Original Article

Comparison of the effects of yoga and lifestyle modification on grade-I hypertension in elderly males: A preliminary study

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Abstract

Background and Aim: Aging along with hypertension is a major risk factor for cardiovascular (CV) morbidity and mortality. It is noticed that systolic hypertension in elderly is often associated with increased CV risks and is resistant to pharmacological treatment. Hence, we aimed to assess the difference between practice of yoga and lifestyle modifications (LSM) in elderly grade-I hypertensive males.

Methods: A randomized control study was conducted on age and body mass index (BMI)-matched elderly male subjects (n = 42) between 60–80 years with grade-I hypertension. They were equally divided into yoga group (n = 21) and LSM group (n = 21). Their fasting blood glucose and lipid profile were recorded before the intervention period, and both the groups were matched for these biochemical parameters. The yoga group was assigned for practice of a yoga module and the LSM group (n = 21) was assigned for stretching exercises and brisk walk, for 6 days in a week, for 1 h in the morning for 6 weeks. Their CV parameters including heart rate and blood pressure (BP) were recorded before and after the intervention period.

Results: We found a significant decrease in systolic BP (P < 0.001), pulse pressure (P < 0.001), mean arterial pressure (P < 0.001), and rate pressure product (P < 0.001) in elderly hypertensives following yoga therapy for 6 weeks, whereas no statistically significant change was noticed in the LSM group practicing stretching exercise and brisk walk for the same duration.

Conclusion: Yoga intervention for 6 weeks could be an effective non-pharmacological means for better management than the LSM for control of BP in elderly subjects having grade-I hypertension.

Key words: Elderly, grade-I hypertension, lifestyle modification, males, yoga

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INTRODUCTION

Increased age is an established cardiovascular (CV) risk factor. Aging along with hypertension is a major risk factor for CV morbidity and mortality.[1] The prevalence of hypertension in elderly ranges from 60 to 80%, and it is estimated that two of three individuals over 75 years of age suffer from hypertension.[1,2] A change in the patterns of hypertension with age has been observed. In elderly, systolic blood pressure (SBP) increases without much change in diastolic blood pressure (DBP), which is categorized as isolated systolic hypertension (ISH). Systolic hypertension may lead to stroke, myocardial infarction, dementia, renal failure, and death.[3] These clinical complications affect the quality and longevity of life in elderly. According to World Health Organization, the most common cause of preventable death in developed countries is hypertension, which is significantly increasing in developing countries.[4]

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Reduction of systolic hypertension in elderly subjects could reduce clinical complications, extend lifespan, and improve

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quality of life.[5] However, the elderly individuals suffering from ISH are often resistant to pharmacological treatment and attempts to reduce the SBP aggressively also lowers DBP to a greater extent that compromises coronary blood flow.[6] Among the non-pharmacological approaches, yoga has emerged as the most effective therapy to control hypertension and improve CV function.[7-10] Though practice of lifestyle modification (LSM) such as morning walk and stretching exercises is known to reduce blood pressure (BP), its impact in elderly patients may not be effective as many of them invariably suffer from osteoarthritic joint diseases that prevent them from fruitful participation in such LSM program. Yoga is an ancient system of spiritual practice having a psychosomatic discipline comprising physical and mental techniques, that help to achieve a harmony between the mind and body. However, no study has been conducted till date to compare the benefits of yoga with LSM practice in elderly mild hypertensives. Therefore, the present study was conducted to assess the difference in the effects of practice of yoga and LSM in elderly grade-I hypertensive males.

MATERIALS AND METHODS

Participants and study design

It is a randomized control study conducted on elderly male subjects between 60 to 80 years with grade-I hypertension. Subjects with SBP from 140 to 159 mmHg and DBP from 90 to 99 mmHg were included for the study. Subjects on any medications, suffering from diabetes mellitus or CV diseases, hypercholesterolemia, and high triglyceride level were excluded from the study. The task force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC) in its 2007 guidelines, classified hypertension/ISH into three categories: Grade-I (SBP/DBP: 140–159/90–99 mmHg), grade-II (SBP/DBP: 160–179/100–109 mmHg), and grade-III (SBP ≥ 180 or DBP ≥ 100 mmHg).[11] In the same guidelines, they recommended for lifestyle changes intervention for few months for grade-I hypertension without any CV risk factors, before drug therapy. The present study was approved by the institutional ethical committee as per the guidelines (2006) of Indian Council of Medical Research. We followed the declaration of Helsinki and the study was reported as per the recommendations of the CONSORT group.[12] Informed written consent was obtained for participation in the study.

Randomization and intervention

Subjects were randomly divided into yoga group (n = 21) and LSM group (n = 21) by using random number table. However, it was ensured that subjects of both the groups matched for age, body mass index (BMI), fasting blood glucose, and lipid profile [Table 1]. The yoga group was assigned to yoga practice by an authorized yoga instructor for 6 days in a week for 1 h daily in the morning from 06:00 to 07:00 h for 6 weeks. The integrated yoga module for intervention includes: Opening prayer (1 min); Sukshma Vyayama or loosening practices (5 min); breathing practices like hands in and out breathing, ankle stretch breathing, straight leg raising breathing, lumbar stretch breathing (5 min); asanas or maintaining postures such as Padhastasana, Ardhachakrasana, Shashankasana, Ardha Ustrasana, Bhujangasana, Ardha Salabasana, and Trikonasana (15 min); Pranayama or breathing exercises such as Anuloma-Viloma Pranayama and Brahmari Pranayama (5 min); cyclic meditation, a yoga-based guided relaxation technique;[13] devotional session (5 min); and closing prayer (1 min). The protocol for the LSM group consisted of flexibility or stretching practices for 20 min followed by brisk walk for 35 min and rest for 5 min for 6 days in a week, for 1 h in the morning between 06:00-07:00 h for 6 weeks under the supervision of an authorized instructor.

Table 1: Baseline characteristics of participants in both yoga and LSM groups

Parameters	Yoga (n=21)	LSM (n=21)	P value
Age (years)	69.42±5.32	69.52±6.59	0.959
BMI (kg/m^2)	24.18±3.39	24.64±3.67	0.676
HR (bpm)	70.33±8.30	72.09±8.82	0.509
Systolic BP (mmHg)	147.23±5.62	147.00±5.82	0.894
Diastolic BP (mmHg)	74.95±3.8	75.52±5.43	0.695
Pulse pressure (mmHg)	72.28±6.03	71.47±6.09	0.668
MAP (mmHg)	98.8±3.53	98.8±4.94	1.000
Fasting blood glucose (mg/dl)	95.09±10.79	91.52±12.51	0.328
Serum triglyceride (mg/dl)	97.85±27.14	105.76±23.29	0.317
Total cholesterol (mg/dl)	149.19±24.98	152.33±21.84	0.667
HDL cholesterol (mg/dl)	46.66±4.37	46.61±4.63	0.973

Values are expressed in mean±SD. Statistical analysis was done by student's unpaired 't' test. P<0.05 was considered statistically significant. LSM: Lifestyle modification, HR: Heart rate, BMI: Body mass index, MAP: Mean arterial pressure, HDL: High-density lipoprotein, BP: Blood pressure, SD: Standard deviation

Measurement of heart rate and BP

Heart rate (HR) was derived from RR interval of electrocardiogram (ECG) recordings (Physiopac, Medicaid systems, India). Brachial BP recordings were made twice, one at baseline and another after 6 weeks of intervention in the morning between 08:00-11:00 h after supine rest for 10 min. BP was measured thrice with an interval of 1 min for 3 consecutive days using mercury sphygmomanometer (Diamond, Industrial electronic, and allied products, India) and the average of nine measurements was considered.[5,14] Rate pressure product (RPP), a determinant of myocardial oxygen consumption and work load was calculated using the formula, RPP = (BHR × SBP) ×10^{-2}.[15] Pulse pressure (PP) was calculated as the difference between SBP and DBP.

Mean arterial pressure (MAP) was obtained by adding one-third of the PP and DBP. No intervention has been given on the day of investigation to both the yoga and LSM group. Persons handling data analysis were kept blinded.

Statistical analysis

The obtained data were expressed in mean and standard deviation. To determine the statistical significance, paired '*t*' test and Wilcoxon signed rank test for normally and non-normally distributed data were applied respectively, using software Statistical Package for Social Sciences (SPSS) version 20 (SPSS Software Inc, Chicago, IL, USA). Statistical significance was established at $P < 0.05$.

RESULTS

The baseline characteristics of the participants were shown in Table 1. As there was no significant difference in age, BMI, and BP parameters between the yoga and LSM groups, it implies that samples were equally distributed. Table 1 also shows that DBP was within the normal range where as SBP was high indicating ISH in both the groups. Fasting blood glucose, serum triglyceride, total cholesterol, and high-density lipoprotein (HDL) cholesterol levels of the participants were summarized in Table 1.

Yoga practice for 6 weeks has significantly lowered HR ($P < 0.01$), SBP ($P < 0.001$), PP ($P < 0.001$), and MAP ($P < 0.001$) in elderly individuals, whereas no significant change was noticed in the LSM group subjects practicing brisk walk and stretching exercise. There was no significant difference in DBP of both yoga and LSM groups following intervention [Table 2]. The results further revealed reductions in SBP by 2.72% and in PP by 6.53% following yoga practice for 6 weeks. RPP was significantly reduced in yoga group when compared with the LSM group [Figure 1].

DISCUSSION

There are diverse etiologies and mechanisms involved in the development of hypertension in elderly. The major age-related physiological changes attributed for the development of hypertension in elderly are vascular stiffness, endothelial dysfunction, and sympathetic overactivity.[5] Two major age-related structural changes that take place in elastic arteries are stiffness and dilatation. These changes result in decline in expansion of aorta (due to stiffness) during ventricular systole leading to elevation in SBP (ISH), and failure in recoiling (due to decreased elasticity) of the arterial wall results in decrease in DBP, thus causing widening of PP. The PP is a good indicator and independent predictor of arterial stiffness.[16] RPP is an established marker of CV risks, especially in hypertensives.[15] In the present study, there was a significant decrease in SBP and PP [Table 1], though there was no significant change in DBP following 6 week practice of yoga therapy in yoga group. Thus, reduction in PP implies improvement in vascular compliance in these subjects. Further, decreased RPP in these subjects [Figure 1] indicates decreased myocardial work stress and reduced CV risk. These findings suggest that practice of yoga for six weeks could be beneficial in reducing the SBP (arterial stiffness) and CV risks in elderly mild hypertensives. However, changes in BP parameters were not significant in LSM group, indicating that 6 week practice of LSM was not effective in these mild

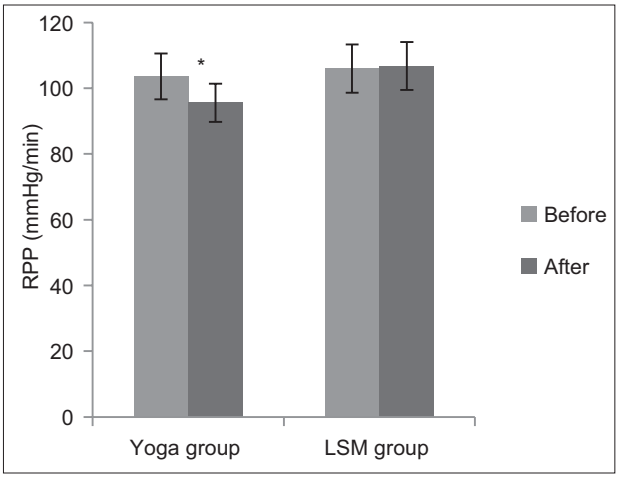

Figure 1: Change in RPP (mmHg/min) in yoga and LSM group following intervention Asterisk (*) indicates $P = 0.002$. RPP = Rate pressure product, LSM = Lifestyle modification.

Table 2: HR and BP changes in yoga and LSM group

Parameters	Yoga group			LSM group		
	Before	After	*P* value	Before	After	*P* value
HR (bpm)	70.33±8.30	66.8±5.95	0.006**	72.09±8.82	72.95±9.16	0.247
SBP (mmHg)	147.23±5.62	143.09±5.67	0.000***	147.0±5.82	146.28±5.41	0.105
DBP (mmHg)	74.95±3.8	75.33±3.54	0.214	75.52±5.43	75.09±5.43	0.358
PP (mmHg)	72.28±6.03	67.76±5.11	0.000***	71.47±6.09	71.19±5.16	0.642
MAP (mmHg)	98.8±3.53	97.61±3.12	0.000***	98.80±4.94	98.28±4.07	0.349

Values are expressed in mean±SD; *P<0.05, **P<0.01, ***P<0.001. Statistical analysis was done by student's paired '*t*' test. P<0.05 was considered statistically significant. LSM: Lifestyle modification, HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, PP: Pulse pressure, MAP: Mean arterial pressure, SD: Standard deviation

hypertensive elderly patients. The decrease in MAP and PP was secondary to the decrease in SBP. The present study is the first of its kind comparing the effects of yoga with LSM in elderly hypertensive patients. Another novelty of the present study is assessment of RPP, the indicator of myocardial work load and stress,[15] which was significantly less in yoga practice group, compared with the LSM practice group. Also, there was significant reduction in basal HR following practice of yoga therapy in yoga group subjects, indicating further reduction in CV risk in these subjects, as decrease in resting HR *per se* has been reported to reduce CV risk.[15]

The yoga module advocated in the present study included slow pranayamic breathing as a major component of yoga practice. It was reported in previous studies that practice of slow and regular breathing lowers BP and maintains sympathovagal balance through stabilization of CV reflex control system.[17-19] As slow and paced breathing was part of the yoga module in the present study, we presume that the reduction in BP in yoga group might be through the improvement in respiratory and CV reflex control systems. Evidences suggest that yoga reduces sympathetic activity and stabilizes the sympathovagal balance by optimizing the autonomic function.[20,21] In the present study, the practice of relaxation technique such as meditation in addition to pranayama might have contributed to the sympathovagal balance and reduction of BP, as recently a study by Pal *et al*. has reported improvement in autonomic balance and CV function following practice of such relaxation therapy.[22] Therefore, studies should be conducted to assess if reduction in BP in elderly hypertensives could be due to improvement in sympathovagal balance. Age-related endothelial dysfunction results in a decreased bioavailability of nitric oxide, a potent vasodilator, with resultant enhanced vascular tone leading to hypertension.[3,5] A study conducted by Sivasankaran *et al*. has demonstrated that the yoga practice enhances endothelial-dependent vasodilation in elderly subjects with coronary artery disease.[23] The findings of this preliminary study has not only demonstrated reduction in BP in elderly group-I hypertensives but also the reduction in CV risks in this elderly population that is at higher risk of CV diseases. Therefore, future studies should address the biochemical mechanisms, especially the level of endothelial inflammatory markers in reduction in CV risks in these highly vulnerable subjects.

The difference in the effect of yoga therapy and LSM (mainly brisk morning walk and stretching exercises) could be due to the fact that the elderly people usually suffer from osteoarthritis and do not exercise or walk effectively. Nevertheless, they adapt to yoga practice (breathing, asana, pranayama, and meditation) effectively because of their attitude towards a yoga life, which is usually observed in old age. Present study is the first of its kind to assess the difference between practice of yoga and LSM in elderly group-I hypertensive males. The novelty of the study was that we had two groups of apparently healthy subjects matched for age, BMI, blood glucose, and lipid profile, which is difficult to get in elderly population. However, this study is a preliminary one that suggests further clinical research in establishing the efficacy of yoga therapy in the management of mild hypertension in elderly population.

Limitations of the study

In the present study, the major limitation was small sample size, which was mainly due to less availability of elderly male grade-I hypertensives not on any medications and not suffering from diabetes mellitus, CV diseases, and hypercholesterolemia. It is difficult to get a larger sample size of elderly subjects aged between 60-80 years with grade-I hypertension without having diabetes and CV risks. Another limitation was that we could not do correlation and regression analysis for establishing the relationship between BP status and RPP (CV risk) due to the less sample size. The CV risks in males are equal to females after menopause. But, in the present study, we did not include females. Therefore, future studies in larger sample size should address the effect of gender on benefits of yoga, in treatment of group-I hypertension in elderly population.

CONCLUSION

In the present study, yoga practice for 6 weeks in elderly grade-I hypertensive subjects not only reduced BP but also the CV risks compared with the subjects practicing LSM. As elderly people cannot effectively perform regular physical exercises and may not be able to tolerate chronic antihypertensive medication, the yoga therapy could be a non-pharmacological alternative for management of hypertension, at least during its early phase. Yet, as the sample size was less in the present study, the results of this study cannot be directly extrapolated to application in general population. Therefore, future studies are warranted to address the effect of such yoga therapy in a larger sample size in both male and female elderly hypertensives.

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