Published in final edited form as:

Arch Phys Med Rehabil. 2010 May ; 91(5): 714–721. doi:10.1016/j.apmr.2010.01.015.

Moving to Maintain Function in Knee Osteoarthritis: Evidence from the Osteoarthritis Initiative

Dorothy D. Dunlop, PhD¹, Pamela Semanik, PhD, APN³, Jing Song, MS¹, Leena Sharma, MD¹, Michael Nevitt, PhD⁴, Jerry Mysiw, MD, and Rowland W. Chang, MD, MPH^{1,3} for the OAI Investigators

¹ Northwestern University Feinberg School of Medicine, Chicago, IL

² Ohio State University, Columbus OH

³ Rehabilitation Institute of Chicago, Chicago, IL

⁴ University of California, San Francisco CA

Abstract

Objectives—Investigate the association between baseline physical activity and 1-year functional performance in adults with knee osteoarthritis (OA).

Design—Prospective cohort study of knee OA development and progression with 1-year follow-up.

Setting—Community Participants: Osteoarthritis Initiative (OAI) public data on 2274 adults with knee osteoarthritis (age 45–79 years) who participated in functional performance assessments (timed 20 meter walk and chair stand test) at baseline and 1-year followup.

Interventions—Not applicable.

Main Outcome Measure—A good 1-year performance outcome (separately defined for walk time and chair stand measures) was improvement from baseline quintile or maintenance in the best quintile.

Results—Almost two in five persons with radiographic knee OA improved or maintained high performance at 1-year. Physical activity measured by the Physical Activity Scale for the Elderly (PASE) was significantly associated with good walk rate and chair stand outcomes (odds ratio per 40 units PASE [95% confidence interval]= 1.13, [1.13,1.17] and 1.10, [1.05,1.15], respectively), as were participation in sports/recreational activities (1.45, [1.23, 1.71] and 1.29 [1.09,1.51], respectively), and lifestyle activities (1.11, [1.06, 1.16] and 1.09 [1.04,1.14], respectively). An independent protective relationship for these physical activity measures approached significance after adjusting for sociodemographic and health factors. Older adults reported the least baseline physical activity and least frequent good 1-year outcomes.

Conclusions—These findings support public health recommendations to be physically active in order to preserve function for persons with knee OA. Physical activity messages should specifically target older adults whose low activity levels may jeopardize their ability to maintain functional performance.

Arthritis is a costly disease to the society and the individual. Costs due to arthritis exceed \$128 billion annually.¹ More than 46 million Americans (more than 1 in every 5 adults) report arthritis and other rheumatic conditions and 19 million (1 in every 11 adults) report arthritis-

attributable activity limitations.² Knee osteoarthritis is a highly prevalent condition in adults and is a leading cause of arthritis-related activity limitations.^{3–4}

While some reports examine risk factors predicting functional decline, the research on maintaining high physical function or improving physical function among adults in the general population is limited.^{5–10} Among persons with knee osteoarthritis, such studies are particularly scarce. Physical activity is widely recognized to be beneficial to cardiovascular health in the general population and is an attractive mutable risk factor to improve health outcomes for persons with arthritis.¹¹ Recently released updated physical activity guidelines include a section specifically for persons with osteoarthritis.¹²

This paper examines factors that may preserve or improve function over time for persons with knee OA. A good outcome is defined as maintaining high function or improving functional performance over one year. Longitudinal data from the Osteoarthritis Initiative (OAI) that included 2274 persons with radiographic knee osteoarthritis at the baseline interview were used to answer the following research questions related to functional performance one year later.

1. What proportion demonstrated good one-year outcomes (i.e., improved performance by at least one quintile compared to baseline or maintenance in the highest performance quintile).
2. Is there a type of physical activity that is particularly associated with good outcomes?
3. What are the significant sociodemographic and health determinants of good outcomes?

MATERIALS AND METHODS

Data and study sample

This study analyzed public data from the Osteoarthritis Initiative, a prospective study of the development and progression of knee OA in men and women aged 45–79 at enrollment. Annual OAI interviews began in 2004 and continue at four clinical sites: Baltimore Maryland, Columbus Ohio, Pittsburgh Pennsylvania, and Pawtucket Rhode Island. The baseline OAI visit identified 2678 participants with radiographic knee OA (i.e., radiographic evidence based on Kellgren-Lawrence grade ≥ 2 calculated from separate scores for osteophytes and joint space narrowing in a knee) in one or both knees of whom 1403 had knee symptoms (pain, aching, and/or stiffness on most days of a month during the past year) from the total OAI enrollment of 4796 persons. Excluded were persons with bilateral total knee replacement, planned knee replacement, inflammatory arthritis, contraindications to 3.0 Tesla MRI (men >130 kg and women >114 kg), non-ambulatory, comorbid conditions likely to interfere with participation, plans to relocate, and other clinical trial participation. To investigate factors related to good functional performance over one year, we merged public data from OAI baseline (V0.2.1) and 1-year (V1.2.1) interviews. A total of 2274 persons with baseline radiographic knee OA who participated in functional performance assessments (timed 20 meter walk and chair stand test) at both interviews compose the analysis sample. An additional 8 decedents, 163 not returning for the OAI 1-year evaluation, 69 with incomplete baseline data, and 164 persons with incomplete 1-year performance data were excluded from analysis.

Functional performance outcome from baseline to one year

Functional performance was assessed by a timed 20 meter walk and a chair stand test. The timed 20 meter walk is a standard outcome measure for osteoarthritis.¹³ Walk rates based on two trials measured in meters/minute from the entire baseline OAI radiographic knee OA cohort were classified by quintile from worst to best performance: first quintile Q1 ≤ 67 ; second quintile Q2 (65,75]; third quintile Q3 (75,81]; fourth quintile Q4 (81,88]; fifth quintile Q5 >88 .

Walk rates from the baseline and one year evaluations were categorized into one of these quintiles.

Chair stand testing (time required for 5 repetitions to rise from a chair and sit down) depends heavily upon knee function, and assesses strength, balance, coordination, and flexibility. The OAI chair stand protocol standardizes the chair, its position, the stopwatch, floor surface footwear, arm position (crossed over the chest), and scripted instructions. Chair stand rates based on two trials measured in repetitions/minute from the entire baseline OAI radiographic knee OA cohort were classified by quintile from worst to best performance: first quintile Q1 ≤ 21.0 ; second quintile Q2 (21.0, 25.8]; third quintile Q3 (25.8, 30.0]; fourth quintile Q4 (30.0, 35.4]; fifth quintile Q5 >35.4 . Chair stand rates from the baseline and one year evaluations were categorized into one of these quintiles.

The baseline to one year functional experience was characterized separately for each performance test using a quintile grid shown in Figure 1. This approach captures practical, meaningful changes in functional performance over time in osteoarthritis populations.^{14–16} Good outcomes based on improved/high performance are defined by transition to an improved functional performance quintile over one year (i.e., moving from Q1–Q4 at baseline to better quintile at the 1-year evaluation) or maintaining function in the best performance quintile (i.e., Q5 at both baseline and 1-year evaluations) as shown by the shaded Figure 1. Boxes that are not shaded represent a poor functional performance outcome.

Physical activity—Self-reported physical activity was measured using the Physical Activity Scale for the Elderly (PASE)¹⁷. The self-administered 26 question PASE assesses a broad spectrum of activities during the previous 7-day period.¹⁸ The calculated PASE score has demonstrated reliability and validity.^{19–20} PASE scores increase with greater moderate intensity activity time. For the purpose of analysis, we divided the total PASE score into portions corresponding to questions that assess lifestyle activity (housework, home repair, gardening, yard work, paid or volunteer work-related activity), purposeful exercise/sports (light, moderate, strenuous sport/recreation; and muscular strength and endurance), and walking outdoors (outside the home or in the yard for any reason).

Covariates

Baseline sociodemographic factors included race, age, gender, marital status, and education. Individuals were classified as African-American, White, or other race based on self-report. Education was dichotomized as post high school versus less education.

Knee health was assessed at baseline. The presence of knee symptoms was ascertained from a positive response to “Do you have pain, aching, or stiffness on most days of a month during the past year.” Disease severity for each knee was based on a Kellgren-Lawrence grade calculated by the OAI from the baseline scores for osteophyte and joint space narrowing as Grade 1 (doubtful): possible osteophyte of doubtful significance or isolated mild-moderate joint space narrowing; Grade 2 (minimal): definite osteophytes and unimpaired joint space or isolated severe joint space narrowing; Grade 3 (moderate): definite osteophytes and moderate diminution of joint space; Grade 4 (severe): definite osteophytes, joint space greatly impaired. Self-reported knee pain was measured by a 5-point Likert scale from the WOMAC (Western Ontario and McMaster University OA Index, Likert version, 3.1) modified to ask about the right and left knee symptoms separately²¹ in the past 7 days. The WOMAC pain score range is 0–20; a higher number represents worse symptoms. Person-level scores were calculated from knee specific scores (i.e., disease severity grade and WOMAC pain score) using the maximum value of the two knees.

General health factors assessed included the self-report of hip pain, ankle pain, foot pain, current smoking, current alcohol consumption, comorbidity, high depressive symptoms, and body mass index (BMI). The presence of comorbidity was ascertained from a Charlson index²² score >0. Evidence of high depressive symptoms was based on a score ≥ 16 from the full 20 item Center for Epidemiological Studies Depression scale²³. BMI was calculated from measured height and weight [weight (kg)/height (m)²].

The protocol for the OAI was approved by the institutional review boards at each of the participating sites.

Statistical analysis

Analyses were restricted to individuals who participated in both the baseline and 1-year OAI visits. Descriptive statistics characterized the baseline sample by physical activity (above or below median baseline PASE score). Logistic regression evaluated the relationship between baseline physical activity and 1-year performance outcomes; those results are reported as odds ratios (ORs). Physical activity scores ORs are expressed per 40 units; this increment equals 0.5 standard deviations (SD) in the PASE score to reflect a potentially meaningful change in physical activity as measured by PASE. Recognizing that systematic differences between persons included (n=2274) and excluded (n=404) from the analysis sample could influence our findings, we performed weighted analyses recommended by Hogan²⁴ and Robins²⁵. Results and statistical significance were very similar for weighted and unweighted analyses. For simplicity, unweighted analyses were reported. All analyses were performed using SAS software version 9.2.

RESULTS

A total of 2274 persons with radiograph knee OA (aged 45–79 years) participated in performance tests at the baseline and one year OAI evaluations. In this sample 60% had bilateral involvement and half had knee symptoms based on the report of pain, aching, or stiffness most days in month during the previous year. This analytic sample was predominantly white (81.6%), female (56.8%) and average baseline age was 62.5 years. The group of 404 persons with radiographic knee OA who did not return for the one year evaluation or had incomplete data were similar in age (mean: 62.0 vs. 62.5 years) but were more likely to be African American (34% vs. 17%) or female (67% vs. 57%) than those included on the analysis sample.

Baseline physical activity measured by the total PASE score ranged from 0 to 465, with mean of 157 (SD=79), indicating this radiographic knee OA cohort had substantial variability in physical activity. The total PASE was divided into lifestyle activity, purposeful exercise/sports and walking outdoors which had mean $\pm$ SD of 130 ± 72 , 12 ± 21 and 14 ± 17 , respectively.

For descriptive purposes, this radiographic knee OA cohort was stratified by baseline levels of physical activity (Table 1). Persons with baseline PASE scores above the median tended to be younger, male, reported more education, and were less likely to report comorbidity or prior knee injuries compared to their less active counterparts. There were no notable differences in disease severity or knee pain related to physical activity.

The cross-sectional relationship between baseline physical activity levels and functional performance for this knee OA cohort is shown in Figure 2. Average physical activity measured by the total PASE score increased with membership in higher (i.e., better) performance quintiles for both walk rate and chair stand rate. Each PASE score bar is divided into those portions contributed by lifestyle activities, exercise/sports, and walking outdoors questions. It is notable that lifestyle activities contributed the largest portion to the total PASE score. The portion of the total PASE score contributed by walking outdoors is relatively constant across

all performance quintiles. Increased physical activity among persons in high performing quintiles is largely due to more participation in lifestyle and exercise/sports activities.

Analyses addressing the first research question examined the frequency of good functional performance outcomes. The average cohort performance was unchanged at baseline and 12 months (at both evaluations walk rate averaged 78 meters/minute; chair stand rate averaged 28 repetitions/minute). However many individuals demonstrated improvements in performance or maintenance in the highest performance quintile (Table 2). More than one out of four persons improved performance (i.e., moved to a better quintile compared to baseline). Another 11–15% remained in the best performing quintile. Together approximately 40% of this knee OA cohort had good (improved/high) outcomes after one year.

Analyses to address the second research question examined the relationship of the total PASE score and that of the partitioned PASE scores (exercise/sport, lifestyle activities, and walking outdoors) with good functional performance outcomes (Table 3). Good outcomes were significantly related to higher values of the total PASE score for walk rate (OR per 40 units=1.13) and chair stand performance (OR/40 units=1.10). Separate analyses entered the partitioned PASE scores into logistic regression models in place of the total score. Lifestyle activity had a significant beneficial relationship to subsequent high/maintained performance (OR/40 units: walk rate =1.11; chair stand rate =1.09) as did purposeful exercise/sports (OR/40 units: walk rate =1.45; chair stand rate =1.29). Walking outdoors as ascertained by PASE was not significantly related to good outcomes (OR/40 units: walk rate=0.99; chair stand=1.00). These analyses demonstrated positive relationships between baseline physical activity and good performance outcomes one year later; that relationship was strongest for exercise/sports followed by lifestyle activities. Further analyses that controlled for sociodemographics and health factors demonstrated a positive but attenuated relationship between physical activity and good outcomes. In sensitivity analyses (not shown) that additionally controlled for one-year changes from baseline in PASE and WOMAC pain; the odds ratio of baseline PASE on good outcomes was identical to the Table 4 results.

Analyses to address the third research question investigated the relationship of baseline sociodemographic and health factors to subsequent improved/high performance controlling for physical activity (Table 4 multiple logistic regression results). Sociodemographic factors that significantly increased the odds of good outcomes one year later adjusting for all factors were higher education (OR: walk rate =1.45, chair stand =1.66), and being married (OR: walk rate=1.32) while the odds of good outcomes were significantly decreased by older age (OR/5 years: walk rate=0.88, chair stand=0.90) and female gender (OR: walk rate=0.70). Health factors that significantly decrease the adjusted odds of good outcomes were greater BMI (OR/unit: walk rate = 0.96) and greater WOMAC knee pain (OR/unit: chair stand =0.94). It is notable that disease severity based on radiographic evidence was not associated with subsequent good performance outcomes.

The strong inverse relationship of older age to less frequent good outcomes and the attenuated relationship of physical activity with good outcomes after accounting for sociodemographic factors motivated further analyses. We examined the frequency of good outcomes in persons with high (above the median PASE score) versus low physical activity levels stratified on age group (45–54, 55–64, 65–75 years). The stratified odds ratios of good walk rate outcomes for persons in the high versus lower physical activity groups ranged from 1.01–1.14 and the stratified odds of good chair stand outcomes ranged from 1.02–1.07 with adjustment for other sociodemographic and health factors. These analyses showed that within each age group good outcomes were most frequent among those persons with higher levels of baseline physical activity compared to their less active counterparts.

Further analyses examined for the potential of an effect modification related to knee symptoms by adding an interaction term between knee symptoms and physical activity to our model. That interaction term was not significant, which indicates these findings do not depend on the presence or absence of knee symptoms.

DISCUSSION

This paper adds to the literature by examining factors that may *preserve* function over time for persons with knee OA. This study provides evidence of the positive benefit from physical activity in relation to good outcomes in functional performance over one year from a cohort of 2274 persons with radiographic knee OA. Almost one in four persons in this cohort improved functional performance at one year compared to baseline. Among persons performing in top quintiles at baseline on the timed 20 meter walk or chair stand tests, over half maintained that high function one year later. Greater physical activity measured by the total PASE was significantly associated with improved/high performance over one year. Physical activity from lifestyle activities and exercise/sports had strong associations with subsequent improved/high performance.

Our findings that exercise/sports activities (those performed to achieve a training effect) are related to subsequent good performance outcomes are consistent with other studies. Randomized clinical trials demonstrate that exercise, muscle strengthening regimens, and aquatic therapy improve performance in walking, stair stepping, and getting in/out of a car.^{26–29} However, the value of lifestyle activities are not addressed in those studies. Recent interest in lifestyle activity is spawned by poor adherence rates^{26, 30–33} to structured exercise regimens which reduces potential benefit.^{34–35} Our findings suggest that lifestyle activities are related to subsequent improved/high performance among persons with knee OA.

Sociodemographic and health factors attenuated (often to non-significance) the positive relationship of physical activity to good outcomes in walk rate and chair stand performance. Although sociodemographic factors are recognized confounders, some health factors may be on the causal pathway. For example, physical activity is beneficial to reduce pain, depressive symptoms, and body weight. These health factors also influence function and may partially be due to the beneficial effect of physical activity on function. In addition, more precise objective measures of physical activity may demonstrate stronger relationships in the presence of confounders.

Predictors of good functional outcomes in persons with radiographic knee OA are in harmony with other studies in the general population. Sociodemographic factors related to good functional outcomes in this osteoarthritis cohort were younger age, more education, and male gender, consistent with literature on older adults.^{8, 10, 36–37} Health factors in the present study that were significantly detrimental to good outcomes were knee pain and greater BMI. Pain in the leg or knees is also negatively associated with improved function in the general population.^{6, 8} Greater BMI has been identified as both protective¹⁰ and detrimental^{5, 9} to good function in the general population. Our finding that the severity of knee OA did not affect subsequent improved/high performance is consistent with a knee pain study in older adults that concluded severity of radiographic knee OA had limited value to predict which persons experienced progressive functional difficulties.¹⁶

The value of lifestyle activities and exercise/sports to improve or maintain high function is a valuable message for clinicians to convey to their patients with knee OA. Advice from a health care provider can positively influence the physical activity behavior of patients.³⁸ However, advice to exercise may not resonate with some persons having knee OA due to lack of resources or limited interest in exercise regimens. This study suggests that a broad spectrum of activities

is beneficial. The positive relationship of lifestyle activities and exercise to sustained or improved functional performance strengthens the appeal of a clinician's advice.

Findings from this study have important public health implications. First, the substantial frequency of subsequent improved performance is an encouraging indication that functional decline is reversible in adults with knee OA. Second, results demonstrating a relationship of physical activity to good subsequent performance strengthens the arthritis public health message from the Centers for Disease Control to keep moving to preserve function.³⁹ Finally, this study indicates that an important target for this public health message is older adults with arthritis. Low levels of baseline physical activity were common among older persons with knee OA. In turn, older persons with lower levels of physical activity were less likely to have good outcomes in functional performance. Taken together, this information spotlights older adults with knee OA as an important target for the message to keep moving.

Some limitations related to these findings should be considered. Our physical activity measure is based on self report. However the validity of PASE is established for adults with knee pain and physical disability.²⁰ While the PASE score was not designed to be partitioned, in general our findings related to exercise/sports, lifestyle, and walking portions of the PASE are consonant with other physical activity studies in adults including persons with arthritis.^{14, 26–29, 40} The weak relationship between walking outdoors and good performance outcomes may be related to the aggregation of various walking intensities within the single posed PASE walking question. We were unable to adjust for OA grade at follow-up. However, the proportion with worsening of grade by one year is likely to be extremely low.⁴¹ The generalizability of this cohort merits consideration. While all persons in this analysis sample had radiographic disease, some did not have knee symptoms. However there was no evidence of an effect modification of these results based on knee symptoms. Also, causation cannot be inferred from these observational data.

In summary, findings based on over 2200 persons with radiographic knee OA support a positive relationship of physical activity with improved/high performance over one year. These findings undergird clinical advice to patients to engage in physical activity including lifestyle activity and exercise to sustain or improve their functional performance. Public health physical activity messages should specifically target older adults whose low activity levels may jeopardize their functional performance, a critical component of independent community living.

Acknowledgments

We thank Leilani Lacson for her diligent search of the literature. This manuscript has received the approval of the OAI Publications Committee based on a review of its scientific content and data interpretation.

This work is supported in part by National Institute for Arthritis and Musculoskeletal Diseases (grant no. P60-AR48098, R01-AR055287, and R01-AR054155) and the Arthritis Foundation. 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.

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit upon the authors or upon any organization with which the authors are associated.

List of Abbreviations

BMI	body mass index
CESD	Center for Epidemiological Studies Depression

CI	confidence interval
OR	odds ratio
OAI	Osteoarthritis Initiative
PASE	Physical Activity Scale for the Elderly
WOMAC	Western Ontario and McMaster University OA Index

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Quintile Group at baseline	Quintile Group at 12 month follow-up				
	Q1 Worst	Q2	Q3	Q4	Q5 Best
Q1 (Worst)					
Q2			†GOOD	OUTCOMES	
Q3					
Q4	POOR	OUTCOMES			
Q5					
Walk rate quintiles (meters/minute) ††	<=67.4	67.4 – 74.9	74.9 – 80.9	80.9 – 87.8	>87.8
Chair stand quintiles (repetitions/minute) †††	<=21	21 – 25.8	25.8 - 30	30 – 35.4	>35.4
†Good Outcome: Improved performance from Q1-Q4 at baseline to higher quintile at 1-year evaluation or maintained performance in best Q5 quintile at both baseline and 1-year evaluation †† Walk rate quintiles based on all n=2664 baseline OAI participants with radiographic knee OA evaluated by timed 20 meter walk test ††† Chair stand quintiles based on all n=2667 baseline OAI participants with radiographic knee OA evaluated by chair stand test					

Figure 1.

Good and Poor Functional Performance Outcomes from Baseline to One Year

Figure 2.

Baseline relationship between physical activity and function, N=2274

Table 1

Baseline Characteristics n=2274 persons with radiographic knee OA participating in OAI baseline and one-year evaluations

	Overall (N=2274)	PASE score <median (147) (n=1132)	PASE score >=median (147) (n=1142)
Baseline Characteristics	% or mean (sd)	% or mean (sd)	% or mean (sd)
OAI radiograph OA sample	100%	100%	100%
SOCIODEMOGRAPHICS			
Age (mean)	62.48 (9.1)	65.1 (8.9)	59.9 (8.5)
Race			
White	81.2	80.4	82.1
African American	16.6	17.6	15.6
Other	2.2	2.0	2.4
Gender Female	57.0	62.5	51.4
Married Yes	66.9	64.3	69.5
Education: Post High School	83.5	80.5	86.4
HEALTH FACTORS			
Knee Health			
Knee OA Severity			
OA Grade 2	31.5	30.7	32.3
OA Grade 3	47.7	47.5	47.9
OA Grade 4	20.8	21.8	19.8
Knee Symptoms: report of pain, aching, or stiffness most days in month past 12 months	50.0	47.7	52.4
Knee pain severity ^a	3.8 (3.8)	3.8 (3.8)	3.8 (3.8)
Prior Knee Injury	45.4	40.7	50.1
General Health			
Any Hip Pain	55.2	56.4	54.0
Any Ankle Pain	10.7	11.2	10.2
Any Foot Pain	11.4	11.3	11.5
Charlson Index >0	25.6	28.6	22.7
High depressive symptoms ^b	9.6	9.9	9.3
BMI (mean)	29.4 (4.8)	29.6 (4.9)	29.3 (4.7)
Current smoker	5.6	5.1	6.1
Alcohol Usage 0 drinks/day	18.7	21.1	16.3
<1 drinks/day	36.9	37.2	36.7
1+ drinks/day	44.4	41.7	47.0

^a WOMAC pain score in the more symptomatic (painful) knee

^b CESD>16

Table 2

Frequency of One Year Good Functional Performance Outcomes, N=2274 with radiographic knee OA

Functional Performance Assessment	Good outcome based on maintaining top quintile performance level	Good outcome based on improved performance by at least one quintile	Total good outcomes
20M walk (m/min)	14.6%	28.4%	43.0%
chair stand (#/min)	11.4%	28.4%	11.4%

Table 3

Baseline physical activity odds ratios in relation to good walk rate outcomes and good chair stand performance outcomes over one year.*

Adjustment Factors	Good Walk Rate Outcome over One Year (n = 2274)			Good Chair Stand Outcome over One Year (n = 2274)		
	PASE Total Activity OR (per 40 – units) ^d	PASE Lifestyle Activity OR (per 40-unit)	PASE Exercise/Sports Activity OR (per 40-unit)	PASE Total Activity OR (per 40-unit)	PASE Lifestyle Activity OR (per 40-unit)	PASE Exercise/Sports Activity OR (per 40-unit)
Unadjusted	1.13 (1.08, 1.17) ^d	1.11 (1.06, 1.16)	1.45 (1.23, 1.71)	1.10 (1.05, 1.15)	1.09 (1.04, 1.14)	1.29 (1.09, 1.51)
Sociodemographic ^b	1.05 (1.01, 1.10)	1.04 (0.99, 1.09)	1.27 (1.07, 1.51)	1.04 (0.99, 1.09)	1.03 (0.97, 1.08)	1.15 (0.97, 1.36)
Sociodemographic^b + Health Factors^c	1.05 (1.00, 1.10)	1.04 (0.98, 1.09)	1.22 (1.03, 1.44)	1.04 (0.99, 1.09)	1.03 (0.98, 1.08)	1.12 (0.94, 1.32)

* Bolded values indicate statistical significance based on 95% OR confidence intervals that exclude 1

^a An OR per 40 units is given to reflect a potentially meaningful change of 0.5 standard deviations in the PASE score

^b Sociodemographic factors: race, age, gender, marital status, and education

^c Health factors: knee OA severity, knee symptoms, knee pain severity, hip pain, ankle pain, foot pain, presence of comorbidity, presence of high depressive symptoms, body mass index, current smoking, and current alcohol consumption

Table 4

Multivariate Odds Ratios for Good Outcomes in Walk Rate and Chair Stand Performance from Baseline to One Year (N=2274)*

Baseline Characteristics	Odds Ratio for Good Outcome	
	20 Meter Walk Rate	Chair Stand Performance
	OR (95% CI)	OR (95% CI)
PHYSICAL ACTIVITY		
Total PASE (per 40-unit increase)	1.05 (1.00, 1.10)	1.04 (0.99, 1.09)
SOCIODEMOGRAPHICS		
Age per 5 years	0.88 (0.83, 0.93)	0.90 (0.85, 0.95)
Race		
White/Other	Reference	Reference
African American	1.14 (0.87, 1.49)	0.92 (0.70, 1.21)
Female	0.70 (0.58, 0.84)	0.83 (0.69, 1.01)
Married	1.32 (1.08, 1.62)	0.99 (0.81, 1.21)
Education years		
0–12	Reference	Reference
13+	1.45 (1.13, 1.86)	1.66 (1.28, 2.16)
HEALTH FACTORS		
Knee Health		
Knee OA Severity		
OA Grade 2	Reference	Reference
OA Grade 3	0.91 (0.75, 1.11)	1.00 (0.82, 1.22)
OA Grade 4	0.79 (0.61, 1.02)	0.94 (0.72, 1.22)
Knee Symptoms	0.95 (0.78, 1.17)	1.10 (0.90, 1.34)
Knee pain Severity ^a	0.98 (0.95, 1.00)	0.94 (0.91, 0.97)
Prior knee Injury	1.09 (0.91, 1.31)	0.91 (0.76, 1.09)
General Health		
Any Hip Pain	0.92 (0.77, 1.11)	0.91 (0.76, 1.08)
Any Ankle Pain	1.16 (0.86, 1.57)	0.80 (0.58, 1.08)
Any Foot Pain	0.82 (0.62, 1.10)	0.85 (0.63, 1.14)
Charlson Index>0	0.84 (0.68, 1.03)	0.96 (0.78, 1.18)
High Depressive Symptoms ^b	0.89 (0.65, 1.21)	0.91 (0.66, 1.25)
BMI per unit	0.96 (0.94, 0.98)	0.99 (0.97, 1.01)
Current Smoker	0.78 (0.53, 1.15)	1.23 (0.84, 1.80)
Uses Alcohol	0.92 (0.73, 1.16)	1.06 (0.84, 1.34)

* Bolded values indicate statistical significance based on 95% OR confidence intervals that exclude 1

^a per unit of WOMAC pain score in the more symptomatic (painful) knee

^b CESD>16