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The impact of a home-based walking programme on falls in older people: the Easy Steps randomised controlled trial

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Abstract

Background: walking is the most popular form of exercise in older people but the impact of walking on falls is unclear. This study investigated the impact of a 48-week walking programme on falls in older people.
Methods: three hundred and eighty-six physically inactive people aged 65+ years living in the community were randomised into an intervention or control group. The intervention group received a self-paced, 48-week walking programme that involved three mailed printed manuals and telephone coaching. Coinciding with the walking programme manual control group participants received health information unrelated to falls. Monthly falls calendars were used to monitor falls (primary outcome) over 48 weeks. Secondary outcomes were self-reported quality of life, falls efficacy, exercise and walking levels. Mobility, leg strength and choice stepping reaction time were measured in a sub-sample ($n = 178$) of participants.
Results: there was no difference in fall rates between the intervention and control groups in the follow-up period (IRR = 0.88, 95% CI: 0.60–1.29). By the end of the study, intervention group participants spent significantly more time exercising in general, and specifically walking for exercise (median 1.69 versus 0.75 h/week, $P < 0.001$).
Conclusion: our finding that a walking programme is ineffective in preventing falls supports previous research and questions the suitability of recommending walking as a fall prevention strategy for older people. Walking, however, increases physical activity levels in previously inactive older people.

Keywords: *accidental falls, older people, physical activity, walking*

Introduction

Injuries resulting from falls are a leading cause of death and hospitalisation in people aged 65 years and over [1]. Falls can also lead to poor quality of life, loss of independence and nursing home admission [2]. Exercise has been identified as an effective way of reducing the risk of falling, especially in community-dwelling older people [3]. Fall prevention guidelines developed in the UK, USA and Australia [4–6] refer to several studies which include a walking component.

The Otago Exercise Program is a home-based exercise programme consisting of balance and strength exercises and walking [7]. The exercise programme used in the study by Rubenstein *et al.* [8] also consisted of strength and balance training together with endurance training including treadmill and indoor walking. Another study that effectively reduced falls in older people used an exercise intervention that included Tai Chi, dance steps, weight transference, using resistance bands and fast walking [9]. Freiberger et al. [10] used two similar interventions in their study; both interventions included strength, balance and motor coordination training, however one intervention also included walking. All of these studies showed that interventions that include a walking component are associated with reduced falls. However, as these studies had walking as one component of a multi-component exercise intervention, it is difficult to evaluate the effectiveness of walking alone on falls.

There are other studies that suggest walking is not an effective intervention to prevent falls in older people. One randomised controlled trial found that a brisk-walking intervention increased the risk of falls compared with a no-exercise control group in a sample of post-menopausal women, [11] and two other studies found that walking had no significant effects on falls in older people [12, 13]. A meta-analysis of 54 trials of exercise-based interventions found that greater falls prevention effects were seen in studies that did not include a walking component in the intervention [14].

Walking is a physical activity widely accepted by older people that has many health benefits [15, 16]. In one survey, walking was identified by around 90% of older people as an effective way of preventing falls [17]. However, the effect of walking on the risk of falling in older people remains inconclusive. This study investigated the impact of a 48-week, progressive walking programme on falls in inactive, community-dwelling people aged 65 years and over.

Methods

This study began in August 2009 and was completed in October 2012. The study design was a parallel-group, randomised controlled trial with a 1:1 allocation ratio and a waiting list control. Participants were recruited between August 2009 and October 2011 (see Figure 1). A detailed description of the study methods has been published elsewhere [18].

The Sydney South West Area Health Service Ethics Review Committee (RPAH Zone) gave approval for this study, and informed consent was obtained from all participants prior to their participation. The study is registered with the Australian New Zealand Clinical Trials Registry (ACTRN12610000380099).

Participants and recruitment

Participants were recruited from community-dwelling people aged 65 years and over from the greater Sydney region, Australia. Recruitment methods included paid advertisements and editorials in community newspapers, personal and professional referrals and sampling from the Australian electoral roll.

To be eligible for participation in the study, people had to be: inactive (i.e. <120 min of exercise per week); mobile (i.e. able to walk at least 50 m with minimal aid); and, able to communicate in English. People were excluded if they: had a medical condition precluding participation in the study (e.g. dementia, Parkinson's disease, stroke, debilitating arthritis, severe vision impairment); or, were participating in another research study [18].

We estimated a sample size of 232 per group ($N = 464$) was required to detect a relative reduction in falls of 35% (RR = 0.65) over 48 weeks. This calculation was based on fall reduction rates from previous exercise-based fall prevention trials, a fall rate of 33%, a significance level of 0.05 and 80% power [3]. A sub-sample of 178 participants, based on detecting an absolute difference of 10% in choice step reaction time (CSRT), also received physical performance assessments.

Randomisation and blinding

After baseline assessments (questionnaire) were completed participants were randomised into either the intervention group or control group by a research assistant using sequentially numbered sealed opaque envelopes. The randomisation scheme used randomised permuted blocks of size six and four prepared by the chief investigator (A.V.). The randomisation scheme was kept by the chief investigator and personally handed to a research assistant as participants were randomised. The chief investigator had no contact with participants and was not involved with gathering any data. Neither research assistants nor participants were blinded to group allocation.

Outcome measures

Falls

Falls were defined as an unexpected event in which the participant came to rest on the ground, floor or lower level [19]. Falls were monitored for 48 weeks through monthly calendars. When participants reported a fall, they were contacted by telephone to confirm the fall and document any fall-related injuries.

General health status (questionnaire)

Research assistants administered the study questionnaire at the beginning and end of the trial. The questionnaire gathered demographic information and used validated questionnaires to gather information on quality of life, falls efficacy and levels of physical activity. Quality of life was assessed using the Australian Quality of Life questionnaire (AQoL) Mark 2, an earlier version of which has been shown to be a sensitive and valid measure of health-related quality of life in community-dwelling older people [20, 21]. Falls efficacy was measured using the Falls Efficacy Scale-International (FES-I), a 16-item questionnaire with excellent reliability and construct validity [22]. Average weekly exercise walking levels over the previous 3 months were assessed using the Incidental and Planned Exercise Questionnaire (IPEQ), specifically designed for older people with good reliability and validity [23].

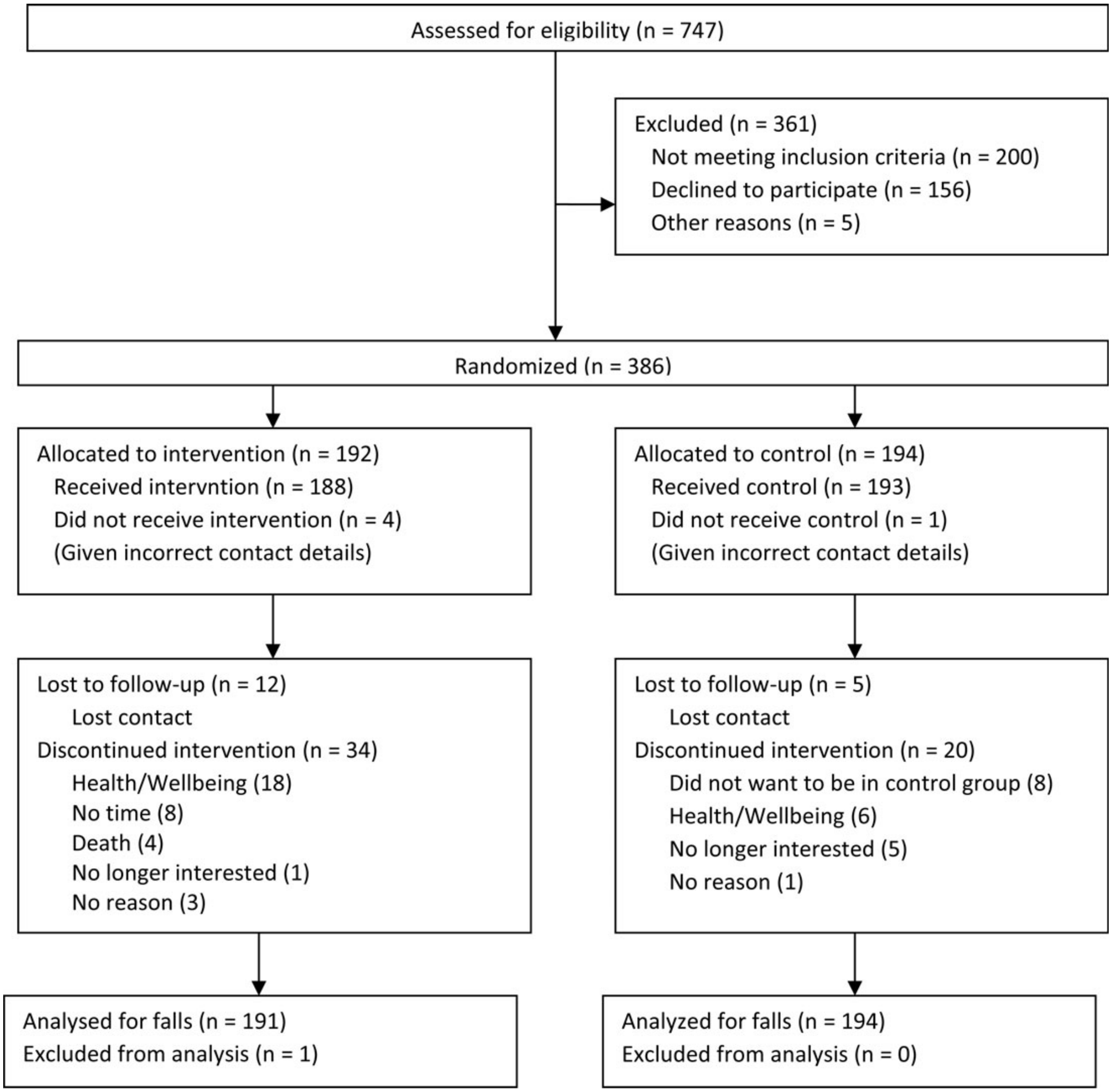

Figure 1. Flowchart of participant recruitment.

Physical performance assessment

Participants who were living within a 50 km radius of the study centre were asked to undergo additional tests to assess their physical performance ability at four time points through the trial; baseline, 12, 24 and 48 weeks. (Only data from baseline and 48 weeks are considered for this paper.) The physical performance assessments were selected because they have been identified as important fall risk factors [24]. Maximal isometric knee extension strength in the dominant leg was assessed in a seated position using a portable electronic dynamometer (Brand: CE. Model: OCS-2) [24]. CSRT involved participants making quick and accurate steps in response to visual stimuli. This assessment has been shown to have good reliability and external validity with respect to fall prediction [25]. Mobility was assessed using the short physical performance battery (SPPB), a standardised measure of lower extremity physical performance with good reliability and validity [26].

Intervention and control activities

The 48-week intervention comprised a walking programme designed for inactive, community-dwelling older people. The programme involved self-paced, progressive walking that could be undertaken at participants' preferred times and locations. The walking programme was designed to gradually build a walking routine from an inactive starting level. It was guided by five constructs derived from social cognitive theory: knowledge, behavioural skills, goal-directed behaviour, outcome expectations and reinforcement [27].

The walking programme was split into three stages focusing on frequency and duration of walks (12 weeks duration), walking intensity (12 weeks) and finally maintaining the level of walking achieved in the previous stages (24 weeks). The walking programme was delivered through three programme manuals mailed out at the beginning of each stage (Weeks 1, 13 and 25). In addition participants received telephone coaching at the beginning of and approximately half-way through each stage, with extra calls in the first stage, to help modify and support adherence to their programme.

Participants in the control group were mailed information about health issues (nutrition, sleeping habits and mental health) at the same time the intervention group received their walking manuals. Control group participants were contacted via telephone at the same points in the study as intervention group participants to discuss the health information sent. At the end of the study control group participants were sent the walking programme materials.

Statistical analysis

All data were analysed using Stata IC version 12.1 according to intention to treat principles. Fall outcomes were compared over the 48-week follow-up period across the two groups using incidence rate ratios from negative binomial regression models. Analysis for faller–non-faller and non-multiple–multiple faller comparisons were under taken with the relative risk statistic. Additional *post hoc* analyses on fall data were also conducted on sub-groups defined as: participants aged 65–74 years and those aged 75+ years. Secondary outcome variables with categorical data were analysed using chi-squared analysis. Continuous physical performance scores were compared by forced entry multiple linear regression analysis, with baseline scores and experimental group included as independent variables in the models. Finally, a Cohen's D score was used to evaluate the impact of the walking programme by using responses to the exercise walking component of the IPEQ. This score indicates the standardised effect size between two means and was calculated using the STATA *COHEND* macro [28].

Results

Baseline comparisons and participant retention

Three hundred and eighty-six participants were enrolled in the study; 192 intervention participants and 194 controls. One of the participants randomised to the intervention group provided no falls data at all and was therefore excluded from all analyses. The average age of study participants was 73.2 years (range: 65–90) and most participants were female (74%, $n = 285$). The groups were balanced across demographic, socioeconomic and outcome measure variables (Supplementary data, Table S1 available in *Age and Ageing* online) [29, 30].

Study participants were comparable to the broader New South Wales (NSW) population aged 65 years and over on most demographic and socioeconomic variables (Supplementary data, Table S1 available in *Age and Ageing* online). However, the study sample had a greater proportion of females, and a greater proportion of participants who had completed post-secondary level education compared with the NSW state average for this age group. The study sample also had a greater proportion of participants who were in paid employment, relatively fewer receiving a pension and a higher percentage reporting fewer hours of exercise per week compared NSW reference population (please see Supplementary data, Table S1 in Appendix 1 available in *Age and Ageing* online) [29, 30].

Seventy-one participants (18.4%) withdrew from the study (46 intervention and 25 control participants) (Figure 1). Participants who withdrew were more likely to be female, born in Australia, with a lower level of education, and less likely to have had a fall in the past year compared with participants who completed the study. All participants, even those that withdrew, contributed at least partial falls data.

Altogether 178 participants (91 Intervention; 87 Control) undertook the home visit physical performance assessments. Two participants from the home visit sub-sample were lost to follow-up and 27 (intervention 20, control 7) discontinued the intervention.

Falls

Analyses for faller versus non-faller and non-multiple versus multiple faller comparisons included participants ($n = 339$; control $n = 180$, intervention $n = 159$) who completed 24+ weeks of falls follow-up. Analysis of fall rates included data from all except one intervention group participant who provided no falls data ($n = 385$).

There was no significant difference in fall rates between the two groups (Table 1) (IRR = 0.88, 95% CI: 0.60–1.29; $P = 0.52$), as well as no significant differences in the proportion of fallers or recurrent fallers between the groups (Table 1). The *post hoc* sub-group analysis indicated that the intervention showed trends for contrasting effects for those aged 65–74 years (IRR = 0.70; 95% CI: 0.43–1.12, $P = 0.14$), and those aged 75 year and over (IRR = 1.19; 95% CI: 0.61–2.33, $P = 0.61$) but no significant interaction effect was evident ($P = 0.19$). There were also no significant differences between the two age groups in the impact of the intervention on the proportion of fallers or multiple fallers (please see Supplementary data, Table S2 in Appendix 2 available in *Age and Ageing* online).

Secondary outcomes

Altogether, 313 participants (169 control and 144 intervention) completed the follow-up assessments and 147 participants (79 control and 68 intervention) completed the home visit assessments.

Table 1. Fall outcomes by group at 48 weeks

	Control	Intervention	Relative rate or risk (95% CI)	*P*-value	Attributable risk reduction (95% CI)
Rate of falls, mean	0.802	0.713	0.88[a] (0.60–1.29)	0.52	
1+ falls, number	68/180 (0.378)	54/159 (0.340)	0.90[b] (0.67–1.20)	0.47	0.038 (−0.064–0.140)
2+ falls, number	28/180 (0.156)	25/159 (0.157)	1.01[b] (0.61–1.67)	0.96	−0.002 (−0.079–0.076)

[a]Incident rate ratios calculated using a negative binomial regression with time in study as the exposure variable.
[b]Relative risk, excludes 47 participants who did not provide at least 24 weeks of falls data.

Table 2. Outcome variables at baseline and 6 months retest

	Baseline		Retest		*P*-value
	Control (*n* = 194)	Intervention (*n* = 191)	Control (*n* = 169)	Intervention (*n* = 144)	
FES-I—mean (95% CI)[a,b]	21.1 (20.3–21.9)	20.4 (19.8–21.1)	21.2 (20.3–22.1)	20.4 (19.7–21.2)	0.2
IPEQ—median hours/week (IQR)[c]					
Planned walking exercise	0 (0.88)	0.25 (1.50)	0.75 (1.69)	1.69 (2.63)	<0.0001
All planned exercise	0.94 (3.00)	0.75 (2.81)	1.69 (3.38)	3.19 (3.19)	0.0007
AQoL—mean (95% CI)[b]	0.81 (0.79–0.83)	0.81 (0.79–0.83)	0.83 (0.81–0.85)	0.84 (0.82–0.86)	0.09
Home visit sub-sample	*n* = 87	*n* = 91	*n* = 79	*n* = 68	
CSRT in ms—mean (SD)[b,d]	1146 (1091–1201)	1126 (1059–1193)	991 (934–1048)	1002 (922–1082)	0.68
Quadriceps strength in kg force – median (IQR)[b,e]	22.9 (14.8)	25.2 (13.0)	24.0 (12.2)[e]	23.3 (13.7)[e]	0.74
Mobility (SPPB)—median score (IQR)[c]	11 (3)	11 (2)	11 (2)	12 (1)	0.04

[a]Scores 16–64 where the lower scores indicate high falls efficacy.
[b]Follow-up values compared between groups by multiple linear regression with adjustment for baseline score.
[c]Follow-up values compared using the Mann–Whitney *U*-test.
[d]Due to equipment failure the number of participants completing this test varied (at baseline: control = 80, intervention = 75; at follow-up: control = 44, intervention = 42).
[e]Due to equipment failure the number of participants completing this test varied (at baseline: control = 87, intervention = 89; at follow-up: control = 75, intervention = 60).

There was no significant difference between groups in falls efficacy (FES-I); however, there was a non-significant increase in self-reported quality of life for the walking group at retest (Table 2). Intervention group participants significantly increased the median amount of time spent walking for exercise and in planned exercise activity (walking: 1.69 versus 0.75 h per week, $P > 0.0001$; planned exercise: 3.19 versus 1.69, $P = 0.0007$). The Cohen's D statistic based on amount of time spent exercise walking between the two groups was 0.52.

For the home visit sub-sample, there were no differences between groups at 48-week retest for CSRT or knee extension strength. However, intervention group participants had significantly better SPPB mobility scores (median 11 versus 12, $P = 0.04$) (Table 2).

Discussion

The walking programme did not reduce falls in a representative sample of inactive, older community-dwelling people. These results are consistent with two previous smaller trials that have investigated the effect of walking on falls [12, 13], and support findings from a meta-analysis that indicated walking does not add to the effectiveness of a fall prevention programme [14]. The intervention did, however, increase general physical activity as well as walking levels and mobility scores.

There was some indication that age was an effect modifier. There was a non-significant trend ($P = 0.19$) indicating the effect of walking in participants aged 65–74 years was opposite to that observed in those aged 75 years and over. People aged 75 years and over are more likely to be frailer and at higher fall risk. It may be that walking is of insufficient intensity to ameliorate this higher risk in the older age group and/or walking more often or for longer periods may have led to a greater exposure to fall hazards and subsequently more falls in this group.

Whereas other studies of the effects of walking on mobility have shown mixed results [33, 34], the current walking programme significantly increased overall physical activity levels as well as walking levels in the intervention group [31]. The small but significant improvement in SPPB mobility evident in the intervention group may be due in part to the small scope for improvement possible as baseline scores were near ceiling levels. Even so, it has been suggested that a one point change in the SPPB, as found here, is substantial [32].

The walking programme did not improve lower limb strength, balance, falls efficacy or quality of life. Previous studies have shown some improvement in one or more balance measures including limits of stability, functional reach, tandem standing, tandem walking and gait speed [35–37]. However, a meta-analysis of several studies found that there is insufficient evidence to make any firm conclusions about the effect of walking on balance in older people [38]. Studies of the effect of walking on the quality of life of older people have also shown mixed results [39, 40].

It is acknowledged the study has certain limitations. The study did not reach the necessary sample size. However, a power analysis based indicates that even if the full sample had been recruited, the study findings (i.e. a 12% reduction in falls) would have still shown no significant difference between groups. The removal of blinding after baseline assessments could have resulted in experimenter bias; however, the use of objective measures would have minimised the impact of this. The differential attrition across the two groups is of concern. As three times as many intervention group participants (n = 18) withdrew from the study for health reasons compared with the control group (n = 6) remaining participants in the intervention group may have had better health than the control group. This may have overestimated the positive effects of the intervention. There were also considerable missing data for physical measures due to equipment issues. Nevertheless, the samples assessed were still adequate for detecting clinically significant differences. Finally, the age-group sub-group analysis was conducted *post hoc*, and it is acknowledged the study was not powered to conduct such an analysis.

The current study, along with findings from other studies, shows that walking has no effect on falls. Therefore, guidelines for physical activity need to reconsider how walking is promoted to older people given that it is currently considered by a majority of older people as a good way of preventing falls [15]. The finding that the walking programme also had no impact on balance may explain why the walking programme was ineffective with respect to falls. However walking may be a useful adjunct to increase physical activity for this group, particularly for those aged under 75 years.

Key points

- A walking programme delivered through mailed printed materials and phone calls did not reduce falls in older people but increased walking behaviour, and physical activity levels.
- Walking should not be recommended as a falls prevention strategy.

Conflicts of interest

None declared.

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Supplementary data

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

References

The long list of references supporting this manuscript has meant that only the most important are listed here and are represented by bold type throughout the text. The full list of references is available in Supplementary data in *Age and Ageing* Online.

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