**Title:** Physical activity habits among older adults living with rheumatic disease.

**Short running head:** Physical activity among older adults.

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**Abstract:**

**Objective:**

To describe levels of physical activity (PA) in older adults with rheumatic diseases and study the association between PA level and patient reported outcomes (PROs).

**Methods:**

Using data from FORWARD, a cross-sectional analysis was performed among adults ages 65 and older with rheumatic diseases to assess the levels of PA. PA was categorized as high (vigorously active for at least 30 min, 3 times per week), moderate (moderately active for at least three times per week) or low (seldom active). We assessed the self reported levels of PA amongst patient with different types of rheumatic diseases and assessed the association between levels of PA and PROs including the PROMIS29 assessment.

**Results:**

Among the 3,343 eligible participants, rheumatoid arthritis (68%) was the most common rheumatic disease. Vigorous PA was reported by 468 (14%) participants, and 1,799 (54%) reported moderate activity. Overall, participants reported a median of 7 days of moderate to vigorous level of PA for 30 min or more per month (IQR 0-15). Obese participants were significantly more likely to report low levels of activity (44% of obese compared to 25% of non-obese individuals). Participants with low PA levels had higher (worse) pain scores, higher (worse) HAQ-DI scores, higher depression rates and worse PROMIS29 scores related to pain, sleep and fatigue.

**Conclusions:**

Among patients with rheumatic diseases, levels of vigorous PA were relatively low among older patients. These observations, though descriptive, support a relationship between physical inactivity and obesity, depression, poor sleep, and fatigue in patients with rheumatic disease.

**Introduction**

Physical activity (PA) offers primary, secondary and tertiary prevention of several chronic conditions like hypertension, obesity, and cardiovascular disease. Regular PA can extend years of active independent living, reduce disability and improve the quality of life for older people [1]. PA helps in the reduction of all-cause mortality by 30% in general population to as high as 51% in older population [2,3]. Despite the multiple benefits offered by PA, the proportion of older adults meeting PA guidelines is between 27% to 44% [4]. Across all surveys, Non-Hispanic White males reported higher levels of PA which declined with age and functional limitation across all groups [4]. Rheumatic and musculoskeletal diseases (RMDs) like rheumatoid arthritis (RA), spondyloarthritis (SpA), systemic lupus erythematous (SLE) and osteoarthritis (OA) are a diverse group of multi-system diseases that commonly affect the joints. As older adults with RMDs can have significant functional limitation, it is important to understand the level of PA in this group.

The European Alliance of Associations for Rheumatology (EULAR) recommendations for people with inflammatory arthritis and osteoarthritis state that PA is effective, feasible, safe and should be an integral part of care [5]. In the United States, moderate intensity aerobic PA for a minimum of 30 minutes, 5 days per week or vigorous intensity aerobic activity for a minimum of 20 minutes, 3 days per week is recommended by the Department of Health and Human Services (DHHS) guidelines for general population [6]. For adults 65 years and older who have good fitness and no chronic conditions, at least 150 minutes of moderate-intensity or 75 minutes a week of vigorous-intensity aerobic PA is recommended [7]. Preferably, aerobic activity should be spread throughout the week. Older adults with chronic conditions should understand whether and how their conditions affect their ability to do regular PA safely and should be as physically active as their abilities and conditions allow [7,8]. With advancing age, structural and functional deterioration occurs in most physiological systems, even in the absence of disease. This process is exacerbated in patients with rheumatic diseases like RA, SpA and OA who may experience

joint pain, restricted mobility and reduced muscle strength and endurance [9,10]. The presence of chronic systemic inflammation might account for the substantially increased cardiovascular risk and associated co-morbidities of muscle wasting, anemia, and accelerated atherosclerosis [11,12]. This can cause fatigue, decreased energy and diminish the ability of patients to perform physical activities.

Historically, exercise was not routinely recommended in patients with rheumatic diseases due to concerns that it might exacerbate joint damage. However, it is now known that exercise is safe for people with rheumatic conditions, and that PA is capable of reducing chronic inflammation by direct and indirect anti-inflammatory effects and is important in management of rheumatic diseases [13-15]. Aging is generally associated with a loss of both aerobic capacity and muscle mass, as well as an increase in fat mass. Thus, the maintenance of PA as one ages is an important potential tool to disrupt this cycle and prevent deteriorations in health. Participation in PA has also been shown to improve patient reported outcomes (PRO) including health related quality of life, function, and fatigue in most rheumatic conditions [16].

In order to understand how to intervene on physical activity amongst older patients with rheumatic diseases, it is paramount to first define and describe the problem. The objective of this study was therefore to describe patient-reported level of PA across different diagnoses as well as the association between activity level and PROs among a large and representative sample of older adults with rheumatic disease.

## Methods

### Study sample:

A cross sectional study was performed within the FORWARD database /National Databank (NDB) for Rheumatic Diseases (now called the Forward Databank), the largest patient reported databank in the United States. The FORWARD database/NDB is a patient-based multi-disease, multi-disease registry

though the largest cohorts are patients with RA, SLE, FM, SpA and OA. All are patient reported diagnoses, though most were also confirmed through a questionnaire to the provider. The Forward databank enrolls patients from the community, follows up with questionnaires every 6 months and validates key patient data using medical records [17]. Data from this analysis were taken from a single questionnaire administered in 2019 that included relevant physical activity questions. Individuals were included in the current analysis if they completed those items and were ≥65 years of age and had received a physician-confirmed diagnosis of RA, SpA which includes axial spondyloarthritis (axSpA) and psoriatic arthritis (PsA), OA, SLE or FMS. These specific RMD's were chosen as they were the most common RMD's in the FORWARD database.

**Variables**

**Physical activity**

Self-reported level of PA across different diagnoses was the primary exposure of interest. Three validated questions about PA were added to the survey in 2019. Participants were asked the following questions about their PA; a) which of the following best describes your physical activity level. PA level was categorized as high (vigorously active for at least 30 min, 3 times per week), moderate (moderately active for at least three times per week) or low (seldom active); b) In the past month, on how many days have you done a total of 30 minutes or more of physical activity that was enough to raise your breathing rate? This might include sports, exercise, and brisk walking or cycling for recreation or to get around, but should not include housework or physical activity that is part of your job; c) Compared to other people your age, do you think you are: much more active, more active, about as active, less active, much less active. Each of these items have previously been established as a validated measure of physical activity [18,19,20].

**Patient-reported outcomes (PROs)**

Patients in the Forward databank complete a wide range of patient reported outcomes (PROs) (e.g., Psoriatic Arthritis Impact of Disease Questionnaire, ClinHAQ, EQ5D, patient global assessments, and more). We used HAQ-DI and PROMIS29 in the analysis. Participants complete a survey every 6 months including information on medications used, health care utilization and are asked to fill out all questionnaires including PROs like PROMIS measures. The Patient-Reported Outcomes Measurement Information System (PROMIS®) was developed as a PRO measure to assess functioning and wellbeing across different domains. PROMIS-29 profile measure assesses pain intensity using a single 0–10 numeric rating item and seven health domains like physical function using four items for each domain [21]. The PROMIS29 profile has been used to assess different domains in patients with rheumatic disease [22]. The PROMIS-29 profile measure assesses pain intensity using a single 0–10 numeric rating item and seven health domains (physical function, fatigue, pain interference, depressive symptoms, anxiety, ability to participate in social roles and activities, and sleep disturbance) using four items for each domain [21]. Each item in the 7 health domains is scored on a scale from 1-5.

**Covariates**

Self-reported patient characteristics such as age, gender, disease duration, rheumatic disease comorbidity index, college education, obesity (defined as body mass index ≥30 based on self-reported height and weight), and depression (self-reported) were collected [23].

**Statistical Analysis**

Descriptive statistics defined the characteristics of the cohort. Analysis of variance with post-hoc means comparisons, Kruskal Wallis tests or Chi-squared tests (for normally distributed, non-normally distributed continuous outcomes and categorical outcomes respectively) were used to determine whether differences between those who were active or inactive were statistically significant. Finally, we

utilized linear regression models to examine the association of PA and PROs, after adjustment for potential pre-hypothesized confounders (i.e., age, sex, and obesity).

**Ethics**

All NDB procedures are approved by Via Christi Institutional Review Board (Wichita, Kansas, USA, FWA00001005). Informed consent was obtained from all study subjects prior to enrollment in the registry.

**Results**

Among 5,335 persons enrolled in the FORWARD/National Databank for Rheumatic Diseases who completed the questionnaire, 3,343 (62.7%) were 65 years or older. There were 2,278 (68.1%) participants with RA, 681 (20.4%) with OA, 161 (4.8%) with SLE, 137 (4.1%) with FMS, and 111 with SpA (3.3%). Diagnoses are not mutually exclusive. The mean age (SD) of the group was 74.4 years (6.6), and most of the patients were women (83%). Additional characteristics of the sample are also shown in Table 1. There were 457 (14%) respondents who reported a high level of PA, 1820 (54%) with moderate levels of PA, and 1091 (32%) reported seldom being active. Levels of PA varied by diagnosis; for example only 9% of patients in the FMS group reported high physical activity compared to 14% in RA and SpA. The level of moderate PA in the FMS group was 50%, similar to participants with SpA but numerically lower than participants with RA, SLE or OA **(Figure 1; Table 2).** Overall, participants reported a median of 7 days of moderate to vigorous level of PA for 30 min or more per month (IQR 0-15; mean 9.3). **Table 2** illustrates the number of patients with different levels of physical activity among key sub-groups. Amongst female participants, 34% reported low levels of physical activity compared to 24% of men. There were only 4% of current smokers who had a high level of PA. Majority of obese participants reported either low or moderate levels of PA (44% vs 50% respectively). Similarly, among patients with depression, 48% reported a low level of activity, 45% moderate activity and 7% with high PA (**Table 2**). In

unadjusted analyses, participants with low PA activity had worse (higher) mean (SD) HAQ-DI scores compared to participants with higher level of PA [1.32 (0.68) vs 0.50 (0.55)]. When we looked at pain scores, participants with lower or moderate PA levels had numerically higher pain scores compared to participants higher PA levels [4.86 (2.82) vs 3.44 (2.58) vs 2.53 (2.38)]. Patients with the lowest level of PA had poor PROMIS29 scores across the board (**Table 3**) and as the level of PA increased, participants reported better scores in all PROMIS29 domains including pain, sleep, fatigue, social satisfaction and physical function. This was true even after adjustment for age, sex, and obesity (**Table 4**). PROMIS29 scores were not adjusted for individual diagnoses as there was significant overlap between various diagnoses amongst participants.

**Discussion**

In our cohort of persons above the age of 65 years and a diagnosis of rheumatic disease, the level of PA was far lower than the EULAR recommended PA guidelines [5]. A very small percentage of patients (<15%) reported performing vigorous PA at least 3 times a week. As PA was self-reported which is subject to recall and desirability bias, we expect that the actual percentage is even lower. This report of the low level of PA amongst patients above 65 years with rheumatic diseases reveals a clinical care gap. Though the reasons for lower level of PA activity in our cohort can be multifactorial, some of the potential factors related to clinical care are persistent disease activity, diagnostic delay leading to joint damage and disability. This can be an excellent opportunity for providers to educate and promote PA amongst elderly individuals.

A number of studies have described physical activity in older adults from the general population. For example, a comparison of PA across three national surveys reported a significantly higher proportion of recommended aerobic PA amongst older adults compared to those levels identified in our study [4]. In the National Health and Nutrition Examination Survey (NHANES), 27% of older adults reported being physically active compared to 36% in the National Health Institute Survey (NHIS) and 44% in the

Behavioral Risk Factor Surveillance System (BRFSS) [4]. In the NHANES survey, participants were asked about the frequency and duration of vigorous and moderate intensity activities the past 30 days along while in the NHIS survey, participants were asked how often they did vigorous or light/moderate intensity activity per week and then the average duration in each intensity. In the BRFSS survey, participants reported the number of days per week and time per day they engaged in moderate and vigorous PA for at least 10 minutes [4]. Our study had relatively similar definitions for PA but reported lower levels of PA amongst older adults with rheumatic diseases.

In contrast, there are few studies examining the level of PA across different rheumatic diagnoses [24-26]. A study comparing PA amongst RA patients and healthy controls in New York City found that 48% of RA patients did not meet the PA recommendations [27]. In the Swedish RA registry, more than 50% of the patients did not meet the recommended PA guidelines, the number was even higher in older female patients [28]. It is expected that patients with active disease will have lower PA but a US based study enrolling mostly patients in low disease activity (60% in LDA) also found that only 29% of patients were participating in moderate to vigorous PA [29]. Thus, disease activity alone does not explain the inability to exercise and other factors like inherent motivation which is difficult to capture might be playing a role. On the other hand, similar to the findings in this study, higher body mass index (BMI) was associated with lower levels of PA [30]. Additionally, though exercise is recommended in FMS, patients with FMS were less physically active in our cohort which was similar to prior studies [31].

PA has benefits in patients with RA, SpA and OA and results in improvement across a variety domains including fatigue, pain, depression and physical function [32-35]. A systematic literature review examining the role of PA as a conservative treatment option for OA showed that active exercise and sport are effective to improve pain and physical function [35]. In our study, patients with lower PA had higher pain, depression and fatigue and those with higher PA had lower pain, depression and fatigue. While this study is cross-sectional, previous studies have demonstrated that PA improves pain, fatigue and

depression [36-41]. Fatigue can have a tremendous impact on patients with rheumatic diseases and adequate pharmacotherapy is often inadequate to improve fatigue [42]. Wearable technology can help promote PA which can increase PA and decrease fatigue [39,43]. Similarly, a home based exercise program in SpA patients proved to be effective in improving physical fatigue which can be considered as a strategy for the older population [37]. However, long term adherence to exercise can be difficult for older patients [44,45]. A Swedish follow up cohort study showed that older adults with RA, who participated in an exercise intervention with person-centered guidance had increased PA after 4 years, which can be crucial for older adults [46]. Such exercise programs may help not only increase PA but also improve patient reported outcomes.

One of the strengths of our study is it captured the level of PA in a large number of older adults with different rheumatic diseases as well as patient reported outcomes and symptoms. We examined the association between the level of PA with different domains of PROMIS-29, a set of validated measures with scoring that allows comparison with the general population. There are also limitations of our study including the fact that this was a questionnaire-based study which is prone to volunteer bias and recall bias and did not employ a complete physical activity questionnaire such as the international physical activity questionnaire (IPAQ), a longer questionnaire. In particular, there may be differences in reporting of physical activity, particularly among those with lower physical activity level. As patients were asked about their perceived PA, it is prone to desirability bias. Similarly, the perceived level of PA is prone to bias in severely de-conditioned participants. Next, we did not have physician-assessed specific disease activity measures and thus were unable to correlate the level of PA with disease activity. Patients with several conditions were pooled in the examination of levels of physical activity and symptoms as measured by the PROMIS29, limiting the generalizability to any individual disease. Diagnoses were defined by patient-report of diagnosis (including fibromyalgia) although a large proportion of these

patients had the diagnosis confirmed by a rheumatologist. Additionally, patients may have had more than one condition (e.g., OA, PsA, and fibromyalgia).Given the large number of potential combinations, we examined outcomes by diagnosis and allowed for patients to contribute to more than one group and did not attempt to adjust for other diagnoses nor examine smaller subsets [47]. Finally, this is a cross-sectional study and we are unable to draw conclusions about causation or temporality about the association between physical activity and patient reported outcomes.

In conclusion, despite multiple recommendations regarding PA from national and rheumatology specific organizations, the level of PA is overall quite low in older adults with rheumatic diseases in the U.S. The lower level of PA was associated with greater pain, fatigue and sleep disturbances. This demonstrates an opportunity for improving outcomes for these patients. Activity trackers may be an effective technology to encourage physical activity among older adults. However, initial positive response to tracker use does not guarantee tracker use maintenance. Maintenance depends on recognizing the long-term benefits of tracker use, social support, and internal motivation [48]. Furthermore, additional efforts are needed to encourage rheumatology providers to council patients on the importance for physical activity. Innovative efforts to promote and sustain physical activities among older adults should be initiated as well as programs that help providers create meaningful change [41,49].

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**Table 1. Patient Demographics**

| | Total | RA | OA | SpA | SLE | FM |
|---|---|---|---|---|---|---|
| Age n (mean, SD) | 74.4 (6.6) (n=3343) | 74.4 (6.6) | 75.4 (6.9) | 72.6 (6.1) | 72.8 (5.4) | 72.2 (5.9) |
| Female (n,%) | 2671 (83%) | 1820 (82%) | 555 (83%) | 83 (75 %) | 154 (96%) | 124 (91%) |
| Disease duration, months (mean, SD) | 25.1 (13) (n=3066) | 25.2 (13) | 25.1 (12.2) | 27.1 (14.7) | 30.8 (14) | 29.5 (13.4 |
| Rheumatic Disease Comorbidity index (mean, SD) | 2.3 (1.7) (n=3343) | 2.3 (1.7) | 2.6 (1.8) | 2.6 (1.9) | 2.8 (1.9) | 2.6 (1.6) |
| Obesity n (%) (BMI >30 kg/m²) | 1068 (34%) | 676 (32%) | 256 (40%) | 27 (39%) | 50 (32%) | 59 (45%) |
| College Education n (%) | 1390 (45%) | 914 (43%) | 322 (51%) | 34 (54%) | 58 (44 %) | 62 (48 %) |
| Depression n (%) | 423 (13%) | 268 (12%) | 96 (14 %) | 9 (14 %) | 25 (16 %) | 15 (26 %) |

**Table 2. Participant Characteristics by Physical Activity**

| | Low PA | Moderate PA | High PA | Mean Days of PA per month |
|---|---|---|---|---|
| Males (n=557) | 24% | 57% | 19% | 11.4 (10.0) |
| Females (n=2671) | 34% | 54% | 13% | 8.0 (9.2) |
| Ethnicity, White (n=2848) | 31% | 55% | 14% | 9.4 (9.4) |
| Ethnicity, Non-White (n=244) | 38% | 47% | 15% | 8.1 (9.1) |
| Current Smoker (n=73) | 47% | 49% | 4% | 5.1 (7.7) |
| Past Smoker (n=1334) | 33% | 53% | 14% | 9.3 (9.5) |
| Never Smoker (n=1799) | 31% | 55% | 14% | 9.5 (9.3) |
| Obese (n=1068) | 44% | 50% | 6% | 7.1 (8.4) |
| Not Obese (n=2040) | 25% | 57% | 18% | 10.5 (9.6) |
| Depression (n=423) | 48 % | 45% | 7% | 6.5 (7.9) |
| No Depression (n=2920) | 30% | 55% | 15% | 9.7 (9.5) |
| **Disease** | | | | |
| RA (n=2278) | 31% | 55% | 14% | 9.2 (9.4) |
| OA (n=681) | 33% | 54% | 13% | 9.4 (9.2) |
| FMS (n=137) | 41% | 50% | 9% | 8.5 (8.9) |

| | | | | |
|---|---|---|---|---|
| SpA (n=111) | 36% | 51% | 13% | 9.0 (9.8) |
| SLE (n=161) | 34% | 57% | 10% | 9.8 (9.4) |

*Abbreviations*: PA= Physical activity, RA = rheumatoid arthritis, OA = osteoarthritis, SpA = spondyloarthritis, SLE = systemic lupus erythematosus, FMS = fibromyalgia syndrome, SD = standard deviation

**Table 3. Patient reported outcomes by level of physical activity**

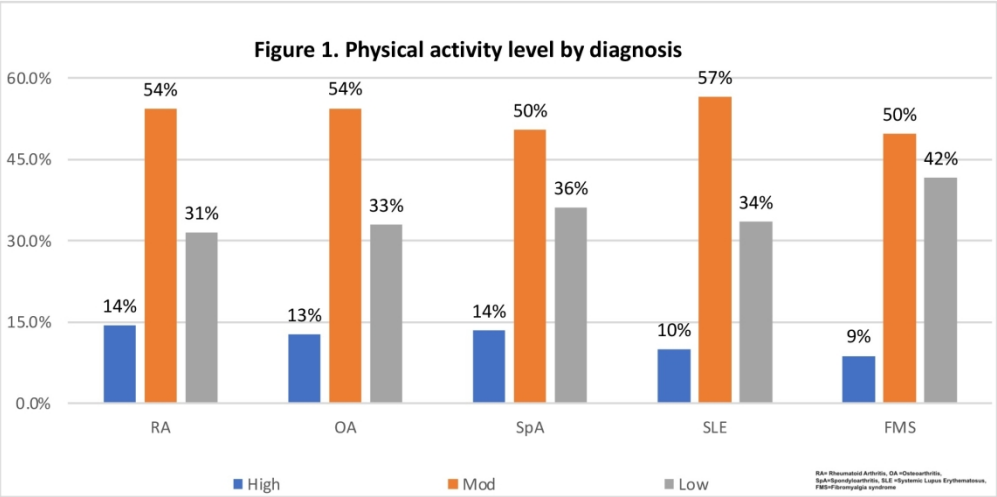
| | Low PA | Moderate PA | High PA |
|---|---|---|---|
| Physical function, mean (SD) | 35.3 (7.8) | 42.7 (8.1) | 48.5 (8.1) |
| Sleep Disturbance, mean (SD) | 52.2 (9.2) | 48.9 (8.3) | 46.1 (8.4) |
| Fatigue, mean (SD) | 57.3 (10.6) | 50.1 (10.1) | 45.4 (9) |
| Pain interference mean (SD) | 61.3 (8.4) | 55.3 (8.5) | 51.5 (8.7) |
| Social role satisfaction, mean (SD) | 43.0 (8.4) | 50.0 (8.3) | 54.8 (8.4) |
| HAQ-DI, mean (SD) | 1.32 (0.68) | 0.83 (0.62) | 0.50 (0.55) |

Physical activity level was categorized as high (vigorously active for at least 30 min, 3 times per week), moderate (moderately active for at least three times per week) or low (seldom active).

**Table 4. Multivariable models examining the association between level of physical activity and patient reported outcomes**

| PROMIS measure | Physical activity level | Unadjusted | Age-sex adjusted | Age, Sex and Obesity Adjusted* |
|---|---|---|---|---|
| Physical Function | High | Ref | Ref | Ref |
| | Mod | -5.73 (-6.69 to -4.77) | -5.49 (-6.44 to -4.53) | -4.89 (-5.85--3.94) |
| | Low | -13.22 (-14.28 to -12.17) | -12.85 (-13.91 to -11.8) | -11.68 (-12.76--10.6) |
| Sleep | High | Ref | Ref | Ref |
| | Mod | 2.75 (1.72 to 3.79) | 2.83 (1.78 to 3.88) | 2.66 (1.6-3.72) |
| | Low | 6.11 (4.96 to 7.25) | 6.13 (4.97 to 7.29) | 5.81 (4.61-7.01) |
| Fatigue | High | Ref | Ref | Ref |
| | Mod | 4.68 (3.47 to 5.89) | 4.64 (3.41 to 5.87) | 4.19 (2.95-5.43) |
| | Low | 11.95 (10.62 to 13.29) | 11.84 (10.48 to 13.21) | 10.99 (9.58-12.4) |
| Pain | High | Ref | Ref | Ref |
| | Mod | 3.8 (2.28 to 5.31) | 3.91 (2.34 to 5.49) | 3.6 (2.01-5.19) |
| | Low | 9.76 (8.14 to 11.39) | 9.78 (8.09 to 11.47) | 9.27 (7.53-11) |
| Social | High | Ref | Ref | Ref |
| | Mod | -4.88 (-5.88 to -3.89) | -4.74 (-5.76 to -3.72) | -4.35 (-5.38--3.33) |
| | Low | -11.81 (-12.91 to -10.7) | -11.56 (-12.69 to -10.43) | -10.81 (-11.97--9.64) |

*Fully adjusted model adjusts for age, sex, obesity (BMI≥30 vs BMI<30)
Abbreviations: Ref = reference (high level of physical activity is the reference group for all of the reported models). PROMIS scores increase for a patient having 'more' of the construct (i.e., higher physical function scores are good, higher pain scores are bad) and the T-scores range from 0-100 where 50 is the population mean.




Physical Activity Level by Diagnosis

176x88mm (300 x 300 DPI)