Effectiveness of a 12-Week Yoga Program on Physiopsychological Parameters in Patients with Hypertension

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ABSTRACT

Background: Hypertension is a major chronic lifestyle disease affecting one in three adults over 25 years or about one billion, thereby resulting in cardiovascular, cerebrovascular, and renal complications. In addition, it is an important contributor for increased cardiovascular morbidity and mortality in industrialized countries. Reports suggest that hypertension is rapidly increasing in the developing countries like India. Although medical management is effective in treating hypertension, owing to the side effects, alternative therapy such as Yoga practice is recommended. However, evidences on the efficacy of yoga practice in patients with hypertension are insufficient and further research is required.

Objective: The study aimed to investigate the effectiveness of a 12-week Yoga program on physiopsychological parameters in patients with hypertension.

Methods: Of 238 patients, 118 were randomly assigned to participate in yoga program (YP) group and 120 to the control group (CG) with no treatment. Parameters such as blood pressure (BP), heart rate (HR), body mass index (BMI), anxiety, and perceived stress were measured before and after intervention.

Results: The groups were initially homogeneous; however, after intervention, the groups significantly differed. The YP group exhibited reduced BP, HR, BMI, anxiety, and perceived stress (P < 0.001).

Conclusion: Our study suggests a 12-week yoga program may offer an effective intervention in reducing BP, HR, BMI, anxiety and perceived stress in patients with hypertension. Practicing Yogaasanas at home are helpful to avoid increased BP-related complications.

Keywords: Hypertension, Yoga, Blood pressure, Heart rate, Body mass index, Anxiety, Stress

INTRODUCTION

Hypertension is a chronic lifestyle disease and a major public health problem. More than half of coronary heart diseases and two-third of stroke and heart failure events are directly attributed to either high blood pressure (BP) or hypertension1. In 2000, the total number of adults with hypertension was estimated to be 972 million, of which 333 million were in economically developed countries and 639 million in economically developing countries. By 2025, this number is predicted to increase by about 60% to a total of 1.56 billion2.

High BP is estimated to affect one of three adults aged ≥25 years or about 1 billion people worldwide. The theme of the “World Health Day” 2013 is “Measure your BP, reduce your risk”, which is a call for intensified efforts to prevent and control hypertension3. Hypertension is a chronic condition with systolic blood pressure (SBP) of 140 mmHg and/or diastolic blood pressure (DBP) of 90 mmHg (JNC7 2003). An increased workload of the heart can result in the damage to the heart muscles and valves, thereby resulting in heart failure4.

Hypertension is a major contributor to the cardiovascular morbidity and mortality in the industrialized countries. Reports suggest that hypertension is rapidly increasing in the developing countries like India. It has now become a global pandemic. The World Health Organization reports that hypertension affects more than 100 million individuals in India. Due to decreased awareness, the treatment and control rates are abysmally low in India5.

Yoga may be an appropriate intervention to reduce BP. There is no single definition of universally accepted yoga practice, although it is generally described as an ancient tradition6,7. Yoga includes the techniques of posture (asana), breath control (pranayama), and meditation, as well as moral and ethical observances8,9. A complete description of the historical origins of yoga and its philosophy can be found elsewhere10. Reviews of current literature suggests that yoga can reduce BP and related dysfunction in adults11,12; although most of these reviews suggest caution is warranted, as several studies have substantial methodological limitations. Few studies have examined the effect of yoga on stress in patients with hypertension.

In particular, controlled studies on hypertension have demonstrated improvement with yoga practice on BP13,14, obesity15, lipid16, depression17, stress18, self-concept19, and anxiety20,21. The mechanism of yoga in reducing psychosocial stress remains unclear. Theory suggests that yoga alters the extent to which events are experienced as being stressful or impacts reactions to perceived stress22.

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In addition, yoga on stress management is directly associated the regulation of autonomic arousal. Therefore, parameters such as BP, HR, BMI, and anxiety may provide additional sources of information to understand both the efficacy and mechanisms of yoga.

During yoga practice, participants develop the ability of focused attention to the present moment, instead of being arrested by thoughts and ruminations. This mental stability seems to be related to the sympathetic reduction and conversely improvement in the parasympathetic activity contributing to stress and anxiety reduction. Few studies investigated the stress levels of the hypertension patients before and after yoga therapy. A pilot study was conducted among 24 participants with hypertension. The protocol developed included meditation, yoga body positions, and respiration techniques. The study assessed physiological variables, namely, BP, HR, BMI, and psychological variables such as anxiety and stress level. Application of specific questionnaires allowed the researchers to detect improvement in the participant’s state and trait anxiety and the perceived stress level. Therefore, the present study aimed to investigate whether yoga practice alters BP, HR, BMI, stress, and anxiety levels in patients with hypertension.

METHODS

Study participants: The present study was approved by the Research Ethics Committee of SRM University, Protocol no.57/IEC/2010. The study volunteers were recruited by means of announcements on radios and newspapers. Inclusion criteria were as follows: patients with Stage 1 and Stage 2 hypertension (SBP, 140–169 mm hg; DBP, 90–109 mm hg), aged 30–60 years, and those receiving antihypertensive medications. Exclusion criteria included patients with diabetes mellitus, asthma, and hypercholesteremia, alcoholics, smokers, antenatal and postnatal mothers, and those with regular yoga practice or practicing similar techniques.

Of 272 patients, 238 were randomly allocated into two groups: 118 patients (55 males and 63 females) participated in the yoga program group (YP group), and 120 (55 males and 65 females) in the control group (CG). For ethical reasons, after the study completion, the CG also participated in the suggested intervention. The participants visited the community health centers of SRM University and were subjected to clinical examination for assessing overall health, identification questionnaires were filled, and informed consent was obtained. Furthermore, psychological scales and inventories, such as BP, HR, and BMI were assessed. These assessments were repeated after 12 weeks in both the groups.

Outcome measures

The following instruments were used to assess the physiological aspects:

- An ISO certified weighing machine to measure weight;
- An inch tape and a scale (Stadiometer) to determine height;
- A sphygmomanometer to determine BP, and
- A Stethoscope to determine HR.

BP was recorded in the sitting position in the right arm to the nearest 2 mm Hg using mercury sphygmomanometer (Diamond Deluxe BP apparatus, Pune, India). Two readings were taken 5 min apart, and the mean was recorded as BP. BMI was calculated as weight divided by height squared (kg/m²).

Psychological variables have been assessed by 2 standardized tools.

State Trait Anxiety Inventory (STAI): A four point Standardised State Trait Anxiety Inventory devised by Spielberger was adapted, which consists of 40 statements in 2 sections to assess the anxiety level (Spielberger 1983).

### Table 1: Frequency distribution of the level of stress before and after intervention.

<table>
<thead>
<tr>
<th>Level of stress</th>
<th>Before intervention</th>
<th>After intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YP group</td>
<td>Control group</td>
</tr>
<tr>
<td>Slightly lower</td>
<td>7 (6%)</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Average</td>
<td>51 (43%)</td>
<td>53 (44%)</td>
</tr>
<tr>
<td>Slightly higher</td>
<td>54 (46%)</td>
<td>57 (48%)</td>
</tr>
<tr>
<td>Much higher</td>
<td>6 (5%)</td>
<td>7 (6%)</td>
</tr>
<tr>
<td></td>
<td>YP group</td>
<td>Control group</td>
</tr>
<tr>
<td>Slightly lower</td>
<td>38 (32%)</td>
<td>3 (2%)</td>
</tr>
<tr>
<td>Average</td>
<td>68 (58%)</td>
<td>52 (44%)</td>
</tr>
<tr>
<td>Slightly higher</td>
<td>12 (10%)</td>
<td>59 (49%)</td>
</tr>
<tr>
<td>Much higher</td>
<td>-</td>
<td>6 (5%)</td>
</tr>
</tbody>
</table>

Data described as frequency (percentage); 001YP: yoga program.

### Table 2: Scores of anxiety as measured using STAI in both groups before and after intervention.

<table>
<thead>
<tr>
<th>Anxiety State</th>
<th>Before intervention</th>
<th>After intervention</th>
<th>t value</th>
<th>t (inter)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>YP group</td>
<td>Control group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trait</td>
<td>50.42 ± 7.65</td>
<td>40.33 ± 7.14</td>
<td>29.12, P = 0.001</td>
<td>0.85, P = 0.39</td>
</tr>
<tr>
<td></td>
<td>49.54 ± 8.17</td>
<td>48.98 ± 8.18</td>
<td>1.80, P = 0.07</td>
<td>8.69, P = 0.001</td>
</tr>
<tr>
<td></td>
<td>46.31 ± 9.05</td>
<td>37.27 ± 8.18</td>
<td>52.54, P = 0.001</td>
<td>0.29, P = 0.77</td>
</tr>
<tr>
<td></td>
<td>45.98 ± 8.42</td>
<td>45.55 ± 7.75</td>
<td>1.13, P = 0.26</td>
<td>8.01, P = 0.001</td>
</tr>
<tr>
<td></td>
<td>96.72 ± 15.07</td>
<td>77.60 ± 13.13</td>
<td>44.81, P = 0.001</td>
<td>0.61, P = 0.53</td>
</tr>
<tr>
<td></td>
<td>95.52 ± 15.09</td>
<td>94.53 ± 14.51</td>
<td>1.32, P = 0.24</td>
<td>9.36, P = 0.001</td>
</tr>
</tbody>
</table>

Data are described as the mean ± standard dev., 10.001 differs before and after the intervention in the corresponding group— student’s dependent t-test, 0.001 differs between the groups— student’s independent t-test.
Table 3: Scores of BP of hypertension patients before and after intervention

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>Before Intervention</th>
<th>After intervention</th>
<th>t value</th>
<th>F (inter)</th>
<th>F (within)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YP group</td>
<td>152.75 ± 11.57</td>
<td>138.51 ± 9.39</td>
<td>10.88</td>
<td>16.39</td>
<td>384.1</td>
</tr>
<tr>
<td>CG</td>
<td>152.85±10.68</td>
<td>152.38 ± 10.25</td>
<td>P = 0.001</td>
<td>P = 0.001</td>
<td>P = 0.001</td>
</tr>
<tr>
<td>DBP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>YP group</td>
<td>94.51 ± 6.92</td>
<td>86.17 ± 6.3</td>
<td>9.78</td>
<td>22.7</td>
<td>254.3</td>
</tr>
<tr>
<td>CG</td>
<td>94.77 ± 6.4</td>
<td>94.23 ± 6.43</td>
<td>P = 0.001</td>
<td>P = 0.001</td>
<td>P = 0.001</td>
</tr>
</tbody>
</table>

Data are described as mean ± standard deviation; *p < 0.001 differs before and after the intervention as well as between and within the groups. YP: Yoga program; CG: Control group; SBP: Systolic blood pressure; DBP: Diastolic blood pressure.

Perceived Stress Scale (PSS): A five point Perceived Stress scale consists of 10 statements rated on a five-point likert scale ranged from 0 to 4 as very low, low, average, high, and very high level of stress (Cohen 1983).28

Intervention: The yoga program comprised a 5-day intensive continuous training for 2 h/day, after which the participants were asked to practice yoga daily for 30–45 mins at home, at least for 5 days per week. They were followed-up for 12 weeks. Instruction was provided to these participants through DVD, and they were requested to attend the yoga group session once in two weeks till 12 weeks. The program included the following traditional Hatha Yoga exercises:

Yoga body poses (asanas for 18 min): Sukhasana—practitioner sits with the legs crossed and the back straight.
Vajrasana—practitioner sits on the heels, keeping the legs and thighs together, and the back straight. Ardha-Matsyendrasana—practitioner sits intertwining the legs, the back straight, and twists the back to look behind; this movement is performed in both directions. Shavasana—practitioner lies on the floor, on the back, with the arms along the body, and the knees extended. Bhujangasana—practitioner lies on the floor, on the abdomen, with the palms of the hands on the floor, at the pectoral level. Upon the instructor’s command, the practitioner raises the trunk gently from the floor while stretching the back. Standing Chakrasana—practitioner stands with the feet together, raises the right arm, and bends the trunk toward the left side; this movement is performed on both sides. The average duration of each movement was approximately 3 min.

Exercises involving awareness and voluntary regulation of breath (pranayamas for 12 min): Bhastrika—forceful expirations through the nose followed by passive inspirations. Ujjayi—slow and complete inspiration, retention of the air in the lungs, and slow expiration through partially closed glottis. Nadi Shodhana—inspiration through the left nostril, retention of air in the lungs, expiration through the right nostril, inspiration through the right nostril, retention of air in the lungs, and expiration through the left nostril. Kapalabhati—forceful, short, and fast expiration through the nostrils followed by passive inspiration. The average duration of each pranayama was approximately 3 min.

Meditational practices (10 min): mindfulness meditation, originating in Buddhist meditation, involves paying sustained attention to sensations, perceptions, and thoughts with suspension of judgment.

Statistical analysis: Data were analyzed using SPSS Version 16 (IBM, Chicago, USA). Baseline equivalence of both the groups related to age, gender, ethnicity, annual family income, medication, and nature of work were determined using independent t-tests or chi squared tests as appropriate. BP (systolic and diastolic), HR, and BMI values at pre- and post tests were evaluated for normality for parametric assumptions and were evaluated for baseline equivalence between the groups at pretest using independent t-tests. To analyze the psychological (STAI and PSS) and physiological (BP, HR and BMI) measurements, a 2-way ANOVA was applied before and after intervention. The differences between the groups and time points were investigated according to their statistical significance and as was the interaction between these factors. With regard to STAI and PSS, the chi-square test (χ^2) was used to compare the groups.

RESULTS

Before intervention, both groups were statistically homogeneous with regard to the following variables: male gender (YP group: n = 55, 47%; CG: n = 55, 46%) and female gender (YP group: n = 63, 53%; CG: n = 65, 54%); educational level, no formal education (YP group: n = 26, 22%; CG: n = 25, 21%), complete elementary education (YP group: n = 63, 53%; CG: n = 54, 45%), complete secondary education (YP group: n = 36, 22%). The participants in the YP group reported 100% commitment to the suggested program. This level of adherence was most likely facilitated by the relative flexibility of the program, as the group sessions could be attended at two different times. Furthermore, the use of DVD for practice at home facilitated the optimal rate of adherence to the protocol.

Table 1 shows the frequency of distribution of the level of stress in both the groups. Before intervention, the groups were statistically similar: χ^2 (P > 0.001). In the YP group, 7 (6%) participants had lower stress, 51 (43%) average stress, 54 (46%) with higher stress, and 6 (5%) with extreme level of stress. In the control group, 3 (2%) participants had lower stress, 53 (44%) had average stress, 57 (48%) with higher stress, and 7 (6%) with extreme level of stress.

However, after intervention, the groups exhibited statistically significant differences: χ^2 (P < 0.001). In the YP group, 36% of the participants had higher stress before intervention exhibited lower level of stress after stress. In addition, Table 1 illustrated statistically significant differences in the YP group. Conversely, CG did not
The present study aimed to analyze whether an intervention using yoga exercises could change BP, HR, BMI, stress and anxiety levels in patients with hypertension. The stress levels of the participants in the YP group changed from the level of much higher (N = 6), slightly higher (N = 54), average (N = 51) and lower (N = 7) to absence in much higher, slightly higher (N = 12), average (N = 68), and lower (N = 38), thereby demonstrating the effectiveness of intervention. These changes indicated that the yoga program could reverse stress-related symptoms (Table 1). The intervention group exhibited a statistically significant reduction in the stress and anxiety scores, thereby indicating that this type of intervention may be useful to reduce stress in patients with hypertension.

**DISCUSSION**

This study demonstrates statistically significant reduction in the anxiety symptoms among the participants in the YP group. An emergent body of evidence points to the possible therapeutic effects of the practice of aerobic or anaerobic exercises on anxiety (Kang et al 2009). In addition, these exercises may be either mindful or nonmindful physical exercises, which proved to be effective in reducing anxiety symptoms35.

It is worth noting that among other activities, the volunteers in our study were subjected to the practice of hatha yoga, which includes physical exercise, most were anaerobic. Nevertheless, our results cannot be discussed on
the grounds of the therapeutic effects of practicing only physical exercise, because our purpose was to subject the volunteers to a program that included exercises to the mind and meditation. Therefore, our results must be attributed to the program as such and not merely to one of its parts. In addition, Kozasa et al. investigated the efficiency of a program that included mantra meditation and pranayamas, known as Siddha Samadhi Yoga, in reducing scores of anxiety in patients with anxiety. This program includes meditation exercises associated with exercises of respiration (pranayamas), of 22 volunteers, 14 were allocated to the intervention group and eight to the control group. The intervention group received practice 3 times a day for 15 mins. The intervention group exhibited a significant reduction in the anxiety and depression scores compared to the control group (Kozasa et al 2008), and the results were consistent with the present study.

With regard to BP, 80 (67.8 %) adults with Hypertension in the YP group had Stage 1 systolic hypertension, 38 (32.2%) had Stage 2 SBP, whereas at the end of 12th week, 35 (29.7%) shows Normal or in Pre hypertension stage. In CG, 75 (63.6%) had Stage 1 and only 8 (6.8%) had Stage 2 level of systolic hypertension. Similarly in DBP, 69 (58.5%) had Stage 1 level of hypertension, 36 (30.5%) had Stage 2 DBP, whereas at the end of 12th week, 68 (57.6%) shows Normal or in Pre hypertension stage, 42 (35.6%) had Stage 1 and only 8(6.8%) had Stage 2 levels of diastolic hypertension. Though it is evident that more than 70% of participants exhibited a improvement in both systolic and diastolic BP in study group, they did not achieve 100% achievement. Hence further research is needed and those who have not received yoga also to be provided with other alternative methods.

A significant reduction in HR (5%) and BMI (7%) scores were also observed in the YP group compared to that in the control group. These findings were similar to the study conducted by Pramanik et al to evaluate the immediate effect of slow pace bhasrika pranayama (respiratory rate; 6/min) on HR and BP and the effect of the same breathing exercise for 5 mins. It was noted that after slow bhasrika pranayamic breathing for 5 mins, both the systolic and diastolic BP significantly decreased with a slight fall in HR. Similarly, Soubia Malik et al observed the effect of BMI on BP among 100 respondents from Karachi. The findings proved that decreased BMI reduces the systolic pressure and diastolic pressure.

Comparing to previous studies in patients with hypertension, the present study is randomized and controlled and has a bigger sample. However, both the groups are under regular antihypertensive medications, which could be a study limitation. We suggest that further research is necessary to analyze the effect of Yoga program in those without treatment. The control group could be given some other mode of exercises. In this study, data on the impact of yoga on quality of life was not collected.

As previously mentioned, the mental stability could be related to sympathetic reduction and improvement in the parasympathetic activity contributing to decrease in BP, HR, BMI, stress and anxiety. Several studies about the effects of yoga practice have been indicating a number of physiological changes, such as increased GABA concentration, adrenalin and noradrenalin reductions, increased serotonin and melatonin concentrations, which can be related to improvements in mood, reductions in body temperature, and increased galvanic skin resistance may be related to stress management, and also increased gray matter density in brain regions related to emotional regulation.

CONCLUSIONS
The study reported that the yoga practice may represent an effective intervention in patients with hypertension to reduce BP, HR, BMI, stress, and anxiety. Therefore, it is considered to have positive effects on the cardiovascular system. In addition, yoga practice can be encouraged to be used as a non-pharmacological method to prevent hypertension-related complications.

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REFERENCES