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HEALTH CARE RESOURCE USE, HEALTH CARE EXPENDITURES AND ABSENTEEISM COSTS ASSOCIATED WITH OSTEOARTHRITIS

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ABSTRACT

Menon, Jyothi, Ph.D., Purdue University, December 2015. Health Care Resource Use, Health Care Expenditures and Absenteeism Costs Associated with Osteoarthritis. Major Professor: Joseph Thomas III.

The objectives of this study were to determine incremental health care resource utilization, incremental health care expenditures, incremental absenteeism, and incremental absenteeism costs associated with Osteoarthritis. An observational database analysis was conducted using information from the Medical Expenditure Panel Survey (MEPS). Individuals 18 years of age or older and employed during 2011 were eligible for inclusion in the sample for analyses. Individuals were identified with Osteoarthritis diagnosis based on ICD-9-CM diagnosis codes. Out of a sample of 26,992 individuals, 1,354 were diagnosed with osteoarthritis. Individuals with osteoarthritis were compared to individuals without osteoarthritis.

Incremental health care resource utilization examined included annual hospitalization, annual hospital days, annual emergency room visits, annual outpatient visits. Incremental health expenditures examined included annual inpatient expenditures, annual outpatient expenditures, annual emergency room expenditures, annual miscellaneous expenditures, annual medication expenditures and annual total expenditures. Incremental resource utilization, incremental resource expenditures, incremental absenteeism and incremental absenteeism costs were estimated using

regression models, adjusting for other covariates including age, gender, sex, region, marital status, insurance coverage, comorbidities, anxiety, asthma, hypertension and hyperlipidemia. Multivariate regression models revealed incremental mean annual resource use associated with osteoarthritis of 0.07 hospitalizations, equal to 70 additional hospitalizations per 100 osteoarthritic patients annually, and 3.63 outpatient visits, equal to 363 additional visits per 100 osteoarthritic patients annually. Mean annual incremental total expenditures associated with osteoarthritis were $2,046. Mean annual incremental expenditures were largest for inpatient expenditures at $826, followed by mean annual incremental outpatient expenditures of $659, and mean annual incremental medication expenditures of $325. Mean annual incremental absenteeism was 2.2 days and mean annual incremental absenteeism costs were $715.74.

In conclusion, osteoarthritis was associated with considerable incremental health care resource utilization and expenditures. Presence of osteoarthritis was also associated with significant incremental absenteeism and incremental absenteeism costs.

INTRODUCTION

Background

Osteoarthritis

Musculoskeletal disease commonly causes chronic pain and disability (Chen, Gupte et al. 2012). Due to increasing morbidity and mortality related to musculoskeletal diseases, the United Nations, the World Health Organization, and thirty-seven countries recognized the importance of improving understanding and treatment of musculoskeletal disorders (Woolf and Pfleger 2003). Arthritis is a prevalent musculoskeletal condition (Murray and Lopez 1997; Blixen and Kippes 1999) and is one of the causes of pain among older Americans (Chen, Gupte et al. 2012). From 2010 to 2012, 49.7 percent of adults sixty-five years or older reported an arthritis diagnosis (Centers for Disease Control and Prevention 2013). It is predicted that by 2030, an estimated sixty-seven million Americans aged 18 years or older will be diagnosed with arthritis (Hootman and Helmick 2006). Among all civilian, non-institutionalized United States adults between eighteen and sixty-four years of age, five percent (8.2 million) reported diagnosed arthritis and arthritis-attributable work limitations (Theis, Murphy et al. 2007). Direct medical expenditures for arthritis and other rheumatic conditions in 2003 were estimated at eighty billion dollars (Centers for Disease Control and Prevention 2007). Indirect costs including productivity losses for arthritis and other rheumatic conditions in 2003 were estimated at forty-seven billion dollars (Centers for Disease Control and Prevention 2007).

Among different types of arthritis, osteoarthritis reportedly affects 27 million individuals in the United States (Lawrence, Felson et al. 2008). Research for osteoarthritis have focused on direct costs including medications, hospitalizations, transport to and from the medical center, and ancillary medical devices (Woo, Lau et al. 2003; Leardini, Salaffi et al. 2004; Gupta, Hawker et al. 2005; Kotlarz, Gunnarsson et al. 2010). Productivity losses or losses at work due to absenteeism or presenteeism because of osteoarthritis have also been examined (Woo, Lau et al. 2003; Leardini, Salaffi et al. 2004; Gupta, Hawker et al. 2005).

Literature Review

Characteristics of Osteoarthritis

Osteoarthritis is characterized by symptoms related to abnormalities in joints, subchondral bones and periarticular structures (Altman, Alarcon et al. 1990). Individuals are diagnosed either due to pathological changes including joint space narrowing, and bony sclerosis, or due to the presentation of symptoms including pain, swelling or stiffness, or a combination of both (Altman, Alarcon et al. 1990). In the United States, it was estimated that twenty-seven million adults suffered from osteoarthritis in 2005 (Lawrence, Felson et al. 2008). Men have 45 percent lower risk of incident knee osteoarthritis and 36 percent lower risk of hip osteoarthritis than women (Srikanth, Fryer et al. 2005).

Osteoarthritis usually affect joints in the knee, hip, hand, spine and foot (Newman et al. 2003). Among United States adults age thirty years or older, it has been estimated that symptomatic osteoarthritis in the knee occurs in 6 percent of individuals and 13 percent in individuals who are sixty years old or older (Felson and Zhang 1998). Osteoarthritis of the knee or hip that often lead to significant problems with mobility are treated with expensive surgical treatments (Guccione, Felson et al. 1994). Knee replacement surgeries due to osteoarthritis are one of the most commonly performed orthopedic procedures in the United States. Approximately 50 percent of all joint arthroplasties performed on the knee, and 97 percent of those are performed for knee osteoarthritis (United States Bone and Joint Initiative 2011). Osteoarthritis is expected to increase in the future in developed and developing countries due to increasing aging population and increasing prevalence of obesity, a risk factor of osteoarthritis (Badley and Wang 1998; March and Bagga 2004; Hagen, Zwart et al. 2005; Busija, Buchbinder et al. 2013).

Risk factors

Osteoarthritis and Age

Prevalence of osteoarthritis increases with age (Felson, Naimark et al. 1987; Kallman, Wigley et al. 1990). Felson and colleagues evaluated 1,424 individuals from the Framingham Heart study cohort whose ages ranged from sixty-three to ninety-four years. The Framingham Heart Study investigated development of cardiovascular disease in an adult population of Framingham, Massachusetts. Felson and colleagues evaluated these participants for the presence of knee osteoarthritis. Osteoarthritis was diagnosed in

27 percent of individuals between 65 to 69 years and in 51 percent for individuals who were 85 years or older (Felson, Naimark et al. 1987). Losina and colleagues estimated that approximately 10 percent of the United States population will be diagnosed with knee osteoarthritis by sixty years of age (Losina, Weinstein et al. 2013).

Osteoarthritis and Gender

Prevalence and incidence of osteoarthritis is significantly greater in women than men, especially after fifty years of age (Oliveria, Felson et al. 1995). Felson and colleagues estimated that there was a slightly higher prevalence of osteoarthritis in women (34%) than in men (31%) (Felson, Naimark et al. 1987). Zhang and colleagues examined 1,041 subjects older than seventy years of age and estimated a higher prevalence of hand osteoarthritis in women (26.2%) than in men (13.4%) (Zhang, Xu et al. 2001). Srikanth and colleagues conducted a meta-analysis in differences between men and women with respect to osteoarthritis incidence. Males as compared to females had a significantly reduced risk for osteoarthritis in the knee (Incidence Rate Ratio (IRR) of 0.55), but not in other joints (Srikanth, Fryer et al. 2005).

Osteoarthritis and Race

Anderson and Felson employed data from the HANES I survey which was the first national Health and Nutrition Examination Survey of 1971-1975, that examined a total of 5,193 individuals. Black women, as compared to white women, had increased risk of osteoarthritis (odds ratio = 2.12, 95% confidence interval = 1.39 to 3.23) but no differences were observed between black men and white men (Anderson and Felson 1988). Sowers and colleagues examined 1,053 women for presence of osteoarthritis in

Michigan and reported higher prevalence of knee osteoarthritis in black women at 23.1 percent than white women at 8.5 percent (Sowers, Lachance et al. 2000).

Osteoarthritis and Genetic factors

Research suggests that multiple genes and environmental factors can increase osteoarthritis susceptibility (Felson and Zhang 1998; Jonsson, Manolescu et al. 2003; Spector and MacGregor 2004). At least 50 percent of cases of osteoarthritis in the hands, hips and spine are associated with genetic factors (Spector, Cicuttini et al. 1996). Genes that are considered to have an association with risk of osteoarthritis include VDR, AGC1, IGF-1 and collagen II, IX, and XI (Spector and MacGregor 2004).

Osteoarthritis and Occupation

Occupational factors have been associated with risk of development of osteoarthritis. In a textile mill in Virginia, female workers whose jobs required continual motion had a much higher rate of osteoarthritis than other female workers (Hadler, Gillings et al. 1978). Felson and colleagues assessed the association between osteoarthritis in the knee and occupation of the individual. Individuals whose jobs had repetitive knee motion had higher rate of knee osteoarthritis than men whose jobs did not include repetitive knee motion (odds ratio = 2.22) (Felson, Hannan et al. 1991). Coggon and colleagues reported that farmers who regularly lifted weights in excess of ten kilograms had higher rates of hip osteoarthritis as compared to those who did not lift weights (odds ratio=3.2) (Coggon, Kellingray et al. 1998).

Osteoarthritis and Physical activity

Buckwalter and Lane reported that participation in sports that caused repetitive high levels of impact increased the risk of cartilage degeneration and caused osteoarthritis (Buckwalter and Lane 1997). Buckwalter and Lane also suggested that people with abnormal joint alignment or joint injury had greater risk of osteoarthritis (Buckwalter and Lane 1997). Kujala and colleagues selected 117 male former top-level athletes who had participated in different sports activities including long-distance running, soccer, weight lifters and shooters. They reported increased premature risk of development of osteoarthritis in soccer players and weight lifters due to higher knee injuries (Kujala, Kettunen et al. 1995).

Osteoarthritis and Comorbid disease conditions

Caporali and colleagues evaluated 29,132 patients with osteoarthritis in Italy and reported that the most common comorbidities were hypertension (52 percent), osteoporosis (21 percent), type II diabetes mellitus (15 percent), and chronic obstructive pulmonary disease (12 percent) (Caporali et al 2005). Marks and Allegrante examined 1,000 hip osteoarthritis surgical patients and reported that 55 percent of the cohort had at least one comorbid condition related to an insufficiency of the cardiovascular, peripheral vascular or respiratory systems (Marks and Allegrante 2002). Another risk factor for osteoarthritis is obesity (Felson, Lawrence et al. 2000; Runhaar, Koes et al. 2011). Being overweight increases the risk of osteoarthritis (Oliveria, Felson et al. 1995). In the Framingham Study, women who had a mean weight loss of eleven pounds decreased their risk for knee osteoarthritis by 50 percent (Felson, Zhang et al. 1992).

Comorbid conditions including obesity, cardiovascular diseases, anxiety, hypertension and diabetes have been associated with limitations in activities, and quality of life in osteoarthritis (Vebrugge, Gates et al. 1991; Creamer, Lethbridge-Cejku et al. 2000; Carporali, Cimmano et al. 2005).

Treatment for Osteoarthritis

There is no treatment that can cure osteoarthritis. Treatment options include reducing pain and improving function of the joint. Physical therapy, drug therapy and surgical interventions are some options for relieving pain. Some pharmacological therapies include administering Nonsteroidal anti-inflammatory drugs (NSAIDs), which relieve pain and swelling (Tannenbaum, Peloso et al. 2000; Milder, Williams et al. 2011).

NSAIDs are used as first-line treatment for moderate to severe osteoarthritis and work by inhibiting the COX pathway in the osteoarthritis joint (Tannenbaum, Peloso et al. 2000). NSAIDs have been commonly prescribed with 80 percent of rheumatologists prescribing NSAIDs for osteoarthritis (Baum, Kennedy et al. 1985; Hochberg, Perlmutter et al. 1996). There have been concerns regarding adverse effects due to NSAIDs, including NSAID related gastrointestinal ulcers (Graham 2000; Tang and Chan 2012). As a result, second generation COX-2 inhibitors were developed as safer alternatives.

Opioids are becoming more common in treating osteoarthritis. Rutjes and colleagues conducted a systematic literature review for individuals with osteoarthritis on pain, function and safety of oral or transdermal opioids as compared to patients with placebo. They reported that while patients reported 50 percent greater improvement in pain with opioids than with placebo, there were also higher adverse events reported with opioids as compared to placebo (Nuesch, Rutjes et al. 2009). Since prescription opioids have been reported as a common source of opioid misuse, international osteoarthritis guidelines recommend use of opioids only in exceptional cases (Dunbar and Katz 1996; Zacny, Bigelow et al. 2003; Sproule, Brands et al. 2009; Zhang, Nuki et al. 2010).

Other pharmaceutical agents used in the treatment of osteoarthritis are dietary supplements of glucosamine and chondroitin sulfate (Clegg, Reda et al. 2006), hyaluronic acid derivatives, NGF monoclonal antibodies (Lane, Schnitzer et al. 2010), growth factors (Sellers, Peluso et al. 1997), and stem cell therapy (Coleman, Curtin et al. 2010).

Physical rehabilitation is effective in improving symptoms of osteoarthritis (Ettinger, Burns et al. 1997; Rejeski, Focht et al. 2002). Rejeski and colleagues reported that physical activity led to an improvement in beliefs of individuals with osteoarthritis regarding performing their tasks (Rejeski, Ettinger et al. 1998). Rejeski and colleagues randomly assigned 316 obese individuals with osteoarthritis to one of four interventions: weight loss due to dietary restrictions, exercise, dietary restrictions and exercise, or healthy lifestyle control for eighteen months. The authors found that the individuals with combined diet and exercise intervention, had a significant increase in physical component summary score on the SF-36 instrument as compared to the control group ($p<0.001$). There were no significant differences between groups for the mental component summary score of the SF-36 (Rejeski, Focht et al. 2002).

Surgical treatment is employed when there is serious damage or pain in the affected joint (Ronn, Reischl et al. 2011). Surgery may involve repair of the joint through small incisions. Joint replacement is conducted if damage cannot be repaired through incisions (Fortin, Penrod et al. 2002; Bruyere, Pavelka et al. 2008; Ronn, Reischl et al. 2011).

Osteoarthritis and health-related quality of life

Pain due to osteoarthritis causes functional limitations, stress, depression, and interferes with performance of various life roles (Gignac, Backman et al. 2008; Sale, Gignac et al. 2008). Salaffi and colleagues compared individuals suffering from osteoarthritis with healthy individuals and evaluated their health-related quality of life using the Short Form-36 (SF-36). One hundred and forty-five patients (54.9 percent) out of 264 patients reported at least one chronic comorbid disease. Individuals with osteoarthritis reported significantly lower scores for physical functioning domain (mean score =48.2) ($p<0.001$) as compared to individuals without osteoarthritis (mean score=79.2) (Salaffi, Carotti et al. 2005).

Similarly, Jakobsson and Hallberg conducted a literature review on pain and health-related quality of life among people aged seventy-five years and older with osteoarthritis. They reported that individuals with osteoarthritis had more pain, functional limitations, and lower physical quality of life than those without osteoarthritis (Jakobsson and Hallberg 2006).

DiBonaventura and colleagues compared individuals with osteoarthritis and individuals without osteoarthritis using data from the 2009 National Health and Wellness Survey. There were 2,173 individuals who reported osteoarthritis and 37,599 individuals without osteoarthritis. Individuals suffering from osteoarthritis (mean age of 52.1 years) were significantly older than individuals without osteoarthritis (mean age of 41.4 years) (p< 0.0001). Most of the individuals were predominantly females (58.2 percent). There was higher impairment in work for individuals with osteoarthritis (34.4 percent) as compared to individuals without osteoarthritis (17.8 percent, p<0.001) (Dibonaventura, Gupta et al. 2011).

Individuals with osteoarthritis have been reported to suffer from higher levels of depression as compared to individuals without osteoarthritis (Maisiak 1990; Kim, Han et al. 2011). Apart from the fact that pain in osteoarthritis limits functioning, it also deters a person from carrying out personal and social functions. This could, in turn, lead to further depression and anxiety (Williamson and Shaffer 2000).

In summary, three studies reported lower physical functioning among individuals with osteoarthritis than individuals without osteoarthritis (Salaffi, Carotti et al. 2005; Jakobsson and Hallberg 2006; Dibonaventura, Gupta et al. 2011). Three studies reported lower mental functioning among individuals with osteoarthritis than individuals without osteoarthritis (Maisiak 1990; Williamson and Shaffer 2000; Kim, Han et al. 2011; Gignac, Backman et al. 2013).

Direct resource utilization and expenditures

All-cause direct utilization and costs for individuals with osteoarthritis

Direct costs are expenditures associated with interventions or treatments for hospital care, physician services, equipment, medications and laboratory studies (Gabriel, Crowson et al. 1997). White and colleagues analyzed a de-identified claims data base for privately insured members between 1998 and 2004. Individuals older than eighteen and younger than sixty-four years of age and having at least two claims of osteoarthritis diagnosis were included. A total of 32,043 osteoarthritis patients comprised the study sample. Mean age for the total sample was fifty-five years, and sixty percent of the sample was female. For annual medical utilization, the mean all-cause outpatient visits was 26.11 with standard deviation of 25.89, the mean all-cause inpatient hospitalization was 0.60 with standard deviation of 1.57 and the mean all-cause emergency room utilization was 0.30 with standard deviation of 1.57. Mean all-cause expenditure for patients diagnosed with osteoarthritis annually was estimated at $8,601 (White, Birnbaum et al. 2008).

Osteoarthritis-related utilization and cost

Osteoarthritis-related utilization and costs, survey-based studies

Gupta and colleagues mailed a screening questionnaire to individuals older than fifty-five years in Ontario, Canada to obtain information on self-reported arthritis. Individuals who reported suffering from osteoarthritis were requested to participate in a five-year follow up study. Individuals provided their demographic information, health status, whether they had physician diagnosed arthritis and whether they had joint replacement through a self-reported questionnaire. Patients were asked to report the actual costs for the health care services and medical equipments used. Using information from the questionnaire, osteoarthritis related direct costs in this study were calculated as sum of equipment, transport, homecare, home aide care, and other expenditures due to arthritis. Costs due to prescription and non-prescription drugs were not included, as Canada provides public insurance that covers medication charges. Mean direct costs were $2,300 per person per year. Logistic regression was used to analyze any osteoarthritis-related costs. Age, gender, race, body mass index, income, employment, education were included in the analyses as predictors to determine the likelihood of reporting any osteoarthritis related costs. Older individuals as compared to younger individuals were more likely to have osteoarthritis-related costs ($p<0.001$). Women were more likely than men to having osteoarthritis-related costs ($p<0.001$) (Gupta, Hawker et al. 2005).

Woo and colleagues estimated osteoarthritis related direct utilization and costs of osteoarthritis in Hong Kong in 2001. Patients with osteoarthritis were recruited from four different types of clinic of Hong Kong. Participants were given a questionnaire that collected data on sociodemographic information and information on disease. Information on all hospital or clinic services related to osteoarthritis in the past twelve months was collected. Means and standard deviations for costs and utilization for groups with mild osteoarthritis and severe osteoarthritis were calculated. Direct costs of osteoarthritis were summation of costs due to hospital inpatient and outpatient services, drug treatments, transport to hospital or clinic for the previous twelve months for osteoarthritis. Mean emergency visits annually for osteoarthritis were 1.8 days, mean outpatient visits annually for osteoarthritis were 3.4 days, mean duration of hospitalization visits annually for osteoarthritis were 36.1 days, mean duration of physiotherapy visits annually for osteoarthritis were 19.7 days, and average duration of occupational therapy annually for osteoarthritis were 18.8 days. Average direct costs for a person per year ranged from $192 dollars for mild osteoarthritis to $658 Hong Kong dollars for severe osteoarthritis (Woo, Lau et al. 2003).

Leardini and colleagues evaluated a cohort of 254 patients from twenty-nine rheumatology institutes suffering from osteoarthritis in Italy from 2000 to 2001. Patients in the rheumatology institutes reported to a rheumatologist in each institute. Data collection was conducted by the rheumatologists who obtained information on the patient's sociodemographic characteristics and clinical information about the disease with a survey. Direct costs related to osteoarthritis including hospitalizations, visits to general practioners, specialists, laboratory examinations, and physical therapies were obtained from the survey and summed. Mean age of the sample was sixty-six years, and 75 percent of the sample were females. Mean direct costs per person annually was calculated. The authors reported mean direct cost of €934 ($1,061) per patient per year, which included €233 ($256) spent on hospitalization, €209 ($230) on diagnostic procedures, and €146 ($160) on drug therapy (Leardini, Salaffi et al. 2004).

In summary, three studies found osteoarthritis-related costs using survey data (Woo, Lau et al. 2003; Leardini, Salaffi et al. 2004; Gupta, Hawker et al. 2005). The range of osteoarthritis related direct total costs was between $192 (Woo, Lau et al. 2003) to $2,300 (Gupta, Hawker et al. 2005) per person annually. The range in costs can be attributed to the different medical insurance systems that are present in different countries.

Osteoarthritis-related utilization and costs, claims data

Lanes and colleagues evaluated arthritis related direct costs for patients with osteoarthritis or rheumatoid arthritis from July 1, 1993 to June 30, 1994. Medical records of patients were obtained from records of a group-model health maintenance organization. Utilization included hospital care, outpatient visits and prescriptions. Individuals thirty years and older, with either rheumatoid arthritis and osteoarthritis and who were actively enrolled between July 1, 1993 and June 30, 1994 were included. Individuals diagnosed with rheumatoid arthritis were 365 in number and individuals with osteoarthritis were 10,101 in number. Mean costs for medication, office visits, ambulatory visit, and inpatient costs from the utilization records were calculated. An average individual direct cost of $543 was attributed for osteoarthritis per year while an average individual direct cost for rheumatoid arthritis was $2,162 annually. Hospital care was an average cost of $249 per person per year (Lanes, Lanza et al. 1997).

Dunn and colleagues employed data from the IMS or Pharmetrics Integrated Patient-Centric Database, which are medical and pharmaceutical claims from many health plans across the United States. Inclusion criteria were a diagnosis of osteoarthritis from January 1, 2007 through December 31, 2007 and being continuously enrolled for a year. The sample included 1,116,437 eligible participants with average age of fifty-four years. Means and standard deviations for inpatient costs, outpatient costs, prescription medications, and emergency department visits for individuals with osteoarthritis were calculated from claims. More than half of the sample (56%) were fifty years and older in age, and 60 percent of the sample were females. Mean inpatient visit annually was one visit, mean outpatient visit annually were fifteen visits, mean emergency rooms visits annually were 0.2 visits, and mean medications prescribed annually were 3.8 medications. Average charges annually due to osteoarthritis were estimated to be $5,398 per patient with nearly 40 percent of total charges due to inpatient costs (Dunn and Pill 2009).

In summary, two studies evaluated osteoarthritis-related utilization and expenditures using claims data. The average costs annually due to osteoarthritis varied between $543 per person per year (Lanes, Lanza et al. 1997) to $5,398 per patient per year (Dunn and Pill 2009). Difference between expenditures can be attributed due to fact that Dunn and Pill calculated charges submitted by providers and not actual payer costs while Lanes et al. calculated costs by actual payers.

Incremental direct costs

Incremental utilization and costs, matched cohort analyses

Berger and colleagues examined incremental direct costs for osteoarthritis using MarketScan® commercial database in the United States (Berger, Hartrick et al. 2011). Private-sector employees, aged eighteen years or older osteoarthritis in 2007 were examined. Individuals aged eighteen years or younger, uninsured, or Medicaid beneficiaries were excluded. Direct care costs were estimated as summation of costs due to inpatient visits, outpatient visits that included physician visits and emergency department visits, hospitalizations, and prescription medications. Employed persons with osteoarthritis were identified (2,399 individuals) and matched on age and sex to an equal number of individuals without osteoarthritis. Mean age of the sample was 53 years, and 62 percent of the sample were men. Individuals with osteoarthritis also had significanly higher outpatient visits (28.5 visits) and hospitalizations (0.4 visits) as compared to individuals without osteoarthritis (11.8 visits) and hospitalizations ($P < 0.01$). Individuals with osteoarthritis also had significanly higher hospitalizations (0.4 visits) as compared to individuals without osteoarthritis (0.1 visits) ($P < 0.01$). Annual incremental cost associated with osteoarthritis was $8,060 per person (Berger, Hartrick et al. 2011).

A study by Macclean and colleagues estimated incremental direct costs due to osteoarthritis using insurance claims from 1991 and 1993 in a national managed care organization. Patients with osteoarthritis were matched on age and sex to subjects who had no insurance claims for osteoarthritis. The sample consisted of 10,000 individuals with osteoarthritis who were matched to an equal number of individuals without osteoarthritis on age, sex, and insurance plan. Direct care costs were summation of costs due to inpatient visits, outpatient visits that included physician visits and emergency department visits, hospitalizations, and prescription medications. Mean annual direct costs for individuals with osteoarthritis were $5,294 and mean annual direct costs for individuals without osteoarthritis were $2,467. Incremental annual direct cost per person associated with osteoarthritis was $2,827 (MacLean, Knight et al. 1998).

In summary, two studies reported incremental costs associated with osteoarthritis. Incremental costs associated with osteoarthritis ranged from $2,287 (MacLean, Knight et al. 1998) to $8,060 per person per year (Berger, Hartrick et al. 2011). Both studies did not incorporate comorbid disease conditions while reporting incremental estimates. Maclean et al. conducted their study in 1993, while Berger et al. conducted their studies in 2011 respectively. Increased expenditures from the study conducted by Maclean et al. to Berger et al. can be attributed to the increasing costs of medical services with time.

Incremental utilization and costs, regression analyses

Le and colleagues included individuals older than eighteen years of age with an osteoarthritis claim in 2007 using MarketScan® Commercial and Medicare Supplemental Databases. Direct costs were compared between individuals with osteoarthritis and individuals without osteoarthritis. Individuals with an osteoarthritis diagnosis on an inpatient or outpatient claim in 2007 were included in the study. The number of individuals in the study with osteoarthritis was 258,237 patients who were matched to individuals without osteoarthritis on age, gender, geographic region, health plan type, and Medicare eligibility. Generalized linear model regressions estimated hospitalizations and expenditures. Incremental annual mean hospitalizations was 0.3 ($p<0.05$), incremental annual mean emergency room visits was 0.2 ($p<0.05$) and incremental annual mean outpatient visits was 2.9 ($p<0.05$). Incremental annual direct cost due to osteoarthritis per person was $10,941 (Le, Montejano et al. 2012).

DiBonaventura and colleagues used 2009 National Health and Wellness Survey to estimate direct medical costs of employed individuals in the U.S. Individuals indicated in the survey if they suffered from arthritis and the type of arthritis they suffered. Of the 39,772 individuals, 2,173 were diagnosed with osteoarthritis. Mean age of individuals without osteoarthritis was 41 years and mean age of individuals with osteoarthritis was 52 years. More than half of the sample with osteoarthritis were females (58.2 percent), while 46 percent of individuals with no osteoarthritis were females. Individuals who reported osteoarthritis were compared to individuals without osteoarthritis. Resource utilizations estimated were prescriptions, outpatient visits, hospitalizations and emergency room visits. Direct mean annual costs were $3,702 for individuals with osteoarthritis and $2,158 for individuals without osteoarthritis. Mean annual cost associated with osteoarthritis was estimated at $1,544 per person. (Dibonaventura, Gupta et al. 2011).

Kotlarz and colleagues used data 1996 to 2005 from the Medical Expenditure Panel Survey (MEPS) and calculated direct costs for individuals with osteoarthritis and individuals without osteoarthritis. Individuals eighteen years or older were included in the study. Generalized linear models were conducted to estimate incremental direct costs using a zero inflated negative binomial distribution model. Hospital, outpatient, medication and related medical expenditures were estimated. The authors estimated costs separately for men and women. The study sample included 74,603 women and 53,890 men. Out-of-pocket direct costs and costs attributable to insurers were calculated. Among women, there was an increase of out of pocket expenditures by $1,379 per woman per year due to osteoarthritis and insurer expenditures by $4,833 per person per year. There was an increase of out-of-pocket expenditures by $694 per man per year due to osteoarthritis and insurer expenditures by $4,036 per person per year (Kotlarz, Gunnarsson et al. 2009).

In summary, three studies examined osteoarthritis related incremental direct costs (Dibonaventura et al 2011; Kotlarz et al. 2009; Le et al. 2012). Kotlarz et al. did not estimate an annual direct cost per person and instead estimated an average direct cost for females ($1,379) out-of- pocket and males ($694) out-of-pocket, separately.

Indirect expenditures associated with osteoarthritis

Indirect expenditures are defined as expenses incurred from the cessation or reduction of work productivity as a result of morbidity and mortality associated with a given disease (Gupta, Hawker et al. 2005). Indirect costs consist of reduced productivity from illness, and costs accrued by family and friends for taking care of an individual due to his or her disease (Andersson, Levin et al. 2002). Indirect costs incurred due to absenteeism from the workplace are referred to as absenteeism costs (Andersson, Levin et al. 2002).

Absenteeism costs

Work productivity has been defined as production output per labor hours (Beaton, Bombardier et al. 2009). Loss of work productivity can be due to days missed from work (absenteeism), or difficulties experienced at work due to illness (presenteeism) (Brouwer, Koopmanschap et al. 1999; Meerding, Jzelenberg et al. 2005). Absenteeism costs are commonly determined by calculating number of working days lost due to illness and multiplying with market wage rates (Beaton, Bombardier et al. 2009).

All-cause absenteeism associated with osteoarthritis

White and colleagues analyzed a claims database for privately insured members from 1998 to 2004 in the United States. In order to calculate absenteeism, the authors counted a hospital outpatient visit as a half day of absenteeism and a hospital inpatient visit as a full day of absenteeism. Individual’s daily wage was multiplied with days absent to obtain absenteeism costs. Average annual absenteeism costs for individuals with osteoarthritis were $4,603 (White, Birnbaum et al. 2008).

Osteoarthritis-related absenteeism

Leardini and colleagues evaluated a cohort of 254 patients from twenty-nine rheumatology institutes suffering from osteoarthritis in Italy from 2000 to 2001. Patients in the rheumatology institutes reported to a rheumatologist in each institute who obtained information on the patient's sociodemographic characteristics and clinical information about the disease. Information was collected from patients about the number of working days lost in the past year due to osteoarthritis. Average wages of individuals in different occupations were obtained from the National Statistics Institute of Italy. Annual working days missed due to osteoarthritis was multiplied with daily wages to obtain absenteeism costs. Patients who reported absenteeism due to osteoarthritis reported missing twenty-five working days in the past year, on an average. Absenteeism costs were €1,236 ($1,360) per year per patient (Leardini, Salaffi et al. 2004).

Woo and colleagues estimated absenteeism costs of osteoarthritis in Hong Kong in 2001 for individuals with mild and severe osteoarthritis. Patients with a diagnosis of osteoarthritis were recruited from different medical clinics. In the survey, participants provided information related to sick days absent from work due to osteoarthritis. Participants also provided information about their wage rates. The authors reported that for individuals with mild arthritis, the average annual costs due to absenteeism or retirement or change in jobs were $422 and for severe arthritis due to absenteeism or retirement or change in jobs, the average annual costs were $850 (Woo, Lau et al. 2003).

Gupta and colleagues evaluated absenteeism costs among 1,258 individuals suffering osteoarthritis in Canada. The authors asked individuals to report the amount of time they had taken off from work in the past three months due to osteoarthritis. Wages lost due to absenteeism were obtained by using occupation specific wages from 2001 Canadian census and were multiplied with number of working days missed at work. Mean absenteeism costs were $7,905 per person per annum (Gupta, Hawker et al. 2005).

Osteoarthritis-related incremental absenteeism, regression approach

Kotlarz and colleagues used Medical Expenditure Panel Survey (MEPS) data of employees in the United States to examine association between osteoarthritis and absenteeism costs from 1996 to 2005. There were 56,379 women and 61,424 men in the study. Individuals annual wages were multiplied with annual days missed at workplace to estimate absenteeism costs. Generalized linear models were conducted to estimate incremental direct costs using a zero inflated negative binomial model. Variables included in the analysis were age, occupation, race, gender, region, education, marital status, presence of diseases including hypertension and hyperlipidemia. Incremental annual absenteeism associated with osteoarthritis for women was 3.7 days per woman. Similarly, incremental annual absenteeism associated with osteoarthritis for men was 4.5 days per man. Incremental annual absenteeism costs associated with osteoarthritis for women were $469 per woman. Similarly, incremental annual absenteeism costs associated with osteoarthritis for men were $520 per man. (Kotlarz, Gunnarsson et al. 2010).

Berger and colleagues examined absenteeism costs using MarketScan® commercial database. Employees, aged eighteen years or older with osteoarthritis in 2007 were examined. Absenteeism costs were obtained by multiplying number of hours absent from work by the mean hourly wage of US full-time civilian employees in 2007 estimated at $21.08 in year 2007 from United States census. Incremental annual absenteeism associated with osteoarthritis was 1.8 days. The authors also reported that average annual absenteeism cost for individuals with osteoarthritis was $3,165, as compared to average annual absenteeism cost for individuals without osteoarthritis at $1,747, with incremental absenteeism costs at $1,418 (Berger, Hartrick et al. 2011).

DiBonaventura and colleagues used 2009 National Health and Wellness Survey to estimate productivity costs in the U.S. Individuals reported absenteeism from their workplace during the previous seven days. For absenteeism costs, average annual income values were obtained from the Bureau of Labor Statistics, and then multiplied with number of days missed at work. Individuals with osteoarthritis were compared to individuals without osteoarthritis. Incremental annual absenteeism costs were $5,328 (Dibonaventura, Gupta et al. 2011).

There are variations in how absenteeism costs were calculated in literature. While Kotlarz et al., (Kotlarz, Gunnarsson et al. 2010) and Woo et al.(Woo, Lau et al. 2003), employed earnings as reported by individuals, DiBonaventura et al.(Dibonaventura, Gupta et al. 2011), Berger et al. (Berger, Hartrick et al. 2011), Leardini et al. (Leardini, Salaffi et al. 2004), and Gupta et al. (Gupta, Hawker et al. 2005) used estimated average wages from census data to estimate absenteeism costs. Studies that used average wages from census data reported higher absenteeism costs in general than studies that used wages reported by individuals.

Study Rationale

Maetzel and colleagues suggested that economic burden of arthritic conditions, primarily osteoarthritis, will increase as the working population generation gets older (Maetzel, Li et al. 2004). Kotlarz and colleagues examined absenteeism costs for employed individuals suffering from osteoarthritis from 1996 to 2005 from the Medical Expenditure Panel Survey (MEPS) (Kotlarz, Gunnarsson et al. 2010). Berger et al., and Le et al. also calculated direct and absenteeism costs using Marketscan claims data for 2007 (Berger, Hartrick et al. 2011; Le, Montejano et al. 2012). Berger et al. and Le et al. however did not adjust for comorbid disease conditions while analyzing incremental direct expenditures for osteoarthritis. The authors reported that adjusting for comorbid diseases for individuals with osteoarthritis in future research, would help determine expenditures attributable solely to osteoarthritis (Berger, Hartrick et al. 2011). The current study estimated incremental utilization and incremental costs of direct healthcare associated with osteoarthritis as well as incremental absenteeism and incremental absenteeism costs associated with osteoarthritis.

Significance

Current estimates of the economic burden of osteoarthritis ignore the cost of some therapies such as physical therapy and chiropractic care. Current estimates may likely underestimate the impact of the disease and the need for research into strategies for prevention and treatment. The findings will provide current burden data to better inform health policy and resource allocation decisions.

Objectives

The goal of this study was to assess burden associated with osteoarthritis. The specific objectives of the study were to:

1. determine incremental annual direct health care resource utilization associated with osteoarthritis by categories including hospitalizations, hospital days, emergency room encounters, and outpatient visits
2. determine incremental annual direct health care expenditures associated with osteoarthritis by categories including total expenditures, inpatient hospital expenditures, emergency room expenditures, outpatient expenditures, medication expenditures and miscellaneous expenditures
3. determine incremental annual number of days absent from work associated with osteoarthritis and
4. determine incremental annual absenteeism costs associated with osteoarthritis

Hypotheses

The current study hypotheses were:

1. presence of osteoarthritis will increase annual direct utilization of health care resources, including increase in hospitalizations, hospital days, emergency room encounters, and outpatient room visits
2. presence of osteoarthritis will increase annual direct health care expenditures, including increase in total expenditures, inpatient hospital expenditures, emergency room expenditures, outpatient expenditures, medication expenditures and miscellaneous expenditures

3. presence of osteoarthritis will increase annual absenteeism from workplace and
4. presence of osteoarthritis will increase annual absenteeism costs from workplace

Notes

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METHODS

Study Design

An observational database analysis was conducted using data from the Medical Expenditure Panel Survey (MEPS). Individuals eighteen years old or older with osteoarthritis were compared to individuals without osteoarthritis. A one-year study interval was used for analyses.

Data Source

Agency for Healthcare Research and Quality (AHRQ) conducts the Medical Expenditure Panel Survey (MEPS) nationally (Cohen, Monheit et al. 1996). The MEPS survey collects information on sociodemographic characteristics, employment information, health conditions, and health care utilization of individuals surveyed. Estimates of healthcare expenditures are provided for the United States civilian noninstitutionalized population by the MEPS (Cohen, Monheit et al. 1996). The MEPS sample design is a complex survey with disproportionate sampling where Hispanics and blacks are oversampled. Sampling weights are used to adjust for the complex design of the survey (Cohen, Monheit et al. 1996).

The MEPS database has two major components: the Household Component and the Insurance Component. The Household Component provides data from individual households and their members and their medical providers. The MEPS collects data for each person in the household on demographic characteristics, health conditions, health insurance coverage, income, and employment. The survey has many rounds of interviewing covering two full calendar years. The present study employed MEPS household component data for the year 2011.

Study Variables

Osteoarthritis diagnosis

International Classification of Diseases (ICD-9-CM) system codes were used to identify individuals with osteoarthritis. Individuals with ICD-9-CM code of 715 for osteoarthritis and allied disorders in the year 2011 were considered to be diagnosed with osteoarthritis (Centers for Disease Control and Prevention, 2011). The code for osteoarthritis was obtained from an online 2011 ICD-9-CM and Medical Terminology dictionary (Centers for Medicaid and Medicare 2011). For the analyses, osteoarthritis was coded as a binary variable, with ‘1’ indicating presence of the disease, and ‘0’ indicating absence of the disease. Frequencies were tabulated for the osteoarthritis variable.

Clinical Variables

Charlson Comorbidity Index

The Charlson Comorbidity Index characterizes comorbidities of patients based on the International Classification of Diseases (ICD) diagnosis codes (Charlson, Pompei et al. 1987). Higher comorbidity scores indicate a more severe burden of comorbidity. The Charlson Comorbidity Index score consists of nineteen different disease comorbidity categories, each allocated a weight of one to six and added to provide a total score, to indicate disease burden (Charlson, Pompei et al. 1987). A Charlson Comorbidity Index score of zero indicates a patient has no or minimal comorbid burden, scores between one and four indicate moderate burden and scores of greater than or equal to five indicate substantial burden (Charlson, Pompei et al. 1987). The Charlson Comorbidity Index scores were created from 2011 claims from MEPS using an algorithm by Romano and colleagues (Romano, Roos, and Jollis 1993). To control for potential comorbidities, Charlson Comorbidity Index score was included as a covariate in the analyses and coded as a continuous variable. Frequencies were tabulated for the Charlson Comorbidity Index score.

Hypertension

Hypertension in the sample was identified from administrative claims with corresponding ICD-9-CM diagnosis code for hypertension during the one year period in 2011. The ICD-9-CM code for hypertension is 401 (Centers for Medicaid and Medicare 2011). The code for hypertension was obtained from an online 2011 ICD-9-CM and Medical Terminology dictionary (Centers for Medicaid and Medicare 2011). For the analyses, hypertension was coded as a binary variable, with '1' indicating presence of the disease, and '0' indicating absence of the disease. Frequencies were tabulated for the hypertension variable.

Hyperlipidemia

Hyperlipidemia in the sample was identified from administrative claims with corresponding ICD-9-CM diagnosis code for hyperlipidemia during the one year period in 2011. The ICD-9-CM code for hypertension is 272 (Centers for Medicaid and

Medicare 2011). The code for hyperlipidemia was obtained from an online 2011 ICD-9-CM and Medical Terminology dictionary (Centers for Medicaid and Medicare 2011). For the analyses, hyperlipidemia was coded as a binary variable, with '1' indicating presence of the disease, and '0' indicating absence of the disease. Frequencies were tabulated for the hyperlipidemia variable.

Asthma

Asthma in the sample was identified from administrative claims with corresponding ICD-9-CM diagnosis code for asthma during the one year period in 2011. The ICD-9-CM code for hypertension is 493 (Centers for Medicaid and Medicare 2011). The code for asthma was obtained from an online 2011 ICD-9-CM and Medical Terminology dictionary (Centers for Medicaid and Medicare 2011). For the analyses, asthma was coded as a binary variable, with '1' indicating presence of the disease, and '0' indicating absence of the disease. Frequencies were tabulated for the asthma variable.

Anxiety

Anxiety in the sample was identified from administrative claims with corresponding ICD-9-CM diagnosis code for anxiety during the one year period in 2011. The ICD-9-CM code for hypertension is 300 (Centers for Medicaid and Medicare 2011). The code for anxiety was obtained from an online 2011 ICD-9-CM and Medical Terminology dictionary (Centers for Medicaid and Medicare 2011). For the analyses, anxiety was coded as a binary variable, with '1' indicating presence of the disease, and '0' indicating absence of the disease. Frequencies were tabulated for the anxiety variable.

Days missed at workplace

To determine absenteeism, the MEPS survey in 2011 asked individuals to report number of work days lost because of illness or injury. Days missed at work annually due to illness or injury in the year 2011 was coded as a count variable.

Sociodemographic variables

Sociodemographic variables included age, gender, degree, race, region, marital status, and health insurance type. Age of individuals in January of 2011, was coded as a continuous variable for the analyses. Gender was coded in this study as “0” for males and “1” for females. Race was coded as a categorical variable including “1” for White, “2” for Black, “3” for others. Region was coded as a categorical variable including “1” for Northeast, “2” for Midwest, “3” for South, and “4” for West. Marital status categories using data of individuals in January of 2011 included “1” for married, “2” for widowed, “3” for separated, “4” for divorced and “5” for never married.

Highest degree obtained by an individual in year 2011 was coded as “1” for no degree, “2” for general education degree (GED), “3” for high school diploma, “4” for bachelor’s degree, “5” for master’s degree or doctorate degree and “6” for other degree.

Health insurance status was coded as a categorical variable with three categories, “1” as private insurance, and “2” as public insurance and “3” for no insurance. Frequencies were tabulated for all the sociodemographic variables.

Wage variable

Individuals were asked to report their annual wage in MEPS for 2011. Based on a report by Bureau of Labor Statistics, number of working days annually is calculated by considering there are five working days per week, excluding federal holidays (Bureau of Labor Statistics 2011). For the purposes of the current study, number of working days in 2011 was calculated by excluding federal holidays and weekends, obtaining 250 days. Annual wages were divided by number of working days in 2011 to obtain daily wages. Daily wage was coded as a continuous variable. Daily wage was multiplied with annual days missed at the workplace to obtain annual absenteeism costs.

Healthcare utilization variables

Health care resource utilization among persons with osteoarthritis was estimated from individuals' claims during 2011 for hospitalizations, hospital days, outpatient visits, and emergency room visits. One visit at an outpatient facility was defined as a summation of all visits to that facility per day. For example, if a patient visited an outpatient office two times in one day the resultant visit count for that day was one outpatient visit. Similarly, for an emergency room visit if a patient visited an emergency room once on a particular day, the resultant visit count for emergency room was one.

Hospitalizations were determined by identifying and counting the number of unique confinements per patient. One admittance to the hospital for a person was considered as one hospitalization for the person. Number of hospital days spent by each patient were identified by subtracting the patient's admit date and discharge date at the hospital for each visit.

Healthcare expenditures

Health care resource expenditures among persons with osteoarthritis was estimated from individuals' claims during 2011. For inpatient expenditures, standard cost of the inpatient admission was added to professional fees associated with the confinement. Total hospitalization costs per patient were calculated by adding expenditures from all hospital episodes. If there were multiple visits to the same facility on the same day, a visit-level summation of expenditures was generated to obtain one record per visit (outpatient facility or emergency room) per day. Total annual emergency room expenditures and total annual outpatient expenditures per patient were calculated by adding facility-specific expenditures for the patient in the specified one-year period. Total annual prescription expenditures per patient, were calculated by adding standard prices for all medication claims during the specified one year period. Total miscellaneous expenditures were calculated per person by adding all costs not included in any other resource category during the specified one year period.

Ethical Considerations

Application for human subjects research was approved by the Institutional Review Board at Purdue University, West Lafayette, Indiana. Research proceeded upon approval.

Study Sample

Sample Inclusion Criteria

Osteoarthritis cohort sample

Osteoarthritis cohort included all employed people eighteen years old or older using claims data from 2011. ICD-9-CM codes were used to identify employees with osteoarthritis: 715 for osteoarthritis and other allied disorders.

<u>Comparison sample</u>

Osteoarthritis cohort was compared to a comparison cohort consisting of all employed individuals in year 2011, eighteen years old or older and employed, but with no diagnosis of osteoarthritis.

Sample Exclusion Criteria

Individuals missing any information on age, sex, race, region, marital status, insurance were excluded. Individuals missing any information on number of days missed at work in 2011 were excluded. Individuals who had missing information for their wages in MEPS were excluded.

<u>Statistical Analysis</u>

SAS for UNIX version 9.3 (SAS Institute, 2001 Cary, NC) and STATA for UNIX version 12 was used for analyses. An a priori alpha level of 0.05 was used for all analyses. Frequency distributions were developed and Chi-square tests were used to assess statistical differences between persons with or without osteoarthritis on age, gender, geographical region, marital status, race, insurance status, hypertension, hyperlipidemia, anxiety, asthma, and Charlson Comorbidity Index.

All-cause Health Care Resource Utilization

<u>All-cause Hospitalization</u>

All-cause hospitalizations were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

<u>All-cause Hospital days</u>

All-cause hospital days were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

<u>All-cause Outpatient visits</u>

All-cause outpatient visits were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

<u>All-cause Emergency room visits</u>

All-cause emergency room visits were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

All-Cause Health Care Expenditures

All-cause Inpatient expenditures

All-cause inpatient expenditures were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

All-cause Outpatient expenditures

All-cause outpatient expenditures were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

All-cause Emergency room expenditures

All-cause emergency room expenditures were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

All-cause Medication expenditures

All-cause medication expenditures were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

<u>All-cause Miscellaneous expenditures</u>

All-cause miscellaneous expenditures were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

<u>All-cause Total expenditures</u>

All-cause total expenditures were determined for the year 2011. Unadjusted means and 95 percent confidence intervals were computed. Residuals were not normally distributed and Wilcoxon Mann Whitney tests were used to detect differences between individuals with osteoarthritis and those without osteoarthritis.

Incremental Direct Resource utilization associated with Osteoarthritis

Based on examination of data distributional characteristics and assessment of fit of alternative models, a multivariate model for analysis was selected. Direct resource utilization variables were count variables with discrete values. When a count variable is used in an ordinary least square regression analysis as a dependent variable, violations of assumptions to ordinary least square regression can occur (Gardner, Mulvey, and Shaw 1995; Coxe et al. 2009). Residuals of ordinary least squares regression models with untransformed dependent variables were examined for violation of assumptions. P values lower than 0.05 for each Kolmogorov-Smirnov test were used to assess whether residuals were normally distributed (D'Agostino and Stephens 1986). Residuals were observed to be non-normal, a violation of assumption of ordinary least square regression. Generalized linear models using maximum likelihood method, as opposed to ordinary least squares regression, were then developed and tested for model fit. Presence of over dispersion of dependent variables was assessed using Vuong tests (Long and Freese 2006; Vuong 1989), and likelihood ratio tests (Long and Freese 2006; Vuong 1989; Cameron and Trivedi 1986). Zero inflated negative binomial models are employed if Vuong test statistics are significant at probability less than 0.05 (Vuong 1989). The incremental or marginal effect of independent variables is then computed by estimating the expected change in the dependent variable, holding all other independent variables constant at their mean values.

Incremental Inpatient Hospitalization associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and annual inpatient hospitalizations. Response variable was annual inpatient hospitalization, which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis (Vuong 1989). A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The general regression model developed for estimating incremental hospitalization is shown below:

Inpatient hospitalization annually $= \alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental annual hospitalization associated with osteoarthritis is the estimate of the parameter α1, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Hospital days associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and annual hospital days. Response variable was annual hospital days which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis (Vuong 1989). A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The general regression model developed for estimating incremental hospital days is shown below:

Hospital days annually = α0 + α1 osteoarthritis + covariates

The incremental annual hospital days associated with osteoarthritis is the estimate of the parameter α1, which is the marginal effect of the independent variable "osteoarthritis"

Incremental Outpatient Visits associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and annual outpatient visits. Response variable was annual outpatient visit which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The general regression model developed for estimating incremental outpatient utilization is shown below:

Outpatient visits annually = $\alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental annual outpatient visits associated with osteoarthritis is the estimate of the parameter $\alpha 1$, which is the marginal effect of the independent variable "osteoarthritis"

Incremental Emergency Room visits associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and emergency room visits. Response variable was annual emergency room visit which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The regression model developed for estimating incremental emergency room utilization is shown below:

Emergency room visits annually= $\alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental annual emergency room visits associated with osteoarthritis is the estimate of the parameter $\alpha 1$, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Direct Resource Expenditures associated with Osteoarthritis

Based on examination of data distributional characteristics and assessment of fit of alternative models, a multivariate model for analysis was selected. Direct resource expenditures variables are count variables with discrete values. When a count variable is used in an ordinary least square regression analysis as a dependent variable, violations of assumptions to ordinary least square regression can occur (Gardner, Mulvey, and Shaw 1995; Coxe et al. 2009). Residuals of ordinary least squares regression models with untransformed dependent variables were examined for violation of assumptions. P values lower than 0.05 for each Kolmogorov-Smirnov test were used to assess whether residuals were normally distributed (D'Agostino and Stephens 1986). Residuals were observed to be not normal and a violation of assumption of ordinary least square regression. Generalized linear models using maximum likelihood method, as opposed to ordinary least squares regression, were then developed and tested for model fit. Presence of over dispersion of dependent variables was assessed using Vuong tests (Long and Freese 2006; Vuong 1989), and likelihood ratio tests (Long and Freese 2006; Vuong 1989; Cameron and Trivedi 1986). Zero inflated negative binomial models are employed if Vuong test statistics are significant at probability less than 0.05 (Vuong 1989). The incremental or marginal effect of independent variables is then computed by estimating the expected change in the dependent variable, holding all other independent variables constant at their mean values.

Incremental Inpatient Expenditures associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and inpatient expenditures. Response variable was annual inpatient expenditures which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The regression model developed for estimating incremental inpatient expenditures is shown below:

Annual inpatient expenditures = $\alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental inpatient expenditures associated with osteoarthritis is the estimate of the parameter $\alpha 1$, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Outpatient Expenditures associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and outpatient expenditures. Response variable was annual outpatient expenditures which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The regression model developed for estimating incremental outpatient expenditures is shown below:

Annual outpatient expenditures= $\alpha0 + \alpha1$ osteoarthritis + covariates

The incremental annual outpatient expenditures associated with osteoarthritis is the estimate of the parameter $\alpha1$, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Emergency Room Expenditures associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and emergency room expenditures. Response variable was annual emergency room expenditures which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The regression model developed for estimating incremental emergency room expenditures is shown below:

Annual emergency room expenditure= $\alpha0 + \alpha1$ osteoarthritis + covariates

The incremental annual emergency room expenditures associated with osteoarthritis is the estimate of the parameter $\alpha1$, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Medication Expenditures associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and medication expenditures. Response variable was annual medication expenditures which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The regression model developed for estimating incremental medication expenditures is shown below:

Annual medication expenditures= $\alpha0 + \alpha1$ osteoarthritis + covariates

The incremental annual medication expenditures associated with osteoarthritis is the estimate of the parameter $\alpha1$, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Miscellaneous Expenditures associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and miscellaneous expenditures or expenditures not included in any other category. Response variable was annual miscellaneous expenditures which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The regression model developed for estimating incremental annual miscellaneous expenditures is shown below:

Annual miscellaneous expenditures= $\alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental annual miscellaneous expenditures associated with osteoarthritis is the estimate of the parameter $\alpha 1$, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Total Expenditures associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and total expenditures. Response variable was total expenditures which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. A binary predictor variable for osteoarthritis was included in each model and the covariates included age, gender, degree, race, region marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, asthma and Charlson Comorbidity Index score. The regression model developed for estimating incremental annual total expenditures is shown below:

Annual total expenditures= $\alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental annual total expenditures associated with osteoarthritis is the estimate of the parameter $\alpha 1$, which is the marginal effect of the independent variable "osteoarthritis."

Incremental absenteeism associated with Osteoarthritis

A generalized linear model was developed to estimate independent association between osteoarthritis and absenteeism. Response variable was annual absenteeism which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. Days absent from work due to illness annually was employed as the response variable. A binary variable indicating the presence or absence of osteoarthritis was included as predictor variable. Covariates for the model included age, gender, degree, race, region, marital status, health insurance type and comorbid conditions including hypertension, hyperlipidemia, anxiety, and asthma as well as Charlson Comorbidity Index. The general regression model developed for estimating incremental absenteeism is shown below:

Days absent from work annually= $\alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental absenteeism associated with osteoarthritis is the estimate of the parameter α1, which is the marginal effect of the independent variable "osteoarthritis."

Incremental Absenteeism Expenditures associated with Osteoarthritis

Daily wage was estimated by dividing annual wages by number of working days in the year. Working days in year 2011 was assumed to be 250 days after accounting for holidays and weekends. All working days lost due to health problems was multiplied with daily wage of an individual to obtain annual absenteeism costs (Liu et al. 2002; Krol and Brouwer 2014). A generalized linear model was developed to estimate independent association between osteoarthritis and absenteeism costs. Response variable was annual absenteeism costs which was a count variable. There was presence of over dispersion where the variance was larger than the mean in the response variable. Vuong test statistics were significant at probability less than 0.05 indicating the zero-inflated negative binomial model was required for analysis. The response variable was annual absenteeism costs. Predictor variable included a binary variable indicating the presence or absence of osteoarthritis. Covariates for the model included age, gender, degree, race, marital status, and health insurance type, and comorbid conditions for osteoarthritis including hypertension, hyperlipidemia, asthma, anxiety and Charlson Comorbidity Index scores. The general regression model developed for estimating incremental absenteeism costs is shown below:

Annual absenteeism costs = $\alpha 0 + \alpha 1$ osteoarthritis + covariates

The incremental annual absenteeism costs associated with osteoarthritis is the estimate of the parameter α1, which is the marginal effect of the independent variable "osteoarthritis."

Notes

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RESULTS

Sample for Analyses

Figure 1 shows the sample selection procedure and results of selection of the sample for analyses. The total number of individuals who participated in MEPS Household Component of the Medical Expenditure Panel Survey in 2011 were 35,313. After excluding 5,762 individuals who were younger than eighteen years of age, 29,551 individuals remained. After excluding 2,559 unemployed individuals, 26,992 remained. Out of 26,992 individuals, 1,354 individuals had a diagnosis of osteoarthritis. Individuals with osteoarthritis were compared to individuals without osteoarthritis on age, sex, race, region, marital status, insurance, comorbidities including hypertension, hyperlipidemia, anxiety, asthma, and Charlson Comorbidity Index scores.

Distribution of Individuals by Age

The distribution by age for the sample used in analyses is shown in Table 1. For the total sample, approximately half of the total sample were (48%) were between 18 and 54 years of age. Data on age were not available for 7,252 individuals. Individuals 55 years old or older comprised 27 percent of the total sample.

For individuals with osteoarthritis, a majority of the sample, 1,040 individuals (77.12%) were 55 years or older. However, for individuals without osteoarthritis, 6,078 individuals (23.70 %) were 55 years or older in age.

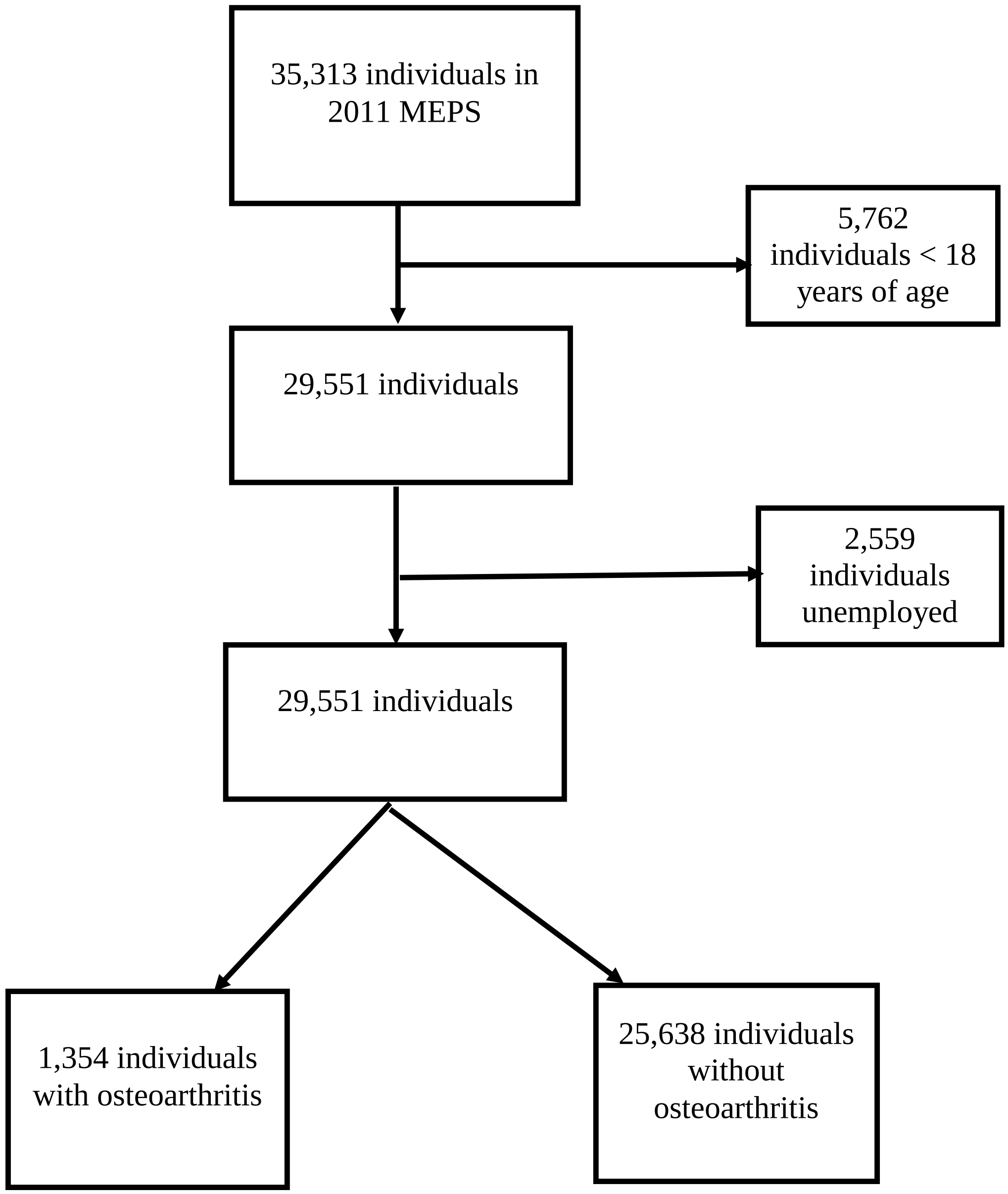

Figure 1. Sample Selection for Analyses

Table 1. Distribution of Study Sample by Age (n=26,992)

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Age	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
							<0.001
18 to 34	5,633	22.10	27	2.01	5,606	21.84	
35 to 44	3,289	12.19	78	5.82	3,211	12.52	
45 to 54	3,327	13.69	195	14.54	3,505	13.67	
55 to 64	3,279	12.12	389	29.04	2,890	11.27	
65 and over	3,839	14.24	651	48.08	3,188	12.43	
Missing	7,252	25.66	14	1.03	7,238	28.23	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Distribution of Individuals by Gender

The distribution by gender for the sample used in analyses is shown in Table 2. For the total sample, the proportion of females was higher (54.43%) than males (45.57%). Similarly, for individuals with osteoarthritis, a majority of the sample were females (70%) and for individuals without osteoarthritis, 54 percent were females.

Distribution of Individuals by Race

Table 3 shows the distribution of the sample by race. For the total sample, majority were whites (70.55%), followed by blacks (19.89%) and the rest belonged to other races. Similarly, for individuals with osteoarthritis, 78 percent were whites, followed by blacks at 15 percent, and the rest of the cohort were from other races. For individuals without osteoarthritis, 70 percent were white, 20 percent were black, and rest were from other races.

Distribution of Individuals by Region

Table 4 shows the distribution of the sample by geographical region. The sample was divided into four regions including the Midwest, Northeast, South and West. Most individuals belonged to the south with 9,953 individuals (37.11%), followed by individuals from the west at 6,881 individuals (25.65%) from the west, 5,793 individuals (21.60%) from Midwest and 4,196 individuals (15.64%) from Northeast. Among persons with osteoarthritis, a total of 500 persons (36.93%) were from the South. The proportion of individuals from the comparison group without osteoarthritis from the South was similar at 36.87 percent.

Table 2. Distribution of Study Sample by Gender (n=26,992)

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Gender	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
Male	12,301	45.57	402	29.69	11,889	46.41	<0.001
Female	14,691	54.43	952	70.31	13,739	53.59	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Table 3. Distribution of Study Sample by Race (n=26,992)

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Race	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
							<0.001
White	19,044	70.55	1,056	77.99	17,988	70.16	
Black	5,369	19.89	207	15.29	5,162	20.13	
Other	2,579	9.55	91	6.72	2,488	9.71	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Table 4. Distribution of Study Sample by Region (n=26,992)

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Region	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
Northeast	4,196	15.64	218	16.10	3,978	15.52	0.003
Midwest	5,793	21.60	329	24.30	5,464	21.31	
South	9,953	37.11	500	36.93	9,453	36.87	
West	6,881	25.65	293	21.64	6,588	25.70	
Missing	169	0.63	14	1.03	155	0.60	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Distribution of Individuals by Marital status

Distribution of sample by marital status is shown in Table 5. For marital status, most of the individuals were not married (45.69%), followed by married individuals (37.17%), individuals who were widowed (5.5%), divorced (9.24%) and separated (2.39%). Approximately half of the individuals with osteoarthritis were married, while 47.65% of individuals without osteoarthritis were not married.

Distribution of Individuals by Degree

Table 6 shows the distribution of the sample by educational degree. At least 8,693 individuals (32 percent) of the total sample obtained a high school degree. Approximately 15 percent of the sample had no degree, followed by 11.5 percent who had a bachelor's degree. Only 6 percent of the total sample had a masters or doctorate degree.

Similarly, for individuals with osteoarthritis, 621 (45.86%) individuals had a high school degree, followed by 226 individuals (16.69%) with no degree and 192 individuals (14.18%) with bachelor's degree. For individuals without osteoarthritis, proportion of individuals with high school degree as compared to osteoarthritis cohort was lower at 31.48 percent.

Table 5. Distribution of Study Sample by Marital status (n=26,992)

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Marital	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
Married	10,034	37.17	670	49.48	9,364	36.52	<0.001
Widowed	1,485	5.50	247	18.24	1,238	4.83	
Divorced	2,495	9.24	274	20.24	2,221	8.66	
Separated	646	2.39	47	3.47	599	2.34	
Never married	12,332	45.69	116	8.57	12,216	47.65	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Table 6. Distribution of Study Sample by highest Degree obtained (n=26,992)

Degree	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
No Degree	4,115	15.25	226	16.69	3,889	15.17	<0.001
GED	879	3.26	80	5.91	799	3.12	
High school	8,693	32.21	621	45.86	8,072	31.48	
Bachelor	3,105	11.50	192	14.18	2,913	11.36	
Masters or Doctorate	1,642	6.08	96	7.83	1,536	6.56	
Other	8,558	31.71	129	9.53	8,429	32.87	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Distribution of Individuals by Insurance

Table 7 shows the distribution of the sample by insurance coverage. Most of the sample, 15,032 individuals (55.7%) had private insurance followed by 8,472 individuals (31.4%) with private insurance and 3,488 individuals (13%) with no insurance.

Similarly, for individuals with osteoarthritis, majority of the sample at 773 individuals (57%) had public insurance, followed by 494 individuals (36.5%) who had private insurance, and 87 individuals (6.4%) who were uninsured. Similar trend was observed for individuals without osteoarthritis where 14,259 individuals (55.6%) had private insurance, 7,978 individuals (31.12%) had public insurance and 3,401 individuals (13.27%) were uninsured.

Distribution of Individuals by Hypertension

The sample distribution based on presence and absence of hypertension is shown in Table 8. Hypertension was present in a total of 6,504 persons (24.1%) of the overall sample. Among persons with osteoarthritis, 844 individuals (62.3%) had a diagnosis of hypertension, which was significantly higher than among persons without osteoarthritis, where 5,660 individuals (22.08%) had hypertension.

Distribution of Individuals by Hyperlipidemia

The sample distribution based on presence and absence of hyperlipidemia is shown in Table 8. Hyperlipidemia was present in a total of 5,001 persons (18.5%) of the overall sample. Among persons with osteoarthritis, 51 percent had a diagnosis of hyperlipidemia, which was significantly higher than among persons without osteoarthritis, where 16.8 percent had hyperlipidemia.

Distribution of Individuals by Anxiety

The sample distribution based on presence and absence of anxiety is shown in Table 8. Anxiety was present in a total of 1,710 persons (6.3%) of the overall sample. Among persons with osteoarthritis, 204 individuals (15%) had a diagnosis of anxiety, which was significantly higher than among persons without osteoarthritis, where 1,506 individuals (5.9%) had anxiety.

Distribution of Individuals by Asthma

The sample distribution based on presence and absence of asthma is shown in Table 8. Asthma was present in a total of 2,267 persons (8.4%) of the overall sample. Among persons with osteoarthritis, 14 percent had a diagnosis of asthma, which was significantly higher than among persons without osteoarthritis, where 8 percent had asthma.

Table 7. Distribution of Study Sample by Insurance Coverage

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Insurance	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
							<0.001
Private	15,032	55.69	773	57.09	14,259	55.62	
Public	8,472	31.39	494	36.48	7,978	31.12	
Uninsured	3,488	12.92	87	6.43	3,401	13.27	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Table 8. Distribution of Study Sample by Comorbid Disease conditions

Comorbidities	Total sample (N=26,992) Number	Percent	Individuals with osteoarthritis (N=1,354) Number	Percent	Individuals without osteoarthritis (N=25,638) Number	Percent	Prob.[1]
Hypertension	6,504	24.10	844	62.33	5,660	22.08	<0.001
No hypertension	20,488	75.90	510	37.67	19,978	77.92	
Hyperlipidemia	5,001	18.53	691	51.03	4,310	16.81	<0.001
No hyperlipidemia	21,991	81.47	663	48.97	21,328	83.19	
Anxiety	1,710	6.34	204	15.07	1,506	5.87	<0.001
Non Anxiety	25,282	93.66	1,150	84.93	24,132	94.13	
Asthma	2,267	8.40	192	14.18	2,075	8.09	<0.001
Non Asthma	24,725	91.60	1,162	85.82	23,563	91.91	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Distribution of Individuals by Charlson Comorbidity Index score

Table 9 describes the distribution of the study sample and compares persons with osteoarthritis and those without osteoarthritis with respect to Charlson Comorbidity Index scores. Seventy-four percent of the sample had a Charlson comorbidity score of zero indicating that they did not have any of the comorbid conditions listed in the Charlson Comorbidity Index. Approximately, 19 percent of the sample had a score of one and 4 percent of the sample had a score of two. Among individuals with osteoarthritis, 50 percent had a Charlson comorbidity score of zero indicating that they did not have any of the comorbid conditions listed in the Charlson Comorbidity Index. Individuals with osteoarthritis and with a score of one on the Charlson Comorbidity Index comprised 30.43 percent of the sample, and 10.19 percent of the group with osteoarthritis had a score of two. Similarly, among individuals without osteoarthritis, 75.46 percent had a Charlson comorbidity score of zero. Individuals without osteoarthritis and with a score of one on the Charlson Comorbidity Index comprised 18.26 percent of the sample.

Distribution of Individuals by Annual Wages

Table 10 shows the distribution of the sample by annual wages. Most of the sample, 13,733 individuals (50.8%) reported zero wages, followed by 10,349 individuals (38.7%) who reported annual wages between 0 and 50,000 dollars. For individuals with osteoarthritis, 793 individuals (58.57%) reported annual wages of zero, followed by 441 individuals (32.57%) with annual wages between 0 and 50,000 dollars. Similarly for individuals without osteoarthritis, 50.5 percent reported annual wages of zero and 38.9 reported annual wages between 0 and 50,000 dollars.

Table 9. Distribution of Study Sample by Charlson Comorbidity Index score

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Charlson Comorbidity Index score	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
0	20,024	74.18	678	50.07	19,346	75.46	<0.001
1	5,094	18.87	412	30.43	4,682	18.26	
2	1,194	4.42	138	10.19	1,056	4.12	
3	390	1.44	74	5.47	316	1.23	
4	118	0.44	28	2.07	90	0.35	
5	24	0.09	3	0.22	21	0.08	
6 or greater	148	0.55	21	1.55	127	0.50	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Table 10. Distribution of Study Sample by Annual Wages

	Total sample (N=26,992)		Individuals with osteoarthritis (N=1,354)		Individuals without osteoarthritis (N=25,638)		
Annual wages	Number	Percent	Number	Percent	Number	Percent	Prob.[1]
0	13,733	50.87	793	58.57	12,940	50.47	0.982
1 to 50,000	10,439	38.67	441	32.57	9,998	38.99	
50,001 to 100,000	2,262	8.38	90	6.64	2,172	8.47	
100,001 to 200,000	514	1.90	28	2.06	486	1.89	
200,001 to 300,000	44	0.16	2	0.14	42	0.16	

[1]Chi-square probability between osteoarthritis and non-osteoarthritis groups

Unadjusted Annual Health Care Resource Utilization

Mean unadjusted annual health care utilization for persons with or without osteoarthritis is reported in Table 11. Mean annual unadjusted hospitalizations among individuals with osteoarthritis were 0.24 (95 percent confidence interval: 0.21 to 0.26). Unadjusted hospital days among individuals with osteoarthritis were 5.45 (95 percent confidence interval: 3.95 to 6.95). Mean annual unadjusted outpatient visits among individuals with osteoarthritis were 12.93 (95 percent confidence interval: 12.11 to 13.76). Mean annual unadjusted emergency room visits among individuals with osteoarthritis were 0.33 (95 percent confidence interval: 0.29 to 0.38).

Compared to individuals with osteoarthritis, significantly lower mean unadjusted hospitalizations, mean unadjusted outpatient room visits and mean unadjusted emergency room visits were observed among those without osteoarthritis. Mean annual unadjusted hospitalizations among individuals without osteoarthritis were 0.09 (95 percent confidence interval: 0.09 to 0.10, P-value <0.001). Mean annual unadjusted outpatient visits among individuals without osteoarthritis were 4.89 (95 percent confidence interval: 4.76 to 5.01, P-value <0.001). Mean annual unadjusted emergency room visits among individuals without osteoarthritis were 0.22 (95 percent confidence interval: 0.21 to 0.23, P-value <0.001). No significant difference in the mean unadjusted hospital days were observed between persons with osteoarthritis and those without osteoarthritis. Mean annual unadjusted hospital days among individuals without osteoarthritis were 5.18 (95 percent confidence interval: 4.74 to 5.63, p value=0.532).

Table 11. Unadjusted Annual Health Care utilization among Individuals with Osteoarthritis and Individuals without

	With Osteoarthritis (n=1,354)		Without Osteoarthritis (n = 25,638)		
Health Care Utilization Category	Mean	95% Confidence Interval	Mean	95% Confidence Interval	Prob.[1]
Hospitalization	0.24	0.21 to 0.27	0.09	0.09 to 0.10	<0.001
Hospital days	5.45	3.95 to 6.95	5.18	4.74 to 5.63	0.532
Outpatient visits	12.93	12.11 to 13.76	4.89	4.76 to 5.01	<0.001
Emergency room visits	0.33	0.29 to 0.38	0.22	0.21 to 0.23	<0.001

[1]Wilcoxon two-sample probability between osteoarthritis and non-osteoarthritis groups

Unadjusted Annual Health Care Resource Expenditures

Mean unadjusted annual health care expenditures for persons with or without osteoarthritis is reported in Table 12. Mean annual unadjusted inpatient expenditures among individuals with osteoarthritis were $3,563.40 (95 percent confidence interval: $2,584.90 to $4,541.90). Mean annual unadjusted outpatient expenditures among individuals with osteoarthritis were $3,242.11 (95 percent confidence interval: $2,922.83 to $3,561.40). Mean annual unadjusted emergency room expenditures among individuals with osteoarthritis were $295.14 (95 percent confidence interval: $234.20 to $356.08). Mean annual unadjusted medication expenditures among individuals with osteoarthritis were $2,366.36 (95 percent confidence interval: $2,137.37 to $2,595.34). Mean annual unadjusted total expenditures among individuals with osteoarthritis were $ 9,651.50 (95 percent confidence interval: 8,521.18 to 10,781.81).

Compared to individuals with osteoarthritis, significantly lower mean unadjusted inpatient expenditures, mean unadjusted outpatient expenditures, mean unadjusted emergency room expenditures, and mean unadjusted medication expenditures and mean unadjusted total expenditure were observed among those without osteoarthritis. Mean annual unadjusted inpatient expenditures among individuals without osteoarthritis were $1,191.64 (95 percent confidence interval: 1,093.91 to 1,289.38, P-value <0.001). Mean annual unadjusted outpatient expenditures among individuals without osteoarthritis were $1,223.09 (95 percent confidence interval: 1,172.04 to 1,274.14, P-value <0.001). Mean annual emergency room expenditures among individuals without osteoarthritis were $186.98 (95 percent confidence interval: $175.30 to $198.66, P-value <0.001).

Table 12. Unadjusted Annual Health Care Expenditures in Dollars among Individuals with Osteoarthritis and Individuals without Osteoarthritis

	With Osteoarthritis (n=1,354)		Without Osteoarthritis (n = 25,638)		
Health Care expenditure Category	Mean	95% Confidence Interval	Mean	95% Confidence Interval	Prob.[1]
Inpatient expenditures	3,563.40	2,584.90 to 4,541.90	1,191.64	1,093.91 to 1,289.38	<0.001
Outpatient expenditures	3,242.11	2,922.83 to 3,561.40	1,223.09	1,172.04 to 1,274.14	<0.001
Emergency room expenditures	295.14	234.20 to 356.08	186.98	175.30 to 198.66	<0.001
Medication expenditures	2,366.36	2,137.37 to 2,595.34	962.28	786.47 to 1,138.10	<0.001
Miscellaneous expenditures	184.48	143.70 to 225.26	66.90	61.83 to 71.96	<0.001
Total expenditures	9,651.50	8,521.18 to 10,781.81	3,630.91	3415.49 to 3,846.34	<0.001

[1]Wilcoxon two-sample probability between osteoarthritis and non-osteoarthritis groups

Unadjusted Annual Absenteeism

Mean unadjusted absenteeism for persons with or without osteoarthritis is reported in Table 13. Mean annual unadjusted absenteeism among individuals with osteoarthritis was 8.72 days (95 percent confidence interval: 6.69 to 10.76). Mean annual unadjusted absenteeism among individuals without osteoarthritis was significantly lower than individuals with osteoarthritis ($p<0.001$). Mean annual unadjusted absenteeism for individuals without osteoarthritis was 4.95 days (95 percent confidence interval: 4.65 to 5.25).

Unadjusted Annual Absenteeism costs

Mean unadjusted absenteeism costs for individuals with or without osteoarthritis is reported in Table 14. Mean annual unadjusted absenteeism costs among individuals with osteoarthritis was $1,393.26 (95 percent confidence interval: $814.91 to $1,971.62). Mean annual unadjusted absenteeism costs among individuals without osteoarthritis was significantly lower than individuals with osteoarthritis ($p<0.001$). Mean annual unadjusted absenteeism costs for individuals without osteoarthritis were $650.16 (95 percent confidence interval: $601.18 to $699.14).

Table 13. Unadjusted Annual Absenteeism among Individuals with Osteoarthritis and Individuals without Osteoarthritis

	With Osteoarthritis (n=1,354)		Without Osteoarthritis (n = 25,638)		
Category	Mean	95% Confidence Interval	Mean	95% Confidence Interval	Prob.[1]
Absenteeism	8.72	6.69 to 10.76	4.95	4.65 to 5.25	<0.001

[1]Wilcoxon two-sample probability between osteoarthritis and non-osteoarthritis groups

Table 14. Unadjusted Annual Absenteeism costs in dollars among persons with Osteoarthritis and those without Osteoarthritis

	With Osteoarthritis (n=1,354)		Without Osteoarthritis (n = 25,638)		
Category	Mean	95% Confidence Interval	Mean	95% Confidence Interval	Prob.[1]
Absenteeism costs	1393.26	814.91 to 1971.62	650.16	601.18 to 699.14	<0.001

[1]Wilcoxon two-sample probability between osteoarthritis and non-osteoarthritis groups

Association between Osteoarthritis and Incremental Annual Hospitalization

Utilization of healthcare resources, health care expenditures, absenteeism and absenteeism costs in this study had a high number of observations with zeros. Over dispersion of each resource utilization variable and expenditure variable evidenced by p-values less than 0.05 for Vuong tests, suggested a need for a zero-inflated generalized linear model (Long and Freese 2006; Vuong 1989). Significant likelihood ratio tests, shown by p-values less than 0.05 indicated that for each dependent variable, zero-inflated negative binomial models were more suitable than zero-inflated Poisson models (Long and Freese 2006; Vuong 1989; Cameron and Trivedi 1986).

Zero-inflated negative binomial models were constructed for each of the statistical models. Results of incremental utilization of hospitalization associated with osteoarthritis is reported in Table 15. Annual mean incremental hospitalizations associated with osteoarthritis was significant at 0.07 hospitalizations ($p<0.001$). There were no significant differences in mean annual hospitalization between males and females ($p=0.072$). Individuals who belonged to other races, exclusive of blacks, had significantly lower mean annual hospitalizations than whites (0.03 visits, $p=0.015$). Individuals who had public insurance had higher mean annual hospitalizations as compared to individuals with private insurance (0.07 visits, $p<0.001$). Individuals who were uninsured had lower mean annual hospitalization utilization as compared to individuals with private insurance (0.04 visits, $p<0.001$). Among comorbid conditions, individuals with hypertension showed significant higher mean annual hospitalization as compared to individuals without hypertension (0.04 visits, $p=0.001$).

Table 15. Association between Osteoarthritis and Annual Incremental utilization of Hospitalizations (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	0.07	0.01	<0.001
Region			
Northeast	Reference		
Midwest	0.001	0.01	0.848
South	0.002	0.01	0.844
West	-0.001	0.01	0.870
Age	-0.001	0.01	0.331
Sex			
Male	Reference		
Female	0.01	0.01	0.072
Race			
White	Reference		
Black	0.01	0.01	0.380
Other	-0.03	0.01	0.015
Marital Status			
Married	Reference		
Widowed	0.02	0.02	0.384
Divorced	-0.01	0.01	0.624
Separated	-0.05	0.01	0.012
Never married	-0.03	0.01	0.003
Degree			
No degree	Reference		
GED	0.01	0.02	0.546
High School Diploma	-0.001	0.01	0.515
Bachelor’s degree	-0.01	0.01	0.021
Masters or Doctorate	-0.01	0.02	0.161
Other degree	-0.04	0.01	0.038
Insurance coverage			
Private	Reference		
Public	0.07	0.01	<0.001
Uninsured	-0.04	0.01	<0.001

Table 15. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	0.04	0.01	0.001
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	-0.001	0.01	0.566
Anxiety			
No Anxiety	Reference		
Has Anxiety	0.04	0.01	0.005
Asthma			
No asthma	Reference		
Has asthma	-0.001	0.01	0.682
Charlson Comorbidity Index	0.05	0.003	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable.

Association between Osteoarthritis and Incremental Annual Hospital days

Results of incremental hospital days associated with osteoarthritis is reported in Table 16. Hospital days spent was not incrementally greater for individuals with osteoarthritis (0.06 days, p=0.287). There was no significant difference in annual mean days spent at hospital between females and males (p=0.447). Black individuals had significantly higher mean annual hospital days than whites (0.10 days, p=0.032). Individuals who were never married spent fewer days at hospital compared to individuals who were married (0.09 days, p=0.045). Individuals who had public insurance had greater mean annual hospital days as compared to individuals with private insurance (0.34 days, p<0.001).

Among comorbid conditions, individuals with hypertension spent more days at hospital as compared to individuals without hypertension (0.13 hospital days, p=0.006). Individuals with hypertension spent more days at hospital as compared to individuals without hypertension (0.13 hospital days, p=0.006). There were no significant differences observed in annual mean hospital days spent between individuals who had hyperlipidemia and those who did not have hyperlipidemia. Similarly, there were no significant differences observed in annual mean hospital days spent between individuals who had anxiety and those who did not have anxiety. Also, there were no significant differences observed in annual mean hospital days spent between individuals who had asthma and those who did not have asthma. With every unit increase in Charlson comorbidity index score, there was an additional 0.26 mean annual days at the hospital (p<0.001).

Table 16. Association between Osteoarthritis and Annual Incremental utilization of Hospital days (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	0.06	0.06	0.287
Region			
Northeast	Reference		
Midwest	-0.03	0.04	0.456
South	0.01	0.04	0.896
West	0.07	0.07	0.340
Age	0.001	0.001	0.336
Sex			
Male	Reference		
Female	0.04	0.05	0.447
Race			
White	Reference		
Black	0.10	0.04	0.032
Other	0.05	0.07	0.495
Marital Status			
Married	Reference		
Widowed	0.05	0.07	0.468
Divorced	-0.02	0.05	0.891
Separated	0.04	0.09	0.646
Never married	-0.04	0.06	0.500
Degree			
No degree	Reference		
GED	-0.04	0.08	0.575
High School Diploma	0.05	0.05	0.316
Bachelor’s degree	-0.04	0.06	0.490
Masters or Doctorate	0.07	0.12	0.533
Other degree	-0.07	0.06	0.297
Insurance coverage			
Private	Reference		
Public	0.32	0.06	<0.001
Uninsured	-0.07	0.05	0.213

Table 16. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	0.13	0.04	0.006
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	0.01	0.04	0.844
Anxiety			
No anxiety	Reference		
Has anxiety	0.10	0.05	0.070
Asthma			
No asthma	Reference		
Has asthma	0.02	0.09	0.775
Charlson Comorbidity Index	0.26	0.03	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Outpatient visits

Results of incremental utilization of outpatient days associated with osteoarthritis is reported in Table 17. Mean annual outpatient visits were significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis (3.63 visits, $p<0.001$). With every year increase in age, there was 0.08 increase in outpatient visits ($p<0.001$). There were significantly greater mean annual outpatient visits by females as compared to males (1.73 visits, $p<0.001$). Black individuals had fewer mean annual outpatient visits as compared to whites (1.53 visits, $p<0.001$). Individuals who belonged to other races also had fewer mean annual outpatient visits as compared to whites (1.31 visits, $p<0.001$). Individuals with high school degree had higher mean annual outpatient visits as compared to individuals without degree (0.62 visits, $p=0.029$). Individuals with bachelor's degree had higher mean annual outpatient visits as compared to individuals without degree (2.31 visits, $p<0.001$). Individuals with master's degree or doctorate degree had higher mean outpatient visits as compared to individuals without degree (2.60 visits, $p<0.001$). Individuals who were uninsured had fewer mean annual outpatient visits as compared to individuals with private insurance (3.08 visits, $p<0.001$).

Among comorbid conditions, individuals with hypertension showed significant higher mean annual outpatient visits as compared to individuals without hypertension (1.21 visits, $p<0.001$). Individuals with hyperlipidemia showed significant higher mean annual outpatient visits as compared to individuals without hyperlipidemia (1.10 visits, $p<0.001$). Individuals with anxiety showed significant mean annual outpatient visits as compared to individuals without anxiety (4.10 visits, $p<0.001$). .

Table 17. Association between Osteoarthritis and Annual Incremental Outpatient visits (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	3.63	0.50	<0.001
Region			
Northeast	Reference		
Midwest	-0.38	0.41	0.361
South	-1.52	0.41	<0.001
West	-0.06	0.40	0.884
Age	0.08	0.01	<0.001
Sex			
Male	Reference		
Female	1.73	0.22	<0.001
Race			
White	Reference		
Black	-1.53	0.27	<0.001
Other	-1.31	0.36	<0.001
Marital Status			
Married	Reference		
Widowed	-0.96	0.35	0.007
Divorced	0.32	0.33	0.325
Separated	0.10	0.85	0.904
Never married	0.78	0.38	0.039
Degree			
No degree	Reference		
GED	0.80	0.66	0.225
High School Diploma	0.62	0.28	0.029
Bachelor’s degree	2.31	0.38	<0.001
Masters or Doctorate	2.60	0.49	<0.001
Other degree	1.04	0.43	0.016
Insurance coverage			
Private	Reference		
Public	0.55	0.30	0.068
Uninsured	-3.08	0.30	<0.001

Table 17. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	1.21	0.27	<0.001
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	1.10	0.23	<0.001
Anxiety			
No Anxiety	Reference		
Has Anxiety	4.10	0.46	<0.001
Asthma			
No Asthma	Reference		
Has Asthma	1.15	0.45	0.011
Charlson Comorbidity Index	1.86	0.13	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Emergency room utilization

Results of incremental utilization of emergency rooms associated with osteoarthritis is reported in Table 18. Mean annual emergency room visits were significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis (0.009 visits, p<0.001). With every year increase in age, there was 0.002 decrease in mean annual emergency room visits (p<0.001). There was no significant difference between males and females with respect to the utilization of emergency rooms (p=0.958). Individuals who were widowed had higher mean annual utilization of emergency rooms as compared to individuals who were married (0.07 visits, p=0.001). Individuals who were divorced also had higher annual mean utilization of emergency rooms as compared to individuals who were married (0.07 visits, p=0.001). Individuals with bachelor's degree had significantly fewer mean annual emergency room visits as compared to individuals without degree (0.09 visits, p<0.001). Individuals with master's or doctorate degree had significantly fewer mean annual emergency room visits as compared to individuals without degree (0.07 visits, p=0.008). Individuals who had public insurance had higher annual mean emergency room visits as compared to individuals with private insurance (0.13 visits, p<0.001). Among comorbid conditions, individuals with hypertension showed significant higher annual mean emergency room visits as compared to individuals without hypertension (0.07 visits, p<0.001). Individuals with anxiety showed significant higher mean annual emergency room visits as compared to individuals without anxiety (0.12 visits, p<0.001).

Table 18. Association between Osteoarthritis and Annual Incremental Emergency room utilization (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	0.09	0.02	<0.001
Region			
Northeast	Reference		
Midwest	0.01	0.02	0.670
South	-0.03	0.02	0.121
West	-0.05	0.02	0.003
Age	-0.002	0.0004	<0.001
Sex			
Male	Reference		
Female	0.0006	0.01	0.958
Race			
White	Reference		
Black	0.05	0.01	<0.001
Other	-0.02	0.02	0.194
Marital Status			
Married	Reference		
Widowed	0.07	0.02	0.001
Divorced	0.07	0.02	0.001
Separated	0.06	0.03	0.088
Never married	0.03	0.02	0.081
Degree			
No degree	Reference		
GED	0.02	0.03	0.543
High School Diploma	-0.01	0.01	0.472
Bachelor's degree	-0.09	0.02	<0.001
Masters or Doctorate	-0.07	0.03	0.008
Other degree	-0.06	0.01	0.001
Insurance coverage			
Private	Reference		
Public	0.13	0.02	<0.001
Uninsured	0.01	0.01	0.545

Table 18. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	0.07	0.12	<0.001
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	-0.04	0.02	0.034
Anxiety			
No anxiety	Reference		
Has anxiety	0.12	0.02	<0.001
Asthma			
No Asthma	Reference		
Has Asthma	0.03	0.02	0.230
Charlson Comorbidity Index	0.05	0.01	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Inpatient Expenditures

Results of annual incremental inpatient expenditures associated with osteoarthritis is reported in Table 19. Mean annual inpatient expenditures were significantly greater for individuals with osteoarthritis as compared to individuals without osteoarthritis ($826.38, p=0.021). With every year increase in age, there was $12.61 increase in mean annual inpatient expenditures (p=0.031). There were no significant differences in mean annual inpatient expenditures observed between males and females. Black individuals had significantly higher mean annual inpatient expenditures as compared to whites ($387.50, p=0.050). Individuals who were never married had significantly lower annual mean inpatient expenditures as compared to married individuals ($513.82, p=0.006). Individuals who were uninsured had lower annual mean inpatient expenditures as compared to individuals with private insurance ($819.42, p<0.001).

Among comorbid conditions, individuals with hypertension showed no significant difference in inpatient expenditures as compared to individuals without hypertension (p=0.083). Individuals with hyperlipidemia showed no significant difference in inpatient expenditures as compared to individuals without hyperlipidemia (p=0.702). Individuals with anxiety showed no significant difference in inpatient expenditures as compared to individuals without anxiety (p=0.309). Individuals with asthma showed no significant difference in inpatient expenditures as compared to individuals without asthma (p=0.333). With every unit increase in Charlson comorbidity index score, there was an additional $772.95 spent in mean inpatient expenditures annually (p<0.001).

Table 19. Association between Osteoarthritis and Annual Incremental Inpatient Expenditures (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	826.38	357.33	0.021
Region			
Northeast	Reference		
Midwest	72.25	187.92	0.701
South	42.92	182.95	0.814
West	377.84	241.70	0.118
Age	12.61	5.83	0.031
Sex			
Male	Reference		
Female	66.69	170.77	0.696
Race			
White	Reference		
Black	387.50	197.50	0.050
Other	-178.22	259.57	0.492
Marital Status			
Married	Reference		
Widowed	-336.37	239.65	0.160
Divorced	-80.04	251.27	0.750
Separated	-300.71	315.80	0.341
Never married	-513.82	187.42	0.006
Degree			
No degree	Reference		
GED	139.20	382.91	0.716
High School Diploma	97.03	235.94	0.681
Bachelor’s degree	-119.22	274.12	0.664
Masters or Doctorate	482.72	465.61	0.300
Other degree	-197.09	287.25	0.493
Insurance coverage			
Private	Reference		
Public	241.07	200.79	0.230
Uninsured	-819.42	173.43	<0.001

Table 19. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	316.33	182.68	0.083
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	77.55	202.84	0.702
Anxiety			
No Anxiety	Reference		
Has anxiety	243.44	251.45	0.333
Asthma			
No asthma	Reference		
Has asthma	-107.35	246.20	0.663
Charlson Comorbidity Index	772.95	104.73	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Outpatient expenditures

Results of annual incremental outpatient expenditures associated with osteoarthritis is reported in Table 20. Mean annual outpatient expenditures were significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis (\$658.94, $p<0.001$). With every year increase in age, there was \$20.67 increase in mean annual outpatient expenditures ($p<0.001$). There were significantly higher mean annual outpatient expenditures for females as compared to males (\$223.43, $p=0.012$). Black individuals had significantly lower mean annual outpatient expenditures as compared to whites (\$276.32, $p=0.015$). Individuals who were widowed had significantly lower annual mean outpatient expenditures as compared to individuals who were married (\$388.92, $p=0.015$). Individuals who had public insurance had lower annual mean outpatient expenditures as compared to individuals with private insurance (\$405.77, $p<0.001$). Individuals who were uninsured had lower outpatient expenditures as compared to individuals with private insurance (\$1,205.95, $p<0.001$). Individuals with bachelor's degree had significantly higher outpatient expenditures as compared to individuals without degree (\$830.02, $p<0.001$).

Among comorbid conditions, individuals with hypertension had significantly higher outpatient expenditures as compared to individuals without hypertension (\$298.83, $p=0.005$). Individuals with hyperlipidemia showed higher significant mean annual outpatient expenditures as compared to individuals without hyperlipidemia (\$319.05, $p=0.001$). Individuals with anxiety had significantly higher mean annual outpatient expenditures as compared to individuals without anxiety (\$778.26, $p<0.001$).

Table 20. Association between Osteoarthritis and Annual Incremental Outpatient Expenditures (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	658.94	154.29	<0.001
Region			
Northeast	Reference		
Midwest	-263.93	129.21	0.041
South	-413.90	132.14	0.002
West	-134.07	150.98	0.375
Age	20.67	3.64	<0.001
Sex			
Male	Reference		
Female	223.43	88.79	0.012
Race			
White	Reference		
Black	-276.32	113.52	0.015
Other	-440.13	115.33	<0.001
Marital Status			
Married	Reference		
Widowed	-388.92	159.14	0.015
Divorced	86.68	137.24	0.528
Separated	-125.36	267.94	0.640
Never married	-100.65	111.73	0.368
Degree			
No degree	Reference		
GED	275.44	174.73	0.115
High School Diploma	421.05	110.64	<0.001
Bachelor's degree	830.02	135.64	<0.001
Masters or Doctorate	802.04	185.03	<0.001
Other degree	415.57	146.99	0.005
Insurance coverage			
Any private insurance	Reference		
Public	-405.77	98.04	<0.001
Uninsured	-1205.95	104.39	<0.001

Table 20. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	298.83	105.34	0.005
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	319.05	100.41	0.001
Anxiety			
No anxiety	Reference		
Has anxiety	778.26	173.65	<0.001
Asthma			
No asthma	Reference		
Has asthma	33.31	163.08	0.838
Charlson Comorbidity Index	743.95	57.59	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Emergency Expenditures

Results of annual incremental emergency room expenditures associated with osteoarthritis is reported in Table 21. Emergency room expenditures were not significantly different for individuals with osteoarthritis as compared to individuals without osteoarthritis ($p=0.663$). With every unit increase in age, there was \$1.72 decrease in emergency room expenditures ($p=0.010$). There were no significant differences in emergency room expenditures between males and females ($p=0.368$). Individuals who were uninsured had lower emergency room expenditures as compared to individuals with private insurance (\$62.88, $p=0.001$). Individuals with bachelor's degree had significantly lower emergency room expenditures as compared to individuals without degree (\$90.22, $p=0.035$). Individuals with master's degree or doctorate degree had significantly lower emergency room expenditures as compared to individuals without degree (\$100.86, $p=0.014$).

Among comorbid conditions, individuals with hypertension had significantly higher emergency room expenditures as compared to individuals without hypertension (\$81.85, $p=0.004$). Individuals with anxiety showed significant emergency room expenditures as compared to individuals without anxiety (\$137.96, $p<0.001$). With every unit increase in Charlson comorbidity index score, there was an additional \$50.17 spent in mean emergency expenditures annually ($p<0.001$).

Table 21. Association between Osteoarthritis and Annual Incremental Emergency room Expenditures (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	11.92	29.61	0.687
Region			
Northeast	Reference		
Midwest	32.17	27.30	0.239
South	11.38	23.86	0.633
West	-15.55	28.06	0.579
Age	-1.90	0.73	0.009
Sex			
Male	Reference		
Female	14.44	16.37	0.378
Race			
White	Reference		
Black	28.21	21.76	0.195
Other	-34.24	33.55	0.308
Marital Status			
Married	Reference		
Widowed	-14.00	37.52	0.709
Divorced	74.79	37.25	0.045
Separated	39.21	44.59	0.379
Never married	-20.33	21.64	0.347
Degree			
No degree	Reference		
GED	-82.52	47.44	0.082
High School Diploma	-32.05	40.54	0.429
Bachelor’s degree	-93.18	44.40	0.036
Masters or Doctorate	-103.79	42.60	0.015
Other degree	-87.18	49.31	0.077
Insurance coverage			
Private	Reference		
Public	-21.57	20.72	0.298
Uninsured	-68.23	20.58	0.001

Table 21. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	84.05	29.30	0.004
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	-18.92	29.65	0.523
Anxiety			
No anxiety	Reference		
Has anxiety	141.42	36.81	0.000
Asthma			
No asthma	Reference		
Has asthma	4.17	27.39	0.879
Charlson Comorbidity Index	51.80	9.75	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable.

Association between Osteoarthritis and Incremental Annual Miscellaneous Expenditures

Results of annual incremental other miscellaneous medical expenditures including medical equipment, supplies, glasses and other medical items associated with osteoarthritis is reported in Table 22. Annual mean miscellaneous expenditures were not significantly different for individuals with osteoarthritis as compared to individuals without osteoarthritis (p=0.117). With every year increase in age, there was $2.23 increase in mean annual miscellaneous expenditures (p<0.001). There was no significant difference in mean annual miscellaneous expenditures between males and females (p=0.106). Black individuals had significantly lower mean annual miscellaneous expenditures as compared to whites ($22.71, p=0.005). Individuals who had public insurance had lower annual mean miscellaneous expenditures as compared to individuals with private insurance ($26.28, p=0.015). Individuals with bachelor's degree had significantly higher annual mean miscellaneous expenditures as compared to individuals without degree ($53.08, p<0.001). Individuals with master's degree or doctorate degree had significantly higher annual mean miscellaneous expenditures as compared to individuals without degree ($61.92, p=0.003).

Among comorbid conditions, individuals with hypertension had no significant difference in annual mean miscellaneous expenditures as compared to individuals without hypertension (p=0.526). With every unit increase in Charlson comorbidity index score, there was an additional $22.50 spent in mean miscellaneous expenditures annually (p<0.001).

Table 22. Association between Osteoarthritis Annual Incremental Miscellaneous expenditures (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	27.96	17.85	0.117
Region			
Northeast	Reference		
Midwest	9.35	12.88	0.468
South	-4.99	11.01	0.651
West	18.01	12.68	0.156
Age	2.23	0.39	<0.001
Sex			
Male	Reference		
Female	12.73	7.88	0.106
Race			
White	Reference		
Black	-22.71	8.15	0.005
Other	15.60	18.23	0.392
Marital Status			
Married	Reference		
Widowed	1.41	15.60	0.928
Divorced	15.47	14.14	0.274
Separated	-32.74	24.19	0.176
Never married	23.27	15.63	0.137
Degree			
No degree	Reference		
GED	-2.18	16.88	0.897
High School Diploma	17.37	8.63	0.044
Bachelor's degree	53.08	13.12	<0.001
Masters or Doctorate	61.92	21.09	0.003
Other degree	13.13	15.12	0.385
Insurance coverage			
Private	Reference		
Public	-26.28	10.84	0.015
Uninsured	-75.15	7.06	<0.001

Table 22. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	7.12	11.24	0.526
Hyperlipidemia			
No hyperlipidemia			
Has hyperlipidemia	14.84	11.88	0.211
Anxiety			
No anxiety			
Has anxiety	29.76	21.75	0.171
Asthma			
No asthma			
Has asthma	3.09	18.72	0.869
Charlson Comorbidity Index	22.50	4.39	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Medication Expenditures

Results of annual incremental medication expenditures associated with osteoarthritis is reported in Table 23. Annual mean medication expenditures were significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis (\$325.03, $p=0.013$). With every year increase in age, there was \$17.75 increase in mean annual medication expenditures ($p<0.001$). There was no significant difference in medication expenditures between males and females ($p=0.41$). Black individuals had significantly lower annual mean medication expenditures as compared to whites (\$361.94, $p<0.001$). Individuals who had public insurance had higher medication expenditures as compared to individuals with private insurance (\$567.61, $p<0.001$). Individuals with bachelor's degree had significantly higher medication expenditures as compared to individuals without degree (\$417.41, $p=0.011$). Individuals with master's degree or doctorate degree had significantly higher medication expenditures as compared to individuals without degree (\$516.66, $p=0.024$).

Among comorbid conditions, individuals with hypertension had higher mean annual medication expenditures as compared to individuals without hypertension (\$422.22, $p<0.001$). Individuals with hyperlipidemia had higher annual mean medication expenditures as compared to individuals without hyperlipidemia (\$802.67, $p<0.001$). Individuals with anxiety had higher annual mean medication expenditures as compared to individuals without anxiety (\$1,028.34, $p<0.001$). Individuals with asthma had higher annual mean medication expenditures as compared to individuals without asthma (\$1,096.23, $p<0.001$).

Table 23. Association between Osteoarthritis and Annual Incremental Medication Expenditures (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	325.03	130.27	0.013
Region			
Northeast	Reference		
Midwest	-265.18	176.97	0.134
South	-200.56	155.90	0.198
West	-250.49	170.01	0.141
Age	17.75	4.03	<0.001
Sex			
Male	Reference		
Female	-71.91	98.08	0.463
Race			
White	Reference		
Black	-361.94	97.32	<0.001
Other	-3.48	254.34	0.989
Marital Status			
Married	Reference		
Widowed	-142.40	132.14	0.281
Divorced	-46.58	121.37	0.701
Separated	-132.27	185.74	0.476
Never married	46.83	135.40	0.729
Degree			
No degree	Reference		
GED	1738.76	1180.24	0.141
High School Diploma	185.01	119.10	0.120
Bachelor’s degree	417.41	165.01	0.011
Masters or Doctorate	516.66	229.52	0.024
Other degree	38.52	155.07	0.804
Insurance coverage			
Private	Reference		
Public	567.61	146.62	<0.001
Uninsured	-715.10	103.85	<0.001

Table 23. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	422.22	89.94	<0.001
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	802.67	93.73	<0.001
Anxiety			
No anxiety	Reference		
Has anxiety	1028.34	134.05	<0.001
Asthma			
No asthma	Reference		
Has asthma	1096.23	316.16	<0.001
Charlson Comorbidity Index	731.59	67.15	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Total Expenditures

Results of annual incremental total expenditures associated with osteoarthritis is reported in Table 24. Mean annual total expenditures were significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis ($2,045.75, p=0.001). With every year increase in age, there was $52.14 increase in annual mean total expenditures (p<0.001). There was no significant difference in mean annual total expenditures between males and females (p=0.053). Individuals who had no insurance had lower annual mean total expenditures as compared to individuals with private insurance ($2,779.96, p<0.001). Individuals with master's degree or doctorate degree had significantly higher total expenditures as compared to individuals without degree ($1,470.84, p=0.014).

Among comorbid conditions, individuals with hypertension had higher mean annual total expenditures as compared to individuals without hypertension ($973.03, p=0.001). Individuals with hyperlipidemia had higher mean annual total expenditures as compared to individuals without hyperlipidemia ($1,238.88, p=<0.001). Individuals with anxiety had significant higher annual mean total expenditures as compared to individuals without anxiety ($2082.09, p<0.001). With every unit increase in Charlson comorbidity index score, there was an additional $2,494.08 spent in mean total expenditures annually (p<0.001).

Table 24. Association between Osteoarthritis and Annual Incremental Total Expenditures (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	2045.75	603.94	0.001
Region			
Northeast	Reference		
Midwest	-444.38	318.52	0.163
South	-535.93	331.77	0.106
West	135.04	392.16	0.731
Age	52.14	8.87	<0.001
Sex			
Male	Reference		
Female	477.48	246.67	0.053
Race			
White	Reference		
Black	-486.33	261.11	0.063
Other	-156.25	677.23	0.818
Marital Status			
Married	Reference		
Widowed	-819.21	404.33	0.043
Divorced	302.09	414.58	0.466
Separated	-46.44	778.33	0.952
Never married	-599.24	273.30	0.028
Degree			
No degree	Reference		
GED	2762.10	1893.92	0.145
High School Diploma	689.18	407.53	0.091
Bachelor’s degree	819.10	473.56	0.084
Masters or Doctorate	1470.84	596.92	0.014
Other degree	258.22	480.86	0.591
Insurance coverage			
Private	Reference		
Public	618.82	340.10	0.069
Uninsured	-2779.76	263.00	<0.001

Table 24. Cont'd

	Marginal effect	Standard error	Prob.
Hypertension			
No hypertension	Reference		
Has hypertension	973.03	293.22	0.001
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	1238.88	331.02	<0.001
Anxiety			
No anxiety	Reference		
Has anxiety	2082.09	347.44	<0.001
Asthma			
No asthma	Reference		
Has asthma	1066.63	678.76	0.116
Charlson Comorbidity Index	2404.08	160.13	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Absenteeism

Results of annual absenteeism associated with osteoarthritis is reported in Table 25. Annual absenteeism was significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis (2.21 days, $p=0.042$). With every unit increase in age, there was 0.03 increase in absenteeism ($p=0.030$). Females had significant higher absenteeism than males (1.96 days, $p<0.001$). Individuals who had public insurance had higher absenteeism as compared to individuals with private insurance (2.52 days, $p=0.007$). Individuals with bachelor's degree had significantly lower absenteeism as compared to individuals without degree (3.16 days, $p=0.005$). Individuals with master's degree or doctorate degree had significantly lower absenteeism as compared to individuals without degree (4.22 days, $p<0.001$).

Among comorbid conditions, individuals with hypertension had higher significant absenteeism as compared to individuals without hypertension (1.58 days, $p=0.011$). There were no significant differences in annual absenteeism between individuals with hyperlipidemia and individuals without hyperlipidemia. There were also no significant differences observed between individuals with anxiety and individuals without anxiety for annual absenteeism. Individuals with asthma did not show any significant difference in annual absenteeism as compared to individuals without asthma. Individuals with higher Charlson Comorbidity Index scores had higher absenteeism as compared to individuals with lower Charlson Comorbidity index scores (1.48 days, $p<0.001$)

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Table 25. Association between Osteoarthritis and Annual Incremental Annual Absenteeism (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	2.21	1.09	0.042
Region			
Northeast	Reference		
Midwest	-0.74	0.53	0.169
South	-0.54	0.56	0.310
West	-1.08	0.53	0.045
Age	0.03	0.01	0.030
Sex			
Male	Reference		
Female	1.96	0.39	<0.001
Race			
White	Reference		
Black	0.39	0.46	0.401
Other	0.49	0.69	0.487
Marital Status			
Married	Reference		
Widowed	-0.91	1.50	0.546
Divorced	-0.08	0.51	0.873
Separated/never married	-0.33	0.44	0.454
Degree			
No degree	Reference		
GED	-0.07	2.11	0.973
High School Diploma	-2.11	1.09	0.053
Bachelor's degree	-3.16	1.12	0.005
Masters or Doctorate	-4.22	1.15	<0.001
Other degree	-2.66	1.15	0.021
Insurance coverage			
Private	Reference		
Public	2.52	0.93	0.007
Uninsured	-0.51	0.46	0.274
Hypertension			

Table 25. cont'd

	Marginal effect	Standard error	Prob.
No hypertension	Reference		
Has hypertension	1.58	0.62	0.011
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	-0.13	0.58	0.817
Anxiety			
No anxiety	Reference		
Has anxiety	1.34	0.70	0.056
Asthma			
No asthma	Reference		
Has asthma	-0.12	0.65	0.845
Charlson Comorbidity Index	1.48	0.21	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

Association between Osteoarthritis and Incremental Annual Absenteeism Expenditures

Results of annual absenteeism costs associated with osteoarthritis is reported in Table 26. Annual absenteeism costs was significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis ($715.74, p=0.05). With every unit increase in age, there was 8.91 increase in absenteeism costs (p=0.002). Females had significantly higher absenteeism costs than males ($206.85, p=0.001). Individuals who had no insurance had lower absenteeism costs as compared to individuals with private insurance ($321.73, p<0.001). Individuals with bachelor's degree had significantly higher absenteeism costs as compared to individuals without degree ($269.14, p=0.015). Individuals with master's degree or doctorate degree had significantly higher absenteeism costs as compared to individuals without degree ($255.36, p=0.048).

Among comorbid conditions, individuals with hypertension had higher significant absenteeism costs as compared to individuals without hypertension ($234.90, p=0.016). There were no significant differences in annual absenteeism costs between individuals with hyperlipidemia and individuals without hyperlipidemia. There were also no significant differences observed between individuals with anxiety and individuals without anxiety for annual absenteeism costs. Individuals with asthma did not show any significant difference in annual absenteeism costs as compared to individuals without asthma. Individuals with higher Charlson Comorbidity Index scores had higher absenteeism costs as compared to individuals with lower Charlson Comorbidity index scores ($212.28, p<0.001).

Table 26. Association between Osteoarthritis and Annual Incremental Absenteeism Expenditures (n=26,992)

	Marginal effect	Standard error	Prob.
Osteoarthritis	715.74	370.63	0.050
Region			
Northeast	Reference		
Midwest	-195.97	81.90	0.017
South	-127.40	91.67	0.165
West	-210.38	82.13	0.010
Age	8.91	2.88	0.002
Sex			
Male	Reference		
Female	206.85	59.93	0.001
Race			
White	Reference		
Black	51.45	77.96	0.509
Other	31.89	87.12	0.714
Marital Status			
Married	Reference		
Widowed	-315.62	185.29	0.089
Divorced	7.40	96.59	0.939
Separated/never married	-216.98	66.36	0.001
Degree			
No degree	Reference		
GED	58.06	118.60	0.624
High School Diploma	152.84	93.23	0.101
Bachelor's degree	269.14	110.24	0.015
Masters or Doctorate	255.36	129.07	0.048
Other degree	236.08	110.07	0.032
Insurance coverage			
Private	Reference		
Public	-161.95	93.45	0.083
Uninsured	-321.73	62.82	<0.001
Hypertension			

Table 26. Cont'd

	Marginal effect	Standard error	Prob.
No hypertension	Reference		
Has hypertension	234.90	97.18	0.016
Hyperlipidemia			
No hyperlipidemia	Reference		
Has hyperlipidemia	-112.44	73.91	0.128
Anxiety			
No anxiety	Reference		
Has anxiety	141.66	107.16	0.186
Asthma			
No asthma	Reference		
Has asthma	-32.71	115.01	0.776
Charlson Comorbidity Index	212.28	45.58	<0.001

Marginal effects for dichotomous variables are change in the expected value of the dependent variable for the discrete change from 0 to 1 of the independent variable, that is, from no osteoarthritis to osteoarthritis and females to males

Marginal effects for continuous variables are change in the expected value of the dependent variable for a unit change in the independent variable, given a specific starting value for the independent variable

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SUMMARY AND CONCLUSIONS

Background

Osteoarthritis is the most common form of arthritis where there is progressive degeneration of cartilage in the joint (Felson and Nevitt 2004). Symptoms of osteoarthritis include pain, swelling or stiffness, or a combination (Altman, Alarcon et al. 1990). Joints commonly affected by osteoarthritis include knee, hip, hand, spine and foot (Newman et al. 2003). In the United States, it was estimated that twenty-seven million adults or 12.1 percent of the adult population suffered from osteoarthritis in 2005 (Lawrence, Felson et al. 2008). Risk of osteoarthritis increases with age (Felson, Naimark et al. 1987; Kallman, Wigley et al. 1990; Losina, Weinstein et al. 2013). Incidence of osteoarthritis is significantly greater in women than men (Oliveria, Felson et al. 1995; Srikanth, Fryer et al. 2005). Occupations that include bending and lifting have been associated with greater risk of osteoarthritis (Felson, Hannan et al. 1991; Coggon, Kellingray et al. 1998). Strenuous physical activity (Buckwalter and Lane 1997; Kujala, Kettunen et al. 1995) and genetic factors (Spector and MacGregor 2004) are some other risk factors identified with osteoarthritis.

There is wide variation in the estimates of direct health care utilization and costs among studies examining incremental costs due to osteoarthritis. This study provides a current description of the utilization and expenditures of health care resources associated with osteoarthritis. Estimates of incremental utilization and incremental costs of direct healthcare associated with osteoarthritis as well as incremental absenteeism and incremental absenteeism costs associated with osteoarthritis were developed.

Objectives

The goal of this study was to assess burden associated with osteoarthritis. The specific objectives of the study were to:

1. determine incremental annual direct health care resource utilization associated with osteoarthritis by categories including hospitalizations, hospital days, emergency room encounters, and outpatient visits
2. determine incremental annual direct health care expenditures associated with osteoarthritis by categories including total expenditures, inpatient hospital expenditures, emergency room expenditures, outpatient expenditures, medication expenditures and miscellaneous expenditures
3. determine incremental annual number of days absent from work associated with osteoarthritis and
4. determine incremental annual absenteeism costs associated with osteoarthritis

Hypotheses

The study hypotheses were:

1. presence of osteoarthritis will increase annual direct utilization of health care resources, including increase in hospitalizations, hospital days, emergency room encounters, and outpatient room visits
2. presence of osteoarthritis will increase annual direct health care expenditures, including increase in total expenditures, inpatient hospital expenditures,

emergency room expenditures, outpatient expenditures, medication expenditures and miscellaneous expenditures

3. presence of osteoarthritis will increase annual absenteeism from workplace and
4. presence of osteoarthritis will increase annual absenteeism costs from workplace

Methods

An observational database analysis was conducted using data from the Medical Expenditure Panel Survey (MEPS). Individuals eighteen years old or older with osteoarthritis were compared to individuals without osteoarthritis. A one-year study interval was used for analyses. The study was approved by the Institutional Review Board of Purdue University.

Sample

Individuals eighteen years or older and employed in 2011 were included in the study. ICD-9-CM codes were used to identify employees with osteoarthritis: 715 for osteoarthritis and other allied disorders. Individuals diagnosed with osteoarthritis were compared to individuals without any diagnosis of osteoarthritis. Individuals missing any information on number of days missed at work in 2011 were excluded. Individuals who had missing information for their wages in MEPS were excluded.

Study Variables

Study variables included a predictor variable of osteoarthritis that was coded as ‘1’ for presence of the disease and ‘0’ for absence of the disease. Covariates in the model included age, coded as a continuous variable, gender, coded as a binary variable with ‘0’ for males and ‘1’ for females. Race was coded as a categorical variable including “1” for White, “2” for Black,“3” for others. Region was coded as a categorical variable including “1” for Northeast, “2” for Midwest, “3” for South, and “4” for West. Marital status categories included “1” for married, “2” for widowed, “3” for separated, “4” for divorced and “5” for never married. Highest degree obtained by an individual was coded as “1” for no degree, “2” for general education degree (GED), “3” for high school diploma, “4” for bachelor’s degree, “5” for master’s degree or doctorate degree and “6” for other degree. Health insurance status was coded as a categorical variable with three categories, “1” as private insurance, and “2” as public insurance and “3” for no insurance. Comorbid disease conditions including hypertension, hyperlipidemia, anxiety and asthma were also included. Each comorbid disease was coded as ‘1’ for presence of the disease and ‘0’ for absence of the disease.

Annual wages were divided by number of working days in 2011 to obtain daily wages. Daily wage was coded as a continuous variable. Daily wage was multiplied with annual days missed at the workplace to obtain annual absenteeism costs.

Hospitalizations were determined by identifying and counting the number of unique confinements per patient. Number of hospital days spent by each patient were identified by subtracting the patient’s admit date and discharge date at the hospital for each visit. One visit at an outpatient facility defined as a summation of all visits to that facility per day. Similarly, for an emergency room visit if a patient visited an emergency room once on a particular day, the resultant visit count for emergency room was one.

Total annual emergency room expenditures and total annual outpatient expenditures per patient were calculated by adding facility-specific expenditures for the patient in the specified one-year period. Total annual prescription expenditures per patient, were calculated by adding standard prices for all medication claims during the specified one year period. Total miscellaneous expenditures per patient were calculated by adding costs that did not belong in any other resource category during the specified one year period.

Statistical Analyses

Data were analyzed using SAS for Unix Version 9.2 and STATA for Unix version 12. Frequency distributions were developed to describe the sample and Chi-square tests were used to assess statistical differences between persons with osteoarthritis and those without osteoarthritis on demographic variables and clinical variables. Unadjusted means and 95 percent confidence intervals for annual hospitalizations, annual hospital stays, annual outpatient visits and annual emergency room visits were computed and Wilcoxon Mann Whitney tests were used to detect differences between the osteoarthritis and comparator group. Similarly, unadjusted means and 95 percent confidence intervals were developed for annual inpatient expenditures, annual outpatient expenditures, annual emergency room expenditures, annual medication expenditures, annual miscellaneous expenditures and annual total expenditures. Wilcoxon Mann Whitney tests were used to detect differences between the osteoarthritis and comparator group. Unadjusted means and 95 percent confidence intervals were calculated for annual absenteeism and annual absenteeism costs. Wilcoxon Mann Whitney tests were used to detect differences between the osteoarthritis and comparator group.

Individual zero inflated negative binomial regression models were developed to estimate independent association between osteoarthritis and hospitalizations, hospital days, outpatient visits and emergency room visits. A binary predictor variable for osteoarthritis was included in each model and covariates in each model included age, gender, race, region, marital status, insurance, education, presence of comorbid diseases including hypertension, hyperlipidemia, anxiety and asthma and Charlson Comorbidity Index scores. Similar regression models for health care expenditures were developed, with the predictor variable and covariates described above, with individual models for total expenditures, hospital expenditures, outpatient expenditures, emergency room expenditures, medication expenditures and total expenditures. Zero-inflated negative binomial models were also developed for assessing association of osteoarthritis with annual absenteeism and association of osteoarthritis with annual absenteeism costs. Predictor variable and covariates as described above were included in the models.

Results and Discussion

Demographic characteristics of sample

The total number of individuals who participated in MEPS Household Component of the Medical Expenditure Panel Survey in 2011 were 35,313. After excluding individuals who were younger than eighteen years of age and unemployed, 26,992 individuals remained. Out of 26,992 individuals, 1,354 individuals had a diagnosis of osteoarthritis, representing 15,363,338 persons with osteoarthritis nationally.

Incremental Annual Resource Utilization associated with Osteoarthritis

Annual mean incremental hospitalizations associated with osteoarthritis in the current study were 0.07 hospitalizations ($p<0.001$). Mean annual hospital days were not incrementally greater for individuals with osteoarthritis (0.06 days, $p=0.287$). Mean annual outpatient visits were significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis (3.63 visits, $p<0.001$). Mean annual emergency room visits were significantly higher for individuals with osteoarthritis as compared to individuals without osteoarthritis (0.009 visits, $p<0.001$).

Findings from this study are consistent with findings from prior studies that reported higher utilizations for individuals with osteoarthritis as compared to individuals without osteoarthritis. Le et al. and Berger et al., in different studies, compared individuals with osteoarthritis with individuals without osteoarthritis using Marketscan databases and calculated incremental healthcare utilization associated with osteoarthritis (Le, Montejano et al. 2012; Berger, Hartrick et al. 2011). Mean annual incremental outpatient visits in this current study was 3.63 visits which was similar to the mean annual incremental outpatient visits reported by Le et al. at 3.1 visits and Berger et al. at 3.9 visits. However, when compared to findings by Le et al. (Le, Monjetano et al. 2012), and findings by Berger et al. (Berger, Hartrick et al. 2011), incremental mean annual hospitalization was lower in the current study at 0.07 annual mean visits, as compared to the estimate provided by Le et al. and Berger et al. at 0.3 visits. Mean incremental annual hospital days in the current study was 0.06 days as compared to 1.3 days as reported by Berger and colleagues.

Berger et al. and Le et al. used samples similar to this current study by examining individuals eighteen years or older and employed. A possible reason for variation in utilization estimates across studies may include differences in the process of data collection. Berger et al. and Le et al. estimated utilizations from MarketScan® database which contains information from enrollment files and medical and outpatient pharmacy claims from a variety of private insurers that provide health care coverage to their employees (Berger, Hartrick et al. 2011; Le, Montejano et al. 2012). However, the current study employed MEPS database where the medical conditions and health care utilization reported by the individual in the survey were recorded by the interviewer as verbatim text, which was then coded by professional coders to fully-specified 2011 ICD-9-CM codes. Researchers have reported that the ability of survey respondents to report medical conditions that can be coded accurately should not be assumed to be precise in MEPS (Cox and Iachan, 1987; Johnson and Sanchez, 1993). A study conducted by Zuvekas and Olin, compared participants in MEPS from 2001 to 2003 with Medicare coverage and matched them to their Medicare enrollment and claims data using Medicare health insurance claim numbers (HICNs) or social security numbers (SSNs). The authors reported that individuals in the MEPS underreported utilization of health care services including underreporting of emergency room visits and physician office visits by 19 percent (Zuvekas and Olin. 2009). Lower utilization estimates in this current study can be attributed to the underreporting in the MEPS survey by individuals.

Incremental Annual Expenditures associated with Osteoarthritis

In the current study, mean annual incremental total expenditures associated with osteoarthritis were $2,045.75 (p=0.001). Mean incremental inpatient expenditures were the largest component of direct health expenditures at $826.83 (p=0.021). Mean incremental outpatient expenditures were significantly associated with osteoarthritis at $658.94 ($p<0.05$). Mean annual incremental medications expenditures associated with osteoarthritis were $325.03 (p=0.013). Mean annual incremental emergency expenditures was not significantly associated at $11.93 ($p<0.687$). Similarly, mean annual incremental miscellaneous expenditures associated with osteoarthritis were $27.96 ($p=0.117$).

In previous studies, incremental expenditures associated with osteoarthritis were reported with higher estimates. Le and colleagues evaluated 258,237 individuals with osteoarthritis and matched them to the same number of individuals without osteoarthritis, using Marketscan® databases. They estimated mean total costs associated with osteoarthritis at $10,941 (Le, Montejano et al. 2012). Similarly, Berger and colleagues using Marketscan® databases for 2007, estimated mean total costs associated with osteoarthritis at $8,060 (Berger, Hartrick et al. 2011). The authors reported that presence of comorbidities including diabetes, hypertension, and cardiovascular disease which were not adjusted in the analyses could have resulted in high expenditure estimates (Berger, Hartrick et al. 2011; Le, Montejano et al. 2012).

By using survey weights for MEPS, national estimates for this population of employed, individuals eighteen years or older were obtained for the current study. A sample of 26,992 individuals in this study represents a population of 204,328,545 nationally. Total direct expenditures for this population was estimated at $41.7 billion with annual inpatient expenditures as major contributor at $16.8 billion dollars, followed by outpatient expenditures at $13.4 billion dollars, annual medication expenditures at $6.6 billion dollars, annual miscellaneous expenditures at 0.57 billion and annual emergency room expenditures at $0.24 billion.

Incremental Annual Absenteeism associated with Osteoarthritis

Mean incremental absenteeism associated with osteoarthritis in the current study was estimated at 2.2 days annually. Findings from previous studies in estimating annual incremental absenteeism were similar. Berger et al. estimated annual incremental absenteeism costs between individuals with osteoarthritis and individuals without osteoarthritis using MarketScan® databases in 2007. Annual incremental absenteeism related to sickness was estimated at 1.8 days (Berger, Hartrick et al. 2011). Kotlarz and colleagues evaluated pooled data from 1996 to 2005 from MEPS and estimated incremental mean annual absenteeism of 1.8 days for women and 1.65 days for men due to osteoarthritis (Kotlarz, Gunnarsson et al. 2010). Kotlarz et al. did not provide an annual average absenteeism estimate for an individual, irrespective of the gender.

Incremental Annual Absenteeism Expenditures associated with Osteoarthritis

Current study estimated mean annual incremental absenteeism costs at $715.74. Absenteeism costs were estimated by employing annual wages reported by individuals in MEPS in 2011. However, 50 percent of the sample reported zero wages, despite being employed. By removing the individuals who reported zero wages, the mean incremental absenteeism costs increased slightly by $784.37. After removing individuals who reported zero wages, the number of individuals who remained in the sample were 10,320. After applying survey weights, 10,320 individuals were equivalent to a population of 112,603,572 to obtain a population of employed, eighteen years or older individuals with wages greater than zero. The mean absenteeism costs for this population was $8.8 billion dollars. Kotlarz and colleagues using MEPS data estimated an aggregate annual absenteeism costs of $4.8 billion for women and $5.5 billion for men. Kotlarz and colleagues obtained the above costs by utilizing information from Morbidity and Mortality Weekly Report from Centers of Disease Control and Prevention, instead of completely relying on MEPS (Kotlarz, Gunnarsson et al. 2010). This could explain the discrepancy in the absenteeism costs reported between the current study and by Kotlarz et al.

Study Limitations

A limitation of this study was that ICD-9-CM codes were used to identify individuals with osteoarthritis. Also, the comorbidities used for the Charlson Comorbidity Index were identified using ICD-9-CM codes. Use of diagnostic codes in claims to identify diagnosis is known to be imperfect due to variations in coding (Romano and Mark 1994). However, the set of codes used in this study to identify osteoarthritis have been utilized in prior studies (Berger, Hartrick et al 2011; Le et al. 2012). Another limitation of this study was that MEPS does not specify the site of osteoarthritis (knee or hip or hand) and thus it is not possible to evaluate associations between site of osteoarthritis and expenditures associated with it. Absenteeism is self-reported in MEPS and this could cause variations while estimating absenteeism costs.

Conclusions

The study findings indicate that osteoarthritis is associated with significant incremental health care resource utilization and incremental health care expenditures even after adjusting for age, gender, race, region, marital status, insurance, Charlson comorbidity score, hypertension, hyperlipidemia, anxiety and asthma. Significant incremental mean annual resource utilization associated with osteoarthritis for hospitalizations (0.07), outpatient visits (3.63 visits), and emergency room visits (0.09 visits) were observed. Considerable mean total annual incremental expenditures of $2,045.75 associated with osteoarthritis were observed. The highest contributor to total direct expenditures were from hospital expenditures ($826.38), followed by outpatient expenditures ($658.94) and medication expenditures ($325.03). Significant mean incremental annual absenteeism at 2.21 days and mean incremental annual absenteeism costs at $715.75 were attained in this current study. These findings indicate that presence of osteoarthritis has a significant economic burden, through direct healthcare expenditures and indirect expenditures.

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APPENDICES

Appendix A

Unadjusted Resource Utilization by Age, Gender and Comorbidities

Table A1. Unadjusted Annual Health Care Resource Utilization among Persons with Osteoarthritis by Age

Utilization Category	Under 35 (n=45) Mean (95% CI)	35 to 44 (n=73) Mean (95% CI)	45 to 54 (n=195) Mean (95% CI)	55 to 64 (n=389) Mean (95% CI)	65 and over (n=651) Mean (95% CI)
Hospitalizations	0.28 (0.13 to 0.43)	0.15 (0.05 to 0.25)	0.19 (0.11 to 0.27)	0.22 (0.16 to 0.27)	0.28 (0.22 to 0.33)
Hospital days	6.58 (2.35 to 7.03)	5.22 (2.16 to 8.26)	5.42 (1.63 to 9.21)	4.42 (2.98 to 5.45)	4.93 (3.85 to 6.01)
Outpatient visits	0.82 (0.07 to 1.57)	0.65 (0.22 to 1.08)	0.95 (0.48 to 1.42)	1.25 (0.75 to 1.25)	1.32 (1.03 to 1.60)
Emergency room visits	0.33 (0.12 to 0.53)	0.64 (0.35 to 0.93)	0.40 (0.26 to 0.53)	0.32 (0.24 to 0.39)	0.29 (0.23 to 0.35)

Table A2. Unadjusted Annual Health Care Resource Utilization among Persons with Osteoarthritis by Gender

Utilization Category	Female (N=952) Mean (95% CI)	Male (N=402) Mean (95% CI)
Hospitalizations	0.23 (0.19 to 0.26)	0.26 (0.20 to 0.33)
Hospital days	5.19 (4.10 to 6.27)	5.98 (1.98 to 9.99)
Outpatient visits	1.25 (0.97 to 1.52)	1.06 (0.77 to 1.35)
Emergency room visits	0.36 (0.31 to 0.42)	0.27 (0.21 to 0.34)

Table A3. Unadjusted Annual Health Care Resource Utilization among Persons with Osteoarthritis and Presence or Absence of Hypertension

	No Hypertension (n=510)	Hypertension (n=844)
Utilization Category	Mean (95% CI)	Mean (95% CI)
Hospitalizations	0.17 (0.13 to 0.22)	0.27 (0.23 to 0.32)
Hospital days	6.69 (1.86 to 11.51)	4.98 (3.98 to 5.98)
Outpatient visits	1.07 (0.67 to 1.46)	1.27 (1.02 to 1.51)
Emergency room visits	0.28 (0.22 to 0.35)	0.36 (0.31 to 0.42)

Table A4. Unadjusted Annual Health Care Resource Utilization among Persons with Osteoarthritis and Presence or Absence of Hyperlipidemia

Utilization Category	No Hyperlipidemia (n=663) Mean (95% CI)	Hyperlipidemia (n=691) Mean (95% CI)
Hospitalizations	0.19 (0.15 to 0.24)	0.28 (0.23 to 0.33)
Hospital days	5.70 (2.47 to 8.93)	5.28 (4.03 to 6.52)
Outpatient visits	1.14 (0.78 to 1.48)	1.25 (1.00 to 1.49)
Emergency room visits	0.33 (0.26 to 0.39)	0.34 (0.28 to 0.40)

Table A5. Unadjusted Annual Health Care Resource Utilization among Persons with Osteoarthritis and Presence or Absence of Anxiety

	No Anxiety (n=1,150)	Anxiety (n=204)
Utilization Category	Mean (95% CI)	Mean (95% CI)
Hospitalizations	0.22 (0.21 to 0.25)	0.31 (0.21 to 1.5)
Hospital days	5.59 (3.79 to 7.40)	4.81 (3.30 to 6.29)
Outpatient visits	1.22 (0.97 to 1.46)	1.05 (0.74 to 1.36)
Emergency room visits	0.29 (0.25 to 0.34)	0.56 (0.41 to 0.73)

Table A6. Unadjusted Annual Health Care Resource Utilization among Persons with Osteoarthritis and Presence or Absence of Asthma

	No Asthma (n=1,150)	Asthma (n=204)
Utilization Category	Mean (95% CI)	Mean (95% CI)
Hospitalizations	0.23 (0.20 to 0.27)	0.27 (0.17 to 0.36)
Hospital days	5.49 (3.71 to 7.14)	5.59 (2.93 to 8.25)
Outpatient visits	1.03 (0.87 to 1.19)	2.18 (1.05 to 3.32)
Emergency room visits	0.33 (0.28 to 0.37)	0.37 (0.25 to 0.49)

Appendix B

Unadjusted Expenditures by Age, Gender and Comorbidities

Table B1. Unadjusted Annual Health Care Expenditures in Dollars among Persons with Osteoarthritis by Age

Expenditure Category	Under 35 (n=46) Mean (95% CI)	35 to 44 (n=73) Mean (95% CI)	45 to 54 (n=195) Mean (95% CI)	55 to 64 (n=389) Mean (95% CI)	65 and over (n=651) Mean (95% CI)
Inpatient expenditures	3,365 (684 to 6,046)	1,742 (312 to 3,172)	4,805 (3,806 to 10,322)	4,396 (2,752 to 6,040)	2,912 (2,259 to 3,564)
Outpatient expenditures	3,090 (211 to 5,968)	3,052 (2,101 to 4,002)	2,726 (2,070 to 3,382)	3,778 (3,165 to 4,391)	3,108 (2,639 to 3,576)
Emergency room expenditures	323 (56 to 591)	557 (88 to 1,025)	298 (155 to 410)	329 (209 to 450)	242 (164 to 319)
Medication expenditures	838 (511 to 1,165)	1,430 (996 to 1,865)	3,304 (2,181 to 4,467)	2,147 (1,848 to 2,447)	2,428 (2,150 to 2,707)
Miscellaneous Expenditures	79 (23 to 182)	67 (36 to 98)	157 (63 to 250)	157 (67 to 246)	229 (170 to 288)
Total health care expenditures	7,695 (3,478 to 11,913)	6,849 (4,904 to 8,794)	11,290 (5,513 to 17,068)	10,809 (8,758 to 12,860)	8,921 (7,951 to 9,890)

Table B2. Unadjusted Annual Health Care Expenditures in Dollars among Persons with Osteoarthritis by Gender

	Male (n=402)	Female (n=952)
Expenditure Category	Mean (95% CI)	Mean (95% CI)
Inpatient expenditures	3,505 (2,515 to 4,494)	3,587 (2,259 to 4,916)
Outpatient expenditures	3,056 (2,507 to 3,604)	3,320 (2,929 to 3,711)
Emergency room expenditures	254 (142 to 366)	312 (239 to 385)
Medication expenditures	2,200 (1,744 to 2,655)	2,436 (2,173 to 2,699)
Miscellaneous expenditures	180 (131 to 354)	189 (129 to 233)
Total expenditures	9,195 (7,842 to 10,548)	9,844 (8,340 to 11,347)

Table B3. Unadjusted Annual Health Care Expenditures in Dollars among Persons with Osteoarthritis and Presence or Absence of Hypertension

	No Hypertension (n=510)	Hypertension (n=844)
Expenditure Category	Mean (95% CI)	Mean (95% CI)
Inpatient expenditures	2,613 (1,725 to 3,501)	4,137 (2,661 to 5,612)
Outpatient expenditures	3,033 (2,538 to 3,528)	3,368 (2,951 to 3,784)
Emergency expenditures	263 (166 to 360)	314 (235 to 392)
Medication expenditures	2,100 (1,653 to 2,548)	2,526 (2,278 to 2,775)
Miscellaneous expenditures	191 (127 to 354)	180 (127 to 233)
Total expenditures	8,202 (6,982 to 9,243)	10,526 (8,871 to 12,182)

Table B4. Unadjusted Annual Health Care Expenditures in Dollars among Persons with Osteoarthritis and Presence or Absence of Hyperlipidemia

Expenditure Category	No Hyperlipidemia (n=663) Mean (95% CI)	Hyperlipidemia (n=691) Mean (95% CI)
Inpatient expenditures	2,690 (1,915 to 3,265)	4,496 (2,692 to 6,301)
Outpatient expenditures	2,876 (2,477 to 3,274))	3,593 (3,098 to 4,047)
Emergency room expenditures	305 (208 to 402)	284 (209 to 359)
Medication expenditures	1,891 (1,541 to 2,241)	2,822 (2,527 to 3,116)
Miscellaneous expenditures	171 (105 to 236)	197 (147 to 246)
Total expenditures	7,835 (6,856 to 8,814)	11,393 (9,393 to 13,393)

Table B5. Unadjusted Annual Health Care Expenditures in Dollars among Persons with Osteoarthritis and Presence or Absence of Anxiety

	No Anxiety (n=1,150)	Anxiety (n=204)
Expenditure Category	Mean (95% CI)	Mean (95% CI)
Inpatient expenditures	3,488 (2,371 to 4,605)	3,985 (2,380 to 5,590)
Outpatient expenditures	3,135 (2,779 to 3,490)	3,845 (3,154 to 4,536)
Emergency room expenditures	260 (201 to 320)	488 (260 to 717)
Medication expenditures	2,106 (1,884 to 2,328)	3,832 (2,988 to 4,675)
Miscellaneous expenditures	188 (141 to 235)	160 (209 to 212)
Total health care expenditures	9,179 (7,914 to 10,444)	12,311 (9,990 to 14,633)

Table B6. Unadjusted Annual Health Care Expenditures in Dollars among Persons with Osteoarthritis and Presence or Absence of Asthma

	No Asthma (n=1,162)	Asthma (n=192)
Expenditure Category	Mean (95% CI)	Mean (95% CI)
Inpatient expenditures	3,705 (2,578 to 4,832)	2,701 (1,643 to 3,759)
Outpatient expenditures	3,084 (2,750 to 3,419)	4,193 (3,206 to 5,180)
Emergency room expenditures	219 (224 to 358)	317 (172 to 461)
Medication expenditures	2,105 (1,884 to 2,325)	3,947 (3,060 to 4,834)
Miscellaneous expenditures	195 (149 to 240)	120 (32 to 209)
Total health care expenditures	9,382 (8,099 to 10,865)	11,279 (9,482 to 13,076)

VITA

VITA

Jyothi Menon was born to Mr. M. N. Kutty and Mrs. Radha Nair on July 5, 1986 in Hyderabad, India. After finishing high school from Bharatiya Vidya Bhavan, in 2002, she joined Gowtham Junior college, Hyderabad to pursue preparation for a career in the Math and Science fields. She then pursued a Bachelor's degree in Pharmacy from Birla Institute of Technology and Science (Pilani) starting in 2004. After obtaining her Bachelor's degree, she joined Purdue University in August 2008 to pursue a doctoral degree in Pharmacy Administration.

Jyothi received her first degree from Purdue University in May 2011 when she graduated with a Masters in Pharmacy Administration. While at Purdue University, she was involved in various research projects, presentations and publications. She has been an active member of the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) and received the ISPOR Distinguished Service Award, May 2011. She also represented the Purdue University Student chapter at the International Society for Pharmacoeconomics and Outcomes Research as President. Jyothi was involved as a graduate senator representing Pharmacy Practice for the graduate student body at Purdue University from 2012 to 2013. She was also a member of Community Standards Board at Purdue University from 2011 to 2012. During her doctoral studies, Jyothi completed an internship at Pfizer Inc. in the Specialty Care Outcomes research group in Summer 2012. Jyothi’s research interests are in the field of health economics and outcomes research and upon graduation she looks forward to build her career in the same field.