

Joanna C. Bovee  
Lake Forest College

## Effects of Transcendental Meditation on Blood Pressure: A Literature Review

Many prevention and treatments methods exist for hypertension, but not all are effective or easy to incorporate into one's life. Stress-reduction methods, including Transcendental Meditation (TM), has been suggested as such a method, but have received inconsistent reviews about its effect on blood pressure. This literature review of twelve clinical studies concludes patients who practice TM can significantly reduce blood pressure. The technique was found to be effective for groups at high risk for hypertension, such as African-Americans, as well as low-risk groups. TM also appears to be more effective than progressive muscle relaxation, another popular stress-management technique. TM should be incorporated into plans for treatment of hypertension.

Hypertension is a common, but serious medical condition. Over 50 million U.S. Americans are considered hypertensive when the condition is defined as a systolic blood pressure (SBP) equal or greater to 140 mmHG and diastolic blood pressure (DBP) equal to or greater than 90 mmHG. People over the age of 55, African Americans, women, and individuals with high-normal blood pressure (BP) during adolescence are at increased risk for developing the disease over the course of their lifetime (National Heart, Lung, and Blood Institute, 2003; Beckett, Rosner, Roche, & Guo, 1992). Hypertension is a major health concern as it is linked to cardiovascular disease (CVD), the leading cause of death in the United States (National Center for Health Statistics, 2004). While high blood pressure is dangerous, this risk factor for CVD is modifiable and even preventable through treatments such as antihypertensive medication,

and lifestyle changes, such as weight reduction; consumption of a diet low in sodium, and rich in fruits, vegetables, and low-fat dairy products; physical activity, and moderate consumption of alcohol (National Heart, Lung, and Blood Institute, 2003).

In the most recent Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC) report on hypertension (2003), the recommendation of stress reduction as part of a lifestyle modification program was not included. The previous JNC report from 1997 acknowledged the ability of emotional stress to raise blood pressure, but the committee was hesitant in recommending stress management approaches, such as relaxation techniques and biofeedback. As a whole, these methods showed little impact on blood pressure when studied in controlled clinical trials. (National Heart, Lung, and Blood Institute, 1997;

Schneider et al., 1995).

One particular relaxation technique is Transcendental Meditation (TM). This practice is derived from an ancient Vedic tradition originating in India. Once used to achieve enlightenment, it has been taught world wide for the last 50 years with the aim of self-development and is free from religious connections. Trained by a qualified instructor, the person sits for 20 minutes twice a day with his or her eyes-closed, and turns attention inward on the repetition of a mantra. During this time, the body experiences a deep level of rest while the mind remains alert (Maharishi University of Management, n.d.; Seer & Raeburn, 1980)

The aim of this particular literature review is to answer the question of whether or not the stress-reduction technique of transcendental meditation can significantly reduce blood pressure, and if so, is it more effective than other commonly used techniques, such as progressive muscle relaxation. If TM is found to be effective, then it should be reconsidered for use in the treatment of high blood pressure.

### **Review of the Literature**

A search (MEDLINE and PsycInfo) for literature on Transcendental Meditation and hypertension was conducted. This search included empirical studies, experimental replications, follow-up studies, longitudinal studies, prospective and retrospective studies, field studies, quantitative studies, and treatment outcome/randomized clinical trials from both peer-reviewed and non-peer-reviewed journals. Meta-analyses, reviewed papers, letters, editorials, practice guidelines, and foreign language reports and studies were excluded. Twelve studies met the search criteria. These four quasi-experimental studies and eight controlled clinical trials examine changes in blood pressure in response to TM. The review of the literature is organized by methodology to allow the reader to better assess the quality and validity of results reported. Quasi-experimental studies are discussed first. These studies resemble clinical trials, but do not control for possible confounding variables either

by using a control group or by randomly assigning participants to the intervention groups. The second set of studies reviewed consists of controlled clinical trials. The studies are experimental in nature, in that participants are randomly assigned to receive treatment or be part of a control group. Because the two groups are equivalent in all but the treatment received, we are able to say that any difference seen in BP is due to the treatment.

### **Quasi-Experimental Studies**

Three of the quasi-experimental studies use a within-subjects, time-series design to look at blood pressure changes in response to the TM practice prescribed by the researchers. If blood pressure decreases throughout the period of treatment, changes may be attributable to the intervention. The fourth study is a between-subjects design in which researchers compare the blood pressure of long-term TM practitioners to non-practitioners. If a difference is found between the groups, then it may be due to the behavioral difference of the two groups. It is important to keep in mind that because these studies are uncontrolled, we cannot eliminate possible confounding variables as causes of the changes seen (e.g., decreasing BP values due to acclimation to the study or healthy behaviors related to practicing TM). We may only conclude that there is an association between the behavior and the physiological response.

Using a time series design, Blackwell and colleagues (1976) looked at SBP and DBP readings in the clinic and at home of seven patients with long histories of hypertension. Following an acclimation period of up to 10 weeks, participants practiced TM regularly for 12 weeks under supervision of a Maharishi Maresh Yogi and then unsupervised for an additional six months. For each participant, the mean of the readings from the four weeks leading up to training, the mean from weeks 9-12, and the mean from the six month follow-up were all compared by Student's t-test. Blackwell et al. (1976) found significant reductions in BP after the first three months for six of the seven partici-

pants, but only two individuals were able to maintain this decrease through the six month follow-up period. Results of this particular study should be interpreted with caution as there was an exceptionally small number of participants and adherence to the TM regimen was not monitored during the last three months.

In another time-series study, Pollack, Case, Weber and Laragh (1977) followed 20 hypertensive patients, ages 22 to 69 over a six-month period. Participants were trained in TM and were seen at monthly intervals for blood pressure readings. When comparing values obtained at follow-up visits to a pre-treatment control value, the investigators found small significant reductions for SBP for the first three months, but no differences for DBP. During the remaining three months, all post-treatment values failed to differ significantly from the original baseline level. Some participants even showed increases in mean blood pressure by the end of the study.

The final time-series study (Agarwal & Kharbanda, 1981) is very similar to that of Pollack et al. (1977). After a three to four week baseline period, 16 hypertensive Hindu patients were trained in and practiced TM for six months. The researchers found significant reductions between pre- and post-treatment SBP and DBP. The majority of this change had occurred during the first two months of the intervention and BP values failed to change significantly for the remainder of the study. The quick tapering off of treatment effects was similar to what was seen by Pollack et al. (1977). It is important to note that all patients were familiar with and had previously practiced some form of meditation. TM may not have had as pronounced of an effect on this particular group as on a group without any prior meditation experience.

These three time series designs exhibit mixed results. The results of the first study (Blackwell et al., 1976) are difficult to interpret as the study had so few participants and compliance with treatment was not verified. Outcome may have possibly been different with a larger sample size. Moreover, without verification of

meditation during the follow-up period, we cannot associate a participant's BP level with TM. Ideally, all participants would have stopped meditating, and consequently served as their own control group. If blood pressure then returned to baseline values, we could determine that TM is the cause of BP change. The next two studies reviewed showed initial support for the hypothesis that TM reduces blood pressure, but the effects were short lived (Pollack et al., 1977; Agarwal & Kharbanda, 1981). In order to establish that the treatment caused changes in BP, a return to baseline following treatment (e.g., stopping meditation) or a control group that receives similar attention would be needed.

The fourth quasi-experiment, conducted by Barnes, Treiber, Turner, Davis, and Strong (1999), examined the acute effects of long-term TM practice on total peripheral vasoconstriction in normotensive individuals. Change in blood pressure was a secondary outcome. Researchers recruited 18 individuals who had practiced TM for an average of 22.4 years and 14 control subjects. SBP and DBP of both groups were measured in the clinic immediately before and every five minutes during a 20 minute eyes-open-rest condition. For the TM group, blood pressure was also recorded in the same manner during a 20-minute meditation condition. For the control group, blood pressure was measured again in the same manner, but during a 20-minute eyes-closed-relaxation condition. All readings were taken while the participant was seated in a chair with his or her feet on the floor. Changes in blood pressure from the eyes-open rest condition to the respective meditation or relaxation conditions were calculated. Data were compared within and between subjects. The authors found that during the eyes-open-rest condition, the TM group experienced a decrease in SBP while the control group showed an increase. During the meditation/relaxation condition, once again the TM experienced a decrease in SBP and the control group an increase in SBP. There was no difference between groups for DBP in either condition. Because participants were not randomized, we cannot

conclude that TM is responsible for the differences. This sacrifice in methodological strength was made in order to study the effects of long-term practice, something that would be difficult to do through random assignment because of poorer attrition rates in long-term studies. In an effort to rule out possible confounding variables, researchers found that the TM group was more physically active and consumed less fat than the control, though these differences were not significant. It is possible that already significant effects were attenuated as the TM group initially had lower blood pressure. Because their BP was already at low levels, it did not have as much of a reduction range. Furthermore, several of the TM subjects complained that the blood pressure cuff was painful and that it was difficult to meditate while sitting in a chair instead of the usual lotus position. These less than perfect situations made it difficult to meditate. The authors predict that in a more ideal situation, stronger effects in support of the hypothesis would be seen.

The third and fourth study described show promising results for TM being able to reduce blood pressure. However, as all four studies lack a form of control (either random assignment to treatment or control groups or failure to return to baseline following intervention), findings are to be interpreted with caution. In the time-series studies, changes could also be attributed to patients becoming accustomed to the study and having levels of arousal that stabilize after a few months. The participants in Agarwal and Kharbanda's 1981 study had previously practiced forms of meditation, which may have reduced their blood pressure. In this instance, while TM may be a helpful treatment, it would not be a significant change in behavior, and therefore no drastic changes would be seen. In Barnes et al.'s study (1999), some unknown difference between the groups could be responsible for the pattern of results. Only through randomized, controlled studies can we rule out these confounds. Therefore, due to weak methodology the results of these four studies should neither be used to support nor to refute the

hypothesis that practicing TM lowers blood pressure.

### **Randomized Controlled Studies**

In the remaining eight studies, the researcher randomly assigned participants, who were not practicing at the time other forms of stress-reduction relaxation techniques, to intervention or control groups. In four of the studies, researchers compared TM participants' BP changes to those of participants in a single active control group. In the other four trials, researchers compared the effects of TM and the effects of another type of stress-reduction technique to each other, as well as to an active control group. For all studies, unless otherwise noted, control group participants attended health education classes about reducing blood pressure. This was intended to control for daily time commitment and attention received from instructors. In addition, subjects were surveyed about the health benefits they expected to attain through participation in the study. These expectancy ratings for treatment outcome were equal between groups or adjusted for during data analysis. Because of these efforts we can assume that attention, time, and expectancy of beneficial effects are not confounds that influenced the results.

### **Single Control Group Studies**

These clinical trials compare changes in resting and/or ambulatory blood pressure. If TM can significantly reduce blood pressure, we would expect to see greater decreases in SBP and DBP in the intervention group than in the active control group.

As part of a study that explored the effects of TM on progression of carotid atherosclerosis in 60 hypertensive African American participants, change in blood pressure was looked at as a secondary outcome (Castillo-Richmond et al., 2000). After baseline assessment, participants were randomly assigned to either the TM intervention or to a control group that received a cardiovascular disease risk education program. Treatment lasted six to nine months. The authors found that while both the

TM group and the control group showed significant reductions in both SBP and DBP from baseline to follow-up, there was no difference in change between groups. As BP was only a secondary measure, researchers did not examine changes in this variable while controlling for possible confounding factors, such as adherence to treatment. These analyses may have depicted different patterns.

A clinical trial by Wenneberg and colleagues (1997) examined the effects of TM on cardiovascular reactivity and ambulatory blood pressure. Normotensive men were randomly assigned either to the TM condition or to a cognitive-based stress education control condition. Treatment lasted 14 to 16 weeks. In order to assess cardiovascular reactivity changes from pre- to post-intervention, SBP and DBP were collected in the lab during stressors that included a mental arithmetic task, a mirror image star racing task, and an isometric hand grip task. Ambulatory blood pressure was monitored while participants prepared and delivered a simulated speech to laboratory assistants, as well as during the next nine hours while participants went about their daily lives. All observers and data collectors in the lab were unaware of the participants' experimental condition. Analysis of changes between pre- and post-intervention SBP and DBP in response to laboratory stressors showed no significant differences between groups. Furthermore, analysis of changes from pre- to post-intervention ambulatory blood pressure failed to show significant group differences. After controlling for compliance to treatment, however, a dose-response relationship emerged for TM condition. Those in the high-compliance TM group had significantly reduced SBP reactivity during the speech task compared to the high-compliance control group. The high-compliance TM group also had significantly lower ambulatory DBP than the high-compliance control group.

Barnes, Treiber & Davis (2001) looked at the effects of TM on cardiovascular function of adolescents—an age group previously not studied—with high normal blood pressure.

Thirty-five participants from a random screening of 200 inner-city youth met criteria for inclusion in the two month study. Following pre-intervention measurements, participants were randomly assigned to either a TM group or to an active control group. In this particular study, the method for TM practice differed from other studies in that five out of the 14 sessions per week took place at school rather than at home. The control group attended seven one-hour lifestyle education sessions. While participants received the same amount of attention from instructors, the individual treatments were not matched for daily time commitment. The authors looked at differences of pre- to post-treatment changes in SBP and DBP from during a resting condition, a simulated car driving stressor condition, and an interpersonal social stressor interview condition. Analysis of resting BP showed no statistically significant main effects of intervention, but a group  $\times$  time interaction showed that from pre- to post-intervention the TM group had a significantly greater decrease in resting SBP and exhibited a trend for a greater decrease in resting DBP compared to the control group. When reaction to acute stress was examined, the TM group showed a significantly greater decrease in SBP and a trend for lower DBP during the car driving simulation. During the social stressor interview, both groups showed a significant decrease in SBP, but those in the TM group had even greater reductions in BP levels. Methodological weaknesses in this particular trial were a short intervention period and more frequent meetings for the TM group. As we saw with Blackwell et al. (1976) and Pollack et al. (1977), changes in BP tended to level off after two or three months of intervention. This limited period of time may not allow us to see the full picture. To address this issue and expand upon these results, another study was done with the same population.

Barnes, Treiber, and Johnson (2004) screened almost 5000 African American adolescents from inner-city high schools to select 156 participants based on criteria similar to those used by Barnes et al. (2001). Following pre-test

measurements, participants were randomly assigned to either a TM group similar to Barnes's previous study or to a control group that attended a lifestyle education program designed to lower BP. Both the TM and control group attended sessions five days a week for 15 minutes each. At pre-test, at 2- and 4-month post-tests, and at 4-month follow-up visits (eight months after the start of treatment), ambulatory blood pressure was measured for a full 24 hours. Over the course of intervention and at the 4-month follow-up, the TM group had a significantly greater decrease in daytime SBP and DBP than the control group. There were no significant differences for nighttime readings. These results are supportive of the hypothesis that TM reduces blood pressure. Changes were sustained over a long intervention period of four months, as well as four months after the end of the formal intervention, showing lasting effects of the treatment.

When the change in BP of a TM group is compared to that of an active control group results show that TM is an effective means of reducing SBP and DBP. Out of the four studies reviewed in this section, the only trial that did not support the hypothesis was one in which blood pressure was a secondary outcome and confounding factors were not controlled for when analyzing the effect of TM on BP (Castillo-Richmond et al., 2000). The other three studies (Wenneberg et al., 1997; Barnes et al., 2001; Barnes et al., 2004) showed TM to be an effective method of reducing both ambulatory and resting BP under acute stress and during daily activities. The effect in these well-designed studies was shown across different ethnicities, different age groups, and for both normo- and hyper-tensives, indicating that the effects of TM are generalizable to different populations.

### **Multiple Control Group Studies**

The last four studies not only compared a TM intervention to an active control group, but also to another stress-reduction intervention as well (e.g., progressive muscle relaxation). As it has been established that TM can successfully

reduce BP, these multiple treatment studies were done in order to discern how TM compares to other modes of relaxation. Treatments were matched for daily time commitment, professional attention received, and expectancy of benefits unless otherwise noted.

In an early study by Seer and Raeburn (1980), 41 unmedicated hypertensive patients were randomly assigned to one of three conditions: SRELAX, which practiced TM with the standard mantra or sound; NSRELAX, which underwent the same training as the SRELAX group but did not use a mantra or sound; and no-treatment control group. Changes in SBP and DBP from baseline, the five weeks of treatment, and a three-month follow-up period of continued treatment practice, were compared across the three groups. Data collectors and intervention trainers were blinded to participants' condition. The NSRELAX group was intended to be a placebo control group based on a claim that it is TM's mantra that has powerful effects on the body (Mahesh Yogi, 1968, as cited in Seer & Raeburn, 1980). This proved to be untrue as the SRELAX group showed a significant decrease in DBP when compared to the no-treatment control group over the course of the study, but showed no significant differences in BP when compared to the NSRELAX group. The use of the mantra made no difference. In hindsight, this second treatment group was as much a form of meditation as the first. For both, sitting and meditating with one's eyes closed significantly changed BP. TM may be no more effective than other meditation techniques. In a follow-up analysis comparing those who responded to the interventions and those who did not, the authors noted that people who responded the most had been hypertensive for a significantly longer period of time and had higher DBP at pre-test. It is unclear whether motivation was stronger for those who needed to reduce BP the most or if treatment was most effective for those who had the most to lose.

A clinical trial by Schneider et al. (1995) compared the effectiveness of two stress-reducing techniques for reducing hypertension to a control group and to each other. One hundred

twenty-seven elderly African American hypertensive patients were randomly assigned to either a TM group, a PMR group, or a lifestyle modification education control group. Pre-intervention data (gathered from four baseline visits), post-intervention data (gathered from the three months of intervention), and follow-up data (gathered from two visits at three months) were collected. Observers were unaware of which treatment participants were receiving. Analysis of the first outcome measure, change in SBP and DBP measured in the clinic, showed that at follow-up both interventions significantly reduced SBP in comparison to the control group, but TM was significantly more effective than PMR. Analysis of the second outcome measure demonstrated that both active treatments significantly reduced home SBP compared to the control group, with reduction of the TM group's SBP being significantly greater than that of the PMR group. Neither group showed significant reductions in home DBP. A post-hoc medication analysis revealed that participants not taking anti-hypertensive medications in the TM condition showed a significantly greater decrease in SBP and DBP compared to both the unmedicated control and PMR groups. For participants on antihypertensive medications, DBP was reduced the most in the TM group.

Alexander et al. (1996) conducted a sex and risk of hypertension subgroup analysis on Schneider et al.'s (1995) data. Evaluation of sex differences revealed that for women, TM had a significant decrease in SBP and DBP when compared to a control group, whereas PMR did not. In addition, the decrease in DBP for women in the TM group was significantly greater than that of the women in the PMR group. Furthermore, men who practiced TM had a significant decrease in both SBP and DBP when compared to the men in the control group, whereas men in the PMR group showed a significant decrease in DBP but not SBP when compared to the control group. Male TM group participants also exhibited a significant decline in SBP and a trend for greater reduction of DBP compared to the men in the PMR group. In order to assess the influence

of hypertension risk factors, participants were divided into high and low risk groups for each of the following factors: psychosocial stress, obesity, alcohol use, physical inactivity, dietary sodium-potassium ratio, and a composite measure of all the risks. In comparison to the control group, the high and low risk TM groups both had significantly greater decreases in SBP and DBP values for all six hypertension risk factors. On the other hand, the PMR low and high risk groups saw significant decreases in both SBP and DBP compared to the control group for only half of the risk factors.

In this research (Schneider et al., 1995; Alexander et al., 1996), not only was TM more effective in reducing blood pressure than PMR at a general level, but also across the major risk factors for hypertension. A further look into a wider age range, across different ethnicities, and for a longer amount of time would allow for greater generalizability.

The final study reviewed (Schneider et al., 2005) also looked at the impact of TM and PMR on blood pressure in hypertensive African Americans. In this clinical trial, participants were randomly assigned with stratification by age, gender, and antihypertensive medication status to either the TM group, the PMR group, or a control group consisting of a health education program similar to what a hypertensive patient would receive normally from his or her physician. Pre-test blood pressure measurements were obtained by unaware clinical staff during a one-month baseline period, and during the intervention period at 3-, 6-, 9-, and 12-months. Over the course of the trial the TM group had a significantly greater decrease in DBP and showed a similar trend for SBP compared to both the PMR and the no-treatment groups. The PMR group did not differ significantly from the control group. The TM group reported a decrease in use of antihypertensive medication, whereas the PMR and control groups both increased their usage. This study extends the results of previous research (Schneider et al., 1995, Alexander et al., 1996) with a longer follow-up period showing lasting effects and including a wider range of

ages.

In these multiple control group studies, TM was shown to cause greater decreases in blood pressure in African Americans across people of varying risk groups than PMR (Schneider et al., 1995; Alexander et al., 1996; Schneider et al., 2005). Because of this comparison, we can conclude that TM, as a treatment for high BP is not only more effective than attending lifestyle changes classes, but it is also superior to another popular stress-management technique, PMR. These well designed, controlled studies support the hypothesis. Seer and Raeburn's 1980 study gave some indication that while TM can reduce BP, it may be no more effective than other styles of meditation.

## **Discussion**

### **Summary of Findings**

In all but three (Blackwell et al., 1976; Pollack et al., 1977; Castillo-Richmond et al., 2001) of the 11 studies reviewed, participants who practiced TM reduced their blood pressure. Two of the studies that did not support the hypothesis, lacked control groups and were methodologically weak (Blackwell et al., 1976; Pollack et al., 1977). Of the eight controlled studies, seven support the hypothesis that TM significantly lowers blood pressure. In the only study that failed to show these results, change in blood pressure was a secondary outcome and not investigated in full (Castillo-Richmond et al., 2001). A more in depth analysis and statistical control of confounding variables may have produced different results. The findings of the controlled trials are convincing and generalizable. The majority of the studies carefully matched treatments for daily time commitment, attention from instructors, and checked for differences in expected treatment benefits between groups. These precautions help to rule out the contributions of non-specific factors simply associated with being part of an intervention. Many studies controlled for anthropometric and lifestyle differences between groups that existed at baseline. Results are generalizable to both resting blood pressure (Alexander et al., 1996;

Barnes et al., 2001; Schneider et al., 1995; Schneider et al., 2005; Seer & Raeburn, 1980; Wenneberg et al., 1997) and ambulatory blood pressure (Barnes et al., 2004; Wenneberg et al., 1997), to normotensives (Barnes et al., 2001; Barnes et al., 2004, Wenneberg et al., 1997) and hypertensives (Alexander et al., 1996; Schneider et al., 1995; Schneider et al., 2005; Seer & Raeburn, 1980), across ethnicities and ages. TM was found to be a successful antihypertensive method across different lifestyle risk factors (Alexander et al., 1996) and for those groups especially at risk for elevated blood pressure, such as women (Alexander et al., 1996), the elderly (Schneider et al., 1995), African Americans (Barnes et al., 2004; Schneider et al., 1995, and adolescents with high normal blood pressure (Barnes et al., 2001; Barnes et al., 2004).

When comparing TM to other relaxation techniques, TM is superior to PMR at reducing psychosocial stress (Alexander et al., 1996; Schneider et al., 1995; Schneider et al., 2005). We cannot determine whether TM is more effective than other meditation techniques from this literature, as this hypothesis was not directly tested (Seer & Raeburn, 1980). As we saw, different stress reduction approaches have different outcomes for controlling blood pressure. If we were to only consider the average results seen for all relaxation techniques, we would be misled. The less successful methods make stress-reduction techniques in general appear to be of little value for treating and preventing hypertension. Because of this, the stress-reduction approaches proven to reduce BP may be ignored. Before excluding behavioral stress-reduction approaches as a recommendation for treatment of high blood pressure, as was the case in the recent JNC report (2003), clinical outcomes of the various stress-reduction techniques should be evaluated individually in order to not overlook any promising methods.

### **Suggestions for Future Research**

Weaknesses found throughout the research reviewed gave rise to ideas for methodologically stronger studies. Factors that may

have confounded results include short baseline and follow-up periods, and very specific samples that limit generalizability. Also in the re-researched reviewed, there are no randomized controlled clinical trials that compare TM to any other stress-reduction approach besides PMR as a method of reducing blood pressure. Because of these limitations, we are unable to get a complete picture of the effects of TM and cannot determine whether TM is the most effective relaxation technique for treating hypertension.

The participants in an ideal study would be diverse; normo- and hypertensive, African Americans and other ethnicities, young adult and elderly, medicated and unmedicated. With this diverse sample, we would have a larger range of values for important factors and would see how TM affects different groups of people, as would allow us to generalize findings to many populations. The sample size would be sufficiently large in order to conduct subgroup analyses and assess the effectiveness of treatment for each individual subgroup. Participants would be randomly assigned to intervention groups, with stratification by traditional risk factors of hypertension such as ethnicity, age, and family history in order to ensure that groups are equivalent at baseline. Intervention groups would include a TM group, similar to those used in the studies reviewed; another stress-reduction therapy group, such as another form of meditation or controlled breathing exercises; and an active control group similar to those used in the studies reviewed. This would help to ascertain the relative effectiveness of TM and other treatments. Blood pressure would be measured over a baseline period of two months, after training for a period of six-months with supervision, and at six-months after the formal intervention period has ended. An extended baseline period is needed to ensure stable pre-intervention blood pressure values. This will rule out participants acclimating to the clinic and study as the cause of changes in BP during the first few months of intervention. A longer intervention period with monitoring of adherence to treatment allows an examination of long-term benefits. We could

determine when changes occur and how long they last. A long post-intervention period, during which participants are told to continue with treatment but not visiting the clinic, allows us to assess whether it is feasible for patients to continue treatment alone, and, if so, whether the treatments are worth continuing for a long period time. During this time period, participants should keep daily records of practice. Primary and secondary measures would include changes in SBP and DBP from pre- to post-intervention, as well as at the last follow-up period, and compliance to treatment.

Another possible study would be similar to one described above, except the intervention groups would consist of TM alone; another well-established method of hypertension treatment such as physical activity or a diet low in sodium and rich in fruits, vegetables, and low-fat dairy products or physical activity; and TM plus the other hypertension treatment. This would allow us to establish how TM affects BP relative to other proven methods, and whether it increases the effectiveness of other treatments.

Transcendental meditation is a cheap, feasible, and effective method of controlling blood pressure that is free from unwanted side effects. Since hypertension is linked to CVD (National Center for Health Statistics, 2004), reductions in blood pressure should also decrease the risk of cardiovascular diseases, (i.e., heart attacks and stroke). Moreover, because TM is a method of reducing psychosocial stress, practitioners might be less inclined to partake in unhealthy, stress-related, hypertension-causing behaviors, such as smoking, drinking, and poor eating habits. Because of its proven effects, TM should be included in lifestyle modification programs for primary and secondary prevention of hypertension.

## References

- Agarwal, B. L., & Kharbanda, A. (1981). Effects of transcendental meditation on mild and moderate hypertension. *The Journal of the Association of Physicians of India*, 29(8), 591-596.
- Alexander, C. N., Schneider, R. H., Staggers, F., Sheppard, W., Clayborne, B. M., Rainforth, M., et al. (1996). Trial of stress reduction for hypertension in older African Americans. II. Sex and risk subgroup analysis. *Hypertension*, 28(2), 228-237.
- Barnes, V. A., Treiber, F. A., & Davis, H. (2001). Impact of transcendental meditation on cardiovascular function at rest and during acute stress in adolescents with high normal blood pressure. *Journal of Psychosomatic Research*, 51(4), 597-605.
- Barnes, V. A., Treiber, F. A., & Johnson, M. H. (2004). Impact of transcendental meditation on ambulatory blood pressure in African-American adolescents. *American Journal of Hypertension*, 17(4), 366-369.
- Barnes, V. A., Treiber, F. A., Turner, J. R., Davis, H., & Strong, W. B. (1999). Acute effects of transcendental meditation on hemodynamic functioning in middle-aged adults. *Psychosomatic Medicine*, 61(4), 525-531.
- Beckett, L. A., Rosner, B., Roche, A. F., & Guo, S. (1992). Serial changes in blood pressure from adolescence into adulthood. *American Journal of Epidemiology* 135(10), 1166-77. (Abstract).
- Blackwell, B., Bloomfield, S., Gartside, P., Robinson, A., Hanenson, I., Magenheimer, H., et al. (1976). Transcendental meditation in hypertension: individual response patterns. *Lancet*, 1(7953), 223-226.
- Castillo-Richmond, A., Schneider, R. H., Alexander, C. N., Cook, R., Myers, H., Nidich, S. I., et al. (2000). Effects of stress reduction on carotid atherosclerosis in hypertensive African Americans. *Stroke: a Journal of Cerebral Circulation*, 31(3), 569-573.
- Maharishi University of Management (n.d.). *Transcendental Meditation*. Retrieved November 2005 from the World Wide Web URL: <http://www.mum.edu/tm.html>
- National Center for Health Statistics (September 2004). *Health, United States, 2004. With Chartbook on Trends in the Health of Americans*. DHHS Publication No. 2004-1232. Retrieved November 2005 from the World Wide Web, URL: <http://www.cdc.gov/nchs/data/hus/hus04.pdf>
- National Heart, Lung, and Blood Institute (November 1997). *The sixth report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure*. NIH Publication No. 98-4080. Retrieved November 2005 from the World Wide Web, URL: <http://www.ncbi.nlm.nih.gov/books/bookres.fcgi/hbp/hbp.pdf>
- National Heart, Lung, and Blood Institute (December 2003). *JNC 7 Express: The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure* (pp. 1-11). NIH Publication No. 03-5233. Retrieved November 2005 from the World Wide Web, URL: <http://www.nhlbi.nih.gov/guidelines/hypertension/express.pdf>
- Pollack, A. A., Case, D. B., Weber, M. A., & Laragh, J. H. (1977). Limitations of transcendental meditation in the treatment of essential hypertension. *Lancet*, 1(8002), 71-73.
- Schneider, R. H., Alexander, C. N., Staggers, F., Orme-Johnson, D. W., Rainforth, M., Salerno, J. W., et al. (2005). A randomized controlled trial of stress reduction in African Americans treated for hypertension for over one year. *Journal of the American Society of Hypertension*, 18(1), 88-98.
- Schneider, R. H., Staggers, F., Alexander, C. N., Sheppard, W., Rainforth, M., Kondwani, K., et al. (1995). A randomized controlled trial of stress reduction for hypertension in older African Americans. *Hypertension*, 26(5), 820-827.

- Seer, P., & Raeburn, J. M. (1980). Meditation training in and essential hypertension: a methodological study. *Journal of Behavioral Medicine*, 3(1), 59-71.
- Wenneberg, S. R., Schneider, R. H., Walton, K. G., Maclean, C. R., Levitsky, D. K., Salerno, J. W., et al. (1997). A controlled study of the effects of the Transcendental Meditation program on cardiovascular reactivity and ambulatory blood pressure. *The International Journal of Neuroscience*, 89(1-2), 15-28.