The Direct and Indirect Costs of Untreated Insomnia in Adults in the United States

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Objectives: To estimate the direct and indirect cost burden of untreated insomnia among younger adults (age 18 – 64), and to estimate the direct costs of untreated insomnia for elderly patients (age 65 and over).

Design: A retrospective, observational study comparing insomnia patients to matched samples without insomnia.

Settings: Self-insured, employer sponsored health insurance plans in the U.S.

Patients or Participants: 138,820 younger adults and 75,558 elderly patients with insomnia, plus equal-sized, matched comparison groups.

Interventions: NA

Measurements and Results: Direct costs included inpatient, outpatient, pharmacy, and emergency room costs for all diseases, for six months before an index date. The index date for insomnia patients was the date of diagnosis with or the onset of prescription treatment for insomnia, sometime during July 1, 1999 – June 30, 2003. Non-insomnia patients were assigned the same index dates as the insomnia patients to whom they were matched. Indirect costs included costs related to absenteeism from work and the use of short-term disability programs. Propensity score matching was used to find insomnia and non-insomnia patients who had similar demographics, location, health plan type, comorbidities, and drug use patterns. Regression analyses controlled for factors that were different even after matching was completed. We found that average direct and indirect costs for younger adults with insomnia were about $1,253 greater than for patients without insomnia. Among the elderly, direct costs were about $1,143 greater for insomnia patients.

Conclusions: Insomnia is associated with a significant economic burden for younger and older patients.

Keywords: Insomnia, Cost, Burden of illness

Citation: Ozminkowski RJ; Wang S; Walsh JK. The direct and indirect costs of untreated insomnia in adults in the united states. *SLEEP* 2007;30(3):263-273.

INTRODUCTION

INSOMNIA CAN BE AN ACUTE EXPERIENCE OR A CHRONIC DISORDER, CHARACTERIZED BY DIFFICULTY IN FALLING ASLEEP AND/OR REMAINING ASLEEP or by poor quality of sleep.[1] The sleep difficulty is associated with daytime distress, such as tiredness, negative mood, or difficulty with memory or concentration. The estimated prevalence of chronic insomnia in the US is about 10% (about 25 million people), but prevalence varies a great deal across studies.[2] For approximately 20%-25% of chronically affected persons, insomnia appears as a primary disorder.[3, 4] For the majority, insomnia occurs in the presence of medical and psychiatric conditions, such as depression,[5] anxiety, restless leg syndrome, or painful illnesses, although the nature of the relationship between insomnia and those conditions has not been established.[6,7] For that reason a recent National Institutes of Health State of the Science conference[8] concluded that the term "comorbid insomnia" was preferable to "secondary insomnia."

Risk factors for chronic insomnia include female sex and increasing age, although the latter appears due to the increase in various illnesses with age, rather than age per se.[9] Chronic insomnia generally lasts for at least several years[6,10] and can be associated with reduced quality of life[11, 12] and an increased risk of a major depressive disorder.[13, 14] Other correlates of insomnia may include fatigue, reduced physical ability, impaired social performance, and higher rates of absenteeism from work, accidents at work, and presenteeism (i.e., lower productivity while at the workstation).[15]

Several studies have examined the health care utilization and cost burden associated with insomnia. Hatoum and colleagues[16] reviewed the experience of 5 American Medical Group Association clinics and found that insomnia patients had more emergency room visits, more calls to the doctor, and more use of over-the-counter drugs than noninsomnia patients. Health-related quality of life was also lower for insomnia patients. Similarly, Simon and VonKorff[17] surveyed 1,962 patients at primary health clinics and conducted face-to-face interviews with a stratified random subsample (n = 373), in order to estimate the prevalence and cost-burden of chronic insomnia. They found the prevalence of chronic insomnia was 10%, and they found that chronic insomnia patients had higher health care costs and significantly greater physical and social disability than good sleepers. Leger et al.[18] also found higher rates of absenteeism, more trouble concentrating at work, and more medical problems (resulting in more physician office visits) among insomnia patients, compared with good sleepers.

Other studies have attempted to estimate the cost burden of insomnia from a public health perspective. While methods have

Disclosure Statement

This research was funded by Sepracor, Inc. Dr. Ozminkowski is employed by Thomson Medstat. Sepracor, Inc. provided the funding directly to Thomson Medstat for Dr. Ozminkowski's time in writing this paper. Dr. Ozminkowski received no direct funds from Sepracor, Inc. Dr. Walsh reported that research support has been provided to his instution by Evotec, Pfizer, Merck & Co., Neurocrine Biosciences, and Cephalon. Dr. Walsh has been a consultant for Abbott Laboratories, Pfizer, Sanofi-Aventis, Cephalon, Organon, Neurocrine Biosciences, Takeda Pharmaceuticals North America, Actelion, Sepracor, Elan, Guilford Pharmaceuticals, Respironics, Merck KGaA, Darmstadt, King Pharmaceuticals, TransOral Pharmaceuticals, Neurogen Corporation, GlaxoSmithKline, SleepTech, Eli Lilly and Company, Evotec, and Merck & Co. Dr. Wang has reported no financial conflicts of interest.

Submitted for publication April 13, 2006

Accepted for publication November 27, 2006

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varied, the typical approach has been to estimate the costs of prescription and nonprescription insomnia medications; the costs of accidents and other work mishaps that are due to insomnia; the costs of using alcohol to manage sleep problems; and the added inpatient, outpatient, emergency room, and nursing home costs associated with insomnia. Reviews of earlier studies by Walsh and Engelhart[19] and Chilcott and Shapiro[20] suggest a total cost of insomnia ranging from about $30 billion to $35 billion in the United States, in the early to mid-1990s.

To date, most of the studies of the burden of insomnia have been based on relatively small samples of patients at a small number of treatment sites. While there are some advantages of using survey methods in those studies (e.g., one can address a wide array of indirect costs via survey), self-reports may be prone to reliability and validity concerns.

With a different set of data sources at hand, we took a different approach to estimating the insomnia cost burden. We used medical claims data to investigate direct costs; employer absenteeism and short term disability program records were used to estimate indirect costs. We also focused on the costs of untreated insomnia.

METHODS

Study Design

Retrospective, observational studies were conducted using data from July 1, 1999 to June 30, 2003. Direct costs were investigated, using information from medical claims for inpatient, outpatient, pharmacy, and emergency room services. Expenditures for these services were transformed to year-2003 metrics, to adjust for inflation. Expenditures were then compared for 138,820 patients aged 18 – 64 years who developed insomnia, and for an equal-sized, matched sample of patients who did not. Expenditures were also compared for 75,558 elderly insomnia patients, versus an equal-sized, matched sample of elderly patients who did not have insomnia. To estimate indirect costs (also in year-2003 cost values), absenteeism records and short-term disability program records were examined for matched workers who did and did not develop insomnia. Propensity score methods were used to conduct the matching processes, as described below. The propensity score analyses were then supplemented by multiple regression analyses, to control for differences that remained after the matching was completed.

Overview of Analytic Strategy

Our goal was to estimate the average dollar impact of untreated insomnia on total medical expenditures, absenteeism from work, and the use of short-term disability program services. With regard to medical expenditures, the following general equation summarizes the way we estimated cost burden:

(1) Average dollar impact of untreated insomnia on medical expenditures = (Average health care expenditures for sample members who were diagnosed with, or treated for, insomnia) – (Average health care expenditures for matched sample members who were not diagnosed with, or treated for, insomnia).

For those who were diagnosed with or treated for insomnia, average medical expenditure was calculated for 6 months before the diagnosis of insomnia or beginning treatment for it. For those who did not develop insomnia, a matching calendar period was used, as noted below.

Similar equations were used to summarize the average dollar impact of untreated insomnia on absenteeism-related costs and the costs of short-term disability program use. Therefore:

(2) Average total dollar impact of untreated insomnia = Average impact on medical expenditures + Average impact on absenteeism costs + Average impact on short-term disability costs.

Prior to estimating the figures needed for equations (1) and (2), the following steps were completed to enhance the accuracy of the analyses.

First, those eventually diagnosed with or treated for insomnia were statistically matched to those who were not, using propensity score analyses. The propensity score analyses matched the eventual insomnia patients to the most similar subset of those who were never diagnosed with or treated for insomnia, based on their demographics and casemix.

Second, since no matching process can ever be perfect, we compared demographics and casemix measures after the matching was completed. Two-sided t-tests that were adjusted for differences in variances were used to learn whether averages for continuous measures of demographics or casemix were different. T-tests for differences in proportions were used to learn whether there were significant differences in categorical measures, such as the existence of particular diagnoses or the use of pharmaceuticals of interest. P-values <0.05 were considered statistically significant.

Third, multiple regression analyses were used to estimate the relationship between the eventual diagnosis of or treatment for insomnia and medical expenditures. These regressions controlled for any significant demographic or casemix factors that were found in the second step above.

Fourth, multiple regression analyses were used to estimate the relationship between eventual diagnosis of or treatment for insomnia and the dollar value of lost work time, for the subsets of sample members who were employed and for whom absenteeism or short-term disability program use could be observed. Separate analyses of absenteeism and short-term disability were conducted.

Fifth, the results of the regression analyses were input into equations (1) and (2) above, to estimate the cost burden of untreated insomnia. Thus, our cost burden estimates accounted for measurable differences in demographics and casemix, increasing the likelihood that any dollar differences between the 2 groups of patients would be due to untreated insomnia.

Details of our analytic strategy are described below, after noting data contributors and sources and study inclusion criteria.

Data Contributors and Data Sources

Three data sources were used for this study. These include The Medstat Group MarketScan Commercial Claims and Encounters Database, the MarketScan Medicare Supplemental and Coordination of Benefits Database, and the MarketScan Health and Productivity Management Database. Each is described briefly below.

For younger adults (those age 18 – 64), direct costs were estimated with data from The Medstat Group's MarketScan Commercial Claims and Encounters (CCAE) Database for 1999 - 2003. Over this period, the CCAE database included data on over 3.2 million enrollees; this accounts for about 3% of all privately insured lives in the United States.

The enrollees whose data were included in the CCAE files were those whose employers self-insured for medical care services. There were 79 such large employers (those with more than 200 employees in the CCAE database for 1999 – 2003). These employers contracted with 150 insurance plans to arrange for health care services. These plans included commercial insurance companies, Blue Cross and Blue Shield plans, and third-party administrators that have fee-for-service, partially and fully capitated arrangements. (Data from capitated health plans were not used for this study, because those data lack service-level payment information.)

While the 79 employers did use the services of insurance companies, it is important to note that the employers were "self-insured"; they (and their employees) paid all of the medical costs. They did not pay premiums to the insurance companies.

The 79 employers who contributed to the Commercial Claims and Encounters Database are a convenience sample of employers who do business with The Medstat Group, Inc. of Ann Arbor, Michigan. The CCAE Database has been the source of information used in over 160 peer-reviewed studies published since 1997 (a complete list of publications is available upon request; inquiries can be made at www.medstat.com).

The CCAE database includes information on patient demographics, diagnosis codes, procedure codes, type and place of service, service dates, payment information, and other metrics. Financial, clinical, and demographic variables are standardized to common definitions.

Direct costs for elderly insomnia patients (≥65 years) were obtained from The Medstat MarketScan Medicare Supplemental and Coordination of Benefits Database, for 1999 - 2003. This Medicare database includes the same types of financial, clinical, and demographic variables as in the CCAE database, for 545,645 elderly plan members whose medical care was covered in part by the federal government under the Medicare program, and in part by their former employers or their spouses' former employers. Contributors to the MarketScan Medicare Database include large employers who supplement Medicare by offering prescription drug and other services to retirees. In 2001, about 34% of Medicare beneficiaries had prescription drug coverage through their current or former employers.[21] By examining the experience of employees with these benefits, we can learn about the possible impact of insomnia on their health expenditures.

Indirect costs were obtained from Medstat's MarketScan Health and Productivity Management Database. This database contains employee absence and short-term disability data from 9 large employers in the United States. Since not all employers who contribute to the MarketScan Commercial Claims and Encounters Database submit productivity data to Medstat, the Health and Productivity Management Database is a nonrandom subset of the CCAE Database. The Health and Productivity Management Database contains short-term disability data for more than 300,000 employees. Absence data were available for more than 200,000 employees in 2001; 160,000 employees in 2000; 112,000 employees in 1999; and 15,000 employees in 1998 and 1997.

Study Sample and Inclusion Criteria

For the studies of direct costs, sample selection began by searching the CCAE and Medicare databases for all patients who had one or more claims with a diagnosis of insomnia (ICD-9-CM diagnosis code = 307.41, 307.42, 780.52), or one or more claims for an insomnia medication between July 1, 1999 and June 30, 2003. The first observed date when evidence of insomnia was found in the period is called the sample member's "index date."

Insomnia medications and associated doses are provided in Table 1. Because the doses noted in the table for mirtazepine are sometimes used to treat depression, patients who took that drug were excluded from the analysis if they also had a diagnosis of depression or used other drugs to treat depression. All other patients were retained for analysis if they had a diagnosis of insomnia or took one of the medications in the dose ranges noted in Table 1 between July 1, 1999–June 30, 2003. All such patients who could be tracked for at least 6 months before that index date and who had no evidence of insomnia treatment in the 6-month period before that date were retained for initial analysis (n = 184,879 for the younger adult sample and n = 84,015 for the elderly sample).

The initial samples also included 1,051,787 younger adults and 457,701 elderly patients who had no evidence of insomnia in 1999–2003. These people were used to find subsets of noninsomnia patients who could be matched to insomnia patients using the propensity score analyses described below.

The samples of patients used for the indirect cost (i.e., absenteeism and short-term disability) analyses were subsets of the younger adult samples obtained from the Commercial Claims and Encounters Database. These included active employees for whom absenteeism or short-term disability data were available. Absenteeism and short-term disability information was obtained from the MarketScan Health and Productivity Management Database.

Patients were excluded from the indirect cost analysis if they did not have at least 6 months of eligibility for absenteeism or short-term disability benefits prior to or after the insomnia index date. After matching, there were 3,033 employees found to have insomnia and absenteeism data (i.e., about 1.6% of all insomnia patients), and 5,028 employees who had insomnia and short-term disability data (2.7% of all insomnia patients).

Variables Used in the Propensity Score Matching Process

Once the initial samples of insomnia and noninsomnia patients were selected, the variables needed for the propensity score matching process were created. The dependent variable for this process was a binary indicator for having a diagnosis of insomnia or being treated for insomnia with prescription pharmaceuticals in the study period (coded as 1 if yes, and 0 if no).

The objective of the propensity score matching process was to generate samples of patients with and without insomnia who were comparable to each other, before estimating the cost burden of untreated insomnia. Comparability of the patient samples was assessed by considering factors related to the likelihood of having insomnia (e.g., demographics, comorbidities, and prescription medication use patterns) and other factors that may influence direct or indirect costs for insomnia in similar patients (e.g., index year and health plan type). These factors are noted below.

The demographic factors included in the analyses were patient age and sex. As noted earlier, insomnia is more prevalent among females, and its prevalence tends to increase with age.

Comorbidities were measured for the first 6 months that patients were observed during the 1999–2003 study period. For insomnia patients, this was prior to their insomnia index date. Comorbidities were measured in terms of severity, number, and type. To control for differences in severity of the comorbidities, we used the Charlson Comorbidity Index, which estimated the likelihood of death or serious disability in the coming year, on the basis of diagnosis codes for up to 18 different diseases that were observed in the data. Values of the index may range from zero to 28, with the number of points for each disease depending on its prognosis for death or major disability. Higher values are associated with higher probabilities of these outcomes. Charlson Comorbidity Index values below 2.0 suggest low odds of death or major disability for most patients; values between 2 and 6 suggest moderate risk, and values above 6.0 indicate high risk.[22] (A recent study of the predictive ability of the index with regard to health care expenditures is described in a paper by Farley et al.[23])

To control for the number of comorbidities, we included the number of unique ICD-9-CM diagnosis codes that each person had (at the 3-digit level), and the number of psychiatric diagnostic groups that any mental health problems fell into. Psychiatric diagnostic groupings were developed by Ashcraft et al. as an efficient way of accounting for the types of mental health problems that people may have.[24]

To control for specific types of comorbidities, we used the MarketScan data to find the most prevalent comorbidities among insomnia patients. Since there were hundreds of possible comorbidities, we arbitrarily focused on the ones that were most costly or prevalent. The comorbidities were characterized in terms of whether they were primary diagnoses (coded first on a claim), or secondary. The most expensive primary diagnoses (those 11 or 12 (depending on age group) that accounted for more than half of the total expenditures of the sample) were included in the analyses, and the most prevalent secondary diagnoses (those that were most often listed in claims for sample members) were also included. The detailed list of comorbidities used in the matching processes is available upon request. Examples include angina, diabetes, low back problems, severe osteoarthritis, hypertension, various forms of cancer, and other back or joint problems.

The analyses also controlled for the types of medications that sample members used. These measures included binary indicators to account for most of the pharmacy expenditures incurred by insomnia patients. These were drugs for all diseases except insomnia, and were measured for the first 6 months when patients were observed in the study period. This was done to control for the cost-impact of medications used to treat comorbidies. Controlling for drug use also helped find patients with conditions that may not be recorded with diagnosis codes on medical claims because of stigma or other reasons, and to find patients with chronic conditions that may have been diagnosed >6 months prior to the index date. For example, depression (a common comorbidity with insomnia)[25] was not among the most costly or common comorbidities when diagnosis codes were reviewed, but antidepressant drugs were the most costly drugs taken by these patients, so many patients with depression were found in the search for medications. The detailed list of pharmaceuticals that accounted for most of the drug expenditures among sample members is available upon request; examples are antidepressants, gastrointestinal drugs, antihyperlipidemic drugs, analgesics/antipyretics, and nonsteroidal anti-inflammatories, opiate agonists, and medications for heart disease

When controlling for location, the objective was to balance the samples in terms of where patients lived, using indicators for US geographic census region of residence and urban versus rural location. The 4 US census regions included the Northeastern, North Central, Southern, and Western regions of the country. Urban (vs rural) location was measured on the basis of residence in a Metropolitan Statistical Area, as designated by the US Census. In general, health care expenditures tend to be higher in urban areas[26] and in northern and eastern census regions.[27]

Next, it is unknown whether insomnia prevalence differs by plan type, but one may surmise that the availability of sleep specialists and pharmacotherapy choices are associated with plan type, and plan type is well known to influence health care utilization.[28] We controlled for plan type by using indicators for membership in indemnity plans, preferred provider organizations, or point of service plans.

The index year is the first year the patient was observed to have insomnia (for insomnia patients) or the first year he or she was observed in the data base (for noninsomnia patients) during the study period. Index years ranged from 1999–2003. Medical expenditures generally increase over time for all patients. Thus, the objective here was to account for differences in the distributions of insomnia and noninsomnia patients according to index year.

All of the above variables were observable for all patients; missing data were not problematic.

Conducting the Propensity Score Matching Process

The conventional application of propensity score analysis is to use important variables to balance 2 samples of interest[29] (in our case, patients with and without eventual diagnosis for or treatment of insomnia). This is typically done via logistic regression analyses designed to predict the probability that each observation belongs to one of the two types of samples. For example, we know that only 184,879 of our younger adult sample members were diagnosed with insomnia or treated for it, but all sample members (even the 1,051,787 patients without evidence of insomnia) had an underlying probability of having insomnia. If we have reason to believe these underlying probabilities depend on the demographic, case mix, location, and other factors noted above, then we can estimate the underlying probability of having insomnia for each sample member, using information about these variables. Matching insomnia and noninsomnia patients on these probabilities helps minimize their differences on these variables.

All of the variables listed above were used as predictors of insomnia in logistic regression analyses. (All of the variables were entered into the regression at the same time; no stepwise procedures were used.) These analyses yielded a predicted probability that each patient would eventually be diagnosed with or treated for insomnia. By matching on these predicted probabilities (and thereby excluding any insomnia or noninsomnia patients who could not be matched), many of the differences between insomnia and noninsomnia patients were minimized. This yielded sets of insomnia and noninsomnia sample members who were comparable.

Once the matches between patients with and without insomnia were made, each patient with insomnia was assigned an index date. The index date was defined as the calendar date of the first inpatient or outpatient medical claim showing a diagnosis of insomnia, or the date of the first prescription for an insomnia medication, during the study period. Each patient without insomnia was assigned the same index date as the one associated with the insomnia patient to whom he or she was matched. To estimate the costs of untreated insomnia, each patient was then tracked for 6 months before his or her index date. This assured that insomnia and noninsomnia patients were followed for exactly the same calendar periods when direct and indirect costs of untreated insomnia were estimated.

Outcome Variables and Statistical Analyses

If the propensity score matching process had been perfect, one could simply compare the costs of patients with and without eventual diagnosis of or treatment for insomnia, using t-tests. However, no matching process is ever perfect.[30] Our propensity score matching process worked reasonably well, but many variables were still significantly different between samples after matching was conducted (details are available upon request. Even though the statistical power associated with large sample sizes may have been the cause of many of these significant differences, we used multiple regression analyses to adjust for the cost-impact of variables that remained significantly different for insomnia versus noninsomnia patients after the matching process was completed.

For the analyses of direct medical expenditures, exponential conditional regression models were used to control for these remaining differences. (More information about exponential conditional regression models can be found in Mullahy.[31]) The results obtained from the regressions produced more accurate estimates of the average direct medical costs of untreated insomnia.

For the analyses of indirect (i.e., absenteeism and short-term disability) costs, 2-part regression models were used to control for remaining differences. Separate 2-part modeling processes were used for absenteeism and short-term disability, because sample sizes differed for these metrics, due to the differences in data availability from the Health and Productivity Management data contributors.

A 2-part regression process was used to study absenteeism and short-term disability benefit costs because not all employees used these benefits. Two-part statistical models have been designed for situations like this, where there are large percentages of non-users of a benefit.[31] The first step of each 2-part model included a logistic regression designed to estimate the impact of untreated insomnia on the probability of using any absenteeism (or disability) benefits. The second step of each 2-part model included an exponential regression designed to estimate the impact of untreated insomnia on the magnitude of absenteeism (or short-term disability) costs, if any such benefits were used. Each part of each regression model controlled for those factors that remained significantly different between eventual insomnia and noninsomnia patients, after the matching process was completed. Thus, the results of the 2-part modeling processes yielded more accurate estimates of the impact of untreated insomnia on indirect (absenteeism and short-term disability benefit) costs.

Sensitivity Analyses

To provide some context for interpreting the results of our main analyses described above, we also conducted some sensitivity analyses. Two types of sensitivity analyses were conducted. The first sensitivity analysis involved removing from the sample those observations whose medical care expenditures were abnormally low or high during the 6-month observation period. This was done to assure that the range of medical expenditures would be the same, for eventual insomnia and noninsomnia patients. Such leveling has been suggested by Heckman et al.[32] when propensity score analyses are used, to see whether a small number of outlier observations would have a large impact on the results.

Table 1—Percent of sample members prescribed medications believed to be used to treat insomnia, and percent of sample members diagnosed with insomnia but not prescribed a study medication to treat it

	Age 18–64 years		Age ≥65 years	
Drug Type and Dosage	**Number**	**Percent**	**Number**	**Percent**
Patient had insomnia diagnosis but no study drug	11,280	8.13%	3,077	4.07%
Zolpidem tartrate -- 5 mg - 20 mg	55,179	39.75%	29,273	38.74%
Zaleplon -- 5 mg - 20 mg	8,670	6.25%	3,697	4.89%
Temazepam/Temaz/Razepam -- 15 mg - 30 mg	8,940	6.44%	9,461	12.52%
Trazodone -- < 150 mg/day	16,011	11.53%	7,214	9.55%
Triazolam -- 0.125 mg - 0.5 mg	4,288	3.09%	1,511	2.00%
Flurazepam -- 15 mg - 30 mg	1,985	1.43%	1,221	1.62%
Estazolam -- 1 mg or 2 mg	503	0.36%	438	0.58%
Quazepam -- 7.5 mg - 15 mg	48	0.03%	59	0.08%
Amitriptyline -- 10 - 100 mg	29,542	21.28%	15,562	20.60%
Mirtazepine -- 15 - 30 mg	2,374	1.71%	4,045	5.35%
Total:	138,820	100.00%	75,558	100.00%

Mirtazepine patients could not have a depression diagnosis or antidepressant study period.
Sources: MarketScan® Commercial Claims and Encounter Database, and Medicare Supplemental Insurance and Coordination of Benefits Database, 1999–2003

The second type of sensitivity analysis was conducted with the entire sample (including outliers), to address the arbitrary choice of using a 6-month period for our main analyses. The obvious assumption here is that patients had insomnia for at least 6 months prior to its diagnosis or the onset of pharmaceutical therapy to treat it. This seems reasonable, since most insomnia patients report sleeping problems for more than one year.[6,10] Nevertheless, we conducted sensitivity analyses to see how cost burden would vary if other lengths of time were considered, ranging from 1 to 5 months prior to the diagnosis of or treatment for insomnia.

RESULTS

Insomnia Medication Use

Table 1 lists the percentages of patients who used each medication for insomnia in our analyses. For younger adults and elderly patients, zolpidem tartrate was used most often, by roughly 39% of patients. Amitriptyline was used by about 21% of both samples, and temazepam was used by about 6% of the younger adults and 13% of the elderly. Trazodone was used by about 10% of the elderly and 12% of the younger patients. Other drugs were used less frequently. These percentages pertain to the first insomnia medication observed. About 8% of the younger insomnia patients and 4% of the elderly patients were diagnosed with insomnia but used no prescription therapy involving any of the study drugs.

Matching Process

To save space, we do not report the detailed results from the logistic regression analysis that was used to match younger adults eventually diagnosed with or treated for insomnia with those who were not. Similarly, we do not report the detailed results for the

Table 2—Demographic and clinical characteristics, after matching, for those eventually diagnosed with or treated for insomnia, and those who were not, by age

Parameter	Age 18–64 years: Eventual Insomnia Patients (n = 138,820)	Age 18–64 years: Control (n = 138,820)	Age 18–64 years: P-value	Age ≥65 years: Eventual Insomnia Patients (n = 75,558)	Age ≥65 years: Control (n = 75,558)	Age ≥65 years: P-value*
	N/Mean (%/S.D.)	N/Mean (%/S.D.)		N/Mean (%/S.D.)	N/Mean (%/S.D.)	
Mean age	47.07 (11.13)	47.58 (12.27)	0.00	75.19 (7.01)	75.31 (6.86)	0.00
Female	85350 (61.48%)	85067 (61.28%)	0.27	46163 (61.10%)	46447 (61.47%)	0.13
Region						
Northeast	11432 (8.24%)	12853 (9.26%)	0.00	10426 (13.80%)	10470 (13.86%)	0.74
North Central	44623 (32.14%)	46073 (33.19%)	0.00	29476 (39.01%)	29254 (38.72%)	0.24
South	66247 (47.72%)	63436 (45.70%)	0.00	27251 (36.07%)	27302 (36.13%)	0.78
West	16518 (11.90%)	16458 (11.86%)	0.72	8405 (11.12%)	8532 (11.29%)	0.30
Resided in urban area	99861 (71.94%)	99652 (71.79%)	0.38	58279 (77.13%)	58022 (76.79%)	0.12
Insurance Plan Types						
Indemnity	42688 (30.75%)	42117 (30.34%)	0.02	53231 (70.45%)	52911 (70.03%)	0.07
Point of service	32271 (23.25%)	34381 (24.77%)	0.00	1499 (1.98%)	1503 (1.99%)	0.94
Preferred Provider Organization	63861 (46.00%)	62322 (44.89%)	0.00	20828 (27.57%)	21144 (27.98%)	0.07
Index Year						
1999	10673 (7.69%)	11146 (8.03%)	0.00	7819 (10.35%)	7841 (10.38%)	0.85
2000	22024 (15.87%)	21974 (15.83%)	0.79	13816 (18.29%)	13766 (18.22%)	0.74
2001	33913 (24.43%)	33800 (24.35%)	0.62	22456 (29.72%)	22071 (29.21%)	0.03
2002	43502 (31.34%)	43089 (31.04%)	0.09	22281 (29.49%)	22394 (29.64%)	0.52
2003	28708 (20.68%)	28811 (20.75%)	0.63	9186 (12.16%)	9486 (12.55%)	0.02
Baseline Clinical Characterisitcs						
Charlson Comorbidity Index	0.34 (0.89)	0.35 (0.88)	0.00	1.09 (1.61)	1.07 (1.56)	0.06
Number of psychiatric diagnosis groups	0.12 (0.38)	0.10 (0.34)	0.00	0.08 (0.31)	0.06 (0.28)	0.00
Number of unique 3-digit ICD-9 codes	3.84 (3.17)	3.95 (3.08)	0.00	6.24 (4.56)	6.18 (4.46)	0.01

*Two-sided t-tests of differences between insomnia cohort and matched control were used.
Sources: 1999-2003 MarketScan® Commercial Claims and Encounter and Medicare Supplemental Insurance and Coordination of Benefits Databases

matching processes used for the elderly sample. All of these results are available upon request. In both cases, nearly every demographic, location, plan type, index year, comorbidity, and drug use measure had a statistically significant impact on the odds of having insomnia. Among the younger sample members, the odds of having insomnia were significantly higher for females, and increased by about 0.08% per year of age. The odds of having insomnia were also higher for those in Northeast, North Central, and Western US census regions (compared to those living in the South). The odds of having insomnia were lower for those in urban areas, and for those in point of service and preferred provider organization health plans. The odds of having insomnia also varied by the year of entry into the study, but this is an anomaly related to the fact that data contributors varied by year.

In general, higher Charlson Comorbidity Index values and higher numbers of physical or mental health problems were associated with a higher likelihood of having insomnia. Finally, most but not all of the comorbidity and pharmacy-use measures were associated with higher odds of having insomnia.

Among Medicare beneficiaries, increasing age was associated with a lower probability of insomnia, but the probability of insomnia declined only about 1% per year after age 65. The impact of census region and urban location was about the same in this sample as in younger sample members, but members of preferred provider organizations were more likely than traditional fee-for-service members to have insomnia. In contrast to the younger adult sample, Medicare beneficiaries were more likely to have insomnia if they entered the study in earlier years.

As with the younger sample, most of the comorbidity and drug use variables influenced the likelihood of having insomnia among Medicare beneficiaries. The lists of most costly or most prevalent comorbidity measures differed somewhat though, as one would expect.

Sample Characteristics After Matching

Table 2 shows the demographic, location, plan type, index year, and some of the clinical metrics which describe the younger adult and elderly samples after matching. Many of these means and percentages were significantly different between those eventually diagnosed with or treated for insomnia and those who were not. However, statistical significance is due primarily to the large sample sizes used in the analyses. A close inspection indicates very little difference in the magnitude of the characteristics measured in insomnia and noninsomnia patients. Thus, the matching seems to have worked well.

Regression Results

Tables 3 - 6 present the results of the regression analyses. Tables 3 and 4 focus on analyses of direct medical costs (inpatient, outpatient, emergency room, and pharmacy expenditures) during the 6 months prior to the index date. For younger adults and elderly patients alike, these 2 tables show that eventual insomnia patients had significantly higher expenditures ($P < 0.001$ for both), after matching was completed and regression analyses were used to control for differences in age, location, plan type, index year,

Table 3—Regression Analyses of Direct Costs, Age 18–64

138,820 patients eventually diagnosed with or treated for insomnia; 138,820 matched controls.

Independent Variable	Parameter Estimate	Standard Error	Wald P-value
Intercept	6.35	0.01	0.00
Eventual Insomnia Patient	0.22	0.00	0.00
Age	0.01	0.00	0.00
Northeast	0.06	0.01	0.00
North Central	0.03	0.01	0.00
South	0.08	0.01	0.00
Point of Service Plan Type	-0.09	0.01	0.00
Preferred Provider Organization Plan Type	-0.02	0.01	0.00
Index Year = 1999	-0.12	0.01	0.00
Baseline Clinical Characteristics			
Charlson Comorbidity Index	0.46	0.00	0.00
Number of psychiatric diagnosis groups	0.30	0.01	0.00
Comorbidities and Drug Use Measures			
Angina pectoris, chronic maintenance	0.80	0.02	0.00
Diabetes Mellitus, chronic maintenance	-0.44	0.01	0.00
Mechanical low back disorder	0.31	0.01	0.00
Renal failure	1.05	0.05	0.00
Preventive health encounters	0.21	0.01	0.00
Essential hypertension, chronic maintenance	0.15	0.01	0.00
Disease of ears, nose or throat or mastoid process, not elsewhere classified	0.11	0.01	0.00
Symptoms involving respiratory system and other chest symptoms	1.22	0.02	0.00
General symptoms	0.90	0.02	0.00
Disorders of lipoid metabolism	0.17	0.02	0.00
Other and unspecified disorders of back	0.70	0.02	0.00
Special investigations and examinations	0.64	0.02	0.00
Special screening for malignant neoplasms	0.02	0.02	0.34
Psychother, antidepressants	0.12	0.01	0.00
Antihyperlipidemic drugs, not elsewhere classified	0.24	0.01	0.00
Analgesics/antipyritics, nonsteroidals/ anti-inflammatories	0.18	0.01	0.00
Unclassified agents, not elsewhere classified	0.28	0.01	0.00
Analgesics/antipyritics, opiate agonists	0.94	0.01	0.00
Antihistamines & combinations, not elsewhere classified	0.15	0.01	0.00
Predicted 6-Month Expenditures			
Patients eventually diagnosed with or treated for insomnia	$4,755		
Matched comparison group	$3,831		
Difference	$924	(P < 0.01)*	

*P-value comes from Wald chi-squared test of regression coefficient for Eventual Insomnia Patient variable
Source: MarketScan© Research Databases: 1999-2003.

Table 4—Regression analyses of direct costs, Age ≥65 years

75,558 patients eventually diagnosed with or treated for insomnia; 75,558 matched controls.

Independent Variable	Parameter Estimate	Standard Error	Wald P-value
Intercept	7.70	0.03	0.00
Eventual insomnia patient	0.22	0.01	0.00
Age	0.00	0.00	0.16
Index Year = 2001	-0.09	0.01	0.00
Index Year = 2003	0.14	0.01	0.00
Number of psychiatric diagnosis groups	0.28	0.01	0.00
Comorbidities and Drug Use Measures			
Diabetes mellitus, chronic maintenance	0.30	0.01	0.00
Renal failure	1.14	0.02	0.00
Essential hypertension, chronic maintenance	0.09	0.01	0.00
Cancer of lungs, bronchi, or mediastinum	1.06	0.03	0.00
Cataract	0.21	0.01	0.00
Diseases and disorders of skin & subcutaneous tissues, not elsewhere classified	0.01	0.01	0.09
Symptoms involving respiratory system and other chest symptoms	0.82	0.01	0.00
Essential hypertension	0.65	0.01	0.00
Other forms of chronic ischemic heart disease	0.88	0.01	0.00
Cardiac dysrhythmias	0.81	0.02	0.00
General symptoms	0.66	0.02	0.00
Gastrointestinal drug miscellaneous, not elsewhere classified	0.29	0.01	0.00
Antihyperlipidemic drugs, not elsewhere classified	0.09	0.01	0.00
Analgesics/antipyretics, nonsteroidals/ anti-inflamitories	0.11	0.01	0.00
Unclassified agents, not elsewhere classified	0.18	0.01	0.00
Cardiac, calcium channel	0.05	0.01	0.00
Predicted 6-Month Expenditures			
Patients eventually diagnosed with or treated for insomnia	$5,790		
Matched comparison group	$4,648		
Difference	$1,143	(P < 0.01)*	

*P-value comes from Wald chi-squared test of regression coefficient for Eventual Insomnia Patient variable
Source: MarketScan© Research Databases: 1999-2003.

and comorbidity patterns.

Table 3 also presents estimates of average medical expenditures that were obtained from the regression, first for 138,820 younger adult patients eventually diagnosed with or treated for insomnia and the 138,820 noninsomnia patients to whom they were matched. (The process of estimating average expenditures from exponential regression results has been described in detail by Mullahy[31]). After the matching process was completed, and after further controls for the variables just mentioned were applied via the exponential regression, younger adult patients eventually diagnosed with or treated for insomnia were found to incur an average of $4,755 in medical expenditures, while those never diagnosed with or treated for insomnia had average medical expenses of $3,831 (2003 dollars). The $924 difference in average direct medical expenditures is our estimate of the direct medical costs of untreated insomnia, for patients who were under age 65 (P < 0.001).

A similar pattern was found for elderly patients, but the direct costs were much higher for both elderly groups, as one would expect. Also, the difference in direct costs between eventual insomnia and noninsomnia patients was larger. Table 4 shows that

Table 5—Two-part regression model of absence payments

3,033 patients eventually diagnosed with or treated for insomnia; 4,058 matched controls.

Two-Part Model	**Part I: Logistic Regression**		**Part 2: Exponential Cost Model**		
Dependent Variable	**Any absence from work in 6 Months prior to index date**		**Dollar value of absence, when it occurred within 6 months prior to index date**		
Independent Variable	**Odds Ratio**	**Chi-square P-value**	**Parameter Estimate**	**Standard Error**	**Wald P-value**
Intercept		<0.01	8.17	0.04	0.00
Eventual Insomnia Patient	0.88	0.06	0.14	0.02	0.00
Female	1.11	0.12	-0.02	0.02	0.38
Northeast Census Region	0.76	0.02	-0.10	0.04	0.01
North Central Census Region	0.67	<0.01	-0.23	0.02	0.00
West Census Region	0.77	0.01	-0.22	0.03	0.00
Resided in Urban Area	0.47	<0.01	-0.29	0.03	0.00
Point of Service Plan Type	0.65	0.00	0.02	0.03	0.46
Preferred Provider Organization Plan Type	0.38	<0.01	0.58	0.04	0.00
Index Year = 1999	0.78	0.04	0.01	0.04	0.90
Index Year = 2000	15.12	<0.01	0.04	0.03	0.14
Index Year = 2001	0.92	0.28	0.01	0.03	0.77
Comorbidities and Drug Use Measures					
Preventive health encounters	1.24	0.03	0.03	0.03	0.23
Disorders of lipoid metabolism	0.67	0.01	0.04	0.05	0.45
Gastrointestinal drug miscellaneous, not elsewhere classified	1.05	0.68	0.14	0.03	0.00
Analgesics/antipyritics, nonsteroidals/anti-inflammatories	1.11	0.24	0.10	0.02	0.00
Unclassified agents, not elsewhere classified	0.98	0.88	0.15	0.04	0.00
Analgesics/antipyretics, opiate agonists	1.60	<0.01	0.17	0.02	0.00
		Predicted 6-Month Expenditures			
Patients eventually diagnosed with or treated for insomnia			$3,042		
Matched comparison group			$2,637		
Difference			$405	(P < 0.0001)	

*P-value comes from Wald chi-squared test of regression coefficient for Eventual Insomnia Patient variable
Source: MarketScan© Research Databases: 1999-2002.

elderly patients who were diagnosed with or treated for insomnia had adjusted expenditures of about $5,790, while those never diagnosed with or treated for insomnia had expenditures averaging $4,647. The difference of $1,143 is the estimated direct cost of untreated insomnia for elderly patients.

Table 5 presents the results obtained from the 2-part regression models used to analyze absenteeism costs among working adults. Prior to conducting any regression analyses, absenteeism costs were measured for each patient by counting all days absent in the 6-month period prior to the index date, and multiplying the number of days by $240 – the estimated value of a day's wages and benefits. The same $240 per day multiplier was used for all employees, regardless of whether insomnia was diagnosed or treated. The $240 value of a lost workday is a compromise based on the $193.20 value suggested by the Bureau of Labor Statistics for all US companies in 2002 and the $344 per day value that pertains to very large companies like the ones who contributed to the Health and Productivity Management database, as found in a benchmarking study conducted by Goetzel et al.[33]

Table 5 shows that absenteeism costs were significantly influenced by census region, plan type, urban/rural location, index year, and some of the comorbidity and prescription drug use patterns. Absenteeism costs were also significantly higher for patients eventually diagnosed with or treated for insomnia, after controlling for these factors. Average absenteeism costs were $3,042 for patients eventually diagnosed with or treated for insomnia and $2,637 for other patients, a difference of $405.

Table 6 presents the result obtained from the 2-part regression model used to analyze short-term disability program costs. The likelihood of using any short-term disability program services in the 6 months prior to the index date was significantly higher for patients eventually diagnosed with or treated for insomnia. However, utilization of short-term disability services was lower during that 6-month period for these eventual insomnia patients. Overall, total short-term disability expenditures were $86 lower for patients who were diagnosed with or treated for insomnia, on average ($310 for eventual insomnia patients, and $396 for patients never diagnosed with or treated for insomnia, P <0.0001).

Sensitivity Analyses

These cost burden estimates were not heavily influenced by a small number of outlier cases who had very large costs. In analyses of those under age 65 (not shown here), we dropped outliers, in an effort to equalize the ranges of medical expenditures, absenteeism costs, and short-term disability benefit costs for eventual insomnia and noninsomnia patients in the 6 months prior to the index date. This further leveled the playing field before the cost burden was estimated. Since the ranges of expenditures were already close after the matching process was conducted, only 19 sample members were dropped. The only cost burden estimate that was affected was for medical expenditures, which were $771 higher for those eventually diagnosed with or treated for insomnia, compared to the the $924 estimate found prior to dropping outliers (details are available upon request). Dropping outliers (only 49 sample members) from the Medicare direct cost analyses changed

Table 6—Two Part Regression Model of Short-Term Disability Payments

5,028 patients eventually diagnosed with or treated for insomnia; 6,635 matched controls.

Two-Part Model	Part I: Logistic Regression		Part 2: Exponential Cost Model		
Dependent Variable	Short-term disability program use in months prior to index date		Dollar value of short-term disability 6 program within 6 months prior to index date		
Independent Variable	Odds Ratio	Chi-square P-value	Parameter Estimate	Standard Error	Wald P-value
Intercept		<0.01	8.42	0.19	0.00
Eventual Insomnia Patient	1.71	<0.01	-0.25	0.07	0.00
Age	1.01	0.13	0.00	0.00	0.62
Female	1.18	0.02	0.13	0.07	0.04
Northeast	1.25	0.05	0.23	0.10	0.03
North Central	1.32	0.00	-0.01	0.07	0.88
West	0.71	0.00	0.11	0.10	0.28
Point of Service Plan Type	0.78	0.01	0.13	0.09	0.16
Preferred Provider Organization Plan Type	0.84	0.16	-0.10	0.12	0.37
Index Year = 1999	0.94	0.65	0.05	0.12	0.70
Index Year = 2000	0.93	0.32	0.06	0.07	0.36
Index Year = 2003	0.82	0.52	-0.17	0.29	0.54
Number of Psychiatric Diagnosis Groups	1.46	<0.01	0.08	0.06	0.17
Comorbidities and Drug Use Measures					
Preventive health encounters	1.33	0.00	-0.11	0.08	0.16
General symptoms	1.28	0.15	0.20	0.15	0.17
Other symptoms involving abdomen and pelvis	2.75	<0.01	-0.04	0.14	0.77
Psychother, antidepressants	0.67	0.00	-0.05	0.11	0.64
Analgesics/antipyretics, nonsteroidals/anti-inflammatories	1.98	<0.01	0.10	0.07	0.18
Antihistamines & combinations, not elsewhere classified	0.91	0.33	-0.09	0.09	0.29
			Predicted 6-Month Expenditures		
Patients eventually diagnosed with or treated for insomnia			$310.4		
Matched comparison group			$396.8		
Difference			-$86.4	(P < 0.01)*	

*P-value comes from Wald chi-squared test of regression coefficient for Eventual Insomnia Patient variable
Source: MarketScan© Research Databases: 1999-2002.

the estimated direct cost of untreated insomnia among the elderly to $1,128 on average, compared with $1,143 found when the entire sample was used (details are available upon request).

The results reported above are based upon the assumption that insomnia existed for 6 months prior to diagnosis or treatment. Without survey data, this cannot be verified. To address this issue, we estimated the direct cost burden by month, for periods ranging from 1 month to 5 months before the index date. The details are available upon request, but all analyses showed statistically significant and higher direct costs for patients eventually diagnosed with or treated for insomnia. These costs estimates for untreated insomnia ranged from $677 (for a 1-month analysis) to $800 (for the 3-month analysis) on average, for younger adults. For Medicare beneficiaries, the average direct costs of untreated insomnia ranged from $994 (for a 1-month analysis) to $1,369 (for a 3-month analysis)

DISCUSSION

The objective of this study was to estimate the 6-month cost burden of untreated insomnia, by focusing on differences in direct and indirect costs between patients eventually diagnosed with or treated for insomnia and similar patients who were not.

Why focus on untreated insomnia? Why not estimate cost burden for insomnia the way that cost burden is often estimated for other diseases (i.e., by focusing on the cost of treatment?) We thought it would be more informative to focus on the period prior to diagnosis or treatment because insomnia often goes untreated.[6,10] Moreover, the costs of treating insomnia are generally quite low and therefore of limited financial consequence. In the MarketScan Commercial Claims and Encounter data we used, treatment costs rarely exceeded $200 in the year after the index date. Thus, the medical claims data suggest that, unlike many other conditions, insomnia is not an expensive condition to treat when it occurs (details are available upon request). We therefore assumed that a more complete understanding of its burden of illness can be gained by estimating cost differences between similar insomnia and noninsomnia patients, shortly before diagnosis or treatment begins. Others may wish to focus on the posttreatment period, comparing the costs of treatment, however small, with alternative medications.

Next, given our focus on the prediagnosis or pretreatment period, how can we infer that the added costs we observed were related to insomnia? The answer to this question lies in the methods we used to control for differences between those eventually diagnosed with or treated for insomnia, and those who were not. The propensity score analyses, and the subsequent regression analyses, ruled out the impact of demographics, plan type, location, year of entry into the study, comorbidities, and the use of various pharmaceuticals, as reasons for observing the cost differences we found. By leveling the field in terms of these factors, it is more likely that the added costs for those who eventually were diagnosed with or treated for insomnia were due to that disorder, not to other factors.

After matching and regression-based adjustments were made, we found that direct medical expenditures were $924 higher for younger patients eventually diagnosed with or treated for insomnia, compared with those who were not. Direct medical expenditures were also $1,143 higher for elderly patients eventually diagnosed with or treated for insomnia, compared with elderly patients who were not.

These estimates are comparable to earlier estimates of health care costs of insomnia from a much smaller health maintenance organization patient sample[17] and also similar to the health care costs of depressive and anxiety disorders.[34] We also found differences in indirect costs. Specifically, absenteeism costs were $405 higher for those eventually diagnosed with or treated for insomnia, but short-term disability costs were $86 lower for those patients, on average.

Other studies have also addressed the impact of insomnia on absenteeism. Two recent studies were conducted by Leger et al.[35] and Godet-Cayre[36] in France. Both studies used the same sample, but analyzed the data differently. Leger et al. focused on the relationship between insomnia and days of work lost, by job type. Godet-Cayre focused on the added costs of treated insomnia for employers and the added costs to the national health care system. Both found that absenteeism costs or absent days were about twice as high for insomnia patients as for good sleepers. We also found higher costs for those eventually diagnosed with or treated for insomnia. Our $405 average cost increase for absenteeism, coupled with our $86 decrease in short-term disability benefits, amounts to about 1.3 more days' lost work that may be due to untreated insomnia. Godet-Cayre found that insomnia was associated with an additional 3.4 days' lost work in their sample.

What do our results mean for the typical patient and employer? In our database, the average insomnia patient paid about 20% of total medical expenditures out of his or her pocket (the employer paid the rest). As noted in Table 3, the average medical cost burden of untreated insomnia for those under age 65 was $924. With a 20% patient share, $184 would have been paid by the patient, and the other $740 would have been paid by the employer.

The $740 employer share is equivalent to about 3 days' wages and benefits (i.e., $740 / $240 value of a day's wages and benefits = 3.1 days). Adding the cost of absenteeism and short-term disability program use (which are also self-insured by the employer), another $319 would be paid by the employer. The $319 estimate is the difference between the $405 untreated insomnia cost burden for absenteeism noted in Table 5, and the $86 cost savings from lower short-term disability program use by untreated insomnia patients, also shown in Table 6. This $319 net cost increase is equivalent to roughly 1.3 days' wages and benefits, bringing the total employer's cost to 4.4 days' wages and benefits per untreated insomnia patient. We do not yet know how much of this cost could be avoided by successful treatment, but would guess that most employers would consider this cost burden to be important.

The analyses conducted for this project were limited by the following factors.

First, the burden of insomnia we estimated was financial. We were unable to estimate the impact of insomnia on psychosocial functioning, accident rates, or productivity while at the workstation (presenteeism). Thus, our burden estimates may be conservative.

Second, absenteeism and disability data were not available for all sample members, and the number of sample members with absenteeism data was sparse in the earlier years of the study, prior to 2001. This is because the initial request for absenteeism data was made in 2001, and many employers did not retain data for previous years. This means that analyses of absenteeism data may not be generalizable beyond our sample, and cost burden estimates may vary in other settings.

Third, it has been noted in the literature that many insomnia patients do not seek medical care to treat that disorder.[37] Thus, some members of the comparison group may have had undiagnosed or untreated insomnia. This may also lead to a conservative estimate of cost burden.

Fourth, without medical records, it is impossible to verify that all of the insomnia drugs we considered were indeed taken for that purpose. For example, low-dose amitriptyline may be used for pain. We expect the majority of uses to be for insomnia, but if we are incorrect then some bias may have resulted in our findings.

Finally, other drugs may be used for insomnia that we did not consider. For example, other benzodiazepines (e.g., clonazepam, alprazolam, lorazepam) or antipsychotics were not considered, even though they may be used for insomnia in some cases.[38] Anxiolytic drugs may be used for insomnia, as may quetiapine, hydroxyzine, and diphenhydramine,[39] but we did not include patients who took these drugs in our analyses because dose cannot be used to distinguish between use for insomnia or other conditions. Results may have differed if patients with these drugs were included.

Acknowledging these limitations, we also note some advantages to the analyses we conducted. Specifically, the matching and regression processes accounted for 44 demographic and casemix variables that might differ between insomnia and noninsomnia patients. We also used more recent econometric techniques (i.e., 2-part exponential cost regression models) to account for the natural skew in cost data, without the need for logarithmic transformations in the estimation process. As a result, we were able to account for a large number of comorbidities while producing a set of reliable estimates for the cost burden of insomnia. These estimates will complement the estimates produced in prior research.

Finally, for readers who are outside the United States and less familiar with the US health system, some context may be added by noting that our data come from large employers who, along with their employees, paid for the health care services received by sample members. Payments to health care providers came directly out of company or personal funds; they were not paid by insurance premiums. Outside insurance companies were used only as vendors to provide administrative services; the employers did not pay the insurance companies premiums for health care coverage. In the late 1990s (most recent data available), about two-thirds of those under age 65 in the US were covered by employer-sponsored, self-insured plans.[40]

Many of these employers also offered self-insured, paid sick leave, but usually for only a few days per year. Generally, full-time employees who were sick >5 consecutive days were also eligible for short-term disability program benefits, which paid the employee for 60% to 70% of lost wages while not at work. Employees who had sick leave and short-term disability benefits generally had higher incomes than average.[31]

To the extent that medical coverage and the availability and use of paid sick leave and disability program services are different in the US than abroad, the results noted here may not generalize well beyond US borders. Others may wish to investigate the cost burden of untreated insomnia outside the United States.

ACKNOWLEDGEMENTS

This work was funded by Sepracor, Inc., under contract to Thomson Medstat, Ann Arbor, Michigan. No recommendations about pharmacotherapy are made for either on-label or off-label use.

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