Health Benefit Costs and Absenteeism Due to Insomnia From the Employer's Perspective: A Retrospective, Case-Control, Database Study

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Objective: To objectively assess the economic impact of insomnia on direct medical and prescription costs and indirect absence-related salary replacement costs and on absences and to compare the prevalence and costs of comorbidities in employees with and without insomnia.

Method: A retrospective analysis was performed on employee data from the Human Capital Management Services Research Reference Database (January 2001–September 2007). Employees were identified as having insomnia (*ICD-9* criteria) based on history of receiving medications used to treat insomnia or physician's diagnosis of insomnia. Control employees had no history of medications used to treat insomnia and no insomnia diagnosis. Annual costs and number of absences were compared using 2-part regression models, controlling for demographics, job information, geographic region, comorbid disorders, and the Charlson Comorbidity Index score. Comorbidity prevalence, costs, and services were compared.

Results: Data were collected for 299,188 employees (17,230 employees with insomnia and 281,958 control employees). Annual mean incremental costs were $2,053 greater (in total) for employees with insomnia compared with controls (specific increments: medical $751, drug $735, sick leave $208, short-term disability $179, long-term disability $10, and workers' compensation $170). Employees with insomnia missed a mean of 3.10 more workdays annually than those without insomnia. Nearly all comorbid conditions were more prevalent, were more costly, and resulted in a greater utilization of services in employees with insomnia compared to those without. All of the above comparisons were significant ($P < .05$).

Conclusion: Insomnia was associated with increased costs, greater absenteeism, and an increased number of comorbid conditions in an employed population. Consistent with other analyses based on these data, the study estimated the annual cost of insomnia in the US civilian labor force to be approximately $15.0–17.7 billion (US dollars).

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Sleep disturbances in general and insomnia in particular are underestimated drivers of health care cost, health care utilization, and absenteeism. Prevalence estimates of insomnia suggest that approximately 10% of adults suffer from chronic insomnia.[1] Insomnia can affect men and women of all age groups but tends to be more prevalent in women and increases with age.[2] Consequences of insomnia include impaired concentration and memory, psychomotor dysfunction, decreased ability to accomplish daily tasks, and decreased enjoyment of interpersonal relationships.[3,4] People with insomnia also report a reduced overall quality of life.[5,6]

Falling asleep at the wheel is the most costly and devastating problem on American highways. A National Sleep Foundation survey found that 5% of chronic insomniacs reported having a car accident due to sleepiness compared to 2% of those with occasional or no insomnia.[3] Accidents in the workplace due to sleep deprivation are commonplace and can be quite damaging to industry. Work-related accidents have been estimated to occur 1.5 times more often in employees with insomnia compared with the overall employee population.[7]

Insomnia is also associated with a wide range of comorbid conditions that include psychiatric, cardiovascular, and gastrointestinal disorders.[8] Psychiatric disorders are most commonly associated with insomnia and include major depression, generalized anxiety disorder, substance abuse, attention-deficit/hyperactivity disorder in children, and dementia.[8,9] The National Institute of Mental Health Epidemiologic Catchment Area study, an epidemiologic study of sleep disturbances and psychiatric disorders in 7,954 adults, found that 10.2% reported insomnia during the baseline interview, with 40% of those experiencing a comorbid psychiatric disorder.[10] A multinational telephone survey of 14,915 adults across 4 European countries found that approximately 28% of adults with chronic insomnia lasting between 6 months and 5 years had a current diagnosis

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of a mental disorder and 25.6% had a history of psychiatric problems.[11]

The true economic burden of insomnia is difficult to determine. Only about 5% of patients with chronic insomnia seek medical help specifically for insomnia. An estimated 65%–70% of these patients try to manage their insomnia symptoms using over-the-counter remedies, essential oils, herbal options, and nondrug self-help approaches.[12] However, it has been estimated that in the United States, insomnia is associated with approximately $15 billion annually in direct costs, including physician visits, sleep recordings, and prescription medications.[13] The cost of absenteeism associated with insomnia alone was estimated to be approximately $57 billion per year.[13]

The goal of this analysis was to objectively assess the economic impact of insomnia on employee health benefits and lost time associated with work-force absenteeism and to compare the prevalence and costs of comorbidities in employees with and without insomnia.

METHOD

Data Collection

A retrospective analysis was conducted using the Human Capital Management Services (HCMS) Research Reference Database, a private database containing employee data from multiple United States employers (January 2001–September 2007). Employers come from a variety of industries, including retail, manufacturing, finance, transportation, telecommunications, and health care. Study employees were identified, and data were collected from health insurance claims (including prescription drugs), work absences, and payroll records. Confidentiality and anonymity of person-level data were maintained in accordance with the guidelines of the Health Insurance Portability and Accountability Act.

Subjects

Employees were included in the insomnia cohort based on a diagnosis of insomnia identified by the *International Classification of Diseases*, *Ninth Revision* (*ICD-9*) codes 307.41 (transient disorder of initiating or maintaining sleep), 307.42 (persistent disorder of initiating or maintaining sleep), 307.49 (subjective insomnia), and 780.52 (insomnia). Employees were also included if they had a record of any prescription for a newer "z" medication (zaleplon, zolpidem, or eszopiclone), a prescription for the melatonin receptor agonist ramelteon, or a prescription for a benzodiazepine (flurazepam, triazolam, estazolam, quazepam, or temazepam). The control cohort consisted of employees with no history of a primary, secondary, or tertiary *ICD-9* code for insomnia and no history of a prescription for a medication used to treat insomnia. The index dates for all employees in the insomnia cohort were based on the first identified date of service associated with insomnia (medical or prescription claim). The index date assigned to control employees was the mean index date based on the set of employees with insomnia. Employees with a prescription record for trazodone and those who were not continuously employed or eligible for health benefits for at least 1 year after their index date (during the study period) were excluded from the analysis.

To evaluate comorbidities, each employee from the insomnia cohort was demographically matched to an employee from the control cohort. Employees were matched by age, years with the current employer (tenure), gender, marital status, work status (exempt/nonexempt and full-time/part-time), geographic region, and salary using an algorithm for matching an employee from the insomnia cohort to an employee from the control cohort with the smallest weighted sum of absolute differences in demographic factors.

Outcome Variables

Measures of outcomes in this analysis included employee health benefit costs and days missed due to absences. Health benefit costs were calculated on the basis of direct medical and prescription drug costs and indirect costs (due to salary replacement payments for sick leave, short-term disability, long-term disability, and workers' compensation). All costs were inflated to 2007 US dollar values. Absences were defined as days missed due to sick leave, short-term disability, long-term disability, and workers' compensation.

The prevalence, cost, and utilization of services for various comorbid conditions were also compared between the insomnia and control cohorts. The prevalence of a comorbid condition was defined as the percent of employees who received services for the comorbidity according to the 17 Agency for Healthcare Research and Quality (AHRQ) major diagnostic categories that group *ICD-9* codes into major organ-, disease-, and therapeutic-specific categories.[14] The mean annual medical cost (paid by the employer) and number of services utilized (reasons for visit or procedures during a visit) per employee were calculated and compared for each of the major diagnostic categories.

Statistical Analysis

Demographics were compared between the insomnia and control cohorts using Student *t* tests for continuous variables and χ^2 tests for discrete variables. The existence of comorbidities used as controls in the regression models was also compared. Differences between cohorts were considered to be statistically significant when $P < .05$. Regression techniques were used to model the differences in health benefit costs and absences between the insomnia and control cohorts. Separate regression models were run for each of the dependent variables of health benefit costs (medical, prescription drug, sick leave, short-term disability, long-term disability, and workers' compensation) and absences (sick leave days, short-term disability days, long-term disability days, and workers' compensation days). Because of

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Table 1. Demographic Differences Between Employees With and Without Insomnia

Characteristic	Employees With Insomnia		Employees Without Insomnia		*P* Value[b,c]
	n	Value	n	Value	
Age at index date, mean (SE), y[a]	17,228	41.92 (0.07)	218,939	40.09 (0.02)	**<.0001**
Employment tenure at index date, mean (SE), y	17,230	8.56 (0.06)	281,955	9.23 (0.02)	**<.0001**
Women, %	17,230	55.2	281,958	40.8	**<.0001**
Married, %	16,516	56.9	258,045	55.5	**.0005**
Race, %	15,296		208,867		
White		73.8		58.8	**<.0001**
Black		7.0		17.9	**<.0001**
Hispanic		9.3		9.7	.1493
Exempt employees, %	17,230	51.0	281,958	27.9	**<.0001**
Full-time employment, %	17,230	95.2	281,958	88.4	**<.0001**
Annual salary, mean (SE), US $	17,230	64,598 (419)	278,594	49,760 (166)	**<.0001**
Charlson Comorbidity Index score, mean (SE)	17,230	0.38 (0.01)	281,958	0.18 (0.00)	**<.0001**
US geography, zip code first digit, %	17,230		281,958		
0		8.5		11.6	**<.0001**
1		9.4		13.3	**<.0001**
2		10.8		12.7	**<.0001**
3		16.9		19.6	**<.0001**
4		4.2		5.3	**<.0001**
5		1.3		1.3	.6014
6		3.4		3.4	.8655
7		29.4		15.6	**<.0001**
8		6.9		5.1	**<.0001**
9		9.1		12.2	**<.0001**

[a]Differences are considered significant if $P < .05$ (based on *t* tests for continuous variables and χ^2 tests for binary variables).
[b]For employees with insomnia, the index date is the date of the first insomnia diagnosis (*ICD-9* codes 307.41, 307.42, 307.49, or 780.52) or the first insomnia medication prescription in the study period. For employees without insomnia, the index date is the mean index date based on the cohort of employees with insomnia.
[c]Bolded values indicate statistical significance.

different eligibility requirements, the analysis of each benefit included only employees who qualified for that benefit. In each case, the regression models controlled for confounding factors including age, employment tenure, gender, marital status, race, exempt/nonexempt status, full-time/part-time status, salary, geographic region (defined by first digit of the employee's postal code), Charlson Comorbidity Index, and AHRQ category comorbid diagnoses, including infectious and parasitic diseases, neoplasms, endocrine and immunity disorders, diseases of the blood, circulatory disease, respiratory disease, digestive system disease, genitourinary system disease, pregnancy, skin diseases, musculoskeletal disorders, congenital anomalies, injury and poisoning, senility/organic mental disorders, affective disorders, schizophrenia and related disorders, other psychoses, and other mental conditions.

Two-part regression models were used for each benefit cost type and all absence dependent variables. This approach accounted for the fact that the data were not normally distributed, were highly skewed, had nonconstant variances, and contained many zero observations.[15] As an example, for the absence variables, logistic regression was used first to model the likelihood of having a given type of absence during the year following the index date. Generalized linear models were then used to model the amount of work time lost by those employees who had absences during the year. The results of the 2 regression models were then combined to produce adjusted absence mean values for the combined group of employees with and without absences.

To compare the prevalence of comorbidities between the insomnia and control cohorts, 95% confidence intervals were calculated for the comorbidity odds ratio using the Woolf method.[16] The prevalence of each comorbid condition was considered to be different between cohorts ($P < .05$) if the confidence interval for the odds ratio did not include 1.0. Means were calculated for each of the 17 major diagnostic categories in each cohort to compare costs and utilization. Differences between cohorts in costs and number of services were evaluated using *t* tests.

RESULTS

Demographics

Using the inclusion criteria, 17,230 employees with insomnia and 281,958 without insomnia were identified, with an insomnia prevalence rate of 5.76%. In the insomnia cohort, 13% of employees had both an insomnia diagnosis and a prescription for an insomnia medication, 75% of employees had only a prescription, and 12% had only a diagnosis. The demographics of the 2 cohorts are compared in Table 1. Highly significant demographic differences ($P < .01$) were identified between the 2 cohorts for all fields except Hispanic race and zip code regions that start with 5 or 6. Salary was particularly higher in the insomnia cohort than in the noninsomnia cohort ($64,598 vs $49,760).

For the analysis of comorbid conditions, 17,230 employees without insomnia were matched to the same number of employees with insomnia. There were no statistically

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Table 2. Health Benefit Costs for Employees With and Without Insomnia (US $)[a]

	Employees With Insomnia		Employees Without Insomnia		
Cost Category	n	Adjusted Mean Cost	n	Adjusted Mean Cost	Difference[b]
Direct costs	17,230		281,958		
Health care		2,457		1,706	751
Prescription drug		1,251		516	735
Indirect costs					
Sick leave	7,951	543	134,094	335	208
Short-term disability	11,096	380	138,778	201	179
Long-term disability	14,335	20	200,418	10	10
Workers' compensation	16,518	406	258,669	236	170
Totals		5,057		3,004	2,053

[a]Costs were adjusted using regression modeling, controlling for age, gender, marital status, race, exempt status, full-time/part-time status, salary, location, Charlson Comorbidity Index, and the following Agency for Healthcare Research and Quality major and specific category diagnoses: infectious and parasitic diseases, neoplasms, endocrine and immunity disorders, diseases of the blood, circulatory disease, respiratory disease, digestive system disease, genitourinary system disease, pregnancy, skin diseases, musculoskeletal disorders, congenital anomalies, injury and poisoning, senility/organic mental disorders, affective disorders, schizophrenia and related disorders, other psychoses, and other mental conditions. Costs are also inflation adjusted to 2007 US dollars. Only employees eligible for each specific benefit were included in the regression models for that benefit. Lost-time costs include all costs from claims begun at some point during the year following the index date.

[b]All reported numbers have been rounded; differences are based on original numbers. Differences are considered significant if $P < .05$. For all differences, $P < .0001$, except long-term disability ($P = .0135$).

significant demographic differences between these 2 cohorts by design.

Comparison of Health Benefit Costs and Absenteeism

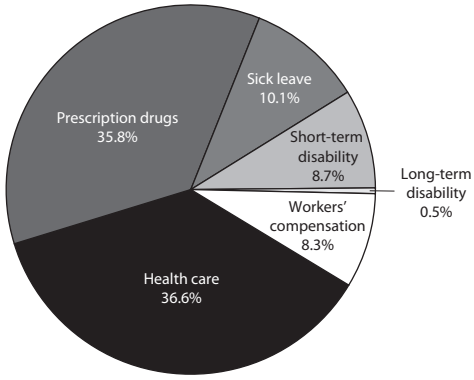
Analysis of health benefit costs found employees with insomnia to be more costly in every health benefit cost category studied (Table 2). Overall, the insomnia cohort incurred significantly greater costs than the control cohort ($2,053, $P < .0001$). The majority of the incremental costs were attributed to direct medical health care (36.6%) and prescription drugs (35.8%), with the remaining costs attributed to indirect components (Figure 1).

Employees with insomnia had significantly more health-related work absences compared to those without insomnia (Table 3). Overall, employees with insomnia missed a mean of 3.10 more workdays annually than did those without insomnia. Most of the incremental absence occurred under sick leave (50.3%; 1.56/3.10) and short-term disability (43.5%; 1.35/3.10) benefits.

Comparison of Comorbidity Prevalence, Costs, and Services

Using the matched insomnia and control cohorts, almost all comorbidity categories for the insomnia cohort had significantly ($P < .0001$) higher prevalence, increased costs, and increased number of medical services compared with the control cohort (Table 4). There was no significant prevalence difference between cohorts for the perinatal period category. Costs were not significantly different between the insomnia and control cohorts for the perinatal period, pregnancy childbirth puerperium, or the blood and blood-forming organs categories. There was no significant difference between the cohorts in the number of services used for the perinatal period or pregnancy childbirth puerperium categories.

Figure 1. Incremental Costs of Insomnia (direct and indirect)



DISCUSSION

Previous studies of the impact of insomnia on employees have relied on subjective, self-reported data.[10,17–20] The current analysis was based on objectively measured data from a comprehensive source of health benefit claims and health-related absences for employed individuals. The results indicate that total health benefit costs of employees with insomnia are approximately 2-fold higher than those of employees without insomnia. Prescription drug, sick leave, and short-term and long-term disability costs for employees with insomnia are approximately 2-fold higher than twice the costs of employees without insomnia. Insomnia was also a significant driver of absenteeism. Employees with insomnia missed nearly twice as many days as those without insomnia, mostly due to increased sick leave and short-term disability. This finding is exacerbated by the fact that salaries were significantly higher among employees with insomnia. Comorbid conditions were also more prevalent

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Table 3. Annual Absenteeism for Employees With and Without Insomnia[a]

	Employees With Insomnia		Employees Without Insomnia			
Cost Category	n	Adjusted Days, Mean	n	Adjusted Days, Mean	Difference[b]	*P* Value[c]
Sick leave	7,951	3.63	134,094	2.07	1.56	**< .0001**
Short-term disability	11,096	3.14	138,778	1.79	1.35	**< .0001**
Long-term disability	14,335	0.30	200,418	0.17	0.13	.0666
Workers' compensation	16,518	0.34	258,669	0.28	0.06	**.0313**
Totals		7.41		4.31	3.10	

[a]Absence days were adjusted using regression modeling, controlling for age, gender, marital status, race, exempt status, full-time/part-time status, salary, location, Charlson Comorbidity Index, and the following Agency for Healthcare Research and Quality major and specific category diagnoses: infectious and parasitic diseases, neoplasms, endocrine and immunity disorders, diseases of the blood, circulatory disease, respiratory disease, digestive system disease, genitourinary system disease, pregnancy, skin diseases, musculoskeletal disorders, congenital anomalies, injury and poisoning, senility/organic mental disorders, affective disorders, schizophrenia and related disorders, other psychoses, and other mental conditions. Only employees eligible for each specific benefit were included in the regression models for that benefit. Lost days include all days from claims begun at some point during the year following the index date.
[b]All reported numbers have been rounded; differences are based on original numbers. Differences are considered significant if $P < .05$.
[c]Bolded values indicate statistical significance.

Table 4. Prevalence, Annual Costs, and Annual Service Utilization of Comorbidities for Employees With and Without Insomnia (using AHRQ major diagnostic categories)

	Prevalence (%)		Annual Costs (US $)		Number of Medical Services	
AHRQ Major Diagnostic Category	Employees With Insomnia[a]	Employees Without Insomnia[a]	Employees With Insomnia[a]	Employees Without Insomnia[a]	Employees With Insomnia[a]	Employees Without Insomnia[a]
Infectious and parasitic diseases	23.64	13.26	58	18	1.08	0.46
Neoplasms	20.88	14.64	785	203	3.63	1.11
Endocrine, nutritional, metabolic, and immunologic disorders	36.91	23.04	167	66	2.97	1.75
Blood and blood-forming organs	6.87	3.27	40[b]	19[b]	0.55	0.18
Mental disorders	31.14	8.92	177	35	2.82	0.68
Nervous system and sensory organs	44.60	25.31	261	120	2.59	1.16
Circulatory system	33.11	21.08	387	214	3.24	1.71
Respiratory system	49.50	32.52	211	100	2.96	1.51
Digestive system	28.40	15.46	396	141	2.13	0.88
Genitourinary system	42.41	34.09	323	147	3.33	2.03
Pregnancy childbirth puerperium	7.40[c]	6.54[c]	160[b]	162[b]	1.02[b]	0.98[b]
Skin and subcutaneous tissue	28.62	19.32	94	52	1.13	0.69
Musculoskeletal and connective tissue	47.22	27.43	751	235	9.12	3.57
Congenital anomalies	2.61	1.41	23[d]	8[d]	0.09[e]	0.04[e]
Perinatal period	0.55[b]	0.70[b]	1[b]	1[b]	0.02[b]	0.03[b]
Injury and poisoning	27.32	15.94	323	136	3.22	1.37
Other conditions	75.86	52.18	377	157	6.14	3.25

[a]N = 17,230. Differences are considered significant if $P < .05$. For all comparisons, $P < .0001$, except where noted.
[b]Nonsignificant: $P > .05$.
[c]$P = .0016$.
[d]$P = .0360$.
[e]$P = .0007$.
Abbreviation: AHRQ = Agency for Healthcare Research and Quality.

(16 of 17 AHRQ major diagnostic categories) and more costly (14 of 17 categories) and resulted in a greater utilization of services (15 of 17 categories) in employees with insomnia compared to those without.

Using the calculated insomnia prevalence rate (5.76%) and the $2,053 incrementally higher cost for health benefit claims for employees with insomnia, the burden of illness can be estimated for all US civilian employees (Table 5). This estimation is possible because the HCMS Research Reference Database population in Table 1 is similar to the US civilian labor force in several important demographic variables (40 vs 41 years of age on average, 42% vs 46% female, 89% vs 81% full-time, and 56% vs 56% married).[21] By using figures from the US civilian labor force of 150.1 million employees at the end of 2005,[21] the prevalence of insomnia can be estimated as 8.644 million adults, with incremental annual health care costs (medical and prescription drug) estimated at $12.8 billion. Alternatively, if the calculation is based on the population insured by employers in 2005 (126.7 million persons),[22] the overall prevalence of insomnia would be 7.297 million adults with incremental annual health care costs totaling $10.8 billion. Including incremental indirect costs for sick leave, disability, and workers' compensation, costs for employees with insomnia in the civilian labor force rise to approximately $17.7 billion and to $15.0 billion using the employer-insured population figures.

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Table 5. Projections of the Impact of Insomnia to the US Civilian and Employer-Insured Labor Forces (in 2005) Based on the Study Prevalence Rate of 5.76%

Projections	US Civilian Labor Force (150.1 million people)	Population Insured by Employer (126.7 million people)
Prevalence of insomnia (millions of persons)	8.6	7.3
Incremental absence days (millions)	26.8	22.6
Incremental absence years (thousands)	73.4	62.0
Incremental annual direct health care costs (US $ millions)	12,845.19	10,842.68
Incremental annual indirect costs (US $ millions)	4,901.23	4,137.15
Total incremental annual costs (US $ millions)	17,746.42	14,979.82

These results highlight the significant economic burden of insomnia and are consistent with those of other studies assessing impact of insomnia on cost and resource utilization.[18,20,23] In a survey of 738 employed adults, those with insomnia reported significantly more health-related work absences than those without insomnia (11.65 days vs 4.84 days, respectively).[24] Results of another survey found that insomnia was a significant predictor of absenteeism and that employees with insomnia reported 1.4 more absences during the previous 14 days than those with no sleep problems.[25] Using self-reported survey data of telecommunications employees in San Francisco, 41% of employees with sleep problems reported missing work due to illness over a 4-week time period compared with 29% of employees without sleep problems ($P = .003$).[20] When their payroll records were examined, however, there were no significant differences in sick hours from the firm's payroll records.[20] Insomnia was also associated with significantly greater functional work impairment and greater medical and psychiatric comorbidities in a population of subjects surveyed at primary care clinics in Seattle, Washington.[23] A population-based Norwegian health study of 37,308 working-age people showed that insomnia was a strong predictor of subsequent permanent work disability even after adjusting for comorbid medical and psychiatric conditions (adjusted odds ratio = 1.75, 95% CI = 1.40 to 2.20).[19]

A 1996 review on the economic impact of insomnia estimated that the total costs of insomnia in the United States were between $30 and $35 billion annually.[26] This estimate was based on an insomnia prevalence rate of 10% and included both direct (physician's visits, prescription medications, over-the-counter medications, hospital services, and institutionalization) and indirect (sick days, productivity losses, and fatigue-induced accidents) costs.[26] The majority of annual costs associated with insomnia were indirect, with less than $2 billion attributed to direct medical care.[26] These estimates are greater than the current study's estimate of annual insomnia costs between $15.0 and $17.7 billion. The differences in the estimates may be a result of the different methods and populations used to calculate the prevalence of insomnia and the services included in the cost comparisons. The current study was an objective analysis of US employee records with strict guidelines for inclusion in the insomnia group and definitions of direct and indirect costs, whereas the previous study was based on self-report data of all adults with more categories for both direct and indirect costs. Despite the differences, both studies highlight the significant financial burden of insomnia and the need for better recognition and treatment.

The current analysis had several potential limitations. The insomnia cohort included only employees with a diagnosis of insomnia or those who had a prescription for an insomnia medication and was not designed to include employees taking antidepressants or traditional sedative-hypnotic agents. Employees with a prescription for trazodone (an antidepressant used off-label for the treatment of insomnia) were excluded from the analysis. The analysis also did not take into account the use of over-the-counter sleep medications or other nontraditional sleep remedies. These limitations may have resulted in an underestimation of prevalence and cost differences due to nondiagnosed and nontreated cases of insomnia.

Although 88% of the employees with insomnia in the study received at least 1 prescription for an insomnia medication, the impact of insomnia treatments was not studied in the current research. Such a future study would enhance the current results but would need to take into account several additional factors, including persistence, compliance, and the type of medication used.

In conclusion, this retrospective analysis demonstrated that insomnia was associated with significantly increased direct and indirect costs, greater absenteeism, and an increased number of comorbid conditions in an employed population. Management strategies designed to address insomnia and its comorbidities could greatly reduce the cost of care and improve employee outcomes.

Drug names: eszopiclone (Lunesta), flurazepam (Dalmane and others), quazepam (Doral), ramelteon (Rozerem), temazepam (Restoril and others), triazolam (Halcion and others), zaleplon (Sonata and others), zolpidem (Ambien, Edluar, and others).

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