (2–4,9,12,13,16) are characteristics of individuals vulnerable to stress-related insomnia. First, we examined whether cognitive-emotional hyperarousal among general population middle-aged adults is significantly associated with vulnerability to stress-related insomnia, as measured by FIRST scores. Second, we ascertained if both cognitive-emotional hyperarousal and inadequate coping skills are also significantly associated with vulnerability to stress-related insomnia among a more homogeneous sample comprised of

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young adults; an enlarged psychological survey was used. Finally, we compared the scores obtained on measures of personality factors, cognitive-emotional hyperarousal, and coping skills of middle-aged and young adult good sleepers with high vulnerability to stress-related insomnia with those of population-based (12,13) chronic insomniacs.

METHODS

Participants and Procedure

A total of 305 general population adults (161 females; mean age, 51.43 ± 5.41 years; range, 37–70 years) were recruited by a "snowball" technique in which medicine undergraduates invited their relatives to participate voluntarily in a research on vulnerability to insomnia during October 2007. All participants completed an extensive survey that included the Spanish version of the Pittsburgh Sleep Quality Index (PSQI) (20). As we wanted to ensure that our results on the association of psychological factors with vulnerability to stress-related insomnia were not confounded by the presence of current insomnia or poor sleep quality, the inclusion criterion of 1-month subjective good sleep quality was applied. The PSQI (21) is a questionnaire evaluating sleep quality and disturbances over a 1-month time interval; participants were identified as "poor sleepers" and excluded from the present study if they endorsed a PSQI total score of >5, a cutoff point that has been shown to provide a sensitive and specific measure of poor sleep quality and insomnia (21). After exclusion of "poor sleepers" (n = 152; 83 females), the "good sleeper" sample included 149 middle-aged participants (75 females; mean age, 50.34 ± 4.47 years; range, 41–63 years). We found four missing subjects from the 305 adults, because they did not complete some items of the PSQI.

A group of young adult "good sleepers" was drawn from a sample of 196 third-year medical students (147 females; mean age, 20.17 ± 1.00 years; range, 19–28 years), who completed in November 2007 an extended version of the middle-aged adults' survey. All participants were classified as "good" or "poor sleepers" by using the PSQI criterion. After exclusion of "poor sleepers" (n = 111; 86 females), the total medical student "good sleeper" sample included 85 young adults (62 females; mean age, 20.19 ± 1.31 years).

The study and all procedures were approved by the Institutional Review Board of the Universidad Autonoma of Madrid (CEI 20–417), and written informed consent was obtained from all individuals.

Measures

The survey packages included published self-report questionnaires that have shown acceptable indices of validity and reliability. The FIRST was administered as a measure of vulnerability to stress-related insomnia (18). The FIRST is a standardized questionnaire with high test-retest reliability (r = .92) that has been validated as a predictive measure of vulnerability to sleep disturbance in normal noninsomniac individuals, using polysomnographically measured sleep (18). The measure includes nine items and requires the individual to rate the likelihood of having sleep disruption in association with specific and common stressful events or periods of stress occurring during the day or evening. Thus, high scores on the FIRST are indicative of greater vulnerability to stress-related insomnia. Additional studies have demonstrated that this measure is able to predict individual responses to pharmacological sleep-disruptive challenges (19), that FIRST scores are significantly higher in individuals with insomnia in comparison to controls (22), and that a certain degree of familial aggregation seems to exist in this measure (23). Moreover, a cutoff score of 19 in FIRST has been recommended to detect individuals with high vulnerability to insomnia (10). In the present study, indices of internal consistency were satisfactory in both the middle-aged (α = 0.88) and the young adult (α = 0.78) sample. Last month's estimated sleep onset latency, total sleep duration, and sleep efficiency (i.e., time in bed/total sleep duration × 100) were ascertained from items in the PSQI (20,21). The Insomnia Severity Index (ISI) was used to assess the severity of sleep difficulties over a 1-week time interval (24). Based on *Diagnostic and Statistical Manual for Mental Disorders, Fourth Edition, Text Revised* (DSM-IV-TR) criteria (12,25), one question addressed past personal history of insomnia: "In the past, have you ever experienced insomnia 3 or more nights per week for more than one month? yes/no." The Fatigue Scale of the Profile of Mood States-48 was used to measure feelings of fatigue over a 1-week time interval (26–28). The Epworth Sleepiness Scale requires participants to rate the likelihood that they would fall asleep in any of eight different situations on a 4-point rating scale (29,30). The Depression and Anxiety Scales of the Profile of Mood States-48 were used to measure negative aspects of mood over a 1-week time interval (26–28). The Arousability Predisposition Scale was designed as a reliable measure for predicting individual differences in physiological arousal through a trait dimension called arousability (31,32). The Rumination Scale of the Emotion Control Questionnaire is aimed at measuring the tendency to be preoccupied with emotional upset about past or future events (33). The Emotion Regulation Questionnaire is aimed at measuring two emotion regulatory processes: reappraisal (i.e., cognitive restructuring) and suppression (i.e., emotional inhibition) (34). The Perceived Stress Scale was designed to measure the degree to which situations in one's life are appraised as stressful over a 1-month interval (35,36). The NEO Five-Factor Inventory measures five personality factors: neuroticism, extraversion, openness, agreeableness, and conscientiousness (37,38); the neuroticism and extraversion factors were submitted to analyses in the present study.

The extended survey package administered to the study sample comprised of young adults included, together with those also administered to middle-aged adults and mentioned above, the following measures. The Pre-Sleep Arousal Scale contains items tapping eight symptoms of cognitive arousal and eight symptoms of somatic arousal generally experienced at bedtime when attempting to fall asleep (39). The Coping Inventory for Stressful Situations is a self-report measure of ways of coping with stress; the measure is divided into three coping subscales: task-oriented, emotion-oriented, and avoidance-oriented (40,41).

Statistical Procedures

Linear regression models were carried to control for confounding factors in the relationship between psychological traits and FIRST scores. First, we examined the relationship between each psychological trait and FIRST scores with fully unadjusted models. Second, we examined the relationship between each psychological trait and FIRST scores at the same time controlling for gender, depression, and anxiety because of the potential effect of these variables on measures of insomnia or vulnerability to insomnia (14,15,42). This analytical approach was selected because of the well-established interrelationships between the psychological traits measured in the present study (43,44). Table 1 shows the correlations between the study psychological measures within the middle-aged and young adult samples. Data are presented as standardized coefficients (β). Durbin-Watson, variance inflation factor and tolerance collinearity tests were performed to investigate multicollinearity among the variables entered in the regression models. Independent Student's t tests were used to compare mean differences between population-based chronic insomniacs (12,13) and good sleepers scoring high (>19) in FIRST. Effect size was measured by Cohen's d statistic; by convention, values of 0.2, 0.5, and 0.8 are defined as small, medium, and large effects, respectively (45). Analyses were performed, using SPSS 17.0 (SPSS, Chicago, Illinois) and G*Power 3.0 (46).

RESULTS

Characteristics of the Study Samples

Table 2 presents data for self-reported demographic, sleep, and psychological characteristics of middle-aged and young adults. Both samples were comprised of good sleepers, as revealed by mean sleep latency (<30 minutes), total sleep time (±7 hours), sleep efficiency (>85%), ISI (<8) and Epworth Sleepiness Scale (<11) scores. The young adult sample had a higher percentage of females (72.1%). Moreover, mean FIRST scores of young adults were significantly higher than those of middle-aged adults (t_{232} = 2.73; $p < .001$).

TABLE 1. Correlation Matrix of Study Measures

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Perceived stress	1	0.389**	−0.114	0.012	0.648**	−0.119	0.538**	—	—	—
2. Rumination	0.296**	1	−0.181*	0.318**	442**	−0.174*	0.395**	—	—	—
3. Reappraisal	0.189	−0.231*	1	0.108	−0.051	0.067	−0.067	—	—	—
4. Suppression	0.096	0.253*	−0.115	1	0.024	−0.402**	−0.161	—	—	—
5. Neuroticism	0.617**	0.525**	−0.074	0.120	1	−0.279**	0.690**	—	—	—
6. Extraversion	−0.236*	−0.298**	0.137	−0.375**	−0.475**	1	−0.128	—	—	—
7. Arousability	0.583**	0.393**	−0.033	−0.038	0.710**	−0.202	1	—	—	—
8. Presleep cognitive arousal	0.111	0.101	−0.023	−0.082	0.096	0.022	0.215*	1	—	—
9. Presleep somatic srousal	0.219*	0.200	0.133	−0.004	0.200	−0.029	0.290**	0.231*	1	—
10. Task-oriented coping	−0.379**	−0.355**	0.239*	−0.124	−0.422**	0.260*	−0.280*	−0.029	−0.284**	1
11. Emotion-oriented coping	0.550**	0.376**	−0.027	0.073	0.658**	−0.344**	0.495**	0.132	0.259*	−0.203

Pearson correlation coefficients for the middle-aged adult sample ($n = 149$) are above diagonal and for the young adult sample ($n = 85$) below diagonal.
*$p < .05$; **$p < .01$.

TABLE 2. Characteristics of the Samples

	Middle-Aged Adults ($n = 149$)	Young Adults ($n = 85$)
Gender[a]		
Male	74 (49.7)	24 (27.9)
Female	75 (50.3)	62 (72.1)
Age[b]	50.34 (4.47)	20.19 (1.31)
BMI[b]	25.04 (3.39)	21.10 (2.09)
History of insomnia[a]		
Yes	14 (9.4)	4 (5.8)
No	135 (90.6)	81 (94.2)
FIRST[b]	17.51 (5.55)	19.46 (4.72)
PSQI[b]		
Total score	2.95 (1.05)	3.16 (0.84)
SOL	11.05 (8.81)	11.51 (6.74)
TST	414.34 (44.97)	432.45 (42.31)
SE	93.48 (4.94)	95.24 (3.52)
ISI[b]	3.25 (2.92)	5.16 (3.32)
ESS[b]	8.05 (3.38)	9.03 (3.87)
POMS[b]		
Fatigue	5.93 (4.99)	7.74 (4.94)
Anxiety	9.30 (5.75)	11.27 (5.49)
Depression	6.87 (6.92)	9.29 (7.23)

[a] Values are *n* (%).
[b] Values are in mean (standard deviation).
BMI = body mass index; FIRST = Ford Insomnia Response to Stress Test; PSQI = Pittsburgh Sleep Quality Index; SOL = sleep onset latency; TST = total sleep time; SE = Sleep Efficiency; ISI = Insomnia Severity Index; ESS = Epworth Sleepiness Scale; POMS = Profile of Mood States.

Vulnerability to Insomnia Among Middle-Aged Adults

As shown in Table 3, arousability ($\beta = 0.584$; $p < .001$), neuroticism ($\beta = 0.485$; $p < .001$), perceived stress ($\beta = 0.447$; $p < .001$), rumination ($\beta = 0.270$; $p < .01$), extraversion ($\beta = -0.177$; $p < .05$), and suppression ($\beta = 0.155$; $p < .05$) were significantly associated with FIRST scores. After controlling for gender, depression, and anxiety, the regression models showed that arousability, neuroticism, perceived stress, and rumination were still significantly associated with FIRST scores among middle-aged good sleepers, whereas extraversion and suppression failed to maintain statistical significance (Table 3, middle-aged adults, model 2). Collinearity tests showed acceptable variance inflation factor (<10), tolerance (>0.10), and Durbin-Watson (1.5–2.5) values; thus, no problems of multicollinearity were detected. Furthermore, these results remain identical to those shown in Table 2 even if subjects with a history of insomnia ($n = 14$) were removed from the sample or if we controlled for ISI scores.

Vulnerability to Insomnia Among Young Adults

Among young adult good sleepers, arousability ($\beta = 0.463$; $p < .001$), presleep cognitive arousal ($\beta = 0.435$; $p < .001$), neuroticism ($\beta = 0.383$; $p < .001$), emotion-oriented coping ($\beta = 0.300$; $p < .01$), presleep somatic arousal ($\beta = 0.299$; $p < .01$), and rumination ($\beta = 0.263$; $p < .05$) were significantly associated with FIRST scores. After controlling for gender, depression, and anxiety, the regression models showed that those variables were still significantly associated with FIRST scores (Table 3, young adults, model 2). No problems of multicollinearity were detected. Moreover, these results remained identical to those shown in Table 3 even if subjects with a history of insomnia ($n = 4$) were removed from the sample or if we controlled for ISI scores.

Psychological Vulnerability Factors Clinically Relevant to Chronic Insomnia

To ascertain if the psychological measures associated with FIRST scores among our middle-aged and young good sleepers were clinically relevant traits related to chronic insomnia, we selected, according to published criteria (10,15,20), those good sleepers with high FIRST scores and compared them in terms of psychological traits with population-based samples of individuals with "insomnia syndrome" and "primary insomnia" as reported by Le Blanc et al. (12) and Morin et al. (13), respectively (Table 4). These investigators (12, 13) used the same scales of arousability, presleep arousal, perceived stress, coping skills, and personality factors, as shown in this study.

A total of 49 middle-aged good sleepers and 36 young adult good sleepers scored high (>19) in FIRST (Table 4). No significant differences were found in terms of arousability ($d = 0.25$), presleep cognitive ($d = 0.44$) and somatic ($d =$

TABLE 3. Summary of Linear Regression Models of Vulnerability to Stress-Related Insomnia

	Model 1			Model 2		
	β	*t*	*p*	β	*t*	*p*
Middle-aged adults (*n* = 149)						
Perceived stress	0.447	6.046	<.001	0.375	3.840	<.001
Rumination	0.270	3.363	.001	0.214	2.528	.01
Arousability	0.584	8.663	<.001	0.546	6.798	<.001
Neuroticism	0.485	6.707	<.001	0.413	4.518	<.001
Extraversion	−0.177	−2.276	.02	−0.156	−1.902	.06
Reappraisal	−0.078	−0.937	.35	−0.011	−0.130	.89
Suppression	0.155	1.989	.049	0.113	1.362	.17
Young adults (*n* = 85)						
Perceived stress	0.194	1.799	.08	0.027	0.199	.84
Rumination	0.263	2.487	.01	0.212	2.027	.046
Arousability	0.463	4.695	<.001	0.426	3.228	.002
Neuroticism	0.383	3.780	<.001	0.320	2.669	.009
Extraversion	−0.111	−1.021	.31	−0.100	−0.953	.34
Reappraisal	−0.050	−0.467	.64	−0.041	−0.374	.71
Suppression	0.084	0.714	.48	0.019	0.173	.86
Presleep cognitive arousal	0.435	4.404	<.001	0.448	4.748	<.001
Presleep somatic arousal	0.299	2.858	.005	0.290	2.634	.010
Emotion-oriented coping	0.300	2.860	.005	0.220	2.143	.03
Task-oriented coping	−0.057	−0.520	.60	0.038	0.340	.73

Model 1 = fully unadjusted; Model 2 = adjusted for gender, depression, and anxiety.

TABLE 4. Psychological Differences Between Insomniacs (12,13) and Middle-Aged and Young Adult Good Sleepers With High Vulnerability to Stress-Related Insomnia

	Chronic Insomniacs		High FIRST		Student's *t* Test			
	1. Le Blanc et al. (12)[a]	2. Morin et al. (13)[a]	3. Middle-Aged Adults[a]	4. Young Adults[a]	1 Versus 3	2 Versus 3	1 Versus 4	2 Versus 4
n	147	40	49	36				
Cognitive-emotional arousal								
Arousability	34.8 ± 6.9	—	35.3 ± 7.6	36.5 ± 6.6	0.45	—	1.33	—
Presleep cognitive arousal	—	16.5 ± 5.0	—	18.5 ± 4.1	—	—	—	1.77
Presleep somatic arousal	—	11.9 ± 3.4	—	11.3 ± 2.3	—	—	—	0.88
Stress and coping								
Perceived stress	27.5 ± 8.2	27.3 ± 8.5	14.9 ± 5.4	15.7 ± 6.7	10.0**	8.36**	7.97**	6.54**
Task-oriented coping	54.4 ± 9.9	54.3 ± 9.9	—	58.5 ± 7.7	—	—	2.33*	2.05*
Emotion-oriented coping	45.4 ± 11.5	41.6 ± 13.0	—	46.8 ± 10.5	—	—	0.65	1.80
Avoidance-oriented coping	44.8 ± 10.0	—	—	45.4 ± 10.0	—	—	0.30	—
Personality factors								
Neuroticism	22.4 ± 8.5	—	20.3 ± 8.2	22.1 ± 7.6	1.54	—	0.21	—
Extraversion	26.3 ± 5.9	—	26.9 ± 7.6	29.9 ± 6.9	0.59	—	3.22**	—

*$p < .05$; **$p < .01$.
[a] Values are mean ± standard deviation.
FIRST = Ford Insomnia Response to Stress Test.

0.21) arousal, emotion-oriented coping (d = 0.13 and 0.44), and neuroticism (d = 0.04) between insomniacs and young adults scoring high in FIRST. The lack of significant differences in terms of arousability (d = 0.07) and neuroticism (d = 0.25) was corroborated by comparisons made between middle-aged high FIRST adults and insomniacs (Table 3). Although no significant differences were found between insomniacs and middle-aged high FIRST subjects in terms of extraversion (d = 0.09), young high FIRST subjects had significantly higher mean scores in extraversion (d = 0.56) and task-oriented coping (d = 0.46 and 0.47) than insomniacs. As expected, insomniacs showed higher scores in perceived stress than both middle-aged (d = 1.81 and 1.74) and young (d = 1.58 and 1.51) high FIRST good sleepers; the presence of insomnia itself might have an important contribution in this heightened perception of stress.

DISCUSSION

The present study demonstrates that psychological traits of cognitive-emotional hyperarousal are associated with vulner-

ability to stress-related insomnia. Furthermore, young adult and middle-aged good sleepers with high vulnerability to stress-related insomnia are characterized by a psychological profile consistent with arousability, presleep cognitive arousal, rumination, and emotion-oriented coping. Thus, these results suggest that cognitive-emotional hyperarousal may play a role in the vulnerability to stress-related or transient insomnia, and possibly to chronic insomnia.

In clinical samples, the personality patterns of individuals with chronic insomnia have been characterized by the presence of neurotic traits, rumination, and inability to discharge anger outwardly (47). Individuals with chronic insomnia have also been described as having fewer adaptive coping skills, especially relying more on coping strategies oriented toward negative emotions and their internalization (13,47). Consistent with these previous findings, our data reveal that cognitive-emotional hyperarousal and maladaptive coping mechanisms are premorbid trait characteristics associated with transient insomnia that may persist when chronic insomnia is developed.

The importance of the joint effect of stress and psychological predisposing factors in the pathogenesis of insomnia has been emphasized in insomnia research for many years (3, 13, 48). Specifically, Kales and Kales (2) stated earlier that "stressful events . . . when mediated by certain predisposing emotional factors and inadequate coping mechanisms, are indeed closely related to the onset of long-term sleep difficulty" (p. 111). The present study suggests that trait characteristics of neuroticism, arousability, presleep cognitive arousal, rumination, and emotion-oriented coping may play a significant role in the etiopathogenesis of stress-related or transient insomnia.

Individuals with insomnia have been reported to have higher neuroticism and arousability levels than good sleepers (12). Neuroticism is a heritable and stable personality factor (49) basically characterized by sensitivity to negative stimuli that correlates significantly with heightened psychophysiological (cognitive and autonomic) arousal (50). Neuroticism is considered a broad dimension of reactivity to negative stimuli, whereas arousability is a more specific type of emotional reactivity that overlaps with neuroticism, but it is not entirely subsumed by it (44). Studies (2,12) have shown that individuals with insomnia are typically characterized by this arousability, and in the present study, it was consistently related to vulnerability to transient insomnia. Thus, it seems that emotional arousability is the most specific feature of individuals vulnerable to transient insomnia.

Several studies have suggested that chronic insomniacs are more cognitively arousable, suffer from more sleep-retarding intrusive thoughts, ruminate more (2,6,7), and present higher levels of presleep cognitive and somatic arousal (13,39,51,52). In the present study, rumination, presleep cognitive and somatic hyperarousal showed a strong association with vulnerability to transient insomnia.

However, no clear-cut association was found between emotional inhibition (34) and FIRST scores, a finding that is different to what has been documented in large samples of clinical insomniacs (2). These discrepant findings may be explained by the differences in the measures used; in the present study, emotional inhibition was measured with a specific scale of emotion regulation (34), whereas the studies of chronic insomniacs used the Minnesota Multiphasic Personality Inventory (47). Future studies, using similar instruments and wider sample sizes, may clarify whether emotional inhibition is present also in subjects prone to transient insomnia.

Furthermore, vulnerability to transient insomnia was significantly associated with emotion-oriented coping and perceived stress. These findings are consistent with previous studies, which showed that individuals with chronic insomnia perceived their lives as more stressful and relied more on dysfunctional coping strategies than good sleepers (12,13,53). The aim of emotion-oriented coping is to reduce stress through reactions, such as emotional responses, preoccupation, or daydreaming reactions (41). These strategies are not always successful, as they increase emotional arousal and negative mood (41,54). Furthermore, insomniacs have also been shown to resort rigidly to monitoring strategies when coping with controllable and uncontrollable situations (53). Thus, it seems that individuals vulnerable to transient insomnia appraise events as more stressful and cope with them by rigidly using emotion-oriented strategies instead of relying more on active, problem-solving ones.

Past personal history of insomnia has been shown to be significantly related to chronic insomnia (2,12). Although mean values in sleep onset latency and sleep efficiency were within normal ranges and those values in ISI were in the range of absence of clinically significant insomnia (0–7) (24), the finding that some subjects in both samples of good sleepers reported having a personal history of insomnia is consistent with the fact that many patients with chronic insomnia reported to have been "light or episodic poor sleepers" even before developing chronic insomnia (55).

The psychological profile of chronic insomniacs has been traditionally interpreted as reflecting trait dimensions that preexist the onset of the condition (2–4,9,12,13). The present study suggests that scores in trait measures of arousability, presleep cognitive arousal, emotion-oriented coping, and neuroticism might be as high in vulnerable individuals who have not yet developed insomnia as in chronic insomniacs (12,13). These data give support to the notion of these psychological characteristics as causes (56) and not consequences of chronic insomnia. A recent longitudinal study (16) has shown that incident cases of chronic insomnia were premorbidly characterized by high negative affectivity, low extraversion, and high arousability—findings that are consistent with the present study. Further studies should examine age-related changes in some of these variables, as it seems to occur with extraversion and, possibly, with task-oriented coping, which are well-known protective psychological factors (38,41,44).

Interestingly, FIRST scores were lower in middle-aged adults than in young adults, which also points to a role of age-related physiological factors in the vulnerability to insomnia. It has been previously suggested that the increased prev-

alence of chronic insomnia in middle age may be the result of deteriorating sleep mechanisms associated with increased sensitivity to arousal-producing stress hormones (e.g., cortisol), rather than simply to increased stressful life events during this period (57). The findings of the present study support this hypothesis, because middle-aged adults showed lesser vulnerability of sleep to stressful events as compared with young adults. Further studies should examine the role of physiological factors in the vulnerability to transient insomnia.

This study has some limitations, including its cross-sectional nature, which precludes any definite conclusions about the direction of the relationship between vulnerability to insomnia and psychological characteristics. The sample drawn from a population of medical undergraduates (although gaining in homogeneity) may not be representative of the general population, and generalization of their results should be made cautiously. The use of self-report measures alone may have biased the good sleeper samples, and the possibility of having subjects with mild forms of several sleep disorders, such as disorders of the circadian sleep-wake cycle, sleep-disordered breathing, or movement disorders, should not be excluded. However, mean values in sleep latency, duration and efficiency, sleepiness, fatigue, and mood were within the normal range, which makes it unlikely that the sample included individuals who were either sleep deprived or had emotional problems. Moreover, conclusions should be made cautiously when interpreting the comparisons between high FIRST subjects and chronic insomniacs due to the low power retained by the use of small sample sizes. Finally, although the FIRST has been shown to be predictive of stress-related, polysomnographically measured poor sleep (18,19), the specificity and predictive validity (58) of FIRST scores remain to be tested, as a possible overlap with other disorders highly related to insomnia (i.e., depression and anxiety) may be present in this measure.

In summary, our data suggest that trait psychological factors related to the tendency to be easily hyperaroused, to ruminate or worry during the presleep state and when confronted with stress, and to use coping strategies that focus on the negative emotions elicited by stressful events might represent the psychological vulnerability substrate of insomnia. Also, our study suggests that cognitive-emotional hyperarousal is not a consequence of insomnia, but rather a predisposing factor to insomnia, which should be the target of our preventive strategies for this disorder. For example, the development of effective early interventions, such as stress-inoculation programs, reduction of cognitive and somatic hyperarousal, and management of worry, or adequate short-term use of sleeping aids during periods of stress, may reduce transient insomnia, which ultimately may prevent the development of chronic insomnia.

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