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RESEARCH ARTICLE

Chronic Pain and Health Care Spending: An Analysis of Longitudinal Data from the Medical Expenditure Panel Survey

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Objective. To estimate average incremental health care expenditures associated with chronic pain by health care service category, expanding on prior research that focused on specific pain conditions instead of general pain, excluded low levels of pain, or did not incorporate pain duration.

Data Source. Medical Expenditure Panel Survey (MEPS) data (2008–2011; $N = 26{,}671$).

Study Design. Differences in annual expenditures for adults at different levels of pain that interferes with normal work, as measured by the SF-12, were estimated using recycled predictions from two-part logit-generalized linear regression models.

Principal Findings. "A little bit" of chronic pain-related interference was associated with a $2,498 increase in total adjusted expenditures over no pain interference ($p < .0001$) and a $1,008 increase over nonchronic pain interference ($p = .0001$). Moderate and severe chronic pain-related interference was associated with a $3,707 and $5,804 increase in expenditures over no pain interference and a $2,218 and $4,315 increase over nonchronic interference, respectively ($p < .0001$). Expenditure increases were most pronounced for inpatient and hospital outpatient expenditures compared to other types of health care expenditures.

Conclusions. Chronic pain limitations are associated with higher health care expenditures. Results underscore the substantial cost of pain to the health care system.

Key Words. Pain, chronic pain, medical expenditures, health care costs, health services

Chronic pain is responsible for much human suffering, and it is increasingly being recognized as a significant health system challenge (Blyth, van der Windt, and Croft 2010; Croft, Blyth, and van der Windt 2010; Institute of Medicine Committee on Advancing Pain Research, Care, and Education [IOM] 2011; Sessle 2012). The estimated prevalence of chronic pain varies with the assessment method and population, with estimates ranging from 2 to 58 percent (Verhaak et al. 1998; Blyth et al. 2001; Hardt et al. 2008; Tsang et al. 2008; Johannes et al. 2010; IOM 2011). Chronic pain is more often experienced by women (Tsang et al. 2008; Blyth 2010) and older persons (Tsang et al. 2008), and the prevalence of pain is inversely associated with socioeconomic status (Blyth 2010). There is evidence that the prevalence of some types of pain is increasing (Yelin et al. 2007; Freburger et al. 2009; U.K. Department of Health 2009; IOM 2011), and it is likely that the prevalence of pain in the United States will continue to increase given population dynamics and demographic shifts (IOM 2011).

The economic cost of pain in the United States was recently estimated to be between $560 and $635 billion annually, including direct health care expenditures of $261 to $300 billion (Gaskin and Richard 2011, 2012). Given the considerable health care expenditures associated with chronic pain in the United States, there is a need to better understand these costs. Most U.S. studies estimating the average per-person health care expenditures associated with chronic pain investigate specific pain conditions such as fibromyalgia, arthritis, back pain and spine problems, migraines, and painful neuropathic disorders (Edmeads and Mackell 2002; Berger, Dukes, and Oster 2004; Luo et al. 2004; Yelin et al. 2007; Martin et al. 2008; White et al. 2008). When expenditures are analyzed in total and by health service category (e.g., inpatient, emergency department, pharmacy), pain conditions are associated with increased expenditures in total and in most or all categories (Edmeads and Mackell 2002; Berger, Dukes, and Oster 2004; Luo et al. 2004; Yelin et al. 2007; Martin et al. 2008; White et al. 2008).

Studies investigating the health care expenditures associated with pain conditions do not yield a comprehensive measure of the per-person expenditures associated with chronic pain. A number of researchers (Siddall and Cousins 2004; Tracey and Bushnell 2009; Croft, Blyth, and van der Windt 2010; Davis 2013), professional organizations (Niv and Devor 2001), and the U.S. Institute of Medicine (IOM 2011) posit that chronic pain is not simply a symptom of another condition—in many people, chronic pain is a disease.

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However, few studies conducted in the United States look at the health care costs of chronic pain as a condition unto itself. Research by Gaskin and Richard (Gaskin and Richard 2011, 2012) is an exception; their work attempted to provide estimates of the health care expenditures associated with chronic pain using a broad condition nonspecific identification approach. They found that the cost of pain increased as pain-related interference with normal work in the prior 4 weeks increased. For example, moderate interference had an average adjusted annual per-person incremental cost of $1,861 to $2,146 compared to no or little interference (Gaskin and Richard 2011, 2012). However, it is unlikely that pain-related interference over such a short time period is synonymous with chronic pain. A definition of chronic pain incorporating pain persistence would yield more meaningful estimates of the costs of chronic pain. Further, the incremental health care expenditures associated with having a small amount of pain-related interference were not assessed, although the majority of adults with pain-related interference in the prior 4 weeks report only "a little bit" of interference (Agency for Healthcare Research and Quality [AHRQ] 2013b). In addition, Gaskin and Richard's focus was on the societal costs of pain; as such, they did not estimate the average incremental costs of chronic pain in different health service categories, even though prior research on condition nonspecific chronic pain and health care utilization suggests that expenditure increases would be seen in multiple health service categories (Blyth et al. 2004). Expenditure estimates by category are valuable to, for example, estimate how new interventions may impact different types of health care expenditures through the continuum of pain-related interference.

The current study sought to fill these research gaps. The objective of the current study was to estimate average annual incremental health care expenditures associated with low, moderate, and severe levels of chronic pain interference. Expenditures were estimated in total and for office-based visits, hospital outpatient visits, inpatient care, emergency department visits, prescription medication, and other expenditures.

METHODS

Study Setting and Population

Data from the Household Component of the Medical Expenditure Panel Survey (MEPS) were used. The Agency for Healthcare Research and Quality (AHRQ) administers the MEPS, collecting detailed information about health care utilization, health conditions, medical expenditures, and the source of payment for health care services (AHRQ 2009a). All members of the civilian noninstitutionalized U.S. population are in the MEPS target population (AHRQ 2012b). Each year a new panel of households is sampled for the MEPS, and an overlapping panel design is used. For each panel, information is gathered about each individual in the participating households during five rounds of interviews occurring over a 2-year period (AHRQ 2009a). MEPS Longitudinal Files contain household data collected during all five rounds of interviewing over the 2-year period for a given panel of respondents. Longitudinal Files for panels 13, 14, and 15 were combined for use in the current study. Panels 13, 14, and 15 included households interviewed across 2008 through 2009, 2009 through 2010, and 2010 through 2011, respectively (AHRQ 2012a). Additional information about household-reported medical conditions is available in the MEPS Medical Conditions Files (AHRQ 2013c); medical condition information about conditions reported during the first year of each 2-year panel was merged into the combined longitudinal data.

The MEPS Self-Administered Questionnaire (SAQ) is fielded annually as part of the Household Component. The SAQ is a paper-and-pencil questionnaire provided to all eligible respondents who are 18 years of age or older. MEPS participants eligible for responding to the SAQ during both years of participation were considered for inclusion in the study (n = 33,333). Individuals were disqualified from inclusion if they responded to the year 1 SAQ during the year 2 calendar year (n = 1,665) or if they had extremely high year 2 expenditures, defined as expenditures greater than $200,000 ($n$ = 13), resulting in a total possible eligible sample N = 31,655. All analyses included only those adults who did not have any missing data on variables of interest (N = 26,671; 84.3 percent). When weighted and adjusted for the complex survey design of the MEPS, this sample was nationally representative of 184,064,675 U.S. adults.

Measurements

Dependent Variables. Health care expenditure variables describing the total payments for health care services during the second year of each 2-year panel served as the dependent variables. These expenditure variables were based on the sum of expenditures during the year from all payment sources, including out-of-pocket payments and payments by third-party payers. One variable represented expenditures in total, and the other dependent variables represented expenditures by individual health service category, including office-based visits, hospital outpatient visits, inpatient care, emergency department visits, prescription medication, and other expenditures (i.e., expenditures for home health care, dental care, vision aids and other medical supplies, and equipment). Expenditures for Panels 13 and 14 were adjusted for inflation to 2011 levels of expenditures using the service-specific adjustment methodology recommended by AHRQ (2013a).

Primary Independent Variable. The primary independent variable was chronic pain-related interference, based on the SF-12 pain question administered in the annual MEPS SAQ. This question asked, "During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?" and the ordinal response options were "not at all," "a little bit," "moderately," "quite a bit," and "extremely" (Ware et al. 2005). The combined responses to the two annual SF-12 pain questions served as a proxy measure of nonchronic and chronic pain. Individuals responding "not at all" both years were categorized as having no pain-related interference (reference category), while those responding "a little bit" through "extremely" during either year but "not at all" during the other year were categorized as having nonchronic pain (category 1). Individuals reporting "a little bit" of pain-related interference in the first year and at least "a little bit" of interference the second year were categorized as having "a little bit" of chronic pain-related interference (category 2), those reporting moderate pain-related interference in the first year and at least "a little bit" of interference the second year were categorized as having moderate chronic pain-related interference (category 3), and people reporting "quite a bit" or extreme pain-related interference the first year and at least "a little bit" of pain-related interference the second year were categorized has having severe chronic pain-related interference (category 4). Combining "quite a bit" and extreme interference into a single "severe" category is consistent with Gaskin and Richard's categorization approach (2011, 2012).

Model Covariates. The MEPS panel was included in the models to adjust for any differences between the three panels included in the study. Additional variables were analyzed and included in the statistical models to describe the population and adjust for potential confounders in the relationship between pain-related interference and health care expenditures. These covariates align with Aday and Anderson's model of health services use (Aday and Andersen 1974; Andersen 1995), and the covariates and the categorizations thereof largely mirrored those used by Gaskin and Richard (2011, 2012). Covariates were based on responses in the first year of the 2-year panel; questions that are asked multiple times in the year were based on Round 2 responses, while family income was based on income for the full first year.

The demographic covariates included in the models were sex, age, race/ethnicity, and marital status. Education, household income relative to the poverty level, and insurance status were included as socioeconomic covariates, and census region and residing in a Metropolitan Statistical Area (MSA) were included to represent location. Health behaviors and health status covariates representing smoking behavior, physical activity, and body mass index (BMI) category (Flegal et al. 2012) were included, as were chronic condition indicators. Chronic condition covariates were selected based on being high prevalence, high cost, or included in prior research on health care expenditures and chronic pain (Yelin et al. 2007; AHRQ 2009b; Gaskin and Richard 2011, 2012). Specifically, chronic condition covariates representing diagnoses of diabetes, stroke, high blood pressure, high cholesterol, cancer, a heart condition (coronary heart disease, angina, myocardial infarction, or other unspecified heart disease), a respiratory condition (emphysema, asthma, or chronic bronchitis), and any mental health condition were included. All chronic condition covariates were based on MEPS priority condition questions (AHRQ 2009b), with the exception of the mental health condition covariate, which was based on household-reported conditions in MEPS Medical Conditions files, with CCS categories between 650 and 670 (inclusive) representing mental health conditions (Healthcare Cost and Utilization Project 2014). Arthritis, joint pain, and perceived health were highly correlated with the SF-12 measure of pain and, thus, were excluded from the analyses. A similar approach has been used in prior research related to pain and expenditures (Gaskin and Richard 2011, 2012). All covariates were categorical, and categorizations for these variables are detailed in Table 1.

Statistical Analyses

We first explored the characteristics of the population, determining the distribution of each covariate, and we investigated the unadjusted association between the covariates and nonchronic and chronic pain-related interference. Next, we conducted analyses estimating second-year health care expenditures associated with nonchronic pain and increasing levels of chronic pain-related interference. We ran a series of multivariable two-part models for mixed discrete-continuous outcomes, which simultaneously used a logit model,

Table 1: Covariate Distribution in Total and by Level of Pain-Related Interference. All Proportions Account for the Complex Survey Design of the Medical Expenditure Panel Survey ($N = 26{,}671$)

		Pain Interference (Row %)					
	Total (%)	No Pain Interference (40.3%)	Nonchronic Pain Interference (26.4%)	A Little Bit of Chronic Interference (15.5%)	Moderate Chronic Interference (8.3%)	Severe Chronic Interference (9.5%)	p-value
Panel							
13	33.6	39.6	26.9	16.0	8.1	9.3	.3526
14	33.1	41.3	26.3	14.6	8.4	9.4	
15	33.3	40.1	25.8	16.0	8.4	9.7	
Sex							
Male	47.8	43.1	26.8	14.8	7.1	8.1	<.0001
Female	52.2	37.8	25.9	16.2	9.4	10.7	
Age							
18–44	47.9	51.3	27.7	11.3	5.0	4.7	<.0001
45–54	19.7	36.8	26.2	16.5	9.1	11.4	
55–64	15.7	29.1	25.9	20.7	10.5	13.7	
65–74	9.4	26.9	22.7	21.6	14.1	14.6	
75+	7.3	18.8	23.9	21.8	16.0	19.6	
Race/ethnicity							
White non-Hispanic	69.0	38.1	26.1	16.8	9.1	9.9	<.0001
Black non-Hispanic	10.8	41.1	27.4	13.3	7.4	10.8	
Hispanic	13.6	48.3	26.8	11.0	6.2	7.7	
Other non-Hispanic	6.6	46.0	27.4	13.8	6.0	6.8	
Region							
Northeast	17.6	41.9	26.1	14.4	9.0	8.6	.0170
Midwest	22.2	38.3	27.5	16.6	8.1	9.4	
South	37.2	40.5	25.7	15.0	8.4	10.4	
West	23.0	40.7	26.5	16.0	7.9	8.8	
MSA							
Non-MSA	16.1	34.0	25.5	17.4	10.2	13.0	<.0001
MSA	83.9	41.5	26.5	15.2	8.0	8.8	
Marital status							
Married	54.2	38.8	27.3	16.5	8.6	8.7	<.0001
Widowed	6.5	21.4	25.1	19.3	14.7	19.5	
Separated /divorced	14.0	32.3	25.2	16.8	9.9	15.9	
Never married	25.7	52.3	25.3	11.9	5.4	5.1	

continued

Table 1. *Continued*

		Pain Interference (Row %)					
	Total (%)	*No Pain Interference (40.3%)*	*Nonchronic Pain Interference (26.4%)*	*A Little Bit of Chronic Interference (15.5%)*	*Moderate Chronic Interference (8.3%)*	*Severe Chronic Interference (9.5%)*	*p-value*
Poverty level							
0–199% FPL	30.6	34.6	26.2	14.4	9.5	15.2	<.0001
200–399% FPL	31.3	41.1	25.6	16.6	8.3	8.4	
400%+ FPL	38.1	44.3	27.1	15.5	7.4	5.8	
Insurance							
Any private	68.4	43.1	27.1	15.9	7.4	6.5	<.0001
Public only	16.4	24.1	23.1	16.4	13.4	23.0	
Uninsured	15.2	45.4	26.6	12.8	7.0	8.1	
Education							
No degree	16.9	33.1	24.9	14.4	10.3	17.3	<.0001
High school degree	55.0	39.1	26.0	16.2	9.0	9.6	
Bachelor's	18.5	47.5	27.6	14.5	5.8	4.6	
Graduate level	9.7	46.0	28.3	15.7	5.6	4.4	
Stroke							
No	96.7	41.3	26.6	15.4	8.0	8.7	<.0001
Yes	3.3	12.4	18.6	20.0	16.5	32.5	
Diabetes							
No	90.6	42.5	26.7	15.0	7.6	8.2	<.0001
Yes	9.4	19.8	23.5	20.4	14.7	21.6	
High blood pressure							
No	68.1	48.0	27.2	13.1	6.0	5.7	<.0001
Yes	31.9	24.0	24.6	20.6	13.3	17.5	
High cholesterol							
No	69.0	46.0	27.1	13.5	6.5	6.9	<.0001
Yes	31.0	27.6	24.8	20.0	12.3	15.3	
Respiratory condition							
No	87.5	42.4	26.9	15.3	7.7	7.8	<.0001
Yes	12.5	25.6	22.9	17.2	12.9	21.3	
Heart condition							
No	86.0	43.5	27.0	14.9	7.1	7.5	<.0001
Yes	14.0	20.9	22.6	19.5	15.5	21.4	
Cancer							
No	89.9	42.2	26.6	14.8	7.8	8.6	<.0001
Yes	10.1	23.9	24.0	21.6	13.2	17.3	

continued

Table 1. *Continued*

		Pain Interference (Row %)					
	Total (%)	*No Pain Interference (40.3%)*	*Nonchronic Pain Interference (26.4%)*	*A Little Bit of Chronic Interference (15.5%)*	*Moderate Chronic Interference (8.3%)*	*Severe Chronic Interference (9.5%)*	*p-value*
Mental health condition							
No	81.3	44.0	26.7	14.9	7.4	7.0	<.0001
Yes	18.7	24.1	24.9	18.3	12.4	20.3	
BMI category							
Not overweight	34.5	47.5	25.8	13.3	6.6	6.9	<.0001
Overweight	35.2	41.3	27.5	15.6	7.7	7.8	
Obesity: Grade 1	17.9	33.5	27.1	18.3	9.5	11.5	
Obesity: Grades 2–3	12.3	27.3	23.6	17.3	13.1	18.5	
Current smoker							
No	80.8	41.9	26.5	15.2	8.0	8.3	<.0001
Yes	19.2	33.7	25.9	16.8	9.4	14.2	
Activity level							
30+ min/week	58.6	45.5	26.9	14.9	6.9	5.7	<.0001
0–29 min/week	41.3	32.9	25.6	16.3	10.4	14.8	

Percentages may not total 100 due to rounding.
BMI, body mass index; FPL, Federal Poverty Level; MEPS, Medical Expenditure Panel Survey; MSA, metropolitan statistical area.

predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. This model was appropriate for the distribution of the health care expenditure data, which included individuals with zero expenditures but was right skewed when positive expenditures were analyzed (Glick et al. 2007; Gaskin and Richard 2011, 2012). Unadjusted models included only the pain-related interference and MEPS panel variables as predictors, while adjusted models included the pain-related interference variable and all potential confounders described previously.

For each model, the average incremental increase in expenditures—for total expenditures as well as for each health services category analyzed—at each level of pain-related interference was estimated using the method of recycled predictions (Greene 2003; Basu, Polsky, and Manning 2008; Martin et al. 2012). For each of the five levels of pain-related interference, the estimated coefficients from the two-part logit-GLM model were used to predict health care costs for each individual based on the typical expenditures for individuals with similar characteristics holding pain-related interference constant. The average predicted expenditures and 95 percent confidence intervals were then calculated for each level of the pain-related interference variable. Differences representing estimates of the average incremental increase in expenditures at increasing levels of pain-related interference were calculated, and the significance of the difference between each pain-related interference level and no interference was tested with chi-square tests.

All analyses for the current study adjusted for the MEPS complex survey design. Analyses were conducted in *Stata SE version 13* (StataCorp 2013).

Results

No pain-related interference was reported by 40.3 percent of the weighted sample (95 percent CI: 39.5, 41.1), while 26.4 percent (95 percent CI: 25.7, 27.1) reported nonchronic pain-related interference, and 33.3 percent (95 percent CI: 23.5, 34.1) reported some level of chronic pain-related interference. Specifically, 15.5 percent (95 percent CI: 15.0, 16.1) reported "a little bit" of chronic pain-related interference, 8.3 percent (95 percent CI: 7.9, 8.8) reported moderate chronic pain-related interference, and 9.5 percent (95 percent CI: 9.0, 10.0) reported severe chronic pain-related interference. Table 1 describes the distribution of the covariates in total and by pain interference level. There was no significant association between the MEPS panel and the pain interference variable (p = .3526); however, all other covariates were significantly associated with pain-related interference (all $p < .05$). Results of these unadjusted analyses are provided in Table 1.

Table 2 details the average annual unadjusted and adjusted predicted health care expenditures and 95 percent confidence intervals by health service category for each level of pain-related interference. It also reports the change in average expenditures at each level of pain-related interference as compared to no pain-related interference, and it reports the change in average expenditures at each level of chronic pain-related interference compared to nonchronic pain-related interference.

In total and for most health service categories, average annual expenditures were higher for chronic pain interference than nonchronic pain interference, and expenditures increased with chronic pain interference level. People reporting nonchronic pain-related interference had significantly higher adjusted total average annual health services expenditures compared to

Table 2: Average Next-Year Annual Health Care Expenditures Associated with Increasing Levels of Chronic Pain-Related Interference, in Total and by Service Category, in 2011 U.S. Dollars.* Ninety-Five Percent Confidence Intervals in Parentheses. Unadjusted Averages Include Only the MEPS Panel as a Covariate. Averages Are Adjusted for Panel, Sociodemographics, Health Status, and Health Behavior Covariates ($N = 26{,}671$)[†]

	Chronic Pain Interference Level				
Expenditure Category	*No Pain Interference*	*Nonchronic Pain Interference*	*A Little Bit of Chronic Interference*	*Moderate Chronic Interference*	*Severe Chronic Interference*
Total					
Unadjusted average	$2,415 (2,255–2,575)	$4,313 (4,040–4,586)	$6,415 (5,932–6,899)	$8,751 (7,952–9,551)	$13,379 (12,340–14,417)
Increase over none	n/a	$1,898 (1,583–2,213)[‡]	$4,000 (3,523–4,478)[‡]	$6,336 (5,521–7,152)[‡]	$10,964 (9,890–12,038)[‡]
Increase over nonchronic	n/a	n/a	$2,103 (1,531–2,674)[‡]	$4,438 (3,608–5,269)[‡]	$9,066 (7,981–10,151)[‡]
Adjusted average	$3,147 (2,932–3,362)	$4,637 (4,328–4,946)	$5,645 (5,249–6,041)	$6,855 (6,155–7,554)	$8,952 (8,126–9,777)
Increase over none	n/a	$1,489 (1,156–1,823)[‡]	$2,498 (2,070–2,925)[‡]	$3,707 (2,968–4,447)[‡]	$5,804 (4,887–6,722)[‡]
Increase over nonchronic	n/a	n/a	$1,008 (499–1,518)[§]	$2,218 (1,401–3,035)[‡]	$4,315 (3,394–5,367)[‡]
Office-based					
Unadjusted average	$695 (627–763)	$1,152 (1,059–1,245)	$1,628 (1,471–1,684)	$1,970 (1,719–2,222)	$2,716 (2,470–2,961)
Increase over none	n/a	$457 (336–578)[‡]	$933 (761–1,105)[‡]	$1,275 (1,019–1,531)[‡]	$2,021 (1,774–2,268)[‡]
Increase over nonchronic	n/a	n/a	$476 (287–665)[‡]	$818 (564–1,073)[‡]	$1,564 (1,307–1,821)[‡]
Adjusted average	$855 (783–927)	$1,226 (1,135–1,318)	$1,409 (1,302–1,517)	$1,556 (1,385–1,727)	$2,182 (1,961–2,402)
Increase over none	n/a	$371 (268–475)[‡]	$555 (424–685)[‡]	$701 (527–875)[‡]	$1,327 (1,093–1,560)[‡]
Increase over nonchronic	n/a	n/a	$183 (48–318)[§]	$329 (156–503)[§]	$955 (721–1,189)[‡]
Hospital outpatient					
Unadjusted average	$242 (209–274)	$454 (385–524)	$650 (531–768)	$944 (664–1,225)	$1,076 (829–1,323)

continued

Table 2. *Continued*

Expenditure Category	*Chronic Pain Interference Level*				
	No Pain Interference	*Nonchronic Pain Interference*	*A Little Bit of Chronic Interference*	*Moderate Chronic Interference*	*Severe Chronic Interference*
Increase over none	n/a	$212 (136–288)[‡]	$408 (286–529)[‡]	$702 (420–985)[‡]	$834 (588–1,080)[‡]
Increase over nonchronic	n/a	n/a	$195 (53–337)[§]	$490 (203–777)[§]	$622 (361–882)[‡]
Adjusted average	$285 (243–326)	$483 (413–554)	$564 (467–660)	$757 (547–967)	$859 (688–1,030)
Increase over none	n/a	$198 (123–274)[‡]	$279 (173–384)[‡]	$472 (253–691)[‡]	$574 (394–754)[‡]
Increase over nonchronic	n/a	n/a	$80 (−41 to 202)	$273 (40–507)[§]	$376 (184–568)[§]
Inpatient					
Unadjusted average	$483 (376–580)	$1,049 (896–1,201)	$1,839 (1,531–2,148)	$2,623 (2,158–3,089)	$4,363 (3,556–5,170)
Increase over none	n/a	$566 (386–746)[‡]	$1,356 (1,056–1,656)[‡]	$2,140 (1,665–2,615)[‡]	$3,880 (3,054–4,706)[‡]
Increase over nonchronic	n/a	n/a	$791 (448–1,133)[‡]	$1,574 (1,083–2,066)[‡]	$3,314 (2,491–4,137)[‡]
Adjusted average	$660 (524–795)	$1,183 (1,018–1,349)	$1,571 (1,332–1,809)	$1,980 (1,636–2,324)	$2,437 (1,988–2,886)
Increase over none	n/a	$524 (334–714)[‡]	$911 (665–1,157)[‡]	$1,320 (942–1,699)[‡]	$1,778 (1,278–2,277)[‡]
Increase over nonchronic	n/a	n/a	$387 (105–670)[§]	$797 (406–1,187)[§]	$1,254 (760–1,747)[‡]
Emergency department					
Unadjusted average	$100 (83–118)	$221 (180–261)	$208 (170–246)	$317 (211–423)	$419 (354–487)
Increase over none	n/a	$120 (76–164)[‡]	$107 (66–149)[‡]	$217 (107–327)[§]	$319 (250–387)[‡]
Increase over nonchronic	n/a	n/a	−$13 (−68 to 42)	$96 (−16 to 209)	$199 (124–274)[‡]
Adjusted average	$116 (97–135)	$232 (196–269)	$210 (171–249)	$252 (190–314)	$312 (258–366)
Increase over none	n/a	$116 (77–156)[‡]	$94 (49–139)[§]	$136 (69–203)[§]	$196 (138–254)[‡]

continued

Table 2. *Continued*

Expenditure Category	Chronic Pain Interference Level: No Pain Interference	Nonchronic Pain Interference	A Little Bit of Chronic Interference	Moderate Chronic Interference	Severe Chronic Interference
Increase over nonchronic	n/a	n/a	−$22 (−73 to 29)	$20 (−51 to 90)	$80 (17–142)§
Prescription					
Unadjusted average	$555 (507–602)	$1,002 (903–1,102)	$1,561 (1,411–1,710)	$2,110 (1,920–2,301)	$3,353 (3,107–3,599)
Increase over none	n/a	$448 (341–554)‡	$1,006 (861–1,151)‡	$1,556 (1,353–1,759)‡	$2,798 (2,541–3,054)‡
Increase over nonchronic	n/a	n/a	$558 (380–737)‡	$1,108 (893–1,323)‡	$2,350 (2,087–2,614)‡
Adjusted average	$861 (785–937)	$1,079 (971–1,188)	$1,354 (1,221–1,487)	$1,596 (1,413–1,778)	$2,137 (1,963–2,311)
Increase over none	n/a	$218 (94–243)§	$493 (339–647)‡	$734 (528–941)‡	$1,275 (1,086–1,465)‡
Increase over nonchronic	n/a	n/a	$275 (96–453)§	$516 (297–735)‡	$1,057 (853–1,262)‡
Other					
Unadjusted average	$340 (304–377)	$435 (383–488)	$526 (462–589)	$792 (634–951)	$1,442 (1,110–1,773)
Increase over none	n/a	$95 (36–154)§	$185 (111–259)‡	$452 (292–612)‡	$1,101 (781–1,422)‡
Increase over nonchronic	n/a	n/a	$90 (12–168)§	$357 (186–528)§	$1,006 (679–1,343)‡
Adjusted average	$422 (374–469)	$463 (416–511)	$472 (425–519)	$623 (512–734)	$863 (722–1,004)
Increase over none	n/a	$41 (−5 to 88)	$50 (−9 to 109)	$201 (81–320)§	$441 (297–585)‡
Increase over nonchronic	n/a	n/a	$9 (−47 to 64)	$159 (39–280)§	$400 (252–547)‡

*Analyses account for the complex survey design of the MEPS.
†Sociodemographic covariates were age, sex, race/ethnicity, region, MSA status, poverty category, and insurance coverage category. Health status and health behavior covariates were chronic condition indicators (high cholesterol, high blood pressure, diabetes, stroke, heart disease, respiratory conditions, cancer, and mental health conditions), BMI category, being a smoker, and physical activity.
‡Difference significant at the $\alpha = 0.0001$ level.
§Difference significant at the $\alpha = 0.05$ level.
BMI, body mass index; MEPS, Medical Expenditure Panel Survey; MSA, metropolitan statistical area.

people with no pain-related interference (difference = \$1,489; 95 percent CI: \$1,156, \$1,823; $p < .0001$). Based on the adjusted average annual total health care expenditures, “a little bit” of chronic pain-related interference was associated with a \$2,498 increase in expenditures over no pain-related interference (difference = \$2,498; 95 percent CI: \$2,070, \$2,925; $p < .0001$) and a \$1,008 increase in expenditures over nonchronic pain-related interference (difference = \$1,008; 95 percent CI: \$499, \$1,518; $p = .0001$). Moderate chronic pain-related interference was associated with a \$3,707 increase in expenditures over no pain-related interference (difference = \$3,707; 95 percent CI: \$2,968, \$4,447; $p < .0001$) and a \$2,218 increase in expenditures over nonchronic pain-related interference (difference = \$2,218; 95 percent CI: \$1,401, \$3,035; $p < .0001$). Severe chronic pain-related interference was associated with a \$5,804 increase in expenditures over no pain-related interference (difference = \$5,804; 95 percent CI: \$4,887, \$6,722; $p < .0001$) and a \$4,315 increase in expenditures over nonchronic pain-related interference (difference = \$4,315; 95 percent CI: \$3,394, \$5,367; $p < .0001$).

Similar patterns of significant increases in annual average adjusted expenditures with increasing levels of pain-related interference are seen within the office-based, inpatient, and prescription medication service categories; details are provided in Table 2, and the two-part regression model results are available in Appendixes SA2–SA8. Unlike total health service expenditures and expenditures for the aforementioned individual health service categories, “a little bit” of chronic pain-related interference was not associated with significantly higher average adjusted expenditures in the hospital outpatient, emergency department, and “other” expenditure categories as compared to nonchronic pain interference (hospital outpatient difference = \$80; 95 percent CI: −\$41, \$202; $p = .1935$: emergency department difference = −\$22; 95 percent CI: −\$73, 29; $p = .3882$: other expenditures difference = \$9; 95 percent CI: −\$47, 64; $p = .7592$). However, hospital outpatient and emergency department adjusted expenditures were significantly higher for individuals with “a little bit” of chronic pain-related interference as compared to people with no pain interference (hospital outpatient difference = \$279; 95 percent CI: \$173, \$384; $p < .0001$: emergency department difference = \$94; 95 percent CI: \$49, \$139; $p = .0001$). Conversely, other adjusted expenditures for individuals with “a little bit” of chronic pain were not significantly higher than those with no pain interference (difference = \$50; 95 percent CI: −\$9, \$109; $p = .0947$). Moderate chronic pain-related interference was associated with significantly higher average adjusted expenditures as compared to nonchronic pain interference in all categories except emergency department services—average emergency department adjusted expenditures did not differ significantly between individuals with moderate chronic pain interference and nonchronic pain interference (difference = \$20; 95 percent CI: −\$51, 90; p = .5820). In all health services categories, moderate chronic pain-related interference was associated with significantly higher average adjusted expenditures as compared to no pain interference, and severe chronic pain-related interference was associated with significantly higher average adjusted expenditures as compared to both nonchronic pain interference and no pain interference.

Table 2 also makes evident that increases in average adjusted expenditures by chronic pain-related interference levels were most pronounced for inpatient visits and hospital outpatient services compared to office-based visits, emergency department expenditures, prescription medications, and other expenditures. More specifically, adjusted average annual health expenditures for inpatient visits and hospital outpatient services were 269 and 201 percent higher, respectively, for people reporting severe levels of chronic pain-related interference compared to those reporting no pain-related interference. However, adjusted average annual health expenditures for office-based, emergency department visits, prescription medication, and other were 155, 169, 148, and 104 percent higher, respectively, for people reporting extreme levels of chronic pain-related interference compared to those reporting no pain-related interference.

DISCUSSION

This study finds that higher levels of chronic pain-related interference are associated with higher health care expenditures. This pattern is seen for health care expenditures in total and for expenditures specific to office-based, hospital outpatient, inpatient, emergency department, and prescription medication health care service categories. These results are striking, because we show that even "a little bit" of chronic pain-related interference is associated with substantially higher expenditures. Individuals with "a little bit" of chronic pain-related interference had average total expenditures 79.4 percent higher than those with no pain and 21.7 percent higher than those with nonchronic pain, even after adjusting for sociodemographic, health status, and health behavior covariates. With 15.5 percent of the U.S. adult population reporting "a little bit" of chronic pain-related interference, our results suggest that "a little bit" of chronic pain is associated with substantial expenditures in the U.S. health care system. Our results build on prior research that found prior-year health services utilization increases with increases in interference from chronic pain (Blyth et al. 2004), as well as research showing increases in total expenditures for same-year health care expenditures with moderate to severe pain-related interference (Gaskin and Richard 2011, 2012).

Moderate to severe chronic pain-related interference is seen less frequently in the U.S. population than the lowest level of pain-related interference, but our results indicate that these higher levels of interference are more costly, on average. There is a clear relationship between chronic pain-related interference and health care expenditures; average expenditures were higher for chronic pain interference than nonchronic pain interference, and expenditures increased as chronic pain interference level increased. The association between higher chronic pain-related interference and higher expenditures is seen for total expenditures as well as for office-based, hospital outpatient, inpatient, and prescription medication health care service categories. On the other hand, emergency department expenditures have a unique association with chronic pain, in that emergency department expenditures for individuals with chronic pain are only significantly higher than those with nonchronic pain in individuals with severe chronic pain-related interference. Severe chronic pain is associated with substantially higher health care expenditures; individuals with severe chronic pain-related interference have average total expenditures that are 184.5 percent higher than individuals with no pain-related interference and 93.1 percent higher than individuals with nonchronic pain interference, after adjusting for sociodemographic, health status, and health behavior covariates.

While there are a myriad of treatments available for chronic pain, existing treatments do not generally fully eliminate pain. Turk, Wilson, and Cahana (2011) estimate that, on average, treatments for chronic noncancer pain yield only 30 percent pain reduction in approximately half of treated patients, and an improvement in function may not always be associated with pain reduction. Given the inadequacy of currently available treatments to eliminate or even substantially decrease pain in the majority of patients with chronic pain, it is probable that people with high levels of pain-related interference will likely continue to experience pain even after they have received treatment. Our study does not specifically address pain treatments and thus any statements about pain treatments and posttreatment expenditures are speculative. That said, our study shows that even minor chronic pain-related interference is associated with higher health care expenditures; therefore, given the findings of other researchers regarding the limitations of current pain treatments, it seems likely that individuals with chronic pain will have ongoing increased health care expenditures.

Our results underscore the economic consequences of chronic pain and highlight the need for cost-effective treatments. Furthermore, our results align with past research in which single-item self-rated health measures were shown to be effective in predicting health care expenditures (DeSalvo et al. 2009). Self-reported measures of pain are especially important in understanding chronic pain and its relation to health care expenditures because pain is, by nature, subjective (IOM 2011). The experience of pain is accounted for not only by an individual's physiological pathology but also by that person's history, cognitions, emotions, social resources, and financial situation (Turk, Wilson, and Cahana 2011). As such, self-reported pain measures such as the one used in the present study provide insight in a way that a simple diagnostic classification would not. In addition, self-report is critical in studying the relationship between pain and expenditures because patients' pain is unlikely to be well-characterized in administrative data sources. Studies estimating health care expenditures often analyze medical claims data, but the International Classification of Diseases (ICD) coding used to document diagnoses in medical claims poorly captures pain conditions (Buchbinder, Goel, and Bombardier 1996; Croft, Blyth, and van der Windt 2010). Medical providers, accountable care organizations, and third-party payers should consider the value of collecting patient self-reported pain measures to both facilitate patient-centered care and enable predictions of health care expenditures.

It is important to recognize the limitations of the current study. One limitation is that individuals with two episodes of acute pain which coincidentally occurred at the two times the SAQ was completed would be categorized as having chronic pain. If that occurred, it likely resulted in more conservative estimates of the incremental cost of chronic pain. Further, the SF-12 pain question is not universally used as a measure of chronic pain. The most widely accepted definition of chronic pain involves a 3-month duration of pain (Croft et al. 2010), and the SF-12 pain question does not align with that definition. However, that 3-month duration-based definition has been questioned (Dunn and Croft 2006; Von Korff and Dunn 2008), and there is no standard definition or measure of chronic pain used in population-based studies like the MEPS (Croft et al. 2010; IOM 2011). In addition, the SF-12 pain measure used in this study has been used in prior studies on chronic pain and costs (Gaskin and Richard 2011, 2012), and the current study improves upon the past studies' use of the SF-12 pain measure by using longitudinal data to assess pain duration. Thus, until a more standard definition of chronic pain is agreed upon and used in population health surveys, our measure serves as a reasonable proxy measure of chronic pain, allowing us to estimate the health care expenditures associated with chronic pain-related limitations in multiple health service categories. Another limitation of the MEPS methodology is that it does not collect information on expenditures on over-the-counter medications, which means that total health care expenditures are likely to be slightly underestimated in analyses relying on MEPS data.

Like all studies of this nature, the findings reported here are limited by an inability to make causal statements about the relationship between chronic pain and health care expenditures. Nevertheless, important information was gained from the study. The longitudinal nature of the MEPS data, in which individuals are followed over 2 years, expanded our knowledge by providing insights into the costs of persistent chronic pain. In addition, the study makes a unique contribution to the chronic pain literature by estimating the average health care expenditures associated with interference from chronic pain both in total and for many health service categories. These estimates are of great interest to third-party payers that are responsible for paying health care claims, accountable care organizations that assume the financial risk for patients' health care expenditures, and to health policy makers and legislators who must understand the drivers of health care costs in the United States.

CONCLUSIONS

This study finds that higher levels of chronic pain-related interference are associated with higher health care expenditures. This pattern is seen for health care expenditures in total and for expenditures specific to office-based, hospital outpatient, inpatient, emergency department, and prescription medication health care service categories. These results are striking because we show that even "a little bit" of chronic pain-related interference is associated with a sizable increase in expenditures. With 15.5 percent of the U.S. adult population reporting "a little bit" of chronic pain-related interference, our results suggest that "a little bit" of chronic pain is associated with substantial expenditures in the U.S. health care system. Moderate to severe chronic pain-related interference is seen less frequently, but these higher levels of interference are more costly, on average. Our results underscore the high cost of chronic pain to the health care system and highlight the need for cost-effective pain treatments.

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Supporting Information

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix SA2: Results of the Adjusted Two-Part Regression Model Predicting Total Expenditures. The two-part model incorporates a logit model, predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. Exponentiated weights from the logit model may be interpreted as odds ratios, and exponentiated weights from the GLM model may be interpreted as the multiplicative effect on the expected expenditures (*N* = 26,671).

Appendix SA3: Results of the Adjusted Two-Part Regression Model Predicting Office-Based Expenditures. The two-part model incorporates a logit model, predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. Exponentiated weights from the logit model may be interpreted as odds ratios, and exponentiated weights from the GLM model may be interpreted as the multiplicative effect on the expected expenditures (*N* = 26,671).

Appendix SA4: Results of the Adjusted Two-Part Regression Model Predicting Outpatient Hospital Expenditures. The two-part model incorporates a logit model, predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. Exponentiated weights from the logit model may be interpreted as odds ratios, and exponentiated weights from the GLM model may be interpreted as the multiplicative effect on the expected expenditures (*N* = 26,671).

Appendix SA5: Results of the Adjusted Two-Part Regression Model Predicting Inpatient Expenditures. The two-part model incorporates a logit model, predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. Exponentiated weights from the logit model may be interpreted as odds ratios, and exponentiated weights from the GLM model may be interpreted as the multiplicative effect on the expected expenditures (*N* = 26,671).

Appendix SA6: Results of the Adjusted Two-Part Regression Model Predicting Emergency Department Expenditures. The two-part model incorporates a logit model, predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. Exponentiated weights from the logit model may be interpreted as odds ratios, and exponentiated weights from the GLM model may be interpreted as the multiplicative effect on the expected expenditures (*N* = 26,671).

Appendix SA7: Results of the Adjusted Unadjusted Two-Part Regression Model Predicting Prescription Medication Expenditures. The two-part model incorporates a logit model, predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. Exponentiated weights from the logit model may be interpreted as odds ratios, and exponentiated weights from the GLM model may be interpreted as the multiplicative effect on the expected expenditures (N = 26,671).

Appendix SA8: Results of the Adjusted Two-Part Regression Model Predicting Other Health Care Expenditures (i.e., expenditures for home health care, dental care, vision aids and other medical supplies and equipment). The two-part model incorporates a logit model, predicting binary zero versus positive expenditures, and a generalized linear regression model (GLM) with a gamma distribution and a log-link function to predict the positive expenditures. Exponentiated weights from the logit model may be interpreted as odds ratios, and exponentiated weights from the GLM model may be interpreted as the multiplicative effect on the expected expenditures (N = 26,671).