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Evaluating a community-based walking intervention for hypertensive older people in Taiwan: A randomized controlled trial

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Abstract

Objective. To study the effect of a community-based walking intervention on blood pressure among older people.

Method. The study design was a randomized controlled trial conducted in a rural area of Taiwan between October 2002 and June 2003. A total of 202 participants aged 60 years and over with mild to moderate hypertension was recruited. Participants randomized to the intervention group ($n=102$) received a six-month community-based walking intervention based on self-efficacy theory. A public health nurse provided both face-to-face and telephone support designed to assist participants to increase their walking. Control group participants ($n=100$) received usual primary health care. Primary outcome was change in systolic blood pressure and secondary outcomes were exercise self-efficacy, self-reported walking and diastolic blood pressure.

Results. At six-month follow-up the mean change in systolic blood pressure was a decrease of 15.4 mmHg and 8.4 mmHg in the intervention and control group, respectively. The difference in mean change between the two groups was −7.0 mmHg (95% CI, −11.5 to −2.5 mmHg, $p=0.002$). Improvement in exercise self-efficacy scores was greater among intervention group participants (mean difference 1.23, 95% CI, 0.5 to 2.0, $p=0.001$). Intervention group participants were more likely to report walking more ($p<0.0005$) but no differences were observed in diastolic blood pressure ($p=0.19$).

Conclusions. Among hypertensive older people, a six-month community-based walking intervention was effective in increasing their exercise self-efficacy and reducing systolic blood pressure.

Keywords: Hypertension; Older people; Walking; Randomized controlled trial; Self-efficacy

Introduction

Hypertension is responsible for around seven million deaths worldwide (World Health Organisation, 2002) and affects nearly two thirds of those aged 60 years and over (Hajjar and Kotchen, 2003). The evidence for the effect of physical activity, especially aerobic exercise, on reducing blood pressure is relatively well established (Kelley and Kelley, 2001; Whelton et al., 2002). However, this evidence comes from studies conducted in standardized settings such as gymnasiums and exercise laboratories with supervised (Cox et al., 2001; Tsai et al., 2002) or programmed exercise regimes (Tsai et al., 2004). Evidence from trials suggest that walking programmes can improve aerobic capacity (Coleman et al., 1999; Duncan et al., 1991; Murphy and Hardman, 1998), decrease adiposity (Duncan et al., 1991; Hardman and Hudson, 1994; Ready et al., 1996) and enhance psychological well-being (Morgan and Bath, 1998). A meta-analysis examining the effect of walking intervention programmes on blood pressure concluded that walking can lower both systolic and diastolic blood pressure (Kelley et al., 2001a). However, this conclusion was drawn from non-randomized as well as randomized trials with relatively small sample sizes increasing the risk of publication bias.

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[1] This study was carried out while Ling-Ling Lee was a PhD student at the University of Nottingham.

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Older people may be limited in the type and level of physical activity that they can undertake and may be less confident than younger adults in trying new forms of physical activity (Newsom et al., 2004). Unpleasant sensations associated with exercise, such as chest pain, shortness of breath, discomfort, fear of falling, feelings of boredom and worry about security, might also prevent older adults from participating in regular physical activity (Resnick and Spellbring, 2000). Increasing the amount of walking that older people undertake in their daily routines may be a simple way to promote physical activity and prevent cardiovascular health problems.

One of the most widely applied theories in predicting health behavior and facilitating behavioral modification is the theory of self-efficacy. Self-efficacy, a central concept of Bandura's social cognitive theory (Bandura, 1986; Bandura, 1997) is defined as one's sense of confidence in the ability to perform a particular behavior in a variety of circumstances (Bandura, 1982). It has been used extensively in health promotion efforts designed to change behaviors in order to address issues such as weight loss (Roach et al., 2003), smoking cessation (Staring and Breteler, 2004), alcohol misuse (Skutle, 1999) and self-management of diabetes (Clark, 1997). Higher levels of exercise self-efficacy are associated with the likelihood of adopting and maintaining physical activity (Dishman et al., 1985; The Writing Group for the Activity Counseling Trial Research Group, 2001). In reports of walking intervention trials, little attention is paid to the underlying theoretical basis of the programme being tested. The use of self-efficacy theory has been underused to promote increased walking in this way. The current study aimed to test whether a community-based walking intervention based on self-efficacy theory could lower systolic blood pressure among older people with mild to moderate hypertension.

Methods

Study population and recruitment

The criteria for inclusion in the trial were being resident in a local township, aged 60 years and over and with a resting systolic blood pressure between 140 mmHg and 179 mmHg and thereby classified as having mild to moderate hypertension (WHO International Society of Hypertension Writing Group, 2003). The study was carried out in a rural area of Taiwan that has a population density of 75 persons per square kilometer compared to a density of more than 3000 persons for the country as a whole (Department of Statistics Ministry of the Interior Taiwan, 2005). Potential participants were identified from a merged database containing health-check data from residents of the 18 villages from one township. A list was generated of those eligible for screening for entry into the trial and individuals were contacted by telephone initially by a member of the study team (LL) and invited to be screened for eligibility for the trial in their own home or at a local community activity center. For practical reasons, the list was ordered by village so that those living closest to the local health station were contacted initially. Screening ceased once the required number of participants had been recruited into the trial.

During the screening visit to establish eligibility, each individual had their blood pressure taken a minimum of three times and individual mean values for systolic and diastolic blood pressure were calculated. The measurements were taken by the public health nurse (LL) using a traditional mercury sphygmomanometer and following international guidelines (Chobanian et al., 2003). Eligible study participants with known cardiovascular diseases were asked to request confirmation from their usual doctor that they were physically well enough to undertake regular and unaided walking. Eligible participants were provided with an information sheet and their consent sought. All participants recruited to the trial provided written consent. The trial was granted ethical approval by the University of Nottingham Medical School Ethics Committee (Study reference number: D/6/2003).

Baseline measures

Blood pressure recorded to screen for eligibility was taken as baseline blood pressure. Participants were asked how often they undertook 20 min of general exercise or walking and could choose from one of five responses ranging from 'never' to 'more than three times a week'. Each participant was also placed on one of five stages (pre-contemplation, contemplation, preparation, action or maintenance) of the stages of change for exercise scale (Booth et al., 1993) by choosing one of five statements that best described their current and/or intended level of exercise. Weight and height were measured and body mass index calculated.

Exercise self-efficacy was measured by the Self-Efficacy for Exercise Scale (Resnick and Jenkins, 2000), a validated measure used in previous studies involving older people (Resnick and Jenkins, 2000; Resnick and Nigg, 2003). This nine-item scale focuses on self-efficacy expectations relating to the degree of confidence to exercise in the face of barriers such as bad weather and tiredness. Total possible scores ranged from 0 to 10 with higher scores representing greater exercise self-efficacy. The scale was translated into Chinese for the purposes of this study and reviewed by a geriatrician and associate professor of public health with a background in behavior modification theory, both from Taiwan. Minor changes were made to preserve the meaning of the original version and it was then subjected to a small pilot study of older Taiwanese people ($n=22$) from a different area of Taiwan to where trial recruitment took place. Cronbach's alpha of this Chinese version of the Self-Efficacy for Exercise Scale was 0.84, consistent with but slightly lower than that of 0.92 observed in the original English version (Resnick and Jenkins, 2000).

The presence of hypertension was established by self-report and questions were asked about whether or not the individual had previously been told by their doctor they had raised blood pressure and whether they were currently taking medication for controlling this. Self-rated health (Mason-Hawkes and Holm, 1993), social demographic factors and self-reported health behaviors such as frequency of alcohol consumption and cigarette smoking were also recorded.

Randomization

Randomization occurred after all baseline measures were recorded. The total length of time between screening for eligibility and randomization was a maximum of 48 h and typically occurred on the same day. A series of numbered, opaque, sealed envelopes were used to randomly allocate participants to one of the two arms of the trial. To prevent an imbalance in size of study groups, blocks of 12 were used. The randomization list and the block size were concealed from LL.

Interventions

Participants randomized to the control group received usual primary health care involving self-initiated contact with health services as required. In addition to usual primary health care, participants randomized to the intervention group were offered a six-month community-based walking intervention delivered by the public health nurse (LL). A series of regular individual contacts was provided through telephone and face-to-face visits in both local community activity centers and participants' homes according to their preference. The first intervention contact by the public health nurse was made within one month of randomization. The content and timing of subsequent visits were aimed to motivate intervention group participants to walk regularly by increasing the frequency and time spent walking. A pedometer, walking log and advice about regular walking and the use of the pedometer were provided to facilitate participants' initial regular walking. Advice about regular walking was based on established physical activity guidelines (American College of Sports Medicine Position Stand, 1998a; American College of Sports Medicine Position Stand, 1998b). The design of the intervention was underpinned by self-efficacy theory and individualized according to a participant's baseline exercise stage of change. Four sources of self-efficacy were incorporated into the intervention program, mainly through discussion during the contact with the public health nurse. These were as follows: identifying performance accomplishments; vicarious learning from others' experiences of success; verbal encouragement from significant others and the public health nurse; and recognizing positive, and challenging negative, interpretations of physiological and emotional responses to walking. Content areas for discussion for each participant would vary but mainly include perceived benefits of increased walking, ideas for overcoming perceived barriers and sharing practical information gleaned from others about pleasant walking routes and pedometer usage. In general, more frequent contacts were arranged during the first three months of the intervention period in order to facilitate and reinforce regular walking and less frequently during the last three months to minimize reliance on professional support.

Outcome measures

The primary outcome measure was change in systolic blood pressure at six months. There is evidence that systolic blood pressure is a better predictor of adverse health events (such as cardiovascular disease, heart failure and stroke) than diastolic blood pressure, especially among older people (Haider et al., 2003). Secondary outcomes were changes in exercise self-efficacy score, self-reported walking frequency and diastolic blood pressure. With the exception of social demographic factors and body height, all baseline measures were repeated six months following randomization. An invitation for a follow-up appointment was made by the public health nurse and appointments were arranged at a place (community activity center or home) convenient to the participant. Within the time frame of six months from baseline, plus or minus one week, the timing of the appointment was also at the participant's convenience. All outcome measures were recorded during face-to-face interviews by four trained interviewers who were blind to study group allocation and trained in questionnaire administration and blood pressure measurement. The same procedure for measuring and calculating mean blood pressure for each individual was used at baseline and at follow-up.

Statistical analysis

To compare those recruited to the study with those either not recruited or not screened *t*-tests were used for continuous and normally distributed variables and chi-square tests for categorical variables. Intention-to-treat was used to compare the two groups in terms of outcomes where follow-up data were available using independent *t*-tests for normally distributed continuous variables and Mann–Whitney *U* tests otherwise. In order to assess whether the difference in the primary outcome between the two groups was affected by random differences between them, an analysis of covariance (ANCOVA) was undertaken. The required sample size was determined by a power calculation based on local health check data ($n=2312$). To have 80% power in order to detect a 5-mmHg difference in systolic blood pressure between groups with a significance level of 5% and anticipating an attrition rate in line with other studies of this nature (Asikainen et al., 2002; Murphy and Hardman, 1998), the

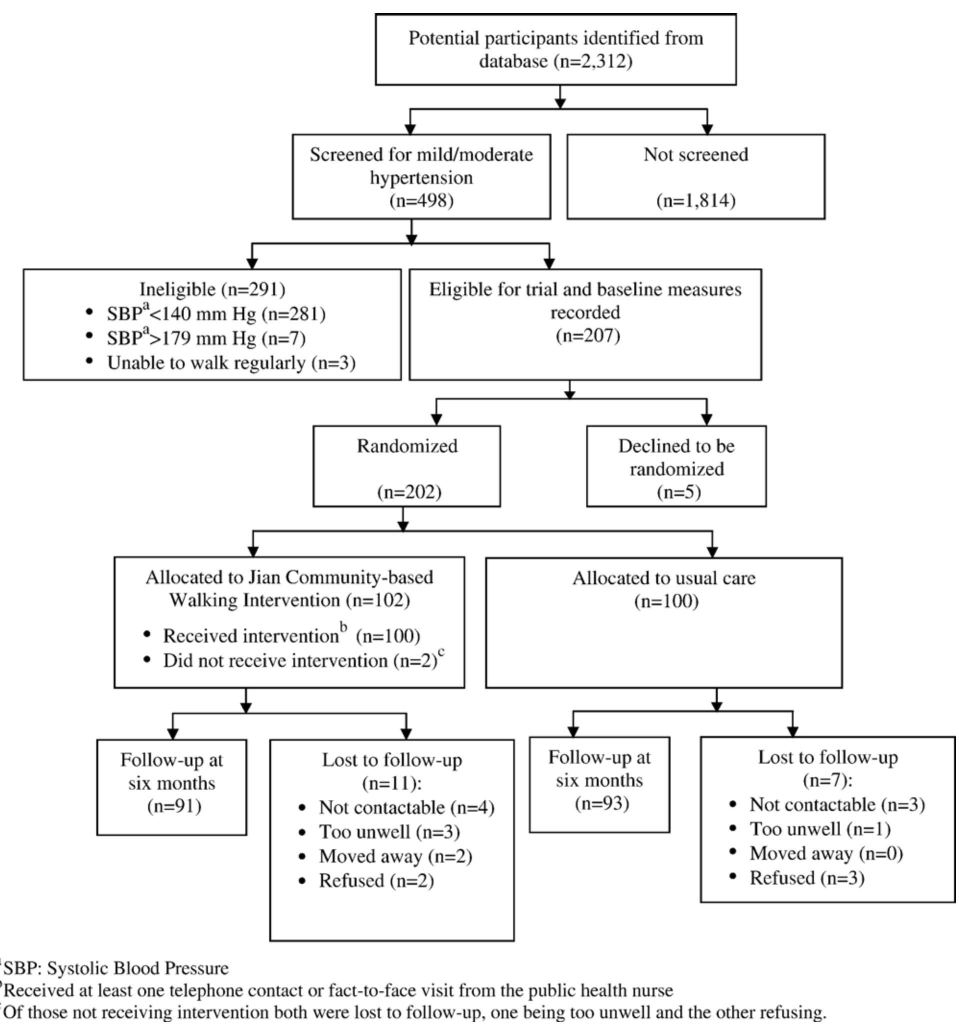

Fig. 1. RCT of community-based walking intervention for hypertensive older people in Taiwan 2002–2003: flow of participants through study.

aim was to recruit 200 participants. All analyses were conducted using SPSS version 11.0.

Results

Screening and recruitment occurred over a period of 10 weeks between October 2003 and December 2003. The flow of participants through the study is presented in Fig. 1. A total of 2312 potential participants were identified from the health check database. Of these it was necessary to screen 498 individuals in order to recruit 202 who fulfilled the eligibility criteria and agreed to take part in the study. Recruited participants were from the nine villages nearest to the Health Station whereas the database included individuals from all 18 villages. Those recruited ($n=202$) were similar to those not screened or not recruited ($n=2110$) in terms of mean systolic blood pressure ($p=0.20$) and proportion female ($p=0.078$) but had a lower mean age of 71.1 years compared with 74.2 years ($p<0.001$).

The 202 participants were randomly allocated to either the community-based walking intervention ($n=102$) or usual care ($n=100$). There was no difference in the mean age of the two randomized groups but slightly more men were allocated to the intervention group (64/102) than to the usual care group (54/100) (Table 1). There was no difference in mean baseline systolic blood pressure between the two groups although those randomized to the intervention group had a slightly lower level of activity at baseline but higher exercise self-efficacy scores. Both groups were similar at baseline in terms of smoking, alcohol consumption and use of antihypertensive medication.

Following randomization, one intervention group participant refused further contact and another became too ill to continue with the study. All remaining intervention group participants ($n=100$) received at least one telephone or face-to-face contact with the public health nurse where walking was discussed. All intervention group participants were offered a pedometer, which the majority ($n=90$) accepted. The type of contact was determined by convenience and participants' preferences with most participants receiving both telephone and face-to-face visits. The public health nurse made a median of six contacts with each member of the intervention group.

At six-month follow-up, data were available from 89% ($n=91$) of the intervention group participants and 93% ($n=93$) of the control group participants. Between baseline and six-month follow-up, a greater reduction in systolic blood pressure was observed in the intervention group than the control group giving a mean difference of −7 mmHg (95% CI −11.5 to −2.5, $p=0.002$) (Table 2). When adjustments were made for gender, whether living alone, changes in antihypertensive medication use, baseline systolic blood pressure, baseline walking and physical activity frequency, baseline self-rated health and baseline self-efficacy score, there was little change in the estimated mean difference between the two groups (Table 2).

There was greater improvement in self-efficacy among intervention group participants than control group participants. Self-efficacy for exercise scores improved by a mean of 2.1 points in the intervention group and 0.8 points in the control group (mean difference 1.3 points, 95% CI 0.5 to 2.0, $p=0.001$) (Table 2). More participants in the intervention group reported an increase in their regular walking than participants in the control group ($p<0.0005$). Although diastolic blood pressure

Table 1
RCT of community-based walking intervention for hypertensive older people in Taiwan 2002–2003: baseline characteristics of study groups

	Intervention group ($n=102$)	Control group ($n=100$)
Mean age in years (SD)	71.3 (6.4)	71.3 (5.7)
Gender, *n* (%)		
Female	38 (37.3)	46 (46.0)
Male	64 (62.7)	54 (54.0)
Education level, *n* (%)		
<4 years	43 (42.2)	45 (45.0)
4–7 years	40 (39.2)	38 (38.0)
>7 years	19 (18.6)	17 (17.0)
Living alone (%)		
Yes	11 (10.8)	12 (12.0)
No	91 (89.2)	88 (88.0)
Diagnosis of hypertension, *n* (%)		
Yes	79 (77.5)	73 (73.0)
No	23 (22.5)	27 (27.0)
Antihypertensive medication usage, *n* (%)		
Yes	70 (68.6)	68 (68.0)
No	32 (32.0)	32 (32.0)
Mean systolic blood pressure (mmHg) (SD)	152.0 (10.5)	152.4 (11.1)
Mean diastolic blood pressure (mmHg) (SD)	83.5 (11.2)	80.6 (8.8)
Mean body mass index (kg/m2) (SD)	25.4 (3.8)	25.31 (3.5)
Self-rated health status, *n* (%)		
Poor	16 (15.8)	17 (17.3)
Fair	43 (42.6)	55 (56.1)
Good	23 (22.8)	15 (15.3)
Excellent	19 (18.8)	11 (11.2)
Missing	1	2
Level of walking frequency, *n* (%)		
More than 3 times a week	32 (31.4)	45 (45.0)
0–3 times a week	10 (9.8)	9 (9.0)
Never	60 (58.8)	46 (46.0)
Mean exercise self-efficacy scores (SD)	4.6 (2.7) [a]	3.7 (2.5) [b]
Stages of change for exercise, *n* (%)		
Pre-contemplation	42 (41.2)	34 (34.0)
Contemplation	2 (2.0)	1 (1.0)
Preparation	6 (5.9)	4 (4.0)
Action	4 (3.9)	6 (6.0)
Maintenance	48 (47.1)	55 (55.0)
Cigarette smoking, *n* (%)		
Non-smoker	81 (79.4)	77 (77.0)
Smoker	21 (20.6)	23 (23.0)
Frequency of alcohol consumption, *n* (%)		
Less than once a week	80 (78.4)	85 (85.0)
More than once a week	22 (21.6)	15 (15.0)

[a] Based on $n=100$ due to missing data
[b] Based on $n=92$ due to missing data.

Table 2
RCT of community-based walking intervention for hypertensive older people in Taiwan 2002–2003: primary and secondary study outcomes by study group

	Intervention group (n=91)	Control group (n=93)	Mean difference (95% confidence interval)	p value
Primary outcome				
Mean resting systolic blood pressure (mmHg) (SD)				
Baseline	152.0 (10.5)	152.4 (11.1)		
Follow-up	136.2 (16.7)	143.6 (15.3)		
Mean change	−15.4 (15.3)	−8.4 (15.8)	−7.00 (−11.5 to −2.5)	0.002 [a]
Mean change	−16.2 (14.8)	−8.1 (14.3)	−8.1 (−12.0 to −2.7)	0.002 [b]
Secondary outcomes				
Self-efficacy for exercise score [c] (SD)				
Baseline	4.6 (2.7)	3.7 (2.5)		
Follow-up	6.7 (2.5)	4.4 (3.1)		
Mean change	2.1 (2.3)	0.8 (2.6)	1.3 (0.5 to 2.0)	0.001 [a]
Change in self-reported level of walking frequency, n (%)				
Walking more	48 (51.6)	8 (8.6)		<0.0005 [d]
No change	43 (46.2)	71 (76.3)		
Walking less	2 (2.2)	14 (15.1)		
Mean resting diastolic blood pressure (mmHg) (SD)				
Baseline	83.5 (11.2)	80.6 (8.8)		
Follow-up	76.7 (12.3)	75.7 (11.6)		
Mean change	−6.47 (9.5)	−4.71 (8.5)	−1.8 (−4.4 to 0.9)	0.19 [a]

[a] Independent t-test.
[b] Analysis of covariance. Change in systolic blood pressure adjusted for gender, whether living alone, change in hypertension use, baseline systolic blood pressure, baseline walking frequency, baseline self-rated health and baseline exercise self-efficacy.
[c] Score range: 0 to 10, a higher score represents higher exercise self-efficacy.
[d] Mann–Whitney U test.

fell between baseline and follow-up for both groups, there was no overall difference between the groups (p=0.19).

Discussion

The present study found that a six-month, community-based walking intervention, underpinned by self-efficacy theory and led by a public health nurse, can reduce systolic blood pressure among older hypertensive adults. The observed effect of 7 mmHg is similar to the magnitude reported in various meta-analyses examining the effect of aerobic exercise on blood pressure (Fagard, 1993; Kelley et al., 2001b). A reduction in systolic blood pressure of this magnitude can have a significant benefit on reducing the risk of cardiovascular disease (Lewington et al., 2002). The decision not to exclude those already undertaking some form of physical activity means that the level of benefit observed here is likely to closely resemble that in general populations of older people with hypertension. We did not detect a similar effect on diastolic blood pressure. Our study was powered to detect differences in systolic blood pressure and inclusion into the study was based on systolic rather than diastolic blood pressure. This finding is broadly consistent with a smaller trial of brisk walking among middle-aged adults conducted in the UK where both systolic and diastolic blood pressure were reduced in both intervention and control groups although there was no overall difference between groups (Tully et al., 2005).

Improvement in exercise self-efficacy scores was greater in the intervention group and they were more likely to report increases in the frequency of regular walking they were taking. The use of self-efficacy theory in the present study was to encourage participants to start and maintain regular walking. Other studies (Brawley et al., 2000; Ettinger et al., 1997) including those involving older people (King et al., 1995; McAuley et al., 1993) have found that the use of self-efficacy theory was more effective in improving adherence to physical activity programmes than merely providing information.

Although the use of self-efficacy theory was considered to be an essential element in the intervention program in this trial, it would be naïve to rely exclusively on this theory to explain the observed results. Indeed, changes were also observed in the control group and this may be due to heightened awareness of health issues for those recruited to a trial concerned with walking and blood pressure reduction. We cannot exclude the possibility that the public health nurse, other than in her role of promoting self-efficacy, may have been key in explaining some of the outcomes observed in the intervention group. Other studies have found that regular follow-up by somebody whom the participant trusts is an important process to motivate people to start an activity and to prevent relapse (Gilliss et al., 1993, King et al., 1997).

It is also possible that regular contact by the public health nurse may have prompted changes in other areas of lifestyle, either not measured or based on crude measures of self-report, that could have produced the observed change in blood pressure. However, our records indicate that smoking status changed for only one control group participant and two intervention group participants. Similarly, the practical difficulties associated with obtaining valid data on changes in diet mean we cannot rule out the possibility that increased awareness about healthy lifestyles prompted intervention group participants to change their diets. Older people who were taking antihypertensive medication were not excluded from the trial. The intervention group participants may have been more likely to have sought other treatments for blood pressure as they became more aware of the problems of raised blood pressure. Our self-report data indicate that the number of participants in both groups reporting change in usage of antihypertensive medications was minimal. It was beyond the scope of our study to disentangle the biological mechanism by which walking affects blood pressure. However, post hoc analysis suggests that body mass index did not change greatly in either group with a mean reduction of 0.21 and 0.03 kg/m^2 in the intervention and control group respectively.

This study has a number of limitations. The roles of recruitment, baseline assessment and the delivery of the intervention were all undertaken by the public health nurse and it would have been preferable to have separated these had resources allowed. Although it was not possible to blind participants given the nature of the intervention, every effort was made to blind the follow-up trained interviewers to the group participants were allocated to. Even so, outcomes where we were relying on self-report may have been affected by social desirability bias and it is always possible that participants could have revealed their allocation during the follow-up interview. We do not have data from the pedometer and walking log because we wished to avoid them being perceived as a surveillance tool rather than a way of for participants to monitor their own progress. Additionally, since this intervention program was conducted in a rural Taiwanese area, where walking may be more enjoyable, it may be that the intervention would not have the same effect in areas where walking is more difficult or less pleasant. Further work would be warranted in order to test the effect of walking on blood pressure reduction in urban areas and within different contexts.

This study provides evidence that a community-based walking intervention program utilizing self-efficacy theory can be effective in reducing systolic blood pressure. The intervention, using telephone and face-to-face contact provided by a public health nurse, secured a relatively high level of adherence to regular walking and greater improvement in exercise self-efficacy among the intervention group participants. This is a relatively short-term physical activity intervention that could have important health benefits for older people with hypertension living in community.

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