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Focus Article

The Economic Costs of Pain in the United States

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Abstract: In 2008, according to the Medical Expenditure Panel Survey (MEPS), about 100 million adults in the United States were affected by chronic pain, including joint pain or arthritis. Pain is costly to the nation because it requires medical treatment and complicates treatment for other ailments. Also, pain lowers worker productivity. Using the 2008 MEPS, we estimated 1) the portion of total U.S. health care costs attributable to pain; and 2) the annual costs of pain associated with lower worker productivity. We found that the total costs ranged from $560 to $635 billion in 2010 dollars. The additional health care costs due to pain ranged from $261 to $300 billion. This represents an increase in annual per person health care costs ranging from $261 to $300 compared to a base of about $4,250 for persons without pain. The value of lost productivity due to pain ranged from $299 to $335 billion. We found that the annual cost of pain was greater than the annual costs of heart disease ($309 billion), cancer ($243 billion), and diabetes ($188 billion). Our estimates are conservative because they do not include costs associated with pain for nursing home residents, children, military personnel, and persons who are incarcerated.

***Perspective:** This study estimates that the national cost of pain ranges from $560 to $635 billion, larger than the cost of the nation's priority health conditions. Because of its economic toll on society, the nation should invest in research, education, and training to advocate the successful treatment, management, and prevention of pain.*

***Key words:** Cost of illness, chronic pain, persistent pain.*

Millions of Americans experience persistent pain.[20] A review of 15 studies of chronic pain among adults found that prevalence estimates ranged from 2% to 40%, with a median of 15%.[23,31,33] Data from the 2009 National Health Interview Survey indicated that during a 3-month period, 16% of adults reported having a migraine or severe headache, 15% reported having pain in the neck area, 28% reported having pain in the lower back, and 5% reported having pain in the face or jaw area. For those who have persistent pain, it limits their functional status and adversely impacts their quality of life. Consequently, pain can be costly to the nation because it requires medical treatment, complicates medical treatment for other conditions, and hinders people's ability to work and function in society.

Several studies have examined the economic costs of pain or selected pain conditions. One study estimated the annual indirect costs of migraines at $14 billion in 1993.[19] A report issued by the American Academy of Orthopedic Surgeons estimated the total cost of musculoskeletal disorders at $215.5 billion in 1995.[29] The U.S. Census Bureau reported that the total cost of chronic noncancer pain was $150 billion in 1996.[9] The National Research Council and the Institute of Medicine (IOM) reported that the economic cost of musculoskeletal disorders, in terms of lost productivity, was $45 to 54 billion in 1999.[28] Another study estimated the annual medical and indirect costs of rheumatoid arthritis at $14 billion in 2000. Stewart et al[30] estimated that common pain conditions (ie, arthritis, back pain, headache, and other

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musculoskeletal pain) resulted in $61.2 billion in lower productivity for U.S. workers in 2002. Turk and Theodore[32] reported that in 2010, the annual cost of pharmaceuticals for pain management was $16.4 billion, and the cost of lumbar surgeries was $2.9 billion. Their estimates of the indirect costs of pain were $18.9 billion for disability compensation and $6.9 billion for productivity loss.[21] The evidence leaves no doubt that the cost of treating pain can be high. However, these estimates are dated, tend to focus on specific pain conditions, and are not comprehensive.

Prior studies used a more exacting, piecemeal approach to compute the cost of pain than that used for our study. For example, Turk and Theodore[32] identified per patient costs of treating pain based on information from the U.S. Workers' Compensation database and the Center for Medicare and Medicaid Services. They computed indirect costs using data on disability compensation and estimates of lost work time for specific pain conditions from the literature. Because researchers are pulling together estimates from different sources and samples of patients, they are not able to provide a comprehensive view of the health care and labor market experiences of persons with pain conditions. Our study offers a comprehensive view because our measures of pain conditions, health care costs, and indirect costs (such as missed days, hours, and wages) were drawn more rigorously from the same sample population. We used nationally representative data sets and econometric techniques to address sample selection issues. Our measures of pain also capture people with chronic and persistent pain that is not formally diagnosed by a physician.

We estimated the annual economic costs of pain in the United States. The annual economic costs of pain can be divided into 2 components: 1) the incremental costs of health care due to pain; and 2) the indirect costs of pain due to lower productivity associated with lost days and hours of work and lower wages. The rationale underlying our analysis is that the medical costs for other conditions are higher for individuals who are experiencing persistent pain. These incremental costs cannot be computed by simply summing the annual costs of treating patients with a primary diagnosis of pain, because unlike cancer, heart disease, and diabetes, persistent pain is not always a diagnosed condition. Rather, we captured the incremental costs of medical care due to pain by comparing the costs of health care of persons with chronic pain to those who do not report chronic pain, controlling for health needs, demographic characteristics, and socioeconomic status. We applied a similar approach to the indirect costs analysis.

Methods

We used the 2008 Medical Expenditure Panel Survey (MEPS) to examine the economic burden of pain in the United States. Cosponsored by the Agency for Healthcare Research and Quality and the National Center for Health Statistics, the MEPS is a nationally representative longitudinal survey that covers the U.S. civilian noninstitutionalized population.[11] For this analysis, we used the Household Component file of the MEPS—the core component of the survey that collects data on demographic characteristics, health expenditures, health conditions, health status, utilization of medical services, access to care, health insurance coverage, and income for each person surveyed. The analytic sample for the analysis of incremental health care costs was restricted to 20,214 individuals aged 18 or older. This sample is representative of all noninstitutionalized civilian adults in the United States. The analytic sample for the analysis of indirect costs was restricted to 15,945 individuals aged 24 to 65 to capture the active labor force in the United States.

Defining Persons With Pain

We defined persons with pain using 3 measures: 1) persons who reported that they experienced pain that limited their ability to work; 2) persons who were diagnosed with joint pain or arthritis; or 3) persons who had a disability that limited their ability to work. The SF-12 pain question of the MEPS asked the respondent whether, during the past 4 weeks, pain interfered with normal work outside the home and housework. The joint pain question inquired whether the person had experienced pain, swelling, or stiffness around a joint in the last 12 months. This includes pain caused by bursitis, gout, strains, and other injuries. The question for arthritis determined whether the person had ever been diagnosed with arthritis, and if so was it osteoarthritis or rheumatoid. The question about functional disability inquired whether the person had any work or housework limitation. We explored whether we could use information from the event files on persons who were diagnosed with headache, abdominal pain, chest pain, back pain, or cancer. We identified relatively few persons who had medical encounters in which pain was the primary diagnosis. Consequently, we decided not to use the event files to determine the prevalence of pain in the population. Rather, we expected that persons suffering from these pain conditions would report having moderate or severe pain on the SF-12. Some persons with cancer reported experiencing pain using the SF-12, but we are unable to distinguish acute and cancer-related pain from chronic, noncancer pain in the MEPS. However, the vast majority of persons who reported mild or severe pain using the SF-12 did not have a cancer diagnosis.

Measuring Health Care and Productivity Costs

We used total expenditures as the dependent variable to predict the incremental costs of care for individuals with selected pain conditions compared with those without these conditions. We aimed to estimate the incremental societal health care costs, which are the additional costs of care borne by individuals and their health plans. Total expenditures in the MEPS include both out-of-pocket payments by individuals and third-party payments to health care providers but do not include health insurance premiums. Expenditures for hospital-based services include those for both facility

and separately billed physician services. Total expenditures include inpatient, emergency room, outpatient (hospital, clinic, and office-based visits), prescription drugs, and other (eg, home health services, vision care services, dental care, ambulance services, diagnostic services, medical equipment). The expenditures do not include over-the-counter purchases.

For the analysis of indirect costs, we used the annual number of days of work missed because of pain conditions, the annual number of hours of work missed because of pain conditions, and hourly wages as dependent variables to predict the productivity loss associated with the different pain conditions. Variations in the annual number of days of work missed measure workers' decisions to use sick days. Variations in the annual number of hours worked measure workers' decisions whether to work full-time, part-time, or overtime. Variations in the hourly earnings measure the value of the amount of work workers can perform in an hour.

Adjusting for Other Factors

We estimated the association between pain and health care expenditures. This model predicts that as pain increases, the propensity to use health services increases and the amount and/or intensity of health service use increases. We used a modified version of the Aday and Andersen[2] behavioral health model of health services to estimate direct medical costs for persons with pain compared with those without any pain. One of the benefits of this framework is that it is widely used and prior studies have found the different constructs of the model to be highly valid or highly associated with the use of health services in different settings for different populations. This model hypothesizes that health expenditures depend on predisposing, enabling, and perceived health need factors. In this conceptual framework, pain is a health need factor. The predisposing factors are individual characteristics that measure biological and social factors that influence health care use such as age, race/ethnicity, gender, education, health behaviors, and marital status. To measure health behaviors, we used whether respondents smoked or exercised and their obesity status. For example, women's health care use varies from men's because of biological differences such as the need for reproductive health services; and married persons, because of the concerns of their spouses, may use health care differently than single persons. The enabling factors included income, health insurance status, and location. Census region and urban-rural residence were used to measure location. Enabling factors control for individual's ability to pay for health care services and their geographic access to health care facilities. Presumably, persons with more income, with better insurance, and who live/work in proximity to physician and hospital services will have higher use and thus higher health care expenditures. The inclusion of perceived health needs is an acknowledgment that sick persons require, seek, and use more medical services than healthy persons. Additional health needs measures included whether respondents reported that they were in fair or poor health, and whether they had been diagnosed with diabetes or asthma. Diabetes and asthma were included because they may complicate the treatment of other conditions and we did not want to attribute these costs to the incremental medical costs of pain. We excluded other chronic conditions, including hypertension, heart disease, emphysema, and stroke, because we were concerned about the potential correlation between these other chronic conditions and the SF-12 measures of pain. We estimated preliminary models with the full complement of chronic conditions; however, some conditions were statistically insignificant. Therefore, we elected to use the most parsimonious models that adequately controlled for health needs.

The lost productivity computation was based on the human capital approach of estimating labor supply and earning models.[5,6,22] Theoretically, hours worked, wages, and labor force participation are based on a set of factors, including age, sex, race, ethnicity, education, marital status, family size, health status, and location. There is longstanding literature that shows the impact of health on wages, earnings, labor supply, and missed days of work.[12,13] Similar to our study, these studies relied heavily on the human capital on human capital theory.[3,4,7,17] According to this conceptual framework, declining health, ie, increasing pain, reduces one's ability to work and lowers one's productivity when working.

Estimating Health Care Expenditures Models

We estimated a 2-part expenditure model to compute the economic burden for persons with the different types of pain conditions noted above compared with those without any pain.[8,10,14,24-26] The 2-part model is appropriate because it accounts for sample selection between persons with expenditures and those with zero expenditures. The first part of the model consisted of estimating logistic regression models to estimate the probability of having any type of health care expenditures. The second part consisted of using generalized linear models with log link and gamma distribution to predict levels of direct expenditures conditional on individuals with positive expenditures. We used a log link and gamma distribution to address the skew in the expenditure data. We eliminated outliers, ie, observations with expenditures greater than $100,000, less than .5% of the sample. We conducted the different diagnostic and specification tests recommended by Manning,[24] Manning and Mullahy,[25] and Mullahy.[26] We estimated the models using the survey regression procedures in Stata 11, which appropriately incorporates the design factors and sample weights.

We developed 3 models to predict total health care expenditures and conduct sensitivity analyses for robustness, varying the degree to which we controlled for health status. In Model 1, we measured pain with indicators for moderate pain, severe pain, joint pain, and arthritis. We controlled for health status using only self-reported general health status and body mass index.

In Model 2, we added functional disability to our pain measures. In Model 3, we included diabetes and asthma in our measures of health status. We conducted sensitivity analyses using several of the chronic condition indicators available in the MEPS and found that diabetes and asthma were significant predictors of expenditures independent of the pain measures. We estimated models with and without an indicator for functional disability. We were concerned that persons with functional disability who had chronic pain might not be captured by the other pain measures; however, we were also aware that the functional disability variable might capture people with functional disability but no chronic pain. By conducting the computation both ways, we could see whether including functional disability in our definition of pain conditions mattered.

We computed the incremental costs of pain by using our model to predict health care costs if a person has any type of pain and subtracting the predicted health care costs if a person does not have pain.[14] To perform this calculation, the probabilities of having health care costs for persons with and without pain must be taken into account. We computed unconditional levels of health care expenditures by multiplying the probabilities obtained from the first part of the model by the predicted levels of expenditures from the second part of the model for individuals with and without pain. Subsequently, we computed the incremental values for each type of pain condition by taking the difference between those with and without pain. We converted the costs estimates into 2010 dollars using the medical care index of the Consumer Price Index.

We computed the impact of the incremental costs of selected pain conditions on the various payers for health care services. The Household Component file from the MEPS contains 12 categories of direct payment for care provided during 2008: 1) out-of-pocket payments by users of care or family; 2) Medicare; 3) Medicaid; 4) private insurance; 5) the VA, excluding CHAMPVA; 6) TRICARE; 7) other federal sources (includes the Indian Health Service, military treatment facilities, and other care provided by the federal government); 8) other state and local sources (includes community and neighborhood clinics, state and local health departments, and state programs other than Medicaid); 9) workers' compensation; 10) other unclassified sources (includes such sources as automobile, homeowner's, and liability insurance, and other miscellaneous or unknown sources); 11) other private (any type of private insurance payments); and 12) other public. For each payer category, we computed its proportion of total health care expenditures. We multiplied our estimate of total incremental health care costs due to pain by these proportions to estimate the impact on each payer.

Estimating Labor Market Productivity Models

As with the health care expenditure models, we used 2-part models to estimate the indirect costs of pain. The structure of the models depended upon the dependent variables. For missed days of work, we estimated the probability of missing a work day as a result of selected pain conditions during the year. Second, we estimated a log linear regression model in which the dependent variable was the log of the number of disability days for those adults who had positive disability days.

For hours worked and wages, the first equation estimated the impact of pain on the probability that a person is working. The second equation estimated the impact of pain on the number of annual work hours and hourly wages. Combining the results from these different parts of the models, we computed the productivity costs associated with chronic pain for each of the conditions noted above. We used a 2-step estimator for labor supply to predict lost productivity due to pain.[10,16] As with the incremental cost models, we multiplied the probabilities obtained from the first part of the model by predicted levels of days missed, lost work hours, or lost wages from the second part of the model for individuals with and without pain. To compute the total cost of missed days, we multiplied the days missed by 8 hours times the predicted hourly wage rate for individuals with the pain condition. To compute the total cost of reduction of hours worked, we multiplied the total of annual hours missed by the predicted hourly wage rate for individuals with the pain condition. To compute the total cost due to a reduction in hourly wages, we multiplied the predicted hourly wage reduction by the predicted annual hours for individuals with the pain condition. We converted the costs estimates into 2010 dollars using the general Consumer Price Index.

The approach of using a 2-part model to estimate lost productivity is similar to the use of Heckman selection models but can be used in the absence of the identifying variables required by Heckman selection models and other limited dependent variables models, such as the Tobit.[15,18] Additionally, we conducted a series of tests to determine the appropriate distribution for each of these models. For instance, we used a log link with Gaussian distribution to estimate the models for hours worked. Similar to the health care expenditure models, we estimated 3 models using the same measures for pain and health status.

Results

The Incremental Costs of Health Care

Table 1 displays the dependent and key independent variables used in the analysis of the incremental costs of health care. The sample includes 20,214 individuals aged 18 and older, representing 210.7 million adults in the United States as of 2008. The mean health care expenditures were $4,475, and 85% of adults had a positive expenditure. The prevalence estimates for selected pain conditions were 10% for moderate pain, 11% for severe pain, 33% for joint pain, 25% for arthritis, and 12% for functional disability.

Adults with pain reported higher health care expenditures than adults without pain. Based on the SF-12 pain measures, a person with moderate pain had health care

Table 1. Health Care Expenditures, Selected Pain Conditions, and Demographic, Socioeconomic, and Health Factors for Persons Aged 18 or Older (N = 20,214, US$ 2010)

Categories	Means/ Proportions	Linearized SEM	95% CI	
Dependent variables				
Total expenditures*	$4,475.23	$93.23	$4,291.41	$4,659.05
Any expenditures	.85	.00	.84	.86
Independent variables				
SF-12 measures				
No pain [reference]	.79	.00	.78	.80
Moderate pain	.10	.00	.10	.11
Severe pain	.11	.00	.10	.11
Other measures of pain				
Joint pain	.33	.01	.32	.35
Arthritis	.25	.01	.24	.26
Functional disability	.12	.00	.11	.12
Gender				
Male [reference]	.48	.00	.48	.49
Female	.52	.00	.51	.52
Age				
Age 18–44 [reference]	.48	.00	.44	.52
Age 45–54	.19	.00	.18	.20
Age 55–64	.16	.00	.15	.17
Age 65–74	.09	.00	.08	.10
Age 75 plus	.08	.00	.07	.09
Race/Ethnicity				
Non-Hispanic white [reference]	.72	.00	.67	.74
Black	.11	.01	.10	.13
Hispanic	.13	.01	.12	.15
Asian	.04	.00	.04	.05
Marital status				
Married [reference]	.55	.00	.53	.56
Divorced	.11	.00	.11	.12
Widow	.06	.00	.06	.07
Separated	.02	.00	.02	.02
Never married	.26	.00	.25	.26
Education				
No high school degree [reference]	.34	.00	.21	.27
High school degree	.50	.01	.49	.51
College degree	.17	.00	.16	.18
Graduate degree	.09	.00	.08	.10
Income				
Between 0 and 199% of FPL [reference]	.29	.00	.27	.32
Between 200 and 400% of FPL	.30	.01	.29	.31
Over 400% of FPL	.41	.01	.39	.42
Insurance status				
Private insurance [reference]	.69	.00	.67	.71
Public insurance	.16	.00	.15	.17
Uninsured	.15	.00	.14	.16
Health behaviors				
Current smoker	.20	.00	.19	.21
Physical activity	.57	.01	.55	.58
Health conditions/status				
Normal weight [reference]	.36	.00	.35	.39
Overweight	.35	.00	.34	.36
Obese	.18	.00	.17	.18
Morbidly obese	.11	.00	.10	.11
Diabetes	.10	.00	.09	.10
Asthma	.09	.00	.09	.10
Health status				
Excellent/very good/good health [reference]	.86	.00	.85	.87
Fair/poor health	.14	.00	.13	.15
Regions/locations				
Northeast [reference]	.18	.00	.13	.23
Midwest	.22	.01	.21	.24
South	.37	.01	.35	.39
West	.23	.01	.21	.24
Non-Metropolitan statistical area	.16	.00	.13	.19
Metropolitan statistical area	.84	.01	.81	.87

Abbreviations: CI, confidence interval; FPL, federal poverty level; SEM, standard error of the mean.

NOTE. Dollar amounts were adjusted for inflation as of 2010 using the Consumer Price Index Medical Care Inflation Index.

*Total expenditures include inpatient, emergency room, and outpatient (hospital, clinic, and office-based visits) care; prescription drugs; and other (eg, home health services, vision care services, dental care, ambulance services, and medical equipment). Expenditures do not include over-the-counter purchases.

SOURCE: Based on the 2008 Medical Expenditure Panel Survey (MEPS).

expenditures $4,516 higher than those of someone with no pain. Persons with severe pain had health care expenditures $3,210 higher than those of persons with moderate pain. We found similar differences for persons with joint pain ($4,048), arthritis ($5,838), and functional disability ($9,680) compared with persons without these conditions. All of these differences were statistically significant ($P < .001$).

The regression results of the logistic regression models and generalized linear models indicate that moderate pain, severe pain, joint pain, arthritis, and functional disability were strongly associated with an increased probability of having a health care expenditure and with higher expenditures. The coefficients were all statistically significant and positive predictors of whether a person had a health care expenditure and the amount of that expenditure. The coefficients were relatively stable across the 3 models. The magnitude of the coefficients declined as we included functional disability, asthma, and diabetes in the models. The coefficients on the control variables had the expected signs. Women were more likely to have a health care expenditure and a higher expenditure than men. The likelihood of an expenditure and the level of expenditures increased with age. Blacks, Hispanics, and Asians were less likely than whites to have a health care expenditure and had lower expenditures. Socioeconomic and health factors had the expected impact. As education, income, and health insurance status increased, health care spending also increased. Health care spending increased for persons who were obese, who reported they were in fair or poor health, who had asthma, and who had diabetes. These regression

Table 2. Total Incremental Costs of Medical Expenditures for Selected Pain Conditions (in Millions of US$ 2010 and Millions of Persons)

Condition	Population (In Millions)	Model 1	Model 2 (Including Functional Disability)	Model 3 (Including Functional Disability, Diabetes, and Asthma)
Moderate pain	21.3	$45,716	$39,024	$39,646
Severe pain	22.6	$89,426	$58,144	$60,009
Joint pain	70.3	$60,054	$48,280	$45,630
Arthritis	53.4	$65,917	$61,071	$59,292
Functional disability	24.7	—	$93,529	$88,680
Total	100.0	$261,113	$300,048	$293,257

NOTE. Dollar amounts were adjusted for inflation as of 2010 using the Consumer Price Index Medical Care Inflation Index. This analysis is based on the total noninstitutionalized adult subpopulation of the United States for individuals aged 18 or older, who represented 210,764,398 individuals as of 2008. Model 2 includes functional disability in addition to all the other control variables. Model 3 includes functional disability, asthma, and diabetes in addition to all the other control variables. One hundred million persons had at least 1 of the pain conditions studied. The population total for the selected pain conditions does not sum to 100 million because some persons have multiple conditions.
SOURCE: Based on authors' calculations using the 2008 Medical Expenditure Panel Survey.

models are reported in Appendix C of the IOM publication, *Relieving Pain in America*. [20]

We computed the total incremental costs of the selected pain conditions (see Table 2). The total incremental costs of health care for selected pain conditions ranged from $45.7 billion for moderate pain to $89.4 billion for severe pain according to Model 1. When functional disability was included in the model, its total incremental costs were $93.5 billion, while the estimates for the other pain conditions declined, particularly for severe pain, which fell to $58.1 billion in Model 2. We estimated that approximately 100 million persons had at least 1 of the pain conditions based on the 2008 MEPS. The most prevalent condition was joint pain, affecting more than 70 million adults. We estimated that the incremental costs of health care for these selected pain conditions ranged from $261 billion to $300 billion annually. Model 1 renders an estimate of $261 billion. This estimate rises to $300 billion when we included functional disability in the model. However, when we included diabetes and asthma in the model, our estimate falls to $293 billion. Including measures of these chronic conditions in the model influenced the incremental cost estimates for each pain condition differently. The cost estimates for functional disability, joint pain, and arthritis declined in Model 3 but the estimate for severe pain increased.

Table 3 shows the distribution of the incremental costs by source of payment. We estimated that private insurers paid the largest share of incremental costs, ranging from $112 billion to $129 billion. Medicare bore 25% of the incremental costs due to pain, ranging from $66 billion to $76 billion. Individuals paid an additional $44 billion to $51 billion in out-of-pocket health care expenditures due to persistent pain. Medicaid paid about 8% of the incremental costs of pain, ranging from $20 billion to $23 billion.

Indirect Costs of Pain

Table 4 shows the dependent and independent variables for the analysis of incremental indirect costs. The sample was 15,945 persons ages 24 to 64, representing 156 million working-age adults. The mean number of work days missed was 2.14, and 46% of adults missed at least 1 day of work. The average number of hours the sample worked annually was 1,601, with 81% of

Table 3. Distribution of Total Incremental Costs of Medical Expenditures by Sources of Payment (in Millions of US$ 2010)

Source of Payment	Percent of Total Cost	Model 1	Model 2 (Including Functional Disability)	Model 3 (Including Functional Disability, Diabetes, and Asthma)
Out of pocket	17%	$44,381	$50,999	$49,845
Medicare	25%	$65,891	$75,716	$74,002
Medicaid	8%	$20,176	$23,184	$22,659
Private insurance	43%	$112,260	$128,999	$126,079
Department of Veterans Affairs/TRICARE/other Federal	3%	$7,322	$8,413	$8,223
State/other public	1%	$2,960	$3,401	$3,324
Workers' compensation	1%	$3,866	$4,443	$4,342
Other sources	2%	$4,258	$4,893	$4,783
Total	100%	$261,113	$300,048	$293,257

NOTE. Dollar amounts were adjusted for inflation as of 2010 using the Consumer Price Index Medical Care Inflation Index. This analysis applied the distribution of total expenditures for noninstitutionalized adults aged 18 or older to the total incremental costs due to persistent pain. Model 2 includes functional disability in addition to all the other control variables. Model 3 includes functional disability, asthma, and diabetes in addition to all the other control variables.
SOURCE: Based on authors' calculations using the 2008 Medical Expenditure Panel Survey.

Table 4. Labor Market Outcomes, Selected Pain Conditions, and Demographic, Socioeconomic, and Health Factors for Working-Age Adults Between 24 and 64 Years Old (N = 15,945)

Categories	Means/ Proportions	Linearized SEM	95% CI	
Dependent variables				
Number of work days missed	2.14	.08	1.98	2.30
Missed any work days	.46	.01	.45	.47
Number of hours worked	1601.17	10.13	1581.19	1621.14
Hourly wages*	14.19	.19	13.83	14.56
Any hours worked	.81	.00	.80	.82
Independent variables				
SF-12 measures				
No pain [reference]	.81	.00	.82	.79
Moderate pain	.09	.00	.08	.10
Severe pain	.10	.00	.10	.11
Other measures of pain				
Joint pain	.31	.01	.30	.33
Arthritis	.21	.01	.20	.22
Functional disability	.10	.00	.09	.10
Gender				
Male [reference]	.48	.00	.49	.48
Female	.52	.00	.51	.52
Age/family size				
Age 18-44 [reference]	.28	.00	.31	.25
Age 35-44	.25	.00	.24	.26
Age 45-54	.26	.00	.25	.27
Age 55-64	.21	.01	.20	.22
Family size	2.87	.03	2.81	2.92
Race/ethnicity				
Non-Hispanic white [reference]	.70	.00	.74	.66
Black	.11	.01	.10	.13
Hispanic	.14	.01	.12	.16
Asian	.05	.00	.04	.05
Marital status				
Married [reference]	.62	.00	.64	.59
Divorced	.13	.00	.12	.14
Widow	.02	.00	.02	.02
Separated	.02	.00	.02	.03
Never married	.21	.01	.20	.22
Education				
No high school degree [reference]	.22	.00	.25	.18
High school degree	.48	.01	.47	.50
College degree	.20	.01	.19	.21
Graduate degree	.10	.00	.09	.11
Income				
Between 0 and 199% of FPL [reference]	.27	.00	.29	.23
Between 200 and 400% of FPL	.30	.01	.29	.32
Over 400% of FPL	.43	.01	.42	.45
Insurance status				
Private insurance [reference]	.74	.00	.75	.72
Public insurance	.09	.00	.09	.10
Uninsured	.17	.01	.16	.18
Health conditions/status				
Diabetes	.08	.00	.08	.09
Asthma	.09	.00	.08	.10
Health status				
Excellent/very good/good health [reference]	.87	.00	.87	.86
Fair/poor health	.13	.00	.13	.14
Regions/locations				
Northeast [reference]	.19	.00	.24	.14
Midwest	.22	.01	.21	.24
South	.36	.01	.34	.38
West	.23	.01	.21	.24
Metropolitan Statistical Area	.85	.01	.82	.88

Abbreviations: CI, confidence interval; FPL, federal poverty level; SEM, standard error of the mean.
*Wages were adjusted for inflation as of 2010 using the general Consumer Price Index.
SOURCE: Based on the 2008 Medical Expenditure Panel Survey.

adults working. The average hourly wage was $14.19. Among working-age adults, 9% reported having moderate pain, 10% severe pain, 31% joint pain, 21% arthritis, and 10% functional disability.

Adults with pain reported missing more days of work than adults without pain. A person with moderate pain, based on the SF-12 pain measures, missed 2.1 days more than someone with no pain. Adults with severe pain missed 2.6 days more than those with moderate pain. The differences for joint pain, arthritis, and functional disability were 1.3 days, 1.3 days and 3.3 days, respectively. Pain was associated with fewer annual hours worked. Persons with functional disability had the largest difference, working 1,203 fewer hours than persons with no functional disability. Compared with persons with no pain, persons with moderate pain worked 291 fewer hours, and persons with severe pain worked 717 fewer hours. We found similar differences in hours for joint pain (220 hours) and arthritis (384 hours). Wages were lower for persons with pain. The largest difference was for persons with functional disability, followed by severe pain, moderate pain, arthritis pain, and joint pain. Persons with functional disability earned $11 an hour less than persons without functional disability.

The regression results for the indirect costs analysis are reported in Appendix C in the IOM publication, *Relieving Pain in America*.[20] The estimates from these models show that the pain conditions had a significant negative impact on the likelihood of working. The impact on hours worked and wages was negative but modest and in several cases insignificant. This means that the negative impact of pain conditions on hours worked and wages occurred largely through the decision to work or not. Persons with pain were less likely to work than persons without pain.

Pain negatively impacted the 3 components of productivity; number of days missed, number of annual hours worked, and hourly wages. Almost 70 million working adults reported having 1 of the pain conditions. The average incremental number of days of work missed was greatest for severe pain, with estimates ranging from 5.0 to 5.9 days. Arthritis caused the fewest days of work

Table 5. Total Incremental Costs of Number of Days of Work Missed, Number of Hours of Work Missed, and Reduction in Hourly Wages Because of Selected Pain Conditions (in Millions of US$ 2010 and Millions of Persons)

Labor Market Outcomes by Selected Pain Condition	Population (In Millions)	Model 1	Model 2 (Including Functional Disability)	Model 3 (Including Functional Disability, Diabetes, and Asthma)
Number of days of work missed				
Moderate pain	14.1	$2,643	$2,541	$2,540
Severe pain	15.6	$6,476	$7,330	$7,196
Joint pain	49.1	$2,401	$1,999	$1,983
Arthritis	32.9	$105	$40	$19
Functional disability	14.9	—	$919	$898
Total	69.8	$11,625	$12,728	$12,635
Number of hours of work missed				
Moderate pain	14.1	$11,380	$2,846	$2,618
Severe pain	15.6	$27,939	$5,422	$5,472
Joint pain	49.1	$19,750	$5,550	$5,296
Arthritis	32.9	$37,472	$20,530	$20,090
Functional disability	14.9	—	$61,495	$61,742
Total	69.8	$96,542	$95,744	$95,217
Reduction in hourly wages				
Moderate pain	14.1	$35,795	$22,114	$21,791
Severe pain	15.6	$78,214	$40,173	$40,453
Joint pain	49.1	$19,959	$3,709	$4,293
Arthritis	32.9	$56,657	$30,340	$29,396
Functional disability	14.9	—	$130,029	$129,577
Total	69.8	$190,625	$226,365	$216,924
Total productivity costs				
Moderate pain	14.1	$49,818	$27,501	$26,949
Severe pain	15.6	$112,629	$52,925	$53,121
Joint pain	49.1	$42,110	$11,258	$11,572
Arthritis	32.9	$94,234	$50,910	$49,505
Functional disability	14.9	—	$50,910	$192,217
Total	69.8	$298,792	$334,837	$324,776

NOTE. Dollar amounts were adjusted for inflation as of 2010 using the general Consumer Price Index Medical Care Inflation Index. This analysis is based on the total noninstitutionalized adult subpopulation of the United States for individuals aged 24–64, who represented 156 million individuals as of 2008. Model 2 includes functional disability in addition to all the other control variables. Model 3 includes functional disability, asthma, and diabetes in addition to all the other control variables. To compute the total cost, we multiplied the total of annual hours of work missed by the predicted hourly wage rate for individuals with the pain condition. A total of 69.8 million persons had at least 1 of the pain conditions studied. The population totals for the selected pain conditions do not sum to 69.8 million because some persons have multiple conditions.
SOURCE: Based on authors' calculations using the 2008 Medical Expenditure Panel Survey.

missed—.1 to .3. Pain also was associated with fewer annual hours worked. For Model 1, severe pain was associated with the largest reduction, 204 hours. However, when we included functional disability in the model, the impact of severe pain fell to 30 hours, while the reduction associated with having functional disability was 740 hours. The average reduction in hourly wages for selected pain conditions ranged from $.26 an hour for joint pain to $3.76 an hour for severe pain according to Model 1. Including functional disability in the models changed the estimates substantially for the other pain conditions—from $.05 an hour for joint pain to $1.66 an hour for severe pain. Functional disability was associated with a large reduction in wages ($9.36 an hour), which did impact the total estimate of the costs due to wage reductions.

Table 5 reports the annual indirect costs for each of the 3 components of productivity. The reduction in hourly wages due to pain was the most costly component, ranging from $191 to $226 billion. Functional disability, followed by severe pain and arthritis, had the biggest impact on hourly wages. Including functional disability in the model increased the costs by $36 billion and dampened the estimates of the other pain measures. The annual indirect costs for fewer hours worked were stable across the models ranging from $95 to $96 billion. While the inclusion of functional disability changed the distribution of the costs, it did not change the overall estimate of the costs associated with fewer annual hours worked. Functional disability, arthritis, and severe pain in Model 1 were the most costly pain conditions. The annual costs for the number of days missed ranged from $11.6 to $12.7 billion. More persons reported joint pain, but severe pain was more costly. Including functional disability in these models did not affect the estimates for the other pain conditions.

The combined total indirect costs by pain conditions are reported at the bottom of Table 5. According to Model 1, total indirect cost was $299 billion, with severe pain and arthritis as the most costly conditions. However, when functional disability was included in the models, the estimates increased to $335 billion. The indirect

cost of functional disability was $192 billion, and the cost estimates for these other pain conditions fell.

Combining the results in Tables 2 and 5, we found that the total annual costs of pain in the United States ranged from $560 to $635 billion. The total incremental costs of health care due to pain ranged from $261 to $300 billion, and the value of lost productivity ranged from $299 to $334 billion.

Discussion

Persistent pain impacts 100 million adults and costs from $560 to $635 billion annually. Based on statistics published by the National Institutes of Health (NIH), the costs of persistent pain exceed the economic costs of the 6 most costly major diagnoses—cardiovascular diseases ($309 billion), neoplasms ($243 billion), injury and poisoning ($205 billion), endocrine, nutritional and metabolic diseases ($127 billion), digestive system diseases ($112 billion), and respiratory system diseases ($112 billion).[27] (For comparison with our estimate, we converted these figures into 2010 dollars).These cost-of-condition estimates differ from our cost-of-pain estimate. NIH combined personal health care costs reported in the MEPS and the costs of premature death due to these conditions; however, the NIH estimates do not include lost productivity. We do not consider the costs of premature death due to pain because pain is not considered a direct cause of death, as are heart disease, cancer, and stroke. The American Diabetes Association reported that in 2007, diabetes cost $174 billion, including $116 billion in excess medical expenditures and $58 billion in reduced productivity.[1] (This is equivalent to $188 billion in 2010 U.S. dollars.) Unlike these diagnosed conditions, pain affects a much larger number of people, by a factor of about 4 compared with heart disease and diabetes and by a factor of 9 compared with cancer. Thus, the per person cost of pain is lower than that of the other conditions, but the total cost of pain is higher.

Our estimate of the cost of chronic pain is conservative for several reasons. First, we did not account for the cost of pain for institutionalized and noncivilian populations. In particular, the incremental health care costs for nursing home residents, military personnel, and prison inmates with pain were not included and may be substantial. Second, we did not include the costs of pain for persons under age 18. Third, we did not include the cost of pain to caregivers. For example, we did not consider time a spouse or adult child might lose from work to care for a loved one with chronic pain. Fourth, we considered the indirect costs of pain only for working-age adults. We did not estimate these costs for working persons over the age of 65 or under the age of 24. While there are persons in these age categories who are retired or continuing their education, there also are persons in both age categories who are working or willing to work. We did not capture the value of their lost productivity. Fifth, we also did not include the value of time lost for other, non-work-related activities. Sixth, we did not include other indirect costs—lost tax revenue, costs for replacement workers, legal fees, and transportation costs for patients to reach providers. Finally, in our cost estimates, we did not attempt to measure the psychological or emotional toll of chronic pain. The presence of chronic pain can lower a person's quality of life and diminish the person's enjoyment of other aspects of life.

Our analysis has a few limitations. First, it is a cross-sectional analysis, so we cannot infer causality. Second, our measures of pain are limited. We cannot estimate the impact of pain associated with musculoskeletal conditions or cancer. Third, our functional disability may include persons who do not have chronic pain. In addition, the MEPS data do not contain measures of varying degrees of functional disability. Finally, we used 2-part models to control for unobserved differences between persons with pain and persons without pain. However, we recognized that the 2-part approach may not fully capture the unobserved differences between the 2 groups and, if so, our estimates of costs associated with pain will be too large.

In general, given the magnitude of the economic costs of pain, society should consider investing in research, education, and care designed to reduce the impact of pain. In *Relieving Pain in America*, the IOM outlined a national agenda for addressing the problem of pain.[20] Eliminating pain may be impossible, but helping people live better with pain may be achievable.

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