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Editorial
Effects of Transcendental Meditation on Blood Pressure in Adults: A Review

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Hypertension is the leading global health risk [1]. In 2016, there were 56.9 million deaths globally; 71% were due to non-communicable diseases. Of these, 44% were cardiovascular diseases of which hypertension is the leading risk factor [2,3]. Data from 154 countries between 1990 and 2015 showed that the rate of systolic blood pressure (SBP) of 140 mmHg or higher increased from 17,307 to 20,526 per 100,000. Also increasing during that same time period was the estimated annual death rate from ischemic heart disease, hemorrhagic stroke and ischemic stroke, from 97.9 deaths in 1990 to 106.3 deaths per 100,000 population in 2015 [1]. To make matters more complex. hypertension disproportionately affects people from low- to middle-income countries[4]. In fact, in 2010, 31.5% of the world's adults had hypertension; 28.5% in high-income countries and 31.5% in low- and middle-income countries[5].

Given these large numbers, a variety of therapies are needed for both prevention and control. While medication is one therapy, nonpharmaceutical interventions that can prevent as well as compliment pharmaceutical therapies can be cost-effective and easily available.

Meditation is one nonpharmaceutical therapy with increasing popularity. Currently there is a growing body of research investigating the effects of various types of meditation on blood pressure (BP). Within that body of research, one meditation method that has been widely used[6] is Transcendental Meditation (TM). The purpose of this editorial is to review the published studies conducted to examine the effects of TM on BP in adults.

Transcendental Meditation Described. Transcendental Meditation (TM) is a mind-body intervention, which was introduced by Maharishi Mahesh Yogi in 1959[7]. It is a systematic, psychophysiological procedure based in the ancient Vedic tradition of India. The main intervention is described as being simple, natural, and effortless. TM instructors who are certified by the Maharishi Foundation provide seven-step standardized instructions including an introductory and preparatory lecture, a personal interview and personal instruction, and consecutive follow-up sessions over three consecutive days. After the seven-step course, participants are invited to attend individual meetings with the TM instructor to verify the mechanics of their practice and maintain regularity[6,8]. TM practitioners then practice on their own for 20 minutes twice a day with eyes closed as a daily routine[9,10].

Inclusion/Exclusion Criteria. For this review, we included the primary studies (with any type of quantitative research design) evaluating TM interventions that were aimed to reduce BP in adults and were published in English. We excluded studies where the

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researchers did not report the actual BP values or used case study or case series designs. In addition, we excluded studies published in a language other than English which may have limited our search to Western studies only.

We searched 19 electronic databases for primaries studies (See Table) without date limitation, i.e., from inception of each database to 2019. Key terms included "pulmonary wedge pressure" OR "blood pressure" OR "arterial pressure" OR "venous pressure" OR hypertension OR hypertensive OR "portal pressure" AND meditate* OR mindfulness OR mindful* OR meditation. Subject headings were exploded to get 8,048 articles. After 1,711 duplicates were removed, 6,337 studies remained. During the review of the title, an additional 6,293 studies were excluded because they did not include TM and blood pressure. Of the remaining 44 studies, 26 were excluded for the following reasons: not English (s=1), systematic review and meta-analysis (s=17), letter/opinion (s=5), and studies did not provide the actual blood pressure values (s=3). Finally, a total of 18 studies met inclusion criteria and were included in this review; that is, 13 from the U.S., 2 from India, and 1 each from Ireland, Germany, and New Zealand.

TM with Normotensive Participants. Researchers used TM with various samples including both healthy participants as well as participants with health conditions. Among presumably normotensive samples, female medical student meditators (n=6) had significantly greater decreases in SBP and DBP than did a control group of non-meditators (n=6) who sat in a relaxed state with eyes closed [11]. Conversely, when comparing meditators over 4 days of TM (n=10) to non-meditators over 4 days of resting (n=10), researchers found no significant main or interaction effects between the two groups [12]. Similarly, when a TM group (n=22) was compared to a stress education group (n=17) who kept a diary, only the highly compliant meditators had a significantly decreased DBP [8]. There may have been no differences across the groups because the effect of stress education and the diary can be cathartic perhaps making the two interventions equally effective.

BPs of Experienced Meditators. Some research teams examined BPs of experienced meditators before and after TM. Parulkar and colleagues[13] compared the BP of 12 meditators pre- and post-meditation and found that only SBP decreased significantly. When comparing 20 meditators' BPs before and after TM to their BPs before and after sitting quietly, Waal-Manning and Jenkins[14] found no significant differences. One explanation for these non-significant changes may be that the experienced meditators already had low BPs allowing little change in their later BPs, that is, there may have been too small of an effect size to show significances given the small sample sizes. It may also be that TM simply was not effective.

BPs after Exercise for Long-Term Meditators. Lang and colleagues[15] examined the effects of long-term TM on BPs before and after 3 minutes of exercise. They compared a group of 10 meditators with 2.3 years of TM experience to a group of 10 meditators with 4.1 years of experience. Meditators with longer TM experience showed significantly higher BPs during and after 3 min of exercise when preceded by meditation than by reading. Participants with a shorter TM practice showed the reverse, significantly higher BPs during and after 3 min of exercise when preceded by reading than by meditation. Further, the researchers showed that TM effects on the autonomic nervous system was more obvious in meditators with longer practices. However, with only 10 males per group, these findings should be interpreted with caution.

TM for Those at Risk for Hypertension. Nidich and colleagues [6] compared a TM group of 93 college students with a waitlist group of 114 college students (N=207). They found no difference in BP between the two groups likely because the sample of young adults had baseline BPs that were too low to be amenable to change at all [6]. However, when analyzing

a subgroup of students (n=112) who were at risk for hypertension, they showed significantly reduced SBP and DBP [6]. This highlights the focus of TM on individuals with hypertension as being those who might benefit most.

TM for People with Hypertension. Blood pressures of people with hypertension may be more amenable to meditation. Some researchers who studied people with borderline or definitive hypertension showed significant improvements in SBP and DBP after 6 months [16,17] regardless of small sample sizes of 16 to 22. Others showed drops in SBP over 6 months without significance when their sample size was 7 [18]. Still others showed significant reductions for the first 3 months that disappeared over months 4-6 in a sample of 20 [19]. In a sample of 150 hypertensive African Americans, SBP and DBP in the TM group dropped significantly over 12 months, but the SBP was not different from the health education group while the DBP was reduced significantly more compared to a health education group [9]. Likewise, researchers showed a significant improvement in SBP over 4 months in the TM group (n=52) compared to health education group (n=51) in patients with heart disease [10] or in DBP of African American patients with heart disease (n=54 in TM group; n=44 in health education group) over 5.4 years [7]. Finally in a sample of hypertensive patients, Seer & Raeburn [20] showed similar SBP and DBP reductions across two meditation groups over 3 months, TM with a mantra (n=14) and TM without (n=14; which some would not consider TM). Compared to the no-treatment controls (n=13), only diastolic reductions were significant.

Sample Sizes. As is obvious from above, most studies had relatively small sample sizes. Samples ranged from 7 to 207. Across the 18 studies, only four had samples greater than 52. One study had 52 participants; 13 had samples less than 52 and typically those were split into two or three groups resulting in quite small group sizes.

Designs. Most researchers used a one-group design [13-19,21]. Using a one group crossover design, Delmonte [22] randomized participants to conditions to control for order and expectations of meditation. Some researchers compared meditators with non-meditators [12,23]. Lang and colleagues [15] compared advanced meditators (mean TM practice 4.1 years) to long-term meditators (mean TM practice 2.3 years). Finally, several researchers conducted randomized trials [6,7,9-11,20].

Follow-up Time. Many researchers examined the more immediate effects of TM through designs that included only one or two visits [13-15,21-23]. Others measured follow-up BP within 6 months [16-19] or less [6,8,10,11,20], 12 months [9], or as long as 5.4 years [7].

Comparison Groups. To best test the effects of TM, participants should be randomized to TM or control groups [22]. One might expect that the best control groups would be non-meditators sitting is a relaxed state, possibly with the eyes closed [11,12,22] or a waitlist group [6]. In one study, two groups of TM meditation were compared with similar effects, one group using a mantra and one without a mantra [20]. Another suitable control group might be a health education group that might provide an attention control group [7,9,10]. However, a stress education group that includes keeping a diary might potentially have very calming effects making it impossible to separate the effects of TM from the comparison group [8]. Other comparison groups that may have effects on participants include a Shavasana group where participants laid in deep relaxation with a blank mind [11] and a progressive relaxation group which involves systematically alternating tensing and relaxing of various muscle groups [9].

Summary of Findings and Implications for Research. Overall, TM looks promising as an alternative therapy to reduce BP in particular for people with borderline or definitive hypertension. While findings are inconclusive at this point, future researchers might consider randomized controlled trials over several months with a considerable sample size. In the most immediate future, we plan to examine the TM effects quantitatively through a meta-analysis. This will allow us to determine the effect size across

all studies, with or without large sample sizes. It will also allow examination of moderator effects.

Implications for Practice. Nurses might face several challenges when incorporating TM into treatment regimens for patients with hypertension. One challenge is that to learn TM, patients need training and this has a cost. While these trainings could be scheduled regularly, the bigger challenge will be who would pay for the training. Another challenge might be the lack of support of the medical provider because TM is generally not part of the Western medical model. While TM might be more supported and encouraged by Asian physicians, patients need to consistently feel that support and encouragement across all of their health care providers. Finally, another challenge might be that patients themselves may not believe in TM's effect on BP. While this can be remedied with education, many patients will not be motivated enough to practice TM for 20 minutes twice/day.

In the meantime, nurses might suggest meditation for patients who want to avoid antihypertensive medication, particularly in the early stages when BPs indicate borderline hypertension. While we focused this review on TM, presumably other types of meditation might be effective as well. Nurses might encourage patients to sit quietly with eyes closed, starting with 5 minutes and increasing to 20 minutes over time, during which they repeat a mantra in their head. Some patients might like to focus on their breathing instead. At this point, there is enough evidence to suggest that meditation may be beneficial and should be encouraged as a supplement to other hypertensive therapies. Considering meditation from a risk/benefit perspective, there is no risk but can have a potential benefit. In other words, what can it hurt?

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Table. Databases Searched and Years Included

Journal Literature	Years
Education Resources Information Center (ERIC)	1966+
CINAHL	1937+
Scopus	1788+
Ovid PsycINFO	1967+
Ovid Medline	1946+
Cochrane Library	1995+
Grey Literature	
Bielefeld Academic Search Engine (BASE)	2004+
ProQuest Dissertation & Theses	1996+
ClinicalTrials.gov	2000+
Electronic Journal Hand Search	
American Journal of Hypertension	1988+
The American Journal of Cardiology	1958+
European Society of Hypertension	1983+
Journal of American Society of Hypertension	2007+
International Journal of Hypertension	2009+
Journal of Human Hypertension	1987+
Journal of the American Heart Association	2012+
Journal Mindfulness–Springer link of the American Heart Association	2010+
Website	
ScienceDirect	1995+
American Psychological Association	1892+

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