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# Eccentric Exercise Guidelines for Managing Rheumatoid Arthritis: Findings From a Randomized Controlled Trial

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## ABSTRACT

**Background and Aims:** There are strong indications that the prevalence of poor body composition in RA patients is reportedly high. Evidence in the literature suggests that RA patients have low functional ability, which may negatively impact their work productivity and physical activity levels. Given the beneficial effects of an eccentric exercise intervention on RA conditions, there is still no sufficient information about the eccentric exercise guidelines for managing RA. This study aimed to develop eccentric exercise guidelines for managing RA conditions.

**Methods:** Eccentric exercise guidelines for managing RA were developed in three phases: A scoping literature review, an experimental pretest-posttest randomized control trial, and synthetization of the outcomes. Thirty-seven RA patients participated in the experimental pretest-posttest study and were randomized into control and exercise groups.

**Results:** Eccentric exercise interventions show positive effects on body composition, blood pressure, work-related performance, and physical activity levels in RA patients. Proposed management guidelines for RA conditions include 40-min eccentric exercises three times weekly. It is proposed that an eccentric exercise intervention should be progressive to elicit maximum benefits for RA patients.

**Conclusion:** An eccentric-concentrated exercise intervention is safe and provides a specific exercise trajectory for managing RA conditions. Evidence-based eccentric guidelines were developed to improve RA patients' body composition, physical activity levels, and cardiovascular risk factors. The guidelines could also benefit physical functioning and work productivity in RA patients. It should be used alongside the existing guidelines for managing RA disease conditions.

## 1 | Introduction

Rheumatoid arthritis (RA) is an auto-immune disease linked with joint damage, pain, and poor functional ability, with researchers indicating that exercise is safe and has a positive impact on RA disease activity [1], RA is usually characterized by abnormal body composition, including muscle wasting, while its prevalence is reportedly high in this population [2, 3]. There are indications that RA patients are at higher risk of developing cardiovascular diseases caused by different cardiovascular risk factors (CVD), including increased altered lipid profiles [4]. It is observed that the prevalence of high blood, which is one of the risk factors of CVD, is high in RA patients [5]. Further, the burdens of RA disease have been reported to impair the work performance of RA patients, thereby contributing to increased work productivity loss [6], with recent research indicating that eccentric exercise improved work-related performance in RA patients [7]. Hence, further investigation is required to develop eccentric exercise guidelines to prevent and manage the comorbidities associated with RA disease.

Nonetheless, evidence-based recommendations have been made to include physical exercises in the standard of care and

management guidelines for RA conditions [8, 9]. Specifically, the European League Against Rheumatism (EULAR), a multidisciplinary committee with representatives from 16 European countries following the available evidence-based practices, recommended exercises for managing CVD risks in RA patients [9]. However, there is no adequate information on the type (mode) of the exercise interventions that should be prescribed for managing RA conditions and their comorbidities, as some of the available guidelines vaguely recommended physical exercise interventions. Exercise recommendation guidelines should include a specific type of exercise to achieve the optimum benefits in this population.

However, there appears to be a growing body of knowledge of the benefits of eccentric concentrated exercise interventions, given its reported advantage over conventional resistance exercise [10]. Evidence suggests that eccentric exercise, compared with concentric exercise, may provide more beneficial effects on physical functioning and body composition in patients with chronic disease [11]. Even with minimum energy cost, eccentric concentrated exercise has been described as a safe and feasible intervention for rehabilitating people with chronic disease conditions [12]. Notwithstanding the reported benefits of eccentric concentrated exercise [10, 11], there are no current guidelines advising how to apply this type of intervention for managing RA conditions.

## 2 | Background

There is an observed higher prevalence of comorbidities, which are generally linked to increased mortality in RA patients compared to the general population [13, 14]. Given the high prevalence of RA-associated comorbidities, holistic guidelines should be developed for managing these conditions. Managing RA disease conditions should involve a multidisciplinary approach and recognition of shared responsibilities between the primary and secondary care settings [15]. There are strong indications that exercise intervention could improve RA patients' body composition and functional ability [16–19]. However, it is instructive to note that some available exercise guidelines for managing RA conditions are less prescriptive as they do not provide specific parameters for exercise engagements [20]. Given the inadequate specificity of the available guidelines and recommendations on exercise interventions for managing RA, the main objective of this study is to develop eccentric exercise intervention guidelines for managing RA conditions.

## 3 | Scope and Purpose of the Guidelines

The proposed eccentric guidelines were developed targeting the RA population and stakeholders involved in treating and managing RA disease. The overall objective of the guidelines is to recommend evidence-based eccentric exercise for managing RA conditions. The study recommends the proposed eccentric exercise guidelines for RA patients aged 30–65 for improved body composition, cardiovascular risk factors, functional ability, work-related performance, and physical activity levels. The guidelines provide the stakeholders, including health practitioners and RA patients, with the appropriate information to manage RA comorbidities using an eccentric exercise intervention.

## 4 | Scope of Eccentric Exercise Guidelines

The eccentric exercise guidelines for managing RA conditions were gathered by the researchers from a scoping literature review and evidence-based practice as contained in the objectives of this study, namely:

1. To review the literature regarding the role of exercise interventions in RA patients.
2. To determine the effect of eccentric exercise on body composition, blood pressure, work-related performance, and physical activity levels in RA patients.
3. To develop eccentric exercise guidelines for RA patients.

### 4.1 | Aim of the Study

Due to insufficient information about the impacts of eccentric exercise on RA comorbidities, the study's main aim was to develop evidence-based eccentric exercise guidelines for managing RA conditions.

## 5 | Materials and Methods

The eccentric exercise guidelines for managing RA conditions were developed following the United Kingdom Medical Research Council (MRC) recommendations required for complex interventions: (1) Identifying the current available evidence, (2) developing a theory, and (3) Modelling process and outcomes [21]. Hence, eccentric exercise guidelines were developed in three phases (Figure 1). The study involved a scoping review of the literature to ascertain the beneficial effects of exercise interventions in patients with RA. To develop the eccentric exercise guidelines, the study's second phase recruited 40 RA patients who were randomized into exercise and control groups. The exercise group followed a 12-week eccentric exercise program while the control group continued with their normal daily activities and disease management information as recommended by their physicians. The evidence-based guidelines were analyzed using qualitative and quantitative experimental pretest and posttest design.

## 6 | Sampling Techniques

### 6.1 | Phase 1

A scoping review of scientific papers exploring the effects of physical exercise on body composition, cardiovascular risk factors, functional ability, and physical activity levels in RA patients was performed. Existing original papers were reviewed to analyze the effects of exercise interventions on RA patients using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) method [22].

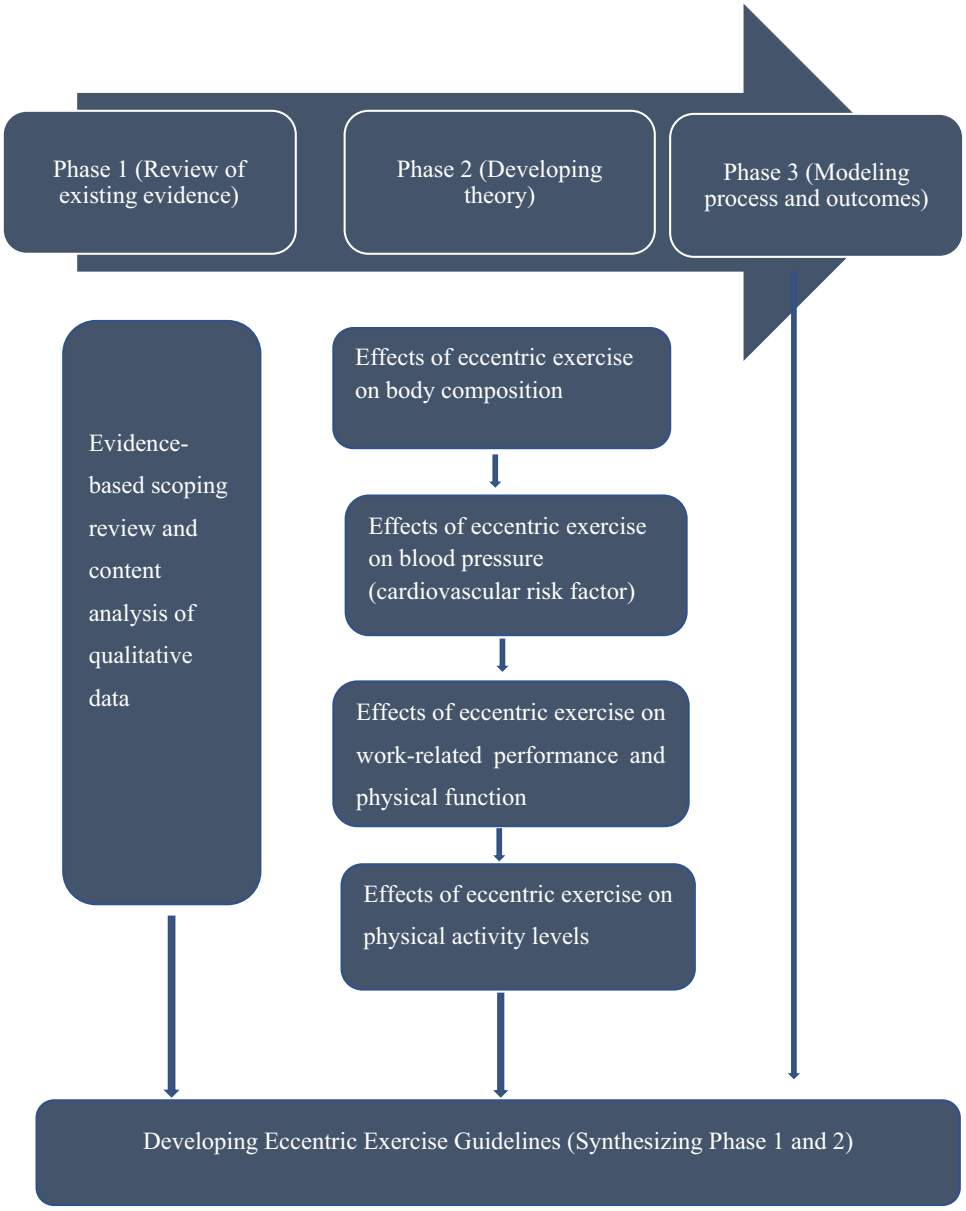


**FIGURE 1** | Triangulation of results to develop eccentric exercise guidelines.

### 6.2 | Phase 2

Further, 40 RA patients aged 30–65 years were recruited to explore the effects of an eccentric exercise intervention on RA patients. To understand the effects of eccentric exercise interventions, 36 RA patients were required to provide 80% statistical power, 95% confidence level, and a confidence interval of 5 [23]. However, 40 RA patients were recruited to allow for participants' attrition. The RA patients recruited for this study were outpatients and fulfilled all the inclusion criteria. To be eligible for the study, RA patients must be male and female patients aged 30–65 years with a sedentary lifestyle at least 6 months before the program; have a stable disease condition at least 3 months before the program; and have the physical ability to follow the exercise protocol as per the ACSM guidelines [24]. The exclusion criteria include RA patients who had recent joint surgery (6 months before the program), recent change of medication (3 months before the program), and contraindications to follow the exercise protocol. RA patients who had met all the inclusion criteria were asked to sign the informed consent.

## 7 | Eccentric Exercise Intervention

A 12-week eccentric exercise intervention program was conducted involving three eccentric exercise sessions per week. RA patients were provided with adequate guidance and support during the eccentric exercise protocol (supervised and unsupervised). One session was supervised per week by an exercise physiologist, while two sessions were not directly supervised. Every session began with 5 min of warm-up, including flexibility and stretching activities. RA patients in the exercise group were asked to follow 40 min of eccentric exercises with 5 min of cool-down. Following the ACSM guidelines, the eccentric phase of the exercise, with minimal energy cost, focused on muscle lengthening [24]. The patients were instructed to slowly activate the eccentric phase for at least 4–6 s at

each repetition of the eccentric exercise interventions, which include forward lunge, bicep curls, banded leg curls, banded chest fly, tricep extension, eccentric crunch, and calf raise. The rate of perceived exertion scale was used to monitor the intensity of the exercise [24]. The training program was an individualized progressive exercise divided into three phases: Phase I (weeks 1–3) required two sets of 15 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) involved required the RA patients to perform three sets of 12 repetitions of eccentric exercises at 55% to 65% (RPE of 11-12/20) of 1-RM); Phase III (week 9–12) three sets of 15repetitions of eccentric exercises at 65% to 75% (RPE of 12-13/20) of their 1-RM strength). The patients were allowed a minute's rest between the sets. The eccentric phase of the exercises was developed to train the muscles of the upper back, shoulders, chest, abdominals, quadriceps, hamstrings, and calves. Given the unpredictability of recovery from delayed onset of muscle soreness (DOMS) after eccentric exercise, participants were advised to employ treatment modalities such as cryotherapy (ice application), menthol-based topical applications, and foam rolling. These interventions were suggested to mitigate exercise-induced pain effectively. After completing the pre-test and posttest, data were analyzed using the Statistical Package for the Social Sciences (SPSS, version 20.0, Chicago. IL, USA).

## 8 | Data Collection and Analysis

Phase 1- A scoping review of the effects of exercise interventions in RA patients: 11 original papers were reviewed to analyze the effects of exercise interventions on body composition, functional ability, cardiovascular risk factors, and physical activity levels in RA patients. For this purpose, a search of three scientific databases (PubMed, CINAHL, and Scopus) was conducted. Available information in the literature was analyzed using qualitative methods. Evidence-based exercise guidelines for managing RA conditions involved a review of the current proposed exercise guidelines. The study used a descriptive analysis to present the current exercise guidelines in the literature.

Phase 2A- Evidence of effects of eccentric exercise on body composition in RA patients: The researchers measured the muscle mass and fat mass of the 40 recruited RA patients for this study using a bioelectrical impedance analysis (BIA) instrument (Omron Karada Scan HBF-375 Body Fat Analyzer, Omron Health Care Pvt Ltd. China). The Statistical Package for Social Science (SPSS) version 20 was used to report the data as means (±) and standard deviation (SD) or as a number of patients with percentages for gender variables. Quantitative data analysis was performed following baseline and post-testing of the muscle mass and fat-free mass using paired student's *t*-test.

Phase 2B- Evidence of the eccentric exercise effects on blood pressure in RA patients: The blood pressure data of the RA patients were collected using an Omron M2 machine (Vietnam model: HEM 7121-E). Classification of blood pressure in RA patients was performed following the ACSM guidelines [24]. The baseline and post-testing of the blood pressure were compared using paired student's *t*-test. The researchers used Pearson correlation to analyze if there was any relationship between loss of muscle mass and blood pressure.

Phase 2C- Investigating the effects of eccentric exercise on work-related performance in RA patients: To determine the effects of an eccentric exercise intervention on work-related performance, the researchers used two questionnaires, the work performance questionnaire (HPQ) and the health assessment questionnaire (HAQ). The HPQ and HAQ questionnaires were used to assess the work productivity and work disability of the RA patients, respectively [25, 26]. The paired student's *t*-test was used to compare the baseline and post-testing values with the statistical significance level set at $p \leq 0.05$.

Phase 2D- Investigating the effects of eccentric exercise on physical activity level in RA patients: The physical activity level of the RA patients was measured subjectively at baseline and post-intervention using the Global Physical Activity Questionnaire (GPAQ). The GPAQ has been reported as a valid tool for assessing the effectiveness of exercise intervention on physical activity levels [27]. The paired student's *t*-test was used to compare the baseline and post-testing values. The findings were part of the strategies for developing eccentric exercise intervention guidelines for managing RA conditions.

Phase 3- Developing eccentric exercise guidelines for managing RA conditions: This phase involved mapping and synthesizing the data collated from phases 1 and 2 to develop a theoretical framework and practice confirming the effects of an eccentric exercise intervention on body composition, blood pressure, work-related performance, and physical activity levels in RA patients.

## 9 | Ethical Considerations

The procedures in the study involved human participation. Hence, the procedures were performed in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study successfully secured ethical approval from the University's Biomedical Research Ethics Committee (BREC) (BFC 327/18). Ethical approval was obtained from the National Health Research Ethics Committee (NHREC/01/01/2007-17/10/2018) as part of the requirement to undertake the study in Nigeria. In addition, ethical approval was obtained from University College Hospital (ref HSD/54) to allow the researchers access to the RA patients recruited for the study. All RA patients recruited for the study were asked to sign the informed consent after explaining the research protocols to them, and they agreed to participate in the study.

## 10 | Results

The study's first phase, a scoping literature review titled “Effects of exercise on body composition and physical function in rheumatoid arthritis patients: a scoping review” by Yekini and Grace (2023) [16], involved a thorough search of journals, which initially brought 2693 published papers. Consequently, after removing the duplicates and articles that did not meet the inclusion criteria, 121 articles were assessed for eligibility. Consequently, 11 articles were reviewed and included in the scoping review because they fulfilled the eligibility criteria.

**TABLE 1** | Guidelines for managing RA conditions.

| Action areas | Current guidelines | Proposed guidelines |
|---|---|---|
| Body composition | 1. Prescription of regular exercise is recommended for managing skeletal muscle disease, including decreased muscle mass in RA patients [29].<br>2. Progressive resistance training is recommended to manage RA patients' abnormal body composition [18]. | Progressive eccentric exercise, using a concentrated protocol that requires lengthening of the muscles, is recommended three times per week for RA patients to manage altered body composition. |
| Cardiovascular risk factor | 1. EULAR recommends dynamic exercise to reduce the high prevalence of cardiovascular risk factors in RA patients [9, 30].<br>2. SFR guidelines suggest lifestyle modification, which includes regular exercise to reduce cardiovascular risk factors [8]. | To reduce high blood pressure, RA patients should perform an eccentric exercise at moderate intensity [55% to 65% (RPE of 11-12/20)]. |
| Work-related performance | 1. Per the Standards of Care (SOC), RA patients should exercise regularly to improve their functional ability [31].<br>2. The Chinese guidelines for diagnosing and treating RA recommend adherence to aerobic exercise to improve functional ability in RA patients [32]. | Progressive eccentric exercise is recommended to improve work productivity (absenteeism and presenteeism) in RA patients. |
| Physical activity level | 1. The Brazilian Society recommends isometric or isotonic exercises for Rheumatology to improve aerobic capacity in RA patients [33].<br>2. Mixed aerobic and resistance exercise interventions are recommended for inclusion in the management guidelines for improving physical activity levels in RA patients [34]. | Evidence-based practice suggests that eccentric exercise improves moderate-intensity activity levels in RA patients. Hence, it is recommended that it be included in the management guidelines for RA conditions. |

Abbreviations: EULAR, European League Against Rheumatism; SFR, French Society for Rheumatology; SOC, Standards of Care.

The scoping review showed a high prevalence of unfavorable body composition among individuals with rheumatoid arthritis (RA). The outcomes suggest that engaging in physical exercise can effectively improve RA patients' body composition and physical function. Specifically, a combination of exercises demonstrated promising outcomes in managing abnormal body composition among RA patients. The findings also emphasize the safety and recommendation of resistance exercises for those with adverse body composition and limited physical function. Nevertheless, the review did not yield information regarding the impact of eccentric exercises on the RA population's adverse body composition and physical function. The scoping review underscored the need to investigate the effects of eccentric exercises on body composition and physical function in RA patients [16].

In phase 2A-2D, 40 RA patients were recruited and randomized into exercise and control groups. This phase reported 37 RA patients who completed the study, as one patient dropped out of the control group, while two RA patients did not complete the intervention in the exercise group. There were 5 males and 14 females in the control group, representing 26% and 74%, respectively. However, the exercise group had 4 males and 14 females, representing 22% and 78%, respectively.

The results of phases 2A and 2B are contained in a manuscript authored by Yekini and Grace (2023) titled "Effects of eccentric exercise on body composition and blood pressure in Rheumatoid arthritis patients." The results showed that an eccentric exercise program conducted over 12 weeks significantly enhanced muscle mass, reduced body fat percentage, and lowered blood pressure among individuals with RA [28]. Therefore, it is advisable to endorse the incorporation of eccentric exercises as a means to manage adverse body composition in RA patients effectively. After completing the eccentric exercise regimen, RA patients exhibited a notable decrease in both systolic and diastolic blood pressure [28].

The results of phases 2C and 2D, enclosed in an article authored by Yekini and Grace (2023) titled "Effects of eccentric exercise on work-related performance and physical activity levels in Rheumatoid arthritis patients," showed clear evidence that integrating eccentric exercise interventions can yield substantial positive advantages in work-related performance for individuals with RA [16]. The findings of this study underscored that engaging in an eccentric exercise program could effectively mitigate the commonly reported high rates of absenteeism and presenteeism among RA patients, consequently boosting overall work productivity. Moreover, our research reaffirmed the efficacy of eccentric exercise as an intervention program capable of ameliorating the reported low levels of physical activity and functional ability among RA patients.

## 11 | Eccentric Exercise Guidelines

Following the findings of the study's objectives, eccentric exercise guidelines were developed and presented in a tabular form, as shown in the table below (Table 1). The evidence-based

practice indicates that progressive eccentric exercise is a safe and effective intervention for managing RA conditions. Hence, the guidelines should include eccentric exercise to improve body composition, work-related performance, physical activity levels, and cardiovascular risk factors such as high blood pressure in RA patients. Due to the variability in recovering from delayed onset of muscle soreness (DOMS) that may occur following eccentric exercise, effective treatment strategies should be provided for RA patients to reduce exercise-induced pain. Hence, treatment strategies, including ice [35, 36], menthol rubs [36, 37], and foam rolling are recommended [38, 39].

## 12 | Discussion

The authors developed evidence-based eccentric exercise guidelines for managing RA conditions following a rigorous and systematic process. The proposed guidelines apply to improving body composition, high blood pressure, work-related performance, and physical activity levels and should be interpreted together with the existing global guidelines for managing RA conditions as developed by the European League Against Rheumatism (EULAR), French Society for Rheumatology (SFR), and Standards of Care (SOC) for rheumatoid arthritis in Europe [8, 9, 30, 31].

There are strong indications that regular exercise training, even though not specific, is recommended and should be included in the guidelines for managing the high prevalence of skeletal muscle disease in RA patients [29]. Our findings have demonstrated that a progressive eccentric exercise intervention could improve adverse body composition and should be recommended as part of guidelines for managing this condition in the RA population. Corroborating this recommendation, there are suggestions that including progressive resistance training in the management guidelines improves muscle mass and strength in this population [18, 40]. Nevertheless, our proposed eccentric exercise guidelines may benefit muscle mass more than conventional resistance training [10]. This, therefore, suggests that eccentric exercise intervention should be incorporated into the exercise guidelines of RA for managing skeletal muscle disease.

Following an evidence-based practice, we recommend including eccentric exercise for managing high blood pressure in RA patients. Exercise interventions have shown a positive impact on cardiovascular health in patients with RA, including improved vascular function and lipid profiles [41]. However, the existing EULAR guidelines recommend dynamic exercise for managing the prevalence of cardiovascular risk factors in RA patients [9]. According to SFR guidelines, lifestyle modification, including regular exercise, was recommended to reduce the cardiovascular risk factors in RA patients. Thus, our proposed eccentric exercise intervention offers a specific exercise guideline for high blood pressure in RA patients.

Notably, a progressive eccentric exercise should be recommended as a guideline to enhance the functional ability required to improve work productivity and work disability in RA patients. This recommendation is consistent with some evidence-based practices that confirm the benefit of resistance training on functional capacities in RA patients [18, 42, 43]. As per the SOC, an existing guideline also suggests that regular exercise should be included in the management guideline to improve functional ability in RA patients [31]. In contrast, the Asia Pacific League of Associations for Rheumatology (APLAR) treatment recommendations did not include physical exercise in the guidelines for managing RA conditions because of the sparse information about the evidence of exercise interventions in Asian Pacific regions [44]. Nonetheless, the SOC guideline did not provide a specific type of exercise that RA patients should engage in to elicit optimum functional ability. Thus, our newly proposed guideline may provide clear information on the specific benefits of eccentric exercise on functional ability in RA patients.

Given the positive effects of eccentric exercise on physical activity levels in RA patients, as observed in our study, this intervention is proposed to be included in the management guidelines for RA patients. Interestingly, a previous study by Lange et al. (2019) observed that aerobic exercise and resistance training at moderate-to-high intensity could improve leisure time physical activity in RA patients [34]. The newly proposed guidelines appear to be consistent with the existing guidelines developed by the Brazilian Society for Rheumatology, which recommends regular engagement in isometric or isotonic exercise to improve aerobic capacity in RA patients [33]. Thus, the proposed eccentric exercise guidelines should be interpreted together with the existing guidelines to elicit the maximum benefits of exercise in RA patients.

## 13 | Applicability

The eccentric exercise guidelines are mainly developed to improve health outcomes in RA patients aged 30–65 years. Nevertheless, these guidelines may be adapted and included in the existing exercise guidelines for managing RA comorbidities in older adults with RA. Further, employers of RA patients can conceptualize eccentric exercise guidelines in the workplace to promote increased work productivity. Hence, the proposed guidelines would positively affect RA patients' body composition, functional capacity, and physical activity levels. The proposed eccentric exercise guidelines provide appropriate information that may encourage the maximum participation of RA patients in regular exercise, thereby reducing the fear of participating in exercise. These guidelines and recommendations could also equip health practitioners, including exercise physiologists and physiotherapists, with the required knowledge to structure exercise programs for RA patients (Table 2).

## 14 | Reference Guidelines

The exercise guidelines were developed through evidence-based practices, original research, and a review of relevant literature and existing exercise guidelines for managing RA conditions. There are numerous existing guidelines developed by various RA professional bodies across the globe that recommend regular exercise for managing RA conditions [8, 10, 32, 33]. These professional bodies include the European League Against Rheumatism (EULAR), the French Society for Rheumatology (SFR), the Brazilian Society for Rheumatology, and the Chinese

**TABLE 2** | The recommendations and eccentric exercise guidelines.

| Recommendations |
|---|
| To improve body composition, functional ability, work-related performance, and physical activity levels in RA patients, they should engage in 40 min of progressive eccentric exercise training, allowing slow motion (at least 4–6 s) during the eccentric phase, three times per week. Considering the diverse recovery patterns associated with delayed onset of muscle soreness (DOMS) after eccentric exercise, it is imperative to implement efficacious treatment modalities for RA patients in mitigating exercise-induced pain. Therefore, suggested treatment approaches encompass interventions such as cryotherapy, menthol topical applications, and the utilization of foam rolling following each exercise session. |
| **Eccentric exercise guidelines are recommended as per the frequency, intensity, type (mode), and time (duration) (FITT) principle:** |
| Frequency (How often?) RA patients should engage in eccentric exercise three times per week.<br>Intensity (How hard?) Moderate-intensity eccentric exercise training is recommended for RA patients. A gradual progression from two sets of 15 repetitions of eccentric exercises at 50% to 55% (RPE of 10-11/20) of one-repetition maximum strength, 1-RM) or 5-RM if 1-RM is unattainable.<br>Time or duration (How much?) 40 min of progressive eccentric exercises, 5 min of warm-up and 5 min of cool-down per session is recommended.<br>Type (What Protocol?) The recommended exercise protocol should concentrate on the lengthening of the muscle contraction (eccentric phase). The eccentric protocol should target the muscles of the upper back, shoulders, chest, quadriceps, hamstrings, abdominals, and calves. |

guidelines for diagnosing and treating RA. Hence, the proposed eccentric exercise guidelines should be interpreted alongside the existing guidelines to promote the optimum benefits of exercise in RA patients. The existing guidelines should be used as references when implementing the eccentric exercise guidelines for managing RA conditions.

## 15 | Limitations

Our study identifies some limitations that must be considered when implementing the eccentric exercise guidelines. It is important to note that this study recruited RA patients, who are mainly African descendants, to develop these guidelines. In addition, the results of our findings involved in developing these guidelines were derived from a small sample size recruited for this study. Hence, the generalization of the implementation of the guidelines globally should be interpreted with caution. Further, our study failed to conduct a longitudinal trial to determine the long-term effects of eccentric exercise intervention and if the benefits of this intervention can be sustained to further improve RA conditions. In addition, we reckon that excluding RA patients older than 65 years in our study may not be able to provide the implications of these guidelines in older adults.

## 16 | Conclusion

Eccentric exercise guidelines were developed following evidence-based outcomes that showed the positive effects of eccentric exercise interventions and available evidence in the literature recommending physical exercises for managing disease comorbidities in RA patients. Thus, eccentric exercise guidelines are recommended to be included in the policy implementation to improve the health outcomes in the RA population. The implementation of these guidelines should be done with reference to the existing management guidelines developed by the health care associations for RA, such as the European League Against Rheumatism (EULAR), the French Society for Rheumatology (SFR), the Brazilian Society for Rheumatology, and the Chinese guidelines for the diagnosis and treatment of RA.

### Author Contributions

**Amidu Yekini:** conceptualization, methodology, visualization, writing – original draft, writing – review and editing, investigation, formal analysis. **Jeanne Martin Grace:** conceptualization, methodology, supervision, visualization, writing – review and editing, formal analysis.


### Acknowledgments

The authors have nothing to report.


### Conflicts of Interest

The authors declare no conflicts of interest.

### Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

### Transparency Statement

The lead author Amidu Yekini affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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