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Stress management in the workplace for employees with hypertension: a randomized controlled trial

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Abstract

While behavioral interventions can improve blood pressure (BP) in individuals with hypertension, getting such services to people who could benefit remains difficult. Workplace programs have potential as dissemination vehicles. The objective is to evaluate the effectiveness of a standardized stress management program delivered in groups at the workplace for reducing BP compared with enhanced usual care. This randomized controlled trial studied 92 urban medical center employees with hypertension randomized into two groups. The intervention was a 10-week group workshop on cognitive-behavioral coping skills. Enhanced usual care included self-help materials for BP reduction and physician referral. Intervention group participants' systolic BP (SBP) decreased 7.5 mm Hg over controls between baseline and follow-up, from 149.1 (95% CI: 146.0–152.1) to 140.0 (95% CI: 134.7–145.2), $p < .001$. The differential change between intervention and enhanced usual care groups (Group × Time interaction) was 7.5 mm Hg ($t = -2.05$; $p = .04$). Diastolic BP reductions were not significantly different. Scores on measures of emotional exhaustion and depressive rumination showed significant improvements and correlated with reductions in SBP. There was no significant change in the usual care group. A standardized worksite group intervention produced clinically meaningful reductions in SBP in participants with hypertension.

Keywords

Hypertension, Stress, Psychosocial intervention, Workplace intervention, Clinical trials

Implications

Practice: A standardized 10-session stress and anger management program delivered in groups in the workplace proved to be a practical and successful approach to reducing SBP in hypertensive employees.

Research: The possibility of decreases in BP being mediated by changes in emotional exhaustion or depressive rumination should be explored in future research and can be effective in reducing BP in hypertensive employees.

Policy: The workplace may be an excellent venue for dissemination of group psychosocial interventions to address chronic conditions or health behaviors, given the high rate of retention of participants in completing the intervention.

INTRODUCTION

Hypertension affects approximately one third of adults in the USA [1] and is one of the most important modifiable cardiovascular risk factors [2]. Large epidemiologic studies have shown that psychosocial risk factors including hostility [3, 4], chronic psychosocial stress [5], nonadaptive coping [6], depression [7, 8], work stress [9, 10], and low socioeconomic status [11, 12] contribute to the development of hypertension, so it seemed logical that interventions targeting these psychosocial risk factors could help improve blood pressure (BP) control [13, 14]. The potential usefulness of such approaches is heightened by patient preferences for alternatives to pharmacotherapy [15]. A number of previous intervention studies have focused on modifying stress [16–20], hostility [21], and other psychosocial risk factors [22] and have found beneficial effects on BP (or the ability to reduce antihypertension medications [23]) compared with control conditions. Recent reviews [14, 24] suggest psychosocial interventions using multiple components of stress or anger management (cognitive-behavioral approaches often combined with meditative or other relaxation techniques) [21–23] are more effective in reducing BP than single-modality interventions.

The dissemination of behavioral and psychosocial interventions focused on stress reduction and health presents a difficult challenge. Most interventions for hypertension noted above have been developed and delivered in clinical settings. However, medical practices are often overburdened, often lack the resources to deliver psychosocial interventions, and can be a difficult setting for patients to attend regular sessions [25, 26]. Worksite health promotion programs offer easy access for employees during work hours. The Federal Government has emphasized the importance of worksite wellness programs and provided incentives in the Affordable Care Act [27, 28], making it likely that employers will be

increasingly committed to health promotion and the improved management of chronic conditions in their workforces.

Workplace interventions for BP and other cardiovascular risk factors have primarily targeted physical activity, diet, and weight loss [29]. Some have included small stress management components [30], but few have focused on BP with stress management. Some recent workplace programs have taken a "mind–body health" approach to stress reduction, focusing on yoga or mindfulness-based techniques [31, 32], or biofeedback [33], with modest BP changes in nonhypertensive participants. Only one study [34] to our knowledge has targeted hypertensives based on workplace screenings, and the stress management intervention was effective in reducing systolic BP (SBP).

The purpose of the present randomized controlled trial was to test the effects of a well-described, standardized, multicomponent cognitive-behavioral intervention for stress and anger management (Williams LifeSkills Workshop, Williams LifeSkills, Inc., Durham, NC), delivered in groups in a multiethnic, urban workplace, on BP in employees with hypertension. This intervention has previously been shown to reduce emotional distress, anger, depression, social isolation, and perceived stress, as well as BP and heart rate both at rest and during acute stress in healthy populations [35–38],in CHD patients [39] and in groups with known stressors [40, 41]. The workplace is a particularly useful intervention site because hypertension is common in working-age adults; there is little stigma attached to either hypertension or workplace interventions, and therefore, treatment tends to be acceptable to participants [34, 42].

METHODS

Study population

Participants were employees (aged 18–70 years) of a large urban medical center who were identified through workplace BP screenings. Staff were placed at tables in high-traffic areas and offered employees a $5 public transit card as an incentive for BP screening. Employees whose screening BP (average of three measurements) was ≥140 mm Hg SBP or 90 mm Hg diastolic BP (DBP) and whose average readings did not exceed 180/110 mm Hg at both this screening and the subsequent baseline evaluation were eligible and invited to participate in the RCT. The exclusion criteria were pregnancy and end-stage renal disease. The study was approved by the Institutional Review Board at Columbia (University Medical Center); all participants gave informed consent. Data collection began in 2003, and the trial is registered at clinicaltrials.gov (Identifier NCT01262066).

Investigator involvement

Although this project was funded with a Small Business Innovation Research (SBIR) grant from the National Institutes of Health (NIH) through Williams LifeSkills, Inc, Durham, NC and the founders (R.B.W. and V.P.W.) share authorship on this paper, the founders' involvement in the study was restricted to ensuring treatment fidelity through the training and initial supervision of the clinician (L.P.C.) who subsequently trained and supervised the clinicians who delivered the intervention. Otherwise, the design and conduct of this study, the data collection, analysis, and interpretation of results occurred completely independent of the developers of the intervention. They were involved in the editing of the manuscript.

Procedures

At the first baseline visit, participants gave informed consent, had a second set of three BP measurements taken, and completed questionnaires to assess stress, depression, and other psychosocial conditions. They also completed a structured interview either during the baseline visit or at a separate visit within 2 weeks. Those with average BP measurements that were in the hypertensive range at the baseline visit and did not exceed 180/110 mm Hg were invited to participate in the trial. Those who agreed to participate were randomly assigned to one of two groups: intervention (LifeSkills workshop) or minimally enhanced usual care. Randomization was done by calling an off-site person holding the randomization envelopes, using random-sized randomization blocks provided by the study statistician (J.E.S.), in accordance with CONSORT (Consolidated Standards of Reporting Trials) guidelines [43]. To ensure that any observed treatment benefits were not occurring only in patients with high hostility levels, the randomization was stratified for baseline hostility (two categories based on Barefoot's [44] criterion of a score ≥13 on the Cook-Medley Hostility Scale [45]). Treatment groups included a mixture of high and nonhigh hostile participants. Follow-up assessments were identical to baseline assessments and occurred approximately 60 days after the end of the intervention. Participants were paid $125 for completing the trial.

BP measurement

At screening, baseline, and follow-up 2 months following the last group session, three BP readings were taken at 1-min intervals using an automated device (BP-TRU BPM-100; VSM MedTech Ltd., Vancouver, BC, Canada). This BP-TRU device is a highly accurate and objective measure of BP considered the "gold standard" [46, 47] for office BP measurement regarding reliability and consistency with ambulatory measurement. BP readings were done in accordance with American Heart Association [48] and *JNC 7* [49] guidelines for office BP measurement. That is, persons are seated quietly for at least 5 min in a chair with feet on the floor and arm

supported at heart level; caffeine, exercise, eating, and smoking have been avoided for at least 30 min prior to measurement. These measurement sessions generally took place during midday breaks or immediate after-work hours.

Demographic measures and medications

Self-report measures were completed at baseline and at follow-up. Table 1 shows the demographic characteristics of the sample by randomization group. Participants listed all current medications for hypertension and any other conditions. A hypertension specialist (T.G.P.) compared hypertension medications at baseline and follow-up and evaluated changes as to whether medication had been increased, decreased, or not changed.

Psychosocial measures

Psychosocial instruments included measures of distress used previously in studies of the LifeSkills

Table 1 | Baseline characteristics of all participants who were randomized[a]

Variable	All (*N* = 92)	Control group (*n* = 46)	Intervention group (*n* = 46)	*p*
Age, years[b]	48.5 (8.7)	48.7 (9.0)	48.4 (8.4)	.89
Height, in[b]	64.9 (3.4)	65.5 (3.4)	64.2 (3.2)	.08
Weight, lb[b]	188.6 (43.6)	187.7 (49.1)	189.5 (37.4)	.85
BMI[b]	31.3 (6.4)	30.6 (6.8)	32.1 (6.0)	.26
Systolic blood pressure, mm Hg[b]	148.0 (10.4)	147.0 (10.2)	149.1 (10.6)	.35
Diastolic blood pressure, mm Hg[b]	90.8 (7.7)	90.3 (8.7)	91.3 (6.5)	.54
Hypertension type				
Controlled on medication	2 (2)	0 (0)	2 (4)	.20
Stage 1	66 (72)	36 (78)	30 (65)	
Stage 2	24 (26)	10 (22)	14 (30)	
Female	71 (77)	33 (72)	38 (83)	.21
Male	21 (23)	13 (28)	8 (17)	
Hypertension medication use at baseline				
No	34 (38)	15 (33)	19 (43)	.30
Yes	56 (62)	31 (67)	25 (57)	
Race				
White (non-Hispanic)	14 (15)	6 (13)	8 (17)	.83
White (Hispanic)	14 (15)	6 (13)	8 (17)	
Black (non-Hispanic)	42 (46)	20 (43)	22 (48)	
Black (Hispanic)	8 (9)	5 (11)	3 (7)	
Asian/Indian	4 (4)	2 (4)	2 (4)	
Asian/Pacific Islander	4 (4)	3 (7)	1 (2)	
Other	6 (7)	4 (9)	2 (4)	
Ethnicity				
Latino	26 (28)	14 (30)	12 (26)	.64
Non-Latino	66 (72)	32 (70)	34 (74)	
Marital status				
Never married	20 (22)	9 (20)	11 (24)	.80
Currently married	41 (46)	22 (49)	19 (42)	
Separated, divorced, or widowed	29 (32)	14 (31)	15 (33)	
Education				
Some college or less	46 (51)	22 (49)	24 (52)	.75
College graduate or graduate school	45 (49)	23 (51)	22 (48)	
Income				
≤$50,000	48 (56)	23 (54)	25 (58)	.66
>$50,000	38 (44)	20 (47)	18 (42)	
Cook-Medley Hostility Scale[26]				
Below 13	50 (54)	25 (54)	25 (54)	1.00
At or above 13	42 (46)	21 (46)	21 (46)	

BMI indicates body mass index, calculated as weight in kilograms divided by height in meters squared.
[a]Data are presented as number (%) unless indicated otherwise.
[b]Data are presented as mean (*SD*).

Intervention, including the 27-item Barefoot version of the Cook-Medley Hostility Scale [44, 45], formatted as true–false responses, Centers for Epidemiological Studies–Depression Scale (CES-D) [50], a 20-item measure of self-rated depressive symptoms, and the 10-item Perceived Stress Scale [51]. As this was a workplace study, we also included the Maslach Burnout Scale [52], a 22-item measure made up of three internally consistent domains: emotional exhaustion, depersonalization (or cynicism), and personal accomplishment (or professional efficacy; Maslach and Leiter, 2016) [53]. The measure has good reliability but is sensitive to changes in circumstance. Work strain was measured by the Karasek Job Content Questionnaire, assessing with 42 items the amount of perceived job strain (defined as low job control vs. high job demand) [54]. Assertiveness, related to issues targeted in the intervention, was measured by the Personal Assertion Analysis (PAA) [55], a 50-item questionnaire for adults that provides scores for assertive, passive, and aggressive interpersonal behavior. Social support was measured by the Interpersonal Support Evaluation List (ISEL) [56]. A final exploratory measure, the Ruminative Response Scale (RRS) [57], was added partway through data collection. The RRS is a 20-item measure widely used in studies of emotional regulation and depression, in which respondents rate items comprising three dimensions of ruminative thinking: depressive rumination, reflection, and brooding. All measures have been subjected to extensive psychometric study and have adequate levels of internal consistency and reliability. Measures were completed on paper and were taken at baseline and 2 months post treatment.

Intervention

Participants assigned to the treatment condition attended 10 weekly 1-hr sessions in groups of 8–10 participants. Group sessions were conducted at midday lunch breaks, during the workday, between 12 noon and 2:00 pm. Sessions followed the Williams LifeSkills Workshop manual and video [32]. The LifeSkills Workshop is a structured cognitive-behavioral group intervention that draws on cognitive-behavioral techniques and stress reduction approaches. It is framed as training to increase a person's resiliency for coping with stressful situations, rather than as treatment for a mental disorder. The facilitator leads participants through each of several behavioral skills, modeling them as necessary. A video [38] developed as an adjunct to the program was integrated into each session, which standardized the presentation of material. Skills included self-monitoring, such as identification and evaluation of thoughts, feelings, and behaviors in response to stressful situations; problem solving; assertiveness in dealing with anger- and stress-inducing events and/or demands; deflection skills to reduce distress in stressful situations, such as breathing and muscle relaxation, distraction, and increasing distress tolerance; communication skills; and increasing empathy and building positive relationships. The weekly sessions were audio recorded to monitor treatment fidelity and to allow for supervision of the facilitators. The same facilitator worked with the same group of participants throughout the course of the intervention. Facilitators offered individual consultation to participants who missed a session. Three doctoral-level clinical or counseling psychologists were trained according to the guidelines used by Williams LifeSkills, Inc., to serve as group facilitators; they received ongoing supervision from the senior study clinician (L.P.C.) to ensure fidelity to the material.

Participants in the minimally enhanced usual care group received a brochure on BP control developed by the National Heart, Lung, and Blood Institute [58], containing information about hypertension and suggestions for making lifestyle changes to reduce BP. With patients' permission, their BP readings were sent to their physicians, along with the two-page *JNC 7* reference card summarizing guidelines for the management of high BP [59]. There were no group meetings for the usual care condition.

Statistical analyses

An intent-to-treat analysis was performed on all randomized participants. A multilevel, repeated-measures regression analysis was performed to generate full information maximum likelihood estimates of the group-specific average change in SBP and DBP between baseline and the 2-month posttreatment assessments and to estimate and test the differential change between the intervention and usual care groups. Consistent with intent-to-treat principles, all participants who were randomized, including two participants who were subsequently deemed ineligible (described below), were included in the analysis [60, 61], In the multilevel model, treatment group, time (baseline vs. 2-month follow-up), and the interaction of treatment group and time were entered as fixed effects predicting the primary outcomes, SBP, and DBP. Because the randomization was stratified by hostility group, hostility group and the interaction of hostility group and time were included as covariates. In secondary analyses, we repeated the analysis excluding those who did not complete the study and repeated the intent-to-treat analysis controlling for the use of hypertension medications at baseline and changes in medication use.

Psychosocial variables were tested for baseline group differences, and change scores from baseline to 2-month follow-up were tested using *t*-tests for group differences. Correlational analyses were conducted to explore relationships between change scores for BP and psychosocial variables. Finally, we conducted exploratory analyses to test whether

psychosocial variables that changed significantly mediated the differential decline in BP associated with the intervention. Given that the assessments of both the mediators and dependent variables were conducted prior to and following the intervention, we followed the procedures of Bauer et al. [62] for conducting mediation in multilevel models.

RESULTS

Participants

As shown in the CONSORT diagram (Fig. 1), of the 2,401 people seen at the worksite BP screenings, 2,009 (84%) were ineligible or declined to participate in research, while 392 (16%) employees were eligible at screening on the basis of BP measurement (≥140/90 mm Hg and <180/110 mm Hg) and agreed to be contacted for research.

Of the 392 eligible employees, 211 declined to participate in this study or could not be contacted after three telephone messages. The remaining 181 employees agreed to participate, but 88 of these individuals were ineligible because the average of their second set of baseline BP readings was below 140/90 mm Hg. One additional person was eligible but declined to participate prior to randomization. Of the 92 who were randomized, 46 were assigned to the intervention group, and 46 were assigned to the usual care control group. Eleven participants dropped out after randomization (six in the intervention group and five in the usual care control group). Two participants, both in the intervention group, were later found to have been ineligible because their average BP measurements were computed in error and were actually below the cutoff.

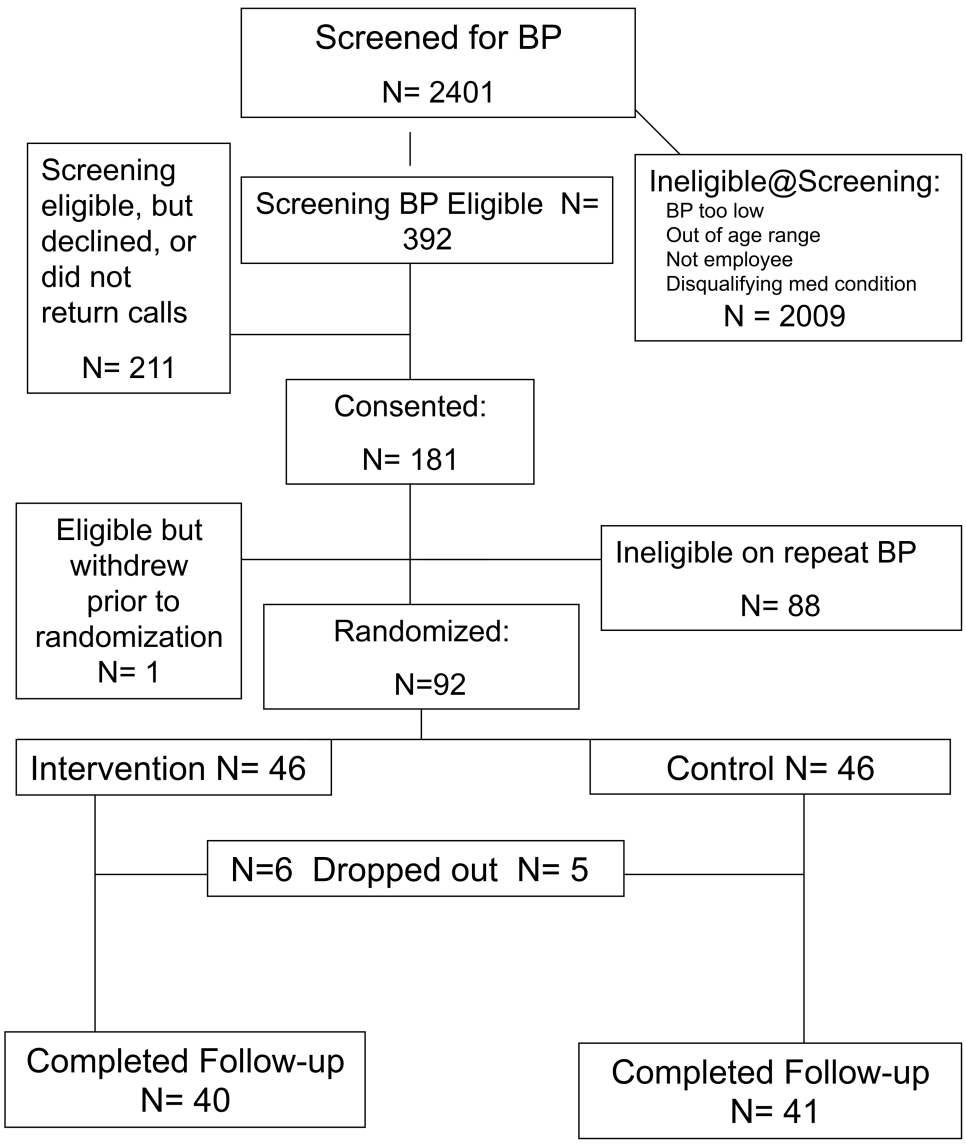

Fig 1 | CONSORT diagram.

Baseline demographic and clinical characteristics

No significant differences were observed between the intervention and control groups on demographic and clinical characteristics at baseline (Table 1). Participants were primarily female, were ethnically diverse (approximately 50% self-identified as black and more than one fourth as Latino/a), and had a mean age of approximately 48 years. They tended to be obese, and most met criteria for Stage 1 hypertension, with an average BP of 148/91 mm Hg. Approximately, 62% (56/92) of participants reported taking BP medication at baseline, and 46% (42/92) scored in the high hostility range based on the Barefoot [39] scoring of the Cook-Medley Hostility Scale.

Intervention process data

Randomized participants attended with mean (*SD*) of 8.1 (1.8) group sessions, with 89.3% attending seven or more sessions.

Intent-to-treat analysis

Blood pressure

All 92 participants who were randomized were included in the analysis. Table 2 shows the adjusted mean levels of BP by treatment group and assessment, the group differences within assessment, the temporal changes within group, and the overall treatment effect (Group × Time interaction) for SBP and DBP. The intent-to-treat, repeated-measures regression analysis showed a small, nonsignificant 1.7 mm Hg decline in SBP in the control group ($t = -0.66$, $p = .51$) and a 9.1 mm Hg decline in the intervention group ($t = 3.47$, $p < .001$). At baseline, SBP and DBP were similar between the two groups. The differential change between groups (Group × Time interaction) was 7.5 mm Hg ($t = -2.05$, $p = .04$; Table 2). The effect size (Cohen's *d*) for this treatment effect was 0.72. Although the pattern of results for DBP (Table 2) was similar to that for SBP—a nonsignificant decline in DBP in the control group and a significant decline of 4.8 mm Hg ($t = 3.33$, $p = .001$) in the intervention group—the differential decline (i.e., treatment effect) of 3.1 mm Hg was not statistically significant ($t = -1.51$, $p = .14$). These SBP and DBP findings are illustrated in Figs. 2 and 3. In secondary analyses, we repeated the previous analyses after restricting the sample to those who completed the protocol (i.e., those in the control group who completed the follow-up assessment [$n = 41$] and those in the intervention group who attended at least six sessions and completed the follow-up assessment [$n = 39$]). The treatment effect for SBP (−7.2 mm Hg; $t = 1.96$, $p = .05$) was essentially identical to that from the intent-to-treat analysis. Similarly, the treatment effect for DBP (−3.0 mm Hg; $t = 1.45$, $p = .15$) was nearly identical to that from the intent-to-treat analysis. We also repeated the intent-to-treat analysis including use of hypertension medication at baseline and change in medication as covariates, and the results were again unchanged; the treatment effects were −7.2 mm Hg ($t = -1.95$, $p = .05$) for SBP and −3.0 mm Hg ($t = 1.46$, $p = .15$) for DBP.

Psychosocial variables

Baseline psychosocial characteristics did not vary between treatment and control groups (Table 3). Only two psychosocial variables showed significant differences between groups in pre- and postchange: (a) the Emotional Exhaustion Scale of the Maslach Burnout Inventory and (b) the Depressive Rumination Scale of the RSS, with the treatment group self-reporting greater reductions in emotional exhaustion ($p = .03$) and depressive rumination ($p = .02$).

Correlational analyses

Pearson product moment correlations were calculated between change scores in SBP and DBP and change in the two psychosocial measures that showed significant group differences. Reductions in SBP in all participants correlated significantly with reductions in emotional exhaustion ($r = .31$, $p = .02$) and the depressive rumination subscale of the RRS

Table 2 | Adjusted mean blood pressure by treatment group and period[a]

Response variable	Baseline	Follow-up	Change	*p*
Systolic blood pressure, mm Hg				
Control group	147.0 (144.0 to 150.1)	145.4 (140.4 to 150.4)	−1.7 (−6.6 to 3.4)	.51
Intervention group	149.1 (146.0 to 152.1)	140.0 (134.7 to 145.2)	−9.1 (−14.4 to −3.9)	<.001
Difference	2.0 (−2.3 to 6.4)	−5.4 (−12.6 to 1.8)	−7.5 (−14.7 to −0.2)	.04
p	.35	.14	.04	...
Diastolic blood pressure, mm Hg				
Control group	90.3 (88.0 to 92.6)	88.5 (85.3 to 91.7)	−1.8 (−4.6 to 1.0)	.21
Intervention group	91.3 (89.0 to 93.5)	86.4 (83.2 to 89.6)	−4.8 (−7.7 to −2.0)	.001
Difference	1.0 (−2.2 to 4.2)	−2.1 (−6.6 to 2.4)	−3.1 (−7.1 to 1.0)	.14
p	.55	.36	.14	...

[a]Data are presented as mean (95% confidence interval) unless indicated otherwise. Multilevel repeated-measures analysis, controlling for hostility category (high vs. other), and Hostility × Period interaction (randomization was stratified by hostility). Ellipses indicate not applicable.

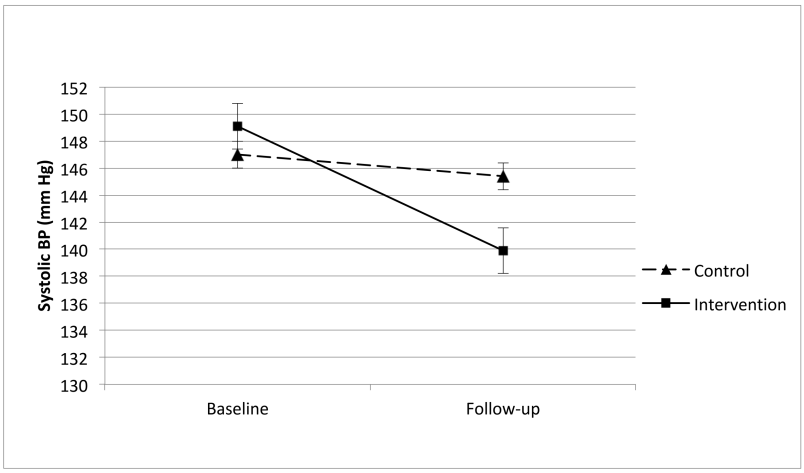

Fig 2 | Systolic blood pressure measurement, mm Hg, at Baseline and at 2 month follow-up in control and Intervention groups. Data are presented as mean (vertical bars represent ±1 *SE*).

(r = .58, p = .001). Decreases in DBP correlated significantly with decreases in depressive rumination (r = .42, p = .03). In the intervention group, the number of group sessions attended did not correlate significantly with changes in either SBP or DBP, though the number of sessions attended did correlate with emotional exhaustion (r = .45, p = .03). Neither hypertension medication use at baseline nor changes over time affected the outcomes.

Mediation analyses

Supplemental, exploratory analyses were conducted to test whether the reduction in emotional exhaustion or depressive rumination mediated the larger decline in BP associated with the intervention. Neither of these two potential mediators explained the differential decline in either SBP or DBP. However, this study may have been underpowered to detect a mediation effect, and thus, the possibility of mediation should be explored in future trials with more participants.

DISCUSSION

A cognitive-behavioral stress and anger management intervention delivered in groups in the workplace for employees with hypertension was effective in reducing SBP compared with minimally enhanced usual care. Effects on DBP were more modest and were nonsignificant in the intent-to-treat analysis. The 9.1 mm Hg reduction in SBP in the intervention group was clinically noteworthy compared with the 1.7 mm Hg reduction in the usual care group. This reduction in SBP compares favorably with the findings of other studies of nonpharmacological approaches to reduce BP, including one that employed stress management in the worksite and found a significant decrease in SBP but not DBP in the intervention group [34, 42].

The intervention had relatively small effects on psychosocial variables compared with previous studies of the LifeSkills Workshop intervention, which had shown substantial reductions in depressive symptoms and hostility [35–41]. However, in

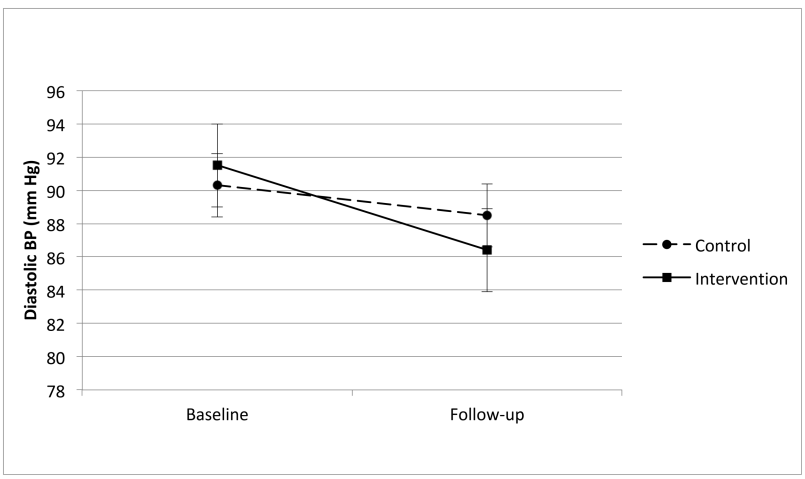

Fig 3 | Diastolic blood pressure measurement, mm Hg, at baseline and at 2 month follow-up in control and intervention groups. Data are presented as mean (vertical bars represent ±1 *SE*).

Table 3 | Baseline characteristics and change scores of randomized participants on psychosocial variables

	Baseline		Change Scores		
Variable	Control (n = 46)	Intervention (n = 46)	Control	Intervention	p=
Cook-Medley hostility	12.2 (5.6)	12.8 (5.6)	0.0 (5.4)	0.32 (5.3)	ns
CES-D	11.2 (10.2)	14.5 (8.7)	1.0 (5.9)	0.10 (8.9)	ns
Maslach Burnout inventory					
Emotional exhaustion	23.2 (12.6)	19.2 (10.8)	3.12 (9.7)	−2.5 (9.6)	.03
Depersonalization	4.2 (4.4)	5.4 (5.2)	−0.06 (4.5)	−0.89 (4.1)	ns
Personal accomplishment	31.5 (11.3)	32.3 (9.7)	−0.7 (7.6)	1.9(10.2)	ns
John Henryism	47.8 (5.6)	48.4 (5.6)	−1.0 (5.4)	1.3 (6.1)	ns
Karasek job questionnaire					
Skill discretion	33.6 (4.9)	33.2 (5.8)	0.7 (4.6)	0.16 (4.6)	ns
Decision-making authority	30.7 (6.3)	29.7 (4.3)	1.7 (6.1)	−0.27 (5.7)	ns
Job demands	32.9 (6.8)	31.2 (5.4)	1.0 (6.5)	−0.70 (6.9)	ns
PAA (interpersonal behavior)					
Passive behavior	28.3 (5.8)	27.4 (5.5)	−0.85 (3.6)	−0.32 (5.2)	ns
Aggressive	31.7 (5.8)	31.4 (5.0)	−0.28 (4.2)	−0.06 (4.3)	ns
Assertive	21.9 (5.8)	21.2 (4.5)	−0.62 (3.5)	0.14 (3.7)	ns
ISEL (social support)					
Belonging	13.7 (2.1)	13.0 (2.8)	−0.08 (1.9)	0.09 (2.4)	ns
Appraisal	13.4 (3.1)	12.9 (3.4)	−0.75 (1.9)	−0.49 (2.5)	ns
Tangible	13.6 (2.9)	13.0 (2.3)	−0.12 (2.6)	0.03 (2.5)	ns
Ruminative Response Scale					
Depressive rumination	17 (5.1)	19.0 (6.1)	1.5 (3.1)	−1.3 (2.6)	.02
Reflection	8.9 (4.1)	9.9 (3.3)	1.2 (3.2)	0.09 (4.5)	ns
Brooding	8.2 (2.1)	10.2 (3.6)	0.35 (1.7)	0.09 (1.9)	ns

PAA personal assertion analysis.
All continuous variables, mean (*SD*) is given.

this study, participants were selected for high BP, rather than elevated levels of emotional distress that served as entry criteria in some other studies, and the baseline emotional distress levels were relatively low, leaving less room for improvement in these participants.

Improvements in the intervention group for a measure of work-specific distress, the Emotional Exhaustion Scale of the Maslach Burnout Inventory, correlated moderately with reductions in SBP. It may be that an intervention at the worksite is particularly effective at addressing problems that affect workplace stress. For example, a recent study of workers on sick leave for work stress found that employees who underwent a similar stress management program returned to work sooner and with fewer symptoms than wait-list controls [63]. The second measure that changed significantly in the intervention group, despite having been added to the protocol later resulting in less power to detect change, was the Depressive Rumination Scale of the RSS. Rumination seems to sustain the physiological impact of stress or anger-inducing events on BP [64, 65] and has been proposed as a mechanism by which episodic stressors may lead to sustained high BP [65, 66].

The potential clinical significance of the 7.5 mm Hg differential change in SBP between the groups is supported by a recent meta-analysis involving 1 million patients in 61 studies reporting that even a 2 mm Hg reduction in SBP was associated with a 10% lower risk of mortality due to stroke and a 7% lower risk of mortality due to ischemic heart disease or other vascular causes in middle-aged persons [67]. The current findings suggest that the intervention used in this study has the potential to be used on a larger scale to reduce BP in patients with hypertension. It might also prove to be applicable to individuals in high-risk groups, such as employees with high job demands [54], persons of lower socioeconomic status (who have been recently reported to have higher SBP levels [11, 12]), and other populations exposed to chronic stress. The group format could be more cost-efficient than individual interventions. Given that the same LifeSkills program delivered via video with telephone coaching has been found to reduce BP in stressed caregivers, with maintenance of BP reductions over 6 months [40], it is possible that such stress reduction training could be disseminated on a larger scale among hypertensive patients in a wide range of real-world settings using video or online platforms.

Several limitations of this study should be noted. First, research staff were not blinded to participant group assignment. However, we attempted to mitigate the potential influence of this problem by using

automated BP measurements, which are blinded to group assignment and less susceptible to bias than manual BP measurements. While our intent was to use a measurement that is standard in clinical care, replication of these findings with ambulatory BP data would strengthen the results. Ambulatory daytime DBP was reduced in healthy normotensive youth who received LifeSkills training in one prior trial [41]. In the absence of an attention-control group, it is not possible to be sure how much of the positive BP change was due to the intervention content itself or the psychologist-led meetings with employees in a group setting. In any case, the intervention as delivered was superior to usual care. A final limitation is that specific cost data were not collected, so cost-effectiveness analyses could not be performed.

Summary

This trial using a standardized stress and anger management intervention led to statistically significant and clinically meaningful reductions in SBP compared with enhanced usual care among employed persons with elevated BP. DBP was not significantly reduced. The magnitude of change in BP between groups is clinically significant and comparable with that shown in other successful studies of nonpharmacologic approaches to hypertension treatment. Although the current trial is relatively small, it featured careful ascertainment of office BP and a standard manualized intervention, which previous stress reduction intervention studies have been criticized for lacking. It also was conducted with an ethnically diverse population. If the present findings are confirmed in future trials with larger samples, it would indicate that this approach to teaching cognitive-behavioral coping skills has the potential to be a useful adjunct to pharmacotherapy with the potential to be delivered on a larger scale in real-world workplace settings for the treatment of hypertension.

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Compliance with Ethical Standards

Conflict of Interest: R.B.W. and V.P.W. are founders and major stockholders in Williams LifeSkills, Inc. Their involvement in the project, as noted in the Methods section, was limited to treatment fidelity and initial training and initial supervision in the intervention. They also assisted in the editing of the manuscript. Otherwise, the design and conduct of the study, the data collection and analyses, and interpretation of results occurred independently of the developers of the intervention. The other authors (L.P.C., T.G.P., K.W.D., J.E.S., V.P.W., J.A.S., R.B.W., W.G.) have no conflicts to disclose.

Primary Data: The authors have full control of all primary data, and they agree to allow the journal to review their data if requested. The findings reported here have not been previously published, and the manuscript is not being simultaneously submitted elsewhere. Portions of these data were presented at the Society of Behavioral Medicine Annual Meeting, 2009.

Ethical Approval: We declare that our protocol is in compliance with the Declaration of Helsinki principles. There were no animals involved in the study.

Informed Consent: The study was approved by the Institutional Review Board at Columbia University Medical Center, and all participants gave informed consent.

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