Efficacy Of Home-Based Body-Weight Resistance Training On Resting Blood Pressure In Middle Aged Hypertensive Patients- Early Evidence From Rct

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Abstract

Purpose: To find out the effect of 8-weeks home-based body-weight resistance training on blood pressure (BP) in early stage hypertensive patients.

Method: Participants: 32 hypertensive patients (16 control; 16 experimental) previous pre-hypertension and stage-1 hypertension aged 30-45 years in both males and females. Stratified sampling used. Intervention group did 8 weeks progressive body-weight resistance training at 3 sessions per week frequency. Total 7 exercises (push-ups, squats, sit-ups, bridging, trunk extension in quadruped position, heel-raises, pull-ups) were done in circuit training method (10 repetitions per exercise, 5-15 seconds rest between exercises) with total 3 sets (2 minutes rest between sets). Outcome measure was resting BP and PP.

Results: 8 weeks training reduced SBP (MD -6.13 mmHg; 95% CI -5.15, -7.10; t_{15}=13.45, p<0.001) and DBP (MD -6.00 mmHg; 95% CI -4.77, -7.23; t_{15}=10.39, p<0.001) in resistance training group. There was no significant difference between control and body weight resistance training group pre-BP values. After 8 weeks, there was significant reduction in body weight resistance training group SBP (MD -6.63 mmHg; 95% CI -0.97, -12.28; t_{30}=-2.39; p=0.023) and DBP (MD -4.38 mmHg; 95% CI -1.42, -7.33; t_{30}=-3.02; p=0.005) values as compared to control group.

Conclusion: 8 weeks body-weight resistance training reduced BP in middle age early stage hypertensive patients.

Trial Registration: CTRI/2017/03/008280.

Keywords: Body Weight; Dynamic resistance; Resting Blood Pressure

Introduction

Hypertension (HTN) is a multifactorial and multicausal syndrome usually associated with metabolic, hormonal, andstructural disorders, and representing a primary risk for coronary disease. The Meta-analysis study from India reported high variation in region about unawareness of HTN in relation to diagnosis and treatment of uncontrolled blood pressure levels among youth of India [1, 2]. Prevalence of HTN is increasing alarmingly in north India and overall prevalence rate was found out to be 40.1% whereas prevalence of pre-hypertension, isolated diastolic and isolated systolic hypertension were 40.8%, 9.2% and 6.5% respectively [3, 4]. In these days, as we have seen complication of hypertension and its impact on multiple system of body, there is need of early diagnosis and well planned treatment of HTN [5]. Among the non drug approach for control of HTN, exercise training is most superior that improves blood pressure [6]. Among exercise training popularity of resistance training (RT) is increasing day by day to reduce BP alone and the mechanism behind this improvement may be reduced peripheral resistance and improved endothelial function [7,8]. Existing Meta-

analytical studies have examined effects of dynamic resistance exercise on resting blood pressure [9] but the protocol that included total training volume (sets + frequency+ duration + number of exercises + number of repetitions + load) is yet not to be decided . Assessing 1 repetition maximum (1-RM) and use of equipment is difficult for individuals who wants to do it in home so we used home based Body-weight exercise that provide resistance to exercising muscles so we developed a resistance protocol that differs in volume, intensity, and training frequency for up to 8 weeks[10]. Therefore, the goal of this experiment was to see the impact of home-based body weight dynamic resistance training on the systolic (SBP) and diastolic blood pressure (DBP) in stage 1 and stage 2 hypertensive patients compared with control group in the Indian community.

Methodology

1.Trail Design

Double blinded, randomized, parallel group, active controlled trials with allocation ratio of 1:1. Only two arms (home-based body weight resistance training and active control) were included from original trial's four arms (aerobic exercise and home-based Isometric hand grip exercise were other two arms).

2. Study Participants

This experimental study was conducted in Hisar, an urban area of Haryana during June to December 2017. 32 participants diagnosed with stage 1 HTN (N=16) and stage 2 HTN (N=16) was recruited from Department of Physiotherapy, G.J.U.S. & T., Hisar, by referral from the hospitals. The inclusion criteria for the study were any adult males or females (30-45 year), who was apparently stage 1 HTN (SBP≥130-139 mmHg; DBP≥80-89 mmHg) and Stage 2 HTN (SBP≥140-159 mmHg; DBP≥90-99 mmHg) [11] and passed physical activity ready questionnaire (PAR-Q) developed by ACSM and willing to participate in the

study. The exclusion criteria for not including in the study were if they have chronic alcoholic, other pathological conditions such as Musculoskeletal conditions, Neurological conditions and Cardio-respiratory conditions that prevent the subject to perform exercise training. After met inclusion criteria, Participants were randomized in to two groups: a control group (N=16; 8 males & 8 females) and home based body weight resistance training group (N=16; 8 males & 8 females) by stratified random sampling (sex, stage of hypertension). The subjects were asked for their consent prior to participating in the study. The subjects were assured confidentiality of the information provided.

3 Study Ethical clearance

The study was approved ethically from the institutional ethical committee of GJUS&T vide letter no. PTY/2016/555. We followed Helsinki guidelines (2013) and ICMR guidelines to maintain ethical standard. Present study protocol was also registered under Indian clinical registry trial (CTRI/2017/03/008280) [12].

4 Intervention

Resistance training group did 8 weeks progressive body-weight resistance training at 3 sessions per week frequency. Total 7 exercises (push-ups, squats, sit-ups, bridging, and trunk extension in quadruped position, heel-raises, and pull-ups) were done in circuit training method (10 repetitions per exercise for 8 weeks) with total 3 sets (5-15 seconds rest between exercises and 2 minutes rest between sets). Each session consisted of a 5 min warm up followed by 30-40 minute resistance training (seven exercises for major muscle groups- using body weight in sequence) and followed 5 min cool down. The protocol was designed to provide progressive increase in intensity by change in body-positioning showing in Table 1[10].For control group, participants had done normal daily activities without any specific training but their resting blood pressure was monitored.

5 Outcome Measure

Three measurement of resting blood pressure of the subjects was measured by using automatic digital Blood Pressure monitor model (Dr Morepen, Model no. BP-09, China) and at least a one minute gap between each measurement should be maintained. Subject was asked to sit without support in comfortable position and apparatus always kept at heart level. This results automatic inflation of cuff to the level above the SBP, then deflated; at the end it shows SBP, DBP. Pulse pressure (PP) was calculated from available SBP and DBP. Baseline data for 32 subjects was collected. Various outcome measures (SBP, DBP & PP) were collected for all subjects before the start of the treatment process and after completion of 8 weeks of training session. Average of three reading of resting BP is used in the final analysis.

6 Randomization and allocation concealment

Whole Hisar urban city was divided into 4 blocks of 5 wards in each. One ward from each block was randomly selected by chit method by supervisor. Invigilator selected 1 house randomly by her convenient and selected eligible participants through screening method using left thumb rule. Recruitment for the study was restricted by block allocation (4 males and 4 females each in stage I and stage II hypertension) through sequential selection (1st come- 1st selection). Similar strategy was followed in each block and each block allocated to same arm of trial which blinded participant from treatment option. Outcome measure was taken in one center by a therapist with 5 year experience after qualification that blinded from treatment arm of participants. All participants were asked to visit the center for outcome assessment and advised not to reveal about their treatment to assessor. Hence present trial was a double blinded, randomized, parallel group, active controlled trial (Flow chart 1).

1. Statistical analysis: Data were analyzed using IBM SPSS v21.0 software. Shapiro-Wilk test was done to check normal distribution of data before analysis and data was found normal so we did parametric analysis. Results were explored as mean±SD. Data was reported with mean difference (MD) along with 95% confidence interval. A related t-test was conducted to compare difference with in group and unrelated t-test was conducted to compare the two groups (resistance and control). Significant level set at "$p \leq 0.05$".

2. Results: All 32 participants had completed average number of training sessions (20-24). There was no significant difference between pre and post values in control group, but 8 weeks training reduced SBP (MD -6.13 mmHg; 95% CI -5.15, -7.10; t_{15}=13.45, p<0.001) and DBP (MD -6.00 mmHg; 95% CI -4.77, -7.23; t_{15}=10.39, p<0.001) in resistance training group (Table 2 & 3).

When we compared resting blood pressure (SBP & DBP) between home-based body weight resistance training group and control group with t value in stage 1 and stage 2 hypertensive patients, there is a significant difference in post intervention BP values. There was no significant difference between control and resistance training group pre Blood Pressure values. After 8 weeks, there was significant reduction in resistance training group SBP and DBP values as compared to control group. When we compared resistance training group pre SBP value (MD 0.37; 95% CI -5.28, 6.03; t_{30}=.135; p=0.893) to 8th week SBP value (MD -6.63 mmHg; 95% CI -0.97, -12.28; t_{30}=-2.39; p=0.023) reduction in SBP was highly significant in contrast to control group. In case of DBP, when we compared resistance training group pre DBP value (MD 1.81; 95% CI -1.44, 5.06; t_{30}=1.138; p=0.264) to 8th week DBP value (MD -4.38 mmHg; 95% CI -1.42, -7.33; t_{30}=-3.02; p=0.005) result was also significant in contrast to control group. But when we compared resistance training group pre PP value

(MD -1.50; 95% CI -2.85, 5.83; $t_{30}=-.703$; p=0.48) to 8th week PP value (MD -2.50; 95% CI 1.72, -6.72; $t_{30}=-1.20$; p=0.23) in contrast to control group, result is non-significant

Discussion

The results of this experimental study demonstrated that body weight Resistance training can be used in reducing the Systolic Blood Pressure (6.63 mmHg) and Diastolic Blood Pressure (4.38 mmHg) in hypertensive subjects. In our knowledge, this was the first experiment to investigate the effects of body weight dynamic resistance training in HTN patients.

The physiological mechanism responsible for the reduction of BP may be reduction in peripheral vascular resistance; double product and arterial stiffness as stated by earlier studies [13]. Fabio T Montrezol et al concluded that improvement of BP and improvement in muscle strength after resistance training due to increased circulating levels of adiponectin and reduced the levels of plasma intracellular adhesion molecule-1. Due to augmentation in catecholamines during resistance training, especially epinephrine, a redistribution of adhesion molecules in the endothelium occur, since neutrophils and

lymphocytes have receptors to catecholamines and catecholamine elicits expression of specific adhesion molecules and changes in its cytoskeletal organizations then altering its adhesion to endothelial wall [14]. In general, protocols of previous studies did not compare different resistance training intensities using body weight as resistance, duration of exercise and positioning of exercise but adopted popular training protocols and showed significant reduction BP [15].

Evitom Corrêa de Sousa et al concluded that resistance training act as stand-alone antihypertensive lifestyle therapy among adults with hypertension on basis of evidence from meta-analysis and corroborate our study findings [16]. A meta-analysis by Cornelissen et al studied only randomized controlled trials and also add in evidence that resistance training alone act as a non-pharmacological approach to treat HTN [17].

Based on these evidences from previous randomized controlled trials, Meta analytical studies and our study findings suggest that moderate intensity body weight dynamic resistance training can be effective as like as antihypertensive drug therapy among adults with hypertension.

Strength of this study was randomization & stratification of sample so results can be used to generalize in middle aged adults. To the best of our knowledge, we are first to study home-based body weight intervention in society to whom distance may be a constrain.

Limitation of present study was that total duration (8 weeks) was relatively short for home-based training. There was no follow-up after intervention.

Our findings suggested that future research should be done by using of this protocol in maintaining BP reduction during detraining periods.

Conclusion: 8 weeks body-weight resistance training reduce blood pressure in middle age early stage hypertensive patients. Hence, home-based body-weight resistance training is a viable option for reducing blood pressure in early stage hypertension

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