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Health-promotion interventions enhance and maintain self-efficacy for adults at cardiometabolic risk: A randomized controlled trial

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ABSTRACT

Objectives: To investigate whether a community-based intervention program, based on self-efficacy theory, might improve older adults' self-care behaviors as well as health outcomes related to hypertension and dyslipidemia.
Methods: This randomized controlled trial was conducted in Taipei, Taiwan, From October 16, 2011 to July 31, 2014. Residents identified during community screening for the over 50 s were invited to participate if their blood pressure was 120–139/80–89 mmHg, high-density lipoprotein cholesterol was < 40 mg/dL (men) or < 50 mg/dL (women), or low-density lipoprotein cholesterol was 130–159 mg/dL. The intervention group participated in a special health promotion program; the control group received conventional health education. Participants' demographic and anthropometric data were recorded, and each completed semi-structured questionnaires about hypertension and cholesterol management, and gave blood samples for biochemical analyses before the intervention and 6 months after it ended.
Results: From 90/98 eligible subjects who enrolled, 84 completed the study: 41/43 and 43/47 respectively in intervention and control groups. Body mass index, blood pressure, hyperglycemia, and high-density lipoprotein cholesterol in the intervention group improved significantly from baseline. The Self-Efficacy Scale ($P = 0.020$), Self-Care Activities Questionnaire ($P = 0.014$) and Perceived Therapeutic Efficacy Scale ($P = 0.023$) scores improved significantly.
Conclusion: This health promotion intervention program enhanced self-efficacy among older adults, with sustained effect through 6-months' follow-up. These findings are consistent with studies that evaluated the effect of a diabetes education program on self-efficacy. The beneficial effect on a population at high-risk for hypertension and hypercholesterolemia, may serve as a model for developing and implementing such interventions.

1. Introduction

Metabolic syndrome (MetS) comprises a cluster of cardiometabolic risk factors that substantially increases the risk for developing cardiovascular disease (CVD) and type 2 diabetes mellitus (T2DM) (Michalakis, Mintziori, Kaprara, Tarlatzis, & Goulis, 2013). MetS is becoming steadily more prevalent worldwide, and is now estimated to affect 20–25% of all adults (O'Neill & O'Driscoll, 2015) reported

Abbreviation: MetS, Metabolic syndrome; CVD, cardiovascular disease; T2DM, type 2 diabetes mellitus; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; CVI, content validity indices; HCMSES, Hypertension and High Cholesterol Management Self-Efficacy Scale; HCPTES, Hypertension and High Cholesterol Perceived Therapeutic Efficacy Scale; SHCSCA, Summary of Hypertension and High Cholesterol Self-Care Activities S; DSCA, Summary of Diabetes Self-Care Activities scale

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prevalence rates in Taiwan are 16.1–20.4% in men, and 13.3–15.3% in women (Hwang, Bai, Chen, & Chien, 2007). The incidence of MetS among people without CVD is approximately 94/1000 person-years in men, and 82/1000 person-years in women (Desroches & Lamarche, 2007), which may significantly increase the risk of CVD (Echahidi et al., 2007), mortality (Zeller et al., 2005), and T2DM (Malik et al., 2010).

Taiwan has the most rapidly aging population in the world(Fu, Huang, & Chou, 2014), which has significantly increased the burden of chronic age-related diseases, exacerbated by lifestyle modernization (Fu et al., 2014; Lin & Huang, 2016). Non-communicable conditions have surpassed acute and infectious diseases as leading burdens of overall disease (Lo et al., 2017) and most middle-aged/elderly people in Taiwan have at least one chronic condition (Lin & Huang, 2016); many have multiple comorbidities, and hypertension, hyperglycemia, dyslipidemia, and combined cardiometabolic risk factors are leading causes of death (Lo et al., 2017).

In 2012, the prevalence of hypertension among adults in the United States was 29.1%, increasing to 65% of those aged ≥60 years (Nwankwo, Yoon, Burt, & Gu, 2013) ; its epidemiology in Asian populations is similar (Chiang et al., 2015). The risks of stroke, heart failure, CVD, kidney disease, and retinal pathology are all increased if hypertension is uncontrolled (Douglas & Howard, 2015). Currently, lifestyle modifications remain the best and safest way to control hypertension (Seals & Hagberg, 1984), which also applies to other components of MetS. Sedentary lifestyle is a risk factor for developing MetS (Chien et al., 1999), and behavioral intervention is an established healthcare strategy to forfend the negative impact of cardiometabolic risk in middle-aged and older adults (Chien et al., 1999). Physical exercise has been reported to increase fat metabolism, reduce triglycerides and increase high-density lipoprotein cholesterol (HDL-C) (Seals & Hagberg, 1984), and consequently improves cardiac and general health (Pourhabib, Fotokian, Nasiri, & Abrotan, 2018; Sedgwick, Brotherhood, Harris-Davidson, Taplin, & Thomas, 1980). Cardiometabolic risk may be controlled by pharmacological and lifestyle modifications, usually combined; although behavioral intervention is considered the safest approach, this is hard to achieve in practice (Chiang et al., 2015; Douglas & Howard, 2015).

Self-efficacy is a widely-accepted psychosocial concept that has been associated with healthcare personnel's capacity to manage chronic conditions (Vivienne Wu et al., 2012), besides significantly increasing individuals' self-confidence in coping with health problems. Hypothetically, self-efficacy may enhance self-efficacy in patients with chronic conditions and improve clinical outcomes (Wu et al., 2007). Although the benefit of self-efficacy in improving hypertension control has been demonstrated (Park, Chang, Kim, & Kwak, 2013), programs for people at higher cardiometabolic risk, for instance those with comorbid hypertension and dyslipidemia, are not available. Hence, the objective of this study was to apply self-efficacy theory to develop a community-

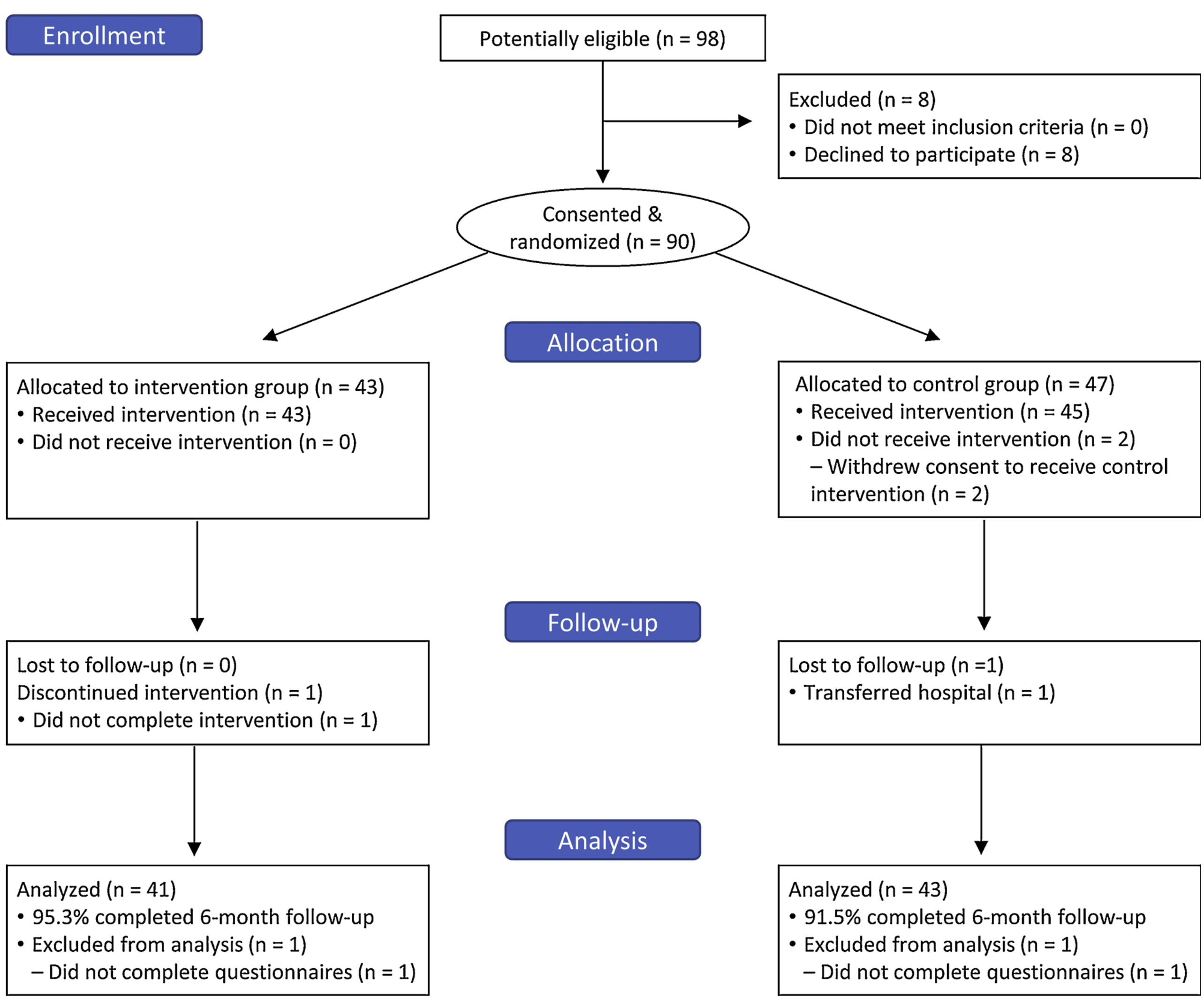

Fig. 1. Study participants sampling and disposition.

based health promotion program for people with CVD risk factors, and to evaluate its effects on participants' self-care behaviors and health outcomes.

2. Material and methods

2.1. Study design and participants

This randomized controlled trial was conducted in Taipei City, Taiwan, from October 16, 2011 to July 31, 2014. During health screening for citizens aged ≥50 years at a local hospital in Taipei, subjects were invited to participate if they fulfilled one inclusion criterion: i) systolic blood pressure 120–139 mmHg or diastolic blood pressure 80–89 mmHg; ii) HDL-C < 40 mg/dL for men and < 50 mg/dL for women; iii) low-density lipoprotein cholesterol (LDL-C) 130–159 mg/dL; iv) triglycerides 150–219 mg/dL; and v) cholesterol total 200–239 mg/dL(Tan, Ma, Wai, Chew, & Tai, 2004). Subjects who signed to affirm informed consent to participate were enrolled and assigned 1:1, at random, between experimental and control groups (Fig. 1). Sample size was estimated using G*power software (version 2.0). At a statistical power of 0.9, an effect size of 0.4, and an alpha error of 0.05, the combined size was calculated to be 44.

Taipei City Hospital Institutional Review Board approved the study (TCH IRB: 10405113-1). All participants were obtained a written signing informed consent. The design and procedures of the study were performed in accordance with the principles of the Declaration of Helsinki. The randomised trial design and reporting format of this study followed CONSORT statements

2.2. Randomization and masking

Independent researchers not involved in assessing outcomes used a random number sequence generated by Excel 2013 (Microsoft, Redmond, WA, USA) to allocate participants by simple direct sampling, 1:1 to intervention or control groups. Opaque sealed envelopes were used to conceal the interventions allocated from participants and assessors. No blinding procedure was adopted after assignment.

2.3. Demographic data

Besides blood pressure and serum lipids, baseline data included participant’s age, sex, education level, marital status, body weight, height, body mass index (BMI), employment and household status, medical history (hypertension, diabetes, hyperlipidemia), tobacco smoking or alcohol drinking habits, and regular physical exercise level.

2.4. Instruments

Each participant completed three semi-structured questionnaires at baseline, and again 6 months after the study ended, which assessed self-efficacy, self-care activities, and perceived therapeutic efficacy. These research instruments were used with the approval of both original and translating authors. Each questionnaire was tested using content validity indices (CVI): seven experts evaluated the validity of every item by assessing its relevance and appropriateness of wording using a four-point Likert scale. A CVI value > 0.8 indicated acceptable content validity (Lynn, 1986). Cronbach's alpha coefficient was used to assess the reliability of each scale.

2.5. Hypertension and high cholesterol management self-efficacy scale (HCMSES)

This scale was adapted from the Chinese Diabetes Management Self-Efficacy Scale, a self-administered scale for patients with T2DM; participants circled responses to 16 items that best expressed their degree of confidence in implementing disease management, and each response was scored from 0 points ("Cannot do it at all") to 10 points ("Can do it completely"). The total score ranged from 0 to 160, where a high score indicated strong self-efficacy. This scale had acceptable reliability and validity for Taiwanese people, with an average CVI score of 0.86 (Vivienne Wu et al., 2008).

2.6. Hypertension and high cholesterol perceived therapeutic efficacy scale (HCPTES)

This scale was based on the 10-item Chinese Perceived Therapeutic Efficacy Scale for T2DM (Vivienne Wu et al., 2008), which measured expectations for outcome in Taiwanese people with T2DM, with good reliability and validity; the average CVI was 0.83 and it showed good internal consistency (Cronbach's alpha 0.95) (Vivienne Wu et al., 2008). The HCPTES focuses on the use of prescription drugs by individuals with hypertension and high cholesterol. Based on expert advice, we included seven items, each scored from 0 points ("Cannot do it at all") to 10 points ("Can do it completely"). The total score ranged from 0 to 70 points, where a high score indicated strong self-efficacy.

2.7. Summary of hypertension and high cholesterol self-care activities (SHCSCA)

The SHCSCA was devised to determine the frequency of daily care activities during the previous seven days by people with hypertension and high cholesterol. It was modified from the Summary of Diabetes Self-Care Activities scale (SDSCA) (Toobert, Hampson, & Glasgow, 2000), which assessed self-care activities by people with DM. In Taiwanese, the SDSCA had a Cronbach's alpha of 0.96, with test-retest reliability of 0.79 (Wu et al., 2007). Based on expert advice, we included seven items.

2.8. Interventions

2.8.1. Experimental health promotion program

The experimental cohort participated in four 2-hour health promotion sessions within 1 month. The specifically-designed sessions entailed learning health promotion skills, watching a 30-minute video about hypertension prevention, and receiving a booklet entitled "Self-Care" to record their blood pressure and daily activities and another, "Health Promotion for Hypertension and High Cholesterol," which covered practicing recommended behaviors, vicarious experiences, verbal persuasion, and physiological and emotional self-evaluation, according to the International Partnership in Self-management and Empowerment. The sessions also enabled face-to-face consultations between participants and a registered nurse or physician about hypertension and high cholesterol, diet, exercise and medication, complications related to hypertension and high cholesterol, and managing blood pressure. Each session finished with a 15-minute physical activity program, as well as experience-sharing and psychological support among group members. The session facilitator contacted participants by telephone after course ended, to encourage them to continue their program. Serum lipid assays, blood pressure measurements and the three questionnaires were repeated 24 weeks after participants had completed the program.

2.8.2. Conventional health education

Conventional health education comprised of nurse consultations and education materials about Health knowledge and skills guidance on disease prevention and it conducted at baseline interview.

2.9. Outcome measures

The primary outcome measures included all laboratory tests for MetS, i.e. systolic blood pressure, diastolic blood pressure, blood glucose, high-density lipoptotein cholesterol and triglyceride and 6-month differences of HCMSES, HCPTES, and SHCSCA.

2.10. Statistical analyses

All statistical analyses were performed using the Statistical Package for Social Sciences Version 20.0 for Microsoft Windows 7 (IBM Corp., Armonk, NY, USA). These included descriptive statistics, independent T-tests, paired T-tests, ANOVA and Chi-square, with p = 0.05, two-tailed, deemed statistically significant. Descriptive summaries report whether participant groups had improved outcome measures, based on mean changes from baseline at 6-months follow up.

3. Results

3.1. Demographic characteristics

Six among 90 enrolled participants did not complete the study; the analytic cohorts comprised 41/43 in the experimental group and 43/47 in the control group (Fig. 1). Participants' mean age was 60.1 years, and most were female (Table 1), married, living with family, and not currently employed. After randomization, participants in both experimental and control group had generally similar baseline characteristics while differences between both groups showed statistical insignificance.

3.2. Pre- vs. Post-study physiological differences within/between experimental and control groups

BMI, systolic and diastolic blood pressure, blood glucose and HDL-C were improved significantly from baseline in the intervention group (Table 2). Systolic and diastolic blood pressures at post-study follow-up was better in both intervention and control groups.

Table 1
Baseline characteristics of participants in experimental and control groups.

Data show number (%), except age mean ± standard deviation.	All participants (n = 84)	Experimental group (n = 43)	Control group (n = 41)
Age (years)	60.1 ± 6.3	58.9 ± 6.3	61.4 ± 6.1
Sex (female)	60 (71.4)	31 (72.1)	29 (70.7)
Education level			
High school and below	45 (53.6)	25 (58.1)	20 (48.8)
College and higher	39 (46.4)	18 (41.9)	21 (51.2)
Marital status			
Single	3 (3.6)	0 (0)	3 (7.3)
Married	75 (89.3)	41 (95.3)	34 (82.9)
Divorced/widowed	6 (7.1)	2 (4.7)	4 (9.8)
Living arrangements			
Living alone	4 (4.8)	2 (4.7)	2 (4.9)
Living with family	78 (92.9)	40 (93)	38 (92.7)
Others	2 (2.4)	1 (2.3)	1 (2.4)
Not employed	61 (72.6)	31 (72.1)	30 (73.2)
Disease	32 (38.1)	18 (41.9)	14 (34.1)
Hypertension	23 (27.3)	12 (27.9)	11 (26.8)
High total cholesterol	14 (16.7)	8 (18.6)	6 (14.6)
Diabetes	4 (4.8)	2 (4.7)	2 (4.7)
Other	1 (1.2)	0 (0)	1 (2.4)
Health education	12 (14.3)	8 (18.6)	4 (9.8)
Hospital visit			
Outpatient	24 (28.6)	15 (34.9)	11 (26.8)
Emergency	1 (1.2)	0 (0)	1 (2.4)
Health-related behaviors			
Drink alcohol	9 (10.7)	5 (11.6)	4 (9.8)
Smoke tobacco	4 (4.8)	0 (0)	4 (9.8)
Regular exercise	66 (78.6)	33 (76.7)	33 (80.5)

3.3. Pre- vs. post-study differences in self-efficacy scales within/between the experimental and control groups

The HCMSES, HCPTES, and SHCSCA scales all showed significant improvement in the experimental group (Table 3). Only the HCPTES showed no statistically significant change in the control group.

3.4. Questionnaire validity and reliability

The modified self-efficacy scales used in this study all had good reliability and validity. The scores of mean content validity index of HCMSES, HCPTES and SHCSCA were 0.91, 090 and 0.80; Their Cronbach's alpha coefficient were 0.78, 0.93 and 0.82, respectively.

4. Discussion

A nurse-led health-promoting intervention program enhanced self-efficacy in managing hypertension and dyslipidemia. The experimental group maintained significant improvement 6 months after the program ended. These findings may be of value in designing programs to improve self-efficacy and self-care skills in patients with hypertension and dyslipidemia.

Many health promotion programs have adopted self-efficacy to improve outcomes, in diverse settings such as chronic obstructive pulmonary disease (Zwerink et al., 2014), smoking cessation (Gwaltney, Metrik, Kahler, & Shiffman, 2009), and AIDS self-management (Nokes et al., 2012). A nurse-led self-efficacy-based community intervention program against hypertension significantly boosted adherence to prescribed medications and salt restriction (Zhu, Wong, & Wu, 2014). In another study, 8-week health education and guidance to strengthen individuals' ability to self-manage hypertension successfully reduced their blood pressure and changed their health-related behaviors (Park et al., 2013). The results of the nurse-led health promotion intervention program in this study were consistent with reported benefit of self-efficacy in diabetes education (Wu et al., 2011).

In this study, participants in the experimental group were empowered to measure their blood pressure by themselves and maintain their BMI within the ideal range, by choosing healthier foods at home and following their diet plan when they ate out. They believed that medications could control blood pressure and cholesterol and reduce the likelihood of complications from these diseases, which increased their levels of mastery. A previous study showed the benefits of high mastery on disability prevention (Lee, Chen, Peng, Chiou, & Chou, 2016). A smart-phone application might enhance the effectiveness of such a health promotion program; patients could record personal data such as daily activities, diet, exercise, and medication use, and set themselves reminders based on their data (Zhao, Freeman, & Li, 2016).

Follow-up rates in both the treatment and control group exceeded 90%, indicating an unusually high level of participant satisfaction with the study interventions. Nevertheless, we acknowledge several limitations. First, the 6-month follow-up period may have been too short to detect an effect on some outcomes. Second, given the before versus after design, it is possible that some results may have been due to factors other than the health promotion program. Future studies with larger representative samples are recommended to determine the role of self-efficacy in modifying high risk behaviors among different racial and ethnic populations.

5. Conclusion

This study evaluated the effectiveness of a health promotion program for people with hypertension and dyslipidemia in Taiwan. The experimental group showed a significant improvement in five physiological indices that was maintained after 6 months of follow-up. The program had a positive effect on a population at high-risk for CVD, and

Table 2
Physiological differences between baseline vs. 6-month follow-up in experimental and control groups.

Characteristics	Experimental group (n = 43)				Control group (n = 41)			
	Baseline Mean ± SD	6-month follow-up Mean ± SD	t	*P*-value	Baseline Mean ± SD	6-month follow-up Mean ± SD	t	*P*-value
Body mass index (kg/m^2))	24.5 ± 3.1	24.2 ± 3.1	2.49	0.017	24.8 ± 3.3	24.8 ± 3.5	−0.10	0.92
Systolic blood pressure (mmHg)	130.4 ± 15.1	123.7 ± 15.9	3.99	< 0.001	129.9 ± 10.6	124.2 ± 17.6	2.14	0.03
Diastolic blood pressure (mmHg)	81.4 ± 9.3	76.2 ± 12.3	4.05	< 0.001	82.9 ± 7.8	78.5 ± 12.9	2.46	0.01
Blood glucose (mg/dL)	108.7 ± 45.6	94.4 ± 22.9	3.34	0.002	95.7 ± 13.2	91.4 ± 16.3	1.77	0.08
High total cholesterol (mg/dL)	201.9 ± 43.9	207.5 ± 44.9	−1.02	0.313	210.3 ± 49.2	218.9 ± 40.3	−1.16	0.25
Triglycerides (mg/dL)	133.0 ± 55.2	121.9 ± 69.2	1.41	0.166	139.5 ± 75.9	131.6 ± 72.8	0.56	0.57
HDL-cholesterol (mg/dL)	56.0 ± 13.11	59.3 ± 17.2	−2.49	0.017	61.2 ± 12.9	62.1 ± 15.7	−0.56	0.58
LDL-cholesterol (mg/dL)	119.4 ± 31.4	124.1 ± 38.3	−1.47	0.148	123.0 ± 29.6	131.4 ± 33.8	−1.84	0.07

SD, standard deviation; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Table 3
Differences in self-efficacy scales between baseline vs. 6-month follow-up in experimental and control groups.

Group	Baseline Mean ± SD	6-month follow-up Mean ± SD	Mean differences	t	*P*-value
Experimental					
Hypertension and High Cholesterol Management Self-Efficacy Scale	110.1 ± 25.6	125.1 ± 20.3	−15.00	−3.31	0.002
Summary of Hypertension and High Cholesterol Self-Care Activities	23.6 ± 8.9	28.3 ± 9.7	−4.67	−2.56	0.014
Hypertension and High Cholesterol Perceived Therapeutic Efficacy Scale	50.7 ± 13.6	59.6 ± 9.8	−8.94	−2.50	0.023
Control					
Hypertension and High Cholesterol Management Self-Efficacy Scale	109.9 ± 33.4	130.51 ± 26.6	−20.59	−3.98	< 0.001
Summary of Hypertension and High Cholesterol Self-Care Activities	23.4 ± 8.9	30.0 ± 9.8	−6.59	−4.06	< 0.001
Hypertension and High Cholesterol Perceived Therapeutic Efficacy Scale	48.5 ± 25.4	62.5 ± 15.0	−14.08	−1.97	0.073

SD, standard deviation.

could serve as a model for developing a feasible scaling-up health promotion programs.

Conflicts of interest

The authors declare that they have no conflict of interest.

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