Rheumatol Int (2007) 27:315–321
DOI 10.1007/s00296-006-0269-2

REVIEW

Osteoarthritis and the impact on quality of life health indicators

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Received: 22 August 2006 / Accepted: 24 October 2006 / Published online: 15 November 2006

Abstract The purpose of this study was to compare quality of life health identifiers in patients with and without osteoarthritis (OA) while controlling for the potentially confounding variables of gender, age, race, education, and income. Data were obtained for comparison from the *Behavioral Risk Factor Surveillance System* (BRFSS) database. Patients with and without OA were analyzed for differences in exercise and activity level, report of physical and mental health, and joint-related symptoms. Over 37,000 individuals were included in the analysis, 6,172 of the participants reported a diagnosis of OA. Participants with a report of OA were more likely to identify problems in all categories except report of mental health. When the potentially confounding variables were controlled, individuals with OA were more likely to report mental health problems. These findings suggest that individuals with OA are more likely to report lower levels of quality of life even while controlling confounding variables.

Keywords Behavioral risk factor surveillance system · Osteoarthritis · Quality of life · Mental health · Physical health

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Introduction

Osteoarthritis (OA) is the most common joint disease for middle aged and older individuals [1–3] and is frequently associated with reports of disability [4]. The prevalence of OA increases with chronological age, affecting nearly 75% of people over the age of 65 [5]. The incidence of OA also intensifies with age, specifically after the age of 40 [3]. Contributory factors correlated with the presence of OA include female gender [6, 7], elevated body mass index (BMI) [6], low socioeconomic status [8], ethnicity [9, 10], lower levels of education [11] and negative behavioral influences [9]; each associated with higher degrees of prevalence and impairment [9].

Osteoarthritis is characterized by joint pain, stiffness, an increased potential for muscular atrophy, and bony deformity [12–14]. Morphological features include changes in articular cartilage and subchondral bone [15]. Nonmorphological features may include the presence of depression, poor coping behaviors [16], and increased report of social and functional activity level changes [17]. Both morphological and nonmorphological phenomena contribute to substantial economic societal burden [18, 19].

Although it is well established that there is poor correlation between imaging studies such as radiographs, and severity of symptoms of OA [14, 20], diagnosis of OA is commonly based exclusively on imaging studies or joint inspection [14, 21, 22]. Visual inspection of joint morphological changes may or may not couple with patient report of symptoms, subsequently, a diagnosis of OA frequently produces higher numbers of patients who qualify for the diagnosis than actually exhibit clinical symptoms [14, 21, 22]. Furthermore,

OA has been associated with psychological factors such as learned helplessness, coping, mood, and self-efficacy [24–26], which often is independent of physical severity of symptoms. Consequently, the physical parameters used in diagnosis of OA, especially those used in diagnostic imaging, may or may not be adequate identifiers of actual report of severity [27, 28].

Although OA is commonly associated with functional changes and poorer quality of life, few studies have directly compared health related identifiers between those with and without OA, and no studies of which we are aware, provide samples that are representative of the population of individuals from the United States. In addition, because a diagnosis of OA represents a wide degree of functional impairments (from very little to significant), the chance exists that OA leads to little overall health related changes. The objective of our study was to compare the quality of life health indicators for patients with and without OA, while controlling for potentially confounding variables such as gender, age, race, BMI, and education, and income. By directly comparing the two populations while controlling for confounding variables, we may further understand the severity of disease processes associated with OA.

Materials and methods

Subjects/data

Data from the years 1996–2000 were obtained from the *Behavioral Risk Factor Surveillance System* (BRFSS) database. The BRFSS is a cross-sectional, random digit, telephone survey conducted by US state health departments (including the District of Columbia, Puerto Rico, and the US Virgin Islands) in cooperation with the Centers of Disease Control (CDC). The BRFSS includes a representative sample of noninstitutionalized individuals over the age of 18 and is administered in several languages, including English, Spanish, and Portuguese, depending on the state. The data are free to researchers at http://www.cdc.gov/brfss/maps/gis_data.htm.

The BRFSS includes three components of questions associated with personal behaviors that increase risk for the 10 leading causes of death in the United States. For this study, we focused on the optional modules, which consisted of questions on specific topics of interest such as OA. Questions are standardized and address specific topics relevant to health behaviors and conditions. For the years, 1996–2000, data were collected monthly by each state and were sent to CDC. At the completion of each year, the CDC performed appropriate data weighting and analytic methodologies [29] to verify appropriateness of the survey. Past findings have found the data were reliable, with similar estimates with other related health-response surveys [29]. The BRFSS has provided national prevalence estimates that have been used to monitor progress toward achieving health promotion and disease prevention goals [30] within the United States.

Variables

Osteoarthritis (as diagnosed by a physician) was the primary predictor variable selected. The variable included two components; (1) being told they had arthritis by a physician and (2) specification of OA versus another form. Outcomes variables selected included: (1) participation in any physical activity, (2) report of overall general health, (3) number of days physical (4) and mental (5) health was not good within the last month, (6) number of days poor health prevented one from performing physical activities, (7) report of pain, aching, stiffness or swelling, (8) limitations associated with joint stiffness, (9) symptoms present as least one month, and (10) level of physical activity. Other variables selected which served as potential confounders include sex, BMI, race/ethnicity, education, and annual household income.

Statistical analysis

All statistical analyses were performed using SPSS Version 12.0.1. Univariate statistics, including standard deviations and interquartiles were used to outline the frequency of the variables within the study. Bivariate analyses (Pearson chi square and *t*-tests) were performed on the outcomes variables with and without control of the potentially confounding variables of age, sex, ethnicity, income, education, and BMI. Lastly, logistic regression modeling was used to determine odds ratios for the dichotomous variables of likelihood of not exercising, report of poor general health, likelihood of report of joint stiffness, presence of symptoms, and level of inactivity, while controlling for the same variables of age, sex, ethnicity, income, education, and BMI. For all comparisons, statistical significance was assigned at the $P \leq 0.05$ level.

Results

This study included a cross sectional report of 37,695 individuals. The mean age was 58.4 years (±15.5) and

nearly 65% were female. Most of participants were White (83%) and held at minimum a high school education. Income was dispersed among several household income classifications representative of the United States population. Slightly over 16% (6,172) of the participants reported a diagnosis of OA. Table 1 outlines the univariate statistics.

Bivariate analyses without adjustments (Table 2) found significant differences in percentage who exercised within the last 30 days ($P < 0.0001$), report of general health ($P < 0.0001$), number of days physical health was not good within the last month ($P < 0.0001$), number of days mental health was not good within the last month ($P < 0.0001$), report of activity reduction associated with poor health ($P < 0.0001$), report of pain, aching, stiffness, or swelling ($P < 0.0001$), limitations associated with joint symptoms ($P < 0.0001$), symptoms present at least one month ($P < 0.0001$), and report of level of physical activity ($P < 0.0001$). OA resulted in an increased report of debilitating findings in all comparisons except mental health, in which the no report of OA group had higher levels of days where the mental health was not good. Additionally, although more individuals with OA reported participation in regular physical activity, a greater number indicated they were physically inactive.

All bivariate analyses with adjustments for confounding variables (Table 3) found significant differences. Comparisons of number of days physical health was not good ($P < 0.0001$) and report of activity reduction associated with poor health ($P < 0.0001$) were still significant upon adjustment of values. The number of days mental health was not good within the last month was also significant ($P < 0.0001$), but unlike the unadjusted values, individuals with OA were more likely to report mental health problems.

Logistic modeling (Table 4), adjusted for confounders, found significance in the likelihood of reporting poor general health (OR = 1.5; $P < 0.0001$), reporting limitations associated with joint symptoms (OR = 2.8; $P < 0.0001$), and reporting symptoms present at least one month (OR = 2.62; $P < 0.0001$), if diagnosed with OA. When adjusted, the likelihood of exercising within the last 30 days and report of physical inactivity was not significant.

Discussion

Osteoarthritis has long been associated with increased reports of disability in selected health related quality of life indicators. This study suggests that the health related quality of life indicators of report general health, number of days physical health was not good within the last month, report of activity reduction associated with poor health, identification of pain, aching, stiffness and swelling, limitations associated with joint symptoms, symptoms longevity, and level of activity are all more prominent in individuals with OA than individuals without OA. When potentially confounding variables such as gender, ethnicity/race, income, education, and BMI are controlled, the problems are still significantly more prevalent in individuals with OA than without.

Osteoarthritis is frequently diagnosed using imaging and clinical examination of joint-related changes [14, 21, 22]. A diagnosis of OA allows a wide degree of potential severity of impairment and potentially includes individuals who qualify for the diagnosis but have little subjective complaints of dysfunction. During comparative analyses in clinical studies, this factor is frequently overlooked, and subjects are typically only included that exhibit severe symptoms. Most researchers have included patients awaiting joint replacement when comparing quality of life parameters of health [31–35], populations that are likely to present with substantially greater impairment levels than a general population with OA. In all studies, evaluated, physical role and functional impairments were always associated with OA either during direct comparison or through associational exploration.

We feel our findings are an important contribution to the literature because we included all subjects diagnosed with OA, versus those awaiting joint replacement surgeries. This suggests that our sample is less debilitated and is more likely to represent the population of patients with OA within the United States. Because we controlled for potentially confounding variables, the findings are more applicable to the influence of OA on quality of life health indicators, versus the interactions of a number of contributory factors.

Our study found that individuals without OA reported similar yet significantly more days of mental health problems than the sample with OA. To our knowledge, we are the first to report this finding. We know of few studies that have directly compared mental health findings in patients with OA to a general population without OA or a comparative group with other disorders [31–35]. Some authors [31, 35] have reported no significant difference between patients with severe OA awaiting hip replacement and a general US population sample counterpart. Others [32] reported no mental health impairments when compared to subjects awaiting Prostatectomy. Salaffi et al. [34] found significant differences when comparing the mental health of patients with hip, knee, and hip and knee OA, with

Table 1 Univariate analysis including means and standard deviations

Variables	Category	Overall	
		%/Frequency mean/median	Std. Dev./25–75%
Sex	Female	64.57% (24,340)	
	Male	35.43% (13,355)	
	Missing	–	
Age		58.39	± 15.53
	Missing	–	
BMI	WTKG/(HTM*HTM)	30.73	± 15.89
	Missing	–	
Race	White	83.00% (31,288)	
	Black	7.12% (2,683)	
	Hispanic	5.20% (1,961)	
	Other	4.01% (1,512)	
	Missing	0.67% (251)	
Education	Never attended school or only kindergarten	0.21% (80)	
	Elementary	4.82% (1,817)	
	Some high school	8.92% (3,364)	
	High school graduate	31.72% (11,957)	
	Some college or technical	28.93% (10,904)	
	College graduate	25.19% (9,494)	
	Missing	0.21% (79)	
Income	Less than $10,000	7.41% (2,792)	
	$10.000–$14,999	7.23% (2,727)	
	$15,000–$19,999	8.47% (3,193)	
	$20,000–$24,999	10.18% (3,839)	
	$25,000–$34,999	13.84% (5,217)	
	$35,000–$49,999	15.83% (5,966)	
	$50,000–$74,999	12.68% (4,778)	
	$75,000 or more	10.90% (4,110)	
	Missing	13.46% (5,073)	
OA	Yes	16.37% (6,172)	
	No	83.63% (31,523)	
	Missing	–	
Exercise in past 30 days	Yes	66.87% (25,208)	
	No	33.03% (12,449)	
	Missing	0.10% (38)	
General health	Excellent	10.60% (3,994)	
	Very good	27.40% (10,327)	
	Good	30.66% (11,559)	
	Fair	19.54% (7,366)	
	Poor	11.51% (4,340)	
	Missing	0.29% (109)	
Number of days physical health not good		8.96 (3 median)	±11.17/0–15 (25–75%)
	Missing	3.23% (1,216)	
Number of days mental health not good		7.18 (2 median)	± 10.11/0–10 (25–75%)
	Missing	3.06% (1,154)	
Poor physical health		5.13 (0 median)	± 9.35/0–5 (25–75%)
	Missing	1.82% (685)	
Had pain, aching, stiffness, swelling	Yes	100% (37,695)	
	No	–	
	Missing	–	
Limited because of joint symptoms	Yes	38.64% (14,566)	
	No	60.84% (22,935)	
	Missing	0.51% (194)	
Symptoms present at least 1 month	Yes	58.92% (22,210)	
	No	40.11% (15,121)	
	Missing	0.97% (364)	
Level of physical activity	Physically inactive	33.03% (12,449)	
	Irregular activity	27.80% (10,480)	
	Regular activity	27.10% (10,215)	
	Regular and vigorous activity	11.97% (4,513)	
	Missing	0.10%(38)	

Table 2 Bivariate analysis (Pearson chi square and *t*-tests) of outcome variables

Outcomes	Osteoarthritis				*P*-value
	OA		No OA		
	% (Freq.)/mean*/ median*	SD/25–75%	% (Freq.)/mean*/ median*	SD/25–75%	
Exercise in past 30 days	62.06% (3,826)		67.90% (21,382)		<0.001
General health					
Excellent	6.26% (385)		11.48% (3,609)		<0.001
Very good	19.47% (1,198)		29.04% (9,129)		
Good	30.75% (1,892)		30.75% (9,667)		
Fair	25.70% (1,581)		18.40% (5,785)		
Poor	17.82% (1,096)		10.32% (3,244)		
Number of days physical health not* good	12.71 (mean) 7 (median 50%)	± 12.182 (25%) 30 (75%)	8.23 (mean)3 (median 50%)	± 10.81 0 (25%) 14 (75%)	<0.001
Number of days mental health not* good	7.12 (mean) 2 (median 50%)	± 10.56 0 (25%) 10 (75%)	7.20 (mean) 2 (median 50%)	± 10.01 0 (25%) 10 (75%)	<0.001
Poor physical health*	7.09 (mean) 0 (median 50%)	± 10.75 0 (25%) 10 (75%)	4.75 (mean) 0 (median 50%)	0 (25%) 4 (75%)	<0.001
Had pain, aching, Stiffness, swelling	100% (6,172)		100% (31,523)	–	
Limited because of joint symptoms	62.11% (3,817)		34.28% (10,749)		<0.001
Symptoms present at least 1 month	79.54% (4,860)		55.57% (17,350)		<0.001
Level of physical activity					
Physically inactive	37.94% (2,339)		32.10% (10,110)		<0.001
Irregular activity	25.58% (1,577)		28.27% (8,903)		
Regular activity	23.41% (1,443)		27.85% (8,772)		
Regular and vigorous activity	13.07% (806)		11.77% (3,707)		

Table 3 Bivariate analysis while controlling for confounding variables of gender, age, race, and education, and income

Outcomes	Osteoarthritis		
	OA	No OA	*P*-value
	Adj. mean	Adj. mean	
Number of days physical health not good	10.69 (10.41, 10.98)	8.18 (8.06, 8.30)	<0.001
Number of days mental health not good	7.65 (7.37, 7.93)	7.08 (6.96, 7.19)	<0.001
Poor physical health	6.31 (6.07, 6.56)	4.66 (4.56, 4.77)	<0.001

Table 4 Logistic modeling of selected variables adjusted for the confounders of gender, age, race, and education, and income

Outcomes	Osteoarthritis		
	OA (Odds ratio)	No OA (Odds ratio)	*P*-value
Exercise in past 30 days[a]	1.06 (0.99, 1.13)	1	0.105
General health[b]			
Fair/poor	1.50 (1.39, 1.61)	1	<0.001
Limited because of joint symptoms	2.80 (2.62, 2.99)	1	<0.001
Symptoms present at least 1 month	2.62 (2.43, 2.82)	1	<0.001
Level of physical activity [b]			
Physically inactive/irregular activity	−0.98 (0.92, 1.05)	1	0.539

[a] Interpreted as no exercise within the past 30 days (this variable was set as not to best interpret the odds ratio)

[b] The variables general health and level of physical activity were divided in two categories (0 and 1). Best quality was coded as 0 and worst quality 1. The values for best quality of life were used as reference

healthy controls, although the physical role, physical functioning, and pain aspects of the SF-36 were more compelling. Hirvonen et al. [33] reported similar findings when comparing patients with knee OA awaiting a total knee replacement against healthy controls. Their findings involved significant impairment associated with sleeping, depression, stress, and vitality.

A number of associational studies have reported mental health dysfunction in patients with OA [36–38]. These studies were not controlled for potentially confounding variables such as gender, ethnicity, or age [36–38], thus is probable that these covariates influenced mental health findings similarly to the inverse relationship exhibited in our study. The lack of control for confounders may explain why past studies have found conflicting results when mental health was evaluated. In our study, when confounding variables were controlled, individuals with OA reported more mental health-related problems than those without OA. This implies that OA is multidimensional and that demographic variables can positively or negatively influence report of symptoms. Specifically, gender [37] and formal education [34] appear to influence report of symptoms.

Although greater numbers of subjects with OA reported participation in exercise within the last 30 days, a larger number of subjects with OA acknowledged participation in regular, vigorous activity. Exercise has long been conveyed as beneficial for subjects with OA [4, 39, 40]. However, compliance with an exercise program in the presence of pain and continuing symptoms is frequently poor and participation declines over time [41]. Perhaps because compliance is poor, supervised exercise appears superior to self-regulated programs [40]. How much exercise is required is still debated and may depend on the body segment afflicted with OA. Variations of exercise or physical activity assists in reducing disability in elderly individuals [41], which may explain the increased levels of regular and vigorous activity identified by those with OA.

In our study, report of joint problems associated with stiffness was significant with and without adjustments. Joint related problems related with stiffness or instability have been frequently reported in the literature [23, 42, 43]. Joint related problems are multivariate and include elevated BMI [44], biomechanical changes associated with OA [45], and joint effusion [23]. In addition, there is a direct relationship between physical activity changes and joint stiffness, each influencing the other [45]. Although factors such as age increase the risk of joint related problems, when controlled, patients with OA were much more inclined to report problems.

There are limitations in our findings. With database research, we are limited to the variables at hand, including the self-report variable of osteoarthritis. Subsequently, diagnosis of OA is based explicitly on identification by the patient's report. Furthermore, the sample size included in this study, although representative of the United States is substantial and may improve the likelihood of significance. For example, although the mental health findings were significant for both controlled and noncontrolled analyses, the actual differences in mean values were quite small. Future studies should measure whether quality of life health identifiers are affected by imaging findings and whether there are physically manifested degrees of impairment in OA that remain undetectable.

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