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Effects of Eccentric Exercise on Work-Related Performance and Physical Activity Levels in Rheumatoid Arthritis Patients

RESEARCH

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ABSTRACT

Background: There is a high prevalence of work productivity loss among patients with rheumatoid arthritis (RA), with a seeming link between loss of work productivity and RA disease activity. The increase in poor clinical outcomes associated with disease activity in this population has largely contributed to poor work performance, thereby creating a huge burden on patients with RA. Notwithstanding the reported more beneficial effects of eccentric exercise compared with conventional resistance training, there appears to be a death of information about the effects of this intervention on RA conditions.

Aims of the study: This study aimed to investigate the effects of an eccentric exercise intervention on work-related performance and physical activity in RA patients.

Method: Thirty-seven RA patients aged 30–65 (9 males; 28 females), who participated in the study were randomized into exercise and control groups. The Health and Work Performance Questionnaire and Health Assessment Questionnaire assessed RA patients' work-related performance. Physical activity at work was assessed with the Global Physical Activity Questionnaire.

Results: The study's results confirmed that an eccentric exercise significantly improved work performance in the RA population (Absenteeism –1.5 P = 0.005, Presenteeism +8.33 P = 0.014). Further, our study found that an eccentric exercise intervention improved physical function in patients with RA (–0.263 P = 0.004). Interestingly, a significant increase in moderate-intensity physical activity was reported among RA patients who participated in the 12-week eccentric exercise intervention program (+106.66 P = 0.008).

Conclusion: These findings, therefore, confirm that an eccentric exercise intervention could improve work-related performance and physical activity levels among RA patients.

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INTRODUCTION

Work productivity loss, characterized by absenteeism and presenteeism, has been widely reported in patients with RA (Jain et al., 2019; Sruamsiri et al., 2018; van Vilsteren et al., 2015). RA disease activity correlated with decreased work productivity implies that RA condition substantially burdens this population in their workplaces (Xavier et al., 2019). Clinical outcomes, including pain and low quality of life in RA patients, negatively contribute to increased loss of work productivity (presenteeism) and missed work hours (absenteeism) (Chaparro Del Moral et al., 2012). Furthermore, fatigue is an important feature of RA significantly associated with poor work performance outcomes (Connolly et al., 2015). Other factors that may contribute to low work productivity among the RA population, include biological therapeutic treatments (van Vilsteren et al., 2015). In some cases, biological treatment for RA may adversely affect workplace productivity. However, treating RA with specific biological interventions such as Adalimumab may improve work productivity in this population, though with notable adverse side effects (Takeuchi et al., 2017). Notably, the adverse effects associated with biological therapy, include severe infections of the joints and tissues (Atzeni et al., 2015). Notwithstanding the potential gains of biological treatment in RA, its adverse effects should not be disregarded.

The burden associated with RA is indicated to impact an increase in work absenteeism and presenteeism among RA patients (Chaparro Del Moral et al., 2012). Impliedly, people with RA may record a high rate of absence and loss of productivity at the workplace because of RA disease activity. Further, RA condition has been documented to place a huge loss on the annual productivity cost of each patient (Sruamsiri et al., 2018; Kruntorádová et al., 2014). With the high loss of productivity and cost associated with poor work productivity among RA patients, employers will likely suffer an increased loss of potential annual profits. The associated burden of RA in the workplace may include the inability to meet the work target, which may consequently affect the output. Given the strong association between RA disease-related factors and absenteeism and presenteeism, otherwise known as loss of work productivity, dedicated attention should be recommended to reducing the disability and disease activity associated with RA to improve work productivity and functioning (Boot et al., 2018). It is thus imperative to identify and understand the effective interventions that could potentially treat and prevent disability and disease activity among people with RA conditions. In this regard, a study by Yekini et al. (2023) showed that exercise interventions greatly improve functional ability in RA patients. Hence effective interventions with positive outcomes, like physical activity for RA should be considered as treatment, with numerous researchers reporting on the positive impact of exercise on RA patients (Yekini et al., 2023; Lau et al., 2019; Jakobsen et al., 2015; Durcan et al., 2014).

Nonetheless, researchers have reported that low physical activity levels are highly prevalent in RA patients (Karstensen et al., 2022; Lee et al., 2012). There are indications that excessive fear of joint damage is one of the common barriers to participation in physical activity among people with RA despite the positive effects of physical exercises on joint damage (Katz et al., 2020). Contrary to the fear that exercise might increasingly worsen the inflammatory conditions in RA, progressive resistance training (PRT) has been suggested as a safe and highly efficient therapy for RA (Yekini et al., 2023; Lemmey et al., 2012). There are indications that physical exercises could improve functional capacity in RA patients (Azeez et al., 2020; Lange et al., 2019). Interestingly, walking exercise has been confirmed as a very effective intervention to improve overall work performance, including quantity and quality of performance in addition to increasing workers' interpersonal relationships (Ben-Ner et al., 2014). Also, in the general population, high-intensity strength training greatly reduces perceived physical exertion during daily work tasks (Jakobsen et al., 2015). Mixed-exercise interventions, including resistance, stretching, and walking exercises, are further reported beneficial to general pain and fatigue in RA patients (Durcan et al., 2014). Thus, physical exercise may be beneficial to improving workplace performance and physical activity levels in patients with RA.

Evidence in the literature suggests that eccentric exercise interventions may provide more effective health outcomes on body composition and functional capacity than concentric exercise in patients with chronic disease conditions (Inostroza et al., 2022). Interestingly, eccentric concentrated exercise requires low energy costs and is reported to be safe and

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feasible for the rehabilitation of people with chronic disease conditions (LaStayo et al., 2014). Hence, it appears that eccentric exercise may benefit RA patients' work performance and functional capacity. However, there is limited knowledge of the effects of an eccentric exercise intervention on work-related performance and physical activity in the RA population. Therefore, the study aims to determine the effects of an eccentric exercise intervention on work-related performance and physical activity levels in RA patients.

MATERIALS AND METHODS

STUDY DESIGN AND SETTING

This study utilized a randomized experimental pretest-posttest study design where participants followed an eccentric exercise intervention for a duration of 12 weeks. The research project was conducted at the University College Hospital (UCH) in Ibadan, Nigeria. UCH, the first teaching hospital in Nigeria established during the British colonial era, remains a prominent healthcare institution even after the country gained independence. Situated in the historic city of Ibadan, the capital of Oyo State, UCH was chosen as it houses a rheumatology clinic and is one of the largest teaching hospitals in Nigeria. The quantitative method was employed to collect baseline and post-intervention data, aiming to assess the impact of eccentric exercise on work-related performance and physical activity levels in patients with rheumatoid arthritis (RA).

SAMPLING

A total of 40 RA patients were recruited for this study. The recruited RA patients were outpatients at the University College hospitals, Ibadan, and fulfilled the following inclusion criteria: Male and female RA patients between 30–65 years and not actively engaged in exercise (6 months before the program); they must have a stable disease condition (3 months before the program); and physical ability to follow exercise protocols. Those who failed to meet the criteria for inclusion were excluded from the study if they had recent joint surgery (6 months before the program), recent medication change (3 months before the program), and contraindications to following exercise protocol as per the ACSM guidelines (Pescatello et al., 2014). The sample size calculation for the case-control design was employed with a confidence level and confidence interval of 95% and 5 respectively (Zhong, 2009). Hence, 36 RA patients, with 18 RA patients in each group, were required to provide a statistical power of 80% (Zhong, 2009). Therefore, the study recruited 40 RA patients to provide for attrition. The recruitment took place during their hospital visits, with the full knowledge and recommendation of the hospital consultant and nurses in the rheumatology department.

WORK-RELATED ASSESSMENT

After completion of the informed consent, RA patients' work-related performance was assessed using the Health and Work Performance Questionnaire (HPQ) and Health Assessment Questionnaire (HAQ). Recruited RA patients completed the HPQ and HAQ questionnaires at baseline and post-exercise intervention. Where necessary, the questionnaires were interpreted in the Yoruba language for better understanding by the RA patients.

The HPQ questionnaire comprises 11 questions with a response scale ranging from top to worst performance to assess work productivity (presenteeism and absenteeism) (Scuffham et al., 2014). Construct validity of the HPQ has been reported using absolute scoring methods to assess the work performance in patients with inflammatory conditions (AlHeresh et al., 2017). Consequently, RA patients were asked to rate their performance to determine absolute presenteeism (0 = worst performance while 100 = most superior performance). Work productivity, involving analysis of the absolute performance at work, was used to calculate the presenteeism in RA patients recruited for the study (Scuffham et al., 2014). Absolute absenteeism was reported by calculating the rate of missed work within the past four weeks.

The HAQ questionnaire comprises 27 questions using a 4-point Likert scale response ranging from 0 (without any difficulty) to 3 (unable to do) to assess the RA patients' ability to perform daily tasks, perceived health status, and pains translating to work disability and economic loss (Maska et al., 2011). The HAQ is a valid questionnaire for assessing functional status in

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RA patients (Hu et al., 2017). A sum of the scores in each category divided by the number of categories was used to calculate the HAQ in RA patients. Higher scores indicate worse functioning capacity (AlHeresh et al., 2017).

PHYSICAL ACTIVITY ASSESSMENT

Physical activity at work was assessed using the Global Physical Activity Questionnaire (GPAQ) to determine the effect of the eccentric exercise intervention on the RA patient's physical activity levels at work. Evidence suggests that GPAQ is a valid questionnaire that can be used to estimate the effectiveness of an intervention on an individual's levels of physical activity (Cleland et al., 2014). The GPAQ questionnaire was completed by all the RA patients in both control and exercise groups at baseline and post-exercise intervention.

ECCENTRIC INTERVENTION PROGRAM

RA patients in the intervention group attended three eccentric exercise sessions per week for twelve weeks (one supervised and two unsupervised) on non-consecutive days. During the supervised session, the exercise physiologist ensured that the patients had adequate guidance and support following the eccentric exercise protocols once a week. On the other hand, the two unsupervised sessions each week required the RA patients to follow the eccentric exercise protocols without direct support or guidance from the exercise physiologist. Before commencing the intervention program, the RA patients in the intervention group (supervised and unsupervised) underwent a 30-minute session to familiarize them with eccentric exercise protocols involving lengthening the muscles during contractions (eccentric phase of movement). At the beginning of each session, RA patients in the exercise intervention group had 5 minutes of warm-up, including stretching and flexibility activities, followed by 40 minutes of eccentric exercises and 5 minutes of cool down. The exercise protocols concentrated on the lengthening of the muscles (eccentric phase) with minimal energy cost following ACSM guidelines (Pescatello et al., 2014). RA patients in the exercise group participated in eccentric exercises, including tricep extension, eccentric crunch, forward lunge, banded leg curls, and calf raise with the eccentric phase performed slowly for at least 4–6 seconds at each repetition. Exercise intensity was monitored using the rate of perceived exertion scale (Pescatello et al., 2014). The participants followed an individualized progressive eccentric training program: Phase I (weeks 1–3), two sets of fifteen repetitions of eccentric exercises at 50% to 55% (RPE of 10–11/20) of their one-repetition maximum strength, 1-RM); Phase II (week 4–8) three sets of twelve repetitions of eccentric exercises at 55% to 65% (RPE of 11–12/20) of their one-repetition maximum strength, 1-RM); Phase III (week 9–12) three sets of fifteen repetitions of eccentric exercises at 65% to 75% (RPE of 12–13/20) of their one-repetition maximum strength, 1-RM) (Figure 1). For this study, 1-RM was determined using 5-RM at submaximal loads. A minute interval was given between the sets. The exercises were designed to train the lengthening (eccentric phase) of the following muscle groups: upper back, shoulders, chest, quadriceps, hamstrings, abdominals, and calves.

Following signed consent, data collection commenced by assessing physical activity levels and work-related performance of RA patients using GPAQ, HPQ, and HAQ questionnaires. Post-intervention assessments, encompassing the same measures with HPQ, HAQ, and GPAQ, occurred after three months of eccentric exercise intervention, conducted at external exercise facilities outside the hospital.

STATISTICAL ANALYSIS

The quantitative data analysis was performed using the Statistical Package for Social Science (SPSS) version 20. Data were reported as means (±), standard deviation (SD), or as the number of patients with percentages for gender variables. The baseline and post-exercise assessment of the patients' work-related performance (HAQ, HPQ) and physical activity level (GPAQ) was compared using paired student's t-test. The statistical significance level was set at $p \leq 0.05$.

ETHICAL CONSIDERATIONS

Human participation was a crucial aspect of this study. As such, all procedures strictly adhered to the ethical standards outlined in the 1964 Helsinki Declaration and its subsequent amendments.

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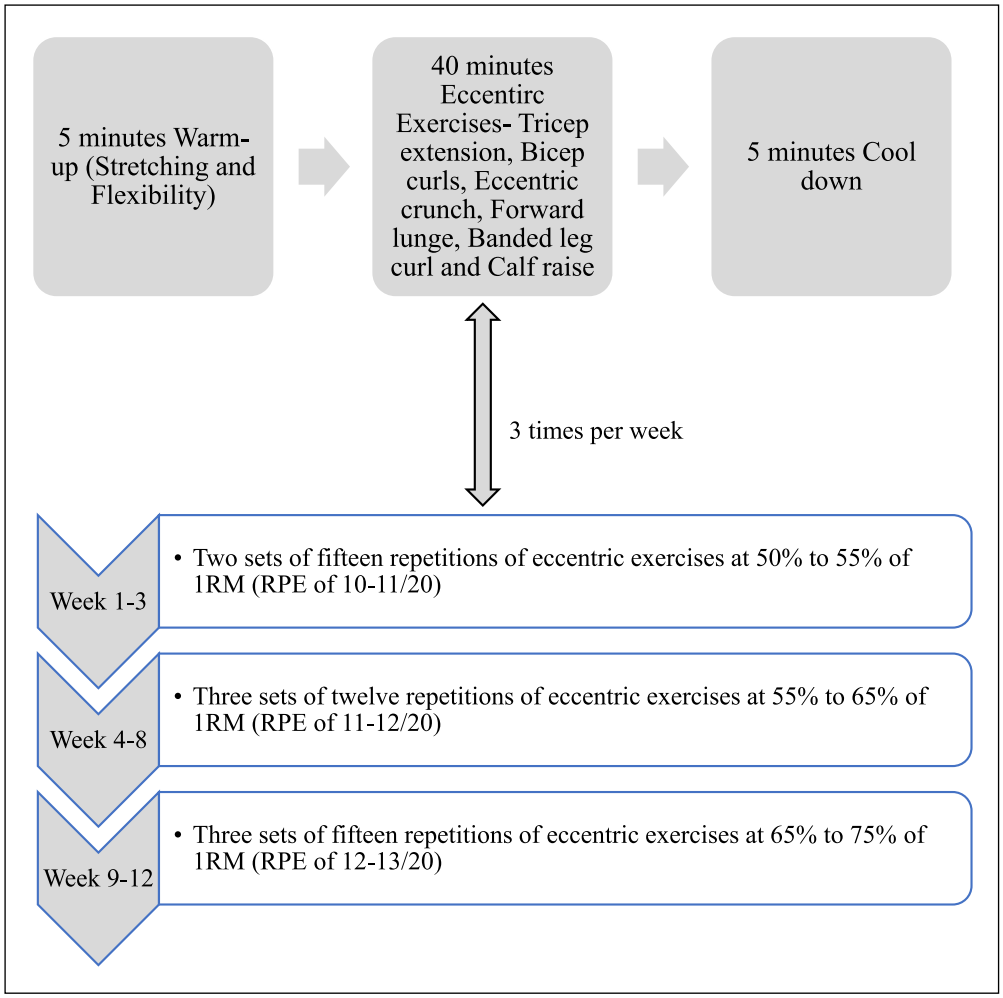

Figure 1 Eccentric Exercise Intervention Process.

Ethical approval was obtained from the University's Biomedical Research Ethics Committee (BREC) (BFC 327/18). To undertake the study in Nigeria, ethical approval was obtained from the National Health Research Ethics Committee (NHREC/01/01/2007-17/10/2018) in Nigeria. After that, ethical approval was obtained from the research committee of the University College Hospital (ref HSD/54) before the researchers were granted access to recruiting RA patients.

RESULTS

From recruitment to completion, the study participants' flow was visually represented using a consort diagram (Figure 2). The RA patients in the experimental group (EG) engaged in a 12-week eccentric exercise intervention, while the RA patients in the control group (CG) were instructed to maintain their regular daily activities.

Forty patients with RA were recruited and randomized into exercise and control groups with thirty-seven RA patients completing the program.

Table 1 presents the baseline and post-intervention characteristics of the RA patients who participated in this study divided into the exercise and control groups. Statistical analysis of patient characteristics revealed that 77.5% of the recruited RA patients were female, while 22.5% were male. Examination of the average age of the RA patients who participated in the study indicated that the control group had a mean age of 52.3 years, whereas the exercise group had a mean age of 51.7 years. No statistically significant difference was observed in the mean age between the two groups at baseline ($P > 0.05$). Table 1 demonstrates a significant decrease in the mean value of the Health Assessment Questionnaire (HAQ) within the exercise group ($P < 0.05$). Conversely, there was no significant difference in the mean value of the HAQ within the control group ($P > 0.05$). The evaluation of absenteeism and presenteeism in RA patients, assessed using the HPQ, revealed improved work performance in the exercise group ($P < 0.05$). In contrast, when assessing work productivity using the HPQ in the control group,

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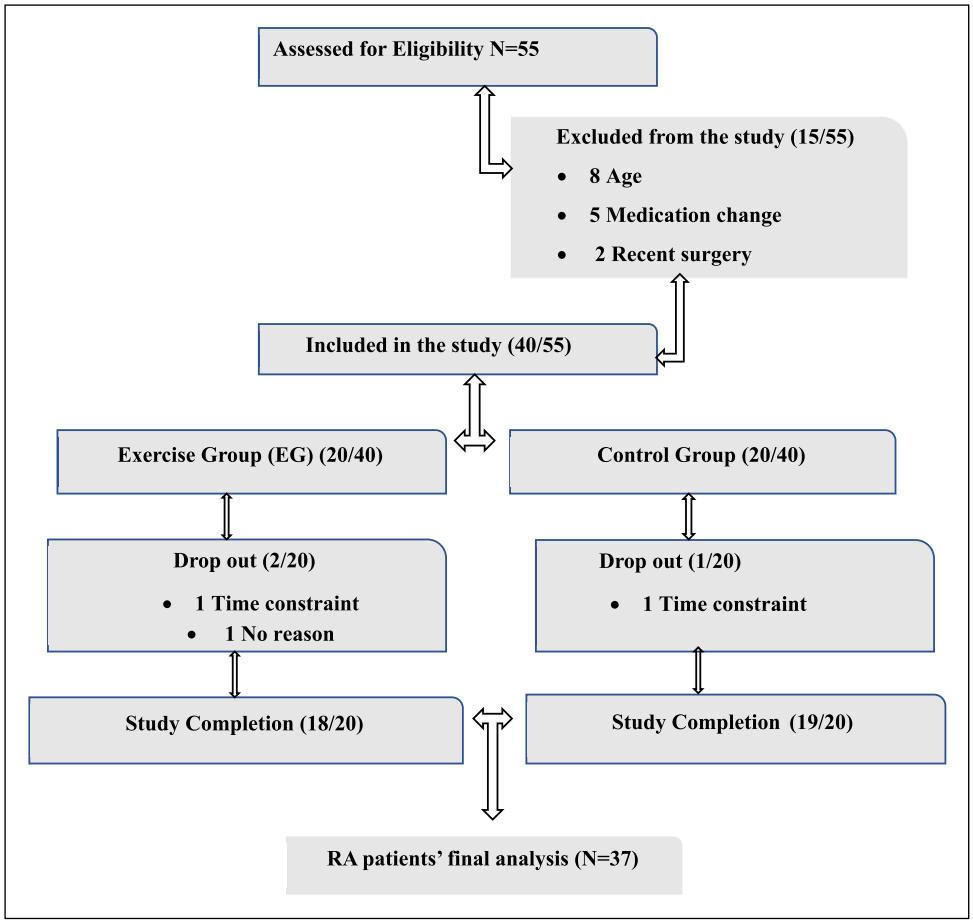

Figure 2 Consort diagram showing the participant's flow through the study.

VARIABLE	CG (N = 19)		EG (N = 18)	
	BASELINE	POST	BASELINE	POST
Gender: Male/female %	25%/75%	26%/74%	20%/80%	22%/78%
Age (years) (Mean ± SD)	52.47 ± 6.65	52.63 ± 6.76	52 ± 7.89	52.22 ± 7.89
HAQ (Mean ± SD)	0.69 ± 0.33	0.65 ± 0.27	0.74 ± 0.3	0.47 ± 0.23*
(HPQ) (Mean ± SD): Presenteeism	63.16 ± 25.61	62.63 ± 18.81	60.56 ± 22.61	68.89 ± 19.06*
(HPQ) (Mean ± SD): Absenteeism	3.74 ± 1.52	3.84 ± 1.60	4.17 ± 2.4	2.67 ± 1.64*

Table 1 Baseline and post-testing of the work-related performance in the exercise intervention group (EG) and control group (CG).

HAQ: Health Assessment Questionnaire, HPQ: Health and Work Performance Questionnaire, SD: Standard Deviation. * $P < 0.05$.

there was no significant difference between the mean values of baseline and post-assessment for both presenteeism and absenteeism ($P > 0.05$).

Table 2 presents the RA patients' vigorous and moderate-intensity activities at work. The findings reveal that participating in an eccentric exercise intervention significantly increased moderate physical activity levels of RA patients in the exercise group ($P < 0.05$). Although the control group exhibited a higher mean value of moderate-intensity activities at work during post-testing compared to the baseline, this difference did not reach statistical significance

Table 2 Baseline and post-testing of the physical activity levels in the exercise intervention group (EG) and control group (CG).

GPAQ: Global Physical Activity Questionnaire * $P < 0.05$.

GPAQ (PHYSICAL ACTIVITY AT WORK): (MEAN ± SD)	CG (N = 19)		EG (N = 18)	
	BASELINE	POST	BASELINE	POST
In a typical week, how many days do you do vigorous-intensity activities as part of your work? (Number of days)	2.37 ± 1.80	2.32 ± 0.946	2.22 ± 1.39	2.56 ± 1.19
How much time do you spend doing vigorous-intensity activities at work on a typical day? (Minutes)	287.37 ± 166.82	281.05 ± 188.73	221.67 ± 163.06	328.33 ± 234.301
In a typical week, on how many days do you do moderate-intensity activities as part of your work? (Number of days)	1.89 ± 1.10	2.21 ± 0.91	1.89 ± 1.60	2.56 ± 1.19
How much time do you spend doing moderate-intensity activities at work on a typical day? (Minutes)	274.74 ± 204.27	287.37 ± 169.50	241.67 ± 194.27	348.33 ± 240.69*

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($P > 0.05$). Additionally, the exercise group demonstrated increased levels of vigorous-intensity activity, but this increase was not statistically significant ($P > 0.05$). Conversely, the control group showed a reduction in vigorous-intensity activities at work.

DISCUSSION

The most important finding in this study that investigated the effects of an eccentric exercise intervention on work-related performance and physical activity level in RA patients is that RA patients who participated in a twelve-week eccentric exercise intervention showed improvement in presenteeism and absenteeism. Therefore, this indicates that the effects of an eccentric exercise intervention significantly improved workplace performance in RA patients. Corroborating this finding, a recent study by Lim and Cho (2021) confirmed that an exercise intervention, including muscle-strengthening exercise at home and the workplace, improves work productivity in patients with inflammatory conditions.

The study's results further demonstrated that the eccentric exercise intervention significantly improved functional ability in RA patients. Previous studies have also demonstrated that resistance training as a stand-alone intervention could improve functional capacity in RA patients (Morsley et al., 2018; Lourenzi et al., 2017; Cima et al., 2013). Another study by Azeez et al. (2020), using combined resistance and aerobic exercise, found that an exercise intervention could improve functional ability in patients with RA. However, all the above studies used conventional resistance exercise interventions, while our study used an eccentric concentrated exercise intervention. Interestingly, a study by Coratella et al. (2022) reported that the benefits of an eccentric concentrated exercise intervention could provide more preserved strength useful for daily activities in the long term compared with the benefits elicited during conventional resistance exercise. Recent studies have consistently shown that RA patients commonly engage in low levels of physical activity associated with an unhealthy lifestyle (Karstensen et al., 2022). However, it is worth noting that maintaining a recommended level of physical activity could potentially offer RA patients an opportunity to lead productive lives and positively impact their overall well-being (Loeppenthin et al., 2014). In this regard, a meta-analysis of the literature reported that exercise and physical activity promotion following the public health recommendations provided by ACSM could benefit physical activity behavior in RA patients (Rausch Osthoff et al., 2018). Importantly, our results showed that the RA patients' moderate-intensity physical activity levels in the exercise group significantly improved after participating in the twelve-week eccentric concentrated exercise intervention. This indicates that the work productivity of RA patients could increase through improved physical function. Moderate-to-high intensity aerobic and resistance exercise intervention increased leisure time physical activity in older adults with light to moderate RA disease activity, while approximately 50 percent of this population could sustain the intensity of the exercise after the intervention period (Lange et al., 2019). Although Coratella et al. (2022) reported a long-term benefit of eccentric exercise on improved strength required for daily activities in the healthy female population, it is not, however, clear if the long-term improvement could be replicated in RA patients after an eccentric exercise intervention program. A longitudinal study may be required to ascertain if RA patients' reported increase in physical activity levels could be preserved for the long term.

While interpreting the findings of this study, it is important to consider several limitations. First, the study had a small sample size, which may limit the generalizability of the results. Second, the outcomes were assessed subjectively, introducing the potential for bias or variability in reporting. Additionally, the exclusion of RA patients above the age of 65 and those who recently underwent medication changes is another limitation to be noted. Furthermore, the study had a partial supervision approach for the exercise intervention. RA patients in the eccentric exercise group were supervised only once a week, leaving two sessions per week unsupervised. This may impact compliance with the exercise programs and could compromise the intervention's overall effectiveness.

CONCLUSION

It is evident that an eccentric exercise intervention could provide significant positive benefits for work-related performance among RA patients. This study demonstrated that participation

in an eccentric exercise program could improve the reported high prevalence of absenteeism and presenteeism, thereby contributing to the increase in work productivity in RA patients. Our study also confirmed that eccentric exercise is an effective intervention program that could improve RA patients' reported low physical activity levels and functional ability. Given the reported benefits of an eccentric exercise intervention on work-related performance, this intervention should be recommended to enhance the work productivity of patients with RA.

COMPETING INTERESTS

The authors have no competing interests to declare.

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