5-5-2016

Case Report: The Effect of Yoga in Adults with Hypertension

Kristen Bowe

Case Report: The Effect of Yoga in Adults with Hypertension

Kristen M. Bowe

University of North Dakota

PERMISSION

Title Case Report: The Effect of Yoga in Adults Hypertension

Department Nursing

Degree Master of Science

In presenting this independent study in partial fulfillment of the requirements for a graduate degree from the University of North Dakota, I agree that the College of Nursing of this University shall make it freely available for inspection. I further agree that permission for extensive copying or electronic access for scholarly purposes may be granted by the professor who supervised my independent study work or, in her absence, by the chairperson of the department or the dean of the Graduate School. It is understood that any copying or publication or other use of this independent study or part thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University of North Dakota in any scholarly use which may be made of any material in my independent study.

Signature: Kristen Bowe

Date: 4/26/2016

Abstract

Approximately 90% of all middle-aged adults will develop hypertension (HTN), making it a leading cause of morbidity, disability, and mortality (Brook et al., 2013; Cramer et al., 2014b). This report discusses the case of Sara, a 48-year-old Black female with newly diagnosed HTN. She had recently initiated pharmacologic management and lifestyle modifications to aid in blood pressure reduction; however, Sara continued to demonstrate elevated blood pressure measurements indicating the need for further intervention and management. Many cardiovascular professional organizations have developed clinical practice guidelines for the pharmacologic management of HTN. Often, these guidelines do not incorporate lifestyle modification strategies to augment the reduction of blood pressure. Yoga participation is a modality not included in the majority of these professional recommendations. Yoga practice has demonstrated a reduction in sympathetic nervous system activation making it a plausible intervention for blood pressure reduction (Miles et al., 2013). Several clinical research trials have demonstrated an effective blood pressure reduction in individuals participating in yoga. Nonetheless, these trials have often been of low-quality methodological design, creating the need for further research prior to the widespread implementation and recommendation of yoga for the reduction of blood pressure (Brook et al., 2013).

Background

Hypertension (HTN), as defined by a systolic blood pressure (SBP) greater than 140 mm Hg and/or a diastolic blood pressure (DBP) greater than 90 mm Hg, is a major public health concern. In the United States, 1 in 3 adults have HTN, accounting for over 77 million cases, and worldwide the number of adults with HTN nears one billion (American Heart Association, 2014; Wang, Xiong, & Liu, 2013). Even more alarming than the prevalence of HTN is the fact that 50% of Americans with HTN experience an uncontrolled disease state. This places a great demand on the entire cardiovascular system and increases the risk of stroke, heart disease, congestive heart failure, renal disease, peripheral artery disease, visual decompensation, and myocardial infarction (Heidenreich et al., 2011; Wang et al., 2013). In 2010, HTN was listed as a primary or secondary cause of death in approximately 2.5 million deaths in the United States. The incidence of HTN and the associated health care costs are rising exponentially. Current predictions estimate that over 40% of all Americans will have HTN by the year 2030. This percentage is an increase of eight percent over the 2012 projected rise (American Heart Association, 2014). In 2015, the total direct care costs related to HTN and its complications totaled over $90 billion, with a projected increase to $200 billion by the year 2030 (Heidenreich et al., 2011).

The case discussed in this report is that of Sara (name has been changed for confidentiality purposes), a 48-year-old, Black woman with HTN. Sara came to the clinic for follow up evaluation of her blood pressure and blood pressure medication. She was diagnosed with HTN four weeks prior to our meeting and started on lisinopril for anti-hypertensive therapy. In addition to beginning pharmacologic treatment for her HTN, she had put substantial effort into making lifestyle changes that would also assist in blood pressure control. She had been following

the Dietary Approaches to Stop Hypertension (DASH) diet and had begun a regular exercise regimen that included use of the treadmill and yoga. However, at this visit her blood pressure remained hypertensive at 142/78 mm Hg. Sara's continued HTN indicated the need for further optimization of her blood pressure with pharmacologic and/or additional lifestyle modifications.

The Eighth National Joint Commission (JNC 8) and several other cardiovascular professional organizations have offered specific clinical practice guidelines regarding the pharmacologic treatment of HTN. The incorporation of lifestyle changes has been less concrete in most of these guidelines. Lifestyle changes scientifically proven to reduce blood pressure include: following a low-sodium diet, incorporation of the DASH diet, weight loss, aerobic physical activity, smoking cessation, stress reduction, and alcohol moderation. These interventions also have an important role in the treatment of resistant HTN and for individuals with drug intolerances or side effects (Tolbaños Roche & Mas Hesse, 2014). Most health care providers choose to start these interventions in the critical pre-hypertension period (defined as a SBP greater than 120 mm Hg but less than 140 mm Hg and/or a DBP greater than 80 mm Hg but less than 90 mm Hg) and encourage continuation of these practices once pharmacologic therapy has been initiated (Brook et al., 2013). Yoga is a practice of meditation using physical postures or poses and deep breathing. It has not traditionally been included in the listings of successful lifestyle modifications but research has shown that yoga is associated with improved flexibility and muscle strength, slowed autonomic activity, and stress reduction, making it a plausible modality to aid in blood pressure reduction (Cramer et al., 2014a; Miles et al., 2013). The purpose of this report is to explore the effects of yoga participation on blood pressure in adults with HTN.

Case Report

Sara, a 48-year-old Black woman, came to the clinic in February of 2016 for evaluation of her HTN and anti-hypertensive medication. She had been diagnosed with HTN four weeks prior. At the time of diagnosis her blood pressure measurement was approximately 160 mm Hg systolic and she was started on lisinopril 20 mg by mouth daily. Since the diagnosis of HTN she had been compliant with her daily medication and also checked her blood pressure at home. Her home blood pressure monitoring revealed readings of 140 to 146 mm Hg systolic and 78 to 80 mm Hg diastolic. Sara noted the development of a "dry, hacking" cough that coincided with the initiation of her anti-hypertensive medication. The cough had been constant for the past four weeks and was worse in the morning and at night while Sara was trying to sleep. It did interrupt her sleep and she described it as "very annoying." Sara was unable to identify any factors that aggravated or relieved the cough. The cough was not associated with fever, chills, shortness of breath, or feeling ill in any way. The remaining review of systems was also negative including absence of blurred vision, headache, weight loss or weight gain, chest pain, palpitations, dizziness, lightheadedness, abdominal pain, nausea, vomiting, bowel changes, or dyspepsia. Sara's other medications included acetaminophen by mouth as needed for pain and a daily women's multivitamin. She denied any medication, food, or environmental allergies. Her past medical history was unremarkable, except for her recent diagnosis of hypertension. Her surgical history included only a cholecystectomy and a tubal ligation. Sara reported a family history of cardiovascular disease, noting both her mother and father with HTN and her brother with elevated cholesterol. She denied any family history of myocardial infarction, cardiac arrest, or early cardiac death. Socially, Sara endorsed initiating lifestyle changes since the diagnosis of HTN. She had been following the DASH diet and exercising three times a week for one hour on

each occasion. She particularly enjoyed using the treadmill and attending yoga class. Sara had never been a smoker but did drink two glasses of wine, four times a week.

At this visit, Sara continued to have an elevated blood pressure, with a measurement of 142/78 mm Hg. Her heartrate was noted to be 72 beats per minute and body mass index (BMI) was recorded at 27 kg/m^2. Her physical assessment was negative for any abnormal findings. The funduscopic exam revealed no AV nicking, cotton wool spots, or hemorrhages; bilateral carotid arteries were without bruit; neck veins were without distention; heartrate was regular without murmur, S3, or S4; lungs were clear to auscultation bilaterally; bilateral radial, pedal, and dorsalis pedis pulses were 2+; and no peripheral edema was observed. The cough she described was not heard during the examination.

Based on the provided history and physical examination, it was determined that the origin of her "dry, hacking" cough was likely an adverse effect of the lisinopril she began as antihypertensive therapy. This medication was discontinued and hydrochlorothiazide (HCTZ) 12.5 mg by mouth daily was initiated. A complete blood count (CBC) and basic metabolic panel (BMP) were collected at this visit to evaluate for anemia, kidney function, and potassium level. These were within normal limits. Sara was instructed to return for a follow-up evaluation of her blood pressure and new antihypertensive medication in four weeks. At this follow-up visit, a BMP should be obtained to evaluate her electrolyte status following the initiation of diuretic therapy. Sara was encouraged to continue home monitoring of her blood pressure, adherence to the DASH diet, and participation in her physical activity and yoga regimen.

Literature Search Strategies

In order to thoroughly examine the notion that yoga participation may have a positive effect on the blood pressure measurements of adults with HTN, a thorough review of the existing

literature was completed. A search of the PubMed and CINAHL databases was completed through the University of North Dakota Harley E. French Library of the Health Sciences. A search of the PubMed database with the Medical Subject Headings (MeSH) "hypertension" AND "yoga" yielded 80 results. These results were then filtered using the modifiers English language, human subjects, and publication years 2010 to 2016. The abstracts of the remaining 27 articles were reviewed. In all, 12 articles were kept for further, more thorough evaluation.

A search of the CINAHL database was completed next, using the CINAHL headings "hypertension" AND "yoga." This search yielded 45 results that were then filtered with the same modifiers as used in the previous search. This yielded 37 articles. The duplicate articles were removed and the abstracts of the remaining articles were reviewed. Only one more article was added for further evaluation. Finally, the reference section of the final 13 articles were reviewed and five more relevant articles were located. In all, a total of 13 articles were considered most appropriate for inclusion in this literature review.

Literature Review

Yoga is a traditional Indian practice involving meditation, deep breathing, and relaxation. The practice of yoga is observed by 30 million people throughout the world and is quickly gaining popularity in the United States (Cramer et al., 2014b). Approximately 16 million Americans practiced yoga in 2008 and half of these Americans cited a desire for health improvement as the main reason for participation (Miles et al., 2013). Contemporary yoga is most often practiced in the United States and involves a combination of physical postures or poses, controlled breathing, and meditation (Cramer et al., 2014a). The poses aim to strengthen muscles, improve posture and breathing, and reduce stress. The deep breathing strives to achieve a state of relaxation by creating a balance in sympathetic and parasympathetic nervous system

activation. The goal of yoga is to create a total mind-body-spiritual connection (Tolbaños Roche & Mas Hesse, 2014).

Research on the health benefits of yoga is mounting. Yoga has demonstrated improvements in flexibility, muscle strength, and mental health through decreased stress and anxiety (Miles et al., 2013). However, the exact mechanism leading to these health benefits is unclear. It has been proposed that the relaxation, meditation, and deep breathing practices cause a decrease in sympathetic nervous system stimulation through an increased sense of well-being and a decrease in cortisol, catecholamines, stress, and emotional hyperresponsiveness. A similar theory believes these same practices create vagus nerve stimulation, resulting in an increase in parasympathetic nervous system responses such as a decreased heart rate and blood pressure. Yoga may also increase sensitivity of the baroreceptors, creating more adaptive responses to blood pressure changes (Hagins, Rundle, Consedine, & Khalsa, 2014; Posadzki, Cramer, Kuzdzal, Lee, & Ernst, 2014). The proposed physiologic changes associated with yoga make this an enticing option for inclusion with standard lifestyle modification measures utilized for blood pressure reduction in adults with HTN.

In the past six years, many original clinical research studies and reviews have been published in an attempt to confirm the positive effect that yoga has on blood pressure reduction. A Brazilian study by Mizuno & Monteiro (2013) of 33 middle-aged adults compared yoga as an intervention to lower blood pressure to a control group that did not participate in yoga. The yoga sessions were each 90-minutes in duration and included the deep breathing and posture exercises frequently included in contemporary Western yoga practice. The study required attendance at a yoga class three times a week, throughout the study period of four months. The experimental group that participated in the yoga classes demonstrated a significant reduction in SBP, from an

average of 123 mm Hg at the beginning of the study to 116 mm Hg at the completion of the study. The average SBP values declined steadily throughout each month of the trial (Mizuno & Monteiro, 2013).

These results were confirmed by a Spanish study of participants aged 40 to 71 years (Tolbaños Roche & Mas Hesse, 2014). The study group participated in yoga for two, 90-minute sessions a week over the span of three months. This resulted in a statistically significant reduction in SBP and DBP in the study population. Conversely, the control group actually demonstrated an increase in SBP and DBP. In the intervention group, 80% of the participants noted a decrease in SBP and DBP. There was also decrease in the SBP of the intervention group measured at the beginning of the yoga class compared to the measurement at the completion of the yoga class, after 20 weeks of intervention. In the control group, 60% of participants noted an increase in SBP and 50% noted an increase in DBP. It is important to note, however, this study included a small sample size with only 10 participants in the control group and 14 participants in the yoga intervention group (Tolbaños Roche & Mas Hesse, 2014).

A frequent cited criticism of many studies evaluating the effect of yoga on blood pressure is the exclusion of 24-hour ambulatory blood pressure monitoring. This method of blood pressure analysis provides a more accurate means to detect blood pressure fluctuations. Hagins, Rundle, Consedine, & Khalsa (2014) completed a 12-week randomized control trial of yoga participation in individuals with pre-hypertension and HTN utilizing 24-hour ambulatory blood pressure monitoring. In this study, participants assigned to the intervention group (36 participants) attended twice weekly, 55-minute yoga classes. They were also asked to practice yoga for three, 20-minute sessions a week at home. The control group (32 participants) participated in a non-aerobic exercise class. In the yoga intervention group, an average reduction

of 3.93 mm Hg was noted in the 24-hour ambulatory DBP, a reduction of 4.7 mm Hg in the night-time DBP, and a reduction of 4.23 mm Hg was noted in the mean arterial pressure (MAP). These were all statistically significant reductions in blood pressure. There was also an average reduction of 5 mm Hg in SBP among the yoga intervention group; however, this was not statistically significant. The authors concluded that yoga is an adequate intervention to promote mild reductions in blood pressure and is comparable to the reduction observed when utilizing the DASH diet as a lifestyle intervention to control HTN. In addition, this study indicated that yoga was a relatively safe intervention, as no adverse events were reported in the intervention group (Hagins et al., 2014).

A randomized control trial conducted in the United States utilized 24-hour ambulatory blood pressure monitoring to compare the blood pressure reduction in a yoga intervention group to a control group that received only education on lifestyle modifications (Cohen et al., 2011). The study included a total of 78 adults, 22 to 69 years of age. The yoga intervention group attended twice weekly, 70-minute yoga classes for six weeks. For the remaining six weeks, the intervention group participated in one yoga class weekly and performed yoga at home using a 25-minute video. The control group attended four, one hour sessions that included education on lifestyle modifications to reduce blood pressure such as weight loss, alcohol moderation, and reduced-sodium diets. The control group also received two personalized, 30-minute phone support sessions. Twenty-four-hour ambulatory blood pressure monitoring was obtained at baseline, after six weeks of participation, and at the conclusion of the 12 week study period. The yoga intervention group demonstrated no change in SBP or DBP after six weeks of intervention; however, there was a 6 mm Hg decrease in the mean SBP noted at the conclusion of the study. This reduction was statistically significant and comparable to that typically produced by other

lifestyle modifications. At six weeks of intervention the educational control group demonstrated a reduction in both SBP and DBP, but this was no longer noted at the conclusion of the study. There was no conclusive evidence that yoga provided a greater reduction in blood pressure compared to the educational control group. The authors concluded that the practice of yoga has the ability to decrease blood pressure measurements similar to that of other lifestyle modification interventions (Cohen et al., 2011).

A similar study published in 2016 by the same lead researcher, followed a similar study design but extended the intervention duration to 24 weeks and included 90 participants with either pre-hypertension or HTN (Cohen et al., 2013; Cohen, Boudhar, Bowler, & Townsend, 2016). This study included a yoga intervention group, a lifestyle modification control group, and a combination group. The yoga intervention group was required to participate in a combination of 90-minute yoga classes and home yoga study throughout the trial duration. As the length of the study period increased the difficulty of the yoga increased as well. The lifestyle modification group participated in a walking program, group health classes, and motivational talks. The combination group was required to attend twice weekly yoga classes, participate in the walking program, and attend the lifestyle modification classes. Twenty-four-hour ambulatory blood pressure measurement was obtained from all participants at initiation, after 12 weeks of intervention, and at the conclusion of the 24 week study period. The study demonstrated significant reductions in both SBP and DBP in all three groups at 12 weeks and 24 weeks of intervention. There was a greater SBP reduction in the yoga and combination intervention groups over the lifestyle modification control group at 12 weeks; however, differences between the intervention groups were no longer noted at 24 weeks. This highlights the difficulty of maintaining lifestyle modifications of any type. The study concluded that the practice of yoga

appears to have the same effect on blood pressure reduction as other accepted forms of lifestyle modification (Cohen et al., 2013; Cohen et al., 2016).

Currently, there is very little published data that contradicts the above findings and may represent a publication bias (Cohen et al., 2013). A study completed by Miles et al. (2013) challenged the above research, finding that the practice of yoga is associated with an increase in blood pressure. The study compared the blood pressure measurements of novice yoga participants (19 total) and advanced yoga participants (18 total) following a yoga session. Both the novice and advanced yoga practitioners displayed an increase in SBP, DBP, and mean blood pressure during the yoga session. The average mean blood pressure increase with inversion and floor poses was 19 mm Hg and a 31 mm Hg rise in blood pressure was observed with standing poses. There was no difference in the degree of blood pressure increase or level of perceived exertion when comparing the novice versus advanced participants. This suggests that there is no mitigation of the blood pressure response with long term or regular yoga practice. This evidence requires health care providers' caution in recommending yoga to individuals at high risk for cardiovascular events or who have recently experienced a cardiovascular event. Mizuno and Monteiro (2013) also acknowledged the possibility of this reaction and recommended meditation and deep breathing exercises for most patients and the use of higher intensity yoga poses only for individuals with controlled blood pressure.

There have been many systematic reviews and meta-analyses compiled to evaluate the effects of yoga practice on blood pressure. In a systematic review and synthesis of 17 randomized control trials, it was determined that 11 confirmed the use of yoga for the reduction of SBP, eight confirmed a decrease in DBP, five confirmed no change in SBP, and eight confirmed no change in DBP (Posadzki et al., 2014). The review concluded that yoga may have

a more positive effect on the reduction of blood pressure in individuals with complicated or resistant HTN rather than individuals with pre-hypertension. It was also determined that yoga has a greater effect on the reduction of SBP compared to DBP. Yoga has a potential place in the treatment of HTN but more research is needed before the intervention is recommended on a broad scale (Posadzki et al., 2014).

A systematic review of 19 studies found that yoga practice created a statistically significant blood pressure reduction in 13 of the trials and concluded that a combination of deep breathing, relaxation, and poses should be used to gain the best results. It also concluded that yoga must be practiced regularly for 2 to 3 months in order for a positive effect on blood pressure to be observed (Sharma & Haider, 2012). This conclusion mirrors the results of the Cramer et al. (2014b) meta-analysis.

A large meta-analysis of 49 randomized control trials examining the effects of yoga on several cardiovascular outcomes reported a positive response to yoga participation with a combined SBP reduction of 5.85 mm Hg and DBP reduction of 4.12 mm Hg. The effects of yoga participation were the greatest after 12 weeks of intervention. The analysis also concluded that yoga participation is a relatively safe practice (Cramer et al., 2014b). However, Wang et al. (2013) was unable to recommend the widespread implementation of yoga due to poor reporting of safety data leading to unknown adverse effects related to yoga participation.

A small systematic review of six randomized control trials and a meta-analysis of seven randomized control trials both discussed the relevance of yoga as an adjunct therapy in combination with traditional blood pressure management, rather than as a substitute to pharmacologic therapy (Cramer et al., 2014a; Wang et al., 2013). Both Sharma and Haider

(2012) and Cramer et al. (2014a) confirmed that yoga provides an equivalent reduction in blood pressure as compared to the reduction observed with adherence to a low-sodium diet.

All of the systematic reviews and meta-analyses addressed major concern with the lack of rigorous clinical trials. Most of the completed clinical trials are of a lower quality design, with limited consideration to blinding, randomization, adequate control groups, and sample size. In addition, many of the current trials have been completed outside of the United States, in areas where yoga practice is a more commonly accepted treatment modality. In essence, this may create a location bias. It is also difficult to recommend the practice of yoga for the reduction of blood pressure because there are many forms or "schools" of yoga practice. Many of the clinical trials have been conducted using varying yoga forms, making a generalized recommendation difficult (Posadzki et al., 2014). Clinical trials have varied significantly on the length of each yoga session, frequency of practice, and total length of intervention. Again, this makes generalization difficult (Wang et al., 2013). In the future, it may be beneficial to include trials comparing the forms of yoga to allow for discovery of the most effective practice in reducing blood pressure (Cramer et al., 2014b). Thus far, the majority of clinical trials have not reported safety data. It is generally assumed that yoga is a low-intensity, safe modality; however, this has not been confirmed in the research (Wang et al., 2013). The small number of clinical trials that have reported safety data have identified only minor musculoskeletal injury among participants. There are no documented cardiovascular complications related to the practice of yoga (Cohen et al., 2016).

A scientific statement from the American Heart Association regarding alternative therapies to aid in the reduction of blood pressure was not able to recommend the use of yoga for this purpose. The lack of high-quality research was cited as the main reason for this

recommendation. However, the statement did recognize yoga as a relatively safe intervention and acknowledged the potential for blood pressure reduction with yoga by calling for further research on the topic (Brook et al., 2013).

Learning Points

- HTN is a major health concern in the United States and throughout the world. Nearly 20% of all deaths in Western countries are related to HTN, either as a primary or secondary causative factor (Heidenreich et al., 2011).
- There are clearly defined clinical practice guidelines to aid health care providers in the proper pharmacologic treatment of HTN; however, there is less guidance in the use of lifestyle modifications. The increasing incidence of resistant HTN, intolerance to antihypertensive medications, drug interactions, and/or the inability to afford antihypertensive medication regimens highlight the importance of defining the lifestyle modifications that result in the greatest blood pressure reduction (Brook et al., 2013).
- Clinical research trials and reviews have demonstrated a positive effect of yoga on the reduction of blood pressure. However, these results have been inconsistent with significant differences noted in the degree of total blood pressure, SBP, and DBP reduction. In addition, there has been little data published demonstrating a null or negative effect of yoga on blood pressure reduction. It is reasonable to consider yoga as an adjunct therapy in the management of HTN but it cannot be recommended for widespread use at this time (Brook et al., 2013; Cohen et al., 2016).
- More research is needed to determine the definitive effects of yoga on blood pressure. Particular attention should focus on the safety of yoga practice, the time commitment and frequency needed to obtain positive reductions in blood pressure, and the form of yoga

that is most useful for blood pressure reduction. Further research must include high-quality studies with attention to randomization, blinding, and adequate sample sizes that are generalizable across multiple settings and populations (Cramer et al., 2014b; Posadzki et al., 2014; Wang et al., 2013).

Conclusion

HTN affects over 25% of the world's adult population and is a leading cause of morbidity, disability, and mortality (Brook et al., 2013; Cramer et al., 2014b). Even a modest blood pressure reduction of 2 mm Hg can reduce the risk of death related to stroke by 10%, the risk of death related to ischemic heart disease by 7%, and transient ischemia attacks (TIA) by 14% (Cohen et al., 2011; Cohen et al., 2013). Lifestyle modifications play an important role in the treatment of HTN, especially when considering the incidence of pre-hypertension, resistant HTN, side effects or intolerances related to pharmacologic therapy, and drug interactions (Tolbaños Roche & Mas Hesse, 2014). It is likely that our case study subject, Sara, will achieve blood pressure control and eliminate her antihypertensive side effects with the alteration in pharmacologic therapy; however, lifestyle modifications are an important adjunct to this therapy. Yoga has great potential for inclusion with the lifestyle modifications proven to reduce blood pressure due to its actions on the sympathetic and parasympathetic nervous systems. Once yoga concepts such as deep breathing and meditation are incorporated into one's life, they often create permanent lifestyle changes, leading to an overall improvement in total health (Tolbaños Roche & Mas Hesse, 2014).

References

American Heart Association. (2014). High blood pressure- statistical fact sheet 2014 update. Retrieved from https://www.heart.org/idc/groups/heart-public/@wcm/@sop/@smd/documents/downloadable/ucm_462020.pdf

Brook, R. D., Appel, L. J., Ruben fire, M., Ogedegbe, G., Bisognano, J. D., Elliott, W. J., . . . American Heart Association Professional Education Committee of the Council for High Blood Pressure Research, Council on Cardiovascular and Stroke Nursing, Council on Epidemiology and Prevention, and Council on Nutrition, Physical Activity. (2013). Beyond medications and diet: Alternative approaches to lowering blood pressure: A scientific statement from the American Heart Association. Hypertension, 61(6), 1360-1383. doi:10.1161/HYP.0b013e318293645f [doi]

Cohen, D. L., Bloedon, L. T., Rothman, R. L., Farrar, J. T., Galantino, M. L., Volger, S., . . . Townsend, R. R. (2011). Iyengar yoga versus enhanced usual care on blood pressure in patients with prehypertension to stage I hypertension: A randomized controlled trial. Evidence-Based Complementary and Alternative Medicine : ECAM, 2011, 546428. doi:10.1093/ecam/nep130 [doi]

Cohen, D. L., Boudhar, S., Bowler, A., & Townsend, R. R. (2016). Blood pressure effects of yoga, alone or in combination with lifestyle measures: Results of the lifestyle modification and blood pressure study (LIMBS). Journal of Clinical Hypertension (Greenwich, Conn.), doi:10.1111/jch.12772 [doi]

Cohen, D. L., Bowler, A., Fisher, S. A., Norris, A., Newberg, A., Rao, H., . . . Townsend, R. R. (2013). Lifestyle modification in blood pressure study II (LIMBS): Study protocol of a randomized controlled trial assessing the efficacy of a 24 week structured yoga program

versus lifestyle modification on blood pressure reduction. Contemporary Clinical Trials, 36(1), 32-40. doi:10.1016/j.cct.2013.05.010 [doi]

Cramer, H., Haller, H., Lauche, R., Steckhan, N., Michalsen, A., & Dobos, G. (2014a). A systematic review and meta-analysis of yoga for hypertension. American Journal of Hypertension, 27(9), 1146-1151. doi:10.1093/ajh/hpu078 [doi]

Cramer, H., Lauche, R., Haller, H., Steckhan, N., Michalsen, A., & Dobos, G. (2014b). Effects of yoga on cardiovascular disease risk factors: A systematic review and meta-analysis. International Journal of Cardiology, 173(2), 170-183. doi:10.1016/j.ijcard.2014.02.017 [doi]

Hagins, M., Rundle, A., Consedine, N. S., & Khalsa, S. B. (2014). A randomized controlled trial comparing the effects of yoga with an active control on ambulatory blood pressure in individuals with prehypertension and stage 1 hypertension. Journal of Clinical Hypertension (Greenwich, Conn.), 16(1), 54-62. doi:10.1111/jch.12244 [doi]

Heidenreich, P. A., Trogdon, J. G., Khavjou, O. A., Butler, J., Dracup, K., Ezekowitz, M. D., . . . Council on Cardiovascular Surgery and Anesthesia, and Interdisciplinary Council on Quality of Care and Outcomes Research. (2011). Forecasting the future of cardiovascular disease in the united states: A policy statement from the American Heart Association. Circulation, 123(8), 933-944. doi:10.1161/CIR.0b013e31820a55f5 [doi]

Miles, S. C., Chun-Chung, C., Hsin-Fu, L., Hunter, S. D., Dhindsa, M., Nualnim, N., & Tanaka, H. (2013). Arterial blood pressure and cardiovascular responses to yoga practice. Alternative Therapies in Health & Medicine, 19(1), 38-45 8p. Retrieved from http://ezproxy.undmedlibrary.org/login?url=http://search.ebscohost.com.ezproxy.undmed

library.org/login.aspx?direct=true&AuthType=ip,url,uid,cookie&db=c8h&AN=108021938&site=ehost-live

Mizuno, J., & Monteiro, H. L. (2013). An assessment of a sequence of yoga exercises to patients with arterial hypertension. Journal of Bodywork & Movement Therapies, 17(1), 35-41 7p. doi:10.1016/j.jbmt.2012.10.007

Posadzki, P., Cramer, H., Kuzdzal, A., Lee, M. S., & Ernst, E. (2014). Yoga for hypertension: A systematic review of randomized clinical trials. Complementary Therapies in Medicine, 22(3), 511-522 12p. doi:10.1016/j.ctim.2014.03.009

Sharma, M., & Haider, T. (2012). Yoga as an alternative and complementary treatment for hypertensive patients: A systematic review. Journal of Evidence-Based Complementary & Alternative Medicine, 17(3), 199-205 7p. doi:10.1177/2156587212452144

Tolbaños Roche, L., & Mas Hesse, B. (2014). Application of an integrative yoga therapy programme in cases of essential arterial hypertension in public healthcare. Complementary Therapies in Clinical Practice, 20(4), 285-290 6p. doi:10.1016/j.ctcp.2014.10.004

Wang, J., Xiong, X., & Liu, W. (2013). Yoga for essential hypertension: A systematic review. PloS One, 8(10), e76357. doi:10.1371/journal.pone.0076357 [doi]