



# HEALTH AND PRODUCTIVITY IMPACT OF CHRONIC CONDITIONS MIGRAINE AND OTHER HEADACHES

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## Executive Summary: Health and Productivity Impact of Migraine

- 14% of employed U.S. adults reported having severe headaches or migraine in the prior three months. Women were more than twice as likely as men to report severe headaches or migraine (20% compared to 9%).
- The rate of treatments for migraine was about one fifth of the reported prevalence—3% of employed U.S. adults had treatments for migraine (ICD-9 diagnosis codes 364.xx and 784.0). Women were almost five times as likely as men to have had treatments for migraine (5.2% compared to 1.1%)
- One in three employees with migraine also has obesity. Mood disorders, back pain, anxiety disorders, and hypertensive disease each afflict about one in five employees with migraine.
- Excess medical and pharmacy treatment costs for employees with migraine averaged almost \$2,000 per year.
- Employees with migraine had an average of 2.2 excess sick days per year, at a cost of almost \$600 in wages and benefits.
- Each year, employers' short-term disability (STD) insurance policies experience an average of 2.4 new claims for migraine per 10,000 covered lives. STD claims for migraine incur an average of 38 lost workdays, at an average cost of about \$7,700 in wage replacements and paid employee benefits. This represents about \$10,400 in lost economic output.
- Each year, employers' long-term disability (LTD) insurance policies manage an average of 1.0 active claims for migraine per 10,000 covered lives. Claims that carried over from previous years outnumber new claims by 1.5 to 1. Of LTD claims for migraine, 37% remain open two years after they begin. LTD claims for migraine incur an average of 179 lost workdays per year that they remain open, at an average cost of about \$37,000 in wage replacements and paid employee benefits per year.
- Overall, for every 1,000 U.S. employees, migraine in the workforce costs about \$84,000 in excess healthcare treatments and lost work time. This does not include the value of returns to lost labor inputs, early exits from the labor force, excess turnover costs and presenteeism (underperformance on the job due to migraine).
- Considerable cost differences are observed across industries, ranging from about \$65,000 per 1,000 employees in the transportation and utilities industry to about \$180,000 per 1,000 employees in the finance industry.



## Introduction to This Series

Helping employees manage chronic illnesses remains one of the most viable strategies for reducing employers' healthcare and disability costs. IBI's *Health and Productivity Impact of Chronic Conditions* series uses high-quality data to model healthcare, illness absence (i.e., sick days) and disability costs for populations of employees across different industries. The results provide a scalable cost benchmark that employers and their supplier partners can use to assess the potential savings from reductions in the prevalence of a condition, costs of treatments, and illness-related absences and disability leaves.

## Data

The series uses data primarily from three sources.

Data from the Agency for Healthcare Research and Quality's (AHRQ's) *Medical Expenditure Panel Survey* (MEPS) are used for healthcare costs and illness absences.<sup>1</sup> MEPS collects annual, nationally representative information about health status, care utilization and treatment costs from components: (1) a survey of U.S. households, with information supplemented by data from household members' medical providers (the household component); and (2) a separate survey of employers about their employment-based health insurance plans (the insurance component). This report uses person-level data from the 2011–2015 household component files for information about health conditions, healthcare costs, illness absences, and demographic and occupational/industrial characteristics.

MEPS data can identify persons with a condition for which they sought treatment. For symptomatic conditions such as migraine that may be underdiagnosed, this may lead to underreporting of the actual prevalence in a population. For this reason, data from the Centers for Disease Control and Prevention's (CDC) *National Health Interview Survey*<sup>2</sup> are used to report the proportion of persons who respond yes to the question, "During the past three months, did you have ... severe headache or migraine?" This report uses data from 2011–2016 surveys.

Data from IBI's *Health and Productivity Benchmarking System* (referred to simply as *Benchmarking*)<sup>3</sup> are used for short-term disability (STD) and long-term disability (LTD) outcomes. Each year, *Benchmarking* collects millions of STD and LTD claims from the books of business of 14 of the largest U.S. disability insurance carriers and third-party administrators. This report uses claims data for calendar years 2011–2016 for information on diagnoses, claims rates, durations and industry.

This report also incorporates information about wages and benefits from the U.S. Bureau of Labor Statistics (BLS) and healthcare cost growth estimates from the Centers for Medicare & Medicaid Services. Detailed information about the data and analytic methods is included in the appendix.

## Methods

Attributing healthcare costs and illness absences to specific conditions poses well-known challenges. This is primarily due to the presence of comorbidities that can impact the severity of illness symptoms and the efficacy

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<sup>1</sup> AHRQ. *Medical Expenditure Panel Survey*. [https://meps.ahrq.gov/mepsweb/about\\_meps/survey\\_back.jsp](https://meps.ahrq.gov/mepsweb/about_meps/survey_back.jsp)

<sup>2</sup> Lynn A. Blewett, Julia A. Rivera Drew, Risa Griffin, Miram L. King, and Kari C. W. Williams. *IPUMS Health Surveys: National Health Interview Survey, Version 6.2*. Minneapolis: University of Minnesota, 2016. <http://doi.org/10.18128/D070.V6.2> <http://www.nhis.ipums.org>

<sup>3</sup> Integrated Benefits Institute. *Health and Productivity Benchmarking*. <https://ibiweb.org/benchmarking>

or intensity of care management.<sup>4</sup> For this reason, we control for the presence of other chronic conditions for analyses of healthcare costs and illness absences in a way that permits us to compare the excess burdens for persons with a specific condition, over and above the burdens associated with their other conditions. See the appendix for details on the models. Lost work time and costs associated with disability claims are more straightforward—no detail on comorbidities is provided, so only average outcomes are reported. All outcomes are reported on an annual basis.

## Definitions of Conditions and Industries

### CONDITIONS

Conditions are defined using the *International Classification of Diseases*, 9th revision (ICD-9),<sup>5</sup> based on the three-digit diagnosis categories available in the MEPS data. *Benchmarking* data contain full ICD-9 diagnosis information, which is truncated to conform to the MEPS three-digit reporting. Individuals in the MEPS data are determined to have a condition based on records in the medical conditions files of the household component. *Benchmarking* disability claims record only the primary claim diagnosis.

### INDUSTRIES

MEPS data record the industry of an employee's current (or past) employer. These include the following civilian categories:

- Natural resources
- Mining
- Construction
- Manufacturing
- Wholesale and retail trade
- Transportation and utilities
- Information
- Financial activities
- Professional and business services
- Education, health and social services
- Leisure and hospitality
- Other services
- Public administration

Given the small sample sizes in the MEPS data, mining is combined with natural resources. *Benchmarking* claims contain North American Industrial Classification System (NAICS) codes, in many cases to the six-digit coding level. To conform to MEPS, NAICS sectors are combined to create major industries, as described in the following table.

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<sup>4</sup> Alonso J, Vilagut G, Chatterji S et al. Including information about comorbidity in estimates of disease burden: Results from the WHO World Mental Health Surveys. *Psychological Medicine*. 2011;41(4):873-86.

<sup>5</sup> World Health Organization. *International Classification of Diseases (ICD)*, 9th revision. <http://www.who.int/classifications/icd/en>

HIPCC industry	NAICS sectors
Natural resources	<ul style="list-style-type: none"> <li>• Agriculture, forestry, fishing and hunting</li> <li>• Mining, quarrying, and oil and gas extraction</li> </ul>
Construction	<ul style="list-style-type: none"> <li>• Construction</li> </ul>
Manufacturing	<ul style="list-style-type: none"> <li>• Manufacturing</li> </ul>
Wholesale and retail trade	<ul style="list-style-type: none"> <li>• Wholesale trade</li> <li>• Retail trade</li> </ul>
Transportation and utilities	<ul style="list-style-type: none"> <li>• Transportation and warehousing</li> <li>• Utilities</li> </ul>
Information	<ul style="list-style-type: none"> <li>• Information</li> </ul>
Financial activities	<ul style="list-style-type: none"> <li>• Finance and insurance</li> <li>• Real estate and rental and leasing</li> </ul>
Professional and business services	<ul style="list-style-type: none"> <li>• Professional, scientific and technical services</li> <li>• Management of companies and enterprises</li> <li>• Administrative and support and waste Management and remediation services</li> </ul>
Education, health and social services	<ul style="list-style-type: none"> <li>• Educational services</li> <li>• Healthcare and social assistance</li> </ul>
Leisure and hospitality	<ul style="list-style-type: none"> <li>• Arts, entertainment and recreation</li> <li>• Accommodation and food services</li> </ul>
Other services	<ul style="list-style-type: none"> <li>• Other services (except public administration)</li> </ul>
Public administration	<ul style="list-style-type: none"> <li>• Public administration</li> </ul>

# MIGRAINE

## Introduction

Migraines are intense, frequent headaches that can last for hours and are often accompanied by other symptoms such as nausea and sensitivity to light and sound.<sup>6</sup> The pathophysiology of migraines is not well understood and the factors that trigger attacks—such as stress, certain foods, alcohol, weather changes, hormonal changes associated with a woman’s menstrual cycle—vary from person to person.

Women are more likely than men to suffer from migraines. Certain mental health and neurological conditions such as depression, anxiety, bipolar disorder, and epilepsy may also be associated with migraines.

For the purpose of this report, migraine is indicated as diagnoses for treatment or disability benefits with ICD-9 code 346.xx. Given the time-intensive, multi-step process for diagnosing migraines, we also include non-specified headache symptoms coded as 784.0. These may be early indicators for migraine—particularly in cases where symptoms result in disability lost work time.

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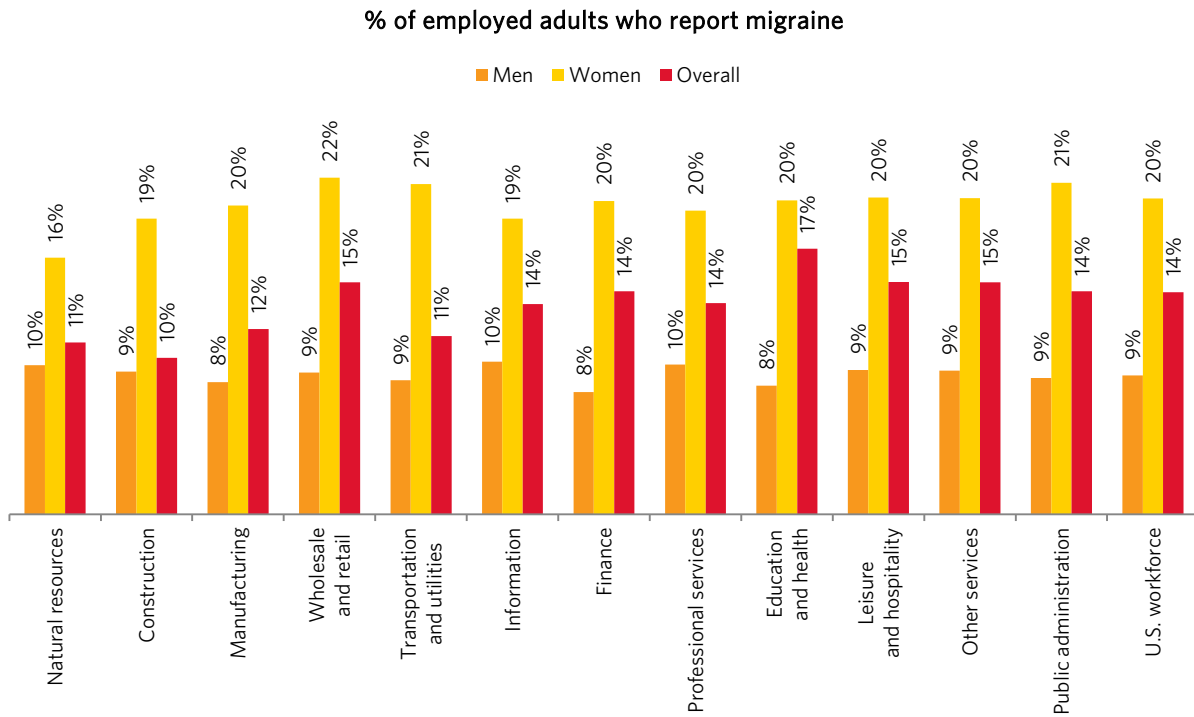
<sup>6</sup> National Institute of Neurological Disorders and Stroke, [NINDS Migraine Information Page](https://www.ninds.nih.gov/Disorders/All-Disorders/Migraine-Information-Page) <  
<https://www.ninds.nih.gov/Disorders/All-Disorders/Migraine-Information-Page>>.



## Prevalence

### HOW MANY PEOPLE HAVE MIGRAINE?

Figure 1 shows that of a nationally representative sample of employed U.S. adults, 14% reported having severe headaches or migraine in the prior three months. Women were more than twice as likely as men to report severe headaches or migraine (20% compared to 9%).

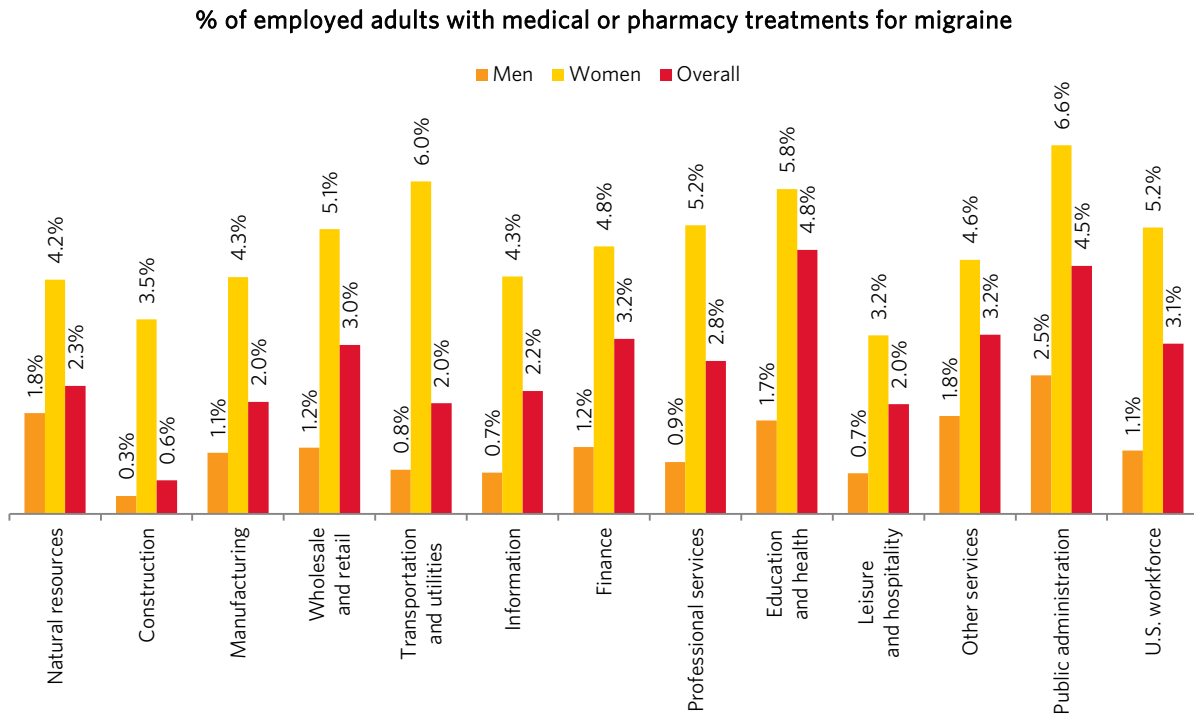


**Figure 1**

Source: Centers for Disease Control and Prevention, National Health Interview Survey, 2011-2016.

## HOW MANY PEOPLE RECEIVE HEALTHCARE TREATMENT FOR MIGRAINE?

Figure 2 shows that compared to the findings in Figure 1, the rate of treatments for migraine was about one fifth of the reported prevalence. Of a nationally representative sample of employed U.S. adults, 3.1% had treatments for migraine. Women were almost five times as likely as men to have had treatments for migraine (5.2% compared to 1.1%).

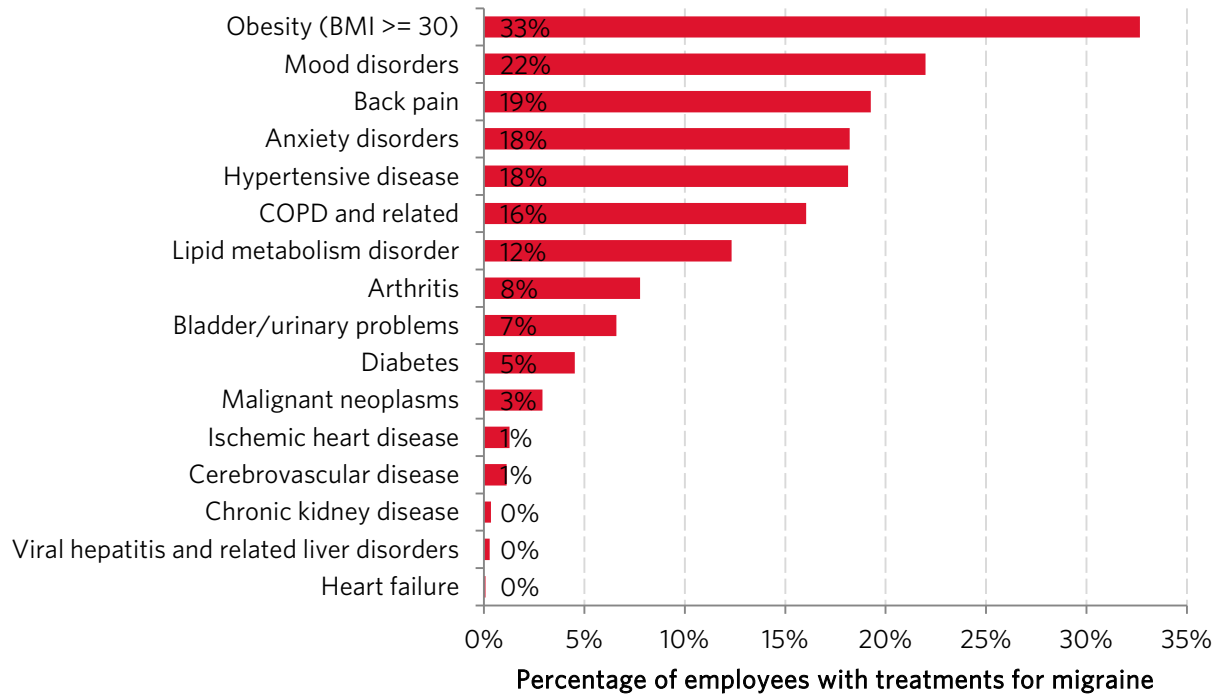


**Figure 2**

Source: Agency for Healthcare Research and Quality, Medical Expenditure Panel Study, 2011-2015.

### WHAT OTHER CONDITIONS (COMORBIDITIES) AFFLICT EMPLOYEES TREATED FOR MIGRAINE?

Figure 3 shows that one in three employees with migraine also has obesity. Mood disorders, back pain, anxiety disorders, and hypertensive disease afflict about one in five employees with migraine.



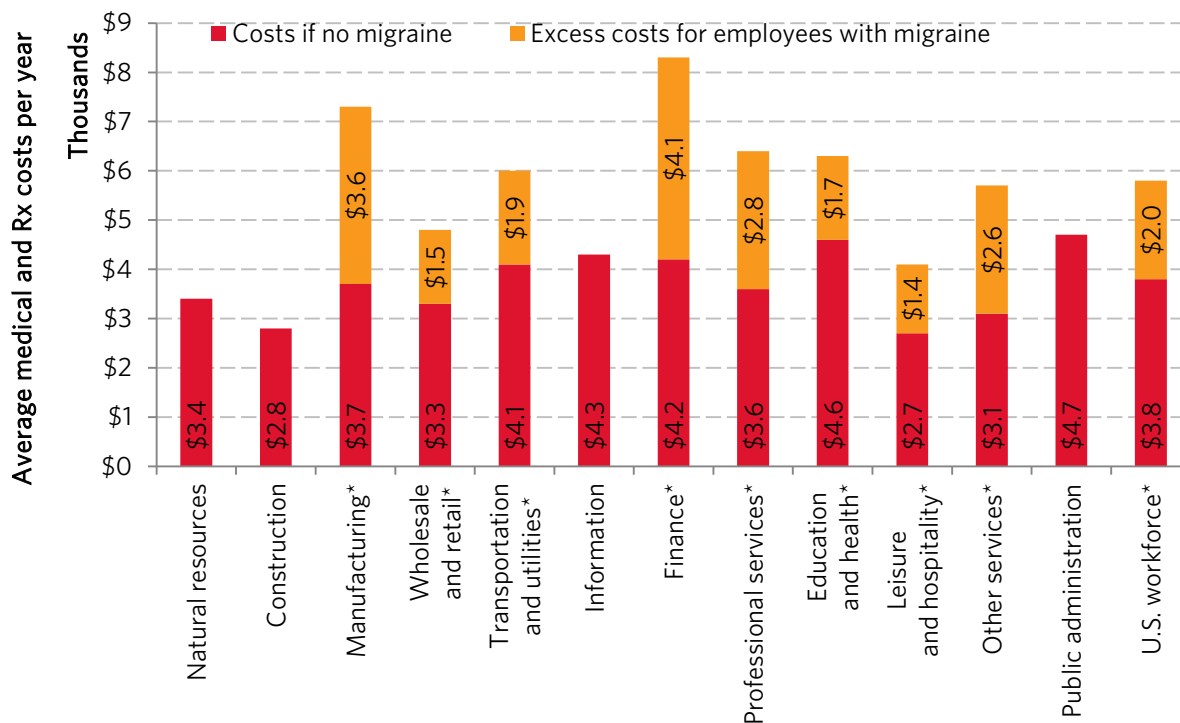
**Figure 3**

Source: Agency for Healthcare Research and Quality, Medical Expenditure Panel Study, 2011-2015. BMI = body mass index. COPD = chronic obstructive pulmonary disease.

## Treatment Costs

### HOW MUCH ARE MEDICAL/RX TREATMENT COSTS FOR EMPLOYEES WITH MIGRAINE?

Figure 3 shows that excess medical and pharmacy treatment costs for employees with migraine averaged almost \$2,000 per year.



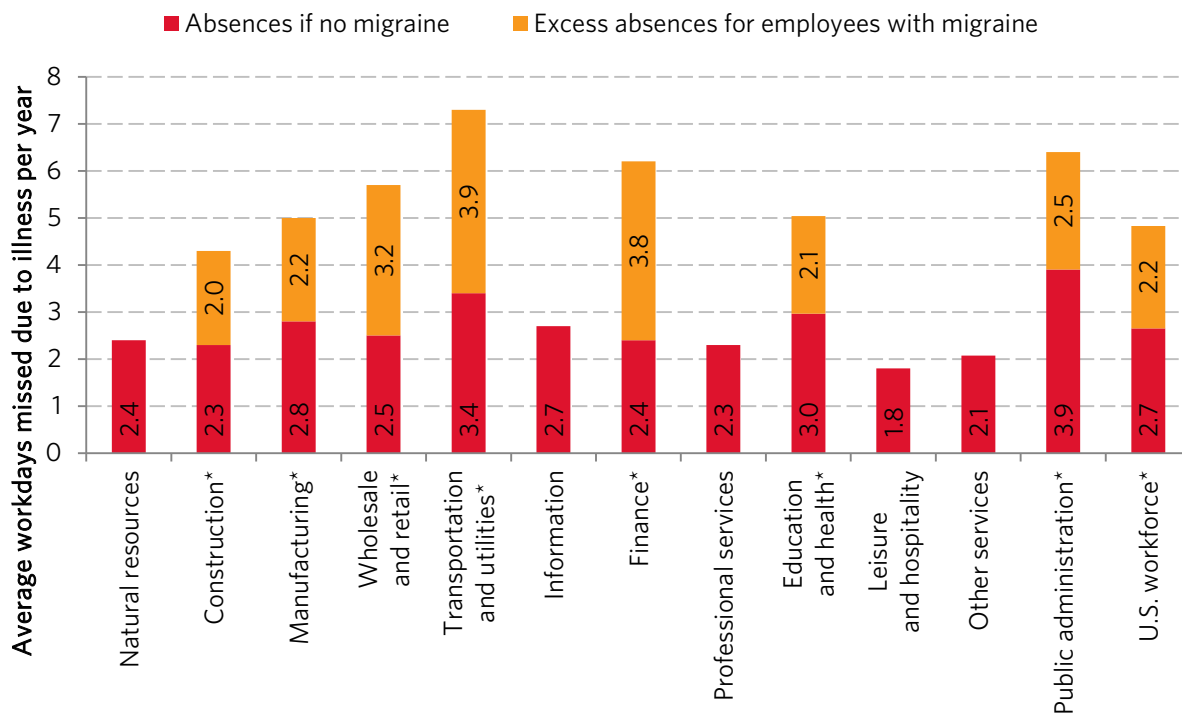
**Figure 4**

Source: Agency for Healthcare Research and Quality, Medical Expenditure Panel Study, 2011-2015. Costs include expenses for all medical and pharmacy treatment, regardless of reason. Costs are estimated from multivariate regression models controlling for other comorbid chronic conditions, age, sex, race and ethnicity. An asterisk (\*) next to an industry label indicates that the estimated excess costs for employees with migraine are statistically significant below the 0.05 level. For industries without an asterisk, a combination of a small sample of employees and wide variation in costs prevent us from confidently estimating that the excess costs are significantly different from \$0 and are therefore not reported. See the appendix for details on the model.

## Illness Absences

### HOW OFTEN ARE EMPLOYEES TREATED FOR MIGRAINE ABSENT FROM WORK DUE TO ILLNESS?

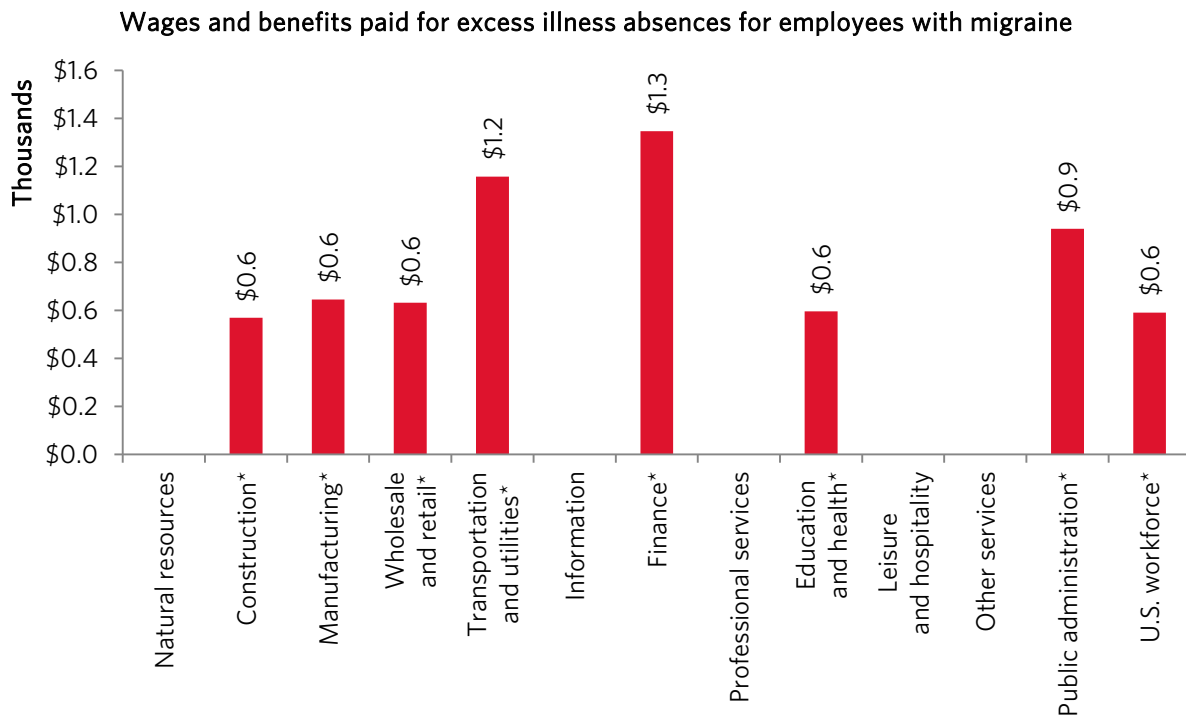
Figure 4 and Figure 5 show that employees with migraine had an average of 2.2 excess sick days per year, at a cost of almost \$600 in wages and benefits.



**Figure 5**

Source: Agency for Healthcare Research and Quality, Medical Expenditure Panel Study, 2011-2015. Illness absences are estimated from multivariate, negative binomial regression models controlling for other comorbid chronic conditions, age, sex, race and ethnicity. An asterisk (\*) next to an industry label indicates that the estimated *excess absences* for employees with migraine are statistically significant below the 0.05 level. For industries without an asterisk, a combination of a small sample of employees and wide variation in absences prevent us from confidently estimating that the excess absences are significantly different from 0 days and are therefore not reported. See the appendix for details on the model.

## WHAT ARE THE COSTS OF ILLNESS ABSENCES FOR EMPLOYEES TREATED FOR MIGRAINE?



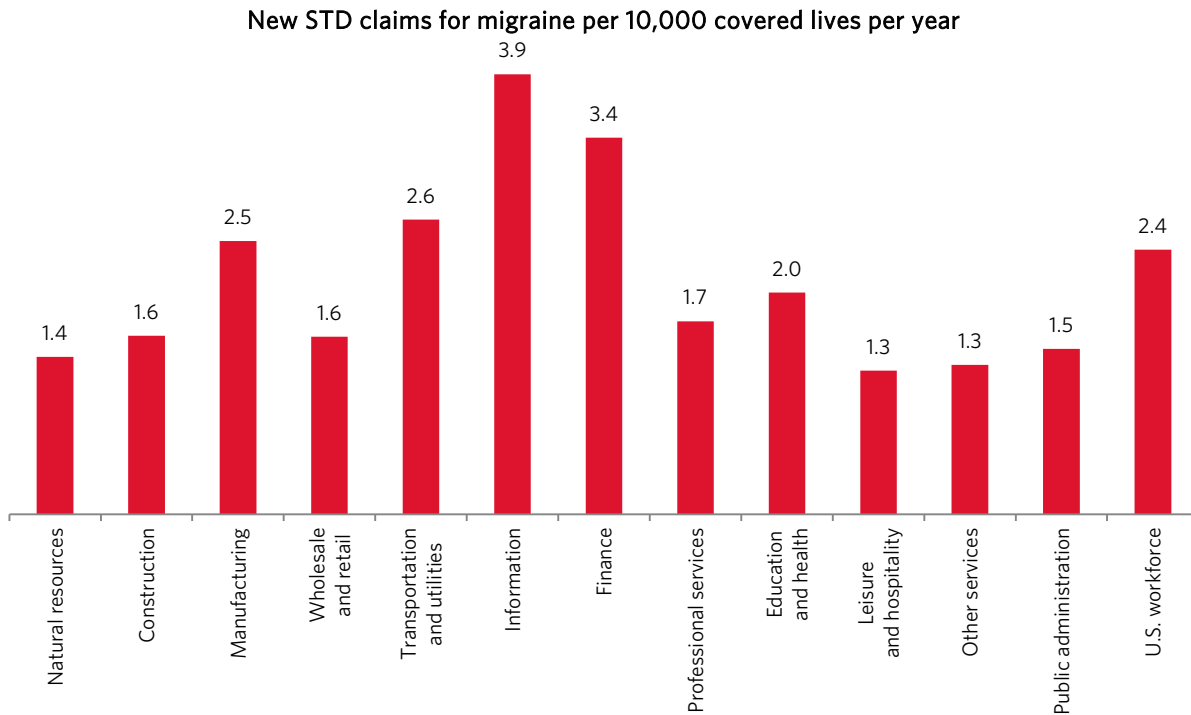
**Figure 6**

See Figure 4 for sources and interpretation of starred industries. Estimates assume that all employees are eligible for paid sick days.

## STD Outcomes

### HOW OFTEN DO EMPLOYEES TAKE STD LEAVE FOR MIGRAINE?

Figure 6 shows that each year, employers' STD policies experience an average of 2.4 new claims for migraine per 10,000 covered lives.

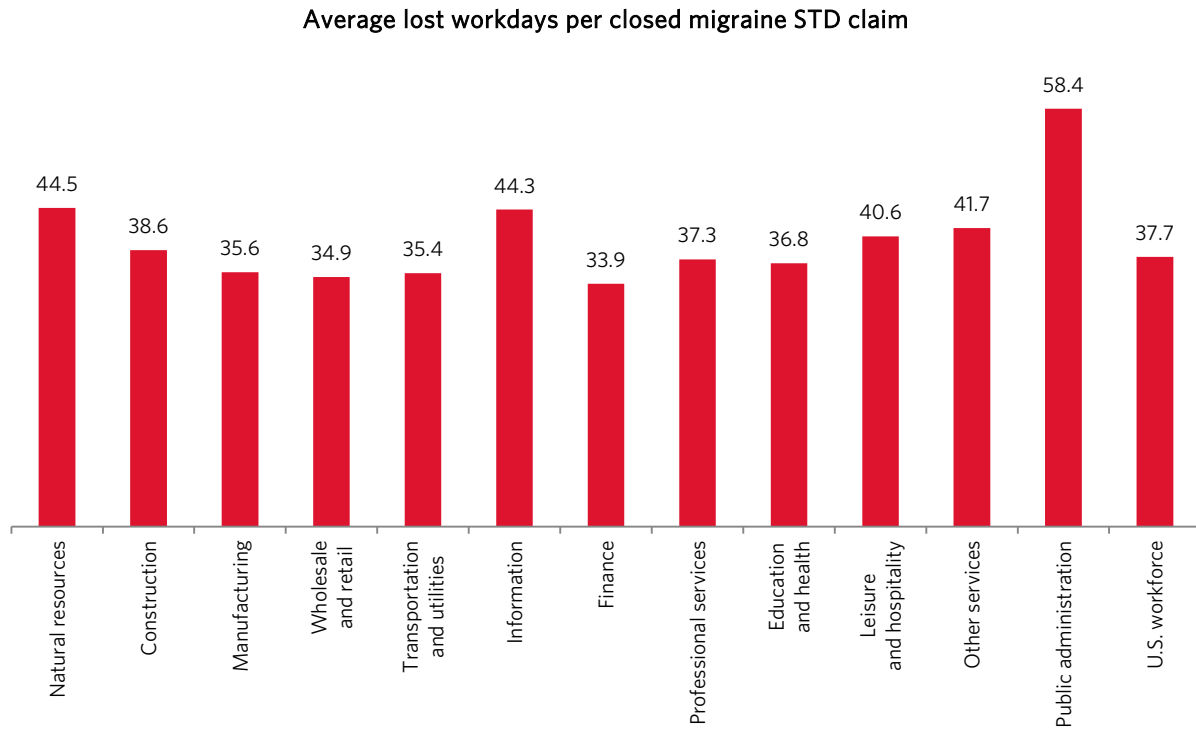


**Figure 7**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011-2016.

## HOW LONG IS THE AVERAGE STD CLAIMANT FOR MIGRAINE AWAY FROM WORK?

Figure 7 shows that STD claims for migraine incur an average of 38 lost workdays.



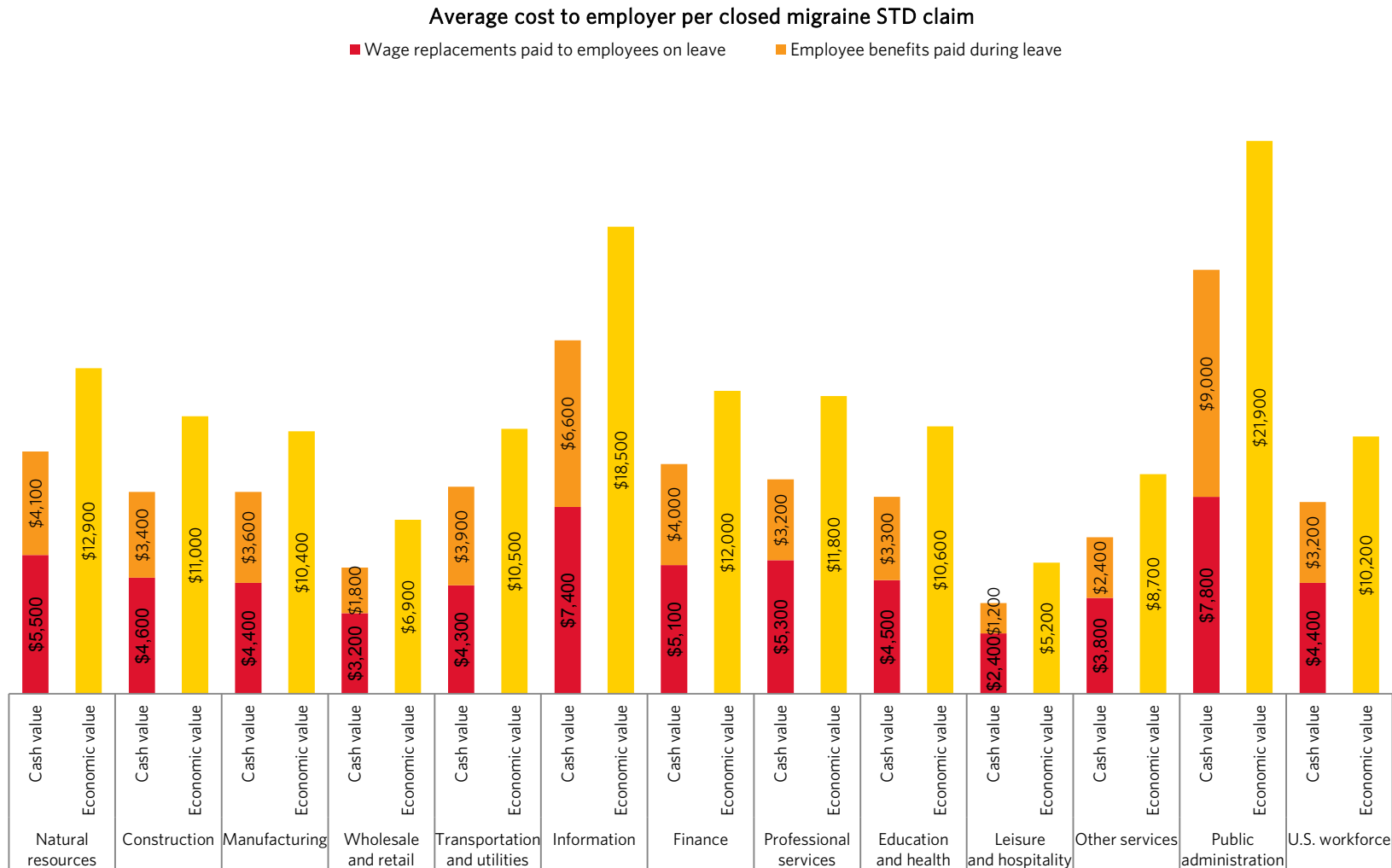
**Figure 8**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011-2016. Lost workdays do not include any elimination period that precedes the claim. Analysis based on 29,000 STD claims for ICD-9 346.XX or ICD-9 784.0.



## HOW MUCH DOES THE AVERAGE STD CLAIM FOR MIGRAINE COST?

Figure 8 shows that the average STD claim for migraine cost about \$7,700 in wage replacements and paid employee benefits. This represents about \$10,400 in lost economic output.



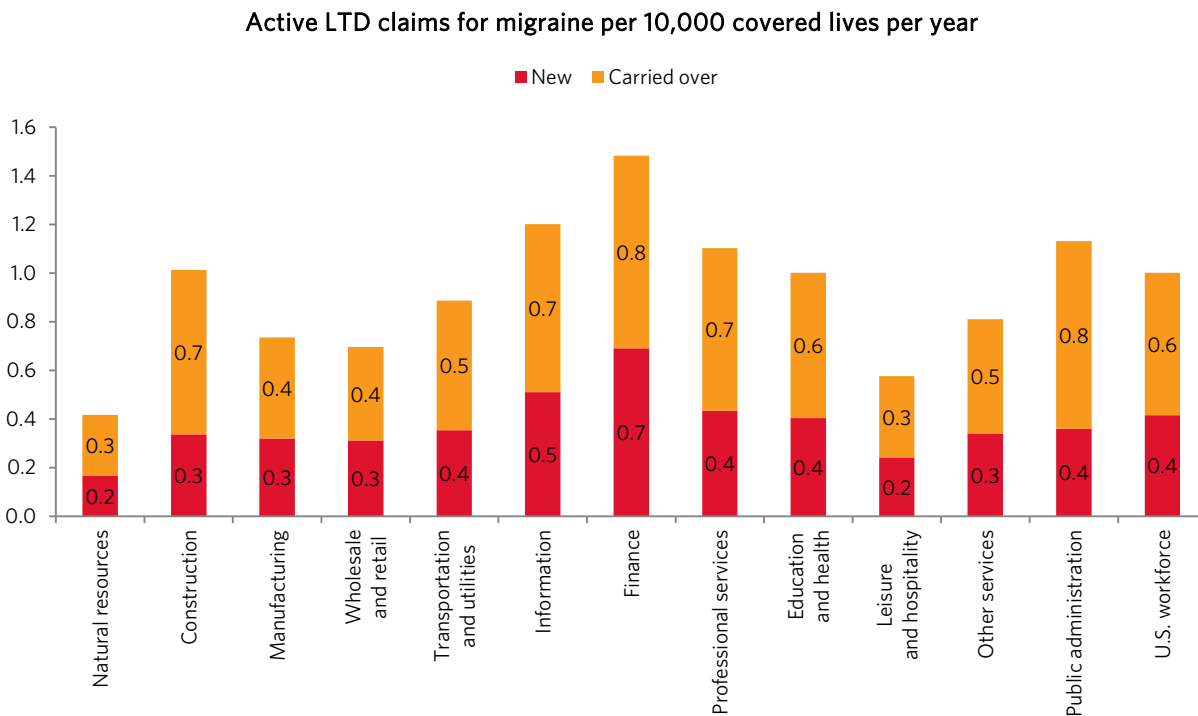
**Figure 9**

See Figure 7 for source and the appendix for cost estimation method. *Cash value* refers to compensation to employees on STD leave, including benefits continuation. *Economic value* refers to the marginal product of lost labor inputs and is estimated by average daily wages and benefits. Cash and economic value represent distinct ways of valuing lost productivity and should not be combined. See the appendix for more information.

## LTD Outcomes

### HOW MANY EMPLOYEES ARE ON LTD LEAVE FOR MIGRAINE OVER A GIVEN YEAR?

Figure 9 shows that each year, employers' LTD insurance policies manage an average of 1.0 active claims for migraine per 10,000 covered lives. Claims that carried over from previous years (0.6 per 10,000) outnumber new claims (0.4 per 10,000) by 1.5 to 1.

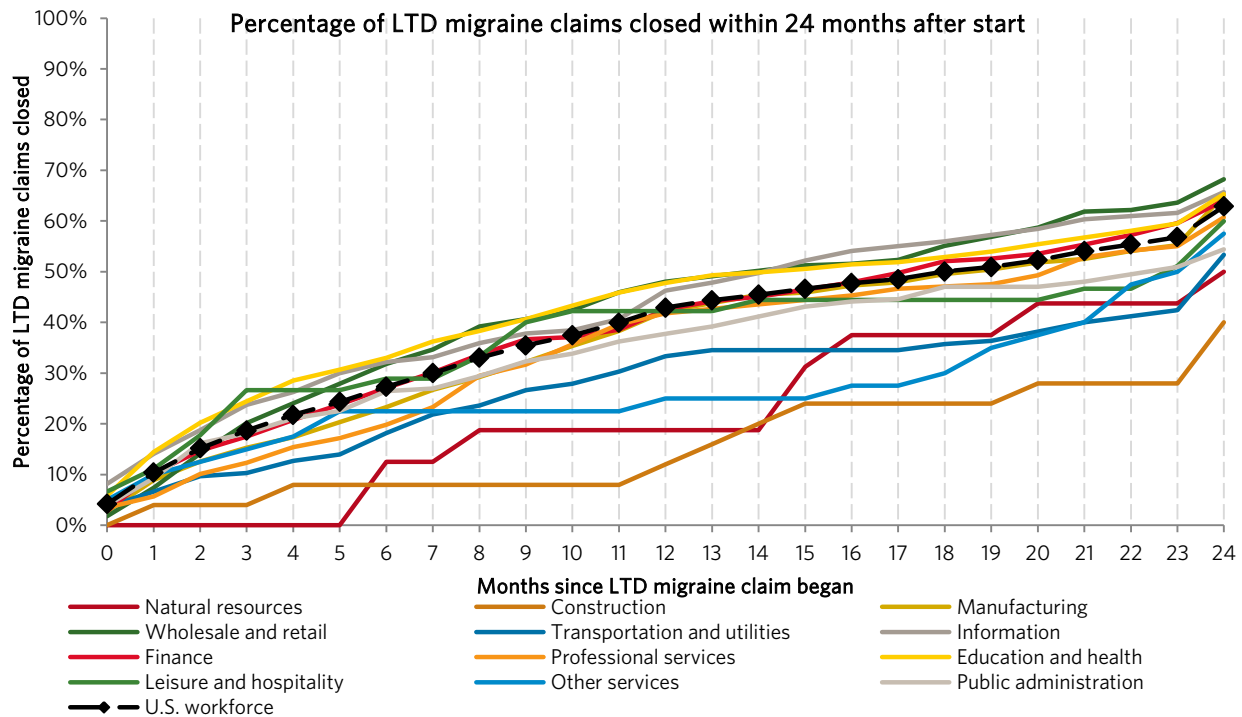


**Figure 10**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011-2016. New claims began within an observed data year. Carried-over claims began prior to an observed data year.

## HOW MANY LTD CLAIMS FOR MIGRAINE CLOSE WITHIN TWO YEARS?

Figure 10 shows the percentage for LTD claims from migraine that close within two years—roughly the point at which LTD policies require an evaluation for whether an employee's condition has improved enough to permit them to perform their own occupation or any other.<sup>7</sup> Of LTD claims for migraine, 37% remain open two years after they begin.



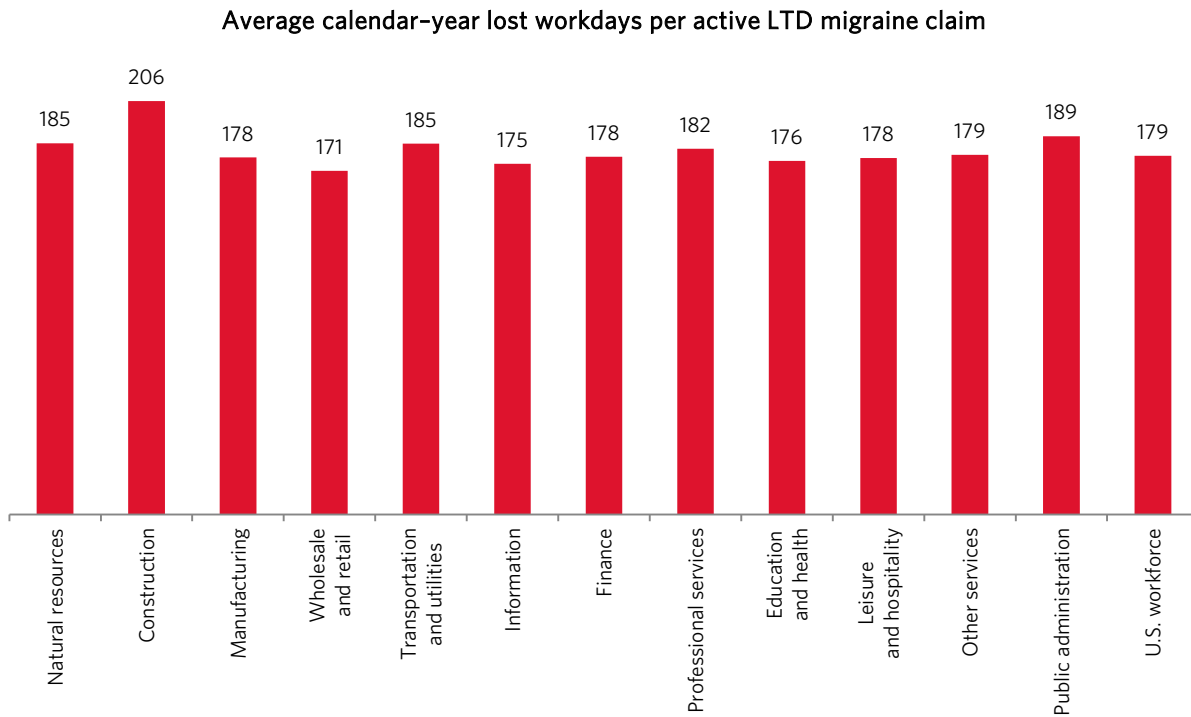
**Figure 11**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011–2016. Analysis is limited to claims with a start date from 2011 to 2014 to provide adequate observation time. Analysis based on 2,900 LTD claims for ICD-9 346.XX or ICD-9 784.0.

<sup>7</sup> See Group Disability Benefits Specialist Course Handbook. The National Underwriter Company. October, 2011. The sharp increase in percentage of closed LTD claims is due to a change in definition of disability from “own occupation” to “any occupation”. This is referred to as a test change and own occupation refers to the claimant’s original occupation while any occupation is defined as one the claimant can reasonably perform based on their education, training or experience.

## HOW MUCH OF EACH WORK YEAR IS LOST BY THE AVERAGE LTD CLAIMANT FOR MIGRAINE?

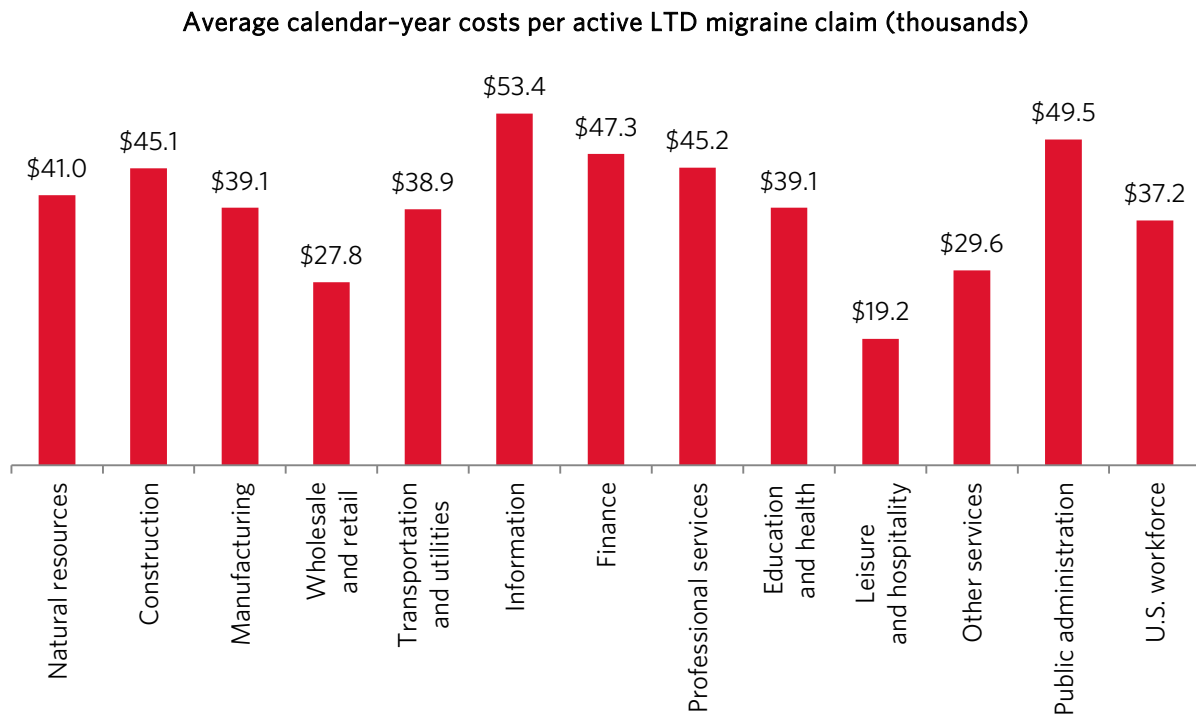
Figure 11 and Figure 12 show that LTD claims for migraine incur an average of 179 lost workdays per year that they remain open, at an average cost of about \$37,000 in wage replacements and paid employee benefits per year.



**Figure 12**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011–2016. Analysis based on 7,500 LTD claims for ICD-9 346.XX or ICD-9 784.0. Days for LTD claims represent wage replacements for lost workdays occurring within a calendar year. This includes claims that began within a calendar year and claims that carried over from previous calendar years.

## HOW MUCH DOES THE AVERAGE LTD CLAIM FOR MIGRAINE COST EACH YEAR?



**Figure 13**

See Figure 11 for source and the appendix for cost estimation method.

## Total Costs of Migraine in a Workforce

### WHAT ARE THE ESTIMATED ANNUAL COSTS ASSOCIATED WITH MIGRAINE IN A 1,000-PERSON WORKFORCE?

Table 1 shows the estimates of annual productivity and healthcare costs associated with migraine. Overall, for every 1,000 U.S. employees, migraine in the workforce costs about \$84,000 in excess healthcare treatments and lost work time. This does not include the value of returns to lost labor inputs (which some economists contend are undercounted by compensation costs, perhaps by as much as 44% on average for different occupations<sup>8</sup>), early exits from the labor force, excess turnover costs and presenteeism (underperformance on the job due to migraine). Considerable cost differences are observed across industries, ranging from about \$65,000 per 1,000 employees in the transportation and utilities industry to about \$180,000 per 1,000 employees in the finance industry.

**Table 1: Estimates of annual costs associated with migraine in a 1,000-person workforce (thousands)**

	Excess medical and Rx treatments	Excess illness absences	STD claims	LTD claims	Total*
Natural resources	n.s.	n.s.	\$1.8	\$0.9	
Construction	n.s.	\$3.4	\$1.8	\$2.7	
Manufacturing	\$72.4	\$13.0	\$2.5	\$1.7	\$89.5
Wholesale and retail	\$45.6	\$19.2	\$1.2	\$1.5	\$67.5
Transportation and utilities	\$37.8	\$23.0	\$2.9	\$1.5	\$65.3
Information	n.s.	n.s.	\$7.6	\$2.5	
Finance	\$129.2	\$42.4	\$4.2	\$4.7	\$180.4
Professional services	\$77.0	n.s.	\$2.1	\$3.1	
Education and health	\$80.8	\$28.3	\$2.1	\$2.6	\$113.7
Leisure and hospitality	\$27.6	n.s.	\$0.7	\$1.3	
Other services	\$83.7	n.s.	\$1.2	\$1.0	
Public administration	n.s.	\$41.9	\$3.3	\$2.1	
U.S. workforce	\$61.2	\$18.1	\$2.5	\$2.2	\$83.9

Sources: Agency for Healthcare Research and Quality, Medical Expenditure Panel Study, 2011–2015; Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011–2016; Bureau of Labor Statistics.

n.s. = Not significant in Figures 3, 4, and 5. \* Totals not calculated for industries with non-significant excess treatment or illness costs.

Treatment costs and illness absence days are calculated by the product of the prevalence of migraine and the average excess outcomes for employees with migraine (see previous charts in this section). Costs for illness absences and STD claims represent the economic value of lost labor inputs from absences. They are calculated by applying industry-average 2015 daily wage and benefits estimates from BLS to the total number of estimated lost workdays. See the appendix for more information. Costs for LTD claims represent wage replacements for lost workdays occurring within a calendar year. Costs assume that all employees are eligible for illness absence, STD benefits and LTD benefits or for other benefits that allow them to take time off from work due to migraine. Analysis of STD is limited to claims with a start date from 2011 to 2015 to provide adequate time to observe a claim closure. Analysis of LTD is limited to claims from data years 2012 to 2016 to observe lost workdays from both new and carried-over claims.

<sup>8</sup> Nicholson, S., Pauly, M.V., Polsky, D., Sharda, C., Szrek, H. and Berger, M.L. "Measuring the effects of work loss on productivity with team production." *Health Economics*. 2006;15(2):111-123.

## Evidence for Workplace Interventions

When a patient is diagnosed with migraines, medications to prevent or minimize the severity or duration of headaches and other symptoms are widely prescribed. These include classes of drugs such as pain relievers, triptans, and ergots, but also cardiovascular drugs, anticonvulsants, antidepressants and botulinum toxin A.<sup>9</sup> Monoclonal antibodies against amino acids thought to be related to migraine (calcitonin gene-related peptides, or CGRP) represent an opportunity to reduce the frequency of migraine attacks.<sup>10</sup> One CGRP inhibitor has been approved for use by the FDA<sup>11</sup> and several others are now undergoing clinical trials.

The current diversity of migraine treatment options reflects the variety of current disease management strategies—for example, minimizing the severity and duration of episodes for patients who do not meet all the migraine criteria vs. reducing symptom frequency among migraineurs. In addition to promoting migraine awareness in their workforce, employers can help chronic headache sufferers manage their conditions and their productivity by developing benefit plans that cover a range of treatment options across different clinical specialties.

Several sources offer good starting points for crafting strategies to manage the health and productivity impact of migraine. Examples include:

- Several studies indicate that controlling headache symptoms can improve migraine sufferers' on the job performance.<sup>12</sup> In particular, adherence with migraine treatment guidelines indicating initial use of migraine-specific medications followed by pain medications can mitigate loss of work functioning.<sup>13</sup> Taking triptans soon after the onset of headache—for example, within half an hour—has also been associated with more rapid return to functioning.<sup>14</sup>
- Work accommodations such as modified schedules, work-at-home arrangements, and special equipment have been shown to improve on-the-job performance among employees with painful conditions such as migraine.<sup>15</sup>
- Using data from two randomized-controlled clinical trials, migraine prophylactic therapy was found to decrease illness absences from work relative to placebo.<sup>16</sup>

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<sup>9</sup> Mayo Clinic, Disease and Conditions Guide: Migraine <<http://www.mayoclinic.com/health/migraine-headache/DS00120/DSECTION=treatments-and-drugs>>

<sup>10</sup> Tso AR and Goadsby PJ. Anti-CGRP Monoclonal Antibodies: the Next Era of Migraine Prevention? *Current Treatment Options in Neurology*. 2017. 19:27. <<https://link.springer.com/article/10.1007/s11940-017-0463-4>>

<sup>11</sup> U.S. Food and Drug Administration, May 17, 2018. <<https://www.fda.gov/NewsEvents/Newsroom/PressAnnouncements/ucm608120.htm>>

<sup>12</sup> Gifford B. Sharing the Pain: The Productivity of Employees with Migraines and Chronic Severe Headaches. Integrated Benefits Institute. 2013. <<https://www.ibiweb.org/ibi-research-director-speaks-at-a-congressional-briefing-on-the-prevention/>>

<sup>13</sup> Seng EK, Robbins MS, Nicholson RA. Acute migraine medication adherence, migraine disability and patient satisfaction: A naturalistic daily diary study. *Cephalalgia*. 2017;37(10):955-64.

<sup>14</sup> Pradel F, Subedi P, Varghese A, Mullins C, Weis K. Does earlier headache response equate to earlier return to functioning in patients suffering from migraine? *Cephalalgia*. 2006;26(4):428-35.

<sup>15</sup> Gifford B, Zong Y. On-the-Job Productivity Losses among Employees with Health Problems: The Role of Work Accommodations. *Journal of Occupational and Environmental Medicine*. 2017;59(9):885-93.

## Additional Information about Migraine

More information about the causes, treatment, and prevention of migraine can be found at the following sources:

[National Institute of Neurological Disorders and Stroke's Migraine Information Page](#)

[The American Migraine Foundation](#)

[National Headache Foundation](#)

[The Migraine Trust](#)

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<sup>16</sup> Lofland JH, Gagne JJ, Pizzi LT, Rupnow M, Silberstein SD. Impact of topiramate migraine prophylaxis on workplace productivity: results from two US randomized, double-blind, placebo-controlled, multicenter trials. *Journal of Occupational and Environmental Medicine*. 2007 Mar 1;49(3):252-7.



## Appendix

### SUPPLEMENTAL DATA

To estimate the costs for each lost workday, we apply industry-average daily wages in 2015 from the BLS's Occupational Employment Statistics (OES) program.<sup>17</sup> We also include an estimate of payments for employee benefits such as healthcare, retirement, and mandatory programs from the BLS's National Compensation Survey.<sup>18</sup>

Our estimates assume a population of employees that is 100% eligible for paid sick days and for STD and LTD benefits. The economic value of each lost workday is the sum of average daily wages and benefits. For the cash value of disability absences, we assume that employees are paid 100% of their daily benefits, but only a portion of their wages based on their industry's average wage replacement rate as a fixed percent of annual earnings reported in the BLS's Employee Benefits Survey.<sup>19</sup> The STD wage replacement rate was 63% for the U.S. workforce, ranging from 59% to 65% across industries. For LTD, the average replacement rate was 58%, ranging from 57% to 61%.

Healthcare treatment costs in the MEPS data are reported in current dollars. We inflate all costs to 2015 dollars using the chain-weighted national health expenditures deflator reported in 2016 by the Centers for Medicare and Medicaid Services (CMS), Office of the Actuary.<sup>20</sup>

### REGRESSION MODELS

Our analyses of healthcare costs and illness absences using the MEPS data employ multivariate regression methods to isolate marginal results on average of employees' demographics and other comorbidities. The basic form of the model is:

$$\hat{Y} = \alpha + \beta_1 \text{Chronic} + \beta_2 \text{Any other chronic} + \beta_3 \text{Chronic} \times \text{Any other chronic} + \sum \beta_k \text{Demographics} + \varepsilon$$

#### Equation 1

Where  $\hat{Y}$  is the predicted value of the outcome,  $\alpha$  is the constant intercept if all variables in the model equal zero, and  $\varepsilon$  is the error term.  $\beta_1$  is the marginal increase or decrease in the outcome for employees with the focal chronic condition (in this case, migraine) compared to employees without the focal condition.  $\beta_2$  is the marginal change for employees with any conditions besides the focal condition, and  $\beta_3$  captures the marginal changes for the interactions between the focal and other conditions.  $\sum \beta_k$  represents the marginal changes for the demographic variables included in the models. These demographics include sex, age, race (white, black, or any other), and Hispanic ethnicity. The models are run separately for each industry. For the estimates of the U.S. workforce, indicator variables for each industry are included.

<sup>17</sup> BLS, Occupational Employment Statistics (OES), 2015; <https://www.bls.gov/oes/home.htm>

<sup>18</sup> BLS, National Compensation Survey, Employer Costs of Employee Compensation, 2015; <https://www.bls.gov/ncs/>

<sup>19</sup> BLS, Employee Benefits Survey, 2015; [https://www.bls.gov/ncs/ebs/benefits/2015/benefits\\_life.htm](https://www.bls.gov/ncs/ebs/benefits/2015/benefits_life.htm)

<sup>20</sup> Martin AB, Hartman M, Washington B, Catlin A, National Health Expenditure Accounts Team. National health spending: faster growth in 2015 as coverage expands and utilization increases. *Health Affairs*. 2016; Dec 2:10-377.

The estimator is ordinary least squares regression for healthcare treatment costs and negative binomial regression for illness absences. To estimate either costs or absences for the baseline case (that is, for employees without the focal condition), the equation is solved at the mean of all variables in the model, with the values of focal condition and the interaction with the focal conditions set to zero. Excess costs or absences are calculated as  $\beta_1$  plus the product of  $\beta_3$  and the proportion of the population with any other chronic conditions (converted to the predicted number of events in the case of absences). All results are weighted to reflect the U.S. workforce.



## About IBI

Founded in 1995, the Integrated Benefits Institute (IBI) is a national, nonprofit research and educational organization focused on workforce health and productivity. IBI provides data, research, tools and engagement opportunities to help business leaders make sound investments in their employees' health. IBI is supported by more than 1,200 member companies representing over 20 million workers.

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