International Journal of Science and Healthcare Research
Vol. 8; Issue: 2; April-June 2023
Website: ijshr.com
Review Article *ISSN: 2455-7587*

Stretching Exercise as a Rehabilitation Modality for Hypertension: A Brief Review

Akanksha[1], Gitanjali Sikka[2], Deepak Jain[3]

[1]B.P.Th., M.P.Th. (Cardiopulmonary-Pursuing), Post Graduate Student, College of Physiotherapy, Pt. B.D. Sharma, University of Health Sciences, Rohtak, Haryana 124001 (INDIA).
[2]B.P.Th., M.P.Th. (Cardiopulmonary), Ph.D., Assistant Professor, College of Physiotherapy, Pt. B. D. Sharma, University of Health Sciences, Rohtak, Haryana 124001(INDIA).
[3]MBBS, M.D. (Medicine), Senior Professor, Department of Medicine, Pt. B. D. Sharma, University of Health Sciences, Rohtak, Haryana 124001(INDIA).

Corresponding Author: Akanksha

DOI: https://doi.org/10.52403/ijshr.20230210

ABSTRACT

Hypertension is the major risk factor for different cardiovascular diseases like ischemic heart disease, congestive heart failure, stroke and chronic kidney disease. Best estimates suggest that 57% of stroke and 24% of coronary artery disease-related deaths are due to hypertension. Various physical exercises such as aerobic exercises, resistance exercises, high intensity interval training performed regularly can help with management of blood pressure, quality of life and cardiovascular complications. Static stretching of the skeletal muscles accrues the benefits of exercise without its accompanying physical stress as in case of aerobic exercise and resisted exercises. Studies have supported that stretching could results in better control of blood pressure in normotensive patients. Also, few studies have been done on hypertensive patients, but have multiple limitations. Studies conducted till date could not conclude definitive conclusion for framing a definitive protocol of stretching exercises in patients with hypertension. Hence, in order to establish a definitive stretching protocol in patients with hypertension further researches needs to be conducted.

Key words: Hypertension, Stretching, Systolic blood pressure, Diastolic blood pressure.

INTRODUCTION

Cardiovascular diseases persist as a top cause of global mortality with an estimated 17.9 million attributed deaths in 2016 (approximately 31% of global deaths). Hypertension is the major risk factor for different cardiovascular diseases like ischemic heart disease, congestive heart failure, stroke and chronic kidney disease. Best estimates suggest that 57% of stroke and 24% of coronary artery disease-related deaths are due to hypertension.[1] Out of approximately 762 million Indians of more than 18 years of age[2], it has been reported that currently 230 million adults are hypertensive. It has been evaluated that the prevalence of hypertension among young adults of age group 20-44 years is high.[1] According to European Society of Hypertension prevalence of stage-I hypertension is 6.8% while according to Government of India it is 5.1%.[3] It has been reported that prevalence of hypertension increases with age, involving large scale of male population as compared to females till the age of 65 years. The values of both systolic blood pressure (SBP) and diastolic blood pressure (DBP) are higher among men than women across all age groups, while the mean value of SBP and DBP increase with age in both genders till the 65 years of age after which it reaches a plateau.[1]

Hypertension is defined as high or raised blood pressure. A new classification has

been recommended by the seventh report of the Joint National Committee report (JNC-VII report)[4] on prevention, detection, evaluation and treatment of high blood pressure for adults who are 18 years of older.

1. Normal: < 120/80 mm Hg.
2. Pre-hypertension: 120-139/80-90 mm Hg.
3. Hypertension-stage 1: 140-159/90-99 mm Hg.
4. Hypertension-stage 2: ≥160/≥100 mm Hg

Primary treatment of hypertension is through drug therapy, including angiotensin converting enzyme inhibitors, angiotensin receptor blockers, beta-blockers, calcium channel blockers and thiazide-type diuretics.[4]

Risk factors in Hypertension and Significance of Physical Activity

Hypertension is a leading risk factor for cardiovascular disease, chronic kidney disease, and death.

Hypertension results in increased sympathetic activity and endothelial dysfunction that are related to increased arterial stiffness, which is an independent risk factor for the development of hypertension and other cardiovascular diseases. It results in increased sympathetic activity and endothelial dysfunction that are related to increased arterial stiffness, which is an independent risk factor for the development of hypertension and other cardiovascular diseases.[5]

Lifestyle modification is also supposed to be helpful in controlling blood pressure in pre- and stage-I hypertensive individuals. It includes exercise, reduction of sodium intake, limiting alcohol consumption, cessation of smoking, low fat dairy products and weight management. It is empirically evident that increasing physical activity can reduce blood pressure in people with high blood pressure and decreases the risk of cardiovascular emergencies.[5]

The American College of Sports Medicine position statement recommends that one should perform 30 minutes of continuous or accumulated mainly aerobic physical activity per day at a moderate intensity most days of the week to reduce blood pressure.[6] Various physical exercises such as aerobic exercises, resistance exercises, high intensity interval training performed regularly can help with management of blood pressure, quality of life and cardiovascular complications. Recent studies have indicated that stretching can reduce arterial stiffness and increase activation of the parasympathetic nervous system, resulting in reduced blood pressure.[5]

Stretching is superior to brisk walking for reducing blood pressure in people with stage-I hypertension.[5] Passive static stretching reduces more blood pressure that active static stretching because the balance of autonomic nerve activity shifts to a parasympathetic nerve-dominant state during passive static stretching and the parasympathetic nerve-dominant state continues even after the completion of passive static stretching (for at least 5 minutes after completion), unlike active static stretching.[7]

Physiological mechanism of Stretching Exercise

There are number of physiological mechanisms which justifies that stretching can be effective for reducing blood pressure. When the muscle is stretched, blood vessels are also stretched and this may induce the structural changes within blood vessels.[8] Structural changes within blood vessels lead to decrease in arterial stiffness and hereby reduces resistance to blood flow which, in turn, reduces blood pressure.[9] Stretching is assumed to produce ischemia within muscles, which may trigger vascular adaptations. These adaptations result in increased production of vascular endothelial growth factor that increase the lifespan of endothelial cells, prevents apoptosis and promotes capillarization that lead to decreased vascular resistance, which could potentially decrease blood pressure.[10]

Another mechanism by which stretching can affect blood pressure is stretching of blood

vessels induces the release of metabolites from endothelial cells that cause vasodilatation. A study reported that stretching exercises of knee extensors and plantar flexors for twelve weeks by performing four stretches five times each for forty-five seconds, five sessions per week are evident in increasing flow mediated dilation which is dependent on nitric oxide release.[10]

A final mechanism by which stretching can affect blood pressure is by its effect on sympathetic and parasympathetic nervous systems. Performing an acute bout of stretching exercise can reduce activation of sympathetic nervous system along with an increased activation of the parasympathetic nervous system. This results in decreased vasoconstriction which, in turn, reduce resistance to the blood flow that ultimately decreases the blood pressure.[11]

Static stretching of the skeletal muscles accrues the benefits of exercise without its accompanying physical stress as in case of aerobic exercise and resisted exercises. Studies[5] have supported that stretching could results in better control of blood pressure in hypertensive patients. Recently new form of physical activities such as active and passive stretching are also reported in treatment of patients with Stage-1 Hypertension.[5]

Table 1: - Summary of studies conducted on stage-1 hypertensive patients using Stretching as an exercise intervention and effect of passive static stretching exercise on acute cardiovascular response in normotensive individuals.

Authors Journal Year	Objective	Design	Characteristics of the participants Sample size	Methods	Outcome Measures	Results	Limitations/ Future Research Suggested
Ko J, Deprez D et al 2021[5]	Stretching is superior to brisk walking for reducing blood pressure in people with high- normal blood pressure or stage-I hypertension	Randomized, Experimental Study	N=40 (16 males and 24 females) having stage-I hypertension according to hypertension Canada guidelines	Participants were randomized to a stretching or brisk walking (30 min/d, 5 d/wk for 8 weeks)	Pre and post blood pressure during sitting and supine positions and for 24h using a portable monitor.	The stretching program elicited greater reductions in blood pressure than walking program.	Small sample size, Lack of statistical power for data analysis, Walking program may not be of sufficient intensity.
Silva G.C, Simao R et al 2019[14]	Does the combination of resistance training and stretching increase cardiac overload?	Cross – over experimental study, with 48h of washout interval	N=12, normotensive healthy men.	Individuals participated in four different stretching protocols: a) Static stretching+ Resistance training b) Resistance training + Static stretching c) Resistance training and d) Static stretching	Variables Heart Rate Variability, heart rate, blood pressure, Rate pressure product and oxygen saturation were measured before, immediately after and 15, 30 and 45 min after the sessions.	Static stretching + resistance training effective in increasing Rate pressure product, static stretching when performed before of the Resistance training session generated higher overload in comparison to Resistance training + Static stretching, hypotensive effective occurred in isolated Resistance training protocol compared to Static stretching.	These types of protocols may increase heart overload raising Heart rate and Rate pressure product.
Silva G.C, Costa P.B. et al 2019[15]	Acute effects of different static stretching exercises orders on cardiovascular and autonomic responses.	Cross – over, randomized experimental study, with 48h of washout interval	N=17, 11 men and 6 women of age between 18 to 30 years, normotensive, familiarized with stretching exercises, no smokers.	Participants were randomly submitted to two stretching sessions of larger to smaller and smaller to	HR, SBP, DBP, SPO_2 and Heart Rate Variability were measured before, at the midpoint of	HR = no difference between order A and B returned to baseline after 5 min of session. SBP = Increase after 1 set then came to baseline.	Small sample size and study is conducted in normotensive, require further studies to see effect on hypertensive.

				larger muscle groups named as Order A and Order B.	the session, immediately after the experimental session and at 5, 10, and 20 minutes after training session.	DBP = Increase at midpoint returned to baseline immediately after the session. RPP = both the groups increases the RPP significantly. SPO_2 = returned to baseline levels 5min after the stretching.	
Lima.T.P, Farinatti P.T.V et al 2015[13]	Hemodynamic responses during and after multiple sets of stretching exercises performed with and without the Valsalva maneuvar.	Randomized, Experimental Study, with 48h of washout interval	N=15, men aged 21-29 years with poor flexibility, normotensive individuals.	10 sets of passive unilateral hip flexion, with and without Valsalva Maneuver (VM).	Pre and post measurement of SBP and HR, and RPP was calculated.	Both SBP and DBP higher in all sets compared with value at rest and with previous value, HR is not affected by number of sets, HR increases with VM, RPP is 20% higher with VM during all sets, VM affect BP significantly.	Lack of control of muscular activity and lung volume during the VM.
Inami T, Shimizu T et al 2014[7]	Acute changes in autonomic nerve activity during passive static stretching.	Randomized, Experimental Study, with 48h of washout interval	N=20, 18-20 yrs of age, non-smoking males without cardiovascular, orthopaedic and neurological disease.	Participants were randomized to two techniques, SS and control with no stretching, Stretching is done passively to minimize the active resistance	Pre and post Autonomic nerve activity, Blood pressure, Heart rate.	Range of motion increased, autonomic nerve activity changed to parasympathetic dominance by passive static stretching, during static stretching the other parameters SBP, DBP and HR increased and decreased after static stretching.	Heart rate variability analysis was done using Second Derivative of Photo plethysmogram (SDPTG) conducted (to minimize invasion) and all parameters were calculated over 1-min interval.
Farinatti P.T.V, Soares P.P.S et al 2011[12]	Cardiovascular responses to passive static flexibility exercises are influenced by the stretched muscle mass and the Valsalva maneuvar.	Cross - over study, with 48h of washout interval	N=22, of age 22± 3 years, normotensive individuals.	Participants performed 2 exercises: 4sets of passive static stretching of gastrocnemius and ischio-tibialis with and without Valsalva maneuvar (VM) They compared between smaller and larger muscle groups.	Pre and post measurement of SBP and HR, and RPP was calculated.	Greater SBP increases when larger muscle mass stretch, no. of sets influence SBP and not HR, no post exercise hypotension was observed in 30 min, RPP increased in larger muscle groups, cardiovascular responses to increase when VM was performed.	VM intensity was not controlled, stretching was not quantified, exercise protocol was not designed.

Stretching protocol for patients with Hypertension

In all the above studies[12,13,14,15], no definitive conclusion could be drawn for forming a definite protocol of stretching exercise in patients of hypertension as all the above studies were carried out in normotensive individuals. Also, studies have not educated patients for Valsalva maneuver during stretching, which is known to increase blood pressure and heart rate as supported by previous studies.[12,13,]

In recent study on people with stage-I hypertension[5], stretching has been proven to be superior to brisk walking for reducing blood pressure. In this study 8-weeks of stretching has been compared with walking exercise in men and women. The stretching program elicited greater reductions in blood pressure than the walking program (P<.05), for sitting systolic, supine diastolic and night time diastolic blood pressure. Limitation of this study were small sample size, there was no proper assessment of physical activity and there was an imbalance of men and women across groups. They have incorporated with multiple groups of muscles for stretching, but they have not provided a customized stretching protocol for individual group of muscles. They have also not specified in the study whether the stretching exercise done by the participants are passive or active. Thereby, there is need to establish a specific protocol of stretching in patients with hypertension.[5]

Studies conducted till date could not conclude definitive conclusion for framing a definitive protocol of stretching exercises in patients with hypertension due to multiple limitations in all the studies like insufficient sample size, lack of control of muscular activity, lung volume during the Valsalva maneuver, stretching was not quantified and exercise protocol was not designed. Till date, no definitive guidelines are present for stretching exercises as treatment protocol for reduction of blood pressure in patients with hypertension.

Hence, in order to establish a definitive stretching protocol in patients with hypertension and to provide an evidence based exercise prescription for hypertensive patients further researches needs to be conducted.

CONCLUSION

Physical activities including muscle stretching, aerobic training, resistance training, high intensity interval training, yoga etc. help in improving blood pressure in hypertensive patients. Static stretching of the skeletal muscles accrues the benefits of exercise without its accompanying physical stress as in case of aerobic exercise and resisted exercises. Several studies have shown that stretching helps in lowering the blood pressure in normotensive individuals immediately after the intervention. But there is dearth of literature, concluding effect of stretching exercise in hypertensive patients. Due to multiple limitations in studies conducted till date, no definitive protocol of stretching exercises in patients with hypertension could be framed. In order to establish a definitive stretching protocol in patients with hypertension and to form an evidence-based exercise prescription for hypertensive patients further researches needs to be conducted.

Declaration by Authors

Ethical Approval: Not Applicable
Acknowledgement: None
Source of Funding: None
Conflict of Interest: The authors declare no conflict of interest.

REFERENCES

1. Ramakrishnan S, Zachariah G, Gupta K, Rao JS, Mohanan PP, Venugopal K, Sateesh S, Sethi R, Jain D, Bardolei N, Mani K. Prevalence of hypertension among Indian adults: results from the great India blood pressure survey. IHJ. 2019;71(4):309-13.
2. Census of India Website: Office of the Registrar General & Census Commissioner, India. http://www.censusindia.gov.in/20
3. Dubey M, Rastogi S, Awasthi A. Hypertension prevalence as a function of different guidelines, India Bull WHO. 2019;97(12):799.
4. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL et al. Seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure. J Hypertens. 2003;42(6):1206-52.
5. Ko J, Deprez D, Shaw K, Alcorn J, Hadjistavropoulos T, Tomczak C et al. Stretching is Superior to Brisk Walking for Reducing Blood Pressure in People With High–Normal Blood Pressure or Stage I Hypertension. JPAH. 2020;18(1):21-28.

6. Pescatello LS, Franklin BA, Fagard R, Farquhar WB, Kelley GA, Ray CA. Exercise and hypertension.MSSE. 2004 Mar 1;36(3):533-53.
7. Inami T, Shimizu T, Baba R, Nakagaki A. Acute changes in autonomic nerve activity during passive static stretching. AJSM. 2014;2(4):166-70.
8. Poole DC, Musch TI, Kindig CA. In vivo microvascular structural and functional consequences of muscle length changes. Am. J. Physiol. Heart Circ. Physiol. 1997 May 1;272(5):H2107-14.
9. Jackson ZS. Gotlieb AI, Langille BL. Wall tissue remodeling regulates longitudinal tension in arteries. Circ Res. 2002;90:918-25.
10. Hotta K, Behnke BJ, Arjmandi B, Ghosh P, Chen B, Brooks R, Maraj JJ, Elam ML, Maher P, Kurien D, Churchill A. Daily muscle stretching enhances blood flow, endothelial function, capillarity, vascular volume and connectivity in aged skeletal muscle. J. Physiol. 2018 May 15;596 (10): 1903-17.
11. Hotta K, Kamiya K, Shimizu R, Yokoyama M, Nakamura-Ogura M, Tabata M, Kamekawa D, Akiyama A, Kato M, Noda C, Matsunaga A. Stretching exercises enhance vascular endothelial function and improve peripheral circulation in patients with acute myocardial infarction. IHJ. 2013;54(2):59-63.
12. Farinatti PT, Soares PP, Monteiro WD, Duarte AF, de Castro LA. Cardiovascular responses to passive static flexibility exercises are influenced by the stretched muscle mass and the Valsalva maneuver. Clinics. 2011;66(3):459-64.
13. Lima TP, Farinatti PT, Rubini EC, Silva EB, Monteiro WD. Hemodynamic responses during and after multiple sets of stretching exercises performed with and without the Valsalva maneuver. Clinics. 2015;70:333-38.
14. Simão R, Conceição RR, Costa PB, Miranda H, Conceição RR, Almeida RL, Sato MA. Does the combination of resistance training and stretching increase cardiac overload?. Clinics. 2019;74.
15. Costa e Silva G, Costa PB, da Conceição RR, Pimenta L, de Almeida RL, Sato MA. Acute effects of different static stretching exercises orders on cardiovascular and autonomic responses. Sci Rep. 2019;9(1):1-0.

How to cite this article: Akanksha, Gitanjali Sikka, Deepak Jain. Stretching exercise as a rehabilitation modality for hypertension: a brief review. *International Journal of Science & Healthcare Research.* 2023; 8(2): 85-90. DOI: *https://doi.org/10.52403/ijshr.20230210*

******