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IMPROVING PHYSICAL ACTIVITY IN ARTHRITIS CLINICAL TRIAL (IMPAACT): STUDY DESIGN, RATIONALE, RECRUITMENT, AND BASELINE DATA

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Abstract

Over 21 million Americans report an arthritis-attributable activity limitation. Knee osteoarthritis (OA) and rheumatoid arthritis (RA) are two of the most common/disabling forms of arthritis.

Various forms of physical activity (PA) can improve a variety of health outcomes and reduce health care costs, but the proportion of the US population engaging in the recommended amount of PA is low and even lower among those with arthritis.

The Improving Motivation for Physical Activity in Arthritis Clinical Trial (IMPAACT) is a randomized clinical trial that studied the effects of a lifestyle PA promotion intervention on pain and physical function outcomes. The IMPAACT intervention was based on a chronic care/disease management model in which allied health professionals promote patient self-management activities outside of traditional physician office encounters. The program was a motivational interviewing-based, individualized counseling and referral intervention, directed by a comprehensive assessment of individual patient barriers and strengths related to PA performance. The specific aims of IMPAACT were to test the efficacy of the IMPAACT intervention for persons with arthritis (N=185 persons with RA and 155 persons with knee OA) in improving arthritis-specific and generic self-reported pain and physical function outcomes, observed measures of function, and objectively measured and self-reported PA levels. Details of the stratified-randomized study design, subject recruitment, and data collection are described. The

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results from IMPAACT will generate empiric evidence pertaining to increasing PA levels in persons with arthritis and result in widely applicable strategies for health behavior change.

Keywords

Physical Activity Promotion; Clinical Trial; Accelerometer; Health Behavior; Arthritis

Introduction

The US is in the midst of an arthritis-associated disability epidemic. The Centers for Disease Control and Prevention (CDC) estimate that more than 21% (nearly 50 million) of Americans have some form of doctor-diagnosed arthritis and more than 9% (more than 21 million) have arthritis-attributable activity limitations.¹ The annual economic burden of arthritis is approximately \$128 billion (\$80.8 billion in direct and \$47.0 billion in indirect costs), equivalent to 1.2% of the gross domestic product.²

A sedentary lifestyle increases the risk of obesity³ and cardiovascular disease,^{4,5} both of which can lead to functional decline and dependence on others to accomplish basic activities of daily living; which in turn threatens full participation in both employment opportunities and independent community living, leading to increased healthcare costs in persons with arthritis.⁶ Various forms of physical activity for adults with arthritis, including structured exercise and lifestyle physical activity programs, can improve a variety of health outcomes, including strength, functional status, self-efficacy,⁷ quality of life,⁸ pain, depressive symptoms, and fatigue without adversely affecting joint status.⁸⁻¹⁹ Notably, the fraction of arthritis-attributable activity limitations due to physical inactivity is 21%.²⁰ Despite strong evidence that physical activity can lead to improved pain and functional outcomes, persons with arthritis are notably not physically active.²¹ The public health challenge is to find replicable, population-based interventions that are effective in improving physical activity participation, thereby reducing pain and improving function in this large population.

The Improving Motivation for Physical Activity in Arthritis Clinical Trial (IMPAACT) was designed to test a tailored behavior change, motivational interviewing-based intervention created to increase lifestyle physical activity participation. The intervention allowed participants to formulate an individual physical activity program based on their skills and symptoms, as opposed to a prescribed exercise intervention. The IMPAACT intervention was administered by a health professional and consisted of counseling and referral to community resources after an assessment of the patient's unique barriers to and facilitators of increased physical activity participation. This tailored intervention was based on the premise that finding physical activity that did not substantially increase joint symptoms was the key to improving muscle strength and overall fitness that would subsequently improve pain and physical function. The intervention was designed to maximize long-term compliance that prescribed exercise interventions have not achieved. The primary outcome of the clinical trial was self-reported physical function in adults with rheumatoid arthritis (RA) and knee osteoarthritis (OA). Other outcomes of the study trial were objectively measured physical activity, observed measures of function, and patient reported pain. The

approach was novel because it was tailored to encourage individual lifestyle physical activity behavior change in conjunction with ongoing medical care in a disease management context.

This paper describes the original design and recruitment strategy of IMPAACT as well as the alterations made in order to meet knee OA recruitment targets. We also present selected baseline demographic, health behavior/comorbidity, physical activity, and pain and physical function data of IMPAACT participants as a means to establishing the representativeness of our two clinical samples.

Study Design and Methods

Cox's Interaction Model of Client Health Behavior (IMCHB)

IMPAACT and the IMPAACT intervention were conceptually based on Cox's Interaction Model of Client Health Behavior (IMCHB, Figure 1).²² The strength of the IMCHB lies in its emphasis on the relationship between individual client characteristics that provide the basis for understanding a person's health behavior *and* the features of provider interactions that influence health outcomes. Selected variables from the model have been successfully used to account for variance associated with exercise group participation in community-dwelling seniors,²³ adherence to a mid-life women's walking program,²⁴ and lifestyle physical activity behavior in older women with RA²⁵. The IMPAACT intervention began with the use of the Arthritis Comprehensive Treatment Assessment (ACTA), an assessment tool of variables from the IMCHB that identifies individual-specific supports and barriers to participation in physical activity.²⁶

The model assumes that clients are not passive, but active dynamic agents who want and are able to make informed decisions regarding their health care.²⁷ The complete model specifies that demographic, social support, and health experience of the client (i.e., IMCHB Client Singularity-Background Variables), and the motivation, beliefs, and worries pertaining to the health behavior in question (i.e., IMCHB Client Singularity-Dynamic Variables of motivation, cognitive appraisal, and affective response) be assessed by the provider. It also directs the formulation of an intervention tailored specifically to the uniqueness of each client. Due to the model's focus on decisional control, its greatest usefulness may be those situations that call for the client's personal responsibility and control of the health promotion effort. The IMCHB Client Singularity Background and Dynamic Variables (Figure 1), were the bases for tailoring interventions to individual client needs during the subsequent client/provider exchange.

Much attention has been focused on other models that have been applied to physical activity behavior, such as the Transtheoretical Model^{28,29} which includes three major concepts: stage of readiness for change, processes of change, and decisional balance. However, during preliminary work with the arthritis population, the model concept "decisional balance" (weighing of benefits and barriers to being physically active) was not a significant predictor of physical activity behavior.³⁰ Several of Transtheoretical Model's cognitive processes of behavior change share concepts with the IMCHB framework, such as self-efficacy, the self-structuring of rewards, and drawing on supportive others.

Description and justification of the study population

Given that there are more than 100 different forms of arthritis (defined here as any chronic condition affecting the joints and surrounding tissues), we chose patients with two well-defined and pathophysiologically distinct diseases to study, rheumatoid arthritis (RA) and knee osteoarthritis (OA). RA is a prototype of the most common chronic *inflammatory* arthropathy, associated with a high rate of disability. Knee OA is a prototype of a chronic *degenerative* arthropathy that has a high prevalence and is associated with substantial disability. We did not require lower extremity involvement in participants with RA. The rationale for how lifestyle physical activity might help all patients with RA stems from the fact that improved fitness can reduce the inflammatory component of RA thus improving overall function. We expected that if the IMPAACT intervention was efficacious in improving the physical activity and health status levels of these two distinctly different groups of arthritis patients, then it should be efficacious for many other, if not all, patients with other forms of arthritis.

Case definitions—Classification criteria developed by the American College of Rheumatology (ACR) were used for patients with both RA and symptomatic, radiographic knee OA. RA participants fulfilled the 1988 ACR criteria for RA.³¹ We included knee x-rays findings to increase the specificity of the clinical knee OA criteria. Radiologic knee OA was defined by Kellgren-Lawrence Class 2 or higher. These are standard case definitions that are used routinely in the rheumatology literature and have been shown to have high sensitivity and specificity.^{31,32}

Selection criteria—Adults with RA or knee OA 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: we explicitly screened for fibromyalgia, lumbar spinal stenosis, peripheral vascular disease, residual of a stroke by self-reported diagnosis and screening physical examination; in addition we asked participants if they had any other diagnoses that might be associated with functional loss, 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.

Recruitment Methods and Results

Because the intervention was to be given in a chronic disease management context, the original plan was to recruit eligible patients with RA from two faculty rheumatology practices of a single academic medical center and eligible patients with knee OA from these practices as well as the general medicine and orthopedic surgery practices at the same academic medical center. Since only 13 participants with knee OA were enrolled into IMPAACT from participating practices during the first 6 months of the accrual period, it was clear that recruitment targets for knee OA participants would not be met using this strategy. Thus knee OA patient recruitment was extended to participants enrolled in two research registries, one of which listed subjects who had previously participated in knee OA

pharmaceutical studies and the second of volunteer community dwelling older adults interested in participating in clinical research. In addition, advertisements to the general public were placed in buses and trains of the city's public transportation system to encourage persons with knee pain and an interest in physical activity to be screened for eligibility into the study. In order to insure that subjects from community sources as well as medical clinics had radiographically confirmed symptomatic knee OA (Kellgren-Lawrence grade 2 or greater), a screening procedure that integrated study eligibility criteria determined by medical record review, phone interview, and knee x-rays (if other criteria were satisfied and no x-rays done within the prior 6 months were available) was created. Informed consent was received from participants who engaged in this screening process.

Enrollment of 185 RA participants into IMPAACT, as shown in Figure 2, were recruited from 272 patients with RA, who consented to a medical record review and phone interview for eligibility in the study. Excluded were 7 who were ineligible and 80 who chose not to enroll in the study. A total of 185 participants with RA were randomized into IMPAACT.

Enrollment of 155 participants with knee OA into IMPAACT were recruited from 617 adults screened to determine eligibility who were identified from three sources, as shown in Figure 3. From clinical practices, 13 persons enrolled from 55 patients screened; excluded were 18 ineligible (6 did not meet radiographic criteria, 12 did not meet other eligibility criteria) and another 24 who chose not to enroll. From research registries, 62 enrolled from 222 participants screened; excluded were 122 ineligible (44 did not meet radiographic criteria, 78 did not meet other eligibility criteria) and another 38 who chose not to enroll. From respondents to public advertising, 80 enrolled from 340 participants screened; excluded were 169 ineligible (77 did not meet radiographic criteria, 92 did not meet other eligibility criteria) and another 91 who chose not to enroll.

The Pre-Randomization (Baseline) Study Assessment Visit (See Figure 4)

At the baseline study assessment visit, a study coordinator fit all participants with the ActiGraph accelerometer (model GT1M), provided instructions and packaging for mailed return, performed the observed physical function test battery, did a joint count and global assessment on subjects with RA for purposes of determining a Clinical Disease Activity Index (CDAI) score,³³ and scheduled the first telephone interview one week later (about two weeks prior to the index clinic visit) at participants' convenience. This enabled telephone interview data (including the health status and physical activity data) to refer to the same week that the ActiGraph data were being recorded. Participants were also advised of prospective dates for up to five subsequent study assessment visits, the first two at three month intervals, the final three at six month intervals, which were entirely unrelated to any subsequent MD visits.

Randomization and the Index Physician Visit (See Figure 4)

After all baseline data were collected, participants were randomized to a control group receiving only physician physical activity counseling or to the IMPAACT intervention group. Blocked randomization was stratified by diagnosis (RA vs. knee OA), site of recruitment (each practice site, registry recruitment, community recruitment), and self-

reported disease specific functional status (high vs low Health Assessment Questionnaire Disability Index (HAQ-DI) for RA participants; high vs low WOMAC Physical Function (PF) scale for knee OA participants). RA subjects were classified as high functional status if their baseline HAQ-DI was greater than the median of subjects enrolled in a study on RA remission³⁴ conducted at our institution. Knee OA subjects were classified as high functional status if their baseline WOMAC-PF was better (i.e., lower) than the median of subjects enrolled in the Mechanical factors in Arthritis of the Knee (MAK) study³⁵ conducted at our institution.

Each participant was notified about their randomized group assignment by a research assistant well before the index physician visit at which all subjects received MD physical activity counseling (full description is below). Intervention group participants were requested to allow additional time after the index physician visit for an initial, no cost, expense-reimbursed IMPAACT intervention visit with the physical activity advocate. If concurrent scheduling was inconvenient for a participant, a separate IMPAACT intervention visit for experimental group participants was scheduled as soon as possible thereafter. The description of the IMPAACT intervention is below. Other than potential interaction with physicians about referrals or other intervention group activities, the IMPAACT intervention visits remained completely independent of study participants' medical care, which proceeded in a usual and customary manner. This was analogous to chronic disease management in other settings.

Physician physical activity counseling (control and intervention groups)

Following notification of randomization, the index visit with the participant's physician was conducted at which scripted physician physical activity counseling occurred for each IMPAACT participant. For knee OA participants who were recruited from research registries or from public advertising, i.e. not from participating practices, a visit with the study's principal investigator (RWC) was scheduled to answer any questions about the study, to review the participant's knee clinical findings and x-rays, and to deliver the physician physical activity counseling. The physician physical activity counseling included a) determining whether the participant self-reported meeting the 1995 physical activity recommendations for all adults from the American College of Sports Medicine and the Centers for Disease Control and Prevention, i.e. 30 minutes per day of accumulated moderate intensity physical activity on most days of the week,³⁶ b) encouraging the participant to work toward or maintain this level of physical activity, and c) providing the participant with a laminated card outlining these recommendations. At the index visit the physicians providing the physical activity counseling were blinded to the group assignment of the participant.

IMPAACT Intervention

Adults randomized to the intervention group received the IMPAACT intervention in addition to physician physical activity counseling. The IMPAACT intervention has been described in detail elsewhere.²⁶ The IMPAACT intervention began with a physical activity advocate (PAA) face-to-face meeting, the goals of which were to 1) establish a relationship between the participant and the PAA, a nurse or allied health professional with training in

motivational interviewing; 2) complete the ACTA; and 3) establish an individual action plan based on the results of the ACTA. The ACTA identifies individual-specific supports and barriers to increased physical activity participation by systematically assessing factors known to influence an individual's level of physical activity, including all concepts from Cox's Interaction Model of Client Health Behavior (IMCHB).²⁷ The ACTA consists of 23 statements that address disease status, functional status, lifestyle, and incentives for physical activity. Statement formulation was guided by variables from the IMCHB and review of the literature.³⁷ Information from this comprehensive assessment provided data for the PAA to identify the key targets for a tailored physical activity intervention.

Because the potential for positive participant health outcomes increases as the provider intervention/interaction molds to each unique patient (background, cognitive, affective, and motivational manifestations), the IMPAACT intervention was based on the relationship between the PAA and the participant. The ACTA interview and the overall IMPAACT intervention were guided by motivational interviewing principles.³⁸ With the PAA's guidance, the participant was encouraged to weigh all aspects of making and committing to a behavior change, to reflect upon issues related to short and long-term goals, and to take a leading role in problem solving.

Based on the above process, the participant set personal short-term goals that he or she found relevant, important, and achievable. Together, the participant and PAA negotiated the strategies and an action plan to help the participant achieve his/her self-identified goals. The participant and PAA established an agreement in writing and determined a strategy to record the participant's progress.

Follow-up IMPAACT intervention contacts occurred in person or by telephone at least every three months in the first year and every six months in the second year. Sessions that occurred at these milestones included the ACTA assessment, an assessment of achievement of short term goals, and revision of short term goals as needed. Participants were encouraged to contact their PAA via telephone, e-mail, and other means if they desired contact in between scheduled visits.

Follow-up Study Assessment Visits (Figure 4)

All study participants were scheduled for up to five subsequent study visits at 3, 6, 12, 18, and 24 months after the baseline assessment, at which ActiGraph fittings, observed physical function tests, and subsequent telephone interview follow-up within a week were administered to both experimental and control subjects. Participants who did not continue to be seen at the study clinics for clinical care were encouraged to remain in the study. Reimbursement for parking was issued at each visit.

Description of study instruments (Table 1)

Client Singularity-Background Variables—Demographic data were collected using standard instruments via a combination of chart review and telephone interview. These included age, gender, race/ethnicity, and level of education.

Current health data included disease activity/severity parameters including a tender joint count and global assessment to assign a Clinical Disease Activity Index (CDAI) score³³ for RA subjects and an assessment of radiographic severity³⁹ for knee OA subjects, disease duration, and medication use (for both RA/knee OA and comorbid conditions). Particular attention was given to the use of disease-modifying anti-rheumatic drugs (including the use of biologics) in RA subjects. Medication use data were collected via telephone interview. Comorbidities (determined from medication logs) were classified as either ‘mobility-limiting’ (e.g. COPD, asthma) or ‘non mobility-limiting’.

Social support for physical activity was measured using the short form of the Health-Care Climate Questionnaire (HCCQ). The short form of the HCCQ includes 6 of the items found in the original 15-item Likert measure that assesses participants’ perceptions of the degree to which they experience their health-care providers (or their physician, or their counselor, or their health-care program leader) to be supportive versus controlling in providing general treatment or with respect to a specific health-care issue, in this case physical activity. With the 6-item scale the Cronbach’s alpha has been about 0.82 in sample of diabetics⁴⁰ and was found to be 0.91 for IMPAACT OA participants and 0.88 for IMPAACT RA participants.

Client Singularity-Dynamic Variables

Intrinsic motivation: In the IMCHB, motivation is based on the belief that when people actively choose a behavior that reinforces their sense of competence that behavior will likely endure.⁴¹ Higher intrinsic motivational levels have been associated with increased levels of physical activity in community samples of adults,^{42,43} while perceived competence significantly predicted participation in a peer-led exercise group of seventy-five senior women.⁴⁴ In this study, motivation for physical activity (Perceived Competence) was measured using a 6 item scale that asks the patient to rate the extent of their confidence in maintaining an active lifestyle on a four point scale from “not at all confident”, to “completely confident” (1–4). This scale was developed using the Perceived Competence Scale.^{45,46} Examples of questions address confidence in the ability to maintain a physically active lifestyle even when feeling tired or fatigued, when having joint symptoms or pain or having other demands on their time. Summed scores ranged from 6 to 24; higher values represent greater confidence in ability to maintain a physically active lifestyle. Cronbach’s alpha was 0.89 for RA participants and 0.88 for participants with knee OA.

Cognitive Appraisal: Beliefs about the benefits of physical activity⁴⁷ must come from an understanding about performing the behavior; this includes simultaneous beliefs of the benefits of performing the behavior and the consequences of not performing the behavior. Positive health beliefs and knowledge⁴⁸ ultimately assist the individual to formulate goals and to establish a sense of competency for engaging in a behavior. Beliefs related to physical activity (Cognitive Appraisal) were measured using 12 items designed to allow the patient to rate their beliefs about being physically active on a four point scale from “does not describe me at all”, to “describes me exactly” (0–3). Examples of the 12 items include addressing beliefs about what physical activity helps me to do as well as beliefs related to physical activity and stress or pain management. Summed scores ranged from 0 to 36 with

higher values representing more positive beliefs about engaging in physical activity. The score had Cronbach's alpha of 0.89 for RA participants and 0.85 for those with knee OA.

Affective Response: The IMCHB model posits that worries (affective response) pertaining to the consequences of not participating in a healthy behavior may also play an important role in determining the participation in that healthy behavior. Life worries (affective response) was measured using 7 items that ask the patient to rate their concerns about general life issues: not being able to work, losing their independence, needing to have someone take care of them, ability to do things they enjoy, difficulty being sexually active, being able to keep up with their friends, and having a major health event like a heart attack or a stroke. Each question consists of three responses: whether the item worried them, whether that worry affected their level of physical activity and whether that worry increased their level of physical activity. The questionnaire was based on the Social Functioning Scale.⁴⁹ Responses are summed into a score that ranges from -7 to +7 with higher positive values representing a more positive affective response to physical activity. Cronbach's alpha for this score was 0.80 for RA participants and .71 for those with knee OA.

Health Outcomes/Behavior—Self-reported disease-specific health status was measured using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)⁵⁰ for knee OA participants and the Health Assessment Questionnaire (HAQ)⁵¹ for RA participants. These widely used and published disease-specific instruments have been found to be more sensitive than the SF-36 to condition severity and change over time for arthritis participants, particularly for those with comorbid conditions also affecting health status.^{52,53} The Likert versions of the WOMAC Pain and Physical Function scales⁵⁰ were used to assess self-reported HRQOL in subjects with knee OA. The five pain and 17 physical function items are rated on an ordinal scale of 0 to 4, with lower scores indicating lower levels of symptoms or functional limitations. Summing the scores for each subscale item produces a WOMAC pain scale score of between 0 (best) and 20 (worst) and a WOMAC physical function score between 0 (best) and 68 (worst). Test-retest reliability for the pain and physical function subscales have both been reported at 0.68 (Kendall's tau).⁵⁴ Internal consistency scores (Cronbach's alpha) have been reported at 0.86 (pain subscale) and 0.95 (physical function). Moderately strong correlations have been noted between WOMAC scores (pain and physical function) and the SF 36 in arthritis populations.⁵⁴

The HAQ Pain and Disability Scales⁵¹ were used to assess self-reported HRQOL in subjects with RA. The HAQ Pain Scale measures arthritis pain on a scale between 0 and 100. The HAQ-Disability Scale assesses the extent of the participant's functional ability. It has been widely used for research purposes in both experimental and observational studies, as well as in clinical settings. The HAQ-Disability is sensitive to change and is a good predictor of future disability and costs. It has been shown to be reliable and valid in different languages and contexts. Test-retest correlations have ranged from 0.87 to 0.99.^{55,56} Correlations between questionnaire or interview scores and task performance have ranged from 0.71 to 0.95 demonstrating criterion validity.^{55,56} The construct/convergent validity, predictive validity and sensitivity to change have also been established in numerous observational studies and clinical trials.^{55,56} The HAQ-Disability has also demonstrated a high level of

convergent validity based on the pattern of correlations with other clinical and laboratory measures.^{55,56}

Observed functional status was measured with the 8-foot up and go test and a 5 minute walking test. The up and go test is a composite measure involving power, agility, and dynamic balance. It requires getting out of a chair, walking 8 feet to and around a cone (or other marker) and returning to the chair in the shortest time possible. Test-retest reliability for the 8-ft up and go test was .95⁵⁷ with excellent discrimination between age groups, as well as individuals known to be exercisers vs. those who were not.⁵⁸ The 5-minute walking test is performed on a rectangular course with an outer perimeter of 26 meters. Subjects are instructed to walk at a brisk pace that can be maintained for 5 minutes. A walking velocity is calculated by dividing the distance covered (in feet) by 300 seconds.

Self-reported physical activity behavior was measured using the two-part The Yale Physical Activity Scale (YPAS),⁵⁹ which was created for use in epidemiologic studies with older adults. Briefly, Part One addresses activities performed during a typical week from the past month, while Part Two addresses estimates of physical activity over the entire past month. Two-week repeatability correlation coefficients on YPAS summaries from 76 men and women (without arthritis) aged 60–86 ranged from 0.57 to .65 ($P < .0001$) for three summary indices, the Total Time Index, the Energy Expenditure Index, and the Activity Dimension Summary Index.⁵⁹ The YPAS has demonstrated sensitivity to change in physical activity in exercise intervention studies^{60,61}

Physical activity measured by accelerometry: Sole reliance on self-report of physical activity is problematic since subjects have been found to both underestimate their daily walking distance⁶² and overestimate the amount of energy expended during moderate intensity daily activity,^{63,64} with a tendency for greater overestimation in older and more obese individuals.⁶⁵ Objective assessment of physical activity was based on accelerometer monitoring. This study measured vertical movements in the community environment with a uniaxial accelerometer (ActiGraph model GT1M), that measured the duration and intensity of activities over 7 days. Accelerometer data were collected at 1-minute periods and transformed to activity counts per day and minutes of non-sedentary activity per day. An activity count is the weighted sum of the number of accelerations measured each minute, where the weights are proportional to the magnitude of measured acceleration. A non-sedentary minute was defined as any minute recording 100 or more activity counts. Physical activity output from accelerometer data includes average daily minutes of non-sedentary activity, average daily minutes of moderate and vigorous physical activity (MVPA), as well as average daily minutes of MVPA that occur in bouts lasting at least 10 minutes.

Power and Sample size Considerations

The sample size of the study was estimated to provide 80% power to detect a minimal clinically important improvement (MCII) corresponding to the primary health related quality of life outcome for each rheumatic disease stratum (i.e., RA HAQ function score difference of 0.3 (SD=0.7) and OA WOMAC function score difference of 4.0 (SD=9.3) between the intervention and control groups). A sample of 172 RA and 172 OA participants was

estimated to provide 80% power to detect this difference in each disease group based on a two-sided two sample t-test with a nominal significance of 0.05. Given an expected 10% attrition rate, we attempted to recruit 189 RA and 189 OA participants, but because of funding limitations we fell short of these targets.

Results

Baseline characteristics of IMPAACT participants (Table 2)

Demographic and clinical, and health status characteristics—Table 2 shows selected baseline characteristics of the IMPAACT participants with RA and those with knee OA. RA participants had a mean age of 55 years and were 84% female, 72% White, and 75% had graduated from college. Their mean BMI was 28. Five percent were current smokers and 38% had one or more mobility limiting comorbid conditions. The mean disease duration for RA participants was 13.2 years.

Knee OA participants had a mean age of 63 years and were 60% female, 60% white, and 63% had graduated from college. Their mean BMI was 31. Eighteen percent were current smokers, and 28% had one or more mobility limiting comorbid conditions. Mean disease duration for knee OA participants was 10.6 years.

Physical activity participation – self-reported

The Yale Physical Activity Scale (YPAS) estimated a mean of 26 hours per week (223 minutes/day) of any intensity physical activity for RA participants. An average of 5575 kilocalories per week was expended by RA participants using YPAS algorithms. The mean YPAS Activity Dimension Summary Index (ADSI) for RA participants was 48.

Corresponding YPAS physical activity mean parameters for knee OA participants were 32 hours per week (280 minutes/day) of any intensity physical activity, 7435 kilocalories per week expended by physical activity, and a YPAS-ADSI of 51.

Physical activity participation – accelerometer measured

The distributions of baseline physical activity by diagnosis are shown in Figure 5. Mean average daily counts (95% confidence intervals) for RA IMPAACT participants was 220743 (204867, 236618) and for OA IMPAACT participants 221431 (204292, 238571). The distributions of the IMPAACT participants' physical activity data were comparable to that of the participants in the physical activity ancillary study of the Osteoarthritis Initiative: 217013 (212205, 221821) [in-house analyses using public data].

Discussion

We have described the design of a tailored physical activity behavior change study for persons with RA and knee OA including procedures to recruit persons with knee pain from non-clinical settings to be screened for knee OA. Notable features of the study design include its integration of a disease management program into the assessment procedures and the stratification of participants by disease (RA vs knee OA), by site (2 practices, research registries, community via advertisement), and by level of functional status prior to

randomization. We demonstrated that a successful physical activity trial recruitment strategy of knee OA subjects may need to reach outside the clinical care context. This need is probably due to the fact that symptoms of knee OA are often not addressed by primary care physicians or rheumatologists and when it is addressed, the severity of knee symptoms and radiographic OA may preclude physical activity as an important therapeutic tool. Research registries are a useful resource to recruit participants with less severe symptomatic knee OA. Public advertising and screening is a strategy used to recruit participants for knee OA cohort studies.^{35,66} This method yielded the majority of IMPAACT knee OA participants.

A unique aspect of the IMPAACT intervention is the delivery in a chronic disease management context,⁶⁷ with the physician supporting the activities of the physical activity advocate (PAA), but participant-PAA interactions which occur independent of the physician-patient encounters. This appears quite feasible for persons with RA where physicians taking care of patients targeted for intervention can be identified. The disease management strategy for persons with knee OA needs to be altered however. The IMPAACT findings for knee OA subjects could be generalized to community-based as opposed to practice-based settings. Alternately, analogous to the recruitment of knee OA participants into IMPAACT, the disease management strategy would have to include advertising and screening for knee OA in a defined population (such as those enrolled in a managed care practice) in order that the research findings be generalizable in actual clinical practices.

One important question that will determine the external validity of the findings of IMPAACT is the similarity of IMPAACT study 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 remissions³⁴ in age (mean age 55 vs. 56), race/ethnicity (72% vs 67% White), and disease duration (13 vs 12 years). IMPAACT's knee OA participants were similar to community participants with knee OA enrolled in the Mechanical factors in Arthritis of the Knee (MAK) study³⁵ in mean age (63 vs 64), mean BMI (31.4 vs 30.3), and the distribution of radiographic findings (46% KL grade 3 or 4 vs 47%), but had a slightly lower frequency of women (60% vs 75%). These findings support the generalizability of IMPAACT results to other adults with RA or knee OA seen at academic centers. The findings may not be generalizable to all RA or knee OA populations in the community.

The purpose of IMPAACT was to test a tailored physical activity behavior change intervention given in a disease management context. Results of this study should inform clinicians and organizations interested in chronic disease management about whether this tailored intervention shows promise to assist persons with arthritis in becoming more physically active, less symptomatic, and more functional. Our experience in recruiting for this trial indicates that while the recruitment of participants with RA from clinical practices into a physical activity promotion trial is feasible, recruitment of participants with knee OA is not. Recruitment into the community via registries and advertising is necessary for trials testing physical activity promotion interventions.

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References

1. Prevalence of doctor-diagnosed arthritis and arthritis-attributable activity limitation --- United States, 2007–2009. *MMWR Morb Mortal Wkly Rep.* Oct 8; 2010 59(39):1261–1265. [PubMed: 20930703]
2. Centers for Disease Control and Prevention. National and state medical expenditures and lost earnings attributable to arthritis and other rheumatic conditions--United States, 2003. *MMWR Morb Mortal Wkly Rep.* Jan 12.2007 56:4–7. [PubMed: 17218935]
3. Brady SR, de Courten B, Reid CM, Cicuttini FM, de Courten MP, Liew D. The role of traditional cardiovascular risk factors among patients with rheumatoid arthritis. *J Rheumatol.* Jan; 2009 36(1): 34–40. [PubMed: 19012364]
4. Metsios GS, Stavropoulos-Kalinoglou A, Panoulas VF, et al. Association of physical inactivity with increased cardiovascular risk in patients with rheumatoid arthritis. *Eur J Cardiovasc Prev Rehabil.* Apr; 2009 16(2):188–194. [PubMed: 19238083]
5. Tureson C, Matteson EL. Cardiovascular risk factors, fitness and physical activity in rheumatic diseases. *Curr Opin Rheumatol.* Mar; 2007 19(2):190–196. [PubMed: 17278937]
6. Wang G, Helmick CG, Macera C, Zhang P, Pratt M. Inactivity-associated medical costs among US adults with arthritis. *Arthritis and Rheumatism.* 2001; 45(5):439–445. [PubMed: 11642643]
7. Bell MJ, Lineker SC, Wilkins AL, Goldsmith CH, Badley CM. A randomized controlled trial to evaluate the efficacy of community based physical therapy in the treatment of people with rheumatoid arthritis. *Journal of Rheumatology.* 1998; 25(2):231–237. [PubMed: 9489812]
8. Hopman-Rock M, Westhoff MH. The effects of a health educational and exercise program for older adults with osteoarthritis for the hip or knee. *Journal of Rheumatology.* 2000; 27(8):1947–1954. [PubMed: 10955337]
9. Minor MA. Exercise in the treatment of osteoarthritis. *Rheumatic Diseases Clinics of North America.* 1999; 25(2):397–415. viii. [PubMed: 10356425]
10. Minor MA, Lane NE. Recreational exercise in arthritis. *Rheumatic Diseases Clinics of North America.* 1996; 22(3):563–577. [PubMed: 8844914]
11. Baker KR, Nelson ME, Felson DT, Layne JE, Sarno R, Roubenoff R. The efficacy of home based progressive strength training in older adults with knee osteoarthritis: A randomized controlled trial. *The Journal of Rheumatology.* 2001; 28:1655–1665. [PubMed: 11469475]
12. Hakkinen A, Sokka T, Konaniemi A, Hannonen P. A randomized two-year study of the effects of dynamic strength training on muscle strength, disease activity, functional capacity, and bone mineral density in early rheumatoid arthritis. *Arthritis and Rheumatism.* 2001; 44(3):515–522. [PubMed: 11263764]
13. Ettinger WH, Burns R, Messier SP, et al. A randomized controlled 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). *Journal of the American Medical Association.* 1997; 277(1):25–31. [PubMed: 8980206]
14. Westby MD, Wade JP, Rangno KK, Berkowitz J. A randomized controlled trial to evaluate the effectiveness of an exercise program in women with rheumatoid arthritis taking low dose prednisone. *Journal of Rheumatology.* 2000; 27(7):1674–1680. [PubMed: 10914850]
15. O'Reilly SC, Muir KR, Doherty M. Effectiveness of home exercise on pain and disability from osteoarthritis of the knee: A randomized controlled trial. *Annals of Rheumatic Disease.* 1999; 58(1):15–19.
16. Kovar PA, Allegrante JP, MacKenzie CR, Peterson MG, Gutin B, Charlson ME. Supervised fitness walking in patients with osteoarthritis of the knee. A randomized, controlled trial.[comment]. *Annals of Internal Medicine.* 1992; 116(7):529–534. [PubMed: 1543305]

17. Neuberger GB, Press AN, Lindsley HB, et al. Effects of exercise on fatigue, aerobic fitness, and disease activity measures in persons with rheumatoid arthritis. *Research in Nursing and Health*. 1997; 20(3):195–204. [PubMed: 9179174]
18. Messier SP, Loeser RF, Miller GD, et al. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. *Arthritis Rheum*. May; 2004 50(5):1501–1510. [PubMed: 15146420]
19. Fransen M, McConnell S. Exercise for osteoarthritis of the knee. *Cochrane Database Syst Rev*. 2008; (4):CD004376. [PubMed: 18843657]
20. Badley EM, Ansari H. Arthritis and arthritis-attributable activity limitations in the United States and Canada: a cross-border comparison. *Arthritis Care Res (Hoboken)*. Mar; 2010 62(3):308–315. [PubMed: 20391476]
21. Fontaine KR, Heo M, Bathon J. Are US adults with arthritis meeting public health recommendations for physical activity? *Arthritis Rheum*. Feb; 2004 50(2):624–628. [PubMed: 14872507]
22. Cox C. An interaction model of client health behavior: theoretical prescription nursing. *Advances in Nursing Science*. 1982; 5:41–56. [PubMed: 6817699]
23. MacLeod P, Stewart NJ. Predictors of participation in a peer-led exercise program for senior women. *Canadian Journal of Nursing Research*. 1994; 26(1):13–25. [PubMed: 7922877]
24. Wilbur J, Michaels Miller A, Chandler P, McDevitt J. Determinants of physical activity and adherence to a 24-week home-based walking program in African American and Caucasian women. *Res Nurs Health*. Jun; 2003 26(3):213–224. [PubMed: 12754729]
25. Semanik, P. Doctoral Dissertation. Chicago, IL: Public Health Nursing, University of Illinois at Chicago; 2002. Determinants of Physical Activity in Older Women with Rheumatoid Arthritis.
26. Ehrlich-Jones L, Mallinson T, Fischer H, et al. Increasing physical activity in patients with arthritis: a tailored health promotion program. *Chronic illness*. Dec; 2010 6(4):272–281. [PubMed: 20696695]
27. Cox CL. An interaction model of client health behavior: theoretical prescription for nursing. *Advances in Nursing Science*. 1982 Oct.5:41–56. [PubMed: 6817699]
28. Marcus BH, Simkin LR. The transtheoretical model: applications to exercise behavior. *Medicine and Science in Sports and Exercise* 1994. 1994; 26(11):1400–1404.
29. Prochaska, JO.; Marcus, BH. The transtheoretical model: Applications to exercise. [References]. In: RKD, editor. *Advances in exercise adherence*. Champaign, IL, US: Human Kinetics Publishers; 1994. p. 161-180.
30. Semanik, P. Doctoral Dissertation. Chicago, IL: College of Nursing, University of Illinois at Chicago; 2002. Determinants of physical activity in older women with rheumatoid arthritis.
31. 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(3):315–324. [PubMed: 3358796]
32. Altman R, Asch E, Bloch D, et al. Development of criteria for the classification and reporting of osteoarthritis. Classification of osteoarthritis of the knee. Diagnostic and Therapeutic Criteria Committee of the American Rheumatism Association. *Arthritis & Rheumatism*. 1986; 29(8):1039–1049. [PubMed: 3741515]
33. Salaffi F, Cimmino MA, Leardini G, Gasparini S, Grassi W. Disease activity assessment of rheumatoid arthritis in daily practice: validity, internal consistency, reliability and congruency of the Disease Activity Score including 28 joints (DAS28) compared with the Clinical Disease Activity Index (CDAI). *Clin Exp Rheumatol*. Jul-Aug;2009 27(4):552–559. [PubMed: 19772784]
34. 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*. Sep; 2005 32(9):1662–1665. [PubMed: 16142857]
35. 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*. Jul 11; 2001 286(2):188–195. [PubMed: 11448282]

36. 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. *Journal of the American Medical Association*. 1995; 273(5):402–407. [PubMed: 7823386]
37. Bauman AE, Sallis JF, Dzewaltowski DA, Owen N. Toward a better understanding of the influences on physical activity: the role of determinants, correlates, causal variables, mediators, moderators, and confounders. *Am J Prev Med*. Aug; 2002 23(2 Suppl):5–14. [PubMed: 12133733]
38. Miller, WR.; Rollnick, S. *Motivational Interviewing: Preparing People for Change*. 2. New York: The Guilford Press; 2002.
39. Kellgren, J.; Lawrence, J. *Atlas of Standard Radiographs*. Oxford: Blackwell Scientific; 1963.
40. Williams GC, Freedman ZR, Deci EL. Supporting autonomy to motivate patients with diabetes for glucose control. *Diabetes Care*. Oct; 1998 21(10):1644–1651. [PubMed: 9773724]
41. Williams G, Rodin G, Ryan RM, Griolnick W, Deci EL. Autonomous regulation and long-term medication adherence in adult outpatients. *Health Psychology*. 1998; 17(3):269–276. [PubMed: 9619477]
42. Macius, P. *The relationship between healthy life styles and intrinsic motivation*. University of Illinois; Chicago: 1985.
43. Hawkes JM, Holm K. Gender differences in exercise determinants. *Nursing Research*. 1993; 42(3): 166–172. [PubMed: 8506166]
44. MacLeod P, Stewart NJ. Predictors of participation in a peer-led exercise program for senior women. *Canadian Journal of Nursing Research*. 1994 Spring;(1):13–25. [PubMed: 7922877]
45. Williams GC, Deci EL. Internalization of biopsychosocial values by medical students: a test of self-determination theory. *Journal of Personality and Social Psychology*. Apr; 1996 70(4):767–779. [PubMed: 8636897]
46. Williams GC, Deci EL. The importance of supporting autonomy in medical education. *Annals of Internal Medicine*. Aug 15; 1998 129(4):303–308. [PubMed: 9729184]
47. Neuberger GB, Aaronson LS, Gajewski B, et al. Predictors of exercise and effects of exercise on symptoms, function, aerobic fitness, and disease outcomes of rheumatoid arthritis. *Arthritis Rheum*. Aug 15; 2007 57(6):943–952. [PubMed: 17665488]
48. Levesque CS, Williams GC, Elliot D, Pickering MA, Bodenhamer B, Finley PJ. Validating the theoretical structure of the Treatment Self-Regulation Questionnaire (TSRQ) across three different health behaviors. *Health Educ Res*. Oct; 2007 22(5):691–702. [PubMed: 17138613]
49. Birchwood M, Smith J, Cochrane R, Wetton S, Copestake S. The Social Functioning Scale. The development and validation of a new scale of social adjustment for use in family intervention programmes with schizophrenic patients. *British Journal of Psychiatry*. Dec.1990 157:853–859. [PubMed: 2289094]
50. 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(12):1833–1840. [PubMed: 3068365]
51. Fries JF, Spitz P, Kraines RG, Holman HR. Measurement of patient outcome in arthritis. *Arthritis & Rheumatism*. 1980; 23(2):137–145. [PubMed: 7362664]
52. Kantz ME, Harris WJ, Levitsky K, Ware JE Jr, Davies AR. Methods for assessing condition-specific and generic functional status outcomes after total knee replacement. *Medical Care*. 1992; 30(5 Suppl):MS240–252. [PubMed: 1583936]
53. Liang MH, Fossel AH, Larson MG. Comparisons of five health status instruments for orthopedic evaluation. *Medical Care*. 1990; 28(7):632–642. [PubMed: 2366602]
54. 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(5):453–461. [PubMed: 11642645]
55. Fries JF, Spitz PW, Young DY. The dimensions of health outcomes: the health assessment questionnaire, disability and pain scales. *J Rheumatol*. Sep-Oct;1982 9(5):789–793. [PubMed: 7175852]
56. Ramey DR, Raynauld JP, Fries JF. The health assessment questionnaire 1992: status and review. *Arthritis Care Res*. Sep; 1992 5(3):119–129. [PubMed: 1457486]

57. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons.[comment]. *Journal of the American Geriatrics Society*. 1991; 39(2):142–148. [PubMed: 1991946]
58. Rikli RE, Jones CJ. Development and validation of a functional fitness test for community-residing older adults. *Journal of Aging & Physical Activity*. 1999; 7(2):129–161.
59. DiPietro L, Caspersen CJ, Ostfeld AM, Nadel ER. A survey for assessing physical activity among older adults. *Medicine & Science in Sports & Exercise*. 1993; 25(5):628–642. [PubMed: 8492692]
60. Young DR, Appel LJ, Jee S, Miller ER 3rd. The effects of aerobic exercise and T'ai Chi on blood pressure in older people: results of a randomized trial. *Journal of the American Geriatrics Society*. 1999; 47(3):277–284. [PubMed: 10078888]
61. Resnick B. Testing the effect of the WALC intervention on exercise adherence in older adults. *Journal of Gerontological Nursing*. 2002; 28(6):40–49. [PubMed: 12071273]
62. Bassett DR Jr, Cureton AL, Ainsworth BE. Measurement of daily walking distance-questionnaire versus pedometer. *Medicine & Science in Sports & Exercise*. 2000; 32(5):1018–1023. [PubMed: 10795795]
63. Conway JM, Irwin ML, Ainsworth BE. Estimating energy expenditure from the Minnesota Leisure Time Physical Activity and Tecumseh Occupational Activity questionnaires - a doubly labeled water validation. *Journal of Clinical Epidemiology*. 2002; 55(4):392–399. [PubMed: 11927208]
64. Conway JM, Seale JL, Jacobs DR Jr, Irwin ML, Ainsworth BE. Comparison of energy expenditure estimates from doubly labeled water, a physical activity questionnaire, and physical activity records. *American Journal of Clinical Nutrition*. 2002; 75(3):519–525. [PubMed: 11864858]
65. Irwin ML, Ainsworth BE, Conway JM. Estimation of energy expenditure from physical activity measures: determinants of accuracy. *Obesity Research*. 2001; 9(9):517–525. [PubMed: 11557832]
66. Torres L, Dunlop DD, Peterfy C, et al. The relationship between specific tissue lesions and pain severity in persons with knee osteoarthritis. *Osteoarthritis Cartilage*. Oct; 2006 14(10):1033–1040. [PubMed: 16713310]
67. Wagner EH, Austin BT, Von Korff M. Improving outcomes in chronic illness. *Managed Care Quarterly*. 1996; 4(2):12–25. [PubMed: 10157259]
68. Cox CL. Online exclusive: a model of health behavior to guide studies of childhood cancer survivors. *Oncol Nurs Forum*. Sep-Oct;2003 30(5):E92–99. [PubMed: 12949602]

Figure 1.
Interaction Model of Client Health Behavior (adapted from Cox⁶⁸)

Figure 2.
Recruitment of IMPAACT participants with rheumatoid arthritis (RA) from clinical practices

Figure 3.
Recruitment of IMPAACT participants with knee osteoarthritis from clinical practices, research registries, and responses to advertising

Figure 4.
Design of Improving Motivation for Physical Activity in Arthritis Clinical Trial (IMPAACT)

Figure 5.
Distributions of average accelerometer counts/day of IMPAACT participants with RA and those with knee OA.

Table 1

Theoretical Concepts and Instruments

IMCHB Concept	Variable	Measure	Data Collection
Client Singularity-Background			
Demographics	<ul style="list-style-type: none"> Age Gender Race Educational level Employment status 	<ul style="list-style-type: none"> ARAMIS protocol 	<ul style="list-style-type: none"> Telephone interview and chart review at baseline
<ul style="list-style-type: none"> Current Health 			
<ul style="list-style-type: none"> Disease Activity/Severity 	<ul style="list-style-type: none"> RA Disease Activity Knee OA Severity Disease duration Medications 	<ul style="list-style-type: none"> DAS 28 from joint exam data Kellgren-Lawrence rating of baseline knee x-ray ARAMIS protocol ARAMIS protocol 	<ul style="list-style-type: none"> Exam at index MD visit Reading within 3 months of baseline Chart review at baseline Telephone interview and chart review at baseline and all follow-ups
<ul style="list-style-type: none"> Comorbid Disease 	<ul style="list-style-type: none"> Depression, Heart Disease, Hypertension, Lung Disease, Diabetes, Obesity, Neuromuscular disease, other 	<ul style="list-style-type: none"> ARAMIS protocol 	<ul style="list-style-type: none"> Chart review at baseline and all follow-ups
Social Influence	<ul style="list-style-type: none"> MD Support Family support Friends support 	<ul style="list-style-type: none"> Health Care Climate Questionnaire 	<ul style="list-style-type: none"> Telephone interview at baseline and all follow-ups
Client Singularity-Dynamic			
Intrinsic Motivation	<ul style="list-style-type: none"> Treatment self-regulation Physical activity self-regulation 	<ul style="list-style-type: none"> Treatment Self-Regulation Questionnaire Exercise Self-Regulation Questionnaire Intrinsic Motivation Subscale 	<ul style="list-style-type: none"> Telephone interview at baseline and all follow-ups Telephone interview at baseline and all follow-ups
Cognitive Appraisal	<ul style="list-style-type: none"> Perceived competence Goals and aspirations 	<ul style="list-style-type: none"> Perceived Competence Scale Aspiration Index 	<ul style="list-style-type: none"> Telephone interview at baseline and all follow-ups Telephone interview at baseline and all follow-ups

IMCHB Concept	Variable	Measure	Data Collection
Affective Response	• Mental Health Status	• Short Form-36 Mental Component Summary Scale	• Telephone interview at baseline and all follow-ups
Client-Professional Interaction	• Self-reported physical activity promotion interventions	• Ad hoc questionnaire follow-ups	• Telephone interview at baseline and all follow-ups
Health Outcome/Behavior			
Health-related quality of life (HRQOL)	<ul style="list-style-type: none"> • Self-reported knee OA-specific HRQOL • Self-reported RA-specific HRQOL • Self-reported generic HRQOL • Observed physical function • Cardiorespiratory fitness 	<ul style="list-style-type: none"> • WOMAC Pain Scale • WOMAC Physical Function Scale • HAQ Pain score • HAQ Disability score • SF-36 Physical Component Score • SF 36 Mental Component Score • 8 foot up and go test • 5 minute walk 	<ul style="list-style-type: none"> • Telephone interview at baseline and all follow-ups • Telephone interview at baseline and all follow-ups • Telephone interview at baseline and all follow-ups • Assessment visit at baseline and all follow-ups • Assessment visit at baseline and all follow-ups
Physical Activity	<ul style="list-style-type: none"> • Self-reported physical activity • Objectively measured physical activity 	<ul style="list-style-type: none"> • Yale Physical Activity Survey • ActiGraph accelerometry; min of non-sedentary PA, min of moderate/vigorous PA (MVPA), min of MVPA in bouts of 10 min or more 	<ul style="list-style-type: none"> • Telephone interview at baseline and all follow-ups • Assessment visit with messenger return at baseline and all follow-ups

Table 2

Demographic and disease characteristics of RA and Knee OA IMPAACT subjects.

Baseline Characteristics	RA subjects (n=185)	Knee OA subjects (n=155)
	% or mean (sd)	% or mean (sd)
RECRUITING SOURCES		
Practices	100%	8%
Research Registries	0%	40%
Advertisements	0%	52%
SOCIODEMOGRAPHICS		
Age in years	54.8 (13.7)	63.1 (12.9)
21–44	22%	7%
45–64	55%	43%
> 65	23%	50%
Female Gender	84%	60%
Race/Ethnicity:		
White	72%	52%
African American	12%	35%
Other	16%	13%
Education:		
< high school	2%	7%
High school graduate	35%	43%
College graduate	63%	50%
HEALTH BEHAVIORS/COMORBIDITIES		
Body Mass Index	27.9 (6.6)	31.4 (6.2)
<25	38%	14%
25–29.9	32%	32%
30	30%	54%
Current Smoker	5%	18%
Disease duration in years	13.2 (10.0)	10.9 (10.3)
Mobility-limiting comorbidity	38%	28%
PHYSICAL ACTIVITY		
YPAS Total Time Index (hours/week)	26 (15)	32 (25)
YPAS Energy Expenditure Index (kcal/week)	5577 (3428)	7435 (6222)

Baseline Characteristics	RA subjects (n=185)	Knee OA subjects (n=155)
	% or mean (sd)	% or mean (sd)
YPAS Activity Dimension Summary Index	48 (21)	51 (20)
Average accelerometer counts/day	220743 (105708)	221431 (105861)
FUNCTIONAL PERFORMANCE		
Walking velocity (m/sec)	3.7 (0.9)	4.1 (1.0)
8 foot up and go time (sec)	8.5 (2.5)	10.0 (2.6)
HEALTH STATUS		
SF 36-Physical Component Score	43.8 (9.8)	44.7 (8.1)
SF 36-Mental Component Score	51.0 (9.1)	54.1 (7.4)
HAQ - Pain	3.3 (2.2)	NA
HAQ – Disability Index	0.7 (0.7)	NA
WOMAC - Pain	NA	5.7 (3.4)
WOMAC – Physical Function	NA	17.5 (11.6)