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The use of a pedometer with or without a supervised exercise program for control of pre- to mild hypertension

A randomized control trial and follow-up study in Thailand

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Abstract

Purpose – Exercise training has been shown to be an effective and integral component of non-pharmacological intervention for the control of blood pressure. The purpose of this paper is to compare the effectiveness of a supervised modified exercise program of moderate-intensity exercise for one hour per week including the use of a pedometer, and with the use of a pedometer alone without additional exercise in reducing blood pressure.

Design/methodology/approach – The study was a randomized control trial, with an experimental group of 30 people and a control group of 26 people. Participants were males and females aged 30-65 years with pre- to mild hypertension, and who were not receiving any drugs for the treatment of hypertension. Participants of the experimental group were assigned to a fitness program with supervised exercise once a week at the Golden Jubilee Medical Fitness Center, given access to a pedometer, and provided with health education. Participants in the control group were assigned to use a pedometer only. All experimental and control group members participated in the study for three months, as well as a follow-up at the third and sixth month.

Findings – Comparison of the experimental and control groups at the first, third, and sixth month, using repeated measures analysis found that interaction effect groups and times were significantly different for mean systolic blood pressure (SBP), body mass index (BMI), hip circumference (HC), and high-density lipoprotein (HDL) ($p < 0.05$). Mean SBP, diastolic blood pressure (DBP), BMI, waist circumference (WC), HC, and low-density lipoprotein (LDL) within groups were significantly different ($p < 0.05$). Mean WC, cholesterol, LDL, and triglyceride between groups were significantly different ($p < 0.05$). Both groups had SBP improved at the third and sixth month when compared with baseline data. Mean HDL increased in the experimental group and decreased in the control group. Multiple regression analysis showed that both groups were not statistically different after intervention, SBP was reduced in the experimental group when compared to the control group. However, at six months, members in the experimental group reported spending less time sitting or reclining on a typical day than members of the control group.

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Originality/value – A supervised one-time per week fitness program combined with pedometer and pedometer alone were not different in reducing blood pressure, as both groups showed decreases in blood pressure. However, the group with the supervised exercise program tended to change sedentary behaviors in the longer term compared to those who used the pedometer alone.

Keywords Thailand, Hypertension, Follow-up studies, Fitness centres, Exercise

Paper type Research paper

Introduction

Exercise is a part of hypertension treatment[1] as exercise and diet control can help to reduce hyperlipidemia, hypertension, diabetes, and cardiovascular disease[2-7], and cardio exercise may attenuate the rate of progression from pre-hypertension to hypertension. The American College of Sports Medicine (ACSM) recommends individuals with hypertension engage in moderate-intensity exercise for 150 minutes per week, aerobic exercise on most days of the week for 30-60 minutes per day, and moderate-intensity resistance training 2-3 days per week as a supplement to aerobic exercise to lower blood pressure[8]. Exercise decreases systolic blood pressure (SBP) by 10.5 mmHg and diastolic blood pressure (DBP) by 8.6 mmHg because of cardiac output and peripheral vascular resistance decline[9]. Exercise training for blood pressure control has been shown to be an effective and integral component of non-pharmacological interventions[10]. However, most previous studies of exercise training intervention were conducted with supervised exercise programs[11-13], and only a few studies have reported the effects of unsupervised exercise on blood pressure [14, 15]. Recently, a systemic review and meta-analysis of exercise and blood pressure showed that less than 210 minutes weekly of endurance training had a significantly large effect on SBP reduction. Combined with the previous guidelines for hypertension, 150-210 minutes per week spread over most days of the week should be appropriate. However, in practical terms, supervised exercise on most days of the week is challenging and costly. Therefore, the main objective of this study was to determine if an additional 60 minutes of supervised exercise training one-day a week, plus the non-supervised use of a pedometer is superior in effect to the non-supervised use of a pedometer alone. The results of this study will help to determine health promotion policy and health care services in the near future.

Materials and methods

Study population and design

This experimental study was a randomized control trial. The study population was based in a hospital setting. Participants with pre- to mild hypertension were included after screening and diagnosis by a doctor or qualified health personnel. The inclusion criteria were both sexes, age 30-65 years, healthy people, having pre-hypertension (SBP 120-139 mmHg/DBP 80-89 mmHg) or mild hypertension (140-159 mmHg/90-99 mmHg), and not receiving any medication for treatment of hypertension. The exclusion criteria were persons who had contraindications to exercise or other diseases such as heart or kidney disease, or cancer. Volunteers to the program were recruited by a public relations announcement advertised on a board at the Golden Jubilee Medical Center (Mahidol University, Thailand). Volunteers interested in being recruited to the program had their blood pressure taken. If the blood pressure and other characteristics met the criteria of the study, they were invited to join the program. Participants were assigned by block randomization into an experimental group (30 people) and a control group (30 people), using block sizes of six people. Each block size consisted of two groups, an experimental group of three people and a control group of three people, repeated ten times. This design did not match individual characteristics. Four participants in the control group were lost to follow-up. Participants of the experimental group were assigned to a fitness program with supervised exercise once a week at the Golden Jubilee Medical Fitness Center and provided with health education (a video on exercise narrated by a doctor and supervisor, and diet control information by a nutritionist). The experimental group undertook a combined training program that consisted of combined dynamic aerobic exercise on a treadmill or stationary bicycle for 30 minutes plus weight training (15×3 sets), lat pulldown, low row, leg extension, leg press, abdominal exercise, as recommended by the ACSM and pedometer use. Participants in the control group were assigned to use a pedometer only. The intervention ended after three months and outcome data were collected at the first, third, and sixth month, including SBP, DBP, body mass index (BMI), waist circumference (WC), and hip circumference (HC), cholesterol, triglyceride (TG), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and fasting blood sugar (FBS). Participants underwent physical examination by a fitness training officer who recorded data such as SBP, DBP, BMI, WC, and HC using standard instruments at the Golden Jubilee Medical Fitness Center. Blood testing was undertaken in the standard laboratory at the Golden Jubilee Medical Center. In addition, participants also filled out a sedentary behavior questionnaire relating to the length of time spent sitting or reclining on a typical day.

Analysis

Descriptive characteristics collected included age, sex, marital status, education, occupation, BMI, WC, HC, SBP, DBP, cholesterol, LDL, HDL, TG, FBS, and sedentary behavior patterns. The independent t-test and the χ^2 test were used to evaluate statistical differences between the experimental and control groups. The differences of mean values between the experimental and control groups for SBP, DBP, BMI, WC, HC, cholesterol, LDL, HDL, TG, FBS, and sedentary behavior were determined using the repeated measures statistic. Multivariate analysis for controlling variables was undertaken using multiple regression. The analysis program PASW Statistics 18 was used.

Ethical consideration

This study was approved by the ethical committee of the Faculty of Social Sciences and Humanities, Mahidol University, Thailand (Institutional Review Board Certificate Number 2015/036(B2)). All of the participants who participated in the study gave written informed consent prior to the commencement of the study.

Results

The total sample size for this study was 56 people, comprising an experimental group of 30 people and a control group of 26 people. There were 17 males and 39 females. The mean age was 36.7 years in the experimental group and 49.6 years in the control group. The majority of the experimental group participants were single with an education below a bachelor degree, and working for the government. The majority of the control group participants were married with an education below bachelor degree level and working as a laborer. Characteristics of the cohorts at baseline were different between the experimental group and the control group with regards to sex, age, marital status, occupation, WC, cholesterol, LDL, HDL, and TG (Tables I and II).

Comparison of the experimental and control groups at the first, third, and sixth month, using repeated measures found that interaction effect groups and times were significantly different for mean SBP, BMI, HC, and HDL ($p < 0.05$). Mean SBP, DBP, BMI, WC, HC, and LDL within groups were significantly different ($p < 0.05$). Mean WC, cholesterol, LDL, and TG between groups were significantly different ($p < 0.05$). Both groups had SBP improved at the third and sixth month when compared with baseline data. Mean HDL increased in the experimental group and decreased in the control group. Mean FBS and sedentary behavior in both groups were not significantly different. However, at six months, members in the experimental group reported spending less time sitting or reclining on a typical day than

Variables	Experimental ($n = 30$) n (%)	Control ($n = 26$) n (%)	p-value
Sex			0.004
Male	14 (46.7)	3 (11.5)	
Female	16 (53.3)	23 (88.5)	
Marital status			0.04
Single	16 (53.3)	6 (23.1)	
Married	13 (43.4)	16 (61.5)	
Widowed/divorced/separated	1 (3.3)	4 (15.4)	
Education			0.47
Below bachelor	17 (56.7)	17 (65.4)	
Bachelor	10 (33.3)	5 (19.2)	
Higher than bachelor	3 (10.0)	4 (15.4)	
Occupation			0.002
Laborer	11 (36.7)	13 (50.0)	
Government	18 (60.0)	5 (19.2)	
Employee	1 (3.3)	8 (30.8)	

Table I. Showed number and percentage

Variables	Experimental ($n = 30$) Mean (SD)	Control ($n = 26$) Mean (SD)	p-value
Age (years)	36.70 (8.42)	49.58 (7.12)	0.001
BMI (kg/m^2)	26.93 (4.58)	25.86 (3.44)	0.33
WC (inch)	36.28 (4.12)	34.02 (3.16)	0.03
HC (inch)	40.01 (3.39)	40.06 (2.37)	0.95
SBP (mmHg)	131.40 (8.87)	135.19 (9.99)	0.14
DBP (mmHg)	82.57 (7.91)	78.77 (8.37)	0.09
Cholesterol (mg/dl)	218.40 (32.24)	199.96 (22.72)	0.02
LDL (mg/dl)	145.30 (30.39)	121.00 (25.01)	0.002
HDL (mg/dl)	52.50 (13.11)	61.31 (17.40)	0.04
TG (mg/dl)	144.03 (88.38)	89.81 (41.64)	0.01
FBS (mg/dl)	98.37 (36.56)	95.81 (13.73)	0.74
Sedentary behavior[a] (hour)	3.69 (2.99)	3.31 (4.00)	0.72

Note: [a]Time usually spend sitting or reclining on a typical day

Table II. Showed mean and standard deviation

members of the control group. On a typical day, members of the experimental group spent 4.2 and 3.5 hours per day sitting or reclining in the third and sixth months, respectively, while on a typical day, members of the control group spent 2.9 and 3.6 hours per day sitting or reclining in the third and sixth month, respectively (Table III).

The characteristics of the cohorts at baseline were different, so confounding factors were controlled for using multivariate analyses. After controlling for these confounders, both groups were not statistically different; at the third month, SBP was not reduced, while at the sixth month, SBP was reduced in the experimental group in comparison to the control group (Table IV).

Discussion

The groups with and without the supervised fitness program showed no statistically significant difference in blood pressure reduction. The reason for this is possibly that the effect of supervised combined dynamic aerobic and resistance exercise for only one hour per week is not sufficient to have an extra beneficial effect on blood pressure reduction. In particular, the use of a pedometer alone has been shown to affect blood pressure

Table III. Effect of the intervention on blood pressure and other physiological and metabolic parameters

	Baseline		3rd month		6th month		*p*-value		
	Mean	SD	Mean	SD	Mean	SD	Group	Time	Group × time
SBP							0.56	0.001	0.04
Control group	135.19	1.84	128.39	2.17	124.46	2.15			
Experimental group	131.40	1.72	125.63	2.02	126.77	1.99			
DBP							0.15	0.001	0.61
Control group	78.77	8.37	74.54	11.26	72.65	11.03			
Experimental group	82.57	7.91	76.40	7.64	76.36	9.59			
BMI							0.23	0.05	0.04
Control group	25.86	0.80	25.62	0.77	25.27	0.76			
Experimental group	26.93	0.75	26.78	0.72	26.91	0.71			
WC							0.02	0.001	0.85
Control group	34.02	0.73	33.48	0.71	33.24	0.71			
Experimental group	36.28	0.68	35.57	0.66	35.55	0.66			
HC							0.72	0.04	0.01
Control group	40.06	0.58	39.89	0.60	39.08	0.57			
Experimental group	40.01	0.54	39.81	0.56	40.03	0.53			
Cholesterol							0.003	0.14	0.48
Control group	199.96	5.54	195.96	5.70	193.15	5.59			
Experimental group	218.40	5.16	221.47	5.31	214.77	5.21			
LDL							0.001	0.01	0.47
Control group	121.00	5.50	117.62	5.14	115.62	5.39			
Experimental group	145.30	5.12	142.37	4.79	134.27	5.01			
HDL							0.13	0.58	0.03
Control group	61.31	2.99	61.23	3.18	59.31	2.95			
Experimental group	52.50	2.78	54.53	2.96	56.97	2.75			
Triglyceride							0.01	0.41	0.15
Control group	89.81	13.86	86.54	17.98	92.27	13.13			
Experimental group	144.03	12.91	145.10	16.74	123.73	12.23			
FBS							0.41	0.49	0.25
Control group	95.81	5.56	95.04	4.97	96.23	3.29			
Experimental group	98.37	5.18	103.97	4.63	99.67	3.06			
Sedentary behavior[a] (hour)							0.39	0.82	0.17
Control group	3.47	0.78	2.69	0.71	3.38	0.58			
Experimental group	3.69	0.68	4.45	0.63	3.17	0.51			

Note: [a]Time usually spend sitting or reclining on a typical day

reduction[14] and the use of a pedometer has been shown to increase physical activity by 26.9 percent[16-18]. Possibly, the pedometer increases the motivation to exercise, and leads to healthy changes in daily routines[19].

A previous study showed that ten weeks of moderate-intensity exercise training significantly decreased SBP of obese children and decreased heart rate responses during exercise[20]. In this study, analysis of interaction between groups and times found that mean SBP, BMI, HC, and HDL were significantly different, consistent with studies that have shown that increased HDL levels are associated with exercise[21, 22]. This study found that members of the experimental group had less sedentary time and increased HDL, whereas members of the control group had more sedentary time and decreased HDL. This suggests that participants who had the supervised moderate-intensity exercise program one-day per week tended to reduce their sedentary behavior in the long term more than those who had only a pedometer. An additional advantage of the experimental group who had the supervised exercise once a week was that they were provided with health education, instructions on technique, and the motivation to exercise by the supervisor. Social support, motivation, emotion, and behavior all influence positive health functioning associated with regular exercise and physical activity[23]. Exercise training programs improve

Variables	1st month Coefficient	Systolic blood pressure (mmHg) 3rd month Coefficient	6th month Coefficient
Age; mean (SD)	0.44 (0.27)	0.71 (0.33)*	0.28 (0.32)
Sex			
Male	1	1	1
Female	5.07	2.64	2.22
Marital status			
Single	1	1	1
Married	−6.03	−11.44*	−6.91
Widowed/divorce/separated	−6.75	−20.76*	−9.61
Education			
Lower than bachelor	1	1	1
Bachelor	1.09	−3.00	−0.08
Higher than bachelor	−4.28	−10.88	−15.96*
Occupation			
Laborer	1	1	1
Government	4.04	6.68	4.73
Employee	1.78	−2.21	3.70
Groups			
Control group	1	1	1
Experiment group	−3.46	5.42	−3.06
BMI	0.07	1.10	−0.58
WC	1.20	−1.17	0.25
HC	−2.01	−1.59	−0.39
Cholesterol	0.25	−0.10	−0.20
LDL	−0.16	0.17	0.25
HDL	−0.29	−0.07	−0.03
Triglyceride	−0.02	0.04	0.04
FBS	−0.01	0.03	0.03
Sedentary behavior (hour)*	−0.36	−0.65	0.26

Note: *p-value < 0.05

Table IV. Systolic blood pressure at 1st, 3rd, 6th month, controlling variables by using multiple regression

cardiovascular parameter and many diseases[24, 25]. However, self-regulated exercise is significantly associated with enjoyment, a positive effect, and exercise frequency[26].When controlling variables using multiple regression analysis, the results showed that age and marital status variables were associated with SBP at the third month. After the program finished by the sixth month, the only variable associated with SBP was education. This result corresponds to a previous study that found that education had a positive correlation to regular exercise[27]. It is possible that education in the program can help to change the health behaviors of the participants, especially over the long term. Although both groups were not statistically different, SBP rates were reduced in the experimental group when compared with the control group at the sixth month after finishing the intervention. A strong point of this study was the long-term follow-up to look at behavior changes three months after the intervention.

The study did have some limitations. First, the study could not control diet, self-exercise, and physical activity outside of the interventions, although the experimental group did receive health education on diet and exercise for the prevention and control of hypertension. Second, individual characteristics of both groups were different due to un-matched characteristics occurring as a consequence of the randomization process, but this problem was solved with multivariate analysis, controlling for confounding factors. Based on the findings of this study, additional supervised fitness program one-time per week plus non-supervised exercise tends to reduce sedentary behavior. It is recommended that health policy should promote supervised moderate-intensity exercise or fitness training at least once a week, or the use of a pedometer for people with pre- or mild hypertension and/or hyperlipidemia for the most effective and reasonable cost in terms of health policy campaign.

Conclusion

A supervised one-time per week fitness program combined with pedometer and pedometer alone were not different in terms of blood pressure reduction as both groups showed decreases in blood pressure. Not only the intervention exercise program, but also individual characteristic factors were associated with blood pressure. However, the group with the supervised exercise program tended to change sedentary behavior in the longer term more than those who used the pedometer alone.

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