Published in final edited form as:
*Arthritis Care Res (Hoboken)*. 2011 December ; 63(12): 1766–1772. doi:10.1002/acr.20644.

# Relationship Between Accelerometer-based Measures of Physical Activity and the Yale Physical Activity Survey in Adults with Arthritis

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## Abstract

**Objective—**To evaluate the correlation between the Yale Physical Activity Survey (YPAS) scores and objective accelerometer measures of time spent in light, moderate-to-vigorous intensity physical activities (MVPA), and moderate-to-vigorous activities in bouts lasting at least 10 minutes.

**Methods—**This study analyzed baseline data from 171 persons with RA and 139 persons with OA in a randomized clinical trial (IMPAACT). Persons fulfilling the 1988 ACR criteria for RA and persons with symptomatic, radiologic knee OA (Kellgren-Lawrence Class ≥ 2) wore an accelerometer for 7 days, then responded to the YPAS questionnaire, and questions regarding demographics (age, gender, and race) and health factors [BMI, disease status (HAQ/WOMAC), comorbidities, pain and function]. Spearman Correlation coefficients were estimated between each YPAS summary measure and accelerometer measures.

**Results—**In the RA participants the strongest correlation was between the YPAS Activity Dimensions Summary Index (Y-ADSI) and Average Daily Minutes of Bouted Moderate/Vigorous Activity (r = 0.51). Additionally, the Y-ADSI correlated significantly with both objectively measured average daily accelerometer counts (r= 0.45) and average daily minutes of Moderate/Vigorous Activity (r = 0.43). For OA participants, a similar pattern emerged: the Y-ADSI had significant correlations with average daily minutes of Bouted Moderate/Vigorous Activity (r = 0.36), average daily minutes of Moderate/Vigorous Activity (r = 0.31), and average daily counts (r = 0.24).

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**Conclusions—**For both RA and OA groups, the summary index Y-ADSI had the strongest significant correlations with objectively measured physical activity, which supports Y-ADSI use as a tool for clinical applications and in rheumatology research.

## Introduction

In both population and clinical settings, physical activity promotion in persons with arthritis would be greatly enhanced by the availability of reliable, valid, and efficient self-report instruments that assess physical activity behavior of those with arthritis. Because persons with arthritis share the physical challenges that confront older populations and those with chronic conditions, focusing on lower intensity physical activities associated with functional independence[1] has been recommended. Self-report physical activity measures used with arthritis populations include the Physical Activity Scale for the Elderly (PASE)[2] and the Life Activity Record (ACTRE), which was formulated specifically for persons with musculoskeletal disorders.[3-4] While the PASE had moderate correlations with objective measures of physical activity[2], the ACTRE has not been validated with objective measures, and both require significant time and energy to collect, limiting their use in research and clinical settings. Objective assessment of physical activity using accelerometers provides reliable, accurate measurement, but can be expensive to implement in large scale studies or in clinical practice. Therefore, a reliable, valid self-report measure of physical activity that has clinical applicability would be a valuable addition to providers' resources.

The Yale Physical Activity Survey (YPAS) was developed specifically for the measurement of physical activity in epidemiologic studies of older adults.[5] The YPAS, like the PASE and ACTRE, includes questions about lower intensity functional activities, as well as the standard higher intensity sporting and leisure activities typically found in many physical activity surveys. However, an advantage of the YPAS for adults with rheumatic disease is its ease in data collection which increases its potential for use in research and clinical settings.

The two-part YPAS measures physical activity over a time period of a typical recent week (Part One), and from the past month (Part Two). Previous studies demonstrated a good correlation of the Yale Physical Activity Survey (YPAS) scores with objectively measured accelerometer counts in normal healthy volunteers,[6] but that relationship has not been examined in the context of either degenerative osteoarthritis (OA) or rheumatoid arthritis (RA), both of which threaten mobility. Therefore, the purpose of this study was to examine the performance of the YPAS as a measure of self-reported physical activity compared to objective accelerometer assessment in individuals with RA and OA.

## Methods

### Study Population and Sample. Study Population and Sample

This study analyzed baseline (pre-intervention) data from 171 persons with RA and 139 persons with OA who participated in the randomized clinical trial, Increasing Motivation for Physical Activity in Arthritis Clinical Trial (IMPAACT) of lifestyle physical activity promotion. This study received IRB approval, and written informed consent was obtained from each of the participating subjects. Eligible persons with RA were recruited for this study from two faculty rheumatology practices of a single academic medical center. Eligible persons with knee OA were recruited from rheumatology, general medicine, and orthopedic surgery practices at the same academic medical center, from two research registries, and through advertisements to the general public placed in buses and trains. RA participants fulfilling the 1988 ACR criteria for RA[7] and persons with symptomatic, radiologic knee OA (Kellgren-Lawrence Class 2 or higher) were eligible if they met the following criteria: 1) age 18 or greater, 2) no primary diagnosis of fibromyalgia, 3) no functionally limiting co-

morbidities such as spinal stenosis, peripheral vascular disease or residual effects of stroke, 4) able to ambulate at least household distances (50ft), 5) BMI < 35, 6) cognitively intact and able to speak and understand English, 7) no contraindication to physical activity intervention due to comorbid conditions, 8) no total joint replacement surgery within the past 12 months and no plans for total joint replacement in the next 24 months, and 9) no plans to relocate from the metropolitan area in the next 24 months. Participants were instructed to "do what they would normally do in a typical week" before accelerometer measures were obtained in this pre-intervention assessment.

## Physical Activity Measures

**The Yale Physical Activity Survey (YPAS)—**Briefly, YPAS Part One requires approximately 15 minutes to assess five categories of activities performed during a *typical week* from the past month: housework activities, yardwork, care-giving of elders or children, purposeful exercise, and leisure (recreational) activities. The values from YPAS Part One are used to calculate the YPAS Total Time Index (Y-TTI) and the YPAS Energy Expenditure Index (Y-EEI). For purposes of this study, subjects were instructed to reflect on activities from the past week (during which the accelerometer was worn.) The YPAS Part Two requires 5-7 minutes to assess five activity dimensions: vigorous activity, leisure walking, moving, standing, and sitting behaviors, performed over the *past month*. The YPAS Part Two scores are used to calculate an Activity Dimensions Summary Index (Y-ADSI). The YPAS instrument has established reproducibility and validity.[5]

**Accelerometer Measures and Procedures—**Physical activity was monitored in all study participants using a GT1M ActiGraph (Pensacola, FL) accelerometer. The GT1M ActiGraph is a small uniaxial accelerometer that measures vertical acceleration and deceleration [8]. Accelerometer output is an activity 'count', which is the weighted sum of the number of accelerations measured over a time period (e.g. in this case 1 minute), where the weights are proportional to the magnitude of measured acceleration. The validity and reliability of ActiGraph accelerometers under field conditions have been established in many populations including RA [9-12] and knee OA.[13-14]

During the week prior to YPAS administration, participants were instructed to don the accelerometer upon arising in the morning, and wear continuously (except for water activities) until going to bed at night for seven consecutive days while going about their usual daily activities. The unit was worn on a belt at the natural waistline on the right hip in line with the right axilla. Participants also maintained a daily log (time sheet) to record when the accelerometer was put on in the morning and removed at night. At least one weekend valid day of data was present for 100% of the sample. Skipped days reported on the time sheets (2.4%) were just as likely to be weekdays as weekend days and were excluded from the analysis.

## Descriptive Measures

**Demographic factors** included age, gender, and race (White, African American, Asian, Hispanic or Other), were collected via telephone interview.

**Health factors** included body mass index (BMI), disease status, comorbidities, pain and function. BMI was calculated using height and weight measured at the time of the baseline visit [weight (kilograms)/height $(m)^2$].[15] Disease Status was defined as the duration of arthritis disease activity in years. Comorbidities were classified as either 'mobility-limiting' (e.g. COPD, asthma) or 'non mobility-limiting'. Pain and function were assessed in participants with RA using the Health Assessment Questionnaire (HAQ), which has demonstrated reliability and validity in RA .[16] The HAQ Pain Scale measures arthritis pain

severity on a scale between 0 (best) and 10 (worst), and function is based on the HAQ Disability (DI) Scales,[17] ranging between 0 (best) and 3 (worst). Pain and function were assessed in participants with knee OA using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)[18] which has demonstrated reliability in validity in OA.[19] The Likert version of the WOMAC provides a pain score between 0 (best) and 20 (worst) and a physical function score between 0 (best) and 88 (worst).

### Statistical Analysis

Accelerometer data from each participant were analytically filtered to identify non-wear periods (a period the monitor was potentially removed during a day) and days with sufficient wear time to be analyzed. Non-wear periods were defined as ≥90 minutes with zero activity counts (allowing for two interrupted minutes with counts<100)[20]. A valid day of monitoring was defined as 10 or more wear hours in a 24-hour period, which was verified from accelerometer output.[21] For this study, we included only participants who had 4 or more valid days of monitoring. These methods are consistent with accelerometer methodology used in the general population and have been validated in patients with rheumatic disease[18, 20].

Accelerometer data were scored for the purposes of standardization. First, an average daily count value was calculated for each subject. We then applied intensity thresholds used by the National Cancer Institute (NCI)[21] on a minute-by-minute basis to classify accelerometer counts into three intensity levels: light (100-2019 counts), moderate (2020-5998 counts), and vigorous (≥5999 counts). Total daily time (minutes) was summed for each intensity level. In addition, we calculated daily bouted minutes of moderate to vigorous (MV) physical activity, a 'bout' being defined as 10 or more consecutive minutes above the 2020 count threshold, with allowance for interruptions of 1 or 2 min below threshold, consistent with NCI methodology.[21] Weekly totals were summed from the daily totals or estimated as 7 times the average daily total for persons with at least 4 valid days of monitoring.

Spearman Correlation coefficients were calculated to estimate the correlation between each of the YPAS physical activity summary measures (Y-TTI, Y-EEI, and Y-ASDI) and four accelerometer physical activity measures [average daily counts, mean light intensity activity minutes, mean moderate-vigorous activity minutes (MVPA), and mean moderate-vigorous minutes occurring in bouts of 10 min].

## Results

### RA Participants

A total of 171 adults meeting ACR criteria for RA participated in accelerometer monitoring. Demographic characteristics for both diagnostic groups can be found in Table 1. The age distribution of the sample was broad (range 23 to 86 yrs, mean age= 55 yrs), but skewed to older ages. Participants were primarily female (82%), and White (76%). On average, participants had RA disease 13.5 years (SD= 10). Participants tended to be overweight (mean BMI= 28). HAQ pain scores were relatively low at a mean score of 3.39 (out of 10); HAQ function scores averaged 0.69 (out of 3). Twenty-eight percent of participants (n=48) reported taking a prescription medication for at least one co-morbidity that may have affected their ability to be mobile: The most frequent were: osteoporosis (n=28), respiratory conditions (n=13), and cardiovascular conditions (n=7). In addition, several subjects reported a diagnosis of depression (n= 32), which may have also have affected physical activity.

### OA Participants

A total of 139 adults meeting the study's criteria for knee OA participated in accelerometer monitoring. Participants had an average age of 63 years (range 34 to 91), were primarily female (58%), and White (58%). On average, participants had OA disease for 11 years (SD= 11), and tended to be overweight (33%) or obese (52%). WOMAC pain scores had a mean of 5.6 (out of 20); WOMAC function scores averaged 17.5 (out of 68). Twenty-four percent of participants (n=34) reported at least one co-morbidity that may have affected their ability to be mobile. The reported mobility-limiting comorbidities (in descending order of frequency) were osteoporosis (n=13), respiratory conditions (n=12), and cardiovascular conditions (n=9). Again, several subjects reported a diagnosis of depression (n= 12), which may have also have affected physical activity.

### Physical Activity Measures

Table 2 describes the physical activity (both subjective and objective measures) of study participants. The objective measures of physical activity supported findings from the self-report measures, with some differences in activity patterns. Participants with RA reported spending an average of 26 hours per week engaged in physical activity, which resulted in a mean Energy Expenditure Index of 5577 kilocalories per week. The Activity Dimensions Summary Index mean for the RA participants was 48. Higher scores indicate more active lifestyles, with possible scores ranging from 0-133. Accelerometer measures indicated that the greatest amount of activity occurred within the context of light intensity physical activity (median= 481 minutes/day), followed by moderate-vigorous minutes (median= 14 minutes/day), and finally bouted moderate-vigorous activity (median= 3 minutes/day). In fact, 94% of all activity time was spent engaged in light intensity activity.

Participants with OA reported spending an average of 32 hours per week engaged in physical activity, which resulted in a mean Energy Expenditure Index of 7435 kilocalories per week. The Activity Dimensions Summary Index mean for the OA participants was 51. Accelerometer measures again indicated that the greatest amount of activity (again, 94%) occurred within the context of light intensity physical activity (median= 459 minutes/day), followed by moderate-vigorous minutes (median= 15 minutes/day), and finally bouted moderate-vigorous activity (median=3 minutes/day).

Correlations among the subjective and objective measures in the RA participants revealed modest but statistically significant positive associations between all YPAS summary measures (Table 3) and at least one accelerometer measure, the strongest being between the Y-ADSI summary score and average daily minutes of bouted moderate/vigorous activity (correlation [r] = 0.51). Additionally, the Y-ADSI demonstrated significant positive associations with both average daily accelerometer counts (r = 0.45) and average daily minutes of unbouted MVPA (r = 0.43). However, the Y-ADSI did not correlate with objectively measured light intensity activity, which had weaker but significant correlations with the other two YPAS summary measures: Total Time Index (r = 0.26) and Energy Expenditure Index (r = 0.15). Among participants with OA (Table 4), the Y-ADSI had modest but significant correlations with accelerometer measures of average daily minutes of bouted MVPA (r = 0.36), average daily minutes of unbouted MVPA (r = 0.31), and average daily accelerometer counts (r = 0.24). Additionally, the Energy Expenditure Index was significantly correlated with accelerometer measures of average daily minutes of bouted MVPA (r = 0.17). However, the YPAS Total Time Index was not significantly correlated with any accelerometer measures in the OA group.

## Discussion

The purpose of this study was to evaluate whether scores on YPAS summary measures from adults with RA and OA correlate with objectively measured time spent in light, MVPA, and bouted MVPA, as well as average daily accelerometer counts. In general, the Y-ASDI had the strongest association with objectively measured physical activity. Among all the YPAS summary scores, it had the highest correlation with average daily accelerometer counts, with MVPA, and with bouted MVPA, in both RA and knee OA participants. The ASDI is a weighted summary measure (analogous to accelerometer counts) that gives higher scores to more intense physical activity behavior, which may account for a stronger correlation with higher intensity accelerometer measures. The Y-ADSI is also more sensitive than other YPAS summary measures to time spent in MVPA, which has relevance to federal guideline physical activity assessments. Because the Y-ADSI requires much less time to administer than the entire YPAS, it could easily be administered and scored in a clinical setting to gain perspective on the physical activity (or lack thereof) of persons with arthritis, making it an efficient summary measure for both diagnostic groups.

Objective accelerometer monitoring showed the vast majority (94%) of physical activity time for these study participants was spent in light intensity activities (median= 481 minutes/day for RA; median= 459 minutes/day for OA), a noteworthy finding, as neither the general health benefits nor the arthritis-specific benefits of light intensity activity are known. Accelerometer- measured light intensity activity was significantly correlated with Total Time Index (r=0.26) and the Energy Expenditure Index (r= 0.30), but only in persons with RA. As noted in Table 4, for persons with OA, correlations between the YPAS measures and accelerometer measures were lower in general, which may be related to measurement precision issues. Possible explanations for the lower correlations in the OA group include the potential for less precise accelerometer monitoring in the OA group. The higher BMI noted in the OA participants may have interfered with accurate accelerometer data collection, especially at slower walking speeds,[22] as can be seen in older persons with knee symptoms.[23, 24] In addition, the demand for more detailed memory regarding the week's activities in YPAS Part 1 (the accelerometer reference week) may have diminished the reporting precision, especially in the older OA subjects, resulting in reducing the correlation. The Y-TTI and Y-EEI values for the OA sample were less precise (larger variation) than those for the RA respondents. However, it is interesting and somewhat counter-intuitive to note that the best correlations were found with the section of the YPAS (Part 2) that inquires about the past month and not Part 1 which asks for activity recall regarding the accelerometer reference week. Overall, this finding is not terribly surprising, because recall for constant low-level activity may not be as strong or accurate as it is for activities that cause more notable physiological responses such as increased heart rate, breathing and perspiration. In YPAS reliability testing, DiPietro also found that light intensity activities were not recalled as precisely as higher intensity activities.[5] It may be that if light intensity activity is the activity of interest, objective measurement is required to adequately capture it.

The performance of the YPAS in the current study compared favorably with other self-report measures that have been compared with accelerometer data. For example, the Physical Activity Scale for the Elderly (PASE) scores were significantly correlated with average 3-day accelerometer readings (r = 0.49) in the total sample and (r = 0.64) in persons over age 70 years.[2] In a New Zealand validation study[25] of the International Physical Activity Questionnaire (IPAQ) (n=70 adults aged 18-65 years), moderate correlations were seen with 7-day ActiGraph data for time spent in moderate-intensity physical activity (r =0.30) and total physical activity (sum of moderate and vigorous-intensity physical activity, r =0.32). The 7-Day Physical Activity Recall (7-Day PAR) was compared to data obtained from the same week using the RT3 triaxial accelerometer over 3 time points from 115 adults

aged 33-85 yrs. There was significant moderate agreement between the 7-Day PAR and the accelerometer with longitudinal serial correlation coefficients of r=0.54 at baseline, r= 0.24 at year 1, and r=0.53 at year 2.[26] Finally, the self-report instrument used for the 2001 Behavioral Risk Factor Surveillance System (BRFSS) was compared to accelerometer data obtained from 60 subjects followed for 22 days in Columbia, SC. Spearman correlation coefficients ranged from r= 0.16 to r= 0.27 for moderate intensity activity, and from r= .52 to r= .63 for vigorous intensity activities[27]. The BRFSS physical activity questions had been updated in 2001 to include domains of leisure time, household, and transportation-related activity of moderate and vigorous intensity, and walking questions, so strong correlation might have been expected.

## Limitations of the study

There were some limitations to this study that must be considered. First, accelerometers are not entirely able to account for activity associated with cycling or water sports, which may have affected the outcome. We attempted to rectify this issue with a review of the YPAS items that asked for estimated time engaged in cycling and water activities. Very few participants reported water activities (4% of OA and 5% of RA). Although more participants reported cycling (20% of OA, 15% of RA), the actual amount of minutes spent cycling (median for OA was 70 minutes; in RA the median was 60 minutes) comprised a small percentage of the total activity time. It is likely that correlations would have been even stronger if these activities had been accurately reflected in the accelerometer counts; this suggests that our correlations represent a conservative estimate. The higher BMI of this sample may have interfered with accurate accelerometer data collection, especially at different walking speeds. It has been shown that abdominal adipose can cause inaccuracies in both placement and sensory capacity of the equipment [22]. Mobility-limiting co-morbidities were inferred from medication logs, and therefore may under represent the actual number of such co-morbidities.

One important question that will determine the external validity of the findings of this study is the similarity of the IMPAACT populations as compared with other RA and knee OA populations. IMPAACT's RA participants were similar compared to participants in a clinical study of RA remissions[28] in age (mean age 55 vs. 56), race/ethnicity (76% vs. 67% White), and disease duration (13 vs. 12 years). These findings support the generalizability of the IMPAACT RA cohort results to persons with RA in other clinical settings.

IMPAACT's knee OA participants were similar to knee OA participants enrolled in a natural history study, the Mechanical factors in Arthritis of the Knee (MAK) [29] in mean age (63 vs. 64), and mean BMI (31.4 vs. 30.3), but had a slightly lower frequency of women (58% vs. 75%). Like those in the MAK study, the osteoarthritis sample examined in this study was comprised of non-clinical community members. These findings support the generalizability of IMPAACT's OA cohort results to other adults with knee OA recruited from the community.

## Conclusions

The moderate correlations between accelerometer data and the Y-ADSI seen in this study add to the literature supporting the validity of the YPAS as a measure of self-reported (moderate to vigorous) physical activity in individuals with RA and OA. While the YPAS Energy Expenditure Index was moderately correlated with objective accelerometer measures, the YPAS Y-ADSI summary index is faster to both administer and score, making it the more feasible choice for clinical applications. Finally, since the Y-ADSI is scored entirely from the shorter YPAS Part 2, it does not appear to be especially important to

administer the longer Part 1 in a clinical setting, unless a rich description of the activities themselves is desired.

## Acknowledgments

GRANTS: R01 AR055287, R01 AR054155, P60 AR048098

## References

1. Masse LC, Ainsworth BE, Tortolero S, et al. Measuring physical activity in midlife, older, and minority women: issues from an expert panel. Journal of Women's Health. 1998; 7:57–67.
2. 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; 39:336–40. [PubMed: 10726435]
3. Gerber LH, Furst GP. Validation of the NIH Activity Record: A quantitative measure of life activities. Arthritis Care & Research. 1992; 5:81–6. [PubMed: 1390968]
4. Gerber LH, Furst GP. Scoring methods and application of the activity record (ACTRE) for patients with musculoskeletal disorders. Arthritis Care & Research. 1992; 5:151–6. [PubMed: 1457490]
5. Dipietro L, Caspersen CJ, Ostfeld AM, Nadel ER. A survey for assessing physical activity among older adults. Med Sci Sports Exerc. 1993; 25:628–42. [PubMed: 8492692]
6. Kolbe-Alexander TL, Lambert EV, Harkins JB, Ekelund U. Comparison of two methods of measuring physical activity in South African older adults. J Aging Phys Act. 2006; 14:98–114. [PubMed: 16648654]
7. Arnett FC, Edworthy SM, Bloch DA, et al. The American Rheumatism Association 1987 revised criteria for the classification of rheumatoid arthritis. Arthritis & Rheumatism. 1988; 31:315–24. [PubMed: 3358796]
8. Matthews CE, Ainsworth BE, Thompson RW, Bassett DR Jr. Sources of variance in daily physical activity levels as measured by an accelerometer. Med Sci Sports Exerc. 2002; 34:1376–81. [PubMed: 12165695]
9. Brage S, Wedderkopp N, Franks PW, Andersen LB, Froberg K. Reexamination of validity and reliability of the CSA monitor in walking and running. Med Sci Sports Exerc. 2003; 35:1447–54. [PubMed: 12900703]
10. Hendelman D, Miller K, Baggett C, Debold E, Freedson P. Validity of accelerometry for the assessment of moderate intensity physical activity in the field. Med Sci Sports Exerc. 2000; 32:S442–9. [PubMed: 10993413]
11. Welk GJ, Schaben JA, Morrow JR Jr. Reliability of accelerometry-based activity monitors: a generalizability study. Med Sci Sports Exerc. 2004; 36:1637–45. [PubMed: 15354049]
12. Munneke M, de Jong Z, Zwinderman AH, Tijhuis GJ, Hazes JM, Vliet Vlieland TP. The value of a continuous ambulatory activity monitor to quantify the amount and intensity of daily activity in patients with rheumatoid arthritis 4. J Rheumatol. 2001; 28:745–50. [PubMed: 11327244]
13. Focht BC, Sanders WM, Brubaker PH, Rejeski WJ. Initial validation of the CSA activity monitor during rehabilitative exercise among older adults with chronic disease. Journal of Aging and Physical Activity. 2003; 11:293–304.
14. Talbot LA, Gaines JM, Huynh TN, Metter EJ. A home-based pedometer-driven walking program to increase physical activity in older adults with osteoarthritis of the knee: a preliminary study. J Am Geriatr Soc. 2003; 51:387–92. [PubMed: 12588583]
15. American College of Sports Medicine. ACSM's guidelines for exercise testing and prescription. Sixth ed. Baltimore: Lippincott Williams & Wilkins; 2000.
16. Bruce B, Fries JF. The Stanford Health Assessment Questionnaire: a review of its history, issues, progress, and documentation. J Rheumatol. 2003; 30:167–78. [PubMed: 12508408]
17. Fries JF, Spitz P, Kraines RG, Holman HR. Measurement of patient outcome in arthritis. Arthritis & Rheumatism. 1980; 23:137–45. [PubMed: 7362664]
18. 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. Journal of Rheumatology. 1988; 15:1833–40. [PubMed: 3068365]

19. McConnell S, Kolopack P, Davis AM. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC): a review of its utility and measurement properties. Arthritis & Rheumatism. 2001; 45:453–61. [PubMed: 11642645]
20. Semanik P, Song J, Chang RW, Manheim L, Ainsworth B, Dunlop D. Assessing Physical Activity in Persons with Rheumatoid Arthritis Using Accelerometry. Med Sci Sports Exerc. 2010
21. Troiano RP, Berrigan D, Dodd KW, Masse LC, Tilert T, McDowell M. Physical activity in the United States measured by accelerometer. Med Sci Sports Exerc. 2008; 40:181–8. [PubMed: 18091006]
22. Feito, Y.; Tyo, BM.; Bassett, DR.; Thompson, DL. The Effect of BMI and Walking Speed on Step Count Validity of Wearable Activity Monitors. ACSM 2010: American College of Sports Medicine (ACSM) 2010 Annual Meeting; Baltimore, MD. 2010.
23. McGibbon CA, Krebs DE. Compensatory gait mechanics in patients with unilateral knee arthritis. J Rheumatol. 2002; 29:2410–9. [PubMed: 12415602]
24. Zeni JA, Higginson JS. Knee osteoarthritis affects the distribution of joint moments during gait. Knee. 2011; 18:156–9. [PubMed: 20510618]
25. Boon RM, Hamlin MJ, Steel GD, Ross JJ. Validation of the New Zealand Physical Activity Questionnaire (NZPAQ-LF) and the International Physical Activity Questionnaire (IPAQ-LF) with accelerometry. Br J Sports Med. 2010; 44:741–6. [PubMed: 18981036]
26. Sloane R, Snyder DC, Demark-Wahnefried W, Lobach D, Kraus WE. Comparing the 7-day physical activity recall with a triaxial accelerometer for measuring time in exercise. Med Sci Sports Exerc. 2009; 41:1334–40. [PubMed: 19461530]
27. Yore MM, Ham SA, Ainsworth BE, et al. Reliability and validity of the instrument used in BRFSS to assess physical activity. Med Sci Sports Exerc. 2007; 39:1267–74. [PubMed: 17762359]
28. Liang GC, Cordero M, Dyer A, Chang RW. Current tumor necrosis factor-alpha inhibitor use is associated with a higher probability of remissions in patients with rheumatoid arthritis. J Rheumatol. 2005; 32:1662–5. [PubMed: 16142857]
29. Sharma L, Song J, Felson DT, Cahue S, Shamiyeh E, Dunlop DD. The role of knee alignment in disease progression and functional decline in knee osteoarthritis. Jama. 2001; 286:188–95. [PubMed: 11448282]

### Significance and Innovation

- A reliable, valid self-report measure of physical activity that has clinical applicability would be a valuable addition to providers' resources.
- This study evaluated the agreement of the Yale Physical Activity Scale (YPAS) questionnaire summary measures from adults with RA and OA with objectively measured accelerometer measures of physical activity.
- The YPAS Activity Dimensions Summary Index (ADSI), which is fast to both administer and score, was moderately correlated with objective accelerometer measures, making it a feasible choice for clinical applications.

## Table 1

Demographic and Disease Variables

| | Rheumatoid Arthritis (n=171) | Knee Osteoarthritis (n=139) |
|---|---|---|
| | **Mean (SD)/Proportion** | **Mean (SD)/Proportion** |
| Age (years) | 55 (14) | 63 (13) |
| Gender, Female | 82% | 58% |
| Race | | |
| White | 76% | 58% |
| African American | 12% | 32% |
| Other | 12% | 10% |
| BMI [weight (kilograms)/height $(m)^2$] | 28 (6) | 31 (6) |
| Mobility Limiting Comorbidities | 28% | 24% |
| Depression | 19% | 9% |
| Disease Duration (years) | 14 (10) | 11 (11) |

## Table 2

Physical Activity Characteristics of the Sample

| | Rheumatoid Arthritis (n=171) | | Knee Osteoarthritis (n=139) | |
|---|---|---|---|---|
| | **Median (Interquartile Range)** | **Mean (SD)** | **Median (Interquartile Range)** | **Mean (SD)** |
| **Yale Physical Activity Survey Subscales** | | | | |
| **Total Time Index** (Hours of activity/week) | 21 (22) | 26 (15) | 26 (22) | 32 (25) |
| **Energy Expenditure Index** (Kilocalories/week) | 4830 (4150) | 5577 (3428) | 5950 (4470) | 7435 (6222) |
| **Activity Dimension Summary Index** | 43 (26) | 48 (21) | 48 (24) | 51 (20) |
| **Mean Accelerometer** | | | | |
| Counts per day | 208566 (116373) | 220506 (106022) | 208259 (139809) | 220915 (110149) |
| Light Intensity minutes/day | 481 (163) | 477 (103) | 459 (153) | 468 (100) |
| MVPA * Intensity minutes/day | 14 (26) | 19 (19) | 15 (25) | 20 (20) |
| Bouted MVPA minutes/day | 3 (3) | 9 (13) | 3 (10) | 8 (14) |

* MVPA= Moderate/Vigorous Physical Activity

## Table 3

Rheumatoid Arthritis: Spearman Correlations of Objective and Subjective Physical Activity Measures (n=171)

| **Subjective Yale Physical Activity Subscales** | **Objective Accelerometer Measurements** | | | |
|---|---|---|---|---|
| | **Average Daily Counts** | **Average Daily Minutes of Light Activity** | **Average Daily Minutes of Moderate/ Vigorous Activity** | **Average Daily Minutes of Bouted Moderate/Vigorous Activity** |
| **Total Time Index** (Hours of activity/ week) | 0.19 | 0.26*** | 0.04 | -0.00 |
| **Energy Expenditure Index** (Kilocalories/week) | 0.30*** | 0.27*** | 0.15* | 0.11 |
| **Activity Dimensions Summary Index** | 0.45*** | 0.04 | 0.43*** | 0.51*** |

* p<.05,

** p<.01,

*** p<.001

## Table 4

Knee Osteoarthritis: Spearman Correlations of Objective and Subjective Physical Activity Measures (n=139)

| **Subjective Yale Physical Activity Subscales** | **Objective Accelerometer Measurements** | | | |
|---|---|---|---|---|
| | **Average Daily Counts** | **Average Daily Minutes of Light Activity** | **Average Daily Minutes of Moderate/Vigorous Activity** | **Average Daily Minutes of Bouted Moderate/Vigorous Activity** |
| **Total Time Index** (Hours of activity/ week) | 0.05 | -0.01 | 0.05 | 0.12 |
| **Energy Expenditure Index** (Kilocalories/week) | 0.12 | -0.00 | 0.13 | 0.17* |
| **Activity Dimensions Summary Index** | 0.24** | -0.08 | 0.31*** | 0.36*** |

* p<.05,

** p<.01,

*** p<.001