Stress Management Intervention for Primary Prevention of Hypertension: Detailed Results from Phase I of Trials of Hypertension Prevention (TOHP-I)

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PURPOSE: Stress Management Intervention (SMI) was one of seven nonpharmacologic approaches evaluated in Phase I Trials of Hypertension Prevention (TOHP-I) for efficacy in lowering diastolic blood pressure (BP) in healthy men and women aged 30 to 54 years with diastolic BP 80–89 mm Hg.
METHODS: A total of 242 and 320 participants were randomized to SMI or an "assessment only" SMI Control, respectively, at four clinical centers. The SMI consisted of 37 contact hours in 21 group and two individual meetings over 18 months and included: training in four relaxation methods, techniques to reduce stress reactions, cognitive approaches, communication skills, time management, and anger management within a general problem-solving format. Standardized protocols detailed methods and timing for collecting BP, psychosocial measures, and urinary samples from both SMI and SMI Control participants.
RESULTS: In intention-to-treat analyses, although significant baseline to termination BP reductions were observed in both groups, net differences between the SMI and SMI Control groups' BP changes (mean (95% CI)) were not significant: -0.82 (-1.86, 0.22) for diastolic BP, and -0.47 (-1.96, 1.01) for systolic BP. Extensive adherence sub-group analyses found one effect: a significant 1.36 mm Hg ($p = 0.01$) reduction in diastolic BP relative to SMI Controls at the end of the trial for SMI participants who completed 61% or more of intervention sessions.
CONCLUSIONS: While the TOHP-I SMI was acceptable to participants as evident from high levels of session completion, the absence of demonstrated BP lowering efficacy in intention-to-treat analyses suggests that the TOHP-I SMI is an unlikely candidate for primary prevention of hypertension in a general population sample similar to study participants. The isolated finding of significant diastolic BP lowering in SMI participants with higher adherence provides very weak evidence of SMI BP lowering efficacy and may be a chance finding. Whether similar or other stress management interventions can produce significant BP lowering in populations selected for higher levels of BP, stress, or intervention adherence remains to be demonstrated.
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INTRODUCTION

Although mortality rates from stroke and coronary heart disease (CHD) have declined for the last two decades as high blood pressure (BP) has been treated in larger segments of the population, progress has slowed substantially in recent years (1). The identification of nonpharmacologic methods to prevent, or significantly delay the onset of hypertension

46 Batey et al.
TOHP PHASE I STRESS MANAGEMENT INTERVENTION RESULTS

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would represent an important advance in the primary prevention of cardiovascular disease (1). The objective of Phase I of the Trials of Hypertension Prevention (TOHP-I) was to assess the efficacy of seven nonpharmacologic interventions in lowering or preventing an increase in diastolic blood pressure (BP) over 18 months of follow-up (2). These nonpharmacologic interventions included three lifestyle change programs: stress management intervention (SMI), dietary sodium reduction, and weight reduction. Four nutritional supplement regimens utilizing calcium, magnesium, fish oil, and potassium were also evaluated. Primary results from the trial have been presented elsewhere (3). This report presents detailed findings from the SMI arm of the trial.

The inclusion of SMI in Phase I of TOHP was supported by three types of evidence. First, some treatment outcome studies (4–6) had reported modest BP reductions associated with SMI. Second, a plausible sympathetic nervous system mechanism for the development of stress-related hypertension had been proposed (7) and was supported by laboratory studies in animal models (8, 9) and humans (10). Third, observational studies of human populations suggested an association between a variety of stressful events and autonomic nervous system responses that included both immediate and delayed cardiovascular reactions such as elevated BP (11, 12).

METHODS

Participants

The TOHP-I design (2) and participant baseline characteristics (13) have been reported elsewhere. Briefly, a total of 242 and 320 participants were randomly assigned to the SMI or SMI Control groups, respectively, at four clinical centers: University of Alabama at Birmingham, Birmingham, AL; University of Tennessee, Memphis, TN; New Jersey Medical School, Newark, NJ; and Kaiser Permanente Center for Health Research, Portland, OR. The major inclusion criteria for study participants were age 30 to 54 years and an average diastolic BP of 80–89 mm Hg. BP was the average of nine readings obtained with a random-zero sphygmomanometer at three separate screening visits 7 to 30 days apart, with three readings taken at each visit. The

major exclusion criteria were: evidence of current hypertension; gross obesity defined as a body mass index $\geqslant 36$ kg/m^2; or a history of cardiovascular disease, diabetes, or any disease or condition that would compromise safe and effective participation in the trial.

Selection of participants who had significantly elevated levels of stress was considered during the planning phase of the trial. However, in early 1987 there was little empirical evidence that SMI efficacy in a general population sample would be increased by selection based on any measure of elevated stress. In addition, the primary objective of TOHP was to develop recommendations that would have broad applicability to the U.S. population rather than to a select group of individuals experiencing high stress levels.

Stress Management Intervention

The primary objective of the TOHP-I Stress Management Intervention (SMI) program was to provide participants with methods to reduce and/or cope more effectively with their everyday stress. The first and principal component of the SMI emphasized training in four relaxation methods to ensure that each participant could use and enjoy at least one approach successfully. The four SMI relaxation methods were: four cycles per minute paced breathing (14); progressive muscle relaxation based on the Bernstein and Borkovec method (15) combined with a modification of the Jacobson approach (16); relaxation using imagery (17); and Carrington's Clinically Standardized Meditation (18).

The goal of the relaxation training was to enable participants to achieve a more relaxed and comfortable state throughout the day. To achieve this goal, daily or more frequent use of one or combinations of the SMI relaxation procedures for periods up to 20 minutes was strongly encouraged. In addition, when appropriate, participants were encouraged to engage in "mini-relaxations" of one or more minutes triggered by regularly-occurring events of their choice like stop lights, elevator rides, ringing telephones, etc. Eyes-open forms of muscle relaxation, slow-paced breathing, and meditation were introduced and practiced in sessions to develop skill with relaxation methods that could be used throughout the day. It was hypothesized that participants who achieved the recommended goal of at least one long ($\geqslant 7$ min) and three brief ($\geqslant 1$ to < 7 min) periods of SMI relaxation each day would: 1) become more relaxed; 2) be able to detect stress responses in their early stages; 3) be able to use these as early warning signs to reduce stress earlier in its development; 4) experience slower response onset when exposed to stress; and 5) experience lower intensity or fewer stress responses.

The second major component of the TOHP-I SMI involved training participants to apply relaxation to reduce stress responses. This included a session on desensitization similar to Suinn's Anxiety Management Training (19) and another session on imaginary rehearsal to stay calm and relaxed in stressful situations when appropriate. The third