Original Article

Nordic Walking as an Exercise Intervention to Reduce Pain in Women With Aromatase Inhibitor–Associated Arthralgia: A Feasibility Study

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Abstract

Context. Women taking aromatase inhibitors as treatment for breast cancer commonly experience joint pain and stiffness (aromatase inhibitor–associated arthralgia [AIAA]), which can cause problems with adherence. There is evidence that exercise might be helpful, and Nordic walking could reduce joint pain compared to normal walking.

Objectives. To determine the feasibility of a trial of Nordic walking as an exercise intervention for women with AIAA.

Methods. A feasibility study was carried out in a sample of women with AIAA using a randomized control design. Women were randomized to exercise (six-week supervised group Nordic walking training once per week with an increasing independent element, followed by six weeks 4 × 30 minutes/week independent Nordic walking); or enhanced usual care. Data were collected on recruitment, retention, exercise adherence, safety, and acceptability. The Brief Pain Inventory, GP Physical Activity Questionnaire, and biopsychosocial measures were completed at baseline, six and 12 weeks.

Results. Forty of 159 eligible women were recruited and attrition was 10%. There was no increased lymphedema and no long-term or serious injury. Adherence was >90% for weekly supervised group Nordic walking, and during independent Nordic walking, >80% women managed one to two Nordic walking sessions per week. From baseline to study end point, overall activity levels increased and pain reduced in both the intervention and control groups.

Conclusion. Our findings indicate that women with AIAA are prepared to take up Nordic walking, complete a six-week supervised course and maintain increased activity levels over a 12-week period with no adverse effects. J Pain Symptom Manage 2016;■:■–■. © *2016 Published by Elsevier Inc. on behalf of American Academy of Hospice and Palliative Medicine.*

Key Words

Feasibility trial, breast cancer, exercise, Nordic walking, joint pain, aromatase inhibitor–associated arthralgia

Introduction

Aromatase inhibitors (AIs) are now the gold standard endocrine therapy[1] for postmenopausal women with hormone-sensitive breast cancer. Evidence from cross-sectional studies[2–4] indicates that approximately 50% of women experience arthralgia as a side effect. The clinical significance of this symptom is that in addition to affecting quality of life,[5] it can affect adherence, with up to 20% of women stopping AIs early, primarily due to this side effect.[6,7] As longer duration of hormone therapy is associated with lower recurrence rates,[8] early discontinuation has the potential to affect disease recurrence and survival.

Exercise improves pain in musculoskeletal conditions including osteoarthritis and rheumatoid arthritis.[9–12] Consequently, it is reasonable to propose that interventions that prove helpful for these conditions also may be effective for women with aromatase inhibitor–associated arthralgia (AIAA). This is

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particularly important as there is evidence that breast cancer survivors may reduce activity levels as a consequence of this symptom.[13] Current national recommendations on exercise from the World Health Organization are that individuals should try to engage in at least 150 minutes of moderate intensity exercise per week[14]; levels also deemed suitable for people with cancer[15] and arthritis.[16] However, the optimal type, frequency, and duration of exercise for women with AIAA are unknown.

Nordic walking (walking with the addition of handheld poles to engage the upper body) is becoming increasingly popular in breast cancer survivors. There is some evidence it might provide additional benefits over normal walking by reducing joint loading[17,18] and increasing aerobic endurance[19,20] and muscular strength.[21] Furthermore, a handful of studies in breast cancer populations have concluded that Nordic walking can improve shoulder function[21,22] and does not increase the risk of lymphedema.[21,23] A literature search of major relevant databases (MEDLINE, PsycINFO, SportDiscus, and CINAHL) from 1960 to 2012 revealed no prior research testing Nordic walking in women with AIAA, and thus, it was concluded that it would be useful and important to conduct a preliminary study to test the study design and whether an intervention could be delivered as intended.[24]

The purpose of this study was to test the feasibility of a Nordic walking trial in women with AIAA. Objectives included determining rates of recruitment, retention, and exercise adherence, safety; participant acceptability, and to observe for effect on outcomes, including pain, physical activity levels, and biopsychosocial outcomes considered to be mediating variables in pain perception.

Methods

Study Design and Participants

The study design was a feasibility, randomized, controlled trial. Women on endocrine therapy and reporting joint symptoms at routine follow-up over the preceding 12 months (as indicated by a symptom checklist used by the clinical team) were sent information pertaining to the study by their clinician. This included an invitation to take part and consent to share data with the research team. Exclusion criteria included those with metastatic disease, those already undertaking Nordic walking (as part of an ongoing weight management program), and those unable to exercise due to mobility issues. Women accepting the invitation attended a baseline visit when further information was provided. Eligibility was rechecked to include the ongoing presence of joint pain and safety to exercise determined by the completion of a Physical Activity Readiness Questionnaire (PARQ). The PARQ is a seven-item questionnaire used to screen for the presence of health factors that may preclude safe exercise. Written informed consent was taken at this point. Women were randomized by an independent data manager using a random permuted blocks method, with a block size of 20 to ensure an even distribution of group size. The study protocol was reviewed and approved by the local research ethics committee (LREC no: 11/SC/0268).

Nordic Walking Intervention

The 12-week Nordic walking intervention included a supervised and an independent component. This was to test an intervention that could be used independently over the longer term. During Weeks 1−6, supervised group training was provided, comprising one hour of Nordic walking per week with a trained instructor experienced in Nordic walking training for women with breast cancer and used for all sessions to maximize consistency. Sessions were carried out outside, in two local parks during spring/summer, with good transport access. Participants were asked to provide transport but were given Nordic walking poles (Leki Supreme^{TM}) which they kept after study completion. A choice of two session times (afternoon or evening) was offered. The hour included 30-minutes Nordic walking, plus 10-minutes warm up and 10-minutes cool down, and was standardized for each of two groups of 10 participants. The first four sessions included instruction on the correct use and technique of poles, with a consolidation period during subsequent sessions, so that by Week 6, participants were competent. Within this first stage, participants were instructed to increase the number of independent Nordic walking sessions per week, by adding a second 30-minute session in Weeks 3−4 and a third in Weeks 5−6. In Weeks 7−12, participants were asked to complete 4 × 30 minute sessions of independent Nordic walking per week for a period of six weeks. Participants were instructed to exercise at a level of intensity equaling an endurance effect on the Borg scale of perceived exertion.[25] This is a widely tested 15-point scale ranging from 6 to 20, which can be used as a proxy measure to estimate heart rate and level of exertion, with Levels 11 to 13 equaling moderate aerobic activity and maximal therapeutic effect.[26]

Participants were contacted by phone every two weeks by the researcher to monitor attendance and safety, including questions on pain, lymphedema, and other injury and to provide support and encouragement. They received a booklet on physical activity after cancer highlighting the benefits of exercise for health and well-being and were asked to complete the Macmillan exercise diary. This is a 12-week diary which enables users to record exercise in terms of

frequency, type, duration, and intensity on a daily basis and encourages the setting of exercise goals over a 12-week period.[27]

Enhanced Usual Care

Participants in the control group received enhanced usual care, in that they did not receive the intervention nor were the benefits of exercise discussed face to face, but were contacted every two weeks to check for any new onset of pain, injury, or lymphedema. Similarly to the intervention group, they received the booklet on physical activity after cancer and completed all measures including the Macmillan exercise diary. After the completion of the study, they were offered the chance to participate in a Nordic walking training program.

Data Collection: Feasibility

Feasibility data were collected on recruitment, attrition, and adherence rates, safety, and suitability of trial methods (Table 1). Acceptability was also assessed by an intervention evaluation (questionnaire survey).

Changes in physical activity levels were assessed by the GP Physical Activity Questionnaire.[28] This questionnaire asks individuals to report on current weekly physical activity levels by duration (hours per week split into none, less than an hour, 1–3 hours or 3 hours or more) and type of exercise: walking, vigorous, cycling. For the purpose of this study, Nordic walking was classified as vigorous activity rather than walking. Exercise adherence was measured throughout the study by the collection of data on frequency and duration of any moderate intensity physical activity over 30-minutes duration using the Macmillan Physical Activity Diary.

Primary Outcome Measure

AI associated arthralgia (AIAA) was assessed using the Brief Pain Inventory–Short Form worst pain single item,[29] with higher scores indicating more pain. This 11-point scale, which measures self-report of pain intensity and interference, has been widely used in populations with cancer and is also validated in studies evaluating the impact of osteoarthritis.[30] The scale consists of five pain intensity items (including worst pain), and six pain interference items, both of which can be used to create aggregate scores. There are currently no validated measures for AIAA, and this

Table 1
Feasibility Outcomes

Outcome	How Measured
Recruitment	
% taking an AI screened for joint pain	Estimation of no. of pts at trial center on AI
% taking AI with joint pain	Checklist for Patients on Hormone Therapy questionnaire (CPET): no. with pain divided by total on AI
% screened fulfilling eligibility criteria	CPET total divided by those eligible
% invited to study who accepted	No. eligible divided by no. accepting invite
Attrition and adherence	
Attrition rates at all points along study process (randomization, allocation, intervention-training, and independent exercise	Researcher datasheets Nordic walking instructor contact sheets Two weekly phone contact with participants
Adherence to weekly supervised Nordic walking	Nordic walking instructor contact sheets
Adherence rate to Nordic walking frequency and duration	Self-report in exercise diaries Average frequency and duration of Nordic walking per week was calculated, as well as what frequency was feasible for the majority (>75%)
Frequency of exercise other than Nordic walking	Average exercise frequency per week (self-report in exercise diary)
Safety	
Injury prevalence	Self-report to instructor
Injury type/outcome	Research team via two weekly phone contact physiotherapy assessment notes
Lymphedema	Incidence of new lymphedema Arm volumes of those with preexisting lymphedema preintervention and postintervention as assessed by the lymphedema nurse
Acceptability	
Acceptability of the type, duration, frequency, location, and intensity of exercise.	A retrospective evaluation (questionnaire survey) administered at the end of the exercise intervention.
Subjective perception of benefit/harm of exercise.	This consisted of likert style questions with an additional free text section
Suitability of research process and methods	
The suitability of waiting list control group	Measurement of exercise frequency in control group
Sensitivity to change in measures	Change in outcomes over time, percentage with maximum/minimum scores
Questionnaire burden	% completed and number of individual item omissions

AI = aromatase inhibitor.

questionnaire has been used to measure self-report of pain in the majority of studies researching AIAA.[2,5,31,32]

Secondary Outcome Measures

Depression was measured by the Center for Epidemiological Studies Depression scale. This is a 20-item self-report measure developed to screen for depressive symptoms and has excellent reliability and validity in cancer patient samples.[33,34] Higher scores indicate worse mood. Self-efficacy for managing pain was measured using the Pain Self-Efficacy Questionnaire (PSEQ),[35] with higher scores indicating better self-efficacy. This 10-item questionnaire assesses confidence in performing activities while in pain and has excellent reliability and validity in chronic pain populations.[36] Quality of life was measured using the Medical Outcomes Short Form−36 (SF-36).[37] This is a multidimensional questionnaire with 36 items divided into eight subscales that assess perceptions of overall health status. Again, higher scores indicate better quality of life. It is frequently recommended as the generic core in disease-specific batteries of health-related quality of life, including cancer populations.[38,39]

Design

Data were collected at three time points: two weeks before the start of the intervention (baseline; T0), Week 6 (T1; end of group supervised Nordic walking) and at Week 12 (T2, end of independent Nordic walking). Feasibility data were collected throughout the trial, and the intervention evaluation was administered at the end of the trial period.

Analysis

Data handling and analyses were performed using SPSS version 20 (SPSS Inc., Chicago, IL). Descriptive statistics were used to summarize baseline demographic details. Feasibility data were analyzed using descriptive statistics. The sample was small and not powered to detect statistical significance. However, to look for evidence of impact on the outcome of pain and biopsychosocial outcomes, trends in effect were described for the two follow-up time points (T1 and T2). As data were not normally distributed, medians and interquartile ranges were used to describe measures of central tendency and dispersion.

Results

Recruitment

A total of 512 women on hormone therapy attending breast cancer follow-up clinics over a 12-month period were assessed for the presence of arthralgia. Of those, 377 (74%) were on an AI and of those, 60% ($n = 227/377$) reported joint pain/stiffness. Thirty percent ($n = 68/227$) did not fulfill inclusion criteria, 14% ($n = 32$) because they had stopped their AI by the time of recruitment. Other reasons included mobility issues or already Nordic walking (Fig. 1). Consequently, 159 eligible women were invited to participate. Forty (25%) agreed, and after a final screen to ensure they were still experiencing joint pain, were randomized (Fig. 1). Those declining participation gave reasons including lack of interest, being too busy, other health problems, and unwillingness to travel. No women who agreed to the study failed the PARQ, possibly as those unfit to exercise had already declined to take part.

Baseline Demographics

The sample consisted exclusively of Caucasian women. The mean age of participants was 63 years, and on average they were 36 months from diagnosis, had been on endocrine therapy for 27 months, and been experiencing arthralgia for 22 months. All had received surgery for breast cancer, 75% had radiotherapy and 50% received chemotherapy (Table 2).

Attrition

Attrition was 10% overall ($n = 4/40$), with all dropouts in the Nordic walking intervention group. Two participants dropped out before the intervention started, one due to work commitments and one due to sudden bereavement. Two further participants dropped out after the six-week supervised Nordic walking, due to longstanding musculoskeletal problems not related to AIAA (sciatica and hip bursitis). There were no dropouts in the control group.

Exercise Adherence

There was 90% adherence to the once-weekly group supervised Nordic walking sessions (97 of 108 training slots). The median number of supervised sessions attended per participant was five (of six; range = 4−6). For unsupervised self-managed Nordic walking, only 8% of participants managed four prescribed sessions per week, the median was two, and between one and two sessions was attained by the majority (68%−85%) (Table 3). However, when all aerobic activity was included, participants in the intervention group managed an average of four sessions a week, and three sessions were attained by most (81.5%) (Table 3).

Change in Physical Activity

Increases in physical activity were recorded from T0 to T2 with 39% (7/18) in the intervention group reporting an increase in vigorous activity (this included Nordic walking) and no change in walking activity, and 45% (9/20) in the control group increasing

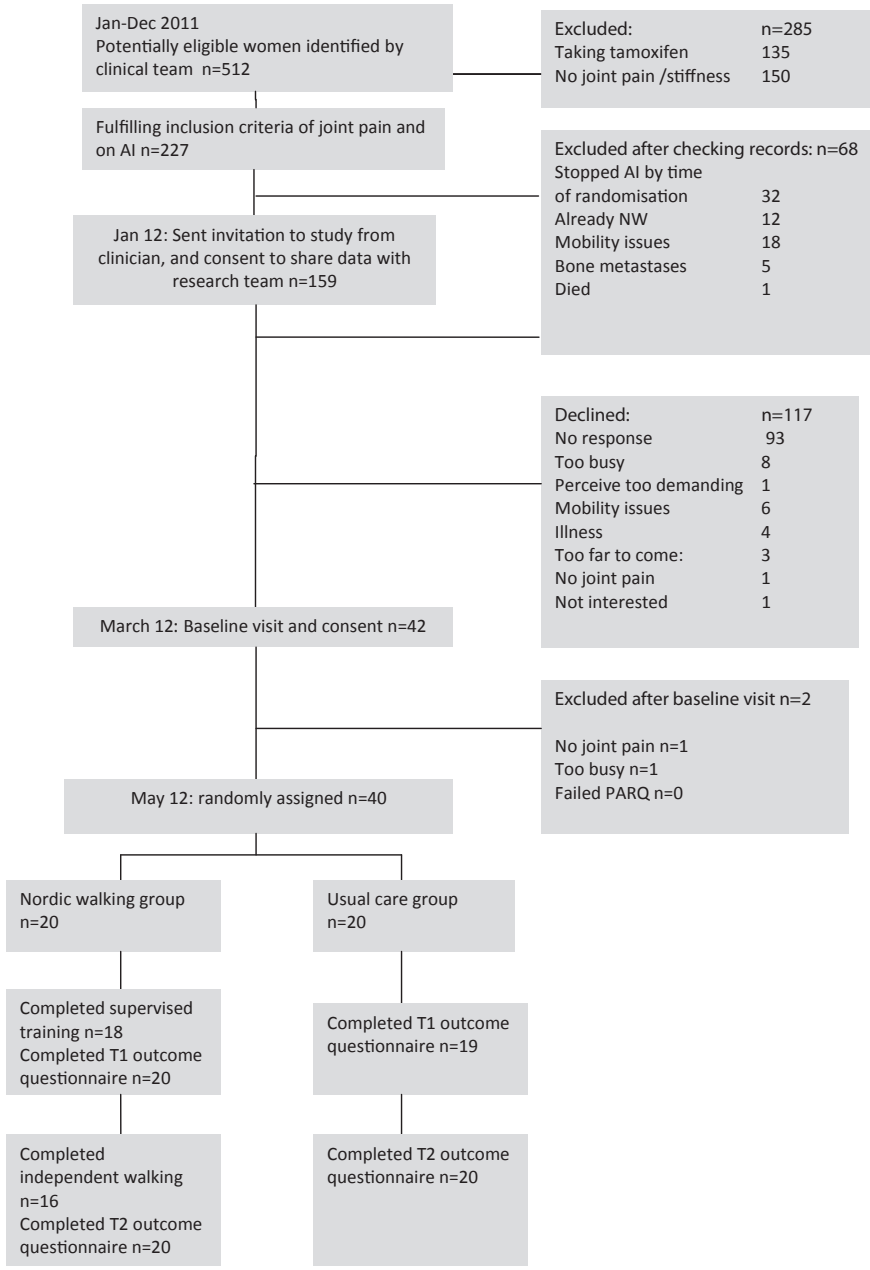

Fig. 1. Flow of participants through study. PARQ = Physical Activity Readiness Questionnaire.

walking activity and 15% (3/20) increasing vigorous activity (Table 4).

Safety

Thirty percent (6/20) of participants in the intervention group reported pain during the study; in four, this predated the intervention. Pain resolved with physiotherapy in all but one, who was found to have new metastatic disease and was referred back to the oncologist for further treatment. No participants reported new lymphedema during the study. Fifteen percent ($n = 3$) of participants in the intervention group had preexisting arm lymphedema, and a pre-post intervention assessment by the lymphedema service concluded lymphedema had improved in all three.

Intervention Evaluation

Seventy-eight percent of participants (31/40) completed an evaluation about taking part in the study. All respondents (100%) enjoyed taking part. In free text comments, having supervised training was mentioned as helpful and motivating, and being in a group was seen as a positive component of the intervention: "being in company … gave a feeling of well-being." Most participants reported that the training sessions and overall length of the program was about right, as was the physical effort required

Table 2
Baseline Data: Demographic and Medical Details

Variable	Nordic Walking Intervention, Mean (SD)	Control, Mean (SD)	Total Sample, Mean (SD)
Age (yrs) at 1.5.12	60 (8)	66 (7)	63 (8)
Time since diagnosis (months)	35 (19)	38 (17)	36 (18)
Time since last menstrual period (yrs)	11 (8)	15.00 (7)	13.00 (7)
Duration current hormone therapy (months)	23 (13)	30 (16)	27 (15)
Duration of arthralgia (months)	21 (13)	24 (15)	22 (14)
Living distance from hospital (miles)	7 (7)	9 (8)	8 (8)
	n	*n*	*n* (%)
Marital status			
Married	14	12	26 (65)
Single/Divorced/Widow	6	8	14 (35)
Living arrangements			
Alone	5	5	10 (25)
With husband/partner	14	14	28 (70)
Other	1	1	2 (5)
Education			
Primary/Secondary	7	10	17 (42.5)
School	6	8	14 (35)
College/Diploma	6	1	7 (17.5)
University/Degree	1	1	2 (5)
Occupational status			
Working	13	5	18 (45)
Not working	7	15	22 (55)
Religious affiliation			
Christian	11	13	24 (60)
Other	9	7	16 (40)
Ethnic origin			
Caucasian	20	20	40 (100)
Other	0	0	0 (0)
Past treatment			
Surgery	20	20	40 (100)
Chemotherapy	13	7	20 (50)
Hormone therapy	20	20	40 (100)
Radiotherapy	15	15	30 (75)
Chemotherapy type			
Fluorouracil, Epirubicin, Cyclophosphamide (FEC)	5	5	10 (25)
Fluorouracil, Epirubicin Cyclophosphamide, Taxotere (FEC-T)	7	1	8 (20)
No chemotherapy	7	13	20 (50)
Missing	1	1	2 (5)
Current hormone treatment			
Tamoxifen	0	0	0 (0)
Anastrozole	10	11	21 (52.5)
Letrozole	7	6	13 (32.5)
Exemestane	3	3	6 (15)
Previous hormone treatment			
Tamoxifen	4	6	10 (25)
Anastrozole	0	0	0 (0)
Letrozole	3	0	3 (7.5)
Exemestane	1	0	1 (2.5)
None (first line tx)	12	14	26 (65)
Previous musculoskeletal disease			
OA (osteoarthritis)	3	5	8 (20)
RA (Rheumatoid arthritis)	0	0	0 (0)
Fibromyalgia	0	0	0 (0)
Other	2	2	4 (10)
None	15	13	28 (70)

(87%). It was also commented that group Nordic walking enabled participants to go at their own pace. Most respondents (87%) found there was no problem with the venues offered; 45% felt that four sessions of independent walking per week was too much to fit in with existing commitments. Despite this, the majority (81%) reported that it was likely that they would continue to exercise three to four times per week. Seventy-eight percent said they would continue with Nordic walking and another exercise type. The most commonly preferred type of future exercise was walking (32%, $n = 10$).

Effect of the Intervention

This was a feasibility study and not powered to detect statistical significance. However, there was a

Table 3
Frequency of Nordic Walking and Total Aerobic Exercise Sessions Per Week During Period of Independent Nordic Walking

Week Number	7	8	9	10	11	12	Median
Number of completed diaries (out of 20)	14	14	14	14	13	13	14
Nordic walking sessions per week achieved: median (range)	2 (0–5)	2 (0–5)	2 (0–4)	2 (0–5)	2 (0–3)	3 (0–4)	2
Minimum number of Nordic walking sessions achieved/week	Number of participants attaining (cumulative %)						
4	1 (7)	2 (14)	1 (7)	2 (14)	1 (8)	1 (8)	8%
3	3 (21)	5 (36)	5 (36)	6 (46)	3 (23)	7 (54)	36%
2	10 (71)	11 (79)	10 (71)	9 (64)	8 (62)	8 (62)	68%
1	2 (84)	1 (86)	3 (93)	4 (93)	2 (77)	2 (73)	85%
Total aerobic sessions per week achieved: median (range)	3 (1–9)	5 (2–9)	4 (1–9)	4 (2–10)	4 (1–9)	4 (1–11)	4
Minimum number of total aerobic sessions achieved/week	Number of participants attaining (cumulative %)						
4	6 (43)	9 (64)	6 (43)	9 (64)	8 (62)	8 (57)	59.5%
3	9 (64)	12 (86)	13 (93)	12 (86)	10 (77)	9 (69)	81.5%
2	13 (93)	13 (93)	14 (100)	14 (100)	11 (85)	12 (92)	93%

trend for improvement in pain and other biopsychosocial outcomes in both groups from baseline (T0) to the end of the intervention (T2). In the intervention group, there was a clinically significant, 30% relative reduction (5–3.5) in the primary outcome measure, worst pain, from baseline to T1, which was maintained by the end of the intervention (T2). There was a 50% relative reduction in the control group (5–2.5) from T0 to T2 (Table 5), again clinically significant. There also was an overall trend for improvement in depression, self-efficacy, and quality of life in both groups (Tables 6–8). For depression, the biggest effect was seen in the intervention group at T1 after supervised Nordic walking in both the Center for Epidemiological Studies Depression and SF-36 mental health subscale. Self-efficacy improved in both groups from T0 to T2, with the biggest improvement in the control group. Quality of life improved from T0 to T2 in the intervention group in all subscales of the SF-36. Improvement was also seen in the control group, except for the physical functioning and general health perception subscales, where scores decreased from T0 to T2.

Suitability of Outcome Measures

Responsiveness was demonstrated in all outcome measures, except for the PSEQ in which 25% of participants achieved a maximum score indicating a ceiling effect. Over 95% of outcome questionnaires were returned at each time point, although exercise diary return rate was lower at 77.5%. Individual item completion in the measures was over 90% except for the GP Physical Activity Questionnaire (84% at T2).

Discussion

Women on AIs as treatment for breast cancer were willing to take part in a randomized, controlled, feasibility trial of Nordic walking, and were highly adherent

Table 4
Change in Physical Activity Frequency at T0, T1, and T2 as Measured by GPPAQ

			n (%)				
Type of Exercise	Group Assignment	Time Point	None	<1 hour	1–3 hours	>3 hours	Missing
Vigorous exercise	Intervention	Baseline	16 (80)	3 (15)	1 (5)	0	0
		T1 (six weeks)	9 (45)	2 (10)	5 (25)	0	4 (20)
		T2 (12 weeks)	7 (35)	3 (15)	4 (20)	4 (20)	2 (10)
		Change	−9	0	+3	+4	
	Control	Baseline	12 (60)	2 (10)	4 (20)	2 (10)	0
		T1 (six weeks)	5 (25)	1 (5)	9 (45)	3 (15)	2 (10)
		T2 (12 weeks)	8 (40)	1	5 (25)	4 (20)	2 (10)
		Change	−4	−1	+1	+2	
Walking	Intervention	Baseline	0	2 (10)	6 (30)	12 (60)	0
		T1 (six weeks)	0	1 (5)	4 (20)	14 (70)	1 (5)
		T2 (12 weeks)	0	1 (5)	9 (35)	9 (45)	1 (5)
		Change	0	−1	+3	−3	
	Control	Baseline	0	4 (20)	11 (55)	4 (20)	0
		T1 (six weeks)	0	1 (5)	6 (30)	10 (50)	3 (15)
		T2 (12 weeks)	0	2 (10)	4 (20)	13 (65)	1 (5)
		Change	0	−2	−7	+9	

GPPAQ = GP Physical Activity Questionnaire.

Table 5
Comparison of Pain Scores Across Time Points (T0 = baseline; T1 = Six Weeks; T2 = 12 Weeks)

	Intervention				Control			
Outcome Measure	T0	T1	T2	Change, T0 − T2	T0	T1	T2	Change, T0 − T2
BPI-SF worst pain (0−10), median (IQR)	5.0 (3−6)	3.5 (2−5.8)	3.5 (2−5)	−1.5	5.0 (4−6)	3.0 (0.8−5.5)	2.5 (0−4.3)	−2.5
BPI-SF pain severity composite (0−10), median (IQR)	3.0 (2.3−3.9)	2.6 (1.2−4.3)	2.3 (1.3−3.8)	−0.7	3.0	2.4 (0.8−4.1)	1.4 (0.4−4.0)	−1.6
BPI-SF pain interference composite (0−10), median (IQR)	2.4 (0.3−4.0)	1.6 (0.6−3.3)	1.4 (0.5−3.0)	−1.0	2.0	0.9 (0.1−3.0)	0.6 (0.0−3.6)	−1.4
Pain (SF-36 subscale), median (IQR)	56 (44−67)	67 (44−67)	67 (56−89)	11	56 (44−67)	61 (44−78)	67 (44−78)	11

BPI-SF = Brief Pain Inventory−Short Form; IQR = interquartile range; SF-36 = Short Form−36.
BPI: lower scores indicate less pain; SF-36 pain subscale: higher scores indicate less pain.

to the intervention while supervised. They were able to sustain increased activity levels over a 12-week period with a reduction in pain, no increases in lymphedema, and a low risk of injury. These findings, which demonstrate feasibility, are discussed in the following, along with recommendations to improve the design and methods used in a future study.

The recruitment strategy was successful, as the 25% recruitment rate was comparable to other U.K.-based exercise studies for women with breast cancer.[40,41] This suggests that it would be possible to recruit to a full trial of Nordic walking in this population. However, as 40 women were recruited from a single site, a fully powered trial would need to be multicenter. Recruitment via follow-up clinics did not identify all women taking an AI. More effective strategies such as dedicating specific resource to recruiting in all clinics, or using a cancer registry to identify women on AIs may increase recruitment.[42,43] Women declining participation gave reasons similar to those reported in other studies.[40,42,44] Providing more clarity about the intervention might have increased uptake and could be given during a follow-up phone call to nonresponders one to two weeks after sending the study invitation. This method has been found effective in previous exercise studies.[42,43] To reduce dropouts due to AI discontinuation, it would be recommended that randomization occur as soon as enough participants were recruited for two smaller groups.

Nordic walking appeared to be a well-tolerated, safe exercise with low risk of injury and improvements in those with preexisting lymphedema, findings consistent with previous research.[21,23,45−47] Therefore it is reasonable to conclude it would be safe to conduct a larger study in this population, although in view of the small sample size it is recommended that safety data should be collected. Further research examining the benefits of Nordic walking in women with lymphedema is recommended.

Attrition (20%) was comparable to other U.K.-based breast cancer exercise studies.[40,41] There was an indication from the evaluation that group sessions were more acceptable than independent Nordic walking. In support of this, adherence was greater and most of the effect was seen in the first six weeks when Nordic walking was supervised. This is consistent with previous findings that supervised exercise can increase adherence in both cancer and musculoskeletal populations.[48,49] Nevertheless, during the independent component, participants maintained one to two sessions of Nordic walking per week and four sessions of exercise in total per week; and as reductions in pain were maintained, four sessions of Nordic walking specifically may not be necessary to achieve a reduction in pain. In addition, normal walking was evaluated as the participants' preferred form of activity, which has been previously found to be the exercise of choice for female cancer survivors.[50−52] This, together with the finding that

Table 6
Comparison of Depression/Mental Health Scores Across Time Points

	Intervention				Control			
Time Point	T0	T1	T2	Change, T0 − T2	T0	T1	T2	Change, T0 − T2
CES-D total, median (IQR)	17 (13−25)	11 (7−17)	14 (11−20)	−3	16 (14−19)	6 (3−12)	15 (11−18)	−1
SF-36 mental health subscale, median (IQR)	76 (61−83)	83 (69−97)	80 (72−88)	4	82 (65−88)	89 (78−100)	84 (70−86)	2

CES-D = Center for Epidemiological Studies Depression; IQR = interquartile range; SF-36 = Short Form−36.
CES-D: lower scores indicate less depression; SF-36: higher scores indicate improved mood.

Table 7
Comparison of Pain Self-Efficacy Scores Across Time Points

	Intervention				Control			
Time Point	T0	T1	T2	Change, T0 – T2	T0	T1	T2	Change, T0 – T2
PSEQ total (0–60), Median (IQR)	48 (38–52)	50 (44–56)	50 (46–56)	2	46 (38–58)	54 (42–60)	58 (49–60)	12

PSEQ = Pain Self-Efficacy Questionnaire; IQR = interquartile range.
PSEQ: higher score indicates improved self-efficacy.

women in the control group also increased their walking activity, suggests that exercise adherence could be increased by combining supervised group Nordic walking with normal walking. This is supported by the findings of a recent feasibility study in women with AIAA[53] in which the proportion of women walking for the target 150 minutes per week increased significantly from 21% at baseline, to 50% at six weeks, with a small reduction in joint pain and stiffness also observed.[53]

Overall, the outcome measures used were suitable, as they had high completion rates and were responsive. However, the ceiling effect observed with the PSEQ suggests a measure with proven validity in breast cancer populations may be more appropriate. Although the exercise diary return rate was similar to that reported in other studies,[42] options for improving the accuracy of recording activity should be explored; to include pedometers/activity trackers. These may have the added benefit of improving exercise adherence[54] and help to clarify between-group differences in exercise intensity.

Trends indicating an improvement in pain were seen in both the intervention and control groups, making it difficult to attribute cause. Possible explanations include increases in physical activity in both groups, increased attention as a result of being a study participant, or improvement in pain with passage of time. Nevertheless, the 30% relative improvement observed in the intervention group has been demonstrated as clinically meaningful change in a previous meta-analysis of trials of people with persistent pain[55] and warrants further investigation. Furthermore, a recently reported trial conducted in the U.S. has provided further evidence that exercise may help reduce pain in women with AIAA.[56]

Limitations/Recommendations

The exercise contamination observed in the enhanced usual care group could have led to a treatment effect. It is most likely this was due to both groups receiving a booklet on the importance of physical activity, and the Macmillan exercise diary. In view

Table 8
Comparison of Health-Related Quality of Life SF-36 Subscale Scores Across Time Points

	Intervention				Control			
SF-36	T0	T1	T2	Change Score	T0	T1	T2	Change Score
Physical function score, Median (IQR)	63 (43–80)	75 (60–80)	75 (66–84)	12	70 (55–80)	75 (58–88)	65 (53–90)	–5
Social functioning score, Median (IQR)	78 (50–100)	78 (69–84)	83 (69–100)	5	83 (67–100)	82 (74–89)	89 (78–100)	6
Energy vitality score, Median (IQR)	48 (31–60)	55 (45–64)	60 (39–71)	12	58 (36–70)	60 (40–75)	70 (48–78)	12
General health perception, Median (IQR)	53 (36–70)	55 (45–70)	58 (40–78)	5	73 (58–80)	73 (63–85)	70 (55–85)	–3
Change in health, Median (IQR)	50 (25–75)	75 (50–100)	75 (50–100)	25	50 (25–69)	50 (50–75)	50 (50–75)	0
Mental health, Median (IQR)	76 (61–83)	83 (69–97)	80 (72–88)	4	82 (65–88)	89 (78–100)	84 (70–86)	2
Pain, Median (IQR)	56 (44–67)	67 (44–67)	67 (56–89)	11	56 (44–67)	61 (44–78)	67 (44–78)	11
Role limitation emotional, Median (IQR)	233 (100–233)	233 (133–233)	233 (158–233)	0	233 (133–233)	233 (133–233_	233 (133–233)	0
Role limitation physical, Median (IQR)	150 (0–325)	200 (106–325)	225 (125–325)	75	225 (125–325)	275 (100–325)	325 (113–325)	100

SF-36 = Short Form–36; IQR = interquartile range.
SF-36: higher scores indicate improvement.

of the known widespread benefits of physical activity in women with cancer, it would be unethical to withhold these entirely from the control group; however, this effect could be reduced by giving information on exercise to the control group at the end. Furthermore, it would be recommended to record activity with the use of a simple exercise diary rather than one setting exercise goals. Other limitations include the relatively homogeneous sample, which restricts generalizability. However, the average age of participants was similar to other studies investigating women with AIAA, suggesting it was representative. The short follow-up period limits the ability to assess whether the effects seen would be maintained over the longer term. Although reductions in pain were observed, the study was not powered to detect a statistically significant effect, and this would be a recommended objective for a future study. The self-report outcomes used could be subject to bias. Consequently, in view of the high prevalence and quick onset of AIAA, consideration should be given to using AI adherence/discontinuation as a more objective measure and randomizing at the start of treatment. This would allow testing of the feasibility and safety of exercise in women with severe AIAA who may stop treatment early as a result. Data were not collected on women declining to participate in the intervention, but this information could prove useful in a future study.

Conclusions

Evidence-based interventions to manage the side effect of AIAA are urgently needed to help women adhere long term to treatment. This study demonstrated that it is possible to recruit and retain women with AIAA to a Nordic walking exercise intervention, despite arthralgia. Nordic walking was observed to carry a low risk of injury and did not worsen lymphedema. There was high adherence to weekly supervised group Nordic walking, and participants maintained an average of one to two independent Nordic walking sessions per week. Increased physical activity levels were maintained in all participants from baseline to the end of the study, and this, together with the trend for reduction in pain, warrants further investigation of exercise interventions to reduce pain and improve treatment adherence in women with AIAA. As this side effect can be experienced for the duration of treatment, that is, five years, there should be focus on interventions that can be sustained over the longer term.

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