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Physical Activity and Sedentary Behavior in People With Inflammatory Joint Disease: A Cross-Sectional Study

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Objective. To determine whether patients with inflammatory joint disease (IJD) meet current guidelines on physical activity, and to determine which factors influence physical activity levels and sedentary behavior (SB) in patients with IJD.

Methods. This was a cross-sectional study of 137 patients with a medical diagnosis of an IJD prior to commencing an NHS-run inflammatory arthritis exercise program. Physical activity and SB were measured objectively using a thigh-worn physical activity monitor for 7 consecutive days. Activity levels were subdivided into low physical activity (LPA) and moderate-to-vigorous physical activity (MVPA). First, activity levels were analyzed against current guidelines of 150 minutes of MVPA per week. Second, time spent in SB, LPA, and MVPA was analyzed against possible determinants.

Results. In total, 29% of patients with IJD met current physical activity guidelines. Patients on average spent 10 hours per day in SB. Poor physical fitness measured by the 6-minute walk test was the only significant predictor ($P = 0.019$) of high SB ($R^2 = 4.7\%$). Attending an exercise facility in the community ($P = 0.034$) and low role limitations due to physical health ($P = 0.008$) predicted high levels of LPA, following a backward multiple regression ($R^2 = 8.0\%$). Low role limitations due to emotional problems ($P = 0.031$), higher physical fitness ($P = 0.002$), and healthier exercise attitudes and beliefs ($P = 0.021$) predicted meeting current physical activity guidelines, following a backward conditional logistic regression, explaining between 22.2% and 31.7% of variance.

Conclusion. Patients with IJD are inactive and spent much time in SB. Good general health predicts high activity levels. No disease-specific factors were found to determine SB, LPA, or MVPA.

INTRODUCTION

Physical activity, defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" (1), has been shown to be of great benefit to people with inflammatory joint disease (IJD), such as rheumatoid arthritis (RA), inflammatory arthritis, and spondyloarthritis (2). Physical activity can help improve joint range of movement, muscle strength, aerobic capacity, and overall function (3). Evidence also exists that regular physical activity does not have any harmful effects such as an increase in joint pain or radiologic joint damage or an increase in disease activity (3,4). However, people with IJD are generally less active compared to healthy controls (5,6). A significant proportion of people with RA have been shown to be physically inactive, characterized by a failure to participate in bouts of moderate-to-vigorous physical activity (MVPA) of ≥10 minutes over 1 week (7). People with RA have also been shown not to meet physical activity guidelines for healthy physical activity levels, but instead demonstrate reduced physical activity and increased sedentary time relative to healthy controls (5,8). Lack of motivation to exercise, lack of belief in its benefits, and beliefs about negative side effects of exercise have been reported as important barriers to exercise in people with RA (9,10).

People with IJD have an increased risk of developing cardiovascular disease (CVD) compared to the general population (11–13). Cardiorespiratory fitness is low in people with RA and this condition is likely to be associated with the increased incidence of CVD-related deaths in RA (14). Cardiorespiratory fitness is important, as emerging evidence suggests that more time spent in sedentary behavior (SB), defined as an energy expenditure of ≤1.5 metabolic equivalents while in a sitting or reclining posture (15), is independently associated with greater risk of developing CVD, cancer, and diabetes mellitus (16). Conversely, people with RA who have higher cardiovascular fitness have a better CVD risk profile and a lower 10-year CVD events risk compared to those with lower cardiovascular fitness (14). There are also several

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> **SIGNIFICANCE & INNOVATIONS**
> - The majority of people with inflammatory joint disease do not meet current physical activity guidelines. People on average spend >10 hours of their waking time in sedentary behavior.
> - People who attend an exercise facility in the community are more physically active.
> - No disease-specific factors could be found to determine sedentary behavior, low physical activity, or moderate-to-vigorous physical activity in people with inflammatory joint diseases.

additional health benefits of physical activity for people with IJD beyond reducing health risks, such as reduced levels of fatigue, reduced disease activity, reduced stiffness, and increased joint health (5,17–19).

Current knowledge of the determinants of physical activity levels in people with IJD is limited. Studies investigating the determinants are largely confined to people with RA and do not extend to those with other common and clinically important IJDs (5,17,19). Methods of physical activity monitoring across these studies also differ, limiting the scope for comparison (7,8,17,19). The majority of studies have used subjective self-report methods to measure physical activity levels, which have been suggested to be subject to recall bias and to be less valid than objective methods (20). Studies that have adopted objective measures of physical activity in RA appear to lack internal validity due to monitor removal during activities such as swimming, and external validity due to variable definitions of low and high physical activity levels that do not follow current guidelines (5,15,17,21–23). Several putative factors that have been identified in other adult populations (24) that could influence physical activity levels and time spent sedentary, such as social derivation and exercise self-efficacy, have not been investigated in people with IJD.

The scarce evidence on determinants of physical activity and SB poses a significant challenge to clinicians who seek to address physical inactivity and SB in this patient group. A greater understanding of the determinants of physical activity levels and SB in people with IJD may facilitate a move toward alternative and enhanced approaches to physical activity interventions in the future.

Therefore, the main objectives of this study were to determine whether patients with IJD meet the current guidelines on physical activity, to determine which factors influence physical activity levels in patients with IJD, and to determine which factors influence SB in patients with IJD.

PATIENTS AND METHODS

Design. This was a cross-sectional study approved by the NHS Health Research Authority, NRES Committee South West–Exeter, UK (Ref: 14/SW/1183). All participants provided written informed consent according to the Declaration of Helsinki.

Participants. Patients were recruited from referrals into the NHS-run Inflammatory Arthritis Exercise Programme (IAEP) across the Greater Glasgow & Clyde (GG&C) Health Board. The NHS is a nation-wide universal health care system in Britain that is free at point of provision. The GG&C Health Board is the largest health board in Scotland, serving 1.2 million people with wide and variable socioeconomic characteristics. The IAEP is a 12-week exercise program run by rheumatology physiotherapists across the GG&C Health Board. Any adult within the health board who has a clinician-confirmed IJD and is under the care of the rheumatology department can be referred into the program.

Inclusion and exclusion criteria. Patients were included in the study if they met all of the following inclusion criteria: physician-confirmed diagnosis of an IJD such as RA, psoriatic arthritis, ankylosing spondylitis, or any other type of inflammatory arthritis/polyarthritis, and age ≥18 years. Patients were excluded from the study if they met any of the following criteria: they did not provide informed consent to be part of the study, they were unable to complete the study within the designated data collection period, or the presence of comorbidity severely limited the patient's ability to participate in an exercise program, such as unstable angina, heart failure, uncontrolled heart arrhythmias, uncontrolled hypertension, severe respiratory condition, uncontrolled epilepsy, or uncontrolled diabetes mellitus, or if the patient had a recent medical instability, such as a stroke, wheelchair use, or pregnancy.

Recruitment strategy. The study population of interest comprised patients who were under the care of the rheumatology department of the GG&C Health Board and who were referred into the IAEP between March 2015 and July 2017. Referrals into this program came from rheumatology consultants, rheumatology nurse specialists, rheumatology allied health professionals, and patient self-referrals. Every patient who was referred into this program and met the inclusion/exclusion criteria for the study was informed in writing and verbally of the research project by their rheumatology physical therapist, who they saw prior to attending the program. If the patient was interested in being part of the study, they were then contacted by the researcher to discuss the study in more depth and to gain written informed consent to become part of the study sample.

Data collection. Data were collected by the researcher prior to the patient commencing the IAEP. Physical activity and SB were objectively measured by wearing an ActivPAL (PAL Technologies Ltd) physical activity monitor permanently for 7 consecutive days prior to commencing the IAEP. This device measures body motion, which is defined by an energy expenditure classification and a postural classification, enabling free-living behavior to be more accurately quantified (25). The device records acceleration counts used to determine energy expenditure, which can be converted into physical activity levels (26). It also records body position, which enables true SB to be recorded as classified by the Sedentary Behaviour Research Network (15). The ActivPAL was programmed to collect data for 7 consecutive days, as this collection provides a reliable measure of adult activity behaviors (27). The device was waterproofed as per the manufacturer's guidelines and worn centrally on the anterior aspect of the left or right thigh. The ActivPAL was fitted by the researcher on the day of data collection and removed by the patient at the beginning of day 8 and posted back to the researcher in a self-addressed stamped envelope. The device was programmed to commence data collection from midnight on the day that the device was fitted. Participants were also asked to self-monitor their physical activity via a hard copy activity diary while wearing the ActivPAL. Physical activity was specifically to record rise time and bedtime on each day of monitoring so that sleep time could be deducted from the data, to enable analysis on just the waking-time data. ActivPAL software was used for physical activity monitor programming, data processing, and data analysis. Low physical activity (LPA) was defined as <100 steps/minute and MVPA was defined as ≥100 steps/minute (26). True SB as defined by the Sedentary Behaviour Research Network (15) was calculated from the ActivPAL data.

Health-related quality of life was measured using the Short Form 36 (SF-36) and Health Assessment Questionnaire disability index (HAQ DI) (28). Self-perceived levels of control were measured using the Arthritis Self-Efficacy Scale (ASES), attitudes and beliefs toward physical activity were measured using the Exercise Attitudes and Beliefs Questionnaire for patients with RA (RA-EAQ), and mental health was measured using the Hospital Anxiety and Depression Scale (HADS). All of these measures have good psychometric properties that have been verified in populations with IJD (29–32). The Scottish Index of Multiple Deprivation (SIMD) measures across 7 domains: current income, employment, health, education, skills and training, housing, geographic access, and crime. These 7 domains are calculated and weighted for small areas, called data zones, with roughly equal population and can be obtained using the participant's postcode (33).

The Disease Activity Score in 28 joints (DAS28) was recorded as a marker of disease activity by the researcher who was trained in undertaking the DAS28 (KB). Acute-phase reactants from blood test results (within 3 months of each data collection session) were obtained from the patient's medical records to complete the DAS28 score. Disease duration was measured from the date of physician-confirmed diagnosis, which was obtained from the participant's medical records. Drug therapy was obtained from the patient's medical records and clarified with the patient in case of any recent changes; the level of pain on average over the past week was measured using a visual analog scale (VAS), and the level of fatigue was measured in the same way using the same 0–100-mm line as the pain VAS (18,19).

To evaluate whether there were any physical condition–related and/or environmental factors that could determine physical activity levels and SB, the following measurements were undertaken. Body mass index (BMI), calculated from the patient's height and weight on the day of data collection; the 6-minute walk test (34), using the American Thoracic Society and current clinical practice protocol (35,36), which measures fitness levels and is well established in IJD research (37); grip strength, using a Jamar grip dynamometer using the Southampton protocol for adult grip strength measurement (38), which has also been well established in IJD research (34,37); and a custom-made environmental questionnaire that was developed with assistance from the study advisory board, which consisted of rheumatology clinicians, NHS health improvement officers, patients, and academics. The questionnaire asked about cost, affordability, transportation to/from, and the variety of activities on offer at the community exercise facilities.

Statistical analysis. Descriptive statistics were used to summarize the variables. All variables were then assessed for normality of distribution using the Kolmogorov–Smirnov test. A Kruskal-Wallis test was carried out between the different diagnostic groups that showed no difference in activity levels between the groups; therefore, these were grouped together for analysis. Time spent in SB, LPA, and MVPA were analyzed against the possible determinants: HAQ DI, SF-36, age, disease duration, DAS28, pain, fatigue, medication, ASES, RA-EAQ, HADS, SIMD, BMI, general fitness, and grip strength using Pearson's (rp) or Spearman's (rs) correlation; and whether participants attended an exercise facility in the community using a Mann–Whitney test. Associations found to have a P value less than 0.2 were taken forward to multiple linear regression modeling. Due to MVPA not being normally distributed, MVPA was dichotomized into those patients meeting and not meeting 150 minutes of MVPA per week following the updated physical activity recommendations published by the American College of Sports Medicine (ACSM) (23), which have removed the requirement of activity taking place in bouts of ≥10 minutes. The groups were then analyzed against the possible determinants listed above using Mann–Whitney or chi-square tests. Associations found to have a P value less than 0.2 (39) were taken forward to multiple logistic regression modeling. Data analysis was undertaken using SPSS software, version 25, and a statistical significance level was set at a P value less than 0.05 for all multivariate tests.

RESULTS

A total of 137 participants provided sociodemographic information (Table 1). A Kruskal-Wallis test revealed that diagnosis was not associated with SB or physical activity levels (SB:

Table 1. Participant sociodemographic characteristics*

Characteristic	Value
Sex, no. (%)	
Female	112 (82)
Male	25 (18)
Age, years	57.8 ± 11.9
Presenting condition, no. (%)	
Rheumatoid arthritis (RA)	73 (53.3)
Inflammatory arthritis excluding RA	37 (27)
Spondyloarthritis	27 (19.7)
Disease duration, years	8.5 ± 11.9
Body mass index (BMI)	31.61 ± 7.37
BMI category, no. (%)	
Underweight	1 (1)
Healthy	24 (18)
Overweight	34 (25)
Obese	78 (57)
Scottish Index of Multiple Deprivation, no. (%)	
1	35 (25.5)
2	28 (20.4)
3	17 (12.4)
4	28 (20.4)
5	29 (21.2)

* Values are the mean ± SD unless indicated otherwise.

P = 0.50; LPA: *P* = 0.36; MVPA: *P* = 0.89); therefore, all participants were grouped together for analysis. The total number of patients providing MVPA and LPA data was 122, as some participants were unable to wear the activity monitor due to being allergic to the tape used to attach the device, and some monitors were also not returned. The total number of patients providing SB data was 115 due to the previous reasons, plus incomplete sleep diaries, so that we could not extract true SB during waking hours (Table 2).

Meeting current activity guidelines. In total, 2% of participants (n = 3) met the older ACSM guidelines and European Alliance of Associations for Rheumatology recommendations on physical activity, which are 150 minutes of MVPA in bouts of ≥10 minutes in a week. A total of 29% of participants (n = 35) met the recently updated ACSM guidelines on physical activity, which are 150 minutes of MVPA per week with no requirement of bouts of activity lasting at least 10 minutes. A strong association was found between more time spent in LPA and less in SB (rp = –0.651, *P* = 0.000), a moderate association with more time spent in LPA and more time spent in MVPA (rs = 0.342, *P* = 0.000), and a moderate association with more time spent in MVPA and less time spent in SB (rs = –0.252, *P* = 0.007).

Determinants of SB. A backward multiple regression was run to predict SB from associations found to have a *P* value of <0.2 (Tables 3–5). The 6-minute walk test (*P* = 0.019) was the only variable left in the model that statistically predicted SB (F[1, 113] = 5.632, *P* = 0.019, R^2 = 4.7%). The model indicates (b = –1.787) that for every meter walked on the 6-minute walk test, SB reduces by 1.8 minutes per week.

Determinants of LPA. A backward multiple regression was run to predict LPA from associations found to have a *P* value of <0.2 (Tables 3–5). Whether or not participants attended an exercise facility in the community and the SF-36 domain of role limitations due to physical health (SF-36 [PH]) were retained in the final model (F[2, 119] = 5.724, *P* = 0.004, R^2 = 8%). SF-36 (PH) was statistically significant (*P* = 0.008), as was attending an exercise facility in the community (*P* = 0.034). The model indicated that for every 25% increase in the SF-36 (PH) scale, LPA increased by 5.9 minutes per week, and if the participant attended an exercise facility in the community, LPA increased by 356.7 minutes per week (5.94 hours [5 hours and 57 minutes]).

Determinants of participants meeting 150 minutes of MVPA per week. A backward conditional logistic regression was performed to assess the impact of associations found to have a *P* value of <0.2 on the likelihood of participants meeting 150 minutes of MVPA per week (Table 6). The final model was statistically significant (X^2[3, N = 122] = 30.571, *P* < 0.001), which consisted of the SF-36 domain of role limitations due to emotional problems, the 6-minute walk test, and the RA-EAQ. The model as a whole explained between 22.2% (Cox and Snell R^2) and 31.7% (Nagelkerke R^2) of the variance in meeting 150 minutes of MVPA per week and correctly classified 78.7% of cases. Participants with lower role limitations due to emotional problems (*P* = 0.031), better fitness (*P* = 0.002), and healthier exercise attitudes and beliefs (*P* = 0.021) were more likely to meet the 150 minutes of MVPA per week.

DISCUSSION

Despite evidence for the effectiveness, feasibility, and safety of the physical activity guidelines in people with IJD (2), in the results of this study, only 2% of participants met previous physical activity guidelines (40), and 29% met the updated physical activity guidelines based on the ACSM guidelines of 150 minutes of

Table 2. Waking-time activity levels and sedentary behavior across 7 days monitoring*

	No.	Minimum	Maximum	Mean	SD
SB, minutes (hours)	115	2,095.80 (34.930)	6,016.80 (100.280)	4,100.94 (68.349)	766.68 (12.778)
LPA, minutes (hours)	122	7.90 (<1)	4,122.47 (68.71)	1,902.65 (31.71)	812.34 (13.54)
MVPA, minutes (hours)	122	0.34 (<1)	586.76 (9.78)	120.06 (2)	111.11 (1.85)

* LPA = low physical activity; MVPA = moderate-to-vigorous physical activity; SB = sedentary behavior.

Table 3. Possible determinants of physical activity and sedentary behavior: bivariate analysis, health-related quality of life*

	HAQ DI	SF-36 (PF)	SF-36 (PH)	SF-36 (EP)	SF-36 (EF)	SF-36 (EWB)	SF-36 (SF)	SF-36 (P)	SF-36 (GH)
95% CI	1.21–1.43	32.80–40.63	13.52–24.44	36.32–51.27	29.51–36.40	58.67–66.29	49.77–58.99	36.44–43.74	35.42–42.56
Time in SB									
P	0.41	0.18	0.04	0.14	0.56	0.93	0.32	0.06	0.16
rs	0.08	–0.13	–0.19	–0.14	–0.06	–0.01	–0.09	–0.18	–0.13
Time in LPA									
P	0.47	0.33	0.06	0.14	0.06	0.13	0.02	0.02	0.02
rs	–0.07	0.09	0.17	0.14	0.17	0.14	0.21	0.21	0.21
Meeting 150 minutes of MVPA/week, *P*†	0.05	0.01	0.01	0.00	0.07	0.09	0.01	0.01	0.02

* 95% CI = 95% confidence interval; EF = energy/fatigue; EP = role limitations due to emotional problems; EWB = emotional well-being; GH = general health; HAQ DI = Health Assessment Questionnaire disability index; LPA = low physical activity; MVPA = moderate-to-vigorous physical activity; P = pain; PF = physical functioning; PH = role limitations due to physical health; rs = Spearman's correlation; SB = sedentary behavior; SF = social functioning; SF-36 = Short Form 36.
† *P* value by Mann–Whitney test.

MVPA per week (23). This finding means that only a minority of people with IJD are undertaking the recommended amount of physical activity per week to keep themselves healthy and to decrease their risk of developing noncommunicable diseases (41). The results suggest that on average 10 hours per day are spent in SB during waking hours, and only 17 minutes per day in MVPA. This finding does, however, correlate with the findings of Hernandez-Hernandez et al and Paul et al (5,8) that patients with RA spend more time in SB and less time in MVPA compared to healthy controls. This finding also correlates with the findings of Swinnen et al (6) that people with spondyloarthritis exhibit lower physical activity levels compared to healthy controls. This lack of activity is a major health concern, as increased time spent in SB is independently associated with a greater risk of developing CVD, cancer, and diabetes mellitus, and people with an IJD already have an increased risk of developing CVD compared to healthy controls (11,12)

A lack of time spent in LPA and MVPA found in this study suggests possible reasons why cardiorespiratory fitness has been found to be low in people with RA (14). RA patients appear to spend long periods during waking hours in SB and only short amounts of time undertaking physical activity. A strong correlation in this study has been found between more time spent in LPA and less time spent in SB. Also, a moderate correlation has been found between more time spent in LPA and more time spent in MVPA, therefore indicating an important and significant public health message to try and break up SB by sitting less and moving more. This action may result in an increase in physical activity levels, improving cardiorespiratory fitness and reducing the health risk of developing noncommunicable diseases (41). As previously stated, people with IJD have a higher CVD risk compared to the general population, and the exact reasons for this risk are debatable (11). People with an IJD who have a higher cardiovascular fitness, however, have a better CVD risk profile and a lower 10-year CVD events risk (14). SB is a modifiable CVD risk factor that clinicians should be aiming to address as a high priority in people with IJD.

Limited determinants of SB in people with IJD have been found in this study following bivariate analysis and when taken forward to multivariate regression analysis. Independent determinants of SB were found to be total drug burden, with the more medications a person was prescribed, the more time spent in SB; the more role limitations a person self-reported to have due to physical health, the more time spent in SB; and the lower a

Table 4. Possible determinants of physical activity and sedentary behavior: bivariate analysis, with disease-specific factors*

	Age, years	Disease duration, years	DAS28	VAS pain	Fatigue	Total drug burden
95% CI	55.63–59.75	6.76–10.05	3.58–4.08	4.78–5.69	6.09–6.94	6.27–7.29
Time in SB						
P	0.49	0.25	0.83	0.28	0.80	0.01
rs/rp	rs = 0.07	rs = 0.11	rp = –0.02	rs = 0.10	rs = 0.02	rs = 0.23
Time in LPA						
P	0.61	0.69	0.99	0.14	0.12	0.08
rs/rp	rs = 0.05	rs = –0.04	rp = –0.00	rs = –0.13	rs = –0.14	rs = –0.16
Meeting 150 minutes of MVPA/week, *P*†	0.39	0.51	0.36	0.44	0.18	0.03

* 95% CI = 95% confidence interval; DAS28 = Disease Activity Score in 28 joints; LPA = low physical activity; MVPA = moderate-to-vigorous physical activity; rp = Pearson's correlation; rs = Spearman's correlation; SB = sedentary behavior; VAS = visual analog scale (VAS for pain and the level of fatigue were measured in the same way, using the 0–100-mm line).
† *P* value by Mann–Whitney test.

Table 5. Possible determinants of physical activity and sedentary behavior: bivariate analysis, with personal, physical condition, and environmental factors*

	ASES	RA-EAQ	HADS	SIMD	BMI	MWT6	Grip strength	Enviro 1
95% CI	41.98–47.42	32.55–34.67	13.50–16.35	2.65–3.17	30.31–32.81	298.51–330.92	15.38–18.53	0.16–0.31
Time in SB								
P	0.09	0.29	0.751	0.97	0.46	0.02	0.79	0.1†
rp/rs	rp = –0.16	rs = –0.10	rs = 0.03	rs = 0.01	rs = 0.07	rp = –0.22	rs = 0.03	–
Time in LPA								
P	0.01	0.04	0.12	0.36	0.16	0.26	0.35	0.05†
rp/rs	rp = 0.23	rs = 0.18	rs = –0.14	rs = 0.08	rs = –0.13	rp = 0.10	rs = –0.09	–
Meeting 150 minutes of MVPA/week, *P*	0.1†	<0.01†	0.03†	0.76‡	0.02†	<0.01†	0.98†	0.05‡

* 95% CI = 95% confidence interval; ASES = Arthritis Self-Efficacy Scale; BMI = body mass index; Enviro 1 = attending an exercise facility in the community (yes/no); HADS = Hospital Anxiety and Depression Scale; LPA = low physical activity; MVPA = moderate-to-vigorous physical activity; MWT6 = 6-minute walk test to measure fitness; RA-EAQ = Exercise Attitudes and Beliefs Questionnaire for patients with rheumatoid arthritis; rp = Pearson's correlation; rs = Spearman's correlation; SB = sedentary behavior; SIMD = Scottish Index of Multiple Deprivation.
† *P* value by Mann–Whitney test.
‡ *P* value by chi-square test.

person's fitness, the more time spent in SB. When taken forward to multivariate analysis, no health-related quality of life, disease specific, psychological, personal, or physical conditioning factors apart from the 6-minute walk test, which measures general fitness and endurance, could be found to determine SB in this patient sample. The 6-minute walk test only explained 4.7% of the variance, indicating that either everyone in the study had high amounts of SB, which Table 2 does suggest, therefore resulting in too little variation to be able to explain differences between patients, or indicating that there are other possible determinants of SB in people with IJD that have not been investigated in this study.

More time spent in LPA was associated with attending an exercise facility in the community and having less self-reported role limitations due to physical health. However, these determinants only explained 8% of the variance; therefore again indicating that other possible determinants of LPA exist in people with IJD that have not been investigated in this study. These study findings correspond with the findings of Larkin and Kennedy (19) that an increase in physical health rating increases physical activity levels and of Rongen-van Dartel et al (17) that the level of activity is not associated with pain, disability, coping, or cognition. However, these findings do not agree with their findings that there is an association between increased physical activity and decreased fatigue. These contrasting findings may, however, be explained by the heterogeneity of the study designs and the fatigue measurement tools used. Nonetheless, this study does demonstrate that people with an IJD who attend an exercise facility in the community are more likely to gain the health benefits that activity can bring as their overall activity levels are increased.

People with IJD who have lower role limitations due to emotional problems, better fitness levels, and better exercise attitudes and beliefs were more likely to meet the current ACSM physical activity guidelines (23) of 150 minutes of MVPA per week. The percentage of variance was low (31.7%); therefore other determinants probably exist that were not investigated in this study. These findings appear to inversely correspond with the findings of Larkin and Kennedy (19) that an increase in physical activity increases motivation to exercise, increases metal health, and increases beliefs about the benefits of physical activity.

These findings indicate the probability that if people with IJD meet the physical activity guidelines (23), they will have better fitness levels, which will decrease their CVD risk profile and lower their 10-year CVD events risk (5,14). They may also improve their mental health and well-being, as depression has been found to be more common in patients with RA than in healthy individuals (32,42).

A limitation of this study may be the wearing of an activity monitor. Although limited standardized information was given about the device, participants may have been more active due to wearing the device. If this possibility is the case, genuine activity levels could be over-recorded and SB under-recorded. This limitation could make the overall findings with regards to time spent

Table 6. Model for participants meeting 150 minutes of moderate-to-vigorous physical activity per week*

	B	SE	Wald	df	Sig	Exp(B) (95% CI)
SF-36 (EP)	0.011	0.005	4.679	1	0.031	1.011 (1.001–1.022)
MWT6	0.009	0.003	9.903	1	0.002	1.009 (1.003–1.015)
RA-EAQ	0.108	0.047	5.334	1	0.021	1.114 (1.017–1.221)

* 95% CI = 95% confidence interval; MWT6 = 6-minute walk test to measure fitness; RA-EAQ = Exercise Attitudes and Beliefs Questionnaire for patients with rheumatoid arthritis; SF-36 (EP) = Short Form 36 health survey role limitations due to emotional problems.

in SB, LPA, and MVPA even more alarming. Another limitation could be that the study participants were recruited from referrals made into an NHS-run IAEP, therefore already showing an interest and willingness to becoming more active. The participants may have also received a consultation from a health professional on the benefits of exercise and been given advice and information prior to being recruited into the study. If so, generalizability to the wider IJD population may be reduced, as this study may not have recruited the most inactive of participants. However, this possibility would essentially mean that the issues described in this article are even more pronounced in that wider population.

In conclusion, the majority of people with IJD in this study did not meet the current guidelines on physical activity. Those who did appeared to have increased fitness, better mental health, and better exercise attitudes and beliefs. However, many hours per day were spent in SB. Few determinants of SB and physical activity could be found when factors such as health-related quality of life, or disease-specific, psychological, personal, or physical conditioning were investigated. There was a strong correlation with regard to more time spent in LPA and less time spent in SB, with a moderate correlation with more time spent in LPA and more time spent in MVPA. This finding therefore may mean that if SB can be broken up, then more LPA will be undertaken, which may result in more MVPA. Further research looking into physical activity levels over time is required to fully address this issue. Further research is also needed into other possible determinants of physical activity and SB that have not been investigated in this study.

ROLE OF THE STUDY SPONSOR

PAL Technologies Ltd had no role in the study design or in the collection, analysis, or interpretation of the data, the writing of the manuscript, or the decision to submit the manuscript for publication. Publication of this article was not contingent upon approval by PAL Technologies Ltd.

AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Ms. Bell had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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