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Effects of a self-determination theory-based physical activity programme for postmenopausal women with rheumatoid arthritis: A randomized controlled trial

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Abstract

Aims: The study aimed to develop and evaluate the effects of a self-determination theory-based, nurse-led, physical activity programme for postmenopausal women with rheumatoid arthritis.

Methods: Between December 2019 and April 2020, this randomized controlled trial recruited 62 postmenopausal women with rheumatoid arthritis from a university-affiliated hospital in South Korea. The intervention group participated in a self-determination theory-based, nurse-led, physical activity programme that consisted of Tai Chi-based physical activity, a supportive psychosocial strategy, and interactive counselling for 16 weeks, and the control group continued to undergo their usual care.

Results: There were statistically significant group-by-time interactions in physical activity and perceived sarcopenia, which favoured the intervention group. Additionally, the intervention group showed significant improvements in the perceived therapeutic efficacy of physical activity, grip strength, walking speed, disease activity score, and health-related quality of life.

Conclusions: The programme developed in this study can be an effective and feasible approach for postmenopausal women with rheumatoid arthritis in improving physical activity, selected osteosarcopenic outcomes, and health-related quality of life. Further research is required to investigate the long-term effects of this theory-based programme for postmenopausal women in diverse settings.

KEYWORDS
physical activity, postmenopausal osteoporosis, randomized controlled trial, rheumatoid arthritis, sarcopenia

Summary statement

What is already known about this topic?

- Tai Chi-based physical activity has been known to be a component of self-management for rheumatoid arthritis.

What this paper adds?

- It highlights the efficacy of a theory-based, nurse-led, physical activity programme to improve the quality of life of postmenopausal women with rheumatoid arthritis.
- The evidenced-based programme could be transferred to postmenopausal women with rheumatoid arthritis in clinical settings.

The implications of this paper:

- The self-determination theory-based, nurse-led, physical activity programme can improve physical and psychosocial outcomes in postmenopausal women with rheumatoid arthritis.
- Importantly, this nurse-led and theory-based programme is expected to be applicable to postmenopausal women with rheumatoid arthritis in clinical settings, including both hospitals and communities.

1 | INTRODUCTION

Rheumatoid arthritis (RA) is an autoimmune and inflammatory disease that occurs in joint tissue, leading to progressive loss of function and impaired joint mobility (Aletaha & Smolen, 2018). The worldwide prevalence of RA is 0.5%–1% in developed countries (Arthritis Foundation, 2020a; Hunter et al., 2017) and 0.27%–1.85% in South Korea (Kim & Sung, 2021). Furthermore, women experience RA at a rate three times higher than men and have more severe functional decline and increased disability associated with RA (Mollard et al., 2018). In addition, as women age and reach menopause, it causes a progressive decrease in muscle mass, strength, and bone density. Sarcopenia and osteoporosis often coexist in postmenopausal women (Agostini et al., 2018). Additionally, pharmaceutical treatments (i.e., corticosteroids and disease-modifying antirheumatic drugs) can alter body composition (i.e., an increase in body fat) in patients with RA (Letarouilly et al., 2021). Therefore, new approaches for postmenopausal women with RA are needed.

2 | BACKGROUND

The concept of "osteosarcopenia" is a newly reported syndrome in which osteoporosis and sarcopenia coexist (Bruyère et al., 2019). Common risk factors for osteosarcopenia are age and sex. Particularly for postmenopausal women with RA, oestrogen deficiency and RA-related inflammation can induce osteosarcopenia (Paolino et al., 2021). In a study that analysed the association of osteosarcopenia in postmenopausal women, the prevalence of osteosarcopenia was higher in postmenopausal women, and the lack of physical activity was found to be the most common risk factor for osteosarcopenia (Hamad et al., 2020). For this reason, increasing physical activity and reducing the possibility of osteosarcopenia is essential.

Improving physical activity is a key component for the management of RA outcomes. Regular physical activity for people with RA can reduce the disease burden and contribute to an improved quality of life (Bremander et al., 2020). Further, physical activity has a positive role in RA patients' pain, fatigue, inflammation, and physical function (Hu et al., 2021). However, people with RA have reported pain, fatigue, and fear of causing further joint damage as barriers to physical activity (Arthritis Foundation, 2020a). Evidence suggests that various physical activity methods should be considered due to symptoms of RA, such as walking, swimming, gardening, and Tai Chi (Centers for Disease Control and Prevention, 2022).

A progressive muscle strengthening programme with resistance training is known to be effective for improving muscle strength and bone mineral density (O'Bryan et al., 2022). The load of resistance exercise is crucial for defining an exercise as a resistance exercise. For example, performing 100 bodyweight squats per day for 4 months did not result in any improvements in muscle strength, muscle thickness, or physical tests among a sample of older adults, although such exercise was undoubtedly a considerable amount of physical activity (Hirono et al., 2023). Resistance exercises of one repetition maximum with an intensity below 50% during the training has little to no effect on muscle strength (Kamiya et al., 2023), with progressively higher training loads providing better results above this level (Steib et al., 2010). Tai Chi is one example of a programme that combines both aerobic and muscle strengthening exercise but is not considered resistance training. Tai Chi can promote physical function, psychological well-being, and quality of life for diverse populations (i.e., healthy older adults, older adults with a history of falls, postmenopausal women, and orthopaedic patients; Qi et al., 2020). Furthermore, it can relieve pain and stiffness in joints, improve joint flexibility and postural balance, and enhance self-efficacy and health-related quality of life (HRQoL) in people with arthritis (Arthritis Foundation, 2020b; Son & Hwang, 2018).

People with RA face barriers to physical activity, such as fear of joint damage and physical symptoms, and lack of direction from health care providers and motivation to participate in physical activity (Katz et al., 2020). Furthermore, given the nature of chronic diseases, interventions to motivate people with RA to engage in regular physical activity are essential (Abbasi-Shavazi et al., 2017). Moreover, theories provide guided frameworks to identify potential determinants and evaluate the mechanisms through which determinants may act to encourage real behavioural changes. However, few studies have investigated theory-based interventions that can change health behaviour, such as physical activity, to motivate people with RA. In this context, theory-driven strategies are required to improve physical and psychosocial health.

The self-determination theory (SDT) fosters the support of patients' autonomy by health care professionals, enhances patients' autonomous intrinsic motivation and competence, and maintains both the physical and psychosocial health of patients with chronic diseases. Taking a key assumption that social environment is essential to an individual's quality of motivation to engage in a behaviour, SDT proposes that supporting autonomy by health care professionals can foster patients' autonomous motivation towards engagement in target behaviours (Ryan et al., 2008). SDT has been successfully applied to health behaviour change interventions. For example, a recent randomized controlled trial (RCT) demonstrated that RA patients who participated in an SDT-based intervention using autonomy-supportive strategies for physical activity showed greater autonomous motivation and engagement in physical activity after 3 months of the intervention (Fenton et al., 2021).

Thus, we developed a 16-week SDT-based physical activity programme using Tai Chi and evaluated its effects in postmenopausal women with RA. During the period of exceptional circumstances of the COVID-19 pandemic that challenged daily physical activity, we hypothesised that changes in scores over time in the intervention group would show less decline in (1) physical activity outcomes; and more improvements in (2) osteosarcopenic outcomes, (3) health outcomes, and (4) SDT-related variables, compared with the control group.

3 | METHODS

3.1 | Design

A parallel-group RCT was conducted with a repeated measures design from December 2019 to April 2020 to develop and evaluate the effects of an SDT-based, nurse-led, physical activity programme for postmenopausal women with RA. Participants meeting all study criteria were randomly assigned using a random numbers table in a 1:1 ratio into two groups—the intervention group and the control group. The intervention group participated in the 16-week SDT-based programme. Nurses conducted the intervention in two phases: the first 8 weeks were group-based and conducted in the hospital, and the second 8 weeks were home-based and required individual intervention. The control group received routine care. Participants' outcomes were assessed at three time points: baseline, 8 weeks (the end of group intervention), and postintervention at 16 weeks.

3.2 | Participants and setting

Sixty-two postmenopausal women with RA at risk for osteosarcopenia were recruited from an outpatient rheumatology department at a university-affiliated hospital in South Korea. The inclusion criteria for this study were women who (1) had been diagnosed with RA based on established criteria (England et al., 2019); (2) had experienced menopause; (3) had a bone density value less than −1.0 SD in the lumbar spine or femur, or with one or more osteoporotic vertebral fractures (International Osteoporosis Foundation, 2020); (4) had undergone a bone density scan within 1 year prior to the study; (5) met at least one of the muscle index evaluation criteria defined by the Asian Working Group for Sarcopenia (Chen et al., 2020): appendicular lean mass <5.4 kg/m^2, grip strength <18 kg, and walking speed >7 s over 4 m; and (6) could perform regular physical activity according to the patients' self-identification and the judgement of their primary rheumatologist. The exclusion criteria were women who (1) had been diagnosed with a malignant tumour or other diseases of which the patients had not been cured; (2) took oral steroids at a dose of 7.5 mg or higher for over 3 months (Buttgereit et al., 2002); and (3) engaged in physical activity programmes for another study.

The sample size was calculated through power analysis using the G*Power 3.0 program (Erdfelder et al., 1996). A total sample of 62 women (31 in each group) was required after estimating an effect size (d) of .50, power ($1-\beta$) of .80, and significance level (α) of .05 using two-sided tests, considering attrition of .30 during the trial.

3.3 | Intervention protocol

3.3.1 | Intervention group

The 16-week SDT-based physical activity programme was conducted by two nurses who were qualified Tai Chi instructors and trained for consistent intervention implementation according to the study protocol before the study. The nurses monitored intervention adherence through face-to-face meetings, telephone calls, and the participants' self-reported weekly diaries. The intervention programme comprised three components: Tai Chi-based physical activity, a supportive psychosocial strategy based on the SDT constructs, and interactive counselling using the telephone/social networking service (Table 1).

Tai Chi-based physical activity

The 16-week intervention programme involved 8 weeks of hospital-based group physical activity and 8 weeks of home-based individual physical activity. (1) Type: Tai Chi with combined aerobic and muscle strengthening exercises (one set consists of 11 motions, five to 10 repetitions per each motion at 40%–70% of one repetition maximum, two to three sets per session), flexibility exercises (stretching 12 motions), dancing (three songs, four beats), as well as warm-up and cool-down stages based on 2018 EULAR recommendations for physical activity in people with RA (Osthoff et al., 2018); (2) frequency: 3–5 days per week; (3) time duration: 30–70 min (two to three sets) per

TABLE 1 Developed intervention programme based on the self-determination theory.

Session week	Components	Contents	Delivery methods
1–8	Group exercise	Flexibility exercise (12 motions) Aerobic exercise (dance movement with three songs, four beats) Strength exercise (11 motions) Combined exercise (Tai Chi-based exercise)	Demonstration and practice, poster, and mobile video
9–16	Individual coaching	Nurse-led coaching	Telephone
1–16	Individual exercise	Combined exercise (Tai Chi-based exercise)	Mobile video
Self-determination theory-based intervention strategies			
1–16	Autonomy-supportive climate	Consultation, motivational support Positive feedback Sympathy Expert's support Information on disease	Interview, professional training, and Q&A
1–16	Autonomy	Setting own goals Self-examination Getting to know myself Troubleshooting	Lecture, group discussion, and mobile video
1–16	Competence	Overcoming pain Setting own goals Finding own strengths Support motivation Exercise execution	Group discussion, personal presentation, demonstration, and practice
1–16	Relatedness	Forming a peer group rapport Sharing experiences Building relationships Providing encouragement Focusing on a problem	Group discussion, mobile video, and support using SNS
1–16	Physical activity and perceived therapeutic efficacy	Progressive achievement Verbal persuasion Vicarious experience	Group discussion, individual coaching, mobile video, and booklet

Abbreviations: Q&A, question and answer; SNS, social networking service.

day; (4) intensity: low to moderate intensity of 40%–70% maximum HR based on the HR reserve method, scores of 11–14 on the Borg Rating of Perceived Exertion Scale (RPE), which has a range of 6–20 (Borg, 1998); (5) progression: participants adjusted their physical activity at least for the first 2–3 weeks at a low to moderate intensity level and then advanced to a moderate level as tolerated. The total weekly dose was at least 150 min of moderate physical activity based on the American College of Sports Medicine recommendation (Garber et al., 2011). The goal of the Tai Chi-based physical activity training was for the participants to engage in physical activity (Tai Chi) for 30–70 min (two to three sets) per day, at least 3 days per week. The nurse-led group programme was conducted twice a week (16 sessions), and the participants combined it with a home-based programme once a week during the first 8 weeks using a physical activity log to record frequency, duration, and RPE. Subsequently, it was followed by a home-based individual programme, conducted independently by the participants at least three times a week with the nurse's telephonic coaching and monitoring via interactive mobile text messages during the next 8 weeks.

Supportive psychosocial strategy based on the SDT

The psychosocial strategy was based on the SDT constructs, such as autonomy, competence, relatedness, and perceived therapeutic efficacy. Specifically, hospital-based group Sessions 1–7 involved the psychosocial strategy to induce changes in participants' physical activity levels, Sessions 8–13 focused on the psychosocial strategy to execute these changes, and Sessions 14–16 emphasized the psychosocial strategy to maintain the physical activity levels.

Interactive counselling using the telephone and social networking service

The nurses provided telephone/social networking service counselling for 10–20 min weekly. Any physical or psychosocial problems or barriers experienced by the participants when performing the home-based programme were discussed and collaboratively investigated. In addition, specific critical thinking skills and coping strategies were individually coached.

3.3.2 | Control group

Women in the control group were instructed to continue their usual daily activities and were provided with routine care at the rheumatology outpatient clinic. This regimen consisted of meeting with their rheumatologist and nurse and receiving brief disease-related and medication information, which remained unchanged during the study.

3.4 | Measurement

3.4.1 | Physical activity outcomes

Physical activity was measured using the Korean version of the World Health Organization's International Physical Activity Questionnaire-Short Form (IPAQ-SF) (Oh et al., 2007). The total physical activity score (metabolic equivalent of task minutes/week) was calculated by multiplying activity intensity (low: 3.3, moderate: 4.0, or high: 8.0) by the duration (minutes) and frequency of physical activity per week. The higher the metabolic equivalent of the task in minutes/week, the greater the amount of physical activity per week, with a score over 600 classifying the participant as clinically physically active.

Perceived therapeutic efficacy of physical activity was assessed with the Korean version of the Perceived Therapeutic Efficacy Scale (Kim et al., 2022), originally developed by Dunbar-Jacob et al. (2006). This scale measures the responses on a 10-point rating scale ranging from 0 to 100, with higher scores indicating higher perceived therapeutic efficacy for arthritis-related physical activity. Cronbach's α was .83 in this study.

3.4.2 | Osteosarcopenic outcomes

Bone density for osteosarcopenia was measured using Dual-Energy X-Ray Absorptiometry (GE Healthcare, Madison, WI, USA). The T-score shows the extent to which an individual's bone mass differs from that of a healthy adult; *t*-scores between −1 and −2.5 indicate low bone mass, and *t*-scores of −2.5 or lower indicate osteoporosis (International Osteoporosis Foundation, 2020).

Muscle mass and function for sarcopenia were measured with a body composition analyser (InBody IOI353®; ACCUNIQ Technology, Daejeon, Korea) for appendicular lean mass. In addition, a digital handgrip strength dynamometer (TKK5401®; Takei Scientific Instruments Co., Ltd., Niigata, Japan) was used, and a 4-m walking speed test was conducted by nurses. We followed the recommendation by the Asian Working Group (Chen et al., 2020) to identify at least one of the three criteria for sarcopenia: appendicular lean mass (<5.4 kg/m^2); handgrip strength (<18 kg); or 4-m walking speed (>7 s) for women.

Perceived sarcopenia was measured through the Korean version of the Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls questionnaire (SARC-F) (Kim et al., 2018), originally developed by Malmstrom and Morley (2013). It comprises five questions pertaining to muscle strength, walking aids, standing up from a chair, climbing stairs, and falling. Items are measured on a 3-point scale (0 = *not difficult at all*, 1 = *a little difficult*, or 2 = *very difficult to perform*). The cut-off point of self-reported sarcopenia is 4 or more out of 10. Cronbach's α was .81 in this study.

3.4.3 | Health outcomes

Disease activity of RA was measured by the Disease Activity Score (DAS)-Erythrocyte Sedimentation Rate (ESR), which examines 28 joints plus ESR (Prevoo et al., 1995). First, the number of swollen and tender joints is counted; specifically, blood is drawn to measure the ESR, and the participant is asked to make a "global assessment of health" (indicated by marking a 10-cm line between "very bad" and "very good"). Then, these results are entered into a formula to produce the overall DAS as 0.56 * sqrt (tender joints) + 0.28 * sqrt (swollen joints) + 0.70 * ln (ESR) + 0.014 * patient global assessment of health. A score greater than 5.1 indicates active disease, a score >3.2 but ≤5.1 indicates moderate disease activity, a score ≥2.6 but ≤3.2 suggests low disease activity, and a score lower than 2.6 indicates remission. Cronbach's α was .84 in this study.

HRQoL was measured using the Korean version of the European Quality of Life-5 Dimension-5 Level (EQ-5D-5L; Kim et al., 2014). It comprises five items regarding exercise ability, self-management, daily activities, pain and discomfort, and anxiety and depression. Scores are expressed as an index, calculated by applying weights to measurements across the five areas. Each country has unique weights calculated and applied according to its cultural circumstances. In this study, we calculated one value between −.66 and .90, using the weight recommended by Kim et al. (2014). It estimates the health utility of Korean adults using the composite time trade-off and discrete choice experience methods for health status. The higher the participant's index, the greater the HRQoL. Cronbach's α in this study was .76.

3.4.4 | SDT-related variables

Autonomy support by health care providers was measured using a 15-item Health Care Climate Questionnaire (HCCQ)–Korean (Han & Shin, 2010) adapted from the HCCQ developed by Williams et al. (1996). Each item is rated on a 7-point rating scale (1 = *strongly disagree* to 7 = *strongly agree*); higher scores indicate a higher level of perceived autonomy support by health care providers. Cronbach's α in this study was .74.

Patients' basic psychological need satisfaction was measured using the Basic Psychological Need Satisfaction Scale (BPNS) - Korean (Lee & Kim, 2008) adapted from the BPNS developed by Deci and Ryan (2000). It comprises 18 items on autonomy, competence, and relationship with responses rated on a 7-point rating scale (1 = *strongly disagree* to 7 = *strongly agree*); higher scores indicate greater satisfaction with basic psychological needs. Cronbach's α in this study was .78.

3.5 | Data collection

Two researchers collected the data, not the nurses who performed the intervention programme. Study variables, except bone density, were measured at baseline, 8-weeks, and 16-weeks for all participants during their hospital visits. Bone density was measured only at baseline and 16 weeks, owing to its high cost.

3.6 | Ethical considerations

This study was approved by the Institutional Research Ethics Board (*coded for blinded review*) and conducted in compliance with the principles of the Declaration of Helsinki. Participants were recruited through an in-hospital advertisement and provided written informed consent to participate. Before the commencement of the study, its procedure and purpose were explained to the participants. They were informed that participation was voluntary and that they could withdraw at any time. Additionally, the contact details of the research director and the institution's research ethics committee were provided to the participants if they wished to clarify any doubt or express inconveniences regarding the study. Data were kept confidential and stored using an independently assigned code in an encrypted computer or storage space with a lock to protect participants' personal details.

3.7 | Data analysis

The data were analysed using IBM SPSS, version 23.0 (IBM Corp., Armonk, NY, USA). The normality of the participants' general characteristics, disease-related characteristics, and outcome variables was analysed using the Shapiro–Wilk test. The participants' baseline demographic and disease-related characteristics and the homogeneity between the groups were analysed using chi-square, Fisher's exact, independent *t*, and Mann–Whitney *U* tests. Analyses to determine the effects of the programme were performed on intention-to-treat principles. Hypothesis testing for outcome variables between the two groups involved repeated-measures ANOVAs to assess any group-by-time (three time points) interactions and ANCOVA after controlling for the baseline score of each outcome variable. A follow-up simple effect test was conducted on a significant group-by-time interaction to explore the degree to which the group factor is differentially effective at each level of a time factor. A two-tailed test at $p < .05$ was considered statistically significant.

4 | RESULTS

4.1 | Flow of participants

The flow of participants through the study is shown in Figure 1. Of the 217 women who met the inclusion criteria, 62 voluntarily consented to participate and were randomly assigned to the intervention or control group using a randomisation computer programme in a 1:1 ratio. Of the 62 participants who received the pre-survey, 56 (intervention group = 27, control group = 29) completed Post-Survey 1 at 8 weeks, and 54 (intervention group = 26, control group = 28) completed Post-Survey 2 at 16 weeks. The attrition rate, based on a dropout criterion of over five missed sessions and aimed at evaluating the effects of programme continuity, was 12.9% (total participant dropout = 8; intervention group = 5, control group = 3) at the end of the 16-week follow-up. No differences in attrition were observed between the two groups.

4.2 | Intervention adherence

Adherence to physical activity in the intervention group during the 16-week intervention is shown in Figure 2. The overall adherence to physical activity intervention was 72.0% (*SD* = 14.8%) during the 16-week intervention period (Figure 2). The average adherence rate during the first 8 weeks of the hospital-based intervention programme was 84.7%. The average weekly adherence to physical activity during the home-based individual programme (Weeks 9–16) was 59.4%, ranging from 48.6% (Week 11) to 72.9% (Week 15). During the 16-week intervention, the average frequency of Tai Chi-based physical activity was 4.7 (*SD* = 0.9) sessions per week, while the average duration of Tai Chi-based physical activity was 38.0 (*SD* = 4.1) minutes per session; the average weekly duration of physical activity was 177.6 (*SD* = 27.8) minutes (Figure 3). Physical activity amount (METs-min/week) during the 16-week period in both groups is shown in Figure 4. Women in the intervention group showed more improvements in physical activity levels than those in the control group (group differences of 1922.61 METs/week at 8 weeks and 998.94 METs/week at 16 weeks, *ps* < .05; Figure 4).

4.3 | General characteristics and baseline measurements

The average age was 63.26 (*SD* = 7.10) years, and the mean duration of RA was 8.82 (*SD* = 6.08) years. No significant differences were found between the two groups at baseline in general and disease-related characteristics and selected outcome variables (Table 2).

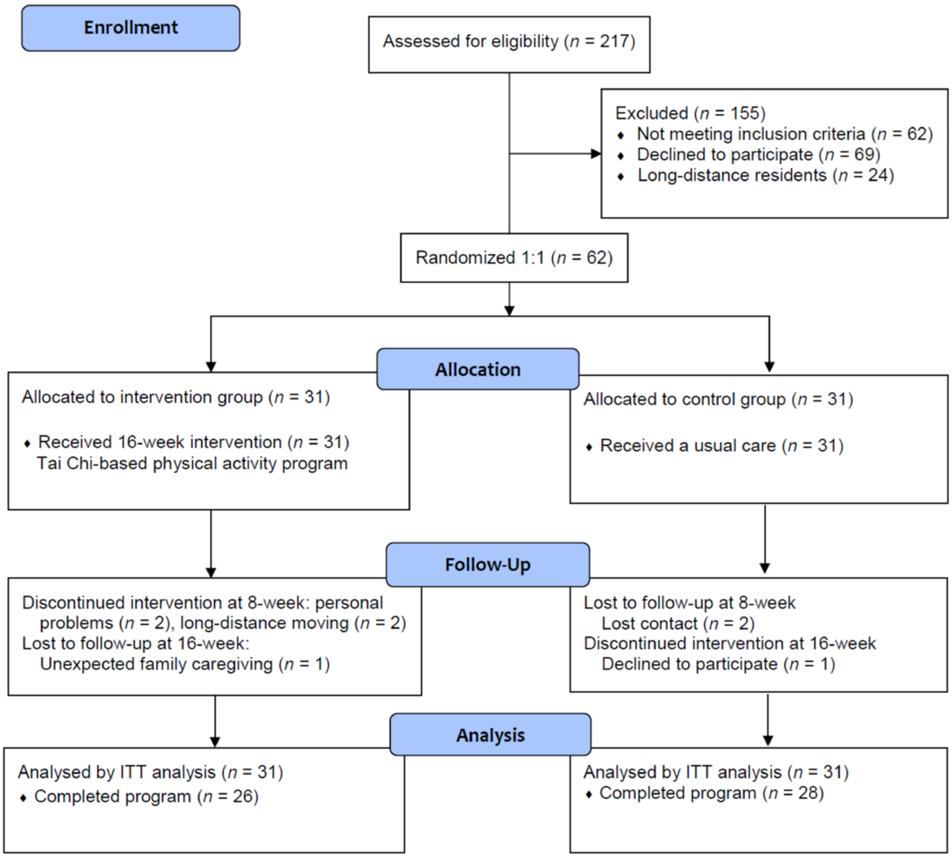

FIGURE 1 Flow diagram of the process through the phases of the randomized trial. Abbreviation: ITT, intention to treat.

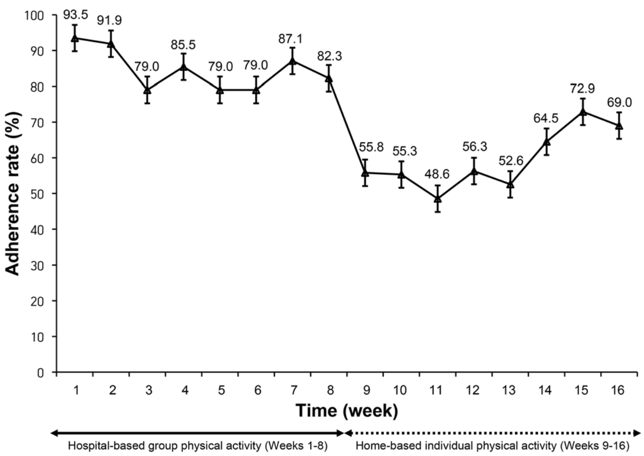

FIGURE 2 Adherence to physical activity programme during the 16-week intervention.

However, there were significant differences between the two groups at baseline in perceived therapeutic efficacy of physical activity, grip strength, walking speed, disease activity of RA, and HRQoL. The mean scores for perceived therapeutic efficacy of physical activity, walking speed, and disease activity of RA were significantly higher in the intervention group than in the control group ($p = .028$; $p = .001$; $p = .032$, respectively). Conversely, the mean scores for grip strength ($p < .001$) and HRQoL ($p = .039$) were higher in the control group than in the intervention group.

4.4 | Effects on physical activity outcomes

There were statistically significant group-by-time interactions indicating that the intervention group showed significantly less decline over time compared with the control group in physical activity level ($F = 3.49$, $p = .040$, $\eta_p{}^2 = .06$). The mean physical activity score in the intervention group changed from 2193.26 to 1511.84 METs-min/week after 16 weeks while the mean score of physical activity in the control group decreased from 1818.71 to 512.90 METs-min/week, representing a change from active to inactive, as a score below 600 is considered inactive (Table 3). Additionally, the ANCOVA, after adjusting for the baseline score, revealed statistically significant group differences for perceived therapeutic efficacy of physical activity at 8 weeks ($F = 39.02$, $p < .001$) and 16 weeks ($F = 84.49$, $p < .001$; Table 4).

4.5 | Effects on osteosarcopenic outcomes

The ANCOVA revealed statistically significant group differences for grip strength at 8 weeks ($F = 8.18$, $p = .006$) and 16 weeks ($F = 23.41$, $p < .001$); and walking speed at 8 weeks ($F = 32.28$, $p < .001$) and 16 weeks ($F = 23.24$, $p < .001$; Table 4) after adjusting for the baseline score. Both outcomes improved more in the intervention group compared with the control group: the adjusted means for walking speed is lower in the intervention group, which is better, and

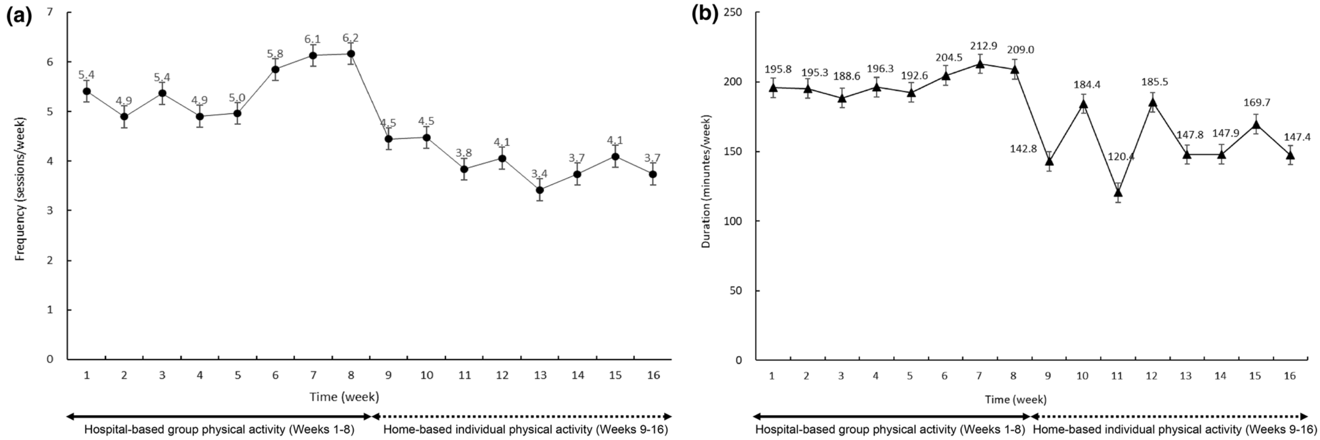

FIGURE 3 Weekly frequency and duration of physical activity programme during the 16-week intervention. (a) Frequency. (b) Duration.

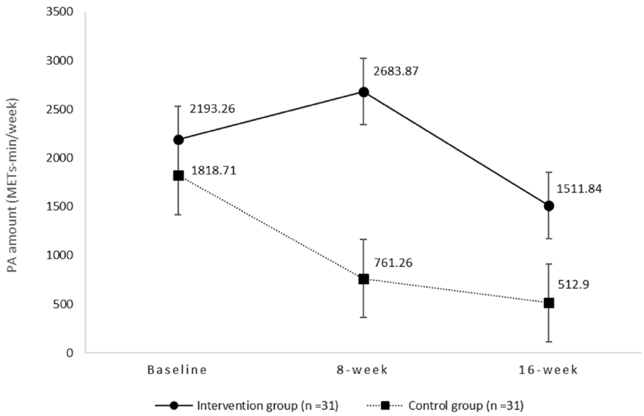

FIGURE 4 Physical activity amounts (METs-min/week) during the 16-week period. Abbreviations: METs-min/week, metabolic equivalents of task minutes/week. Note: Physical activity amount (METs-min/week) was calculated by multiplying activity intensity (low: 3.3, moderate: 4.0, or high: 8.0) by the duration (minutes) and frequency of physical activity per week. A score over 600 classified the participant as clinically physically active.

the adjusted means for grip strength is higher in the intervention group, which is better. Moreover, statistically significant group-by-time interaction was noted, which meant that the intervention group showed significant improvement over time compared with the control group in perceived sarcopenia score ($F = 7.77$, $p = .001$, $\eta_p^2 = .12$), but not for appendicular lean mass ($F = 0.35$, $p = .652$) and bone density ($F = 1.38$, $p = .245$; Table 3).

4.6 | Effects on health outcomes

After adjusting for the baseline score, the ANCOVA revealed statistically significant group differences for disease activity of RA at 8 weeks ($F = 19.21$, $p < .001$) and 16 weeks ($F = 42.21$, $p < .001$). However, there was a statistically significant group difference in HRQoL only at 16 weeks ($F = 8.93$, $p = .004$; Table 4).

4.7 | Ancillary analyses: effects on SDT-related variables

There were statistically significant group-by-time interactions in health care providers' autonomy support ($F = 36.99$, $p < .001$, $\eta_p^2 = .38$) and patients' basic psychological need satisfaction ($F = 4.46$, $p = .014$, $\eta_p^2 = .07$). Women in the intervention group showed significant improvement in health care providers' autonomy support over time, compared with the control group (mean differences 15.61 vs. −2.42 at 8 weeks; 22.42 vs. −16.58 at 16 weeks, $p < .001$). Additionally, women in the intervention group significantly improved in basic psychological need satisfaction than those in the control group (mean differences 0.19 vs. −0.36 at 8 weeks; 8.26 vs. −2.19 at 16 weeks, $p = .018$).

5 | DISCUSSION

This study developed an SDT-based programme, Tai Chi exercise for physical activity, which included aerobic and muscle strengthening exercise for postmenopausal women with RA at risk for osteosarcopenia. We evaluated the programme's effects on physical activity, osteosarcopenia and health outcomes, and SDT-related variables. Significant improvements were observed in physical activity level and perceived therapeutic efficacy of physical activity; osteosarcopenic outcomes, including grip strength, walking speed, and perceived sarcopenia; health outcomes, including disease activity of RA and HRQoL; and SDT-based variables, including health care providers' autonomy support and patients' basic psychological need satisfaction.

Overall adherence to the physical activity intervention was 72.0%, ranging from 48.6% to 93.5%. The average adherence rate during the first 8 weeks of the hospital-based intervention programme (84.7%) was higher than that during the home-based individual programme (59.4%, Weeks 9–16). The control group's physical activity (METs-min/week) dropped dramatically from baseline to Weeks 8 and 16. This decline was related to the COVID-19 pandemic period (Weeks 9–16) after the hospital-based intervention programme. The

TABLE 2 Differences in baseline general characteristics and outcome variables between the intervention and control groups.

Variables	*n* (%) or mean (*SD*)				
	Total (*N* = 62)	Intervention group (*n* = 31)	Control group (*n* = 31)	*t* or χ^2	*p*
General and disease-related characteristics					
Age (year)	63.26 (7.10)	63.19 (6.84)	63.32 (7.46)	−0.07	.944
Duration of RA (year)	8.82 (6.08)	7.68 (5.75)	9.97 (6.28)	−1.50	.139
Age at diagnosis of RA (year)	54.45 (9.29)	55.55 (7.12)	53.35 (11.06)	0.93	.357
Body mass index (kg/m^2)	22.66 (3.95)	22.57 (4.43)	22.74 (3.48)	−0.17	.869
Morning stiffness (yes)	42 (67.7)	21 (67.7)	21 (67.7)	0.01	>.999
Tender joint count	5.03 (4.83)	5.13 (4.55)	4.94 (5.17)	0.16	.876
Swollen joint count	1.87 (3.02)	1.87 (2.77)	1.87 (3.29)	0.01	>.999
Total steroid use (month)	69.14 (57.99)	57.32 (53.53)	80.95 (60.70)	−1.63	.109
Physical activity outcomes					
PA (METs-min/week)[a]	2005.98 (2582.32)	2193.26 (2907.55)	1818.71 (2243.37)	−0.42	.673
Perceived therapeutic efficacy of PA	51.13 (22.99)	57.48 (22.90)	44.77 (21.61)	2.25	.028
Osteosarcopenic outcomes					
Bone density (T-score)	−2.69 (0.89)	−2.73 (0.89)	−2.65 (0.91)	−0.34	.736
Appendicular lean mass (kg)	6.82 (0.74)	6.76 (0.76)	6.88 (0.73)	−0.69	.494
Grip strength (kg)	15.25 (4.64)	12.93 (4.74)	17.58 (3.18)	−4.54	<.001
Walking speed (m/sec)	6.25 (1.34)	6.79 (1.49)	5.72 (0.91)	3.41	.001
Perceived sarcopenia	2.21 (1.56)	2.26 (1.57)	2.16 (1.57)	0.24	.809
Health outcomes					
DAS-ESR	3.59 (1.15)	3.91 (1.18)	3.28 (1.06)	2.20	.032
Health-related quality of life	0.74 (0.13)	0.70 (0.15)	0.77 (0.10)	−2.07	.039
Self-determination theory-related variables					
Health care providers' autonomy support	75.85 (15.59)	77.29 (15.93)	74.42 (15.38)	0.72	.473
Basic psychological need satisfaction	79.82 (12.56)	81.42 (12.31)	78.23 (12.80)	1.00	.321

Abbreviations: DAS-ESR, disease activity score-erythrocyte sedimentation rate; METs, metabolic equivalents of task; PA, physical activity; RA, rheumatoid arthritis; SD, standard deviation.
[a]The Mann–Whitney *U* test was conducted based on the normality test result.

participants in the control group were supposed to continue their daily life unimpeded, which was affected by the COVID-19 pandemic and contributed to the difference between groups. Considering this unexpected occurrence, physical activity decline may result from between-group differences in the outcome variables. For example, this physical inactivity may also be associated with an increase in ESR (Hashem et al., 2018).

Moreover, we observed a progressive decline in compliance throughout the intervention, especially during the home-based individual exercise due to the COVID-19 pandemic. During the home-based programme, most of the population experienced barriers to physical activity and limited support from health care personnel, which impacted physical functioning and had a detrimental effect on performance (Stockwell et al., 2021). This event was critical for the study's outcome as prior involvement in an exercise group and having instructor follow-up have been identified as important factors for promoting motivation and home-based physical activity during periods of lockdown/social distancing (Hailey et al., 2022; Nosaka et al., 2022). Thus, we cannot determine if the COVID-19 pandemic caused the differences in sedentary behaviour that were observed in this study. Therefore, further research is necessary to identify an effective way to increase strategic attention and monitoring, including telephone coaching and other technology-based tracking methods by health care providers during events, such as the COVID-19 pandemic, to increase individual exercise compliance at home.

Regarding the perceived therapeutic efficacy of physical activity, significant improvements were demonstrated in the intervention group during the programme's hospital-based component (at 8 weeks) and maintained during the home-based component (at 16 weeks). The effects of the hospital-based programme may be more prominent from using a planned action strategy to prompt physical activity, and it can be successfully maintained by participants self-monitoring their exercise through videos and exercise logs in the home-based component with nurses' telephone/social networking service counselling support. This strategy was based on a previous study, demonstrating that direct behavioural control by an expert improves physical activity

TABLE 3 Group-by-time effects of the programme using repeated measures analysis of variance.

Variables	Baseline Mean (*SD*)		Week 8 Mean (*SD*)		Week 16 Mean (*SD*)			*F* (*p*)	Partial eta^2
Physical activity (METs-min/week)									
Intervention group	2193.26	(2907.55)	2683.87	(1874.85)	1511.84	(1950.53)	Group	8.61 (.005)	.13
Control group	1818.71	(2243.37)	761.26	(1509.72)	512.90	(855.11)	Time	6.03 (.005)	.09
							Group × time	3.49 (.040)	.06
Bone density (*T*-score)									
Intervention group	−2.73	(0.89)	-		−2.51	(0.82)	Group	0.01 (.981)	.01
Control group	−2.65	(0.91)	-		−2.58	(0.79)	Time	5.63 (.021)	.09
							Group × time	1.38 (.245)	.02
Appendicular lean mass (kg)									
Intervention group	6.76	(0.76)	6.85	(0.81)	6.83	(0.76)	Group	0.29 (.592)	.01
Control group	6.88	(0.73)	6.90	(0.65)	6.94	(0.72)	Time	1.18 (.302)	.02
							Group × time	0.35 (.652)	.01
Perceived sarcopenia									
Intervention group	2.26	(1.57)	1.52	(1.44)	1.03	(1.11)	Group	2.79 (.100)	.04
Control group	2.16	(1.57)	2.03	(1.82)	2.32	(1.78)	Time	5.17 (.007)	.08
							Group × time	7.77 (.001)	.12

Note: Baseline = before intervention; Week 8 = week 8 of completion of hospital-based intervention; Week 16 = week 16 of completion of home-based intervention; repeated measures ANOVA *p* values are adjusted for Bonferroni correction; group × time indicates group-by-time interaction.
Abbreviations: METs, metabolic equivalents of task; SD, standard deviation.

from an intervention development perspective (Choi et al., 2018). Therefore, when establishing a strategy for developing a physical activity programme for chronic illnesses, the importance of incorporating health care professionals directly into the programme should be considered to maintain the patient's continuous behavioural change.

The selected osteosarcopenic outcomes, including grip strength and walking speed of postmenopausal women with RA, demonstrated a greater improvement in the intervention group compared with the control group. In particular, the intervention group in this study mainly used Tai Chi exercise for physical activity. This finding is consistent with a recent systematic review and meta-analysis, which reported that Tai Chi interventions significantly improved handgrip strength and walking distance (Wehner et al., 2021). However, we observed no group-by-time interactions for appendicular lean mass and bone density. Similarly, a systematic review and meta-analysis of RCTs on the effect of Tai Chi on bone mineral density have shown conflicting results (Zou et al., 2017). They presented significant benefits in favour of Tai Chi on bone density of some bones but did not show a substantial increase in bone density of others, such as the lumbar spine and proximal femur neck (Zou et al., 2017). In addition, it was said that it takes more than three years for Tai Chi to increase bone density and improve muscular function in postmenopausal women considering their age-related bone loss, and time should be one of the most critical factors during the study of physical interventions (Liu & Wang, 2017). Thus, we propose that the beneficial effects of the intervention using Tai Chi on bone density may need longer-term practice for improving bone density for postmenopausal women with RA.

Additionally, the intervention in this study primarily used Tai Chi exercise for physical activity, including aerobic and muscle strengthening exercise, which is limited compared with the effect of other types of resistance training. The effect sizes ($\eta_p{}^2$) indicated that the Tai Chi programme had a moderate effect on physical activity level; large effects on selected osteosarcopenic outcomes including grip strength, walking speed, disease activity of RA, and HRQOL; but small effects on bone density and appendicular lean mass. In this study, the partial eta squared ($\eta_p{}^2$) effect size was interpreted as small (.01), medium (.06), or large (.14) effect (Cohen, 1988). Although the magnitude of improvement observed in this intervention cannot be directly compared with other exercise interventions due to different combinations of exercise, a recent systematic review and meta-analysis reported that Tai Chi training had a moderate beneficial effect for improving physical health including grip strength (Wehner et al., 2021). An exercise that is effective in a study should not be viewed as a general recommendation for health care providers to follow, to administer, or to allocate resources. Thus, a recommendation of Tai Chi could be appropriate if the goal is to maintain physical capacity, while other approaches may be more potent for patients with RA.

This study's 16-week SDT-based physical activity programme showed that the intervention group improved more in psychosocial aspects than the control group, specifically regarding the HRQoL and physical indicators. This finding is consistent with a previous RCT that investigated the effects of maximal strength training in patients with inflammatory rheumatic diseases (Haglo et al., 2022), showing that the intervention significantly improved the participants' physical

TABLE 4 Between-group effects of the programme using analysis of covariance.

Variables	Baseline Mean (*SD*)	Week 8 Mean (*SD*)	Week 8 Adjusted mean (*SE*)	Week 8 *F* (*p*)	Week 8 Partial eta^2	Week 16 Mean (*SD*)	Week 16 Adjusted mean (*SE*)	Week 16 *F* (*p*)	Week 16 Partial eta^2
Perceived therapeutic efficacy of physical activity									
Intervention group	57.48 (22.90)	73.94 (23.96)	70.84 (3.78)	39.02 (<.001)	.40	78.58 (22.01)	75.42 (3.38)	84.49 (<.001)	.59
Control group	44.77 (21.61)	33.68 (22.31)	36.78 (3.78)			27.52 (2.67)	30.68 (3.38)		
Grip strength (kg)									
Intervention group	12.93 (4.74)	16.73 (5.38)	18.51 (0.68)	8.18 (.006)	.12	18.56 (4.69)	20.17 (0.62)	23.41 (<.001)	.28
Control group	17.58 (3.18)	17.35 (3.74)	15.57 (0.68)			17.21 (3.72)	15.60 (0.62)		
Walking speed (s)									
Intervention group	6.79 (1.49)	5.67 (1.37)	5.31 (0.17)	32.28 (<.001)	.35	5.66 (1.20)	5.39 (0.18)	23.24 (<.001)	.28
Control group	5.72 (0.91)	6.37 (1.06)	6.74 (0.17)			6.37 (1.06)	6.65 (0.18)		
Disease activity score-erythrocyte sedimentation rate									
Intervention group	3.91 (1.18)	3.17 (1.01)	2.93 (0.13)	19.21 (<.001)	.25	2.83 (1.00)	2.65 (0.17)	42.21 (<.001)	.42
Control group	3.28 (1.06)	3.49 (1.19)	3.73 (0.13)			4.10 (1.29)	4.19 (0.17)		
Health-related quality of life									
Intervention group	0.70 (0.15)	0.77 (0.12)	0.78 (0.02)	0.86 (.359)	.01	0.80 (0.12)	0.82 (0.02)	8.93 (.004)	.13
Control group	0.77 (0.10)	0.77 (0.11)	0.76 (0.02)			0.76 (0.10)	0.74 (0.02)		

Note: Baseline = before intervention; Week 8 = week 8 of completion of hospital-based intervention; Week 16 = week 16 of completion of home-based intervention; *p* values of analysis of covariance are after controlling for the baseline score of each outcome variable.
Abbreviations: SD, standard deviation; SE, standard error.

functioning as well as HRQoL. Perceived change in the quality of life is an important factor in maintaining the physical activity of a health intervention (Salemonsen et al., 2018); thus, future physical activity intervention studies must incorporate methods for improving psychosocial factors as well as promoting physical activity in individuals with RA.

Primarily, the process of behavioural change based on the SDT's autonomy-supportive strategies led by nurses for 16 weeks increased the levels of health care providers' autonomy support and basic psychological need satisfaction of the study participants, which could have motivated the participants to continue to practice physical activity at home after the hospital-based intervention. The finding is consistent with a recent study that demonstrated that an SDT-based intervention comprising autonomy-supportive strategies for physical activity predicted more exceptional autonomous reasons for physical activity in RA patients. Increased autonomous motivation is linked to increased engagement in physical activity in RA patients (Fenton et al., 2021). Moreover, support for autonomy leads to continued exercise behavioural changes in the long term (Ha & Yang, 2019).

This study is noteworthy as it involves a 16-week SDT-based physical activity programme designed in stages and tailored for postmenopausal women with RA. This intervention programme serves as an important basis for preventing RA exacerbation and complications among postmenopausal women by raising awareness regarding the dangers of osteosarcopenia and the importance of maintaining over 150 min/week of physical activity for patients with RA. Maintaining a certain level of physical activity is particularly critical for patients with RA during a public health crisis, such as the COVID-19 pandemic. Health care providers must support patients in maintaining the same level of physical activity outside of clinical practice by utilizing telehealth or mobile technologies (Haglo et al., 2021; Thomsen et al., 2019). Currently, clinicians mainly focus on administering medications when treating patients with RA (Simons et al., 2022). However, based on our findings, interventions focusing on implementing regular physical activity can be one of the most important strategies in nursing practice.

5.1 | Strengths and limitations

This study had a few limitations. First, physical activity data were collected through self-reported questionnaires; thus, self-report bias may have affected the results. Therefore, future studies should consider objectively measuring physical activity using activity trackers or accelerometers. Second, the study did not measure the exact amount of voluntary exercise, which may have affected the results. Consequently, future research should measure voluntary exercise using a wearable device such as a smartwatch to identify more objective effects of the programme. Third, a pilot test to check the fidelity of the developed programme should have been conducted before the intervention. Fourth, although statistically controlling for the baseline score, the confounding effects in a COVID-19 pandemic could have impacted the outcomes because of the study's multicomponent intervention and the diversity of the participants' characteristics (i.e., comorbidity, use of hormone replacement, status of cognitive function, confidence or competency level, or fidelity of delivery of physical activity), which could not be adjusted in this study. Fifth, the intensive attention to the intervention group compared with the control group, who received only usual care, could influence the subjective outcomes (e.g., HRQoL). Sixth, one of the inclusion criteria was that participants needed to have received a bone density scan within the last year. Although the two groups showed no differences at the time of the bone density scan, future research should consider having all participants complete a baseline bone density scan to control for time differences between groups. Seventh, the intervention developed in this study was a combined programme of hospital-based (supervised) and home-based (unsupervised) physical activity sessions, and we could not compare possible differences in results between hospital-based vs. home-based sessions. Eighth, we specifically chose Tai Chi exercise for the participants' physical activity programme; however, Mosti et al. (2013) conducted maximal strength training with postmenopausal women and found this could be implemented with patients with reduced bone mass. Thus, future studies should compare the different types, modes, and intensities of exercise for postmenopausal women with RA to suggest optimal exercise programmes for this population to help guide health care providers in making evidence-based exercise recommendations. Lastly, although we analysed the data after the intervention by adjusting for the baseline score of each outcome variable as a covariate, the marked baseline difference between the intervention group and control group in central outcome measures represents a challenge that deserves further scrutiny. Thus, failures in randomisation to produce similar groups should be considered when interpreting the current results.

Despite these limitations, our findings may serve as evidence for developing theory-based, nurse-led, physical activity programmes for people with diverse chronic illnesses and for expanding the scope of its application in nursing. Furthermore, repeated studies should be conducted to expand the target population with RA to various settings of communities and institutions and to confirm the nurse-led programme's long-term effects. Moreover, studies should examine the frequency, intensity, and duration of exercise and various influencing factors such as lifestyle behaviours, including dietary habits.

6 | CONCLUSION

This study provides evidence regarding the beneficial effects of the SDT-based physical activity programme, particularly regarding the importance of preventing physical activity decline among postmenopausal women with RA. The intervention programme promoted physical activity during a time of exceptional circumstances that challenged daily physical activity due to the COVID-19 pandemic through nurses' support for autonomy, which enhanced motivation and helped participants maintain changes in health behaviours. Our findings also demonstrate that the SDT-based physical activity programme can effectively incorporate physical activity into the lives of postmenopausal women with RA, improving their health outcomes and HRQoL. Furthermore, the findings demonstrate the usefulness of SDT, which may be used to implement other evidence-based nursing interventions. Nurses can apply a Tai Chi-based physical activity intervention using theory-based psychosocial interactive strategies for postmenopausal women with RA at risk of osteosarcopenia.

AUTHORSHIP STATEMENT

All authors listed meet the authorship criteria according to the latest guidelines of the International Committee of Medical Journal Editors and are in agreement with the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interests.

DATA AVAILABILITY STATEMENT

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to further analyses.

CLINICAL TRIAL REGISTRATION NO. (WHO)

The study was registered in CRIS.nih.go.kr (KCT0004683) at https://cris.nih.go.kr/cris/search/detailSearch.do/15416 on January 31, 2020.

INSTITUTIONAL REVIEW BOARD STATEMENT

This study was conducted in compliance with the principles of the Declaration of Helsinki. The Medical Ethics Committee of Ajou University Hospital Institutional Review Board approved the study protocol (IRB No. AJIRB-MED-SUR-19-441). All patients agreed to participate in this study and provided written informed consent.

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REFERENCES

Abbasi-Shavazi, M., Baghianimoghadam, M., Rezaeipandari, H., Chaleshgar, M., & Morowatisharifabad, M. A. (2017). Predictors of using respiratory protection masks among workers of sanitary ware companies in Yazd, Iran, based on the theory of planned behavior. *Journal of Mazandaran University of Medical Sciences*, *27*(151), 180–192.

Agostini, D., Zeppa Donati, S., Lucertini, F., Annibalini, G., Gervasi, M., Ferri Marini, C., Piccoli, G., Stocchi, V., Barbieri, E., & Sestili, P. (2018). Muscle and bone health in postmenopausal women: Role of protein and vitamin D supplementation combined with exercise training. *Nutrients*, *10*(8), 1103. https://doi.org/10.3390/nu10081103

Aletaha, D., & Smolen, J. S. (2018). Diagnosis and management of rheumatoid arthritis: A review. *Jama*, *320*(13), 1360–1372. https://doi.org/10.1001/jama.2018.13103

Arthritis Foundation. (2020a). Arthritis by the numbers. https://www.arthritis.org/getmedia/73a9f02d-7f91-4084-91c3-0ed0b11c5814/abtn-2020-final.pdf

Arthritis Foundation. (2020b). Tai Chi for arthritis. www.arthritis.org/health-wellness/healthy-living/physical-activity/yoga/tai-chi-for-arthritis

Borg, G. (1998). *Borg's perceived exertion and pain scales*. Human Kinetics.

Bremander, A., Malm, K., Andersson, M. L., & the BARFOT Study Group. (2020). Physical activity in established rheumatoid arthritis and variables associated with maintenance of physical activity over a seven-year period—A longitudinal observational study. *BMC Rheumatology*, *4*(1), 53. https://doi.org/10.1186/s41927-020-00151-6

Bruyère, O., Beaudart, C., Ethgen, O., Reginster, J. Y., & Locquet, M. (2019). The health economics burden of sarcopenia: A systematic review. *Maturitas*, *119*, 61–69. https://doi.org/10.1016/j.maturitas.2018.11.003

Buttgereit, F., Da Silva, J. A. P., Boers, M., Burmester, G.-R., Cutolo, M., Jacobs, J., Kirwan, J., Köhler, L., van Riel, P., Vischer, T., & Bijlsma, J. W. J. (2002). Standardised nomenclature for glucocorticoid dosages and glucocorticoid treatment regimens: Current questions and tentative answers in rheumatology. *Annals of the Rheumatic Diseases*, *61*(8), 718–722. https://doi.org/10.1136/ard.61.8.718

Centers for Disease Control and Prevention. (2022). Physical activity for arthritis. https://www.cdc.gov/arthritis/basics/physical-activity/index.html

Chen, L.-K., Woo, J., Assantachai, P., Auyeung, T.-W., Chou, M.-Y., Iijima, K., Jang, H. C., Kang, L., Kim, M., Kim, S., Kojima, T., Kuzuya, M., Lee, J. S. W., Lee, S. Y., Lee, W.-J., Lee, Y., Liang, C.-K., Lim, J.-Y., Lim, W. S., … Arai, H. (2020). Asian Working Group for sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. *Journal of the American Medical Directors Association*, *21*(3), 300–307.e2. https://doi.org/10.1016/j.jamda.2019.12.012

Choi, Y., Yang, S. J., & Song, H. Y. (2018). Effects of the variables related to the health action process approach model on physical activity: A systematic literature review and meta-analysis. *Journal of Korean Academy of Community Health Nursing*, *29*(3), 359–370. https://doi.org/10.12799/jkachn.2018.29.3.359

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry*, *11*(4), 227–268. https://doi.org/10.1207/S15327965PLI1104_01

Dunbar-Jacob, J., Burke, L., Schlenk, E. A., & Sereika, S. (2006). The perceived therapeutic efficacy scale. Paper presented at the 17th International Nursing Research Congress Focusing on Evidence-Based Practice, Montreal, Canada. https://stti.confex.com/stti/congrs06/techprogram/paper_30291.htm

England, B. R., Tiong, B. K., Bergman, M. J., Curtis, J. R., Kazi, S., Mikuls, T. R., O'Dell, J. R., Ranganath, V. K., Limanni, A., Suter, L. G., & Michaud, K. (2019). 2019 update of the American College of Rheumatology recommended rheumatoid arthritis disease activity measures. *Arthritis Care & Research*, *71*(12), 1540–1555. https://doi.org/10.1002/acr.24042

Erdfelder, E., Faul, F., & Buchner, A. (1996). GPOWER: A general power analysis program. *Behavior Research Methods, Instruments, & Computers*, *28*(1), 1–11. https://doi.org/10.3758/BF03203630

Fenton, S. A. M., Veldhuijzen van Zanten, J. J., Metsios, G. S., Rouse, P. C., Yu, C. A., Ntoumanis, N., Kitas, G. D., & Duda, J. L. (2021). Testing a self-determination theory-based process model of physical activity behavior change in rheumatoid arthritis: Results of a randomized controlled trial. *Translational Behavioral Medicine*, *11*(2), 369–380. https://doi.org/10.1093/tbm/ibaa022

Garber, C. E., Blissmer, B., Deschenes, M. R., Franklin, B. A., Lamonte, M. J., Lee, I. M., Nieman, D. C., & Swain, D. P. (2011). American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: Guidance for prescribing exercise. *Medicine and Science in Sports and Exercise*, *43*(7), 1334–1359. https://doi.org/10.1249/MSS.0b013e318213fefb

Ha, Y. M., & Yang, S. K. (2019). The influence of worker's exercise self-efficacy, self-determination, exercise behavior on wellness: Focusing large-scale workplace workers. *Journal of Digital Convergence*, *17*(2), 207–216. https://doi.org/10.14400/JDC.2019.17.2.207

Haglo, H., Berg, O. K., Hoff, J., Helgerud, J., & Wang, E. (2022). Maximal strength training in patients with inflammatory rheumatic disease: Implications for physical function and quality of life. *European Journal of Applied Physiology*, *122*(7), 1671–1681. https://doi.org/10.1007/s00421-022-04948-w

Haglo, H., Wang, E., Berg, O. K., Hoff, J., & Helgerud, J. (2021). Smartphone-assisted high-intensity interval training in inflammatory rheumatic disease patients: Randomized controlled trial. *JMIR mHealth and uHealth*, *9*(10), e28124. https://doi.org/10.2196/28124

Hailey, V., Fisher, A., Hamer, M., & Fancourt, D. (2022). Perceived social support and sustained physical activity during the COVID-19 pandemic. *International Journal of Behavioral Medicine*, 1–12. Advance online publication. https://doi.org/10.1007/s12529-022-10125-2

Hamad, B., Basaran, S., & Coskun Benlidayi, I. (2020). Osteosarcopenia among postmenopausal women and handgrip strength as a practical method for predicting the risk. *Aging Clinical and Experimental Research*, *32*(10), 1923–1930. https://doi.org/10.1007/s40520-019-01399-w

Han, S., & Shin, H. (2010). Validation of the Korean version of the counseling climate questionnaire. *Korea Journal of Counseling*, *11*(4), 1729–1752. https://doi.org/10.15703/kjc.11.4.201012.1729

Hashem, L. E., Roffey, D. M., Alfasi, A. M., Papineau, G. D., Wai, D. C., Phan, P., Kingwell, S. P., & Wai, E. K. (2018). Exploration of the inter-relationships between obesity, physical inactivity, inflammation, and low back pain. *Spine*, *43*(17), 1218–1224. https://doi.org/10.1097/BRS.0000000000002582

Hirono, T., Kunugi, S., Yoshimura, A., Ueda, S., Goto, R., Akatsu, H., & Watanabe, K. (2023). Effects of home-based bodyweight squat training on neuromuscular properties in community-dwelling older adults. *Aging Clinical and Experimental Research*, *35*(5), 1043–1053. https://doi.org/10.1007/s40520-023-02370-6

Hu, H., Xu, A., Gao, C., Wang, Z., & Wu, X. (2021). The effect of physical exercise on rheumatoid arthritis: An overview of systematic reviews and meta-analysis. *Journal of Advanced Nursing*, *77*(2), 506–522. https://doi.org/10.1111/jan.14574

Hunter, T. M., Boytsov, N. N., Zhang, X., Schroeder, K., Michaud, K., & Araujo, A. B. (2017). Prevalence of rheumatoid arthritis in the United States adult population in healthcare claims databases, 2004–2014. *Rheumatology International*, *37*(9), 1551–1557. https://doi.org/10.1007/s00296-017-3726-1

International Osteoporosis Foundation. (2020). Osteoporosis diagnosis. https://www.osteoporosis.foundation/health-professionals/diagnosis

Kamiya, M., Ihira, H., Taniguchi, Y., Matsumoto, D., Ishigaki, T., Okamae, A., Ogawa, T., Misu, S., Miyashita, T., Ohnuma, T., Chibana, T., Morikawa, N., Ikezoe, T., & Makizako, H. (2023). Low-intensity resistance training to improve knee extension strength in community-dwelling older adults: Systematic review and meta-analysis of randomized controlled studies. *Experimental Gerontology*, *172*, 112041. https://doi.org/10.1016/j.exger.2022.112041

Katz, P., Andonian, B. J., & Huffman, K. M. (2020). Benefits and promotion of physical activity in rheumatoid arthritis. *Current Opinion in Rheumatology*, *32*(3), 307–314. https://doi.org/10.1097/BOR.0000000000000696

Kim, H. Y., & Sung, Y. K. (2021). Epidemiology of rheumatoid arthritis in Korea. *Journal of Rheumatic Diseases*, *28*(2), 60–67. https://doi.org/10.4078/jrd.2021.28.2.60

Kim, M., Kim, C. J., Kim, D. J., & Schlenk, E. A. (2022). Psychometric properties of the Korean version of the Perceived Therapeutic Efficacy Scale for Physical Activity in adults with type 2 diabetes. *The Science of Diabetes Self-Management and Care*, *48*(1), 11–22. https://doi.org/10.1177/26350106211058645

Kim, S., Kim, M., & Won, C. W. (2018). Validation of the Korean version of the SARC-F questionnaire to assess sarcopenia: Korean frailty and aging cohort study. *Journal of the American Medical Directors Association*, *19*(1), 40–45.e1. https://doi.org/10.1016/j.jamda.2017.07.006

Kim, S. H., Jo, M. W., Ahn, J., Shin, S., Ock, M., Park, J., & Luo, N. (2014). The valuation of EQ-5D-5L health states in Korea. *Value in Health*, *17*(7), A753. https://doi.org/10.1016/j.jval.2014.08.211

Lee, M., & Kim, A. (2008). Development and construct validation of the basic psychological needs scale for Korean adolescents: Based on the self-determination theory. *Korean Journal of Social and Personality Psychology*, *22*(4), 157–174. https://doi.org/10.21193/kjspp.2008.22.4.010

Letarouilly, J. G., Flipo, R. M., Cortet, B., Tournadre, A., & Paccou, J. (2021). Body composition in patients with rheumatoid arthritis: A narrative literature review. *Therapeutic Advances in Musculoskeletal Disease*, *13*, 1759720X211015006. https://doi.org/10.1177/1759720X211015006

Liu, F., & Wang, S. (2017). Effect of Tai Chi on bone mineral density in postmenopausal women: A systematic review and meta-analysis of randomized control trials. *Journal of the Chinese Medical Association*, *80*(12), 790–795. https://doi.org/10.1016/j.jcma.2016.06.010

Malmstrom, T. K., & Morley, J. E. (2013). SARC-F: A simple questionnaire to rapidly diagnose sarcopenia. *Journal of the American Medical Directors Association*, *14*(8), 531–532. https://doi.org/10.1016/j.jamda.2013.05.018

Mollard, E., Pedro, S., Chakravarty, E., Clowse, M., Schumacher, R., & Michaud, K. (2018). The impact of menopause on functional status in women with rheumatoid arthritis. *Rheumatology*, *57*(5), 798–802. https://doi.org/10.1093/rheumatology/kex526

Mosti, M. P., Kaehler, N., Stunes, A. K., Hoff, J., & Syversen, U. (2013). Maximal strength training in postmenopausal women with osteoporosis or osteopenia. *Journal of Strength and Conditioning Research*, *27*(10), 2879–2886. https://doi.org/10.1519/JSC.0b013e318280d4e2

Nosaka, K., Fox-Harding, C., & Nosaka, K. (2022). Impact of COVID-19 lockdown on physical activity behaviours of older adults who participated in a community-based exercise program prior to the lockdown. *PLOS Global Public Health*, *2*(11), e0001217. https://doi.org/10.1371/journal.pgph.0001217

O'Bryan, S. J., Giuliano, C., Woessner, M. N., Vogrin, S., Smith, C., Duque, G., & Levinger, I. (2022). Progressive resistance training for concomitant increases in muscle strength and bone mineral density in older adults: A systematic review and meta-analysis. *Sports Medicine*, *52*(8), 1939–1960. https://doi.org/10.1007/s40279-022-01675-2

Oh, J. Y., Yang, Y. J., Kim, B. S., & Kang, J. H. (2007). Validity and reliability of the Korean version of international physical activity questionnaire (IPAQ) short form. *Journal of the Korean Academy of Family Medicine*, *28*(7), 532–541.

Osthoff, A. K. R., Juhl, C. B., Knittle, K., Dagfinrud, H., Hurkmans, E., Braun, J., Schoones, J., Vliet Vlie, T. P. M., & Niedermann, K. (2018). Effects of exercise and physical activity promotion: Meta-analysis informing the 2018 EULAR recommendations for physical activity in people with rheumatoid arthritis, spondyloarthritis and hip/knee osteoarthritis. *RMD Open*, *4*(2), e000713. https://doi.org/10.1136/rmdopen-2018-000713

Paolino, S., Hysa, E., Stoian, S. A., Gotelli, E., Casabella, A., Clini, P. V., Pacini, G., Pizzorni, C., Sulli, A., Nikiphorou, E., Smith, V., & Cutolo, M. (2021). Metabolic profile and bone status in post-menopausal women with rheumatoid arthritis: A monocentric retrospective survey. *Nutrients*, *13*(9), 3168. https://doi.org/10.3390/nu13093168

Prevoo, M. L., van't Hof, M. A., Kuper, H. H., van Leeuwen, M. A., van de Putte, L. B., & van Riel, P. L. (1995). Modified disease activity scores that include twenty-eight-joint counts: Development and validation in a prospective longitudinal study of patients with rheumatoid arthritis. *Arthritis and Rheumatism*, *38*(1), 44–48. https://doi.org/10.1002/art.1780380107

Qi, M., Moyle, W., Jones, C., & Weeks, B. (2020). Tai Chi combined with resistance training for adults aged 50 years and older: A systematic review. *Journal of Geriatric Physical Therapy*, *43*(1), 32–41. https://doi.org/10.1519/JPT.0000000000000218

Ryan, R. M., Patrick, H., Deci, E. L., & Williams, G. C. (2008). Facilitating health behavior change and its maintenance: Interventions based on self-determination theory. *European Psychologist*, *10*, 2–5.

Salemonsen, E., Hansen, B. S., Førland, G., & Holm, A. L. (2018). Healthy Life Centre participants' perceptions of living with overweight or obesity and seeking help for a perceived "wrong" lifestyle—A qualitative interview study. *BMC Obesity*, *5*, 42. https://doi.org/10.1186/s40608-018-0218-0

Simons, G., Caplan, J., DiSantostefano, R. L., Veldwijk, J., Englbrecht, M., Bywall, K. S., Kihlbom, U., Raza, K., & Falahee, M. (2022). Systematic review of quantitative preference studies of treatments for rheumatoid arthritis among patients and at-risk populations. *Arthritis Research & Therapy*, *24*(1), 55. https://doi.org/10.1186/s13075-021-02707-4

Son, J. T., & Hwang, H. Y. (2018). Comparison of subjective symptoms, physical fitness, depression, and self-efficacy before and after Tai Chi in patients with rheumatoid arthritis: Based on 3 years' data. *Journal of Muscle and Joint Health*, *25*(3), 230–239. https://doi.org/10.5953/JMJH.2018.25.3.230

Steib, S., Schoene, D., & Pfeifer, K. (2010). Dose-response relationship of resistance training in older adults: A meta-analysis. *Medicine and Science in Sports and Exercise*, *42*(5), 902–914. https://doi.org/10.1249/MSS.0b013e3181c34465

Stockwell, S., Trott, M., Tully, M., Shin, J., Barnett, Y., Butler, L., McDermott, D., Schuch, F., & Smith, L. (2021). Changes in physical activity and sedentary behaviours from before to during the COVID-19 pandemic lockdown: A systematic review. *BMJ Open Sport & Exercise Medicine*, *7*(1), e000960. https://doi.org/10.1136/bmjsem-2020-000960

Thomsen, T., Esbensen, B. A., Hetland, M. L., & Aadahl, M. (2019). Motivational counseling and text message reminders: For reduction of daily sitting time and promotion of everyday physical activity in people with rheumatoid arthritis. *Rheumatic Diseases Clinics of North America*, *45*(2), 231–244. https://doi.org/10.1016/j.rdc.2019.01.005

Wehner, C., Blank, C., Arvandi, M., Wehner, C., & Schobersberger, W. (2021). Effect of Tai Chi on muscle strength, physical endurance, postural balance and flexibility: A systematic review and meta-analysis. *BMJ Open Sport & Exercise Medicine*, *7*(1), e000817. https://doi.org/10.1136/bmjsem-2020-000817

Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*, *70*(1), 115–126. https://doi.org/10.1037//0022-3514.70.1.115

Zou, L., Wang, C., Chen, K., Shu, Y., Chen, X., Luo, L., & Zhao, X. (2017). The effect of Taichi practice on attenuating bone mineral density loss: A systematic review and meta-analysis of randomized controlled trials. *International Journal of Environmental Research and Public Health*, *14*(9), 1000. https://doi.org/10.3390/ijerph14091000

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