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Physical Activity and Correlates of Physical Activity Participation Over Three Years in Adults with Rheumatoid Arthritis

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Abstract

Objective—To characterize physical activity (PA) participation (meeting 150-minutes of moderate intensity or 75-minutes of vigorous (MVPA/week)), examine associations between disease activity and MVPA and identify MVPA correlates in adults with rheumatoid arthritis (RA) over 3 years.

Methods—This study included 573 RA patients (94% Caucasian, 83% female, mean age 61 years, mean RA duration 19.5 years) with 1 annual registry visit and who completed the PA questionnaire. Baseline and annual measures included: demographics/medical history, self-efficacy for disease management, quality of life, patient/physician global assessment, physical function, and self-reported PA. A logistic repeated measures model using the Generalized Estimation Equation examined the relationship between disease activity and MVPA.

Results—Average disease activity (DAS28-CRP3) was 3.1 (SD, 1.4), 36% were physically inactive and 29% met MVPA recommendations. There was a negative borderline association with disease activity (OR=0.89; 95%CI 0.79–1.00). Correlates of meeting MVPA recommendations,

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adjusting for disease activity, were being Caucasian (OR=2.95; 95%CI 1.29–6.75), older age (age >69 OR=0.58; 95%CI 0.36–0.92) poor mental health (OR=0.63; 95%CI 0.41–0.95), poor physical function (OR=0.59; 95%CI 0.34–1.01), overweight/obese (body mass index >25–30 OR=0.69; 95%CI 0.50–0.95; >30–39.9 OR=0.60; 95%CI 0.41–0.88; 40 OR=0.24; 95%CI 0.08–0.74) and patient global assessment (10–20) OR=0.57; 95%CI 0.39–0.83).

Conclusions—A small proportion met MVPA recommendations despite well-controlled disease. Disease activity was negatively associated with PA over time. PA correlates were linked to lifestyle, mental health and patient perceptions of disease, suggesting PA interventions that address patient perspectives may facilitate RA management.

Keywords

Rheumatoid Arthritis; Exercise; Sociobehavioral

Musculoskeletal pain and weakness, joint swelling, and fatigue are cardinal features of Rheumatoid Arthritis (RA). Patients with RA also demonstrate reduced aerobic capacity and associated excess cardiovascular risk. Excess cardiovascular risks include dyslipidemia, endothelial dysfunction, insulin resistance, and pulmonary involvement (1-3) and are modified with physical activity. Patients with RA are also at increased risk for mobility limitations and disability (4).

The standard of care in pharmacologic management of RA includes early aggressive therapy using disease modifying anti-rheumatic drugs (DMARDs) to prevent joint destruction (5, 6). However, the use of potent pharmacologic agents leads to more clinical discussions of medication side effects and potential adverse events and less emphasis on patient counseling regarding physical activity (PA) (7, 8). While PA benefits in healthy adults are well documented, PA participation among adults with RA is suboptimal (9). There is little information about the PA modes selected by these individuals (10). Even less information is available regarding the impact of RA disease activity on PA participation over time and whether disease activity has a greater impact on PA participation than patient-related factors (e.g. self-efficacy for exercise, history of PA and mental health status), all of which are known predictors of healthy behaviors such as PA participation (11-13).

This study draws upon the Social Cognitive Theory (SCT) (14) and Prochaska's Transtheoretical Model (15) to inform the design and selection of study measures. According to the SCT (14), behavior is largely regulated through cognitive processes. Key constructs of the SCT include: health beliefs; self-efficacy (a person's confidence to perform a certain behavior); outcome expectations, defined as the expected results that occur with the performance of targeted behavior; and expectancies, the value an individual places on the expected outcomes of the behavior. The Transtheoretical Model (15) describes behavior change as a progression through discrete stages of change. The model postulates the order in which factors are addressed has important implications for promoting or sustaining behavior change. Thus, messages to promote behavior change should target knowledge of outcomes and expected behavioral outcomes.

This cohort study aimed to: 1) longitudinally examine the relationship between RA disease activity and meeting the Office of Disease Prevention and Health Promotion's (ODPHP) Physical Activity Guidelines for Americans which recommends 150 minutes of moderate PA per week or 75 minutes of vigorous PA per week over three years (MVPA); 2) identify what physical activities patients with RA engage in and determine whether these activity modes change with RA disease activity over time and; 3) characterize prognostic factors associated with meeting MVPA recommendations. We hypothesized the association between disease activity and MVPA would be weak and that physical activities selected by our patients would remain relatively unchanged, regardless of disease state. We also hypothesized that patient factors (e.g. self-efficacy, education) would more strongly impact MVPA participation than undulating RA disease activity.

PATIENTS AND METHODS

Study Design and Sample

Five hundred seventy three adults were sampled from a longitudinal rheumatoid arthritis registry at a large tertiary care hospital (16). Patients eligible for sampling from the registry had to have completed a baseline PA questionnaire and have at least one annual registry visit with complete PA data. Registry patients were recruited from the practices of attending rheumatologists and fellows at the Arthritis Center and screened for participation by a billing diagnosis for RA. A rheumatologist verified all diagnoses. Patients aged 18 years were eligible if diagnosed with RA or seronegative inflammatory arthritis (714.0 or 714.9 billing code), had a CRP measurement at baseline and met American College of Rheumatology criteria for RA (17). Patients were excluded if they had a diagnosis of psoriasis and/or lupus (SLE). Each patient signed an informed consent approved by the Institutional Review Board.

Measures

At study entry, patients completed questionnaires, received a standardized physical examination by a rheumatologist, hand and wrist radiographs, and provided a blood sample for an array of clinical tests including; C-reactive protein (CRP), rheumatoid factor (RF), and anti-cyclic citrullinated peptide (anti-CCP) antibodies. Each participant completed questionnaires during an interview by a trained staff member including: demographics: age, gender, ethnicity, race, marital status, smoking history, alcohol use, employment and education, medical history and medication. Medical history data included history of RA-related joint surgery, physical therapy and PA, and disease duration and medications were coded as a series of nominal variables: (a) nonsteroidal anti-inflammatory drugs (NSAIDs), (b) corticosteroids, (c) synthetic disease modifying agents (DMARDs), and (d) biologic DMARDs, and comorbidities. Comorbidities were assessed using a modified version of the Charlson Comorbidity Index (18, 19). Questionnaires, physical examinations, radiographs, medical record and laboratory data were obtained annually over the three years for this cohort.

The main predictor variable was RA disease activity measured with the Disease Activity Score 28-CRP3 (DAS28-CRP3), a valid and reliable measure of disease activity (20, 21).

The DAS28-CRP3 is calculated based on the number of swollen and tender joints and level of C-reactive protein (CRP). The summary score ranges from 0 to 10. DAS28-CRP3 scores were classified as: low active (< 3.2); moderately active ($3.2\text{--}5.1$) and highly active (> 5.1). The Physician's Global Assessment (22) and Patient Global Assessment of disease scales measured disease severity. This physician-based measure uses a visual analog scale ranging from 0–10. Patient global assessment of disease uses a 100-point VAS scale. The primary outcome variable was participation in PA in line with the ODPHP recommendations for moderate and vigorous minutes of physical activity (MVPA) per week (e.g. meeting 150 minutes of moderate or 75 minutes of vigorous PA per week) versus not meeting this PA threshold (23). Physical activity was measured using the Nurses Health Study II physical activity scale (NHSPAQ II), a simple, short, self-report scale that assesses modes (e.g. swimming, walking, strength training), frequency, intensity, and duration of PA participation in these modes (in minutes) over the past week (24). The NHSPAQII provides the total number of PA minutes per week by intensity. The NHSPAQ II is a well validated and reliable measure of PA (test-retest reliability of the NHSPAQ II is fair (0.59)) and the validity of the NHSPAQ II is good (correlations ranging from 0.79–0.83) (24). We also described patterns regarding modes of PA selected by patients with RA over time. The Medical Outcomes Trust Short Form (SF)-12 provides a measure of function and health related quality of life. The SF-12 was chosen as a global measure of disease impact and is widely accepted as both a valid and reliable self-administered measure (25). Items are scored as dimensions of health: physical functioning, general mental health covering psychological distress and well-being, role limitations due to physical and emotional problems, bodily pain, social functional, vitality-energy and fatigue, and general health perceptions. We also measured Quality of Life using the EuroQOL 5 Dimensions (EQ5D), a universally used generic instrument for assessing health-related quality of life and health status outcome. The EuroQOL5D consists of a visual analogue scale (VAS), and five questions concerning mobility, self-care, usual activities, pain/discomfort and anxiety/depression. The responses are used to calculate an index score where 0 is death and 1 is full health (26). Self-efficacy for disease management, an important factor influencing patients' perception of their general health, was assessed using Lorig's Self-Efficacy Scale (27). This scale yields data with high test-retest reliability (correlations range from 0.85 to 0.90) (27). Physical function was assessed using the Multidimensional Health Assessment Questionnaire (MDHAQ) (28), a self-report health assessment questionnaire designed specifically for patients with RA. This valid and reliable measure is easy to score and includes 8-10 activities of daily living, along with scores for pain and global status, and psychological items (29). The Short Form-36 Mental Health Status (MHI-5) scale assessed mental health. This scale has good test-retest reliability ($r=0.93$) and internal consistency (Cronbach's $\alpha=0.74$) (30, 31) and has been validated against the Diagnostic and Statistical Manual of Mental Disorders-4th edition Axis (32). A visual analog scale (VAS) was used to assess fatigue. This single item is from the CLINHAQII (33). The use of a VAS for fatigue is a reliable and valid technique and has been reported to correlate moderately with poor sleep ($r=0.6$) and mood state ($r=0.4\text{--}0.5$) (34). Patients indicated their fatigue severity on a scale varying from 0 ("no fatigue") to 100 ("maximum fatigue") over the past week (34).

Statistical Analyses—The association between PA and disease activity (DAS28-CRP3) was estimated using the Generalized Estimation Equations (GEE) method in a logistic repeated measures model for the primary outcome meeting ODPHP PA recommendations for MVPA (“yes” or “no”), controlling for confounder variables (35). Variables were categorized based on either the distribution of the variables or established cutpoints. Variables were included in the model based on the p-value of individually run repeated measures models with PA yes/no as the outcome, adjusting for disease activity (DAS28-CRP3), along with the variable being examined. Variables with a p-value ≤ 0.10 were included in the full model. When examining the data, we found that 15.8% of the records were missing at least one of the covariates in the model. A second model was run including only those records with complete data to identify the impact of missing data on the results.

To characterize the types (modes) of MVPA patients engaged in over time, we stratified patients by disease activity level at each time point and plotted these by PA modes using histograms. A repeated measures analysis was used to explore whether there were significant differences between the use of multiple modes of exercise, stratified by disease activity level, over the three years.

For our apriori power calculations, our experience with this registry cohort led us to expect that missing data would be random and at most 15% of data would be missing. With power set at 80% and using a correlation of 0.3 (low) within individuals over time and a correlation of 0.10 (very low) between disease activity (DAS28-CRP3) and PA, a sample of 454 subjects was required. Thus, our sample exceeded the number needed to examine the relationship between disease activity and PA over the years. Data analysis for this paper was generated using SAS software, version 9.4 for Windows (Copyright, SAS Institute Inc., Cary, NC, USA).

Results

The study population consisted of 573 adults and their sociodemographic information is presented in **Table 1**. The mean RA disease duration was 19.5 years (SD=11.8). Three hundred thirty five (59%) subjects were taking biologic DMARDs and 171 (30%) had a history of RA-related surgery. At baseline, 333 (59%) had low RA disease activity, 168 (30%) moderate and 61 (11%) highly active RA. Two hundred and eight patients (36%) reported no physical activity and 169 subjects (29%) met the ODPHP recommendations for MVPA. Among those who reported engaging in MVPA, 171 (30%) reported using a combination of modes of activity and 106 (19%) reported walking for PA. Over 3 years, MVPA there was a negative borderline associated with disease activity (OR=0.89; 95%CI 0.79 – 1.00).

Figure 1 shows the proportion of adults with RA who met the ODPHP recommendations for total weekly MVPA, stratified by disease activity (low, moderate, and highly active disease) over time. With respect to MVPA participation, **figure 1** demonstrates that the proportion of patients meeting MVPA recommendations varies by their disease activity, with fewer people with highly active disease meeting recommendations. **Figure 2** highlights the selection of modes of PA by these individuals. Most individuals reported using a combination of PA

modes, the next frequent choice of PA was walking followed by strength training with weights. With respect to the use of multiple modes of MVPA, individuals with low disease activity were more likely to use multiple modes of MVPA compared to those with moderately active (OR=0.68; 95% CI 0.53 – 0.87) and highly active RA (OR=0.51; 95% CI 0.32 – 0.83).

Adjusting for disease activity (DAS28-CRP3), the following individual variables were significantly associated with meeting ODPHP MVPA recommendations at the $p < 0.1$ level: age, Caucasian, being married or living with a significant other, being employed full-time, college education, any use of alcohol, patient global assessment of health, better physical function (MDHAQ), physician global assessment of health, mental health, self-efficacy for managing arthritis, quality of life, fatigue, having RA-related surgeries, and BMI (**Table 2**). Use of RA medications was not associated with meeting MVPA recommendations.

Multivariable Model

After including all significant variables and adjusting for disease activity, the factor significantly associated with meeting ODPHP MVPA recommendations, was being Caucasian (OR=2.95; 95% CI 1.29 – 6.75). Older age (age ≥ 69) OR=0.58; 95% CI 0.36 – 0.92, poor mental health (OR=0.63; 95% CI 0.41 – 0.95), patient global assessment scores of 10–20, (OR=0.57; 95% CI 0.39 – 0.83), and being overweight/obese (body mass index >25 –30 OR=0.69; 95% CI 0.50 – 0.95; >30 –39.9 OR=0.60; 95% CI 0.41 – 0.88; ≥ 40 OR=0.24; 95% CI 0.08 – 0.74) were associated with not meeting the MVPA recommendations (**Table 3**). There was a borderline significant negative association between MVPA and worse physical function (OR=0.59; 95% CI 0.34 – 1.01). When examining the data, we found that 15.8% of the records were missing at least one of the covariates in the model. A second model including only those records with complete data was run and no significant differences were found between those results and the model reported on above.

Discussion

This study aimed to describe MVPA participation in adults with RA, examine the relationship between RA disease activity and MVPA participation and to characterize correlates of MVPA participation over three years. Using established behavioral models and constructs (e.g. Social Cognitive Theory), we hypothesized that patient factors (e.g. self-efficacy, mental health) would more strongly impact PA participation than undulating RA disease activity. At baseline, despite the fact that 59% of patients in our cohort had low RA disease activity (DAS28-CRP3 < 3.2), only 29% met MVPA recommendations. These data are consistent with other studies of PA engagement in adults with RA, though the preponderance of these studies are cross-sectional in nature, report metabolic equivalents or total PA (all intensity levels), and use different measures of PA, making comparisons with this study difficult (9). For example, in a cross-sectional study of 98 Swedish adults with RA, Eurenus found 36% of adults met PA recommendations. In this study, there was no information on RA disease activity and PA was assessed using a Swedish questionnaire (36). Hernandez et al reported adults who had moderately active RA (mean DAS of 3.75) participated in significantly lower levels of PA than healthy controls (13). In this study,

Hernandez et al found associations with PA participation were stronger with self-reported PA versus accelerometry. However, in a small cross-sectional study of 61 adults with RA with similar mean disease activity (mean DAS-CRP of 3.3), Elkan (37) found adults with RA who had relatively low RA disease activity and good functional capacity self-reported similar PA levels to healthy Swedish women of the same age. Manning et al, reported 61% of adults with arthritis (53% of whom had RA) met the established MVPA guidelines (38). Both Manning and Elkan used the International physical activity questionnaire. In this large sample, we found a significant but weak association between disease activity and MVPA participation over three years. As **Figure 1** illustrates, individuals with low active RA increased their MVPA from baseline to year 3. Whereas, adults with moderate and highly active RA showed a slight decrease in MVPA with time.

Caucasians were roughly three times more likely than individuals of other races to meet MVPA recommendations. Older adults (aged 69 years), those with poor mental health, poorer physical function, higher BMI, and those who perceived their disease to be more severe were less likely to be physically active. These data align with other studies examining the association between correlates of PA in general populations and in adults with RA (39) that indicate sociodemographic factors such as race and age are important correlates of PA participation (40, 41). These results also align with data from Lindstrom et al who identified individual factors, such as social participation and education, were important correlates of self-reported leisure time PA in their large population-based cohort of adults with RA in Sweden (41). In another large cross-sectional study of 5,235 patients with RA from 21 countries, Sokka et al found female gender, older age, lower education, obesity, co-morbidities, low functional capacity, greater disease activity, pain, and fatigue were correlates of self-reported PA, despite differing PA levels across countries (42).

A second aim of this study was to explore PA modes selected by adults with RA and to determine if these modes of PA change over time or in relationship to changes in RA disease activity. Among those individuals who reported engaging in PA, most used a combination of modes of PA. The second most common form of physical activity was walking. In general, combinations of physical activity modes are recommended to avoid overstressing specific joints and walking programs such as the Arthritis Foundation's *Walk with Ease* are effective in helping patients with RA stay physically active (43). Mancuso et al., compared PA levels in 121 adults with RA and 120 healthy individuals and reported those with RA expended fewer calories per week than healthy controls. The greatest difference in calorie expenditure was attributed to less walking rather than to high-intensity activities (44). As walking is an effective and relatively safe activity, walking should be made a priority to improve cardiovascular function in persons with RA.

Physical activity, disease activity and functional status are often considered inter-related. Wesling et al. studied the impact of disease activity and function over 9 years in adults with RA and concluded that the impact of disease activity and joint destruction on function changes with time (45). After adjusting for disease activity, there was a borderline significant association between poor physical function and not meeting MVPA recommendations and that patient perspectives of function were also associated with not meeting MVPA recommendations over time.

Physical activity is also a known mediator of emotional stress, reducing emotional stress by as much as 40% among healthy individuals (college students, adults, adult caregivers) (46). However, the association between PA and psychological health is bi-directional. Physical activity may reduce disease activity through its anti-inflammatory effects and improve psychological health and self-efficacy. These factors in turn, can influence PA engagement. Behavioral theories suggest psychological distress is associated with less PA via behavioral inhibition and with more PA via behavioral activation. This bi-directional relationship between PA and mental health is important to understanding what motivates individuals to be physically active (46). As Veldhuijzen van Zanten et al report in their recent literature review of PA in adults with RA, patient perceptions of benefits of PA for general health and pain relief are important motivators for being physically active among adults with RA (47).

Pharmaceutical management of disease activity, is often considered an effective method of helping patients maintain function and be physically active. In our sample 90% of patients were taking some form of disease modifying agent. When we examined different medications to determine whether medication use influenced PA engagement, medication use was not a significant predictor of PA engagement. The lack of association between disease activity and PA engagement in our sample may be related to learned behavior and adaptation of lifestyle when disease activity is high. Thus, patients who are inactive and whose disease becomes well controlled may not adopt an active lifestyle without encouragement and motivation from their health care provider or family members (47).

Limitations

Physical activity is a summated construct and relies on the mode, frequency and duration of the activity. Self-report of physical activity may not accurately reflect actual PA levels, leading to an over-estimation of PA engagement and the potential for a weaker association with disease activity (13). However, this would likely occur at random and may not be related to disease-activity. Using annual measures of disease activity and physical activity are course measures and may be impacted by seasons. However, we were able to follow patients over time, and any impact on estimates we expect will be random. Additionally, annual assessments are made on the anniversary of the patient's visit so subjects are reporting PA levels in the same season each year. The intent of our study was to examine the association between disease activity and meeting MVPA recommendations. Using ODPHP recommendations of 150 minutes of moderate or 75 minutes of vigorous PA which are applied to all individuals, may have set the threshold for MVPA too high. We recognize that MVPA can impact disease activity levels and that causality cannot be inferred with cohort studies. Additionally, our sample was predominantly Caucasian and well educated limiting generalizability.

Strengths

This study addresses the understudied topic of physical activity in RA, a disease that impacts 1.4 million Americans (48) and is associated with excess cardiovascular risk and disability (1-3). Evidence indicates PA participation rates are suboptimal and RA patients are rarely counseled about PA in clinical visits (6, 7, 49), despite its well-established benefits. We used a multi-modal and theoretical approach to examine the contributing factors for PA

participation, and leverage a well-characterized longitudinal registry of RA patients that enables data acquisition and accessible provider interface. We assessed laboratory measures of disease activity and progression, coupled with well-validated measures of behavioral factors, function, disability and participation.

A recent study of long-term health benefits of counseling for PA in adults with RA noted the need to integrate behavioral factors in counseling to enhance health outcomes (50). Our results suggest both patient perceptions of disease as well as actual function influence PA engagement. We aim to use these findings to inform future PA interventions by tailoring physical activity counseling to identify individuals whose disease has become controlled but who are not returning to or seeking to engage in PA.

Conclusion

A small proportion of adults with RA met PA recommendations over the three year period, despite well-controlled disease. It appears that individuals who met ODPHP MVPA recommendations did so by meeting the recommendations for moderate intensity PA. Though the proportion of individuals meeting MVPA recommendations increased slightly over three years, there is much need for improvement. Counseling adults with RA to become physically active and maintain a physically active lifestyle is important to reduce cardiovascular risk and enhance health outcomes. Counseling activities for these patients should include activities of moderate intensity such as readily available and well tested walking programs, such as the *Walk with Ease* offered by the Arthritis Foundation (43). After controlling for disease activity, modifiable correlates of PA were linked to lifestyle, mental health and patient perceptions of disease, suggesting PA interventions focus on patient perspectives and lifestyles.

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Significance and Innovations

- RA-disease activity was negatively associated with physical activity participation over three years.
- Roughly one third of adults with RA were not physically active over the three years. At baseline, of those who engaged in physical activity, 19% walked for physical activity and 30% used more than one mode of PA. Only 1% lifted weights or swam. Additionally, the majority of patients who met the Office of Disease Prevention and Health Promotion's Physical Activity Guidelines for Americans, met these guidelines at the moderate intensity level. A small proportion engaged in vigorous intensity exercise. Thus, adults with RA may benefit from more information regarding various modes of physical activity that are useful for managing RA symptoms and encouraged to engage in moderate intensity activities.
- Psychosocial factors were significantly correlated with physical activity participation after adjusting for disease activity in these adults with RA. Counseling to promote physical activity should explore psychosocial factors and address patient perceptions of RA disease to motivate patients to be physically active.

Figure 1.
Proportion of Individuals Meeting Moderate and Vigorous Physical Activity
Recommendations Stratified by Disease Activity Over Three Years

A = Low (DAS28-CRP3 < 3.2)

B = Moderate (DAS28-CRP3 3.2–5.1)

C = High (DAS28-CRP3 > 5.1)

Figure 2.

Modes of Physical Activity Engagement Over Three Years Among Patients with Rheumatoid Arthritis by Disease Activity (n=573)

A. Low disease activity (DAS28-CRP3 < 3.2)

B. Moderate disease activity (3.2 ≤ DAS28-CRP3 < 5.1)

C. High disease activity (DAS28-CRP3 ≥ 5.1)

Table 1

Baseline Demographic and Clinical Features of Adults with Rheumatoid Arthritis (n=573)

Variable	Mean (SD) or Number (%)
Age, years	61 (12)
Age, categorized	
18-53 years	141 (25%)
53-62 years	145 (25%)
62-69 years	137 (24%)
69 years	150 (26%)
Female	478 (83%)
Caucasian (n=569)	535 (94%)
Body Mass Index (BMI) (n=555)	27.1 (6.1)
BMI WHO Classifications ⁱ (n=555)	
Under-weight	13 (2%)
Normal Range	221 (40%)
Overweight	179 (32%)
Obese Class I/II	115 (21%)
Obese Class III	27 (5%)
Smoking status (n=543)	
Never smoked	281 (52%)
Smoked in the past	233 (43%)
Current smoker	29 (5%)
RF Positive (n=567)	395 (70%)
CCP Positive (n=496)	335 (68%)
Medication	
Taking Only Methotrexate	101 (18%)
Taking a TNF-alpha	114 (20%)
Taking a steroid	132 (23%)
Taking a NSAID	262 (46%)
Taking any DMARD	518 (90%)
Taking non-biological DMARD	383 (67%)
Taking biological DMARD	335 (59%)
DAS28-CRP (n=562)	
High	61 (11%)
Moderate	168 (30%)
Low	333 (59%)
Married or Significant Other	395 (69%)
Employed Full time	255 (45%)
College Graduate (n=570)	378 (66%)
Had RA-Related Surgery	171 (30%)
Disease Activity (DAS28-CRP3) (n=527)	3.07 (1.4)
Low DAS28-CRP3/Remission 0-3.2	332 (63%)

Variable	Mean (SD) or Number (%)
Moderate /High DAS28-CRP3 > 3.2	195 (37%)
Any alcohol	318 (56%)
Alcohol in grams per week	
0	255 (45%)
1-35	186 (33%)
36-140	104 (18%)
> 140	28 (5%)
Exercise	
No Exercise	208 (36%)
Walking	106 (19%)
Jogging	1 (0.2%)
Running	2 (0.4%)
Bicycling	9 (2%)
Tennis	2 (0.4%)
Swimming	7 (1%)
Other Aerobic	12 (2%)
Low Intensity	42 (7%)
Vigorous	6 (1%)
Weights	7 (1%)
Multiple Modes	171 (30%)
Mean Patient Global Assessment (SD) (n=542)	28.7 (24.5)
Patient Global Categories [*]	
0-10	124 (23%)
10-20	114 (21%)
20-50	140 (26%)
50	164 (30%)
Physician Global Assessment (n=555)	2.4 (1.9)
Physician Global Categories ^{\$\$}	
0-3	420 (76%)
> 3	135 (24%)
Self Efficacy for Managing RA	76 (17.9)
Self Efficacy Categories [†]	
0-50	51 (9%)
50-80	234 (41%)
80	288 (50%)
Quality of Life (EQ Index) [‡] (n=538)	0.81 (0.16)
RA Disease Duration, years	19.5 (11.8)
RA Disease Duration Categories	
< 9 years	122 (21%)
9-16 years	145 (25%)
16-28 years	155 (27%)

Variable	Mean (SD) or Number (%)
28 years	151 (26%)
Number of Comorbidities	1.9 (2.2)
Comorbidity Categories	
0	201 (35%)
1-2	208 (36%)
3	164 (29%)
Fatigue Scale (n=542)	40.2 (29.6)
Fatigue Categories [#]	
< 15	135 (25%)
15-40	133 (25%)
40-70	138 (25%)
70	136 (25%)
Physical Function (MDHAQ Score) [^]	0.55 (0.51)
Mental Health Score (MHI-5)	76.4 (16.6)
Have a Mood Disorder (MHI-5 < 65)	111 (19%)
Physical Therapy Visits (1 in past 6 months)	77 (13%)
Percent who met or exceeded the MVPA Recommendations (150 min moderate PA/week or 75 minutes of vigorous PA/week)	169 (29%)
• Of those who met the MVPA recommendations, the percent who met the recommendations by doing moderate exercise (150 minutes of moderate PA/week)	123 (73%)
• Of those who met the MVPA recommendations, the percent who met the recommendations by doing vigorous exercise (75 minutes of vigorous PA/week)	46 (27%)
• Of those who met the MVPA recommendations, the percent who met the recommendations by doing a combination of vigorous and moderate exercise (equivalent to at least 150 min moderate PA/week)	0

RF = Rheumatoid factor; CCP = cyclic citrullinated peptide; TNF-alpha = tumor necrosis factor alpha; NSAID = nonsteroidal anti-inflammatory drugs; DMARD = disease-modifying anti-rheumatic drug; DAS = Disease Activity Score; MVPA = moderate/vigorous physical activity

[/]Body Mass Index WHO Classifications: Underweight < 18.50, Normal Range 18.50 – 24.99, Overweight 25.00 – 30.00, Obese Class I/II 30.00 – 39.99, Obese Class III 40.00

^{*} Positive scores on the Patient global assessment indicates higher disease severity.

[§] Positive scores on the Physician global assessment indicates higher disease severity.

[†] Positive score on the Lorig's Self-Efficacy Scale indicates higher self-efficacy for disease management.

[‡] Higher scores on the EQ Index indicates better quality of life.

[#] Positive scores on the Fatigue scale indicates higher fatigue severity.

[^] Higher scores on the Multi-dimensional health assessment questionnaire (MDHAQ) indicates worse function and greater disability.

Table 2

Results of Repeated Measures Logistic Model using GEE for Individual Predictors of Meeting Physical Activity Recommendations Over Three Years in Adults with Rheumatoid Arthritis, Adjusting for Disease Activity (DAS28-CRP3)

Variable		Odds Ratio	95% CI
Age	69 years	0.52	0.36 – 0.74
	62-69 years	0.68	0.48 – 0.97
	53-62 years	0.65	0.46 – 0.92
	18-53 years	Reference	
Caucasian		2.85	1.39 – 5.81
Married or Living with Significant Other		1.57	1.17 – 2.09
Full-time employed		1.36	1.08 – 1.75
College Graduate		1.81	1.33 – 2.46
Had RA-related Joint Surgery		0.71	0.52 – 0.97
RA Disease Duration	28 years	0.75	0.51 – 1.11
	16-28 years	0.81	0.54 – 1.20
	9-16 years	0.92	0.64 – 1.31
	< 9 years	Reference	
Any Use of Alcohol		1.46	1.17 – 1.81
Patient Global Assessment of Function [*]	50	0.37	0.26 – 0.52
	20-50	0.49	0.35 – 0.68
	10-20	0.55	0.40 – 0.76
	0-10	Reference	
Physician Global assessment [§]	> 3	0.71	0.52 – 0.97
	0-3	Reference	
Self-efficacy [†]	80	2.18	1.27 – 3.76
	50-80	1.37	0.79 – 2.38
	0-50	Reference	
Number Comorbidities	3	0.82	0.62 – 1.09
	1-2	0.92	0.73 – 1.14
	0	Reference	
Quality of Life (EQ Index) [‡]		5.49	2.34 – 12.89
Fatigue VAS [#]	70	0.51	0.36 – 0.74
	40-70	0.60	0.43 – 0.83
	15-40	0.70	0.51 – 0.95
	< 15	Reference	
Physical Function (MDHAQ Score) [^]		0.38	0.27 – 0.53
Body Mass Index (BMI WHO Category) [^]	Obese Class III	0.18	0.06 – 0.49
	Obese Class I/II	0.52	0.37 – 0.72
	Overweight	0.61	0.46 – 0.81

Variable		Odds Ratio	95% CI
	Normal Range	Reference	
	Under-weight	0.65	0.25 – 1.67
Mental Health Disorder [¶]	0-64	0.49	0.35 – 0.68
	65-100	Reference	
Medications			
Steroid – current		0.86	0.64 – 1.16
Steroid – within past 6 months		1.03	0.80 – 1.32
Non-biologic DMARD		1.05	0.81 – 1.36
Biologic DMARD		1.12	0.87 – 1.44
NSAIDs		1.08	0.86 – 1.

Significant values are printed in bold type.

RF = Rheumatoid factor

* Positive scores on the Patient global assessment indicate higher disease severity.

§ Positive scores on the Physician global assessment indicate higher disease severity.

‡ Positive scores on Lorig's Self-Efficacy Scale indicates greater self-efficacy for disease management.

‡ Higher scores on the EQ Index indicates better quality of life.

Positive scores on the Fatigue scale indicates greater fatigue severity.

ˆ Body Mass Index WHO Classifications: Underweight < 18.50, Normal Range 18.50 – 24.99, Overweight 25.00 – 30.00, Obese Class I/II 30.00 – 39.99, Obese Class III 40.00

^ Higher scores the Multi-dimensional health assessment questionnaire (MDHAQ) indicates worse function and greater disability.

¶ Lower scores on the mental health score indicate poorer mental health. Less than 65 indicates disorder.

Table 3

Results of Multivariable Repeated Measures Logistic Model using GEE in Adults with Rheumatoid Arthritis Who Met Physical Activity Recommendations Over Three Years, Adjusting for Disease Activity (DAS28-CRP3)

Variable		Odds Ratio	95% CI
DAS28-CRP3		0.89	0.79 – 1.00
Physical Function (MDHAQ Score) [^]		0.59	0.34 – 1.01
Quality of Life (EQ Index) [‡]		0.47	0.12 – 1.78
Age	69 years	0.58	0.36 – 0.92
	62-69 years	0.75	0.49 – 1.15
	53-62 years	0.73	0.47 – 1.12
	18-53 years	Reference	
Caucasian		2.95	1.29 – 6.75
Married or living with a partner		1.31	0.93 – 1.84
Employed full time		1.04	0.76 – 1.43
College graduate or higher		1.24	0.88 – 1.75
Any use of alcohol		1.28	0.99 – 1.
Patient global assessment of function [*]	50	0.67	0.38 – 1.19
	20-50	0.70	0.45 – 1.09
	10-20	0.57	0.39 – 0.83
	0-10	Reference	
Physician Global Assessment [§]	> 3	1.01	0.70 – 1.45
Self-efficacy category [‡]	80	1.44	0.72 – 2.84
	50-80	1.28	0.66 – 2.46
	0-50	Reference	
RA Disease Duration	28 years	0.86	0.53 – 1.42
	16-28 years	0.94	0.59 – 1.50
	9-16 years	0.90	0.60 – 1.36
	< 9 years	Reference	
Comorbidities	3	0.97	0.69 – 1.38
	1-2	1.01	0.77 – 1.32
	0	Reference	
Fatigue scale [#]	70	0.97	0.59 – 1.57
	40-70	0.96	0.62 – 1.49
	15-40	0.92	0.63 – 1.33
	< 15	Reference	
Mental Health (MHI-5) Disorder	0-64 [¶]	0.63	0.41 – 0.95
	65-100	Reference	
Body Mass Index (BMI WHO Category) [*]	Obese Class III	0.24	0.08 – 0.74
	Obese Class I/II	0.60	0.41 – 0.88

Variable		Odds Ratio	95% CI
	Overweight	0.69	0.50 – 0.95
	Normal Range	Reference	
	Under-weight	0.54	0.23 – 1.30
Steroid – current use		1.02	0.72 – 1.45
DMARD- current use		1.02	0.62 – 1.69

Significant values are printed in bold type.

RF = Rheumatoid factor;

[^] Higher scores the Multi-dimensional health assessment questionnaire (MDHAQ) indicates worse function and greater disability.

[†] Higher scores on the EQ Index indicates better quality of life.

^{*} Positive scores on the Patient global assessment indicate higher disease severity.

[§] Positive scores on the Physician global assessment indicate higher disease severity.

[‡] Positive scores on Lorig's Self-Efficacy Scale indicates greater self-efficacy for disease management.

[#] Positive scores on the Fatigue scale indicate greater fatigue severity.

[¶] Lower scores on the mental health score indicate poorer mental health. Less than 65 indicates disorder.

^ˆ Body Mass Index WHO Classifications: Underweight < 18.50, Normal Range 18.50 – 24.99, Overweight 25.00 – 30.00, Obese Class I/II 30.00 – 39.99, Obese Class III 40.00