Healthcare Utilization and Costs in Persons With Insomnia in a Managed Care Population

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Objectives

To better understand the direct costs of insomnia. Our study aimed to compare healthcare costs and utilization of patients diagnosed with insomnia who received care in a managed care organization with a set of matched controls.

Design

Our observational, retrospective cohort study compared 7647 adults with an insomnia diagnosis with an equally sized matched cohort of health plan members without an insomnia diagnosis between 2003 and 2006. We also compared a subset of patients diagnosed with and treated for insomnia with those diagnosed with insomnia but not treated.

Setting

A large Midwestern health plan with more than 600,000 members.

Results

Multivariate analysis was used to estimate the association between insomnia diagnosis and costs, controlling for covariates, in the baseline and follow-up periods. Although we cannot conclude a causal relationship between insomnia and healthcare costs, our analysis found that insomnia diagnosis was associated with 26% higher costs in the baseline and 46% in the 12 months after diagnosis. When comorbidities were recognized, the insomnia cohort had 80% higher costs, on average, than the matched control cohort.

Conclusions

These outcomes suggest the need to look beyond the direct cost of insomnia to how its interaction with comorbid conditions drives healthcare cost and utilization.

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Chronic insomnia, difficulty falling or staying asleep or experiencing poor-quality sleep, is a growing health problem with significant consequences for both individuals and the healthcare system.[1,2] Chronic insomnia is associated with a host of physical, psychosocial, and emotional problems, including premature mortality, depression, anxiety, and poor quality of life.[3-7] Chronic insomnia can also exacerbate comorbidities.[8,9] In addition to the personal toll of chronic insomnia on the individual, major economic consequences for the healthcare system include increased direct medical costs and healthcare utilization.[6,10,11] Research examining the economic consequences associated with chronic insomnia has highlighted the burgeoning indirect societal costs of insomnia, such as workplace absenteeism, lost productivity, and increased workplace errors and accidents.[12-16] Less attention has been focused on direct healthcare costs and increased utilization associated with chronic insomnia.

Direct costs to the healthcare system associated with chronic insomnia are difficult to assess due to complexities and gaps in available data.[17] Estimates of the aggregate costs of insomnia vary widely depending on the costs considered.[15,18,19] In earlier work, Simon and Von Korff[20] interviewed patients in primary care clinics to measure insomnia prevalence, associated functional impairment, lost productivity, and comorbidities. They found that 10% of patients reported insomnia, which was associated with functional impairment, disability, and increased use of health services. A more recent study estimated the direct and indirect costs of untreated insomnia and found that direct and indirect costs for adults younger than 65 years with insomnia were $1253 greater than for subjects without insomnia for the 6-month study period.[10]

The most common treatment for insomnia is pharmacotherapy, with 2.5% of Americans taking prescription drugs to treat insomnia each year, and about 1 in 4 of them continuing treatment for 4 months or longer.[21-24] Commonly prescribed US Food and Drug Administration (FDA)–approved hypnotics include benzodiazepines such as temazepam and triazolam, and drugs that act as agonists to benzodiazepine

Take-Away Points

Increasing costs for treated and untreated insomnia suggest the need to look beyond the cost of insomnia to how its interaction with comorbid conditions drives healthcare cost and utilization:

- At baseline prior to diagnosis, insomnia was associated with 26% higher healthcare costs than matched controls.
- In the 12 months following diagnosis, insomnia was associated with 46% higher costs.
- Predicted follow-up costs for the insomnia cohort were 80% higher than the controls, reflecting the relatively greater increase in morbidity in the insomnia cohort.
- Of those diagnosed with insomnia, 75% received pharmaceutical treatment.
- Those treated for insomnia had higher utilization and costs than those not treated.
- Insomnia and its treatment may be indications of more serious underlying conditions.

receptors such as zolpidem.[25] These agents are efficacious in the short-term management of insomnia, but adverse effects include residual daytime sedation, cognitive impairment, motor incoordination, dependence, and rebound insomnia.[26] A variety of cognitive and behavioral therapy (CBT) programs are as efficacious as approved sleep medications in the short term, side effects are nil, and benefits are more durable.[27,28] There is, however, limited access to these programs due to a shortage of trained professionals.[26,29-31] A 2002 national survey estimated that 2.2% of Americans use complementary or alternative therapies for insomnia.[32,33] However, herbals, dietary supplements, over the counter medications such as diphenhydramine, and alcoholic beverages are not recommended for insomnia treatment due to lack of efficacy data, potential for adverse effects, lack of standardization, or a combination of these concerns.[26]

The purpose of this study was to estimate the healthcare costs associated with insomnia diagnosis by comparing costs and utilization of patients who have been diagnosed with insomnia to a set of matched controls. We compared costs in the baseline period before an insomnia diagnosis, in the 12-month follow-up period postdiagnosis, and the change in cost from baseline to follow-up. We also compared a subset of patients who received a diagnosis of insomnia and associated treatment with patients who received a diagnosis of insomnia but no treatment. This research will contribute to the scarce literature currently available on the direct costs and health services used by patients with chronic insomnia.

METHODS

Study Population

We conducted a retrospective observational study using data from a large Midwestern health plan with more than 600,000 members. A study cohort of 7647 adults with an insomnia diagnosis during 2003 to 2006 was identified and compared with an equally sized matched cohort of health plan members without an insomnia diagnosis. All health plan members were eligible for the study if they met the following criteria: (1) at least 18 months of continuous enrollment from January 1, 2003, to December 31, 2006; (2) aged 18 years or older; (3) continuous pharmacy coverage; and (4) Medicaid or commercial insurance coverage.

Members were considered to have insomnia if they had a qualifying insomnia diagnosis code from January 1, 2004, to December 31, 2005, preceded by a 6-month period free of an insomnia diagnosis (baseline period) and if they remained in the plan for at least 12 months after the diagnosis (follow-up period). Qualifying insomnia cohort *International Classification of Diseases, Ninth Revision* codes were: 307.41 (transient disorder of initiating or maintaining sleep), 307.42 (persistent disorder of initiating or maintaining sleep), and 780.52 (insomnia unspecified). This research was reviewed and approved by the local Institutional Review Board.

Propensity Score Matching

A propensity score–matching method was used to create a matched control group that had similar covariate values as the insomnia cohort and therefore reduce confounding by covariate differences.[34] First, a 10:1 age- and gender-matched sample of members without an insomnia diagnosis was created. Members were then matched with controls during the 6-month baseline period and 12-month follow-up period. Second, a logistic model was used to produce propensity scores for all members with an insomnia diagnosis and the 10:1 matched cohort. The dependent variable in the model was an indicator of a qualifying insomnia diagnosis, and the predictor variables were age, sex, insurance type, and specific individual baseline physical comorbidities (diabetes, cardiovascular disease, chronic obstructive pulmonary disorder, chronic heart failure, myocardial infarction, peripheral vascular disease, connective tissue disorder, ulcer disease, mild liver disease, moderate to severe renal disease, acquired immunodeficiency disorder, tumor, hemiplegia, leukemia or lymphoma, metastatic solid tumor) and specific mental health comorbidities (alcohol use disorder, opioid and substance use disorder, major depression, anxiety,

bipolar disorder, posttraumatic stress disorder, dementia, schizophrenia, organic mental disorders, other psychotic disorders, affective disorders, personality disorders, or adjustment disorders). Finally, propensity scores from the model were used to identify a 1:1 cohort, matched on propensity score. This 1:1 propensity score–matched cohort was the comparison group to evaluate differences in healthcare costs and utilization. Multivariate regression methods were used to adjust for differences that remained between the cohorts after matching.

To compare members with an insomnia diagnosis with and without pharmacological treatment, pharmacological treatment was defined as a prescription fill for benzodiazepines or nonbenzodiazepines, categories of medications that have been approved by the FDA for the treatment of insomnia,[27,35] or prescriptions for medications frequently used off label for treatment of insomnia, including: trazodone, ziprasidone, amitriptyline, mirtazapine (with no depression diagnosis), doxepin, quetiapine fumarate (Seroquel), and diphenhydramine (Benadryl).[36]

Healthcare Utilization and Cost Data

Healthcare cost and utilization data were obtained from the health plan's administrative databases. They included type of insurance coverage, diagnostic codes for insomnia and other chronic conditions, plan reimbursed amounts, and member-paid amounts. These data were used to identify major medical comorbidities and total direct medical costs, including inpatient, outpatient, pharmacy, urgent care and emergency department services, for all members. Cost was defined as plan reimbursed amounts plus member-paid.

Analysis

Multivariate analysis was used to estimate the association between study cohort and costs, controlling for covariates. The outcome was total healthcare costs, which captures the effect of insomnia on the use of healthcare services for all reasons. Estimates of the percentage of cost associated with an insomnia diagnosis were made at 3 times: the baseline period, the follow-up period, and the change from baseline to follow-up. For the baseline and follow-up analyses, a 2-part Heckman estimator was used because of the number of members in the control cohort that had no healthcare costs. First, the association between cohort and positive cost was determined by logistic regression. Second, the association between cohort and costs was estimated for those with positive costs. Because the outcomes were heavily skewed, a log transformation with Duan's smearing estimator was used.[37] For the analysis of change from baseline to follow-up, multivariate linear regression analysis was used and the dependent variable was untransformed dollars.

The covariates were age, sex, insurance type, Charlson Comorbidity Index (CCI) score, psychiatric medication use, and mental health diagnoses. We included interaction and polynomial terms that improved model performance. Comorbidities were identified using clinical classification software maintained by the Agency for Healthcare Research and Quality or defined by the health plan's algorithms, which were summarized as a CCI score.[38,39] The CCI includes 19 medical conditions, each with a weight of 1, 2, 3, or 6. The CCI score is the sum of the weights for the conditions identified as comorbidities. Total scores can range from 0 (no conditions) to 37 (all 19 conditions).[40]

The parameter for insomnia diagnosis in the regression models for baseline and follow-up costs was used to estimate the percentage of costs that were associated with insomnia. To estimate the impact of insomnia and comorbidities on total costs, we used regression results to estimate predicted costs for each cohort in the follow-up period, with covariate values set at the mean value for each cohort.

RESULTS

We identified 7647 members with a diagnosis of insomnia who met the enrollment criteria during the identification period. They were matched with 7647 controls. In the insomnia cohort, the average age was 48 years, and 64.2% were women, compared with an average age of 49 years and 66.9% women in the control cohort (**Table 1**). The average CCI score for the insomnia cohort in the baseline period was 0.26, while it was 0.28 for the control cohort. In the follow-up period, the average CCI score increased for both the insomnia and control cohorts and the percentage of members with a mental health diagnosis or psychiatric medication use increased for the insomnia cohort. In the follow-up period, all measures were greater for the insomnia cohort than for the control cohort (Table 1). Baseline and follow-up utilization and costs for each cohort are presented in **Table 2**. The insomnia cohort had higher utilization and costs in all categories than the control cohort in both baseline and follow-up periods. The average cost for the insomnia cohort during the 6-month baseline period was $5484, compared with $3937 for the control cohort. In the year-long follow-up period, the average cost for the insomnia cohort was $11,206, compared with $6939 for the control cohort.

Table 1. Descriptive Characteristics and Utilization of the Sample, After Matching, for Members Diagnosed With Insomnia and Those Who Were Not

	Insomnia Cohort N = 7647		Control Cohort N = 7647		
Parameter	**N/Mean**	**%/SD**	**N/Mean**	**%/SD**	***P***
Age[a] (years)	48.47	12.59	49.37	12.56	<.0001
Female[b]	4908	64.2%	5119	66.9%	.0003
Baseline					
Medicaid recipient[b]	577	7.6%	666	8.7%	.0084
CCI score[a]	0.26	0.84	0.28	0.85	.1711
Mental health diagnosis[b]	1874	24.5%	2484	32.5%	<.0001
Antidepressant prescription[b]	3231	42.3%	2864	37.5%	<.0001
Mood stabilizer prescription[b]	581	7.6%	495	6.5%	.0065
Follow-up					
CCI score[a]	0.42	1.11	0.36	1.01	.002
Mental health diagnosis[b]	3496	45.7%	2174	28.4%	<.0001
Antidepressant prescription[b]	5114	66.9%	2974	38.9%	<.0001
Mood stabilizer prescription[b]	940	12.3%	589	7.7%	<.0001

Baseline, 6 months before insomnia diagnosis or index date; follow-up, 12 months after insomnia diagnosis or index date.
CCI indicates Charlson Comorbidity Index.
[a] *t* test.
[b] χ^2.

Regression Results

Estimated model coefficients for the 2-part models of baseline costs are reported in Table 3. The probability of positive cost in the baseline period was higher for members in the insomnia cohort, women, and those with Medicaid insurance. Among 14,406 members with positive cost in the baseline period, members in the insomnia cohort, women, and those with Medicaid insurance, a mental health diagnosis, and use of psychiatric medication had higher costs. Costs were higher with increased age and CCI score. The parameter estimate for insomnia diagnosis was 0.23, which translates to 26% higher costs associated with insomnia in the baseline period. (The percentage change in US dollars is equal to the exponent of the parameter for log dollars, minus 1.)

Estimated model coefficients for the 2-part models of follow-up costs are reported in Table 4. The probability of positive cost in the follow-up period was higher for members in the insomnia cohort, females, and those with Medicaid insurance. Among 14,975 members with positive cost in the follow-up period, members in the insomnia cohort, women, and those with a mental health diagnosis and use of psychiatric medication had higher costs. Costs were higher with increased age and CCI score. Presence of Medicaid insurance was not a significant predictor of follow-up cost. The parameter estimate for insomnia diagnosis was 0.38, which translates to 46% higher costs associated with insomnia in the follow-up period.

Using mean covariate values for each cohort, the predicted probability of positive costs was 100% for the insomnia cohort and 97% for the control cohort. The predicted follow-up cost for the insomnia cohort was $4395, 80% higher than predicted cost for the control cohort.

The analysis of change in costs from the baseline to the follow-up period showed that insomnia was associated with an increase of $1553 from baseline to follow-up (Table 5).

Treated Versus Untreated Subsets of the Insomnia Cohort

In the insomnia cohort, 5773 (75%) were treated with a prescription medication for insomnia during the 12-month follow-up period. Compared with the insomnia cohort subset without treatment, the treated subset was slightly older (48.85 years vs 47.31 years), more likely to be women (65.7% vs 59.6%), more likely to have Medicaid insurance (8.6% vs 4.2%), and had a slightly higher CCI score (0.27 vs 0.21). The treated subset was more likely to have a mental health diagnosis in the baseline period (27.3% vs 16.0%) and to have a pharmacy claim for an antidepressant (47% vs 27.5%) and a mood stabilizer (9.0% vs 3.3%). All measures were statistically different at P <.005. Those differences persisted and grew into the follow-up period.

Table 2. Healthcare Costs and Utilization of the Sample, After Matching, for Members With and Without an Insomnia Diagnosis

	Insomnia cohort N = 7647		Control cohort N = 7647		
Parameter	**Mean**	**SD**	**Mean**	**SD**	***P*[a]**
Baseline					
ED visits	0.52	1.78	0.36	1.37	<.0001
IP visits	0.15	0.64	0.12	0.55	.0003
OP visits	10.72	13.30	9.49	12.28	<.0001
UC visits	0.28	0.99	0.18	0.69	<.0001
ED costs	172.92	736.00	115.06	533.06	<.0001
IP costs ($)	2202.30	16,099.35	1205.38	8902.80	<.0001
OP costs ($)	2161.58	5057.17	1824.60	4884.44	<.0001
UC costs ($)	21.64	75.92	13.72	55.66	<.0001
RX costs ($)	925.31	1845.82	777.99	1483.51	<.0001
Total costs ($)	5484.01	18,651.46	3937.03	11,450.52	<.0001
Follow-up					
ED visits	1.00	3.52	0.57	1.93	<.0001
IP visits	0.27	0.89	0.17	0.70	<.0001
OP visits	26.00	27.01	17.51	21.80	<.0001
UC visits	0.55	1.70	0.34	1.01	<.0001
ED costs	332.91	1176.29	182.48	737.07	<.0001
IP costs ($)	3249.78	17,551.59	1742.48	10,942.22	<.0001
OP costs ($)	5317.14	10,567.13	3355.71	8282.75	<.0001
UC costs ($)	42.41	130.29	27.09	88.57	<.0001
RX costs ($)	2262.75	3635.37	1630.56	3086.06	<.0001
Total costs ($)	11,206.13	25,027.14	6939.78	17,067.15	<.0001

Baseline, 6 months before insomnia diagnosis or index date; follow-up, 12 months after insomnia diagnosis or index date.
ED indicates emergency department; IP, inpatient; OP, outpatient; UC, urgent care; RX, pharmacy.
[a]t test.

Table 3. Two-Part Regression of Baseline Costs

Two-part model	**Part I N = 15,294**			**Part 2: Cost Model N = 14,406**		
Dependent variable	**Any Cost in Baseline Period**			**Log of Total Baseline Cost**		
Independent variable	**Parameter Estimate**	**Standard Error**	***P***	**Parameter Estimate**	**Standard Error**	***P***
Intercept	0.14	0.14	.3364	5.52	0.11	<.0001
Insomnia diagnosis[a]	0.84	0.07	<.0001	0.23	0.02	<.0001
Age	0.04	0.00	<.0001	0.03	0.00	<.0001
Age squared				0.00	0.00	.0042
Female	1.00	0.07	<.0001	0.23	0.02	<.0001
Medicaid	0.50	0.16	<.0001	0.09	0.04	.0147
CCI score				1.01	0.02	<.0001
CCI score squared				–0.08	0.00	<.0001
Mental health diagnosis				0.63	0.02	<.0001
Antidepressant prescription				0.48	0.02	<.0001
Mood stabilizer prescription				0.68	0.04	<.0001

CCI indicates Charlson Comorbidity Index.
Predicted cost estimated using mean values of covariates for each cohort.
Baseline, 6 months before index date; follow-up, 12 months after index date.
[a]Part 2: Insomnia diagnosis was associated with 26% higher costs. The percentage translated for dollars is equal to the exponent of the parameter for log dollars, minus 1.

Table 4. Two-Part Regression of Follow-up Costs

Two-part model	Part I N = 15,294			Part 2: Cost Model N = 14,975		
Dependent variable	**Any Cost in Follow-up Period**			**Log of Total Follow-up Cost**		
Independent variable	**Parameter Estimate**	**Standard Error**	***P***	**Parameter Estimate**	**Standard Error**	***P***
Intercept	0.76	0.23	.0010	6.01	0.10	<.0001
Insomnia diagnosis[a]	5.89	1.00	<.0001	0.38	0.02	<.0001
Age	0.04	0.00	<.0001	0.04	0.00	<.0001
Age squared				0.00	0.00	<.0001
Female	1.04	0.12	<.0001	0.27	0.02	<.0001
Medicaid	0.25	0.24	<.0001	0.01	0.03	.7799
CCI score				0.76	0.02	<.0001
CCI score squared				–0.06	0.00	<.0001
Mental health diagnosis				0.47	0.02	<.0001
Antidepressant prescription				0.39	0.02	<.0001
Mood stabilizer prescription				0.74	0.03	<.0001
	Probability of Expenditures [95% CI]			**Predicted 12-Month Expenditures [95% CI]**		
Patients with insomnia diagnosis	100.0% [99.9-100.0]			$9884 [$9609-$10,167]		
Matched comparison group	96.6% [96.2-97.0]			$5489 [$5335-$5648]		
Difference	3%; *P* <.05			$4395; *P* <.05		

CCI indicates Charlson Comorbidity Index; CI, confidence interval.
Predicted cost estimated using mean values of covariates for each cohort.
Follow-up, 12 months after index date.
[a]Part 2: Insomnia diagnosis was associated with 46% higher costs. The percentage translated for dollars is equal to the exponent of the parameter for log dollars, minus 1.

In the follow-up period, the treated subset had a higher CCI score (0.46 vs 0.29) and higher percentage of patients with a mental health diagnosis (50% vs 43%), an antidepressant prescription (77% vs 34%), and a mood stabilizer prescription (15% vs 5%) than the untreated subset. The treated subset also had significantly greater utilization and costs in all categories in both the baseline and follow-up periods. The analysis of cost change from the baseline period to follow-up period showed that the treated subset had a significantly greater increase in total costs than the untreated subset ($5527 vs $3145), and a significantly greater increase in medical cost (excluding pharmacy) than the untreated subset ($4276 vs $2309).

DISCUSSION

Our results confirm previous findings that untreated insomnia is associated with increased healthcare utilization and costs. Ozminkowski and colleagues[10] found that direct costs for patients with untreated insomnia were 25% greater than a matched comparison group, $4755 versus $3831. We estimated that the insomnia diagnosis was associated with 26% higher costs in the baseline period, when members who eventually received an insomnia diagnosis were as yet untreated (Table 3). In addition to estimating the association of healthcare costs with untreated insomnia (during the baseline period), we estimated the association of healthcare costs with diagnosed insomnia during the follow-up period. We found that, in the 12 months after diagnosis, the insomnia diagnosis was associated with 46% higher costs (Table 4). Using regression results, we predicted the follow-up costs for the insomnia and control cohorts, using their respective covariate values. That analysis illustrated the impact of insomnia and comorbidities on total costs. We found that, in the 12 months after insomnia diagnosis, the insomnia cohort had 80% higher costs, on average, than the control cohort. The amount of the change from baseline to follow-up that was associated with insomnia was estimated to be $1553 (Table 5). In general, healthcare costs tend to increase from one period to another, but we found that the insomnia cohort had a greater *relative increase* in costs from baseline to follow-up than the control cohort. Part of that greater relative increase appeared to be due to the relative decrease in health of the insomnia cohort, as evidenced by the CCI score and mental health measures.

Table 5. Linear Regression of Change in Total Healthcare Cost From Baseline to Follow-up

Dependent variable	N = 15,294		
	Change in Total Cost From Baseline to Follow-up		
	Parameter Estimate	Standard Error	*P*
Independent variables			
Intercept	–2904.63	771.71	.0002
Insomnia diagnosis	1552.91	150.96	<.0001
Age	147.44	30.63	<.0001
Age squared	–1.53	0.30	<.0001
Female	465.20	153.35	.0024
Medicaid	247.86	272.95	.3638
CCI score	2961.27	71.52	<.0001
Mental health diagnosis	1725.06	165.76	<.0001
Antidepressant prescription	622.56	168.49	.0002
Mood stabilizer prescription	4723.85	257.94	<.0001

CCI indicates Charlson Comorbidity Index.
Predicated cost estimated using mean values of covariates for each cohort.
Baseline, 6 months before insomnia diagnosis or index date; follow-up, 12 months after insomnia diagnosis or index date.

To further understand the association of healthcare costs with an insomnia diagnosis, we identified the subset of the insomnia cohort treated pharmacologically for insomnia. That subset had higher costs in the baseline and follow-up periods and a greater increase in cost from the baseline to the follow-up period than the untreated subset. Because treatment for insomnia may have driven the cost increase, we evaluated the change in cost from baseline to follow up, excluding pharmacy claims and, therefore, the cost of insomnia treatment. We found that the treated subset had an 85% greater increase in medical cost (excluding pharmacy costs) than the untreated subset, $4276 versus $2309. Similar to the insomnia cohort in the main analysis, the treated subset appeared to have a relatively greater decline in health compared with the untreated subset.

We are unable to assess causation from this retrospective observational study, so we cannot conclude that insomnia led to higher spending in the baseline period, when all members of the insomnia cohort were untreated, or in the follow-up period, when 25% of the insomnia cohort was untreated. However, our finding that the treated subset of the insomnia cohort experienced a much greater increase in costs from baseline to follow-up than the untreated subset suggests that insomnia and its treatment are indications of more serious underlying conditions. Not only did healthcare spending increase for the treated subset, but their comorbidities, measured by the CCI score, also increased more than for the untreated group. We found that the untreated subset of the insomnia cohort looked more like the control cohort in the follow-up period.

This analysis is limited by reliance on administrative data. First, using an insomnia diagnosis to indicate insomnia could misidentify members in 2 ways. First, members who experience insomnia but do not seek medical care would be eligible for the control group. Second, members who receive treatment but do not have a recorded insomnia diagnosis would be eligible for the control group. Either way, misidentified members would serve to reduce the difference between the groups, therefore biasing the results toward an understatement of the costs associated with insomnia. Also, because nonpharmocologic treatment data were not available, we limited our definition of insomnia treatment to prescribed medications. Our data do not allow us to firmly document that these medications were only used for the treatment of insomnia and not as adjunct pharmacotherapy for other chronic conditions. However, the medications were prescribed for patients who had a diagnosis for insomnia, increasing the likelihood of insomnia treatment. Deriving our sample from a managed care plan limits the generalizability of our results, but offers the advantage of availability of cost and utilization measures. In addition, although we used propensity scores to select a matched cohort to adjust for underlying differences between the insomnia and control cohorts, important differences may still exist between them. We attempted to adjust for remaining differences

through the use of multivariate regression techniques. Finally, our main analysis was between matched insomnia and control cohorts. Our secondary analysis of treated and untreated subsets of the insomnia cohort was not between matched members.

CONCLUSIONS

Although we cannot conclude a causal relationship between insomnia and growing healthcare costs, our analysis highlights interesting and important findings. Health plan members who eventually receive a diagnosis of insomnia have higher healthcare costs than those who do not, both before and after the insomnia diagnosis. Among those who eventually receive an insomnia diagnosis and treatment, health in the period following that diagnosis appears to decline relatively more than members without an insomnia diagnosis, as evidenced by increases in CCI score and healthcare spending. While estimates of disease burden are useful for directing attention to conditions that result in high health and economic cost, it is also important to consider the total impact of a condition on individuals and society. It is well known that insomnia is associated with many comorbid conditions, such as obesity, depression, and anxiety. We attempted to estimate costs associated with insomnia, both alone and with comorbidities. We found that an insomnia diagnosis was associated with 46% higher costs in the follow-up period, and that when coupled with comorbidities, the costs were 80% higher. These outcomes suggest the need to look beyond the direct cost of insomnia to how its interaction with comorbid conditions drives healthcare costs and utilization.

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