Published in final edited form as:

Clin Rheumatol. 2017 May ; 36(5): 1083–1089. doi:10.1007/s10067-017-3564-2.

Knee Symptoms among Adults at Risk for Accelerated Knee Osteoarthritis: Data from the Osteoarthritis Initiative

Julie Davis, BS, Charles B. Eaton, MD, MS, Grace H. Lo, MD, MSc, Bing Lu, MD, DrPH, Lori Lyn Price, MAS, Timothy E. McAlindon, MD, MPH, Mary F. Barbe, PhD, and Jeffrey B. Driban, PhD

Abstract

Objective—To examine if adults who develop accelerated knee osteoarthritis (KOA) have greater knee symptoms with certain activities than those with or without incident common KOA.

Methods—We conducted a case-control study using data from baseline and the first 4 annual visits of the Osteoarthritis Initiative. Participants had no radiographic KOA at baseline (Kellgren-Lawrence [KL] <2). We classified 3 groups: 1) accelerated KOA: 1 knee developed advance-stage KOA (KL=3 or 4) within 48 months, 2) common KOA: 1 knee increased in radiographic severity (excluding those with accelerated KOA), and 3) No KOA: no change in radiographic severity by 48-months. We focused on individual items from the WOMAC pain/function subscales and KOOS pain/symptoms subscales. The index visit was a year before a person met the definition for accelerated, common, or no KOA. To examine group difference in knee symptoms we used ordinal logistic regression models for each symptom. Results are reported as odds ratios (OR) and 95% confidence intervals (CI).

Results—Individuals who developed accelerated KOA were more likely to report greater difficulty with lying down (OR=2.10, 95% CI=1.04 to 4.25), pain with straightening the knee fully (OR=2.04, 95% CI=1.08, 3.85), and pain walking (OR=2.49, 95% CI=1.38, 4.84) than adults who developed common KOA.

Conclusion—Individuals who develop accelerated KOA report greater symptoms with certain activities than those with common KOA. Our results may help identify individuals at risk for accelerated KOA or with early-stage accelerated KOA.

While knee osteoarthritis (KOA) is often conceptualized as a slowly progressive disorder, approximately 3.5% of adults at risk for KOA develop an accelerated form of KOA [1,2]. Accelerated KOA may be a unique subset of KOA defined by a knee progressing from normal appearance to advance-stage disease within 4 years and often in less than 12 months [3,2,4–6,1,7]. Individuals with incident accelerated KOA report greater difficulty with

Corresponding Author: Jeffrey Driban, PhD, ATC, CSCS, Division of Rheumatology, Tufts Medical Center, 800 Washington Street, Box 406, Boston, MA 02111, Phone: 617-636-7449; Fax: 617-636-1542; jeffrey.driban@tufts.edu.

Ethical standards

The OAI has been approved and meets all criteria for ethical standards regarding human and animal studies defined in the 1964 Declaration of Helsinki and all amendments made after. Institutional review boards at each OAI clinical site and the OAI coordinating center (University of California, San Francisco) approved the OAI study. All participants provided informed consent prior to participation.

activities of daily living and greater knee pain than those with incident common KOA [6]. Additionally, adults with incident KOA, especially those with accelerated KOA, are more likely to report greater knee symptoms the year before they develop radiographic evidence of KOA [6,8,9].

It is unclear if adults who develop accelerated KOA experience symptoms differently than those who develop common KOA. Hence, at one year before presenting with accelerated or common KOA, we examined if adults who develop accelerated KOA had greater knee symptoms with certain activities than those with or without common KOA. If adults with accelerated KOA experience differing symptoms than those with common KOA, it would help identify individuals at risk for accelerated KOA or with early-stage accelerated KOA.

PATIENTS AND METHODS

To characterize knee symptoms among people who develop accelerated KOA, we identified individuals using data from baseline and the first 4 annual follow-up visits of the Osteoarthritis Initiative (OAI). The OAI is a multicenter cohort study of 4,796 adults with or at risk for symptomatic KOA. Four clinical sites (Memorial Hospital of Rhode Island, The Ohio State University, University of Maryland and Johns Hopkins University, and the University of Pittsburgh) recruited participants between February 2004 and May 2006. OAI data are available for public access [10]. Institutional review boards at each OAI clinical site and the OAI coordinating center (University of California, San Francisco) approved the OAI study. All participants provided informed consent prior to participation.

Participant selection

We identified three groups of participants among those with no baseline radiographic KOA (Kellgren-Lawrence [KL] grade <2) in either knee (n = 1,930): 1) accelerated KOA: at least one knee progressed to advance-stage disease (KL grade 3 or 4; definite osteophyte and definite joint space narrowing) within 48 months, 2) common KOA: at least one knee increased in radiographic scoring within 48 months (excluding those with accelerated KOA, progression of osteophyte) and 3) no KOA: no change in KL grade by 48 months [2]. We excluded 364 individuals (19%) because missing radiographic data made it impossible to determine group assignment among those with common or no KOA. The final numbers of participants in each group were 54 adults with accelerated KOA, 187 adults with common KOA and 1,325 adults with no radiographic KOA.

Index visit and observation period

For individuals with accelerated or common KOA, the index visit was defined as the visit a year before a person met the definition for accelerated or common KOA. The index visit for those with no KOA was the second to last visit (36 months). Therefore, the index visit for those with accelerated or common KOA could have occurred at baseline, 12-, 24-, or 36-month visit. We selected the visit before people presented with radiographic evidence for accelerated or common KOA because it is when these individuals are most likely to report greater knee pain severity [6,8,9]. Specifically, people who develop incident KOA start reporting greater knee pain 2 to 3 years before developing radiographic KOA [9], symptoms

peak the year before incident radiographic KOA, and then stabilize or diminish in severity after the onset of radiographic disease [6,8,9]. It would be informative to understand the symptoms among people who develop accelerated KOA before they develop advance-stage disease.

Knee radiographs

Study staff obtained bilateral weight-bearing, fixed-flexion posteroanterior knee radiographs at baseline and the first 4 annual follow-up visits. Blinded central readers recorded KL grades (0 to 4). The intrarater reliability agreement for these readings was good (weighted κ = 0.70–0.80). These data are publicly available (files: kXR_SQ_BU##_SAS [versions 0.6, 1.6, 3.5, 5.5, and 6.3]) [10].

Knee Symptoms

To characterize knee symptoms, we used items from the WOMAC pain and function subscales as well as the KOOS pain and symptoms subscales. We took 5 items from WOMAC pain, 17 items from WOMAC function, 2 items from KOOS pain and 5 items from KOOS symptoms (Table 1). The questions asked were knee-specific (right or left knee) and based on a Likert-type scale. We eliminated one WOMAC function item (difficulty getting in/out of bathtub) and one KOOS pain item (pain twisting/pivoting on knee) from our analyses because >20% of the participants were missing responses.

To assess the frequency of knee symptoms we used participant responses to specific questions [10]. Participants were asked: “During the past 30 days, have you limited your activities because of pain, aching, or stiffness in either knee?” If yes, the participant answered the follow-up question: “During the past 30 days, how many days did you limit your activities because of pain, aching, or stiffness? If you are unsure, please make your best guess.” The participants then gave a number 1 to 30 to indicate the number of days they limited their activity [10].

Additionally, the participants answered the question: “During the past 12 months, have you had pain, aching, or stiffness in or around your right knee on most days for at least one month? By most days, we mean more than half the days of a month.” If the participant answered yes, they answered a follow-up question: “How many months in the past 12 months have you had knee pain, aching, or stiffness on most days? If you are unsure, please make your best guess.” [10] The participant could answer a number between 1 and 12, indicative of the number of months. The same questions were repeated for the left knee.

Participants were also given the question: “How often do you have pain in your right knee?” [10] They could choose from 5 response options: never, monthly, weekly, daily, and always. The same question was then given for the left knee.

Pain Medication

Participants were asked 2 questions regarding their use of pain medications [10]. The first question asked: “Did you take any pain medication today? Include both prescription and over-the-counter medications for any type of pain.” The second question was a 2-part

question. Participants were first asked: “During the past 12 months, have you used medication for knee pain, aching, or stiffness? Include both prescription and over-the-counter medications.” If they answered yes, they were asked the follow-up question: “During the past 12 months, have you used medication for pain, aching, or stiffness in your knees on most days for at least one month?” [10]

Statistical Analysis

Initially, we calculated descriptive statistics and explored the distribution of responses for each WOMAC and KOOS item. Since the majority of responses were “none” we converted each KOOS pain and WOMAC item to three levels: none (score = 0), mild (score = 1), moderate to extreme (score = 2 to 4). The 5 KOOS symptom items failed to meet the proportional odds assumption for ordinal logistic regression. Meeting the proportional odds assumption indicates that the association between the dependent variable (KOA group) and the independent variable (for example, difficulty going down stairs) as measured by an odds ratio is constant across the levels of the independent variable. In that case, a single odds ratio will adequately represent the association. If, however, the odds ratio is close to 1 for lower levels of difficulty and high for upper levels of difficulty, presenting a single odds ratio can be misleading. To overcome this challenge, we reduced the KOOS symptom items to a dichotomous response (never, rarely, or sometimes versus often or always). The three other questions that inquired about frequency of knee symptoms also failed to meet the proportional odds assumption for ordinal logistic regression and therefore we reduced the data until the assumption was met. If we failed to meet the assumption, we converted the response to a dichotomous variable. First, we examined the number of days with symptoms that limited activities in the past 30 days with four levels (0 days, 1 to 7 days, 8 to 14 days, and 15 to 30 days). The other two frequency questions were collapsed to a dichotomous response: months with frequent knee pain (0 to 6 months versus 7 to 12 months) and frequency of knee pain (never, monthly, or weekly versus daily or always).

To examine differences in knee symptoms among the three groups, we initially performed Chi-square tests. As post hoc analyses for statistically significant results, we examined differences in knee symptoms among the 3 groups (predictors) with 3 ordinal logistic regression models (accelerated KOA versus no KOA, accelerated KOA versus common KOA, and common KOA versus no KOA) for each symptom (3- or 4-level outcomes, see Tables 1). To examine differences in KOOS symptoms and the 2 dichotomous frequency items we used 3 logistic regression models.

Any statistically significant differences between those who develop accelerated or common KOA were followed up with a sensitivity analysis. Specifically, we focused on the 32 participants who developed accelerated KOA in 12 months (e.g., baseline KL = 1, index visit KL = 1, and subsequent visit KL = 3). We also conducted a secondary analysis, which replicated the models comparing accelerated and common KOA but adjusted for index visit (0, 12, 24, or 36 months). We were unable to perform this secondary analysis with the models that included the no KOA group because everyone with no KOA had an index visit of 36-months.

Based on these analyses, we report odds ratios (OR) and 95% confidence intervals (CI). Statistically significant findings were based on $p < 0.05$.

RESULTS

A detailed description of baseline characteristics of individuals with accelerated KOA, common KOA, and no KOA has been previously reported [1]. In brief, individuals with accelerated KOA tended to be older (62 years) and have greater body mass index (29 kg/m^2) than those with common KOA (58 years, 28 kg/m^2) or no KOA (59 years, 27 kg/m^2). The majority of each group was female (57 to 65%) and white (82 to 87%)[1]. Adults with incident accelerated KOA had an index visit at OAI baseline ($n = 14$, 26%), 12-months ($n = 10$, 19%), 24-months ($n = 20$, 37%), and 36-months ($n = 10$, 19%). Adults with incident common KOA had an index visit at the OAI baseline ($n = 93$, 50%), 12-months ($n = 40$, 21%), 24-months ($n = 29$, 16%), and 36-months ($n = 25$, 13%). By design, everyone with no KOA had an index visit at 36-months ($n = 1325$). There was no difference in the number of adults who reported taking any pain medication on the day of the index visit among those with accelerated KOA ($n = 9$, 17%), common KOA ($n = 20$, 11%), no KOA ($n = 127$, 10%; $p = 0.24$). However, individuals who developed accelerated KOA ($n = 17$, 31%) or common KOA ($n = 40$, 21%) were more likely to report use of medication for pain, aching or stiffness more than half the days of a month in the 12 months prior to the index visit compared with those with no KOA ($n = 128$, 10%, $p < 0.0001$). No participants in the study had a total knee replacement during the observation period.

Severity of knee pain and functional limitations

Individuals who develop accelerated or common KOA within the next 12 months reported greater symptoms in most activities than those with no KOA (Table 1). Those who developed accelerated KOA were more likely to report greater difficulty with lying down, pain with straightening the knee, and pain walking compared with adults who developed common KOA (Table 1). Our sensitivity analyses among 32 individuals who developed accelerated KOA in 12 months led to similar results with attenuated odds ratios: difficulty with lying down (OR = 2.10, 95% CI = 0.89, 4.92), pain with straightening the knee (OR = 1.58, 95% CI = 0.71, 3.52), and pain walking (OR = 2.19, 95% CI = 1.06, 4.52). Our secondary analyses, which adjusted for index visit, also led to similar results to our primary findings (odds ratios changed $\leq 10\%$). The only exception was difficulty getting out of bed, which increased from an OR = 1.51 in the primary analysis to an OR = 1.68, 95% CI = 0.88, 3.22).

Frequency of knee symptoms

Individuals who developed accelerated or common KOA within the next 12 months reported more frequent knee swelling: accelerated KOA vs No KOA (reference) OR = 9.09 (95% CI = 3.88, 21.26) and common KOA vs No KOA (reference) OR = 3.25 (95% CI = 1.57 to 6.72). An individual who developed accelerated KOA (15%) was 2.80 times (95% CI = 1.06, 7.36) more likely to have knee swelling often or always compared with those who developed common KOA (6%). There were no other associations between KOOS symptoms and those with incident disease. Furthermore, only 1 to 11% of any group reported often or always

having crepitus, knee catching when moving, or inability to straighten or bend the knee. Our secondary analyses, which adjusted for index visit, led to similar results to our primary findings.

Adults who developed accelerated KOA (45%) were more likely to report knee pain as daily or always than those with no KOA (17%; OR = 4.09, 95% CI = 2.33, 2.84) and those who developed common KOA (29%; OR = 2.05, 95% CI = 1.09, 3.83). Furthermore, individuals who developed accelerated KOA limited their activities because of pain, aching, or stiffness in either knee on more days than those with no KOA (OR = 2.55, 95% CI = 1.37, 4.76) but not those who developed common KOA (OR = 1.24, 95% CI = 0.63, 2.46). Finally, we found no statistically significant association between how many months in the past 12 months a person had knee pain, aching, or stiffness on most days and accelerated (7 to 12 months: 26%), common (7 to 12 months: 17%) or no KOA (15%; chi-square test p value = 0.09). Our secondary analyses, which adjusted for index visit, led to similar results to our primary findings.

DISCUSSION

Symptoms are common in the year prior to the development of accelerated or common KOA. Individuals who develop accelerated KOA may have greater symptoms than those who develop common KOA because of more frequent knee pain or swelling as well as difficulty or pain with certain activities of daily living: difficulty with lying in bed, pain with straightening the knee fully, or pain walking. Furthermore, people who develop accelerated KOA may report more difficulty going down stairs and greater pain with bending the knee fully, sitting or lying down, or standing; however, these results were not statistically significant. Collectively, these symptoms may help clinicians recognize adults over 45 years of age who are at risk for incident accelerated KOA or with early-stage accelerated KOA. When a patient reports these frequent or severe knee symptoms it should be an indicator that the patient may need to be evaluated more frequently and targeted for therapeutic interventions (e.g., physical rehabilitation) that actively address these functional limitations and symptoms.

Our findings complement prior studies indicating pain precedes radiographic disease in those with accelerated or common KOA [6,9]. Prodromal symptoms may start 2 or 3 years before incident radiographic KOA [9], peak at one year before the onset of incident radiographic KOA, and then stabilize [8]. Many adults will report swelling and pain when walking one year before incident radiographic KOA [9]. Our findings agreed with these observations and expanded upon them by demonstrating that adults who develop accelerated KOA report more frequent knee swelling than those who develop common KOA. An additional study found that frequency of pain increased in the years preceding incident radiographic KOA [8]. While our results complement these findings, the prior study also showed that adults reported significant increases of crepitus leading up to incident radiographic KOA whereas we did not find this to be significant [8]. The lack of statistical significance in our study may be related to our more stringent definition of crepitus (often or always versus sometimes or more often). Collectively, these studies highlight that knee symptoms often precede the development of radiographic KOA.

We previously found that individuals with accelerated KOA report greater knee pain (WOMAC pain) and greater knee-specific disability (WOMAC function) compared with those with common KOA, even before the onset of radiographic disease [6]. Furthermore, baseline total WOMAC score (averaged from both knees) helped predict who would develop accelerated KOA in the Osteoarthritis Initiative and Multicenter Osteoarthritis Study [11]. When looking at specific symptoms, we found that people who developed accelerated KOA were more likely to report a greater symptom severity compared with those who developed common KOA in 3 symptoms: difficulty lying down, pain straightening the knee fully, and pain walking. Furthermore, we observed a trend suggesting people who develop accelerated KOA may report more difficulty going down stairs and greater pain with bending the knee fully, sitting or lying down, or standing. The pain straightening the knee fully and standing may contribute to pain walking and difficulty going down stairs. The greater symptoms with a diverse range of activities may be a sign that a person has been experiencing symptoms leading up to this evaluation. In two prior studies in the OAI the authors noted that participants first reported pain or difficulty with more demanding tasks (e.g., twisting/pivoting) and then later developed pain or difficulty with less demanding activities (e.g., standing, nonweight-bearing activities) [9,12]. Our results reinforce these findings by demonstrating that by 12 months before the onset of radiographic KOA both groups are more likely to report greater knee symptoms with high and low demanding tasks, which may be a sign that the person has had some symptoms leading up to this visit and are increasingly at higher risk for KOA or has early-stage KOA. This may be particularly true for accelerated KOA since adults in this group were more likely to report a greater severity of symptoms than even those who develop common KOA.

Besides symptom severity, individuals who developed accelerated KOA were more likely to report frequent knee swelling and knee pain on a daily or constant basis. In contrast, there was no difference between accelerated or common KOA in regards to the months with frequent knee pain nor more days with limitations. These two findings may indicate that the onset of frequent knee pain developed within a few weeks or months prior to the index visit. The presence of frequent knee pain and more severe knee symptoms are concerning because these clinical findings are associated with faster cartilage loss and radiographic progression [13,14,6] and may predispose them to a new knee injury, which is a risk factor for accelerated KOA [15]. Hence, clinicians should be concerned about adults over 45 years of age without radiographic KOA who report frequent symptoms or severe knee symptoms with both high and low demanding activities because it may be an early sign of individuals at risk for incident accelerated KOA or with early-stage accelerated KOA. Early recognition of these frequent or severe symptoms may enable clinicians to implement early interventions before the joint develops advance-stage disease, which may be more challenging to treat nonoperatively. Referring a patient for physical rehabilitation to actively address functional limitations and symptoms will improve the patient's symptoms, quality of life, and function as well as reduce the risk of knee injury, which may be a catalyst for accelerated KOA [15].

Only 10 to 17% of participants, regardless of group, reported using pain medication on the day of the index visit. However, the use of pain medication in the year before the index visit showed greater frequency in both accelerated and common KOA groups. Almost 1 in 3 adults who developed accelerated KOA and 1 in 5 adults who develop common KOA

reported frequent use of pain medication in the year prior to the index visit. This may simply reflect that these two groups are reporting greater symptoms before developing radiographic KOA and seeking to manage their symptoms during the year. It is unknown if the frequent use of analgesics in the year leading up to incident radiographic KOA may contribute to incident accelerated or common KOA because other studies have inconclusive results [16,17]. Since only a small percentage of participants took pain medication on the day of the index visit it is unlikely to influence the current findings. However, if the use of pain medication during the prior year affected the results, it would likely cause us to under estimate the frequency and severity knee symptoms among the incident KOA groups because more people in the incident KOA groups reported using frequent pain medication.

While our study offers important findings about knee symptoms among those with accelerated KOA, we acknowledge that this study has limitations. With a larger sample size, it may be more efficient in revealing complex interactions between the factors explored. Despite our limited sample size, we were able to characterize knee symptom differences among those with accelerated or common KOA. A limitation of these findings is that while these symptoms may statistically relate to incident accelerated KOA, these symptoms alone could lead to substantial misclassification when trying to identify a patient at risk for accelerated KOA or with early-stage KOA. It will be informative to see if using several specific symptoms, rather than total WOMAC pain or function scores, enable more accurate classification or prediction of people at risk for accelerated KOA.

In conclusion, individuals who develop accelerated KOA report greater symptoms with certain activities than those with common KOA. Furthermore, individuals with accelerated KOA reported more frequent knee swelling and pain than adults who develop common KOA. Our results may help identify individuals at risk for accelerated KOA or with early-stage accelerated KOA. Clinicians who suspect a patient is at high risk for accelerated KOA may want to be more proactive by initiating early interventions (e.g., physical rehabilitation) to address reported symptoms and functional limitations and examining the patient more frequently to monitor disease status.

Acknowledgments

Grant Support: These analyses were financially supported by the National Institute of Arthritis and Musculoskeletal and Skin Diseases of the National Institutes of Health under Award Number R01 AR065977. The OAI is a public-private partnership comprised of five contracts (N01-AR-2-2258; N01-AR-2-2259; N01-AR-2-2260; N01-AR-2-2261; N01-AR-2-2262) funded by the National Institutes of Health, a branch of the Department of Health and Human Services, and conducted by the OAI Study Investigators. Private funding partners include Merck Research Laboratories; Novartis Pharmaceuticals Corporation, GlaxoSmithKline; and Pfizer, Inc. Private sector funding for the OAI is managed by the Foundation for the National Institutes of Health. This manuscript was prepared using an OAI public use data set and does not necessarily reflect the opinions or views of the OAI investigators, the NIH, or the private funding partners. This work was also supported in part by the Houston Veterans Affairs Health Services Research and Development Center of Excellence (HFP90-020). The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs. The authors have no other conflicts of interest with regard to this work.

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Table 1

Adults at Risk for Accelerated Knee Osteoarthritis (KOA) Are More Likely to Report Greater Knee Symptoms

Variable	No KOA			Common KOA			Accelerated KOA			AKOA vs No KOA OR (95% CI)			AKOA vs KOA OR (95% CI)		
	None score=0	Mild score=1	Moderate-Extreme score = 2 to 4	None score=0	Mild score=1	Moderate-Extreme score = 2 to 4	None score=0	Mild score=1	Moderate-Extreme score=2 to 4	AKOA vs No KOA OR (95% CI)			AKOA vs KOA OR (95% CI)		
Difficulty: down stairs	964 (74%)	240 (18%)	101 (8%)	114 (61%)	52 (28%)	20 (11%)	27 (51%)	13 (25%)	13 (25%)	3.02 (1.79, 5.09)			1.73 (1.26, 2.37)		1.77 (0.99, 3.18)
Difficulty: up stairs	904 (69%)	267 (20%)	134 (10%)	104 (56%)	53 (15%)	29 (16%)	26 (49%)	16 (30%)	11 (21%)	2.32 (1.38, 3.92)			1.74 (1.29, 2.36)		1.34 (0.75, 2.40)
Difficulty: stand from sitting	930 (71%)	262 (20%)	116 (9%)	107 (57%)	45 (24%)	35 (19%)	26 (48%)	16 (30%)	12 (22%)	2.73 (1.63, 4.57)			1.94 (1.44, 2.63)		1.38 (0.78, 2.45)
Difficulty: standing	1121 (86%)	142 (11%)	46 (4%)	142 (76%)	31 (17%)	14 (7%)	37 (69%)	13 (24%)	4 (7%)	2.68 (1.49, 4.83)			1.91 (1.33, 2.76)		1.39 (0.72, 2.69)
Difficulty: bending	856 (67%)	254 (20%)	162 (13%)	94 (53%)	46 (26%)	37 (21%)	27 (53%)	11 (22%)	13 (25%)	1.97 (1.16, 3.36)			1.82 (1.34, 2.46)		1.09 (0.60, 1.97)
Difficulty: walking on flat surface	1131 (86%)	138 (11%)	39 (3%)	147 (79%)	32 (17%)	8 (4%)	39 (72%)	12 (22%)	3 (6%)	2.41 (1.31, 4.45)			1.72 (1.18, 2.53)		1.41 (0.71, 2.79)
Difficulty: getting in car/out of car	972 (74%)	232 (18%)	102 (8%)	112 (60%)	52 (28%)	23 (12%)	31 (57%)	13 (24%)	10 (19%)	2.27 (1.33, 3.86)			1.90 (1.39, 2.59)		1.20 (0.67, 2.17)
Difficulty: shopping	1122 (87%)	119 (9%)	54 (4%)	143 (77%)	30 (16%)	13 (7%)	38 (73%)	12 (23%)	2 (4%)	2.23 (1.18, 4.22)			1.93 (1.33, 2.81)		1.16 (0.57, 2.33)
Difficulty: socks on	1115 (85%)	131 (10%)	63 (5%)	154 (82%)	23 (12%)	10 (5%)	43 (80%)	6 (11%)	5 (9%)	1.51 (0.77, 2.96)			1.22 (0.82, 1.84)		1.24 (0.58, 2.63)
Difficulty: getting out of bed	1067 (82%)	162 (12%)	79 (6%)	133 (72%)	37 (20%)	16 (9%)	35 (65%)	9 (17%)	10 (19%)	2.59 (1.49, 4.53)			1.73 (1.23, 2.44)		1.51 (0.81, 2.81)
Difficulty: socks off	1138 (87%)	114 (9%)	57 (4%)	154 (82%)	27 (14%)	6 (3%)	44 (81%)	7 (13%)	3 (6%)	1.50 (0.74, 3.03)			1.38 (0.92, 2.08)		1.09 (0.50, 2.37)
Difficulty: lying in bed	1174 (90%)	94 (7%)	41 (3%)	157 (84%)	23 (12%)	7 (4%)	39 (72%)	9 (17%)	6 (11%)	3.40 (1.84, 6.28)			1.64 (1.07, 2.52)		2.10 (1.04, 4.25)
Difficulty: sitting	1147 (88%)	122 (9%)	39 (3%)	147 (79%)	32 (17%)	8 (4%)	43 (80%)	8 (15%)	3 (6%)	1.83 (0.93, 3.60)			1.91 (1.30, 2.81)		0.96 (0.46, 2.02)
Difficulty: on/off toilet	1098 (84%)	153 (12%)	57 (4%)	145 (78%)	31 (17%)	11 (6%)	39 (72%)	10 (19%)	5 (9%)	2.03 (1.11, 3.73)			1.51 (1.04, 2.18)		1.36 (0.69, 2.67)
Difficulty: heavy chores	962 (77%)	179 (14%)	104 (8%)	121 (70%)	35 (20%)	17 (10%)	32 (62%)	11 (21%)	9 (17%)	2.16 (1.24, 3.77)			1.42 (1.01, 2.02)		1.53 (0.82, 2.87)
Difficulty: light chores	1129 (86%)	143 (11%)	34 (3%)	149 (81%)	31 (17%)	5 (3%)	43 (80%)	7 (13%)	4 (7%)	1.70 (0.87, 3.32)			1.52 (1.02, 2.26)		1.12 (0.53, 2.36)
Pain: straightening knee fully	1100 (84%)	151 (12%)	57 (4%)	143 (76%)	34 (18%)	10 (5%)	34 (63%)	12 (22%)	8 (15%)	3.22 (1.85, 5.62)			1.60 (1.11, 2.31)		2.04 (1.08, 3.85)
Pain: bending knee fully	962 (74%)	235 (18%)	110 (8%)	121 (65%)	42 (23%)	23 (12%)	29 (54%)	12 (22%)	13 (24%)	2.66 (1.58, 4.48)			1.50 (1.09, 2.07)		1.75 (0.97, 3.15)
Pain: walking	1013 (77%)	222 (17%)	74 (6%)	127 (68%)	47 (25%)	13 (7%)	27 (50%)	14 (26%)	13 (24%)	3.88 (2.31, 6.51)			1.58 (1.13, 2.19)		2.49 (1.38, 4.84)
Pain: up/down stairs	775 (59%)	342 (26%)	190 (15%)	86 (46%)	60 (32%)	40 (22%)	22 (42%)	12 (23%)	19 (36%)	2.53 (1.52, 4.20)			1.67 (1.25, 2.23)		1.51 (0.86, 2.66)

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Variable	No KOA			Common KOA				Accelerated KOA				AKOA vs No KOA OR (95% CI)	AKOA vs KOA OR (95% CI)
	None score=0	Mild score=1	Moderate-Extreme score = 2 to 4	None score=0	Mild score=1	Moderate-Extreme score = 2 to 4	None score=0	Mild score=1	Moderate-Extreme score=2 to 4	AKOA vs No KOA OR (95% CI)	Moderate-Extreme score=2 to 4		
Pain: in bed	1152 (88%)	99 (8%)	58 (4%)	147 (79%)	26 (14%)	14 (7%)	43 (80%)	6 (11%)	5 (9%)	1.91 (0.97, 3.75)	1.98 (1.34, 2.91)	1.98 (1.34, 2.91)	0.97 (0.46, 2.03)
Pain: sit or lie down	1111 (85%)	152 (12%)	45 (3%)	144 (77%)	31 (17%)	12 (6%)	35 (65%)	13 (24%)	6 (11%)	3.12 (1.77, 5.50)	1.70 (1.17, 2.46)	1.70 (1.17, 2.46)	1.82 (0.96, 3.46)
Pain: standing	1038 (79%)	203 (16%)	66 (5%)	129 (69%)	47 (25%)	11 (6%)	32 (59%)	13 (24%)	9 (17%)	2.84 (1.65, 4.87)	1.68 (1.20, 2.35)	1.68 (1.20, 2.35)	1.72 (0.94, 3.15)

Difficulty with tub and pain with twisting was omitted from the analyses because > 20% was missing.

All variables had statistically significant chi-square p-values with the exception of difficulty taking socks on/off.