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Intermittent and constant pain and physical function or performance in men and women with knee osteoarthritis: data from the osteoarthritis initiative

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Abstract

Severe constant and intermittent knee pain are associated with “unacceptable” symptoms in older adults with osteoarthritis (OA) [22]. We hypothesized that constant and intermittent pain would be independently related to physical function, with intermittent knee pain being a better predictor of future declines in physical function in early symptomatic knee OA. This study included men ($n = 189$) and women ($n = 133$) with radiographic, unilateral knee OA, observed using data from the Osteoarthritis Initiative (OAI). Pain types were measured using the Intermittent and Constant Osteoarthritis Pain (ICOAP) scale. Physical function was measured using the Western Ontario and McMaster Universities Arthritis Index (WOMAC-PF) and Knee Injury and Osteoarthritis Outcome Score (KOOS-FSR) and physical performance tests. High baseline intermittent ($B = 0.277$; $p = 0.001$) and constant ($B = 0.252$; $p = 0.001$) knee pain were related to poor WOMAC-PF. Increased constant ($B = 0.484$; $p = 0.001$) and intermittent ($B = 0.104$; $p = 0.040$) pain were related to 2-year decreased WOMAC-PF. High baseline intermittent knee pain predicted poor KOOS-FSR at year 2 ($B = -0.357$; $p = 0.016$). Increased constant pain was related to decreased chair stand test performance over 2 years in women ($B = 0.077$; $p = 0.001$). High baseline intermittent pain was related to poor performance on repeated chair stands ($B = 0.035$; $p = 0.021$), while baseline constant pain was related to poor 400-m walk performance in women ($B = 0.636$; $p = 0.047$). Intermittent and constant knee pain were independent factors in self-perceived physical function and were important predictors of future limitations in physical function. Identifying

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Ethical standards

The study was approved by the participating hospital’s ethics boards and has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its amendments. All participating individuals gave their informed consent prior to their inclusion in the study.

Disclosures

None.

intermittent and constant pain in early symptomatic OA may allow patients to adopt strategies to prevent worsening pain and future declines in physical function.

Keywords

Aging; Arthritis; Knee; Musculoskeletal diseases; Pain; Physical activity

Introduction

Osteoarthritis (OA) is a degenerative disease of the joint that reduces quality of life due to pain and immobility and ranks equal to heart disease as a major cause of disability [7]. Pain related to OA is a main predictor of decreased physical activity in the elderly [33]. Worsening knee symptoms and physical inactivity form a cycle leading to reduced physical function and interference with activities of daily living [28]. Furthermore, avoidance of physical activity leads to the deterioration of muscle strength, which has been associated with disease progression [31]. As such, an understanding of the different manifestations of joint pain in individuals with OA may help identify how pain leads to decreased function and inactivity.

Knee pain that is elicited during movement is associated with worse self-reported physical function [11]. Sensitivity to pain during physical activity was related to self-reported pain and performance on a walking task, and sensitivity to physical activity mediated the relationship between catastrophizing and pain in individuals with OA [46]. In interviews with these patients, it was identified that musculoskeletal pain can be dull and constant which increases over time or intermittent and variable in intensity [16 , 18]. Aching pain was described as “background” pain whereas severe intermittent pain, especially when unpredictable, had a greater impact on quality of life. Intermittent pain was identified as more emotionally draining and was associated with avoidance of social and recreational activities. Importantly, both pain types are associated with sleep disturbances, greater fatigue, disability, and depressed or anxious mood. Thus, episodic knee pain associated with activity may be a main predictor of declines in physical function in those with OA. To address this, the Intermittent and Constant Osteoarthritis Pain scale (ICOAP) was developed as a 12-item self-report questionnaire to separately quantify intermittent and constant OA pain [17].

Intermittent pain is cited as the most distressing and may have the greatest impact on an individual's physical function and quality of life [16 , 17]. Despite the emphasis placed on separating pain by type, research has not yet investigated how intermittent and constant pain independently relate to physical function and performance. Therefore, the aim of this study was to investigate whether constant and intermittent knee pain are independently related to decreased (1) objective physical performance and (2) self-reported physical function in men and women with radiographic, unilateral knee OA. We investigated cross-sectional relationships between baseline pain types and physical function and longitudinally relationships between 2-year changes in pain and physical function. We also investigated whether baseline pain can predict physical function at year 2 follow-up. We separated our

analyses based on sex, as women report pain secondary to knee OA more often than men, perhaps due to differing pain experiences between sexes [27 , 42].

We hypothesized that constant and intermittent pain would be independently related to physical function, but that intermittent knee pain would be a better predictor of future declines in physical function for patients with early symptomatic knee OA. Strategies focused on avoiding episodic pain may differ from those used to manage constant knee pain. If intermittent pain is a predictor of decreased physical function in early OA, coping strategies to mitigate this pain should be devised to help individuals remain physically active and prevent future limitations in physical function.

Materials and methods

Analyses were conducted based on data from enrollment and 4- and 6-year follow-up visits of the Osteoarthritis Initiative (OAI) study. The OAI is an ongoing longitudinal cohort study observing men and women between the ages of 45–79 who are at risk for or have knee OA. It is a multicenter study which began in 2004 with recruitment and annual interviews at four sites in the USA. Data are collected and then released publicly as they become available (<http://www.oai.ucsf.edu/>). The total study sample is $n = 4796$. Inclusion and exclusion criteria for the OAI have been previously documented [5].

Study sample

For the purpose of this study, year 4 follow-up (OAI prefix V06) data were considered baseline as this was the first time point at which the ICOAP questionnaire was administered. Similarly, we considered year 6 follow-up (OAI prefix V08) as year 2 after baseline ICOAP administration. Our analysis included men and women with unilateral radiographic knee OA, defined as a Kellgren/Lawrence (K/L) grade of 2, 3, or 4 in one knee and a K/L grade of 0 or 1 in the contralateral knee at year 4 follow-up. Participants without radiographic knee OA (K/L grade of 1 or lesser in both knees) or with bilateral radiographic knee OA (K/L grade of 2 or greater in both knees) were excluded. Individuals with unilateral knee OA were investigated because the ICOAP is a leg-specific measure of pain, and the relationships of each leg's pain scores with physical function would need to be investigated in individuals with bilateral OA. This was beyond the scope of the present study. Only participants with complete data for each variable at year 4 and year 6 follow-up were included. Figure 1 is a flow diagram of the process for participant inclusion. There were 322 total eligible participants, separated as men ($n = 189$) and women ($n = 133$). Variables including the ICOAP subscores, WOMAC Physical Function (WOMAC-PF), knee symptom frequency, K/L grade, and knee extension maximum force were specific to the knee with radiographic OA. As the OAI database contains scores for each participant's knee, we used only the scores corresponding to the knee with unilateral OA in our analyses.

Intermittent and Constant Osteoarthritis Pain

The ICOAP self-report questionnaire was designed to assess pain in individuals with hip or knee OA by taking into account constant and intermittent pain experiences. Data produced by the ICOAP demonstrates high retest reliability and high internal consistency and was

validated through comparison with the WOMAC and KOOS pain subscales [20]. ICOAP data has exhibited good responsiveness for changes in pain following a clinical trial using a physical therapy intervention [15]. The 12-question pain scale consists of two subscales: five questions for constant pain and seven questions for intermittent pain. Questions for each pain type assess pain intensity, affect on sleep, impact on quality of life, extent to which pain “worries or upsets,” and extent to which it “frustrates or annoys.” Additionally, questions assess the predictability and frequency of intermittent pain. Each question is scored from 0 to 4 with 4 indicating more extreme or more frequent symptoms. Each subscale is summed (constant/20; intermittent/24) and transformed into a score out of 100 by multiplication with a common factor. We calculated 2-year change in ICOAP subscores by subtracting year 4 from year 6 data.

Physical function and performance

Several objective physical performance tests are employed by the OAI and measured at baseline and annual follow-up. The 20-meter walk test (20-m walk), in which participants are timed as they walk down an unobstructed 20-meter corridor at their usual walking speed, is measured twice each visit and is a reliable measure of walking speed in individuals with mild to moderate knee OA [24]. The pace (m/s) of the two trials is averaged. Walking speed is an important outcome for individuals with knee OA, who often suffer from gait disability [2]. The 400-meter walk test (400-m walk) measures the time in seconds required for participants to walk 400 m. The 400-m walk reliably approximates cardiorespiratory fitness and daily physical activity [29]. The repeated chair stands test (CST) involves participants standing up from a seated position five times consecutively, as quickly as possible. The test is performed twice per visit, and time is measured in seconds; we used the first CST time in accordance with another study [23]. The minimum important change (MIC) for the repeated CST has not been reported. As such, we defined poor test performance as an increase in test time determined using linear regression.

The self-reported KOOS function in sport and recreation (KOOS-FSR) subscale produces reliable data regarding the difficulty of performing higher level physical activities such as squatting, running, jumping, twisting/pivoting on the injured knee, and kneeling [32]. It involves five questions scored on five-point scales, with lower total scores indicating greater difficulty. The WOMAC-PF subscale uses 17, five-point Likert scale items to reliably assess knee-specific limitations in daily activities such as stair use, sit-to-stand movement, and getting in and out of a bath or bed [6]. High total scores indicate high knee-related functional limitation.

Covariates

The Physical Activity Scale for the Elderly (PASE) measures self-reported physical activity in older adults. The PASE consists of 12 questions probing the frequency and duration of leisure, household, and work-related activities during the previous 7 days [43]. Questions are assessed on either four-point scales or with yes/no responses. Theoretically, a total score from 0 to 400 is calculated with a high score indicating high physical activity level. High PASE scores are associated with positive gait pace and chair stand outcomes in adults with knee OA [12].

Participant K/L grades are determined for each knee based on fixed flexion radiograph readings by a trained radiologist. This study only observed participants with K/L grades 2 or higher. A K/L grade of 2 is the OAI threshold for radiographic mild knee OA. A K/L grade of 3 indicates moderate OA and 4 indicates severe OA. Radiographic signs of knee OA are associated with slower walking and stair-climbing times in middle-aged women [36].

Knee symptom frequency is scored as 0 to 2 (0 = no symptoms, 1 = infrequent symptoms, 2 = frequent symptoms). The OAI knee symptom status is defined as a combination of the following questions: have you experienced any knee pain, stiffness, or aching in the past 12 months and have you experienced knee pain, stiffness, or aching for more than half of the past 30 days? Positive responses to both questions indicate frequent knee symptoms [34].

Participant age was included as a covariate. The majority of individuals over 65 years of age and up to 80 % of individuals over 75 years of age have radiographic evidence of OA [3]. Body mass index (BMI; kg/m²) was also used as a covariate. Obese individuals have an increased risk of developing OA due to biomechanical and inflammatory factors [37]. Race was also a covariate (0 = other non-White; 1 = White/Caucasian; 2 = Black/African-American; 3 = Asian). The “other” category included individuals with mixed race, American or Alaskan native, Pacific Islander, or any other race not encompassed by other categories. Race/ethnicity is associated with risk of OA as well as symptom severity [14]. Lastly, knee extension maximum force (N) was included as a covariate, and measured using the Good Strength apparatus, which has been previously described [8]. Knee extensor weakness is a risk factor for limitations in activities such as walking and chair stands in individuals with knee OA [10]. Pharmacological treatment of knee pain was also included as a covariate, defined as the use of medication for pain, aching, or stiffness in either knee more than half the days of the month in the past 12 months (0 = no, 1 = yes).

Statistical analyses

Descriptive statistics were investigated for the study samples of men ($n = 189$) and women ($n = 133$). Linear regression analyses investigated the relationships between baseline and 2-year longitudinal changes in ICOAP intermittent or constant pain subscores and each physical performance test and physical function outcome, separately in men and women. We controlled for relevant covariates which also affect physical function and performance, in order to independently investigate the effects of intermittent and constant pain. In addition, linear regression analysis investigated the ability of baseline ICOAP subscores to predict physical performance and physical function at year 2 follow-up. Significance was set at a p value <0.05 . Multicollinearity testing revealed that no covariates demonstrated a variance inflation factor greater than 2.5.

For the analyses looking at cross-sectional relationships and baseline ICOAP subscores' abilities to predict year 2 outcomes, the linear regression model included the baseline ICOAP intermittent and constant pain subscores as independent variables, plus covariates including baseline age, BMI, PASE score, gender, race, K/L grade, pain medication use, knee symptom frequency, and knee max extension force. For the linear regression model of longitudinal 2-year changes in ICOAP and physical performance/function, baseline ICOAP scores were also included as covariates.

Results

Analyses were performed on a sample of men ($n = 189$) and women ($n = 133$) with unilateral radiographic knee OA. Descriptive statistics are shown in Table 1. Men had a mean ($\pm$ SD) age of 63.7 ± 8.7 years and a mean BMI of 27.7 ± 3.6 kg/m²; corresponding values in women were 65.1 ± 9.1 years and 27.6 ± 4.4 kg/m². Baseline mean constant pain score was 1.4 ± 6.5 and 2.4 ± 9.3 in men and women, respectively. Baseline mean intermittent pain score was 10.3 ± 13.3 and 11.3 ± 13.8 in men and women, respectively.

Results of the cross-sectional regression analyses of baseline ICOAP scores and baseline physical performance or physical function measures are shown in Table 2. In women, poor baseline CST performance, or high test time, was related to high baseline intermittent pain score ($B = 0.035$; $p = 0.021$). Also, poor baseline 400-m walk performance, or high test time, was related to high baseline constant pain score ($B = 0.636$; $p = 0.047$), and there was a trend toward a relationship between poor baseline 400-m walk performance and high baseline intermittent pain in women ($B = 0.411$; $p = 0.076$). No relationships between baseline physical performance measures and either baseline ICOAP subscores were observed in men. Poor self-reported physical function, based on low baseline KOOS-FSR, was related to high baseline intermittent pain in women ($B = -0.877$; $p = 0.001$) and high baseline constant ($B = -0.720$; $p = 0.001$) and intermittent ($B = -0.504$; $p = 0.001$) pain in men. Similarly, poor self-reported physical function, based on high baseline WOMAC-PF, was related to high baseline constant and intermittent pain, in both men and women.

Results of the linear regression analyses of baseline ICOAP scores and year 2 follow-up physical function or performance are shown in Table 3. There was a trend toward a relationship between high baseline intermittent pain and poor performance at year 2 follow-up on the CST ($B = 0.032$; $p = 0.086$) in women. Poor year 2 follow-up physical function, based on low year 2 KOOS-FSR, was predicted by high baseline intermittent pain, but not constant pain, in men ($B = -0.287$; $p = 0.030$) and women ($B = -0.357$; $p = 0.016$). Poor year 2 follow-up physical function, based on high year 2 WOMAC-PF, was predicted by high baseline intermittent and constant pain in men, but only by high baseline intermittent pain in women.

Results of the longitudinal regression analyses between 2-year change in ICOAP scores and 2-year change in physical performance or self-reported physical function are shown in Table 4. A 2-year decrease in CST performance, that is an increase in test time, was related to a 2-year increase in constant pain in women ($B = 0.077$; $p = 0.001$). A 2-year decrease in physical function, reported by decreased KOOS-FSR or increased WOMAC-PF scores, were related to a 2-year increase in intermittent and constant pain, in both men and women (Fig. 2). Finally, baseline and 2-year change in 20-m walk pace was not related to intermittent or constant pain in any of the analyses (data not shown).

Discussion

Cross-sectional relationships between pain and physical function

We found that high baseline intermittent pain, but not constant pain, was related to poor baseline performance on the CST in women with early symptomatic OA. Similarly, individuals with knee pain performed poorly on the repeated CST and a test of usual walking [21]. It is well understood that knee pain is a factor in reduced knee extensor strength in individuals with OA [23]. Sit-to-stand movements necessitate knee muscles to develop large joint moments compared to gait or stair-climbing, and patellofemoral pain is related to hydrostatic pressure and sheer stress at the joint interface [13 , 39]. Therefore, episodes of intermittent pain may be brought on by joint mechanical pressure and stress.

We found that high baseline constant pain was related to poor baseline performance on the 400-m walk in women. Also, there was a trend toward a relationship between high baseline intermittent pain and poor baseline 400-m walk performance. These findings suggest that constant knee pain is an important factor in walking tasks. Similarly, unspecified knee pain was associated with a 4.5-fold increased risk for decline in gait speed over 4 years [45]. Furthermore, WOMAC pain score was associated with greater physical fatigue, and fatigue was associated with poor physical function [35]. This may explain why the 20-m walk was not related to constant or intermittent pain, as the test may not be long enough to induce fatigue.

We found a difference between men and women in that baseline intermittent pain and constant pain were not related to baseline physical performance measures in men. Similarly, OA was a determinant of incidence of disability in women, but not in men [1]. In addition, pain duration and catastrophizing explained worse pain and impaired function during a gait speed test in women compared to men with knee OA [41]. Women exhibit greater pain sensitivity than men, suggesting that a relationship between pain and poor physical function may exist at a lower pain score threshold for women [38]. Furthermore, women with knee OA show greater reductions in physical performance compared to men [30]. Thus, our study sample may not have included enough men with pain scores above the threshold necessary to investigate the relationship between pain and physical function.

We found that high baseline constant pain and intermittent pain were related to poor self-reported physical function. Similarly, a cross-sectional relationship between high self-reported WOMAC pain and poor WOMAC-PF was found in individuals with OA [9]. Furthermore, physical function, assessed using WOMAC-PF, was more influenced by WOMAC and MOS 36-item Short Form Health Survey pain subscores than was measures of performance-based physical function in individuals with OA [40]. Performance-based tests and self-reported physical function captured different aspects of physical function [4]. Our findings demonstrate a relationship between these pain types and both self-reported and performance-based measures of physical function. However, pain was more often related to self-reported physical function than performance-based measures, indicating the importance of pain in self-perceived physical function.

Ability of baseline intermittent and constant pain to predict year 2 physical function

We found that high baseline intermittent pain, but not constant pain, predicted poor self-reported KOOS-FSR at year 2 follow-up in men and women. Similarly, high baseline intermittent pain alone in women, but both baseline intermittent pain and constant pain in men, predicted poor self-reported WOMAC-PF at year 2 follow-up. Importantly, relationships between pain and physical/function performance supported our hypothesis that both intermittent pain and constant pain are independent factors in physical function in adults with knee OA. Our findings demonstrated that intermittent pain was a better predictor of future poor function in KOOS function in sport and recreation compared to constant pain. Similarly, Hawker et al. (2008) found that mean distress scores for intermittent pain were higher than for constant pain [17]. Thus, while both pain types are independently important in physical function, intermittent pain in particular may be an early predictor of future physical function deficits.

Furthermore, there was a trend toward a relationship between high baseline intermittent pain and poor performance on the CST at year 2 follow-up in women. As this sample primarily consisted of individuals with low intermittent pain scores, a higher mean intermittent pain score may be necessary to determine if this pain has a significant relationship with future CST performance.

Longitudinal 2-year changes in pain and physical function

We found a significant relationship between 2-year increases in constant pain and 2-year decreases in CST performance in women. As the disease progresses, constant pain surpasses intermittent pain as the most disabling aspect of OA. Neogi et al. found that individuals with radiographic OA were more likely to have consistent pain and that physical function and strength were better in individuals with inconsistent pain [26]. Furthermore, the duration of knee pain explained variance in WOMAC pain severity [19]. Radiographic (K/L) disease severity and duration of the disease were associated with increasing ICOAP pain pattern severity (defined in order of increasing severity as no pain, intermittent pain only, constant pain only, and both constant and intermittent pain) [25]. Our findings agree with this pattern of pain progression, by showing that 2-year increase in constant pain was related to 2-year decline in CST performance. It is well understood that constant pain in knee OA can lead to a sedentary lifestyle and disuse atrophy. Thus, decreases in knee extensor strength secondary to constant knee pain may be responsible for declines in chair stands performance.

Lastly, our study found that increased intermittent pain and constant pain were both associated with decreased self-reported physical function over 2 years. These findings agree with our cross-sectional analyses and previous research which found a relationship between osteoarthritis radiological and symptomatic progression and worsening physical function [44]. In support of our hypothesis, intermittent and constant pain were independently associated with worsening physical function.

Limitations and conclusions

Some limitations to this study are that our findings can only be generalized to individuals with unilateral radiographic knee OA. Additionally, ICOAP subscores are reported separately for each knee, while performance-based tests and the KOOS-FSR assess overall physical performance or function. Future research should investigate the relationship between pain types in both knees and physical performance measures in individuals with bilateral OA. We were unable to perform longitudinal analysis of change in the 400-m walk, as this data was not yet available at year 6 follow-up. Our study sample had low mean ICOAP subscores at baseline, particularly for constant pain, indicating early symptomatic progression. Lastly, a 2-year period may not be long enough to capture meaningful changes in knee symptoms.

In conclusion, we found that intermittent pain and constant pain were independently related to decreased self-reported physical function and decline in physical function over 2 years. However, only baseline intermittent pain was able to predict future poor physical function using the KOOS-FSR after 2 years. As pain sensitivity during physical activity may lead to avoidance and inactivity, it is important to develop strategies for participants to mitigate knee pain so that they can maintain their physical function. As knee symptoms worsen and become more constant, individuals with OA experience further limitations in physical function. By identifying intermittent and constant knee pain in patients with early symptomatic OA, strategies can be used to help prevent worsening symptoms and future declines in physical function, mobility, and performance, leading to disability.

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Fig. 1.
Flow diagram of participant inclusion criteria

Fig. 2.

A 2-year increase in ICOAP intermittent pain subscore is associated with decreased KOOS function in sport and recreation over 2 years in women with knee OA ($B = -0.479$; $p = 0.001$)

Table 1

Baseline descriptive statistics for a sample of men and women from the OAI with unilateral radiographic knee OA.

Variable	Men (n=189)		Women (n=133)	
	Mean (SD)	Min, Max	Mean (SD)	Min, Max
Age (years)	63.7 (8.7)	49, 82	65.1 (9.1)	49, 83
BMI (kg/m ²)	27.7 (3.6)	20.1, 43.8	27.6 (4.4)	19.0, 40.1
Race (n)	Other=1, white=178, black=9, Asian=1		Other=0, white=115, black=17, Asian=1	
Baseline ICOAP Constant (/100)	1.5 (6.5)	0, 50	2.4 (9.3)	0, 55
Baseline ICOAP Intermittent (/100)	10.4 (13.3)	0, 54.2	11.4 (13.8)	0, 58.3
2-Year ICOAP Constant (/100)	2.3 (8.9)	0, 70	2.5 (9.2)	0, 65
2-Year ICOAP Intermittent (/100)	10.8 (13.1)	0, 70.8	9.6 (12.1)	0, 45.8
400m Walk Time (s)	288.7 (38.5)	160.9, 407.1	303.1 (37.6)	220.7, 425.1
20m Walk Pace (m/s)	1.39 (0.17)	0.93, 1.87	1.35 (0.17)	0.83, 1.78
Chair Stand Time 1 (s)	9.9 (2.2)	4.7, 18.7	10.2 (2.1)	6.2, 17.7
KOOS-FSR (/100)	80.5 (21.4)	5.0, 100.0	79.7 (20.8)	0.0, 100.0
WOMAC-PF (/68)	5.0 (7.9)	0.0, 37.0	5.2 (7.1)	0.0, 28.7
K/L Grade (n)	KL2=121, KL3=46, KL4=22		KL2=108, KL3=23, KL4=2	
Knee Symptom Freq. (n)	None=42, infrequent=95, frequent=52		None=26, infrequent=72, frequent=35	
PASE score (/400)	177.1 (78.0)	2, 396	161.4 (82.5)	27, 427
Knee Pain Medication (n)	No=168, yes=21		No=114, yes=19	
Knee Extensor Force (N)	407 (107)	144, 727	280 (75)	82, 471

Abbreviations: Body Mass Index (BMI), Intermittent and Constant OsteoArthritis Pain (ICOAP), Knee Osteoarthritis Outcome Score Function in Sport and Recreation (KOOS-FSR), Western Ontario and McMaster Osteoarthritis Index Physical Function (WOMAC-PF), Kellgren/Lawrence (K/L), and Physical Activity Scale for the Elderly (PASE).

Table 2

Cross-sectional linear relationships between baseline ICOAP subscores and baseline physical performance tests or self-reported physical function.

Baseline Physical Performance/Function	Baseline ICOAP Subscore	Men B coefficient (p)	Women B coefficient (p)
Chair Stands Time 1 [‡]	Constant Pain	0.001 (0.961)	0.006 (0.755)
	Intermittent Pain	−0.013 (0.343)	0.035 (0.021) [*]
400m Walk Time [‡]	Constant Pain	0.055 (0.895)	0.636 (0.047) [*]
	Intermittent Pain	0.226 (0.355)	0.411 (0.076)
KOOS-FSR [‡]	Constant Pain	−0.720 (0.001) [*]	−0.254 (0.120)
	Intermittent Pain	−0.504 (0.001) [*]	−0.877 (0.001) [*]
WOMAC-PF [‡]	Constant Pain	0.442 (0.001) [*]	0.252 (0.001) [*]
	Intermittent Pain	0.261 (0.001) [*]	0.277 (0.001) [*]

[‡]Model covariates: Baseline ICOAP scores plus covariates including baseline age, BMI, PASE score, race, K/L grade, knee symptom frequency, knee pain medication use and max knee extension force.

^{*}Significant at p<0.05.

Table 3

Linear relationships between baseline ICOAP subscores and year 2 follow-up physical performance or self-reported physical function.

Year 2 Physical Performance/Function	Baseline ICOAP Subscore	Men B coefficient (p)	Women B coefficient (p)
Chair Stands Time 1 [‡]	Constant Pain	0.004 (0.895)	0.034 (0.187)
	Intermittent Pain	0.011 (0.523)	0.032 (0.086)
KOOS-FSR [‡]	Constant Pain	−0.274 (0.219)	0.308 (0.129)
	Intermittent Pain	−0.287 (0.030)*	−0.357 (0.016)*
WOMAC-PF [‡]	Constant Pain	0.197 (0.011)*	−0.020 (0.784)
	Intermittent Pain	0.173 (0.001)*	0.132 (0.013)*

[‡] Model covariates: Baseline ICOAP scores plus covariates including baseline age, BMI, race, K/L grade, PASE score, knee pain medication use, knee symptom frequency and max knee extension force.

* Significant at p<0.05.

Table 4

Longitudinal linear relationships between 2-year change in ICOAP subscores and 2-year change in physical performance tests or self-reported physical function.

2-Year Change Physical Performance/Function	2-Year Change ICOAP Subscore	Men B coefficient (p)	Women B coefficient (p)
Chair Stands Time 1 [‡]	Constant Pain	0.006 (0.749)	0.077 (0.001)*
	Intermittent Pain	0.003 (0.815)	−0.028 (0.065)
KOOS-FSR [‡]	Constant Pain	−0.405 (0.006)*	−0.618 (0.001)*
	Intermittent Pain	−0.524 (0.001)*	−0.479 (0.001)*
WOMAC-PF [‡]	Constant Pain	0.150 (0.007)*	0.484 (0.001)*
	Intermittent Pain	0.180 (0.001)*	0.104 (0.040)*

[‡] Model covariates: 2-Year and Baseline ICOAP scores plus covariates including baseline age, BMI, PASE score, race, K/L grade, knee symptom frequency, knee pain medication use and max knee extension force.

* Significant at p<0.05.