Comorbidity of Chronic Insomnia With Medical Problems

Daniel J. Taylor, PhD[1]; Laurel J. Mallory, BA[1]; Kenneth L. Lichstein, PhD[2]; H. Heith Durrence, PhD[3]; Brant W. Riedel, PhD[4]; Andrew J. Bush, PhD[5]

[1]The University of North Texas, Denton, TX; [2]The University of Alabama, Tuscaloosa, AL; [3]Somaxon Pharmaceuticals, Inc., San Diego, CA; [4]The University of Memphis, Memphis, TN; [5]University of Tennessee Health Science Center, Memphis, TN

Study Objectives: Determine the comorbidity of insomnia with medical problems.

Design: Cross-sectional and retrospective.

Participants: Community-based population of 772 men and women, aged 20 to 98 years old.

Measurements: Self-report measures of sleep, health, depression, and anxiety.

Results: People with chronic insomnia reported more of the following than did people without insomnia: heart disease (21.9% vs 9.5%), high blood pressure (43.1% vs 18.7%), neurologic disease (7.3% vs 1.2%), breathing problems (24.8% vs 5.7%), urinary problems (19.7% vs 9.5%), chronic pain (50.4% vs 18.2%), and gastrointestinal problems (33.6% vs 9.2%). Conversely, people with the following medical problems reported more chronic insomnia than did those without those medical problems: heart disease (44.1% vs 22.8%), cancer (41.4% vs 24.6%), high blood pressure (44.0% vs 19.3%), neurologic disease (66.7% vs 24.3%), breathing problems (59.6% vs 21.4%), urinary problems (41.5% vs 23.3%), chronic pain (48.6% vs 17.2%), and gastrointestinal problems (55.4% vs 20.0%). When all medical problems were considered together, only patients with high blood pressure, breathing problems, urinary problems, chronic pain, and gastrointestinal problems continued to have statistically higher levels of insomnia than those without these medical disorders.

Conclusion: This study demonstrates significant overlap between insomnia and multiple medical problems. Some research has shown it is possible to treat insomnia that is comorbid with select psychiatric (depression) and medical (eg, pain and cancer) disorders, which in turn increases the quality of life and functioning of these patients. The efficacy of treating insomnia in many of the above comorbid disorders has not been tested, indicating a need for future treatment research.

Keywords: Insomnia, medical, health, comorbid, prevalence, epidemiology

Citation: Taylor DJ; Mallory LJ; Lichstein KL et al. Comorbidity of chronic insomnia with medical problems. *SLEEP* 2007;30(2):213-218.

INTRODUCTION

INSOMNIA IS A SERIOUS PUBLIC HEALTH CONCERN, WITH 46% TO 69% OF PATIENTS PRESENTING TO A PRIMARY CARE OFFICE REPORTING A COMPLAINT of at least occasional insomnia.[1-3] These rates are generally higher than the 27% to 35% prevalence rate of a complaint of occasional insomnia in the general adult population.[4,5] It is likely that a large proportion of those 46% to 69% of patients complaining of insomnia to their primary care physicians have comorbid medical or psychiatric disorders. These patients with comorbid insomnia are probably accounting for an inordinate proportion of the $30 to $35 billion chronic insomnia is estimated to cost each year.[6] Few studies have detailed the relationship between insomnia and chronic health problems. Cross-sectional studies have attempted to determine if people with insomnia have more medical problems than do people without insomnia, with many finding that people with insomnia report more health problems.[4,7-11] However, very little prevalence data has been reported by these studies, and some of the samples used may limit generalizability.

Foley and colleagues have performed 3 studies in this area with older adults, 2 cross-sectional and 1 prospective.[7,8,11] In the most recent cross-sectional study, researchers collected data from 1506 older adults (55-84 years old) and found that a "past-year" history of insomnia "every night or almost every night" was associated with heart disease and bodily pain.[7] In the other cross-sectional study, researchers collected data from 9000 older adults (> 65 years old) and found that a lifetime history of insomnia was associated with increased difficulties with activities of daily living, respiratory symptoms, and having 2 or more health problems (i.e., hypertension, heart disease, cancer, stroke, diabetes, hip fracture, other fractures).[11] Three years later, these researchers contacted 6800 of the original sample and found that heart disease, stroke, hip fracture, and respiratory symptoms were associated with new episodes of insomnia, whereas heart disease, diabetes, respiratory symptoms, and stroke were associated with retention of insomnia.[8]

Several other studies have been performed in more representative samples. One cross-sectional study surveyed 3161 noninstitutionalized adults, 18 to 79 years old, and found that participants with "trouble falling asleep" or "trouble staying asleep or waking too early" were more likely to endorse "…2 or more health problems" than were people without insomnia.[4] However, there were no details given about the types of medical problems present. Finally, a cross-sectional study of 12,643 Hungarians found that insomnia was related to greater healthcare utilization (i.e., sick leave, emergency room visits, hospitalization) than in people without insomnia.[9]

The above studies have several strengths including large and generally representative samples. However, prevalence rates were not given for the percentage of people with insomnia who have a particular disorder. This makes it difficult to determine the severity of the problem within the insomnia population, especially considering that statistically significant results could have

Disclosure Statement

This was not an industry supported study. Dr. Lichstein has received research support from Respironics; and is a consultant for Lilly and Takeda. Drs. Taylor, Mallory, Durrence, Riedel, and Bush have indicated no financial conflicts of interest.

Submitted for publication October 6, 2006
Accepted for publication October 17, 2006

Address correspondence to: Daniel J Taylor, PhD, Department of Psychology, The University of North Texas, PO Box 311280, Denton, TX 76203; Tel: (940) 565-2655; Fax: (940) 565-4682; Email: djtaylor@unt.edu

been found due to the large sample sizes, but the results may not be clinically significant. For example, if only 5% of people with insomnia have chronic pain, it may not be a good use of resources to focus considerably more effort in this area. On the other hand, if 70% of people with insomnia have chronic pain, then the field would be well served to examine this relationship more closely and determine if new treatments are needed in this group that include active treatment for the pain and the insomnia, or if treating one would alleviate the other.

To fully understand the relationship between insomnia and comorbid medical problems, it is also important to determine the prevalence of insomnia in specific medical conditions. After all, only a small percentage of people with insomnia will have cancer, but the prevalence of insomnia in patients with cancer may be very high and may be a significant problem deserving of more clinical and research attention.

One study of 3445 patients with chronic medical conditions (e.g., hypertension, diabetes, heart problems) found that patients with congestive heart failure, obstructive airway disease, back pain, hip impairment, peptic ulcer disease, angina pectoris, myocardial infarction, osteoarthritis, and prostate problems all were more likely to report insomnia than not.[12] However, actual prevalence rates for insomnia in these medical disorders were never given. Another study found that 18% and 20% of 601 patients with end-stage renal disease, who denied any symptoms of restless legs syndrome, experienced sleep-onset and sleep-maintenance insomnia, respectively.[13] A cross-sectional study of 223 patients with chronic heart failure in Sweden found that 23% of men and 20% of women had "major complaints" of "difficulties maintaining sleep," whereas 18.8% of men had "difficulties initiating sleep"; all of these rates were significantly higher than in a less-than-ideal normative population (n = 876) of participants 65 years or older. In a study of 11,924 Canadians, the prevalence of insomnia was higher in people who were dissatisfied with their health or who had difficulty in activities of daily living, migraines, or circulatory, digestive, respiratory, or rheumatic diseases, than in people who did not have these problems, but actual prevalence rates were not reported.[10] Finally, a review of 15 studies involving patients with cancer found that 30% to 50% experienced symptoms of insomnia.[14] This is not surprising considering that others have found that patients with cancer rated insomnia as their most prevalent symptom; higher than pain, anorexia, fatigue, or nausea.[15]

The above studies provide interesting data that give some insight into the scope of the problem of comorbid insomnia. However, these studies need to be replicated and extended for a variety of reasons. For one, the definitions of insomnia varied greatly among studies, with only a couple of studies[7,9] having definitions that definitively corresponded to any of the currently accepted research diagnostic criteria.[16,17] This lack of agreement and specificity makes it difficult to compare results among studies and to determine prevalence rates for individuals with current chronic insomnia,[18,19] which is arguably the sample of most interest. A second issue is that few of the studies controlled for potential confounds, such as the presence of underlying sleep disorders (e.g., sleep apnea) or mental disorders (e.g., depression). These underlying disorders could be causing both the insomnia[20] and medical disorders.[21,22] For instance, a recent study found that 20% of people with insomnia report clinically significant depression, and 19.3% report clinically significant anxiety, making people with insomnia 10 times more likely to have depression and 17 times more likely to have anxiety than people without insomnia.[19] This represents a serious confound, as it is possible that stress involved with chronic medical problems leads to increased anxiety and depression, which in turn leads to increased insomnia. Thus, it is important to control the independent contributions of depression and anxiety symptoms, as well as underlying sleep disorders, before we can obtain accurate prevalence rates of insomnia as it relates to specific medical disorders.

The present study examined the association between insomnia status and a variety of medical problems with and without controlling for depression and anxiety. We wished to develop a compendium of medical problems comorbid with insomnia for use in future studies examining the treatment of insomnia in these populations. It was hypothesized that people with insomnia (PWI) would have a higher prevalence of medical problems than people not having insomnia (PNI). Conversely, it was hypothesized that people with medical problems would be more likely than people without medical problems to have insomnia.

METHODS

Procedure

The current study is a reanalysis of data collected in a larger epidemiology study, in which the main goals were to establish sleep norms, including differences on age, sex, and ethnicities; determine daytime correlates of sleep; and gain more-detailed information about insomnia.[23] Potential participants were contacted using a random digit dialing protocol in Shelby County, Tennessee. To ensure adequate sampling of sex and age, we employed a stratified random sampling method to obtain data from at least 50 men and 50 women in each decade from 20 to +80. We used unrestricted random sampling until a cell (i.e., men or women within each decade) was filled, and then it was closed to further sampling. Because the population of Memphis, Tennessee, is equally divided between African Americans and Caucasian Americans, we were also able to obtain sufficient numbers of both groups. Short phone interviews were conducted to solicit participation in the study. Volunteers who agreed to participate were mailed an informed consent, 14-day sleep diary, health survey, depression and anxiety questionnaires, and other daytime-functioning questionnaires. Upon receipt, participants began completing the sleep diary and, at the end of the 14 days, completed the remainder of the material in the packet.[23] Statistical analyses were conducted using SPSS 12.0 for Windows (SPSS, Inc., Chicago, Ill).

Participants

Of the 1769 volunteers recruited, an adjusted response rate of 37.7% was obtained.[23] Adjustment was necessary because, as the study progressed, some cells filled more quickly than others (e.g., men older than 80 years of age). Thus, toward the end of the study, when homes were contacted that did not have a member who fell into one of our remaining target cells, this number was coded as ineligible rather than nonresponse. We also coded businesses as ineligible rather than nonresponse. If desired, more detail is given about our adjustment methods elsewhere.[23] The final sample included 772 participants, which consisted of 381 men and 391 women varying in age from 20 to 98 years. The ethnic representation included 539 Caucasians, 223 African Americans, 7 Asians, 1 Hispanic, and 2 whose ethnic information was missing. Patients were excluded if they reported any sleep disorder other than in-

somnia (n = 31); had transient (i.e., < 6 months) insomnia (n = 6); displayed an insomnia sleep pattern (see Sleep Diary Below) but no insomnia complaint, which is necessary for diagnosis (n = 120); or complained of insomnia but did not display an insomnia sleep pattern (n = 77). This resulted in a final sample of 538 participants who could be clearly defined as either PWI or PNI.

MEASURES

Health Survey

A health survey form[23] was used to obtain general health information. The survey asked participants "Do you have a sleep problem?" and to describe the problem. Data from participants who reported non–insomnia-related sleep disorders (e.g., sleep apnea, narcolepsy) were excluded from the subsequent analyses. To explore possible occult organic sleep disorders, participants were asked if they snored heavily, if they had difficulty breathing or gasped for breath during sleep, if their legs jerked while asleep, and if their legs felt restless before falling asleep.

Medical problems were defined by asking participants to "Indicate with a check mark if you have the following health problems…" on a self-report checklist, which included "heart disease, cancer, AIDS, high blood pressure, neurological disease (ex: seizures, Parkinson's disease), breathing problems (ex: asthma, emphysema), urinary problems (ex: kidney disease, prostate problems), diabetes, chronic pain (ex: arthritis, back pain, migraines), and gastrointestinal problems (ex: stomach, irritable bowel syndrome, ulcers) ."

Depression and Anxiety

Depression scores were obtained using the 21-item Beck Depression Inventory.[24] The Beck Depression Inventory is a widely used measure of depression and has good reliability and validity.[25] Anxiety scores were obtained using the 20-item State-Trait Anxiety Inventory, Form Y Trait Scale.[26] The State-Trait Anxiety Inventory is a frequently used measure of trait anxiety and has adequate reliability and validity.[27]

Sleep Diary

Participants completed a sleep diary[23] every morning for 14 consecutive days. The information collected from the diary was used to determine the sleep onset-latency, number of awakenings throughout the night, wake time after sleep onset, total sleep time, frequency of insomnia episodes (number of episodes during the 14 day recording period), and sleep-quality rating (Likert-type scale ranging from 1 = very poor to 5 = excellent). The diagnosis of insomnia was operationally defined as a self-report of insomnia for a minimum of 6 months, with at least 3 nights per week of (a) sleep-onset latency of 31 minutes or longer, (b) wake after sleep onset of 31 minutes or longer, or (c) a combination of the 2, and a daytime complaint.[16]

RESULTS

Prevalence of Medical Problems in PWI

We performed a logistic-regression analysis, with each medical disorder (heart disease, cancer, high blood pressure, neurologic disease, breathing problems, urinary problems, diabetes, chronic pain, and gastrointestinal problems) analyzed separately as the dependent variable, with insomnia status (PWI vs PNI) as the independent variable, to determine if PWI had a greater prevalence than PNI of these medical problems. AIDS was excluded from the analysis because there was only 1 person with this diagnosis, making interpretation of the findings inconclusive. Table 1 shows prevalence rates for specific medical problems in both PWI and PNI. PWI were significantly more likely to report a medical problem, and PWI reported a greater number of medical problems (mean ± SD 2.22 ± 1.64) than PNI (0.81 ± 1.11) ($t_{536} = 11.22$, $p < .001$). More PWI reported heart disease, cancer, high blood pressure, neurologic disease, breathing problems, urinary problems, diabetes, chronic pain, and gastrointestinal problems than PNI.

Table 1—Prevalence of Medical Problems in 137 PWI and 401 PNI

	Prevalence of Medical Problem, %		Unadjusted	Adjusted[a]
Medical Problem	PWI	PNI	Odds Ratio (95% CI)	Odds Ratio (95% CI)
Heart disease	21.9	9.5	2.68 (1.58-4.53)[d]	2.27 (1.13-4.56)[b]
Cancer	8.8	4.2	2.17 (1.01-4.67)[b]	2.58 (0.98-6.82)
High blood pressure	43.1	18.7	3.29 (2.16-5.01)[d]	3.18 (1.90-5.32)[d]
Neurologic	7.3	1.2	6.24 (2.09-18.59)[c]	4.64 (1.37-15.67)[b]
Breathing	24.8	5.7	5.43 (3.06-9.62)[d]	3.78 (1.73-8.27)[c]
Urinary	19.7	9.5	2.35 (1.37-4.01)[c]	3.28 (1.67-6.43)[c]
Diabetes	13.1	5.0	2.88 (1.48-5.63)[c]	1.80 (0.78-4.16)
Chronic pain	50.4	18.2	4.56 (3.00-6.94)[d]	3.19 (1.92-5.29)[d]
Gastrointestinal	33.6	9.2	4.97 (3.05-8.12)[d]	3.33 (1.83-6.05)[d]
Any	86.1	48.4	6.63 (3.93-11.18)[d]	5.17 (2.93-9.12)[d]

PWI refers to people with insomnia; PNI, people not having insomnia; %, percentage of PWI or PNI who have that particular disease; CI, confidence interval.
[a]Adjusted for depression, anxiety, and sleep disorder symptoms.
[b]$p < .05$.
[c]$p < .01$.
[d]$p < .001$.

Prevalence of Insomnia in Medical Problems

We then performed a logistic regression with insomnia status (PWI vs PNI) as the dependent variable, and each medical disorder analyzed separately as the independent variable, to determine if people with each medical disorder were more likely to have insomnia than people without the medical disorder. Table 2 shows prevalence rates of insomnia for people with specific medical problems and people without these disorders. People with heart disease, cancer, high blood pressure, neurologic disease, breathing problems, urinary problems, diabetes, chronic pain, and gastrointestinal problems were significantly more likely than those without these medical problems to have insomnia.

Confounding-Variable Analysis

To determine which sleep-disorder symptoms might be potential confounding variables, χ^2 tests of independence analyses were conducted with each sleep-disorder symptom (snoring, breathing problems, limb jerk, sleep attack; see Health Survey section above) run individually with insomnia status and each medical

Table 2—Prevalence of Insomnia in People with Specific Medical Problems and in People Without That Medical Problem

	Medical Problem		Insomnia Prevalence, %				
Disease	PWP No.	PWOP No.	PWP with Insomnia	PWOP with Insomnia	Unadjusted Odds Ratio (95% CI)	Adjusted[a] Odds Ratio (95% CI)	Adjusted[b] Odds Ratio (95% CI)
Heart disease	68	470	44.1	22.8	2.68 (1.58-4.53)[e]	2.11 (1.07-4.15)[c]	.89 (0.42-1.85)
Cancer	29	509	41.4	24.6	2.17 (1.01-4.67)[c]	2.50 (1.01-6.21)[c]	1.67 (.63-4.42)
High blood pressure	134	404	44.0	19.3	3.29 (2.16-5.01)[e]	3.19 (1.87-5.43)[e]	1.92 (1.06-3.46)[d]
Neurological disease	15	523	66.7	24.3	6.24 (2.09-18.59)[d]	5.21 (1.22-22.21)[c]	3.40 (0.85-13.62)
Breathing problems	57	481	59.6	1.4	5.43 (3.06-9.62)[e]	2.79 (1.27-6.14)[c]	3.26 (1.56-6.81)[d]
Urinary problems	65	473	41.5	3.3	2.35 (1.37-4.01)[d]	3.51 (1.82-6.79)[e]	2.25 (1.13-4.48)[c]
Diabetes	38	500	47.4	23.8	2.88 (1.48-5.63)[d]	2.03 (0.86-4.79)	1.52 (.61-3.82)
Chronic pain	142	396	48.6	17.2	4.56 (3.00-6.94)[e]	3.16 (1.90-5.27)[e]	2.27 (1.33-3.89)[d]
Gastrointestinal problems	83	455	55.4	20.0	4.97 (3.05-8.12)[e]	3.00 (1.66-5.43)[e]	2.57 (1.37-4.80)[d]
Any Medical Problems	312	226	37.8	8.4	6.63 (3.93-11.18)[e]	5.26 (2.82-9.80)[e]	N/A

PWP refers to people who reported having the medical problem listed on left; PWOP, people who did not report having medical problem listed on left; % = percentage of people with or without that particular disease who report insomnia; CI, confidence interval; N/A, not applicable (i.e., because "Any medical problem" was derived from the individual health problems, which we were controlling for in the adjustedb analysis, we did not include this composite variable in this analysis because it would have resulted in extreme multicollinearity.

[a]Adjusted for depression, anxiety, and sleep disorder symptoms.

[b]Adjusted for depression, anxiety, sleep disorder symptoms, and other medical problems.

[c]$p < .05$.

[d]$p < .01$.

[e]$p < .001$.

disorder in a 2 × 2 cell structure. Based on recommendations of Mickey and Greenland,[28] variables significant at the $p < .20$ level were added as covariates to the base model that included depression and anxiety scores. This was done in an attempt to construct the most unbiased logistic-regression model estimating the relationship between insomnia status and medical problems. Table 3 shows the confounding variables associated with each dependent variable.

Since other studies have already shown that anxiety and depression scores are higher in PWI than PNI, these scores were also considered confounds.[19] To control for the confounds of depression, anxiety, and sleep-disorder symptoms, the same nine logistic regressions were conducted again with depression, anxiety and significant sleep disorders symptoms (Table 3) included as covariates. Although the analyses showed a slight decrease in significance, PWI still had significantly more heart disease, high blood pressure, neurologic disease, breathing problems, chronic pain, and gastrointestinal problems (Table 1); cancer and diabetes were no longer significant.

Again, to ascertain the possible contribution that depression, anxiety, and occult sleep disorders might add to the equation, logistic regression analyses were conducted which included depression and anxiety scores along with sleep disorder symptom questions as covariates with the medical problems listed above. Although these analyses showed decreases in significance for most disorders, only 1 became nonsignificant (diabetes). However, when we adjusted for these confound variables as well as included all of the medical disorders into the same model simultaneously (allowing us to account for overlap between medical disorders), we found that only high blood pressure, breathing problems, urinary problems, chronic pain, and gastrointestinal problems were still significantly associated with insomnia (i.e., adjusted[b]).

DISCUSSION

The goal of the current study was to provide valid estimates of the prevalence of chronic insomnia comorbid with medical problems using a random sample. As expected based on the available literature, PWI had a higher prevalence of comorbid medical problems than did PNI, and people with chronic medical problems had a higher prevalence of insomnia than did people without those same disorders. Specifically, PWI had a higher incidence of heart disease, high blood pressure, neurologic disease, breathing problems, urinary problems, chronic pain, and gastrointestinal problems, even after we controlled for depression and anxiety levels and other sleep disorder symptoms (Table 1). Further, people with heart disease, cancer, high blood pressure, neurologic disease, breathing problems, urinary problems, chronic pain, and gastrointestinal problems were more likely than people without these disorders to have insomnia (Table 2). Controlling for depression, anxiety, and sleep symptoms resulted in a decrease in the significance of the differences seen in several of the medical conditions, but only resulted in nonsignificance in diabetes. However, when we also took into account the overlap between medical disorders, only people with high blood pressure, breathing problems, urinary problems, chronic pain, and gastrointestinal problems had more insomnia than people without these medical problems.

Although other studies have shown an association between insomnia and medical problems[4,7-11] the current findings were the first to actually provide prevalence rates of medical problems in people with insomnia. Although comparative data do not exist, we can compare these results with the available insomnia prevalence data in specific medical problems. In the case of cancer, these results (41.4%), were in close agreement with the range reported by Savard and Morin (30%-50%).[14] However, we found significantly higher rates of insomnia in patients with heart dis-

Table 3—Analyses of Confounding Variables

Dependant Variable	Significant Confounds	p Value
Heart problems	Breathing problems	< .001
	Limb jerk	.060
	Sleep attacks	.016
Cancer	Limb jerk	.022
	Sleep attacks	.161
High blood pressure	Snoring	.024
	Breathing problems	.132
	Sleep attacks	.045
Neurologic disease	Snoring	.090
Breathing problems	Breathing problems	< .001
	Limb jerk	.005
	Sleep attacks	.002
Urinary Problems	Snoring	.098
	Sleep attacks	.003
Diabetes	Snoring	.040
	Breathing problems	.111
	Limb jerk	.013
	Sleep attacks	.003
Chronic Pain	Snoring	.190
	Breathing problems	.001
	Limb jerk	.003
	Sleep attacks	.005
Gastrointestinal Problems	Breathing problems	.004
	Limb jerk	< .001
	Sleep attacks	< .001
Insomnia	Snoring	.165
	Breathing problems	< .001
	Limb jerks	< .001
	Sleep attacks	< .001

ease (44.1%) than have other researchers (18%-23%).[4,7-11] This disparity in results was most likely due to significant differences in definitions of insomnia. We did not have a renal-failure group with which to compare with results from other researchers.

To our knowledge, this is the first epidemiologic study not only to focus on the prevalence of medical problems in people with insomnia, but, conversely, to study the prevalence of insomnia in people with specific medical problems to provide a broader picture of the association between physical health and insomnia. In addition, this was the first study to use an empirically validated operational definition of insomnia derived from a 2-week sleep diary and a self-report of 6 months or longer duration of the problem, as opposed to single point retrospective estimates, an approach that commonly exaggerates symptomatology.[23]

One weakness of the current study is the relatively small sample size that is perhaps less representative of the general population. For example, we only had 15 individuals with neurologic disorders; thus, the estimates of prevalence of insomnia in this group likely had large confidence intervals. Sample size is generally a problem because it lowers power, which may lead to failing to find significant results when they in fact exist (i.e., type I error). However, this was obviously not a problem for the current study. A second problem with small sample sizes is that they may result in spurious results. The assumptions of logistic regression require that the estimated cell size be larger than 5, which was not the case for the neurologic data. Thus, those data should be interpreted very cautiously. However, this was the only such medical disorder where this was a problem, so we feel confident that our other outcomes are the most-accurate estimates of the prevalence of insomnia that is comorbid with medical disorders to date.

In addition, our sample is not completely representative of a larger population (e.g., the United States), somewhat reducing the confidence that can be placed in our prevalence estimates in relation to said population. Examples of why our sample differs from the general population include geographically limited (Memphis, Tenn), 38% response rate, underrepresentation of African Americans, and even sampling across decades and sex. Unfortunately, we did not control for these sampling biases but still feel that our results add greatly to the literature to date. Yet, the field continues to need a large, multisite epidemiology study that can control for the above weaknesses.

Another potential weakness was that we excluded 234 subjects from this analysis for various reasons (see participants). This limits our ability to generalize our findings to these other groups. It was beyond the scope of this paper to determine how including these individuals, as PNI, would have changed the results of the study. However, we would hypothesize these individuals would have more complicated medical histories than would a "pure" sample of PNI, and, thus, their inclusion would have weakened our overall results.

We also did not analyze the effects of the medications of patients with particular medical disorders may have had on sleep. Insomnia is a side effect of many medications used to treat some of the medical problems listed. For instance, medications to treat hypertension or breathing problems can cause insomnia. We did not perform this analysis because we felt that there was too much variability (e.g., no uniformity of specific medication used, dosage, or concurrent medication usage) to produce meaningful results given our small sample size. Future research studies, within specific medical conditions, should examine this question more closely.

It is important to note that cross-sectional studies cannot show causation; they can only demonstrate association and, as such, cannot say that insomnia is a direct or indirect result of the medical problem. In truth, when another medical problem is present, determining if insomnia was caused by the other disorder is next to impossible. Therefore, the panel from the National Institutes of Health State-of-the-Science Conference on Insomnia recommended that the term "comorbid insomnia" be used when insomnia presents concurrently with other medical and psychiatric disorders, reasoning (a) "…the limited understanding of mechanistic pathways in chronic insomnia precludes drawing firm conclusions about the nature of these associations or the direction of causality" and (b) to label a patient's insomnia as secondary may lead to undertreatment of these individuals.[29] This decision was made, in part, because research has shown that comorbid insomnia is treatable, indicating that the insomnia is at least partially independent from the comorbid disorder.[30]

It is possible that insomnia could serve to exacerbate and worsen symptoms for people with chronic illnesses, thus significantly decreasing their health-related quality of life and potentially interfering with treatment.[31,32] For instance, there is some research that points to insomnia decreasing pain thresholds, and pain is the number one predictor of disability.[33] Also, there is evidence that decreased immune function is associated with insomnia, making people with chronic illnesses more susceptible to a cold or flu, potentially further compromising health.[18] One theory for how this may occur comes from Selye's *general adaptation syndrome* theory, in which an organism can only fight off a stressor (e.g.,

insomnia) for so long before the organism becomes exhausted and health breakdown begins to occur.[34]

Future longitudinal research studies are now needed, which preferably should start in subjects in their teenage years, to determine the course of insomnia in relationship to the aforementioned medical problems. This research, which also cannot demonstrate causality, can help us determine the risk relationship between insomnia and various medical problems and will allow us to make hypotheses as to which mechanisms can be directly implicated as being causal factors. For example, is insomnia a result of the stress associated with a medical problem, a physiologic effect of the disorder, a medication side effect, or a combination of these factors? Additionally, factors could be differentially dependent on the medical disorder. In other words, factors contributing to insomnia for a person with breathing problems may be quite different from the contributing factors for a person with a urinary disorder.

The results of this study also demonstrate a need for future research in treating insomnia in patients with the above comorbid medical problems. For example, cognitive behavioral therapy for insomnia may be preferred over the use of physiologically systemic sleep medications in patients with certain disease processes and especially those patients with an already complex medication regimen. Additionally, even a relatively minor improvement in insomnia might result in noticeable relief of other disease symptoms (e.g., pain, fatigue) and possibly reduce the risk of secondary infections.

REFERENCES

1. Aikens JE, Rouse ME. Help-seeking for insomnia among adult patients in primary care. J Am Board Fam Pract 2005;18:257-61.
2. Terzano MG, Parrino L, Cirignotta F, et al. Studio Morfeo: insomnia in primary care, a survey conducted on the Italian population. Sleep Med 2004;5:67-75.
3. Shochat T, Umphress J, Israel AG, Ancoli-Israel S. Insomnia in primary care patients. Sleep 1999;22(Suppl 2):S359-65.
4. Mellinger GD, Balter MB, Uhlenhuth EH. Insomnia and its treatment: prevalence and correlates. Arch Gen Psychiatry 1985;42:225.
5. Ancoli-Israel S, Roth T. Characteristics of insomnia in the United States: results of the 1991 National Sleep Foundation Survey. Sleep 1999;22(Suppl 2):S347-53.
6. Walsh JK, Engelhardt CL. The direct economic costs of insomnia in the United States for 1995. Sleep 1999;22(Suppl 2):S386-93.
7. Foley D, Ancoli-Israel S, Britz P, Walsh J. Sleep disturbances and chronic disease in older adults: results of the 2003 National Sleep Foundation Sleep in America Survey. J Psychosom Res 2004;56:497.
8. Foley DJ, Monjan A, Simonsick EM, Wallace RB, Blazer DG. Incidence and remission of insomnia among elderly adults: An epidemiologic study of 6,800 persons over three years. Sleep 1999;22: S366.
9. Novak M, Mucsi I, Shapiro CM, Rethelyi J, Kopp MS. Increased utilization of health services by insomniacs-An epidemiological perspective. J Psychsom Res 2004;56:527.
10. Sutton DA, Moldofsky H, Badley EM. Insomnia and health problems in Canadians. Sleep 2001;24:665.
11. Foley DJ, Monjan AA, Brown SL, Simonsick EM. Sleep complaints among elderly persons: An epidemiologic study of three communities. Sleep 1995;18:425.
12. Katz DA, McHorney CA. Clinical correlates of insomnia in patients with chronic illness. Arch Intern Med 1998;158:1099-107.
13. Gigli GL, Adorati M, Dolso P, et al. Restless legs syndrome in end-stage renal disease. Sleep Med 2004;5:309-15.
14. Savard J, Morin CM. Insomnia in the context of cancer: a review of a neglected problem. J Clin Oncol 2001;1):895-908.
15. Chen ML, Chang HK. Physical symptom profiles of depressed and nondepressed patients with cancer. Palliat Med 2004;18:712-8.
16. Lichstein KL, Durrence HH, Taylor DJ, Bush AJ, Riedel BW. Quantitative criteria for insomnia. Bev Res Ther 2003;41:427.
17. Edinger JD, Bonnet MH, Bootzin RR, et al. Derivation of research diagnostic criteria for insomnia: report of an American Academy of Sleep Medicine Work Group. Sleep 2004;27:1567-96.
18. Taylor DJ, Lichstein KL, Durrence HH. Insomnia as a Health Risk Factor. Behav Sleep Med 2003;1:227.
19. Taylor DJ, Lichstein KL, Durrence HH, Reidel BW, Bush AJ. Epidemiology of insomnia, depression, and anxiety. Sleep 2005;28:1457-64.
20. Lichstein KL, Riedel BW, Lester KW, Aguillard RN. Occult sleep apnea in a recruited sample of older adults with insomnia. J Consult Clin Psychol 1999;67:405-10.
21. Levy P, Pepin JL, McNicholas WT. Should all sleep apnoea patients be treated? Yes. Sleep Med Rev 2002;6:17-27.
22. Parish JM, Somers VK. Obstructive sleep apnea and cardiovascular disease. Mayo Clin Proc 2004;79:1036-46.
23. Lichstein KL, Durrence HH, Riedel BW, Taylor DJ, Bush AJ. Epidemiology of sleep: age, gender, and ethnicity. Mahwah, NJ: Lawrence Erlbaum Assoc; 2004.
24. Beck AT, Steer RA. Beck Depression Inventory Manual. San Antonio: The Psychological Corporation; 1993.
25. Beck AT, Steer RA, Garbin MG. Psychometric properties of the Beck Depression Inventory: twenty-five years of evaluation. Clin Psychol Rev 1988;8:77.
26. Spielberger CD, Gorsuch RL, Lushene RE. State-Trait Anxiety Inventory. Palo Alto: Consulting Psychologists Press; 1970.
27. Spielberger CD, Gorsuch RL. Manual for the State-trait Anxiety Inventory (form Y): ("Self-Evaluation Questionnaire") revised. Palo Alto: Consulting Psychologists Press; 1983.
28. Mickey RM, Greenland S. The impact of confounder selection criteria on effect estimation. Am J Epidemiol 1989;129:125-37.
29. National Institutes of Health State of the Science Conference Statement on Manifestations and Management of Chronic Insomnia in Adults, June 13-15, 2005. Sleep 2005;28:1049-57.
30. Stepanski EJ, Rybarczyk B. Emerging research on the treatment and etiology of secondary or comorbid insomnia. Sleep Med Rev 2006;10:7-18.
31. Brostrom A, Stromberg A, Dahlstrom U, Fridlund B. Sleep difficulties, daytime sleepiness, and health-related quality of life in patients with chronic heart failure. J Cardiovasc Nurs 2004;19:234-42.
32. Katz DA, McHorney CA. The relationship between insomnia and health-related quality of life in patients with chronic illness. J Fam Pract 2002;51:229.
33. Affleck G, Urrows S, Tennen H, Higgins P, Abeles M. Sequential daily relations of sleep, pain intensity, and attention to pain among women with fibromyalgia. Pain 1996;68:363-8.
34. Selye H. Stress in Health and Disease. Boston: Butterworth; 1976.