ORIGINAL ARTICLE

Randomised, controlled walking trials in postmenopausal women: the minimum dose to improve aerobic fitness?

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Br J Sports Med 2002;**36**:189–194

Background: The American College of Sports Medicine recommends 20–60 minutes of aerobic exercise three to five days a week at an intensity of 40/50–85% of maximal aerobic power (V_{O_2}MAX) reserve, expending a total of 700–2000 kcal (2.93–8.36 MJ) a week to improve aerobic power and body composition.
Objective: To ascertain the minimum effective dose of exercise.
Methods: Voluntary, healthy, non-obese, sedentary, postmenopausal women (n = 121), 48–63 years of age, were randomised to four low dose walking groups or a control group; 116 subjects completed the study. The exercise groups walked five days a week for 24 weeks with the following intensity (% of V_{O_2}MAX) and energy expenditure (kcal/week): group W1, 55%/1500 kcal; group W2, 45%/1500 kcal; group W3, 55%/1000 kcal; group W4, 45%/1000 kcal. V_{O_2}MAX was measured in a direct maximal treadmill test. Submaximal aerobic fitness was estimated as heart rates at submaximal work levels corresponding to 65% and 75% of the baseline V_{O_2}MAX. The body mass index (BMI) was calculated and percentage of body fat (F%) estimated from skinfolds.
Results: The net change (the differences between changes in each exercise group and the control group) in V_{O_2}MAX was 2.9 ml/min/kg (95% confidence interval (CI) 1.5 to 4.2) in group W1, 2.6 ml/min/kg (95% CI 1.3 to 4.0) in group W2, 2.4 ml/min/kg (95% CI 0.9 to 3.8) in group W3, and 2.2 ml/min/kg (95% CI 0.8 to 3.5) in group W4. The heart rates in standard submaximal work decreased 4 to 8 beats/min in all the groups. There was no change in BMI, but the F% decreased by about 1% unit in all the groups.
Conclusions: Walking (for 24 weeks) at moderate intensity 45% to 55% of V_{O_2}MAX, with a total weekly energy expenditure of 1000–1500 kcal, improves V_{O_2}MAX and body composition of previously sedentary, non-obese, postmenopausal women. This dose of exercise apparently approaches the minimum effective dose.

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Accepted 11 December 2001

The American College of Sports Medicine (ACSM) states that, to gain positive effects on aerobic fitness and body composition, an adult should exercise three to five days a week at an intensity of 40/50–80% of maximum oxygen uptake (V_{O_2}MAX) reserve for 20–60 minutes continuously or accumulate the exercise in several daily bouts of at least 10 minutes duration, so that a total of 700–2000 kcal (2.93–8.36 MJ) are expended weekly.[1] (V_{O_2}MAX reserve is calculated from the difference between resting and maximum V_{O_2} values. To estimate training intensity a percentage of this value is added to the resting V_{O_2} and is expressed as a percentage of V_{O_2}MAX reserve.) Current exercise recommendations are more moderate, and more frequent, but light exercise with intensity below 40% V_{O_2}MAX is not considered effective.[1] Some researchers[2–4] claim that sufficient experimental evidence is lacking to settle the matter because the minimum effective dose varies depending on the initial fitness level, the duration of the exercise session, the length of the exercise programme, and the individual characteristics of the participant. Very few studies have considered exercise programmes at intensities that border on light and moderate,[5–7] and the evidence on the benefits of such exercise is sparse and confusing.[8]

We conducted a randomised, controlled trial to compare the effects of four low dose exercise programmes on the cardiorespiratory fitness and body composition of postmenopausal women. We chose postmenopausal women, because regular exercise may be of specific importance in this group. Mortality from coronary heart disease rises after the menopause.[9] Also this group is rarely included in exercise studies and thus the need for more studies in postmenopausal women is obvious.[1] According to our hypothesis, the exercise groups would show dose-response improvement, and the minimum dose of effective exercise could be found.

METHODS

Design

The study was a randomised, controlled walking trial with walking groups W1, W2, W3, and W4 and control group C. The outcome measures were the changes in V_{O_2}MAX, submaximal cardiorespiratory fitness, and body composition. The study design was approved by the research ethics committee of the UKK Institute for Health Promotion Research. All the subjects gave their written informed consent.

Subjects

The subjects were recruited through an announcement in the local newspaper. Altogether 413 responded, and 121 were selected. Figure 1 shows the recruitment process.

The eligibility criteria were (*a*) female, (*b*) 2–10 years past the onset of menopause at the start of the study, (*c*) 48–63 years of age, (*d*) no chronic diseases, (*e*) no regular medication, (*f*) non-smoker, (*g*) body mass index (BMI) <32 kg/m, (*h*) resting blood pressure <160/100 mm Hg measured in sitting position, (*i*) not engaged in strenuous work or in regular brisk leisure time exercise more than once a week or in light exercise more than three times a week, and (*j*) willing to continue previous diet and physical activity habits in addition to

Abbreviations: V_{O_2}MAX, Maximal aerobic power; BMI, body mass index; HRT, hormone replacement therapy; F%, percentage of body fat

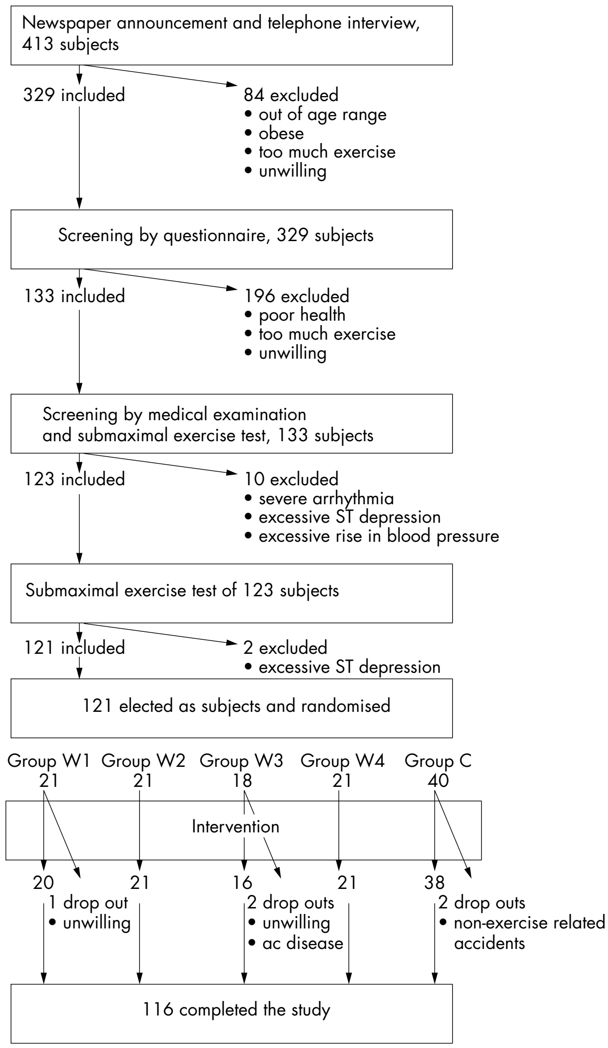

Figure 1 Recruitment and selection of subjects.

the exercise requirements of the study group. Only participants willing to agree to the results of randomisation were accepted in the study.

Randomisation

The 121 subjects were randomly assigned to one of four walking groups or to a control group using computer generated random numbers, and the subjects, as well as the testing personnel, were informed about the group results after the baseline exercise test. To improve the statistical power of the study design in the most economical way, we allocated more people to the control group than to the intervention groups. Users of hormone replacement therapy (HRT) and non-users were randomised separately into the groups so that the number of HRT users and non-users would be approximately equal in each group. There were 21, 21, 18, 21, and 40 subjects in groups W1, W2, W3, W4, and C respectively. Figure 1 shows the randomisation. Table 1 shows the baseline characteristics of the subjects.

Exercise intervention

The exercise programme was planned according to the principles of the exercise recommendation of ACSM.[1] The training intensities were selected from the low range of the recommendation, 55% (groups W1 and W3) or 45% (groups W2 and W4) of the Vo_{2MAX}. The weekly energy expenditure of the exercise was set at 1500 kcal (groups W1 and W2) or 1000 kcal (groups W3 and W4), which were also from the lower end of the recommendation. The subjects in the exercise groups exercised five days a week. A high weekly frequency was chosen to reflect recent recommendations.[1] Twenty four weeks was chosen for the intervention so that the recommended minimum of 15–20 weeks would be exceeded and most of the possible effect would be attained.[1] Walking was considered the commonest and most feasible form of sustainable dynamic aerobic exercise for sedentary subjects[10] and was chosen as the mode of exercise.

The individual target heart rate for the exercise, corresponding to the chosen intensity, was determined for each subject in the baseline exercise test. The target heart rate varied between the subjects, mainly because of the individual differences in maximal heart rate. A heart rate monitor (Polar Edge; Polar Electro, Kempele, Finland) was used to control heart rate during walking. For each subject, the Weir formula,[11] which estimates energy expenditure (kcal/min) from measured oxygen consumption (litres/min), was used to calculate the duration of the daily walking session that would correspond to the chosen weekly energy expenditure. The exercise duration varied between the subjects mainly because of the differences in Vo_{2MAX}, which is related to initial fitness and body mass. Table 2 presents the characteristics of the walking programmes of the exercise groups.

All the participants were asked to maintain their previous diet and daily exercise habits and also refrain from changing their current use or non-use of HRT. The training was to be added to the baseline daily physical activity. Two weekly walking sessions were supervised by an exercise leader on an indoor track. The other three sessions were performed according to the participants' preferences on sidewalks, streets, or forest trails or in parks. As a warm up and for injury prevention, the subjects performed a few minutes of light dynamic exercises at the beginning of each session. Standard flexibility exercises were performed as a cool down after the sessions. Once a month the control group attended a meeting with lectures on different exercise and health topics and a few

Table 1 Baseline characteristics of the subjects

	Group W1	Group W2	Group W3	Group W4	Group C
Number	21	21	18	21	40
Age (years)	57 (3.8)	55 (3.7)	54 (3.5)	55 (4.2)	56 (3.8)
Years since menopause	6 (1.6)	6 (2.4)	5 (2.6)	5 (2.4)	6 (2.4)
Weight (kg)	67.9 (10.4)	68.7 (9.5)	67.5 (10.9)	66.1 (8.5)	70.8 (9.3)
Body mass index (kg/m)	26 (3.2)	26 (3.1)	26 (3.7)	25 (3.3)	27 (3.1)
Fat%	36 (5.5)	37 (4.6)	36 (5.9)	36 (4.8)	38 (3.1)
Vo_{2MAX} (ml/kg/min)	30.3 (5.0)	30.8 (4.2)	29.4 (4.1)	30.2 (4.1)	29.3 (3.6)
PA score	2.4 (0.7)	2.2 (0.5)	2.2 (0.7)	1.9 (0.6)	2.4 (0.6)

Values are mean (SD).
Fat%, percentage of body fat; Vo_{2MAX}, maximal aerobic power; PA score, physical activity score (1–5): 1 = no regular PA, 2 = some light PA every week, 3 = once a week brisk PA, 4 = twice a week brisk PA, 5 = three times a week or more brisk PA.

Table 2 Prescribed exercise programme in groups

	Group W1	Group W2	Group W3	Group W4	Group C
Intensity of walking (% VO_{2MAX})	55	45	55	45	–
Target heart rate of the walking (beats/min)	124 (8.4)	118 (9.1)	124 (7.7)	118 (9.3)	–
Energy expenditure per exercise session (kcal)	300	300	200	200	–
Target exercise duration (min)	54 (5.6)	65 (7.8)	38 (3.9)	46 (6.2)	–
Sessions/week	5	5	5	5	–
Supervised sessions/week	2	2	2	2	–
Length of intervention (weeks)	24	24	24	24	24

Where applicable, values are mean (SD).
VO_{2MAX}, Maximal aerobic power.

minutes of light flexibility exercises. After the intervention, the control group was given detailed instructions on how to start to exercise according the ACSM exercise recommendation.[1] A heart rate monitor was used for the first week of the exercise programme. All the participants were invited to the UKK 2 km walk test after one year of exercise and were instructed to come to the public, yearly walk test events of the UKK institute thereafter.

Measurements

All measurements were performed twice, once before and once after the intervention. A submaximal exercise test was performed before the actual baseline maximal test as a part of the subject screening and also for habituation. A direct, progressive, maximal exercise test on a treadmill (Telineyhtymä Oy, Kotka, Finland) was used to measure VO_{2MAX}. Submaximal responses to the exercise were monitored by heart rate measurements at absolute exercise levels corresponding individually to 65% and 75% of the VO_{2MAX} of the baseline exercise test. The treadmill test protocol[12] consisted of a warm up for five minutes at a speed of 5 km/h on a 5% incline, after which the workload was increased at three minute intervals, from very light to maximal load. The speed was increased by 0.5 km/h during the third, sixth, and ninth stages, and the elevation of the treadmill was increased by 2.5% at each stage, except the third. The electrocardiogram was monitored (Case 12; Marquette Electronics Inc, Milwaukee, Wisconsin, USA) continuously by a doctor. The participants reported their perceived exertion on the Borg scale[13] during each exercise stage.

VO_2 was measured using a metabolic cart (Metabolic Measurement Cart 2900Z; Sensor Medics Corp, Anaheim, California, USA). The device was calibrated before each exercise test. VO_{2MAX} was calculated from one minute collected values.[14] The criteria for reaching VO_{2MAX} were the following: (*a*) best possible effort of the subject as judged by the test supervisor; (*b*) perceived exertion rated at 19–20; (*c*) heart rate >85% of the age predicted maximum; (*d*) no significant rise (<2 ml/min/kg) in VO_2 between the consecutive minute to minute gas analyses; (*e*) respiratory quotient over 1.05. All the subjects had to fulfil the first criterion. The test was repeated within a week if the subject failed to give her best possible effort or if less than three of the other four criteria were not fulfilled.

Body mass (kg) and height (m) were measured in light clothing without shoes. Height was measured to an accuracy of 0.5 cm and body mass to the nearest 0.1 kg. BMI was calculated as body mass (kg) divided by the square of the height (m). Skinfold thicknesses were measured at four sites (the mid-triceps, biceps, subscapularis, and suprailiac muscles) using a Harpenden skinfold caliper (British Indicators Ltd, Luton, Beds, UK). Total body density was estimated from the sum of the skinfolds according to a linear regression equation with age and sex specific coefficients as described by Durnin and Womersley[15] and converted to the percentage of body fat (F%) using an adaptation of Siri's formula[16] for elderly women.[17]

The physical activity of all the subjects—that is, the prescribed exercise and other habitual exercise—was recorded daily in exercise diaries. The participants also wore pedometers (Fitty 3; Kasper & Richter, Utreht, Germany) for three days (Friday to Sunday) in the middle of the intervention period. The diet and exercise habits and the HRT use of all the subjects were checked with a questionnaire at baseline and again at the end of the intervention period. Current dietary intake was also estimated on the basis of three-day (including one weekend day) food diaries at the beginning and end of the study. The subjects were given oral and written instructions on recording their food intake with household measures. The food composition data were calculated with MicroNutrica software (Social Insurance Institution, Helsinki, Finland).

Sample size and statistical analysis

The calculations for adequate sample size were based on the assumption of about 10% (mean (SD) 3 (4) ml/min/kg) change from the baseline VO_{2MAX} in the exercise group when compared with the change in the control group (type 1 error α 0.05). The power of the test was selected as 0.90. The calculations yielded a minimum of 39 subjects for each study group. The actual number of subjects in each group was 18 to 21 at the onset of the study. It was calculated that, if necessary for the sake of statistical significance, groups W1 and W3 and groups W2 and W4 could be combined to form adequate groups for determining the effect of intensity on the results. Groups W1 and W2 and groups W3 and W4 could be combined to determine the effect of energy expenditure. The intention to treat principle was used, and all the subjects were asked to participate in the end measurements, in spite of possible drop out from the exercise programme or change in HRT.

The results are given as mean (SD). An analysis of covariance with the baseline measurements as the covariates was used to analyse the training effects. p values were calculated for differences between the study groups. Training effects were determined as net differences—that is, the differences between the changes in each walking group and the control group) with 95% confidence intervals (CI). A two way analysis of covariance with the exercise groups and the HRT groups as factors was also used to analyse their interaction with the outcome measures.

RESULTS

Compliance

Three of the 81 exercising subjects interrupted the exercise programme. The reasons were psychosocial for two subjects and unwillingness for one. One of these subjects participated, however, in the end measurements and was included in the results in order to fulfil the intention to treat principle.

Five of the 121 subjects did not participate in the end measurements for the following reasons: one was not willing to continue; one had psychosocial problems; two controls had lower limb injuries; one had a recently diagnosed chronic disease. Figure 1 shows the number of subjects completing the study in each group.

Compliance with the exercise programme and the amount of habitual physical activity was similar in all the groups. All

Table 3 Training compliance and habitual physical activity

	Group W1	Group W2	Group W3	Group W4	Group C
Duration of session	95%	90%	98%	98%	–
Walking sessions/week	89%	85%	84%	84%	–
Supervised sessions/week	67%	67%	69%	63%	–
Habitual physical activity (min/day)	16	15	11	11	23
Total walking (km/day)	8.7	8.3	7.0	7.1	–
Length of intervention	97%	98%	99%	99%	121%

Compliance with programme is expressed as a percentage of the completed exercise versus prescribed exercise.
Habitual pysical activity includes walking, cycling, calisthenics, etc but does not include walking training. All variables are calculated from exercise diary recordings, except total walking, which is a pedometric measurement. Pedometric measurements were recorded only in exercise groups and include all physical activity of the day, also walking training.

the subjects worked up gradually to their full exercise programme in the first two weeks. An additional few weeks were allowed with a slightly reduced walking time or intensity for six subjects in group W1, one subject in group W2, one subject in group W3, and three subjects in group W4 . The use of extra 1 kg weights, stair walking, or occasional jogging were allowed for one subject in groups W1, W2, and W3 in the last third of the intervention, in order for them to reach the target heart rate. No other changes in exercise, other than those corresponding to the intervention, were reported in the questionnaire at the end of the intervention. Table 3 presents the details of the subjects' compliance with the exercise programme and also their habitual physical activity.

According to the responses to the questionnaire at the end of the intervention, HRT use remained unchanged. No dietary changes were reported. The mean (SD) daily energy intake of the subjects in the exercise groups, as calculated from the food diary, was 7.5 (1.5) MJ at the beginning and 7.5 (1.4) MJ at the end of the intervention. The respective values for the controls were 7.6 (1.3) MJ and 7.3 (1.4) MJ. No significant quantitative or qualitative changes occurred in the diet of the subjects during the intervention.

Changes in cardiorespiratory fitness

Vo_{2MAX} improved in all the exercise groups. Table 4 shows the mean values before and after the intervention, and the net

Table 4 Main variables before and after the intervention and the net change (95% confidence interval) between the exercise and control groups

	N	Before	After	Net change (95% CI)	p Value
Vo_{2MAX} (ml/kg/min)					
Group W1	20	30.3 (5.1)	31.3 (5.0)	2.9 (1.5 to 4.2)	
Group W2	21	30.8 (4.2)	31.4 (4.4)	2.6 (1.3 to 4.0)	
Group W3	16	29.9 (4.1)	30.4 (4.9)	2.4 (0.9 to 3.8)	
Group W4	21	30.2 (2.8)	30.5 (3.6)	2.2 (0.8 to 3.5)	
Group C	38	29.2 (3.7)	27.5 (3.4)		<0.001
HR at 75% Vo_{2MAX} (beats/min)					
Group W1	20	145 (10)	141 (12)	–7 (–11.1 to –3.1)	
Group W2	21	147 (10)	146 (10)	–4 (–8.3 to –0.5)	
Group W3	16	145 (8)	140 (8)	–8 (–12.5 to –3.9)	
Group W4	21	148 (12)	146 (12)	–5 (–8.6 to –0.7)	
Group C	38	146 (11)	149 (12)		0.001
HR at 65% of Vo_{2MAX} (beats/min)					
Group W1	20	135 (10)	132 (12)	–7 (–10.4 to –2.7)	
Group W2	21	137 (10)	137 (10)	–4 (–7.8 to –0.2)	
Group W3	16	134 (7)	131 (7)	–8 (–11.9 to –3.6)	
Group W4	21	138 (12)	137 (12)	–4 (–8.2 to –0.6)	
Group C	38	136 (11)	140 (11)		0.001
Body mass (kg)					
Group W1	20	67.8 (10.7)	67.0 (10.4)	–0.8 (–1.9 to 0.2)	
Group W2	21	68.7 (9.5)	68.4 (10.0)	–0.4 (–1.4 to 0.7)	
Group W3	16	66.5 (11.1)	66.0 (11.1)	–0.5 (–1.6 to 0.7)	
Group W4	21	66.1 (8.5)	66.2 (9.1)	0.1 (–1.0 to 1.1)	
Group C	38	71.0 (9.3)	71.1 (9.8)		0.528
BMI (kg/m^2)					
Group W1	20	25.7 (3.2)	25.4 (3.1)	–0.2 (–0.7 to 0.1)	
Group W2	21	26.0 (3.1)	25.9 (3.3)	–0.1 (–0.5 to 0.3)	
Group W3	16	25.6 (3.8)	25.4 (3.8)	–0.2 (–0.6 to 0.3)	
Group W4	21	25.4 (3.3)	25.4 (3.5)	0.0 (–0.4 to 0.4)	
Group C	38	26.8 (3.1)	26.8 (3.3)		0.670
Fat%					
Group W1	20	36.2 (5.5)	35.1 (5.5)	–1.2 (–1.9 to –0.4)	
Group W2	21	37.2 (4.6)	36.2 (4.8)	–1.1 (–1.8 to –0.4)	
Group W3	16	35.6 (6.0)	35.1 (6.0)	–0.6 (–1.4 to 0.2)	
Group W4	21	36.0 (4.8)	35.1 (5.3)	–1.0 (–1.7 to –0.2)	
Group C	37	38.3 (3.1)	38.4 (3.3)		0.007

Values are mean (SD). Analysis of covariance is used. Drop outs are excluded.
Vo_{2MAX}, Maximal aerobic power; HR at the 75% or 65% or 55% of Vo_{2MAX}, heart rate at the absolute workload of exercise test corresponding to 75% or 65% of the Vo_{2MAX} of the initial test; BMI, body mass index; Fat%, percentage of body fat.

Table 5 Some randomised, controlled dose-response studies of VO_2MAX and body mass of women

Study	Age group (years)	Length of training (weeks)	Intensity of exercise (% of VO_2MAX)	Net change in VO_2MAX approximately (%)	Net change in body mass approximately (%)
Santiago *et al*[18]	20–40	20			
Jogging			78	31	No change
Walking			62	21	No change
Duncan *et al*[6]	20–40	24			
Walking			83	16	No change
Walking			60	9	No change
Walking			46	4	No change
Ready *et al*[19]	56–67	23			
Walking 5 times/week			60	14	No change
Walking 3 times/week			60	12	No change
Kukkonen-Harjula *et al*[20]	30–55	15			
Walking			65–75	6.8	−1.3
Murphy *et al*[21]	38–50	10			
Walking			63–76	8	−1.3
Jakicic *et al*[22]	35–46	20			
Walking and diet			60	5.6	−7.1
Oja *et al*[5]	20–65	10			
Walking			50	4.5	No change

The formula $\%VO_2MAX = 1.28\%HR-29.12$ was used, where HR is heart rate.[11]
The subjects were normal weight in all studies except that of Jakicic *et al*, in which they were obese.
VO_2MAX, Maximal aerobic power.

changes. The mean net increase in VO_2MAX was 2.2 to 2.9 ml/min/kg (almost 10%) in the exercise groups. In comparison with the controls, the exercise groups showed a 4 to 8 beat/min decrease in the submaximal heart rates at both the measured submaximal exercise levels.

Changes in body composition

Table 4 gives the net changes in body mass, BMI, and F%. Body mass and BMI did not show significant changes, but fat decreased slightly in most of the exercise groups in comparison with the controls. In additional analyses, such as grouping the subjects into two exercise groups according to exercise intensity or exercise energy expenditure, the results were similar. Nor did HRT have any effect on the results.

DISCUSSION

The purpose of our study was to determine the minimum effective dose of exercise for maximal aerobic power and body composition. The net improvement in VO_2MAX in our study was modest, 9.5%, 8.7%, 8.1%, and 7.3% in groups W1 to W4 respectively, partly because the control group developed in a pathogenic way, but the change was statistically significant. We have no explanation for the pathogenic development of the control group other than the fact that being sedentary decreases fitness. With regard to the magnitude of the VO_2MAX improvement, our findings are consistent with other randomised, controlled walking studies of women[5 6 18–22] (table 5). There seems to be a dose-response relation between exercise intensity and the magnitude of VO_2MAX improvement. Our results show a similar trend, although the differences between the results of the groups were small. Our exercise regimen seemed to approach, but not reach, the minimum dose, as even the lowest dose of walking improved maximal aerobic power in our study. A recent, uncontrolled study of 18 premenopausal women showed similar improvements in high exercise intensity and low exercise intensity while energy expenditure was kept constant.[7] Total energy expenditure probably plays an important part in exercise response.

The changes in body mass were not statistically significant, but there was slight improvement in body fat. It is possible that the length of our intervention was too short to detect all the possible change in body composition. Our study apparently approached, but did not reach, the minimum dose of exercise to influence body composition. Our results are in agreement with those of earlier studies of women,[5 6 18–22] with no clear dose-response relation between exercise intensity and changes in body mass or fat. Combining exercise with diet change seems to improve the results.[22] Table 5 summarises the basic elements of these studies. Total energy expenditure during exercise is probably an important factor, but it was not estimated in most of the studies.

Take home message

Sedentary postmenopausal women may benefit from a relatively small dose of exercise. When performed regularly and on most days of the week, aerobic fitness and body composition are improved.

In our study, very few injuries occurred as a result of the training. Consultation with a doctor (T-MA) was strongly recommended at the onset of any health problems. A total of 34 subjects consulted the doctor, and 25 subjects complained of exercise related, mostly mild, lower limb or back problems, yet absence from the exercise programme because of injury was low. There was no difference in the injury rate between the exercise groups. Two subjects had transient, mild cardiac problems. The number of injuries was similar to those of the study of Kukkonen-Harjula *et al*,[20] although the latter study also reported some serious injuries. Duncan *et al*[6] reported no injuries, but their subjects were younger women. Our findings support the observation that walking is a feasible form of exercise for sedentary postmenopausal women and has only a relatively small risk of health problems.

Our study had several strengths. The number of subjects was sufficient for adequate statistical comparisons. The randomised groups were comparable. The exercise dose was carefully controlled with supervision, heart rate monitoring, and exercise diaries. The energy intake was controlled with a food diary. The programme was closely followed by participants and the drop out rate was small. To improve the design further all the exercise sessions could be supervised.

Conclusion

We conclude that 24 weeks of walking at moderate intensity—45–55% of the VO_2MAX with a total weekly energy expenditure of 1000–1500 kcal—improves VO_{2MAX} and body composition in previously sedentary, non-obese or slightly overweight postmenopausal women. The dose of exercise used in this design apparently approaches the minimum effective dose, but even this low dose of regular aerobic training leads to significant training effects.

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Note to readers

Since February 2001, we have included colour pictures of sporting activities on the cover of the *British Journal of Sports Medicine*. We hereby solicit your ideas and contributions for future covers of the *British Journal of Sports Medicine*. Original artwork, photographs, and posters may all be considered. We will credit the photographer and athlete(s)/team on the contents page of the issue.

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