



# HEALTH AND PRODUCTIVITY IMPACT OF CHRONIC CONDITIONS

## OSTEOARTHRITIS

September 2019

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## Executive Summary: Health and Productivity Impact of Osteoarthritis

- One in fourteen employed U.S. adults either reported being diagnosed with osteoarthritis or had medical or pharmacy treatments for osteoarthritis. Fewer than half of employees with osteoarthritis had medical or pharmacy treatments (ICD-9 diagnosis codes 715.XX; ICD-10 diagnosis codes M15.XX to M19.XX).
- Osteoarthritis rates increase sharply with age, and women are more likely than men to have osteoarthritis at every age level. Between ages 55 and 64, one in eight men and one in five women have arthritis.
- Two in five employees with osteoarthritis also had hypertensive disease, obesity, or lipid metabolism disorder. Back pain afflicted one in four employees with osteoarthritis, while mood disorders afflicted one in five.
- Excess medical and pharmacy treatment costs for employees with osteoarthritis averaged about \$4,400 per year.
- Employees with osteoarthritis had about 1.5 excess sick days per year, at a cost of almost \$400 in wages and benefits.
- Each year, employers' short-term disability (STD) insurance policies experience an average of 1.7 new claims for osteoarthritis per 1,000 covered lives. STD claims for osteoarthritis incur an average of 54 lost workdays, at an average cost of about \$11,400 in wage replacements and paid employee benefits. This represents about \$15,400 in lost economic output.
- Each year, employers' LTD insurance policies manage an average of almost 7 active claims for osteoarthritis per 10,000 covered lives. New claims (3.5 per 10,000) slightly outnumber claims that carried over from previous years (3.3 per 10,000). Of LTD claims for osteoarthritis, about one on three remain open two years after they begin. LTD claims for osteoarthritis incur an average of 156 lost workdays per year that they remain open, at an average cost of more than \$21,000 in wage replacements and paid employee benefits per year.
- Overall, for every 1,000 U.S. employees, osteoarthritis in the workforce costs about \$219,000 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 osteoarthritis).
- Considerable cost differences are observed across industries, ranging from about \$161,000 per 1,000 employees in the manufacturing industry to about \$400,000 per 1,000 employees in the education and health 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: (A) a survey of U.S. households, with information supplemented by data from household members' medical providers (the household component); and (B) 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.

Data from IBI's *Health and Productivity Benchmarking System* (referred to simply as *Benchmarking*)<sup>2</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 2011–2017 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 or intensity of care management.<sup>3</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) and 10th revision (ICD-10),<sup>4</sup> based on the three-digit diagnosis categories available in the MEPS data. MEPS data contain ICD-9 codes. *Benchmarking* data contain full ICD-9 and ICD-10 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.

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>

# OSTEOARTHRITIS

## Introduction

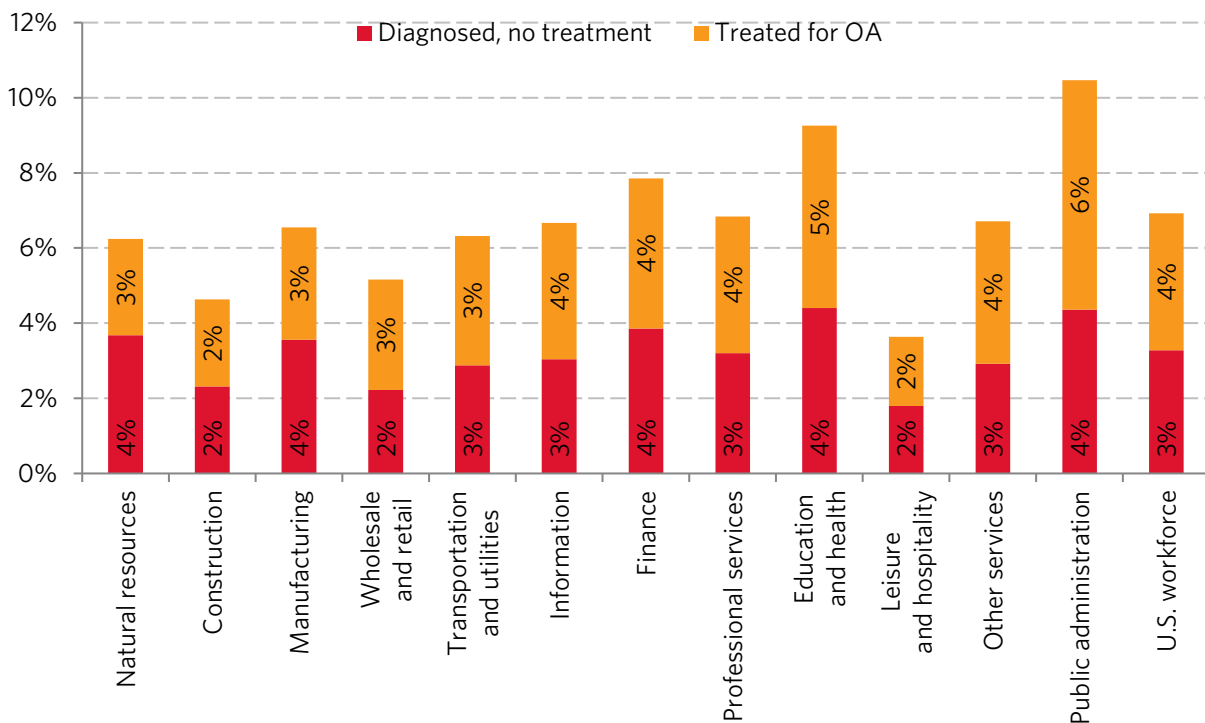
Osteoarthritis It is a degenerative joint disease that most frequently affects the knees, hips, lower back and neck, small joints of the fingers, and the base of the thumb and big toe.<sup>5</sup> Osteoarthritis symptoms include joint pain, stiffness, and movement limitations.<sup>6</sup>

For the purpose of this report, osteoarthritis is indicated as diagnoses for treatment or benefits with ICD-9 codes 715.XX or ICD-10 codes M15.XX to M19.XX.

## Prevalence

### HOW MANY PEOPLE HAVE OSTEOARTHRITIS?

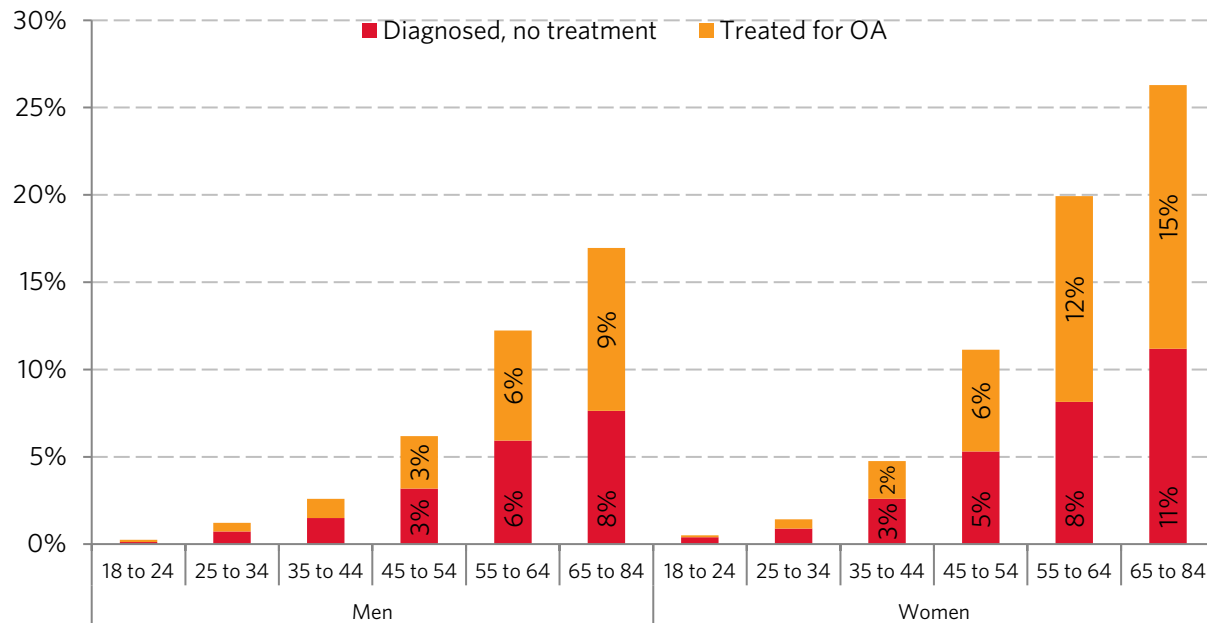
Figure 1 shows that one in fourteen employed U.S. adults either reported being diagnosed with osteoarthritis or had medical or pharmacy treatments for osteoarthritis. Fewer than half of employees with osteoarthritis had medical or pharmacy treatments.



**Figure 1**

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

Figure 2 shows that osteoarthritis rates increase sharply with age, and women are more likely than men to have osteoarthritis at every age level. Between ages 55 and 64, one in eight men and one in five women have arthritis.



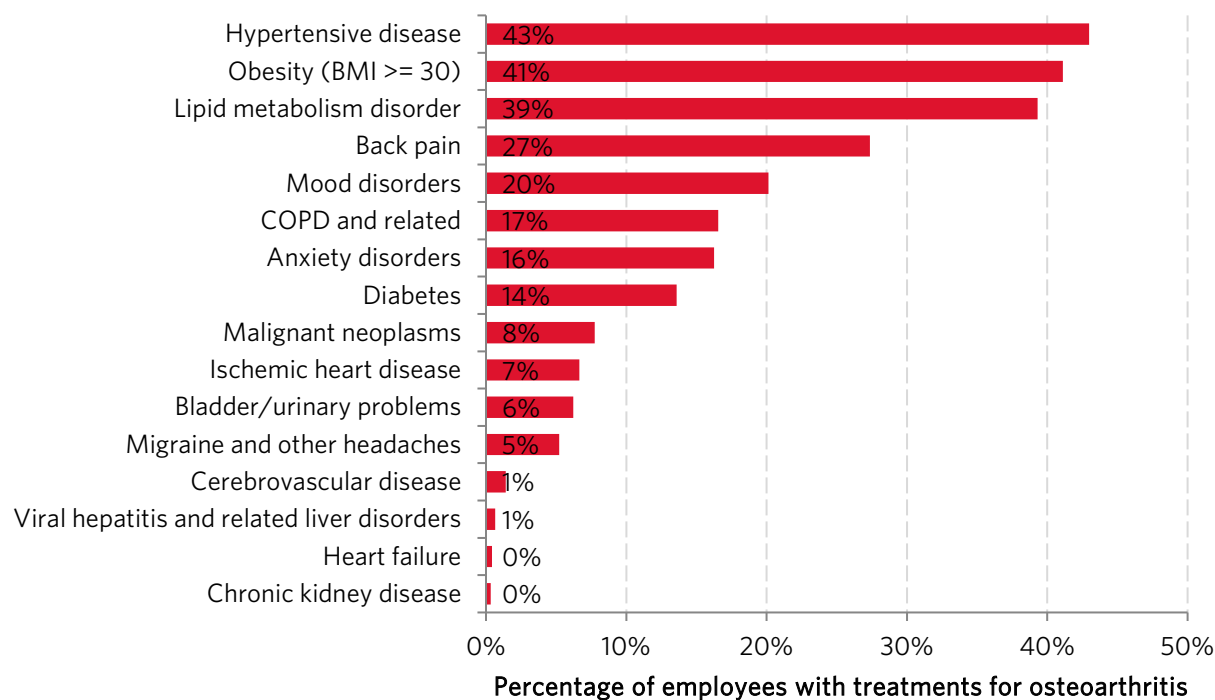
**Figure 2**

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



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

Figure 3 shows that two in five employees with osteoarthritis also had hypertensive disease, obesity, or lipid metabolism disorder. Back pain afflicted one in four employees with osteoarthritis, while mood disorders afflicted one in five.



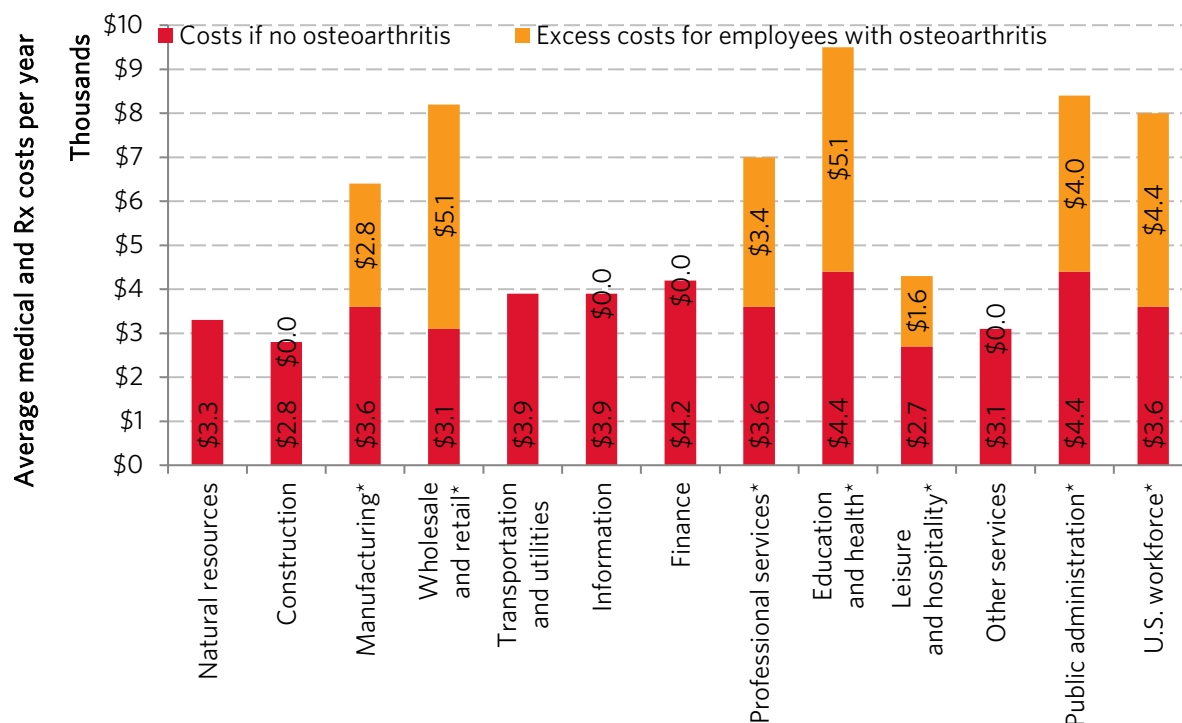
**Figure 3**

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 OSTEOARTHRITIS?

Figure 3 shows that excess medical and pharmacy treatment costs for employees with osteoarthritis averaged about \$4,400 per year.



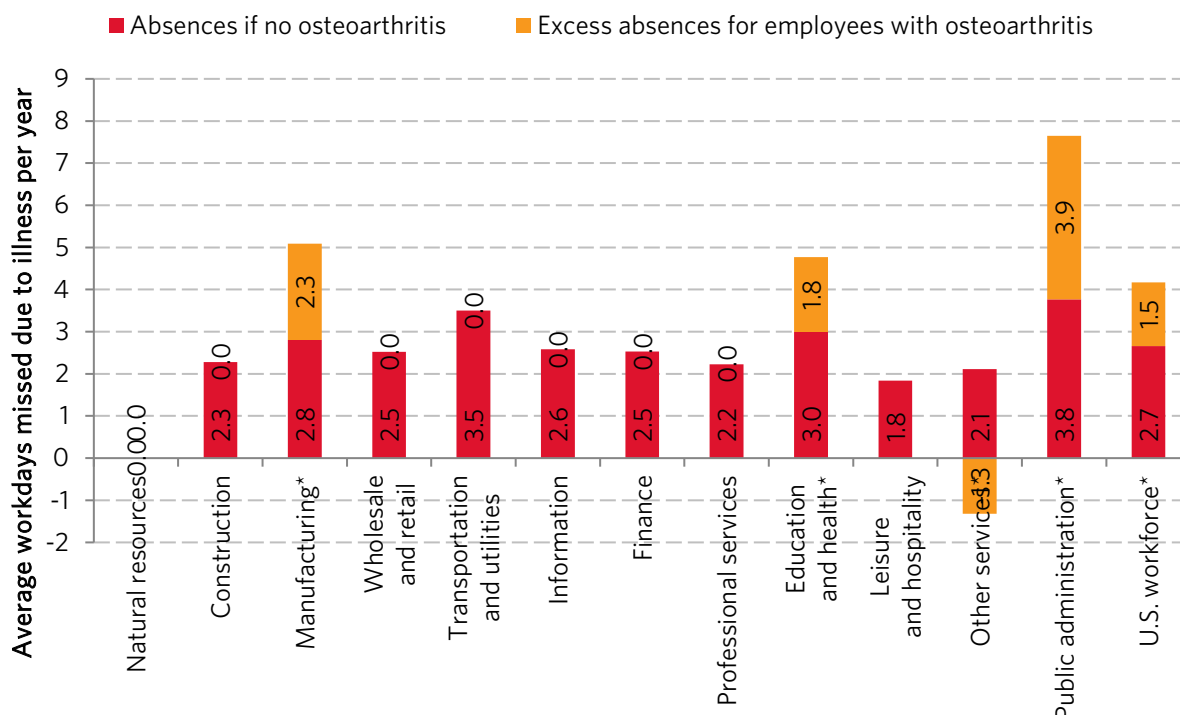
**Figure 4**

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 osteoarthritis 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 OSTEOARTHRITIS ABSENT FROM WORK DUE TO ILLNESS?

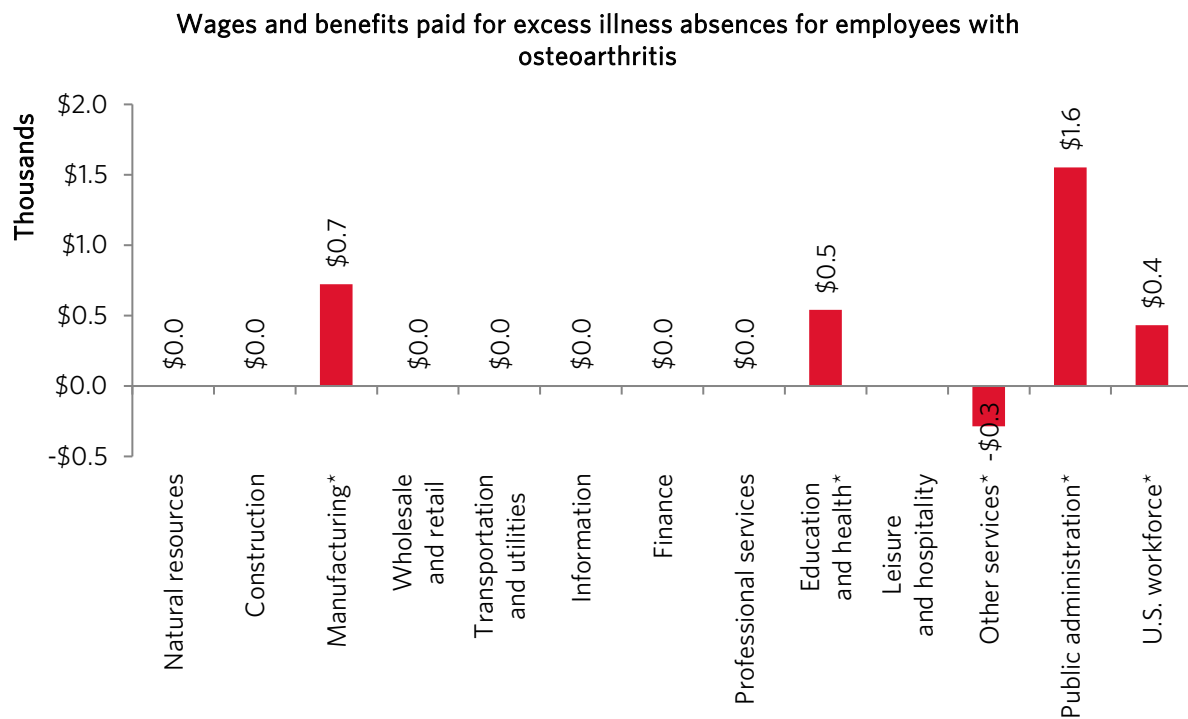
Figure 4 and Figure 5 show that employees with osteoarthritis had about 1.5 excess sick days per year, at a cost of almost \$400 in wages and benefits.



**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 osteoarthritis 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 OSTEOARTHRITIS?



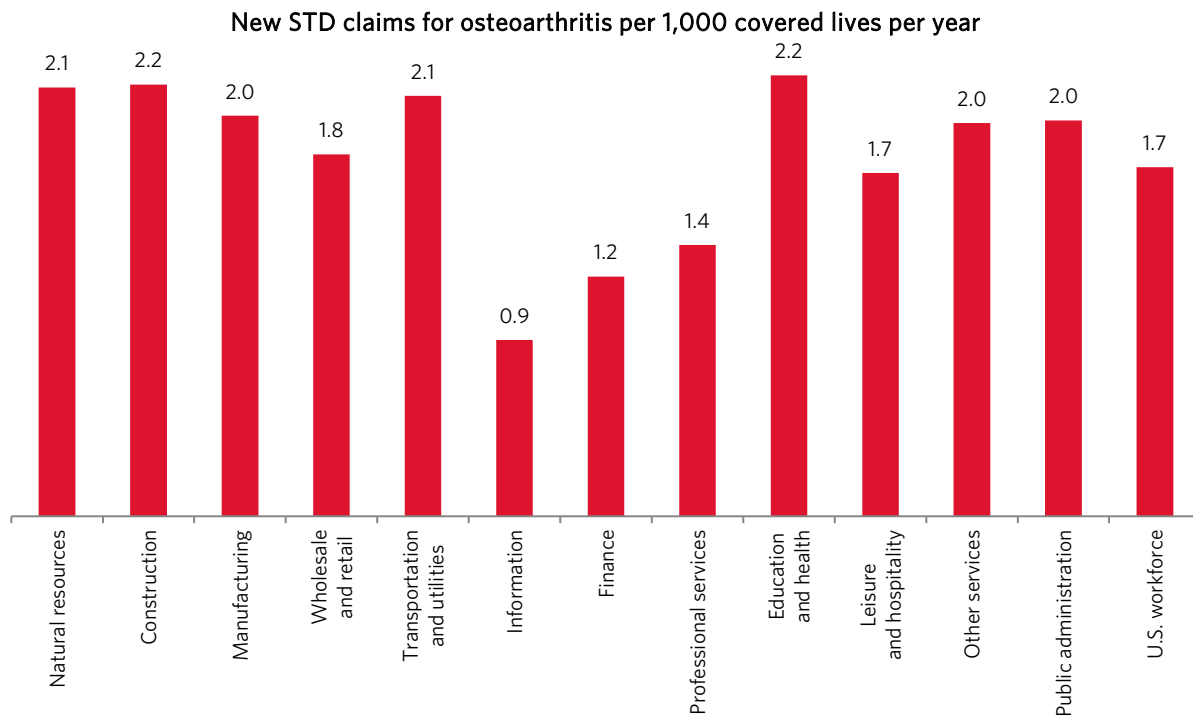
**Figure 6**

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 OSTEOARTHRITIS?

Figure 6 shows that each year, employers' STD policies experience an average of 1.7 new claims for osteoarthritis per 1,000 covered lives.

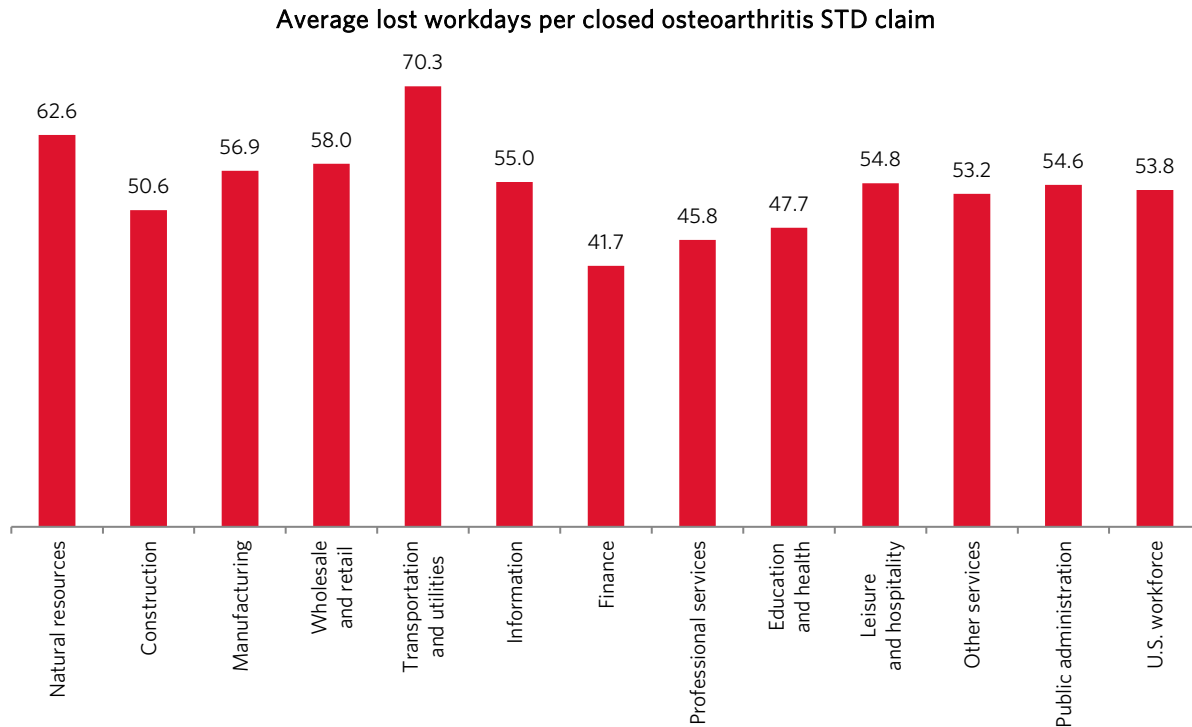


**Figure 7**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011-2017.

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

Figure 7 shows that STD claims for osteoarthritis incur an average of 54 lost workdays.

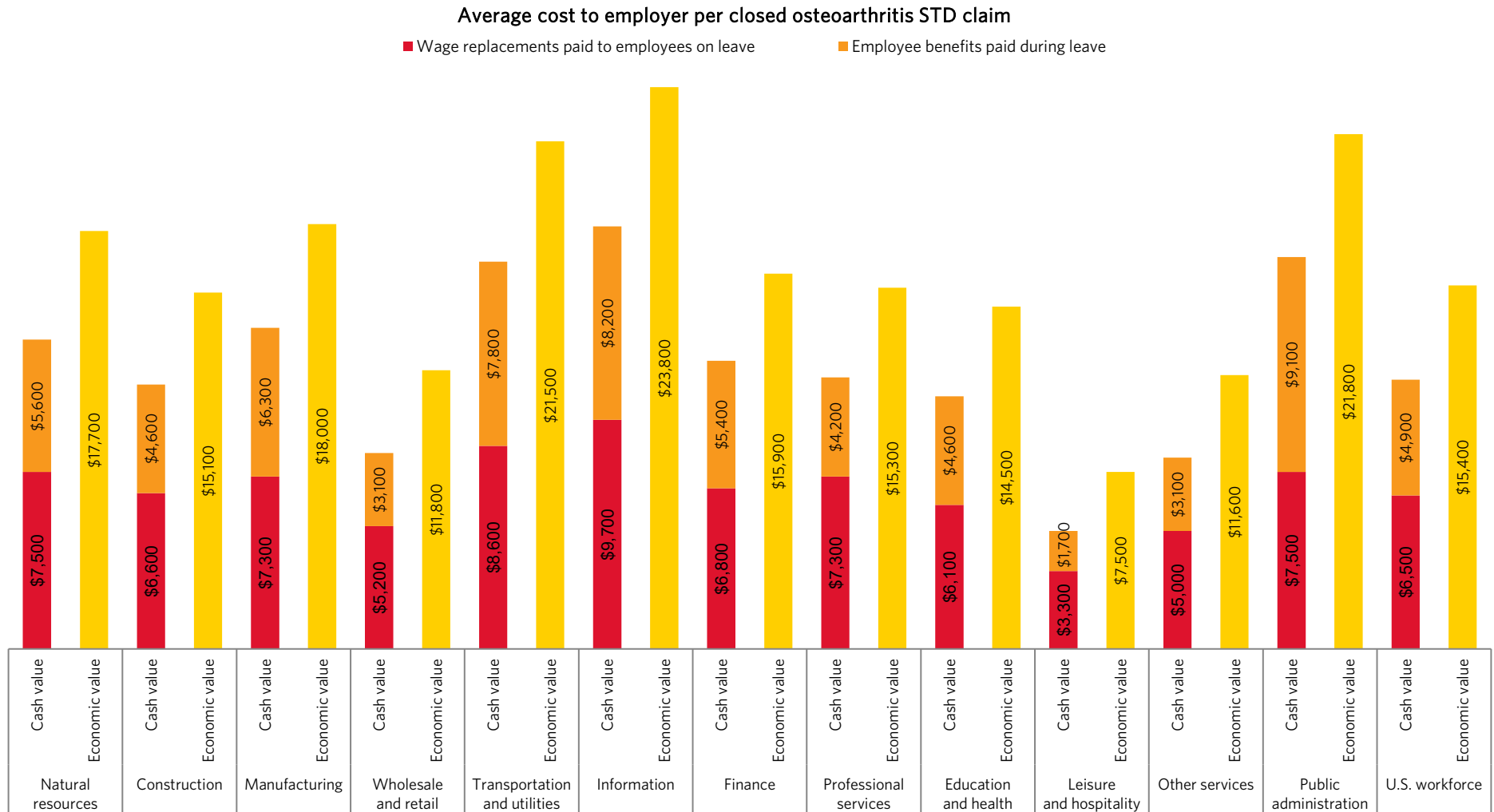


**Figure 8**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011–2017. Lost workdays do not include any elimination period that precedes the claim. Analysis based on 229,946 STD claims for ICD-9 715.XX and ICD-10 M15.XX – M19.XX.

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

Figure 8 shows that the average STD claim for osteoarthritis cost about \$11,400 in wage replacements and paid employee benefits. This represents about \$15,400 in lost economic output.



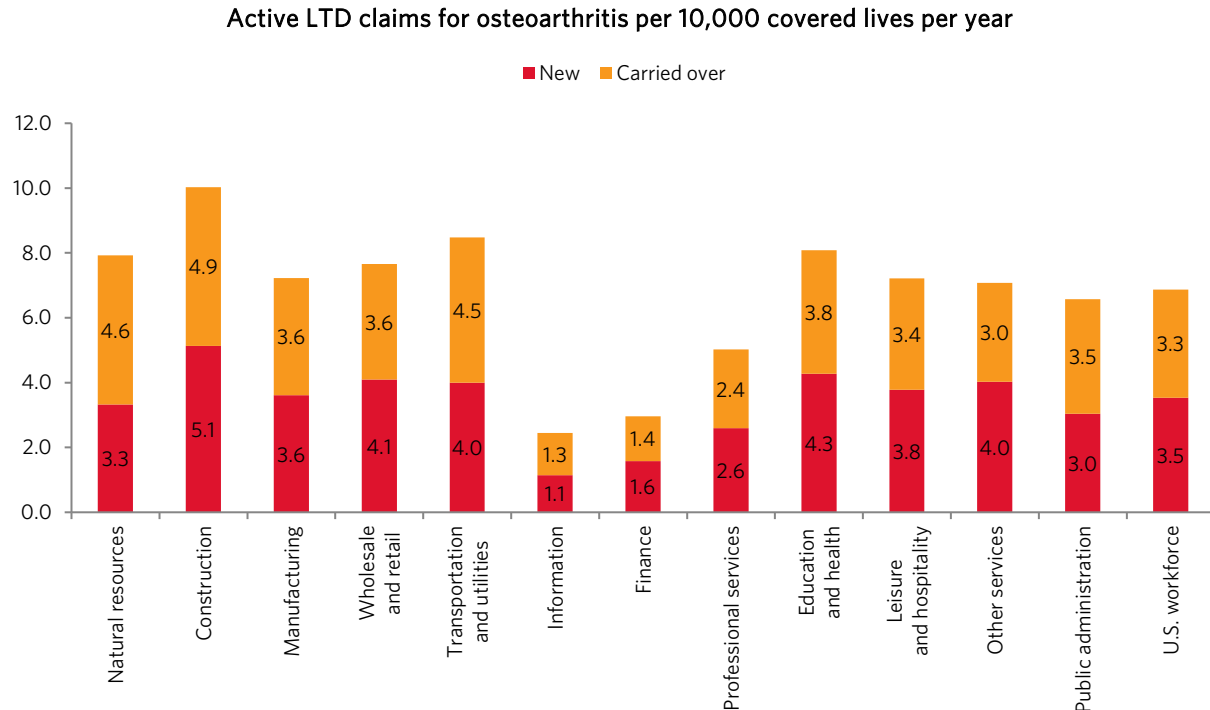
**Figure 9**

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 OSTEOARTHRITIS OVER A GIVEN YEAR?

Figure 9 shows that each year, employers' LTD insurance policies manage an average almost 7 active claims for osteoarthritis per 10,000 covered lives. New claims (3.5 per 10,000) slightly outnumber claims that carried over from previous years (3.3 per 10,000).



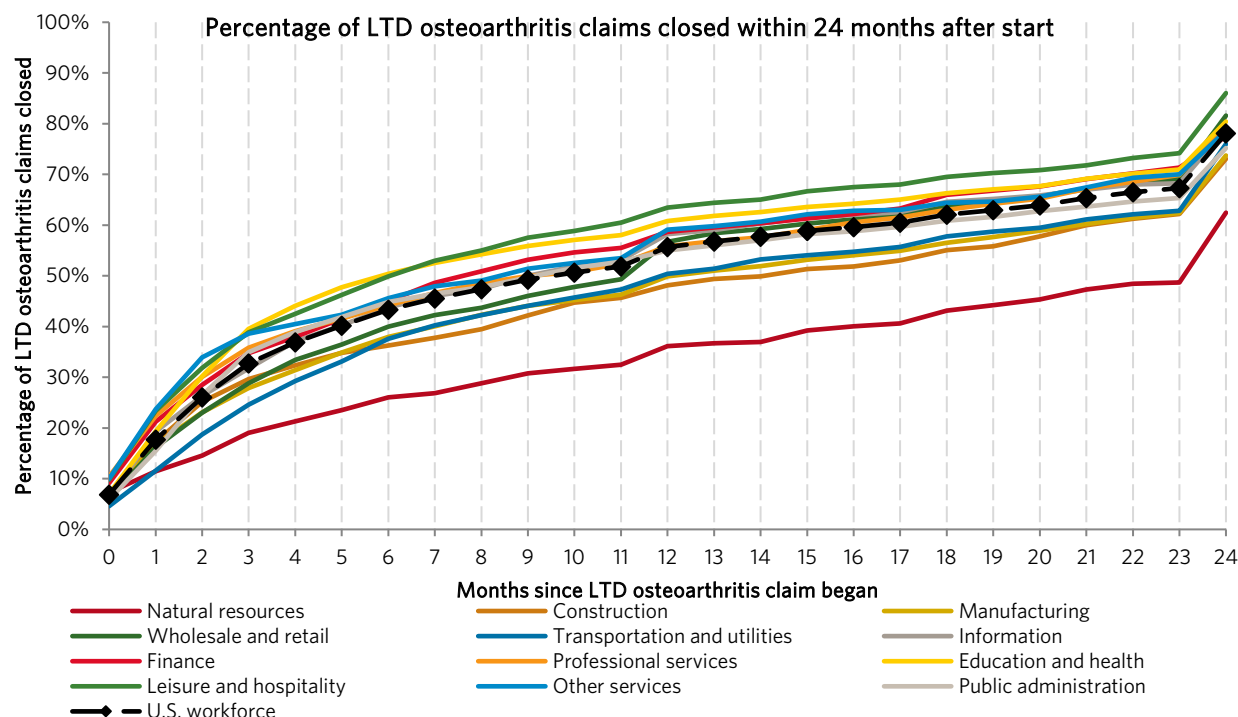
**Figure 10**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011–2017. New claims began within an observed data year. Carried-over claims began prior to an observed data year.



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

Figure 10 shows the percentage for LTD claims for osteoarthritis 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>1</sup> Of LTD claims for osteoarthritis, about one in three remains open two years after they begin.



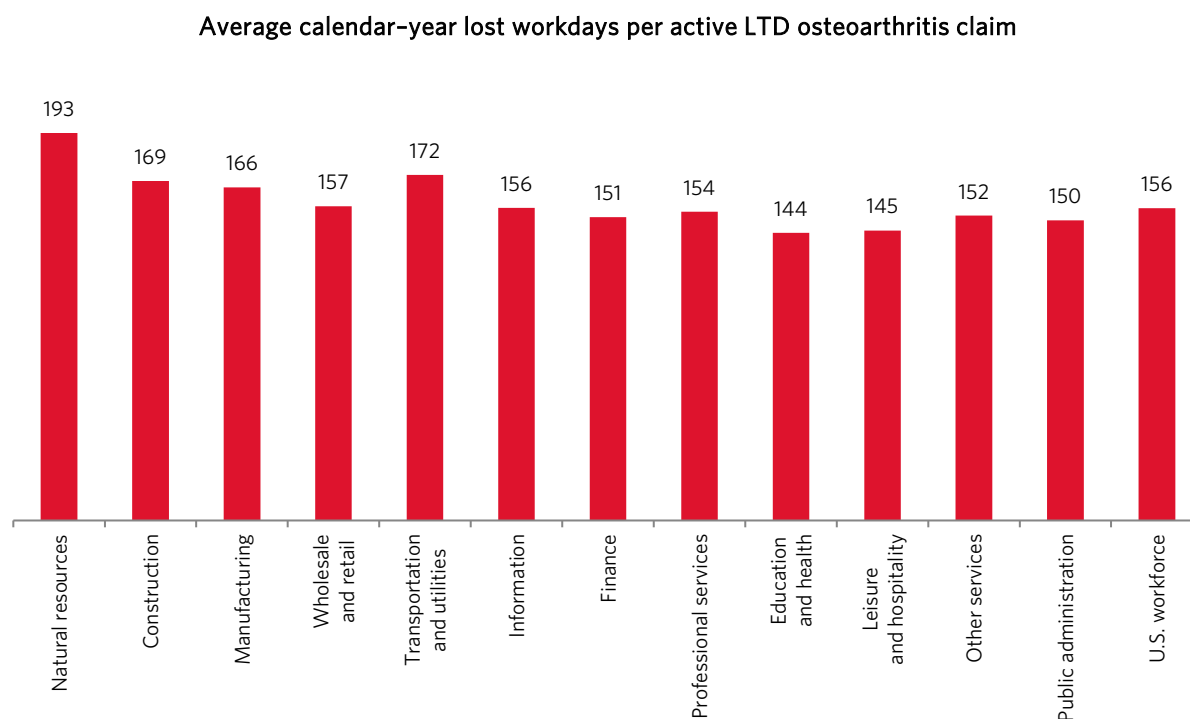
**Figure 11**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011–2017. Analysis is limited to claims with a start date from 2011 to 2015 to provide adequate observation time. Analysis based on 26,049 LTD claims for ICD-9 715.XX and ICD-10 M15.XX – M19.XX.

<sup>1</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 OSTEOARTHRITIS?

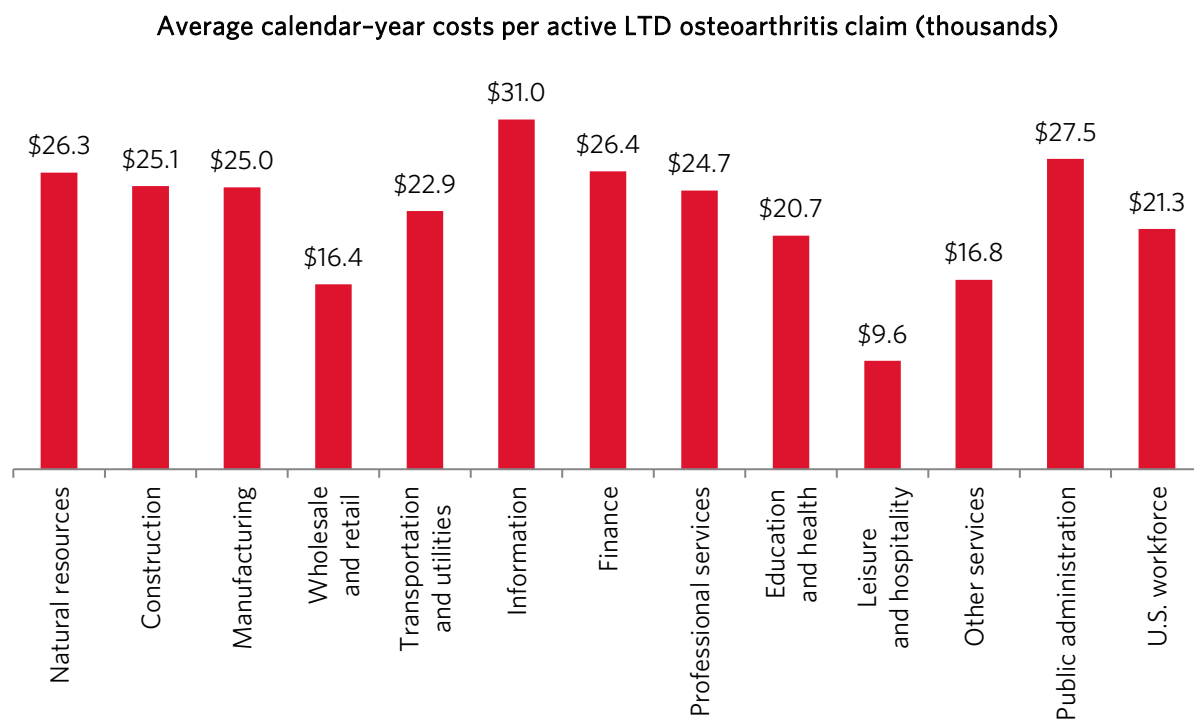
Figure 11 and Figure 12 show that LTD claims for osteoarthritis incur an average of 156 lost workdays per year that they remain open, at an average cost of more than \$21,000 in wage replacements and paid employee benefits per year.



**Figure 12**

Source: Integrated Benefits Institute, Health and Productivity Benchmarking database, 2012–2017. Analysis based on 36,130 LTD claims for ICD-9 715.XX and ICD-10 M15.XX –M19.XX. 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 OSTEOARTHRITIS COST EACH YEAR?



**Figure 13**

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

## Total Costs of Osteoarthritis in a Workforce

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

Table 1 shows the estimates of annual productivity and healthcare costs associated with osteoarthritis. Overall, for every 1,000 U.S. employees, osteoarthritis in the workforce costs about \$219,000 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>7</sup>), early exits from the labor force, excess turnover costs and presenteeism (impaired performance on the job due to osteoarthritis). Considerable cost differences are observed across industries, ranging from about \$161,000 per 1,000 employees in the manufacturing industry to about \$400,000 per 1,000 employees in the education and health industry.

**Table 1: Estimates of annual costs associated with osteoarthritis 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.	\$38.0	\$20.8	
Construction	n.s.	n.s.	\$32.6	\$25.2	
Manufacturing	\$85.2	\$21.6	\$35.9	\$18.0	\$160.7
Wholesale and retail	\$150.5	n.s.	\$21.4	\$12.5	
Transportation and utilities	n.s.	n.s.	\$45.0	\$19.4	
Information	n.s.	n.s.	\$20.9	\$7.6	
Finance	n.s.	n.s.	\$19.0	\$7.8	
Professional services	\$122.3	n.s.	\$20.8	\$12.4	
Education and health	\$246.1	\$26.3	\$31.9	\$16.7	\$321.0
Leisure and hospitality	\$29.8	n.s.	\$12.8	\$7.0	
Other services	n.s.	-\$10.9	\$22.7	\$11.9	
Public administration	\$244.5	\$94.8	\$43.1	\$18.1	\$400.5
U.S. workforce	\$161.7	\$15.7	\$26.7	\$14.7	\$218.8

Sources: Agency for Healthcare Research and Quality, Medical Expenditure Panel Study, 2011–2015; Integrated Benefits Institute, Health and Productivity Benchmarking database, 2011–2017; 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 treatment for osteoarthritis and the average excess outcomes for employees with osteoarthritis (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 osteoarthritis. 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 2017 to observe lost workdays from both new and carried-over claims.

## Evidence for Workplace Interventions

While there is no cure for osteoarthritis, strategies exist for mitigating symptoms. Unfortunately, no randomized control studies have been performed investigating this question, though enough cross sectional studies have been performed to make recommendations.<sup>8</sup> These are aimed at managing symptoms, and improving mobility.<sup>9</sup>

Many sources offer starting points for crafting strategies to manage the health and productivity impact of osteoarthritis:

- Higher levels of osteoarthritis pain are associated with greater work productivity losses. This suggests that even marginal improvements in pain can benefit both workers and their employers.<sup>10</sup>
- Workplace policies have been shown to reduce workforce disruptions from osteoarthritis. Examples include flexible hours, modified schedules, special equipment (such as modified desks or chairs), work at home arrangements, health benefits, short-term leave policies, and paid sick leave.<sup>11-15</sup>
- Self-management programs can reduce medical visits and healthcare costs. These include education, exercise and weight loss to improve function and reduce pain.<sup>16</sup>
- Pain management through medication is another strategy that shows efficacy in treating osteoarthritis. 30% of patients report satisfaction with medications used to treat osteoarthritis, and medication use increases with pain severity.<sup>8,17,18</sup>
- As a last option, surgical interventions can correct biomechanics or restore function.<sup>8</sup>

## Additional Information about Osteoarthritis

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

[National Institute of Arthritis and Musculoskeletal and Skin Diseases' Osteoarthritis Information Page](#)

## Appendix

### SUPPLEMENTAL DATA

To estimate the costs for each lost workday, we apply industry-average daily wages in 2017 from the BLS's Occupational Employment Statistics (OES) program.<sup>19</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>20</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>21</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>22</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, osteoarthritis) 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.

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.

## Works Cited

1. Agency for Healthcare Research and Quality (AHRQ). Medical Expenditure Panel Survey (MEPS). Rockville, MD, 2018. <http://www.ahrq.gov/data/meps.html>.
2. Integrated Benefits Institute. Health and Productivity Benchmarking. 2018; <https://ibiweb.org/benchmarking>.
3. Alonso J, Vilagut G, Chatterji S, et al. Including information about co-morbidity in estimates of disease burden: results from the World Health Organization World Mental Health Surveys. *Psychological Medicine*. 2011;41(4):873-886.
4. World Health Organization. International Classification of Diseases (ICD), 9th and 10th revisions. 2018; <http://www.who.int/classifications/icd/en>.
5. Arthritis Foundation. *Arthritis By The Numbers: Book of Trusted Facts and Figures*. 2018.
6. Litwic A, Edwards MH, Dennison EM, Cooper C. Epidemiology and burden of osteoarthritis. *British Medical Bulletin*. 2013;105:185-199. <https://www.ncbi.nlm.nih.gov/pubmed/23337796>
7. Nicholson S, Pauly MV, Polsky D, Sharda C, Szrek H, Berger ML. Measuring the Effects of Work Loss on Productivity with Team Production. *Health Economics*. 2006;15(2):111-123. <https://onlinelibrary.wiley.com/doi/abs/10.1002/hec.1052>
8. Palmer KT. The older worker with osteoarthritis of the knee. *British Medical Bulletin*. 2012;102:79-88. <https://www.ncbi.nlm.nih.gov/pubmed/22544779>
9. Arthritis Foundation. Osteoarthritis Treatment. <https://www.arthritis.org/about-arthritis/types/osteoarthritis/treatment.php>.
10. daCosta DiBonaventura M, Gupta S, McDonald M, Sadosky A, Pettitt D, Silverman S. Impact of self-rated osteoarthritis severity in an employed population: cross-sectional analysis of data from the national health and wellness survey. *Health and quality of life outcomes*. 2012;10(1):30.
11. Gignac MA, Cao X, McAlpine J. Availability, need for, and use of work accommodations and benefits: are they related to employment outcomes in people with arthritis? *Arthritis Care & Research*. 2015;67(6):855-864. <https://www.ncbi.nlm.nih.gov/pubmed/25370701>
12. Agaliotis M, Fransen M, Bridgett L, et al. Risk factors associated with reduced work productivity among people with chronic knee pain. *Osteoarthritis and Cartilage*. 2013;21(9):1160-1169. <https://www.ncbi.nlm.nih.gov/pubmed/23973126>
13. Chen JC, Linnan L, Callahan LF, Yelin EH, Renner JB. Workplace policies and prevalence of knee osteoarthritis: the Johnston County Osteoarthritis Project. *Occupational and Environmental Medicine*. 2007;64(12):798-805. <https://www.ncbi.nlm.nih.gov/pubmed/17567725>
14. Agaliotis M, Mackey MG, Heard R, Jan S, Fransen M. Personal and Workplace Environmental Factors Associated With Reduced Worker Productivity Among Older Workers With Chronic Knee Pain: A Cross-Sectional Survey. *Journal of Occupational and Environmental Medicine*. 2017;59(4):e24-e34. <https://www.ncbi.nlm.nih.gov/pubmed/28628054>

15. Gifford B, Zong Y. On-the-Job Productivity Losses Among Employees With Health Problems. *Journal of Occupational and Environmental Medicine*. 2017;59(9):885-893.
16. Gay C, Chabaud A, Guille E, Coudeyre E. Educating patients about the benefits of physical activity and exercise for their hip and knee osteoarthritis. Systematic literature review. *Annals of Physical and Rehabilitation Medicine*. 2016;59(3):174-183. <https://www.ncbi.nlm.nih.gov/pubmed/27053003>
17. Kingsbury SR, Gross HJ, Isherwood G, Conaghan PG. Osteoarthritis in Europe: impact on health status, work productivity and use of pharmacotherapies in five European countries. *Rheumatology*. 2014;53(5):937-947. <https://www.ncbi.nlm.nih.gov/pubmed/24489012>
18. Lerner D, Chang H, Rogers WH, et al. Imputing at-work productivity loss using results of a randomized controlled trial comparing tapentadol extended release and oxycodone controlled release for osteoarthritis pain. *Journal of Occupational and Environmental Medicine*. 2012;54(8):933-938. <https://www.ncbi.nlm.nih.gov/pubmed/22850352>
19. U.S. Department of Labor, Bureau of Labor Statistics. Occupational Employment Statistics (OES). 2018; <https://www.bls.gov/oes/home.htm>.
20. Bureau of Labor Statistics. National Compensation Survey, Employer Costs of Employee Compensation. 2018; <https://www.bls.gov/ncs/>.
21. Bureau of Labor Statistics. Employee Benefits Survey. 2018; [https://www.bls.gov/ncs/ebs/benefits/2017/benefits\\_life.htm](https://www.bls.gov/ncs/ebs/benefits/2017/benefits_life.htm).
22. Martin AB, Hartman M, Washington B, Catlin A, Team NHEA. National health spending: faster growth in 2015 as coverage expands and utilization increases. *Health Affairs*. 2016;36(1):166-176.





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