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Physical Activity and Physical Function in Older Adults With Knee Osteoarthritis

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Abstract

Purpose—To assess correlates of physical activity, and to examine the relationship between physical activity and physical functioning, in 160 older (66 ± 6 years old), overweight/obese (mean body mass index = 33.5 ± 3.8 kg/m2), sedentary (less than 30 mins of activity, 3 days a week) individuals with knee osteoarthritis.

Methods—Physical activity was measured with accelerometers and by self-report. Physical function was assessed by 6-min walk distance, knee strength, and the Short Physical Performance Battery. Pain and perceived function were measured by questionnaires. Pearson correlations and general linear models were used to analyze the relationships.

Results—The mean number of steps taken per day was 6209 and the average PAEE was 237 ± 124 kcal/day. Participants engaged in 131 ± 39 minutes of light physical activity (LPA) and 10.6 ± 8.9 minutes of moderate-vigorous physical activity (MPA/VPA). Total steps/day, PAEE, and minutes of MPA/VPA were all negatively correlated with age. The 6-min walk distance and lower extremity function were better in those who had higher total steps/day, higher PAEE, higher minutes of MPA/VPA, and a higher PASE score.

Conclusions—This study demonstrates that a population who has higher levels of spontaneous activity have better overall physical function than those who engage in less activity.

Keywords

exercise; aging; overweight; obese

The leading cause of disability in older adults is osteoarthritis (OA), which affects approximately 50% of individuals aged 65 years and over, and 85% of those older than 75 years.[1,2] Symptomatic osteoarthritis causes joint pain and tenderness, limiting one's ability, which may cause the need of assistance with activities of daily living.[3] Recommended treatments often include physical activity and lifestyle modifications. Emerging evidence shows that regular physical activity may play a preventative and/or restorative role in delaying declines in muscle strength and physical function, and reducing OA symptoms.[3–5] Data from randomized, controlled trials show that both resistance training and aerobic exercise interventions improve physical function by increasing mobility and leg strength, and reduces knee pain in older adults with OA.[6–9] The American Geriatrics Society (AGS) and the American College of Rheumatology endorse physical activity as a key component in the prevention and treatment of overweight patients with lower extremity osteoarthritis.[3,10,11] However, data from the 2001 Behavioral Risk Factor Surveillance Survey (BRFSS) indicate that 24% of adults with self-reported diagnosed arthritis are inactive, and 38% report insufficient levels of physical activity with respect to the public health physical activity guidelines of at least 30 minutes a day of moderate physical activity, 5 or more days a week, or 20 minutes a day of vigorous physical activity on 3 or more days a week.[11,12]

Physical activity is comprised of both "purposeful" exercise, as well as "spontaneous" physical activity which are mobility-related activities that occur during daily life, such as walking to get the mail or taking out the trash. Previous research has shown that purposeful exercise improves physical function and OA symptoms; however, it is less understood how spontaneous physical activity or daily physical activity outside of structured exercise, affects physical functioning in individuals with OA. Therefore, this study used accelerometers to objectively assess physical activity habits in sedentary, older adults with knee OA. The primary purpose of this study was to identify whether interindividual variation in daily physical activity is related to age, gender, race, obesity status, or knee pain among older, overweight and obese adults with knee OA who do not regularly perform purposeful exercise; and to determine whether daily physical activity is associated with physical function in these individuals.

Methods

Participants

This study used baseline data from a random subsample (n = 187) of the 454 participants enrolled in the Intensive Diet and Exercise for Arthritis (IDEA) study. The IDEA study was a single-blind, 18-month, randomized, controlled trial that examined the effects of 3 interventions groups (exercise only, dietary weight loss only, and exercise in combination with dietary weight loss) on biomechanical and inflammatory outcomes. Also at baseline, approximately one-half of the participants were randomized to receive additional testing, this included physical activity monitoring using accelerometers. The IDEA study was approved by the Wake Forest University Institutional Review Board, and all participants signed an informed consent form to participate in the study according to the guidelines for human research. Complete details of the trial design and methodology are reported

elsewhere.[13] Briefly, men and women in and around Forsyth County, NC were recruited through local advertisement. All participants were ambulatory, community-dwelling persons, age ≥ 55 years, with 1) Kellgren Lawrence grade II–III (mild to moderate) radiographic tibiofemoral OA or tibiofemoral plus patellofemoral OA of 1 or both knees, 2) $27.0 \leq BMI \leq 40.5$ kg/m^2, and 3) a sedentary lifestyle, defined as not performing more than 30 minutes per week of formal exercise within the past 6 months.

Measures

Demographic characteristics were obtained through self-report questionnaires, and included age, sex, race, income, and years of education. Body height and weight were assessed in the clinic without shoes or heavy clothing on a calibrated scale using standard techniques. Self-reported pain and function were assessed using the Western Ontario McMasters Universities Osteoarthritis Index (WOMAC;[14]). This version asked participants to indicate on a scale from 0 (none) to 4 (extreme) the degree of difficulty they experienced performing activities of daily living in the last 48 hours due to knee OA. Scores were totaled for each of the 2 subscales separately (maximum of 68 for physical function and 20 for pain); higher scores indicate greater pain and lower function.

Physical Activity—The Kenz Lifecorder EX (NL-2200) uniaxial accelerometer (Suzuken CO., LTD[15]) was used to objectively quantify physical activity levels. Previous research supports using motion devices to measure sedentary behavior and have been validated in free-living conditions.[16,17] The Lifecorder EX accelerometer measures 2–3/4” × 1–1/2” × 3/4” and weighs less than 2 ounces. It was attached to a belt or waistband of the participant’s clothing during all waking hours (excluding time for swimming or bathing) for 7 consecutive days. A maximum pulse over 4 seconds was taken as the acceleration value and activities were categorized based on intensity levels (1, or minimal intensity, to 9, or maximal intensity). When the sensor detected 3 acceleration pulses or more for 4 consecutive seconds, the activity was recognized as physical activity. If an acceleration pulse was not immediately followed by another acceleration pulse then it was not counted as a 0 but as a 0.5. This assumed isolated spurts of acceleration were changes in posture and not physical activity. Activities could then be categorized into 9 different intensity levels; light (LPA; < 3 METs), moderate (MPA; 3–6 METs), and vigorous (VPA; > 6 METs).[18] Based on previous research, these intensity levels are closely related and approximate metabolic equivalents.[18] The display of the Lifecorder EX was locked, giving the participant no visual feedback regarding their activity. Participants maintained accelerometer diaries to note the time of day the device was worn. The accelerometer data were uploaded to a computer for analysis and outcome variables included total steps/day, physical activity energy expenditure (PAEE), minutes of light physical activity (LPA), and minutes of moderate or vigorous physical activity (MPA/VPA). Physical activity was also measured using the self-report Physical Activity Scale for the Elderly (PASE). This 15-item questionnaire assessed level of activity (occupational, leisure, and household) over the past 7 days.[19] A higher PASE score indicates a higher level of physical activity. The PASE has been validated and correlates with accelerometer measures of physical activity in older adults.[20]

Objective Measures of Physical Function—Functional capacity was measured with the 6-minute walk (6-min walk). Participants were told to walk, at a self-selected intensity, as far as possible in 6 minutes on an established course. Participants were not given verbal feedback during the test. Results from the 6-min walk distance correlate with symptom-limited maximal oxygen consumption.[18] The Short Physical Performance Battery (SPPB) was used to assess lower extremity function. The battery involves 3 physical performance measures including preferred gait velocity, repeated chair rises, and a standing balance test. Results from each of the 3 tests were scored from 0–4, with 0 indicating inability to perform the test and 4 indicating highest function. Scores from the 3 tasks were summed for the final SPPB score, that ranged from 0 (lowest performance) to 12 (highest performance).[21] Concentric knee strength was measured at baseline using a Kin-Com 125E isokinetic dynamometer (Chattanooga Corp., Chattanooga, TN) set at an angular velocity of 30 deg/sec.[13]

Statistical Analysis

Statistical analyses were restricted to only those participants with complete accelerometer data (n = 160). Complete accelerometer data were defined as a minimum of 10 hours a day of wear time for at least 4 days of the week. These inclusion criteria were based on study findings from the Look AHEAD trial, that used the same minimum device wear inclusion criteria.[22] Those who were excluded from the analysis had inconsistent accelerometer diaries or less than 4 days of 10-hours wearing the device (n = 27).

All analyses were performed with the use of SAS software, version 9.2 (SAS Institute, Inc., Cary, NC), and significance was a α level of 0.05. If we were to adjust for the 5 correlations with each dependent variable used in the regression models, a Bonferroni adjustment would result in a level of significance of 0.01 (0.5/5). The 3 correlations with *P*-value between 0.02 and 0.04 may be interpreted with caution. Participant characteristics are reported as Mean ± SD or as frequency/percent. Pearson correlation analyses were performed to examine the relationships between physical activity variables and participant characteristics and measures of physical function.

All objective physical activity measures were significantly correlated with each other ($P < .01$), correlations ranged from 0.26–0.92. In addition, a manual stepwise regression analysis was used to evaluate the relationship between physical activity (steps/day, PAEE, LPA, MPA/VPA) and participant characteristics and measures of physical function. The full models included age, gender, race, BMI, and WOMAC pain. A main effect with a *P*-value less than 0.05, or an interaction with a *P*-value less than 0.05, was kept. The models used to assess relationships between physical activity and physical function were adjusted for age, gender, race, BMI, and gender by BMI interaction. All multivariate models controlled for intervention group, days between the start of the exercise intervention and the date the accelerometer was first worn (lag time), and intervention group by lag time interaction. These variables were controlled for in the model to ensure that the physical activity data were collected before the start of the exercise intervention.

Results

Participant Demographics and Physical Characteristics

As shown in Table 1, the 160 participants with complete accelerometer data were predominately women (69%), college-educated (71%), and white (82%), with a Mean ± SD age of 66 ± 6 years, ranging from 55–84 years. Table 2 denotes the participants' physical characteristics, physical function, and physical activity. Their obesity status is reflected by a high average BMI, 33.5 ± 3.8 kg/m^2. The average pain score was 5.8 ± 2.8, indicating mild pain. The functional portion of the self-report WOMAC averaged 22.3 ± 10.5, indicating some difficulty performing activities of daily living. The average SPPB score was 11.0 ± 1.2 and the average 6-min walk distance was 478 ± 79 m. There was large (10-fold, range 46–468N) variability in knee strength.

The average total steps taken per day for these participants was, 6209 steps/day, and there was large (10-fold, range 1459–15,949) interindividual variability (Table 2). On average, PAEE was 237 ± 124 kcal/day, and participants spent 131 ± 39 minutes per day performing light activities (LPA). The average minutes/day spent performing moderate—vigorous physical activity (MPA/VPA) was 10.6 ± 8.9 minutes, with only 1 individual having spent 0 minutes/day participating in MPA/VPA. The average PASE score was 120 ± 53, and ranged from 21 to 308, indicating some accumulation of light physical activity. PASE was significantly correlated with our accelerometer measures of physical activity (r = .17, P = .04 for total steps; r = .20, P = .01 for LPA; and r = .17, P = .03 for MPA/VPA).

Predictors of Daily Physical Activity

Simple correlation analyses (Table 3) showed that less physical activity (lower total steps/day, PAEE, and MPA/VPA) was related to older age. In addition, female gender was associated with lower PAEE (but no other measure of physical activity), and being white was associated with higher levels of all measures of physical activity. No significant correlations were observed between BMI or WOMAC pain and any physical activity measure.

Next a stepwise regression analyses was used to determine the independent predictors of each of the physical activity variables (total steps/day, PAEE, LPA, MPA/VPA, and PASE). The model included each physical activity variable and age, gender, race, BMI, WOMAC pain, intervention group, lag time, and intervention group by lag time. Lag time is defined as days between the start of intervention and accelerometer start date. Results (Table 4) showed that older participants had significantly lower total steps/day, less PAEE, and less MPA/VPA on average and that being white was still positively associated with all physical activity variables. BMI and self-reported WOMAC pain were not significant predictors of any physical activity variable.

Relationships Between Physical Activity Variables and Physical Function

Simple correlation analyses showed that physical function (6-min walk and SPPB) were associated with all physical activity variables, except LPA (Table 5). For each physical function measure, separate models were fitted including 1 physical activity variable at a time

adjusting for age, gender, race, BMI, intervention group, lag time, and intervention group by lag time (Table 6). Results showed greater total steps/day, greater PAEE, and greater minutes of MPA/VPA, were associated with a greater 6-min walk distance. Greater minutes of MPA/VPA was associated with a higher SPPB score, which is indicative of better lower extremity function. None of the physical activity variables were associated with knee-strength or the self-reported measure of physical function (WOMAC).

Discussion

This study contributes to previous literature regarding physical activity habits of overweight/obese older adults with knee OA. By using accelerometers to objectively measure physical activity, our data provide a daily estimate of spontaneous physical activity in those with knee OA. The findings show a wide variability of daily movement that is inversely related to age, but not to obesity status. Moreover, we found that more physical activity was evident in Whites vs. African Americans, and in males compared with females. Of note, pain, one of the most common symptoms of OA, was not associated with physical activity. This may indicate that pain may not be a factor limiting movement in individuals with mild to moderate knee OA.

Analyses of the relationships between measures of physical activity and physical function in this population showed that 2 measures of physical function (6-min walk and global lower extremity function, SPPB) were independently associated with at least 1 measure of physical activity, while knee strength and self-reported physical function (WOMAC) were not independently associated with any measure of physical activity. Interestingly, both the 6-min walk and SPPB were highly related to the number of minutes of moderate-vigorous activity (MPA/VPA). This finding, coupled with prior clinical trial data showing that moderate-intensity exercise interventions improve physical function and reduce pain in older OA patients,[6–9] indicate that it is important to encourage at least moderate-intensity physical activity in older adults with knee OA as a part of their regular treatment plan in an effort to maintain or improve function and mobility.

Previous research shows that the majority of adults in the U.S. are inactive, despite the known benefits of physical activity.[23] On average, the participants in this study were moderately active (MPA) for less than 10 minutes a day, and spent an average of only 131 minutes a day performing light physical activity (LPA). However, participants walked an average of 6209 steps/day, which is consistent with a review suggesting that healthy older adults accumulate between 6000–8000 steps/day, and older adults with chronic diseases accumulate 3500–5550 steps/day.[24,25] Only a small percentage of the study population (7.5%) accumulated the general population recommendation to take at least 10,000 steps per day. Data from this study are in line with previous research that measured physical activity in OA patients.[11,12,26] However, these previous studies assessed physical activity using self-report measures; therefore, we cannot directly compare the magnitude of physical activity due to differences in measurement tools.

The gender and race differences we observed in levels of daily physical activity are supported by prior research showing that, besides age, prominent risk factors for physical

inactivity in individuals with knee OA include being female and a minority.[1,6,27,28] The 2004 Behavioral Risk Factor Surveillance Survey Arthritis Burden Module (BRFSS) assessed self-reported physical activity in patients with professionally diagnosed arthritis, found that men were more likely to engage in physical activity compared with women, and that inactive individuals were less educated, more likely to be African American, and over the age of 65 years.[27]

The results of this study should be interpreted in light of a few considerations. First, the measurements of physical activity were both subjective and objective, which expands previous research that tended only to use self-reported measure of physical activity. Next, the study was conducted in older, overweight or obese men and women who had radiographical evidence of knee OA—a population already at increased risk of disability. These participants met the inclusion criteria for the IDEA study therefore; these findings are only generalizable to this population. Certain limitations are also inherent in this study. Most importantly, the study was a cross-sectional observation, and assumptions regarding directionality or causality, especially between the physical activity and physical function measures, cannot be made. In addition, uniaxial accelerometers detect movement that occurs only in the vertical plane and accelerometers lack the ability to capture water-based activities and upper body activities such as lifting weights; which may under report some individuals' physical activity. Further, although accelerometers are an acceptable tool for measuring physical activity, the Lifecorder EX accelerometer has only been validated in a younger, healthy, population[29,30] and in an older male population (mean age 48 ± 10 years).[31] This specific accelerometer has set, predetermined intensity levels that cannot be manually adjusted to capture varying intensity levels of physical activity. Future research may find it beneficial to adjust the intensity cut points to capture less intense activities for an older adult population, as the predetermined moderate intensity activity level (3–6 METs) may be more vigorous "relative" intensity level.

Despite the limitations, these findings contribute to the knowledge of the physical activity habits of older adults with the common chronic condition of knee OA. Importantly, participants that were more active had better physical function scores than those who were less active. Therefore, promoting physical activity in a population at high risk for disability may help maintain functional independence and delay the onset of disability.

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References

1. Farr JN, Going SB, Lohman TG, et al. Physical activity levels in patients with early knee osteoarthritis measured by accelerometry. Arthritis Rheum. 2008; 59(9):1229–1236. doi:10.1002/art.24007. [PubMed: 18759320]

2. vos-Comby L, Cronan T, Roesch SC. Do exercise and self-management interventions benefit patients with osteoarthritis of the knee? A metaanalytic review. J Rheumatol. 2006; 33(4):744–756. [PubMed: 16583478]
3. American Geriartric Society Panel on Exercise and Osteoarthritis. Exercise prescription for older adults with osteoarthritis pain: consensus practice recommendations. J Am Geriatr Soc. 2001; 49:808–823. doi:10.1046/j.1532-5415.2001.00496.x. [PubMed: 11480416]
4. Fiatarone MA, Evans WJ. The etiology and reversibility of muscle dysfunction in the aged. J Gerontol. 1993; 48(Spec No):77–83. doi:10.1093/geronj/48.Special_Issue.77. [PubMed: 8409245]
5. Fisher NM, Gresham GE, Abrams M, Hicks J, Horrigan D, Pendergast DR. Quantitative effects of physical therapy on muscular and functional performance in subjects with osteoarthritis of the knees. Arch Phys Med Rehabil. 1993; 74(8):840–847. doi:10.1016/0003-9993(93)90011-X. [PubMed: 8347069]
6. Baker K, McAlindon T. Exercise for knee osteoarthritis. Curr Opin Rheumatol. 2000; 12(5):456–463. doi:10.1097/00002281-200009000-00020. [PubMed: 10990187]
7. Ettinger WH Jr, Burns R, Messier SP, et al. A randomized trial comparing aerobic exercise and resistance exercise with a health education program in older adults with knee osteoarthritis. The Fitness Arthritis and Seniors Trial (FAST). JAMA. 1997; 277(1):25–31. doi:10.1001/jama.1997.03540250033028. [PubMed: 8980206]
8. Ettinger WH Jr. Physical activity, arthritis, and disability in older people. Clin Geriatr Med. 1998; 14(3):633–640. [PubMed: 9664110]
9. Miller GD, Rejeski WJ, Williamson JD, et al. The Arthritis, Diet and Activity Promotion Trial (ADAPT): design, rationale, and baseline results. Control Clin Trials. 2003; 24(4):462–480. doi:10.1016/S0197-2456(03)00063-1. [PubMed: 12865040]
10. Chang R, Roubenoff R, Mayer J, Brandt KD, Schanberg LE. Work Group recommendations: 2002 Exercise and Physical Activity Conference, St Louis, Missouri. Arthritis Rheum. 2003; 49(2):280. doi:10.1002/art.11011. [PubMed: 12687524]
11. Fontaine KR, Heo M, Bathon J. Are US adults with arthritis meeting public health recommendations for physical activity? Arthritis Rheum. 2004; 50(2):624–628. doi:10.1002/art.20057. [PubMed: 14872507]
12. Fontaine KR, Heo M. Changes in the prevalence of US adults with arthritis who meet physical activity recommendations, 2001–2003. J Clin Rheumatol. 2005; 11(1):13–16. doi:10.1097/01.rhu.0000152143.25357.fe. [PubMed: 16357691]
13. Messier SP, Legault C, Mihalko S, et al. The Intensive Diet and Exercise for Arthritis (IDEA) trial: design and rationale. BMC Musculoskelet Disord. 2009; 10:93. doi:10.1186/1471-2474-10-93. [PubMed: 19638215]
14. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol. 1988; 15(12):1833–1840. [PubMed: 3068365]
15. Suzuken. Kenz Activity Monitor Lifecorder Ex Operation Manual. Japan: SUZUKEN CO., LTD; 1985. Nagoya 461–8701
16. Tudor-Locke CE, Myers AM. Challenges and opportunities for measuring physical activity in sedentary adults. Sports Med. 2001; 31(2):91–100. doi:10.2165/00007256-200131020-00002. [PubMed: 11227981]
17. Westerterp KR. Physical activity assessment with accelerometers. Int J Obes Relat Metab Disord. 1999; 23:S45–S49. doi:10.1038/sj.ijo.0800883. [PubMed: 10368002]
18. Kumahara H, Schutz Y, Ayabe M, et al. The use of uniaxial accelerometry for the assessment of physical-activity-related energy expenditure: a validation study against whole-body indirect calorimetry. Br J Nutr. 2004; 91(2):235–243. doi:10.1079/BJN20031033. [PubMed: 14756909]
19. Washburn RA, Smith KW, Jette AM, Janney CA. The Physical Activity Scale for the Elderly (PASE): development and evaluation. J Clin Epidemiol. 1993; 46(2):153–162. doi:10.1016/0895-4356(93)90053-4. [PubMed: 8437031]

20. Washburn RA, Ficker JL. Physical Activity Scale for the Elderly (PASE): the relationship with activity measured by a portable accelerometer. J Sports Med Phys Fitness. 1999; 39(4):336–340. [PubMed: 10726435]
21. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol. 1994; 49(2):M85–M94. doi:10.1093/geronj/49.2.M85. [PubMed: 8126356]
22. Jakicic JM, Gregg E, Knowler W, et al. Activity patterns of obese adults with type 2 diabetes in the look AHEAD study. Med Sci Sports Exerc. 2010; 42(11):1995–2005. doi:10.1249/MSS.0b013e3181e054f0. [PubMed: 20386337]
23. Pate RR, Pratt M, Blair SN, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA. 1995; 273(5):402–407. doi:10.1001/jama.1995.03520290054029. [PubMed: 7823386]
24. Tudor-Locke C, Hart TL, Washington TL. Expected values for pedometer-determined physical activity in older populations. Int J Behav Nutr Phys Act. 2009; 6:59. doi:10.1186/1479-5868-6-59. [PubMed: 19706192]
25. Tudor-Locke CE, Myers AM. Methodological considerations for researchers and practitioners using pedometers to measure physical (ambulatory) activity. Res Q Exerc Sport. 2001; 72(1):1–12. doi:10.1080/02701367.2001.10608926. [PubMed: 11253314]
26. Haapanen N, Miilunpalo S, Vuori I, Oja P, Pasanen M. Association of leisure time physical activity with the risk of coronary heart disease, hypertension and diabetes in middle-aged men and women. Int J Epidemiol. 1997; 26(4):739–747. doi:10.1093/ije/26.4.739. [PubMed: 9279605]
27. Fontaine KR, Haaz S. Risk factors for lack of recent exercise in adults with self-reported, professionally diagnosed arthritis. J Clin Rheumatol. 2006; 12(2):66–69. doi:10.1097/01.rhu.0000208611.19231.f0. [PubMed: 16601539]
28. Kaplan MS, Huguet N, Newsom JT, McFarland BH. Characteristics of physically inactive older adults with arthritis: results of a population-based study. Prev Med. 2003; 37(1):61–67. doi:10.1016/S0091-7435(03)00059-8. [PubMed: 12799130]
29. Yamada S, Baba Y. Validity of daily energy expenditure estimated by calorie counter combined with accelerometer. J UOEH. 1990; 12(1):77–82. [PubMed: 2333445]
30. Yamada S, Baba Y. Assessment of physical activity by means of a calorie counter combined with an accelerometer. Sangyo Igaku. 1990; 32(4):253–257. doi:10.1539/joh1959.32.253. [PubMed: 2232320]
31. Rafamantanantsoa HH, Ebine N, Yoshioka M, et al. Validation of three alternative methods to measure total energy expenditure against the doubly labeled water method for older Japanese men. J Nutr Sci Vitaminol (Tokyo). 2002; 48(6):517–523. doi:10.3177/jnsv.48.517. [PubMed: 12778890]

Table 1

Participant Demographics (n = 160)

Characteristics	n	%
Race		
White	132	82
African American	28	18
Sex		
Male	50	31
Female	110	69
Education		
High school or less	46	29
College	73	46
Post graduate	41	25
Income		
< $35,000	44	28
$35,000–$75,000	66	41
> $75,000	50	31
Employment		
Currently employed	49	31
Retired	91	57
Other	20	12

Table 2

Participant Physical Characteristics, Physical Activity, and Physical Function (n = 160)

Characteristics	Mean ± SD	Minimum	Maximum
Age (years)	66± 6	55	84
Body Mass Index, kg/m^2	33.5 ± 3.8	27.0	40.5
WOMAC pain score	5.8 ± 2.8	0	14.0
WOMAC function score	22.3 ± 10.5	0	48.0
6-min walk distance (m)	478 ± 79	249	768
SPPB score	11.0 ± 1.2	8	12
Knee extensor strength* (n)	229 ± 85	46	468
Average steps/day	6209 ± 2554	1459	15,949
PAEE (kcal/day)	237 ± 124	33	790
LPA (min/day)	131 ± 39	32	264
MPA (min/day)	10 ± 8.3	0	39.4
VPA (min/day)	0.6 ± 1.6	0	12.2
MPA/VPA(min/day)	10.6 ± 8.9	0	41.7
PASE score*	120 ± 53	21	308

*PASE score n = 155 and Knee Extensor Strength n = 122

Abbreviations: PAEE, Physical Activity Energy Expenditure; LPA, Light Physical Activity; MPA, Moderate Physical Activity; VPA, Vigorous Physical Activity; MPA/VPA, Moderate-to-Vigorous Physical Activity; PASE, Physical Activity Scale for the Elderly.

Table 3

Correlations Between Physical Activity Variables and Participant Demographic and Physical Characteristics (n = 160)

Variable	Steps/day	PAEE	LPA	MPA/VPA	PASE*
1. Age	$r = -0.21$ **(0.01)**	$r = -0.26$ **(<0.01)**	$r = -0.08$ (0.33)	$r = -0.22$ **(0.01)**	$r = -0.02$ (0.80)
2. Female	$r = -0.08$ (0.40)	$r = -0.24$ **(<0.01)**	$r = .07$ (0.39)	$r = .09$ (0.24)	$r = -0.05$ (0.53)
3. White	$r = .24$ **(<0.01)**	$r = .20$ **(0.01)**	$r = .20$ **(0.01)**	$r = .21$ **(0.01)**	$r = .19$ **(0.02)**
4. BMI	$r = -0.05$ (0.50)	$r = .13$ (0.10)	$r = -0.07$ (0.38)	$r = -0.06$ (0.43)	$r = -0.14$ (0.09)
5. WOMAC pain	$r = -0.08$ (0.30)	$r = -0.12$ (0.14)	$r = -0.04$ (0.58)	$r = -0.14$ (0.07)	$r = .09$ (0.27)

Abbreviations: r = Pearson correlation coefficient (P-value); PAEE, Physical Activity Energy Expenditure; LPA, Light Physical Activity; MPA/VPA, Moderate-to-Vigorous Physical Activity; PASE, Physical Activity Scale for the Elderly; WOMAC, Western Ontario McMasters Universities Osteoarthritis Index; Steps/day: Average Total Daily Steps.

Note. **Bolded** values are significant.

*PASE score n = 155.

Table 4

Stepwise Models for Physical Activity Variables With Participant Demographic and Physical Characteristics (n = 160)

	Steps/day	PAEE	LPA	MPA/VPA	*PASE
Variable	**β (SE)**	**β (SE)**	**β (SE)**	**β (SE)**	**β (SE)**
1. Age	−82.3 (30.7) $P = .01$	−5.8 (1.5) $P < .001$	–	0.3 (0.1) $P < .01$	–
2. Female	–	−71.8 (19.6) $P < .001$	–	–	–
3. White	1750 (507) $P < .001$	64.6 (23.8) $P = .01$	20.7(8.1) $P = .01$	5.2 (1.7) $P < .01$	23.2 (11.2) $P = .04$

*PASE score n = 155.

Abbreviations: Steps/day: Average Total Daily Steps; PAEE, Physical Activity Energy Expenditure; LPA, Light Physical Activity; MPA/VPA, Moderate-to-Vigorous Physical Activity; PASE, Physical Activity Scale for the Elderly.

Table 5

Correlation (*P*-value) Between Physical Activity and Physical Function Variables (n = 160)

	Physical function			
Physical activity	**WOMAC function**	**6-min W**	**SPPB**	**Knee strength***
1. Steps/day	*r* = −0.07 (0.37)	*r* = **0.38 (<.0001)**	*r* = **0.24 (<0.01)**	*r* = .13 (0.15)
2. PAEE	*r* = −0.09 (0.28)	*r* = **0.44 (<.0001)**	*r* = **0.197 (0.01)**	*r* = **0.23 (0.01)**
3. LPA	*r* = −0.06 (0.47)	*r* = .14 (0.09)	*r* = **0.195 (0.01)**	*r* = −0.04 (0.66)
4. MPA/VPA	*r* = −0.07 (0.35)	*r* = **0.39 (<.0001)**	*r* = **0.315 (<.0001)**	*r* = .09 (0.33)
5. PASE score	*r* = .10 (0.22)	*r* = **0.17 (0.03)**	*r* = **0.165 (0.04)**	*r* = .13 (0.17)

Abbreviations: *r* = Pearson correlation coefficient (*P*-value); PAEE, Physical Activity Energy Expenditure; LPA, Light Physical Activity; MPA/VPA, Moderate-to-Vigorous Physical Activity; PASE, Physical Activity Scale for the Elderly; WOMAC, Western Ontario McMasters Universities Osteoarthritis Index; Steps/day: Average Total Daily Steps; 6-min W, 6-minute walk.

Note. **Bolded** values are significant.

* Knee strength n = 122.

Table 6

Models for Physical Function With Each Physical Activity Measure (n = 160)

	WOMAC function	6-min W	SPPB	Knee strength*
Variable	**β (SE)**	**β (SE)**	**β (SE)**	**β (SE)**
1. Steps/day	–	0.01 (0.002) *P* < .01	–	–
2. PAEE	–	0.2 (0.05) *P* < .001	–	–
3. LPA	–	–	–	–
4. MPA/VPA	–	2.9 (0.65) *P* < .001	0.03 (0.01) *P* = .01	–
5. PASE score	–	–	–	–

Abbreviations: PAEE, Physical Activity Energy Expenditure; LPA, Light Physical Activity; MPA/VPA, Moderate-to-Vigorous Physical Activity; PASE, Physical Activity Scale for the Elderly; WOMAC, Western Ontario McMasters Universities Osteoarthritis Index; Steps/day: Average Total Daily Steps; 6-min W, 6-minute walk; SPPB, Short Physical Performance Battery.

Note. Model is adjusted for age, gender, race, BMI, intervention group, lag time (days between accelerometer and intervention start), and intervention group by lag time. Only significant results are presented in the table

*Knee strength n = 122.