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Effect of Resistance Exercise Training on Body Mass Index and Waist Circumference among Hypertensive patients

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Abstract:- The rising prevalence of cardiovascular diseases principally high blood pressure could be corrected by decreasing sedentary lifestyle and engaging on physical activities on continuous basis. This study aimed to determine the effect of resistance exercise training on body mass index (BMI) and waist circumference (WC), among hypertensive patients. The study was carried out from 20/02/2017 to 17/06/2017at referral Hospital of Hawassa University. Mild hypertensive patients were assigned to three-times weekly of 16 weeks resistance exercise Group (REG) (n=23) and control group (CG) (n=23). BMI and WC data were collected at base line and after 16 weeks of study period. Baseline data of BMI and WC were homogenous compared with groups (P>0.05). After 16 weeks of study in REG a significant within group and between group mean reductions was found in WC (P=0.001 and P=0.002) respectively. In BMI within group change was insignificant, but between group change was significant after 16 weeks of intervention in REG. In CG both BMI and WC increased and mean changes were not favorable. 16 weeks of low to moderate intensity RET decreases BMI and WC in mild hypertensive patients compared to CG. Therefore participants with mild hypertension should be encouraged to engage in low to moderate intensity dynamic RET program.

Keywords:- *Resistance Exercise Training, Hypertensive Patients.*

I. INTRODUCTION

High blood pressure is the most widespread, expensive, and avoidable risk factor of cardiovascular disease [Pescatello et al., 2015]. Hypertension is considered as one of the most cardiovascular disease (CVD) risk factor [Moeini et al., 2015]. CVD is the principal reason of death globally [Cutler et al., 2006].CVD can be caused by pathogenesis of atherosclerosis and which is resulted due to weaken endothelial function. Hypertension plays a significant part in bringing the metabolic syndrome [Galassi et al., 2006]. More than two thirds of all patients with high blood pressure will increase the metabolic syndrome [Bulhoes and Araujo, 2007]. Hypertension is commonly associated with additional pathologies [Falkner, 2017]. Greater parts of hypertensive patients have also other risk factors of CVD that may raise the overall risk of CVD [Mancia et al., 2013].

Body mass index (BMI) is an indication of life style, prevalence of hypertension was greater in those with elevated BMI [Kannel, 2000; Mungreiphy et al., 2011; Suman et al., 2014]. There was a considerable association between BMI, fat percentage, SBP as well as DBP. Individuals with above normal BMI were more likely to have hypertension than those with normal BMI [Suman et al., 2014]. Elevated BMI Carnethon et al. [2005] and waist circumference (WC) Ehrman et al. [2013] are among risk factors for hypertension. WC is the most significant anthropometric variable associated with the risk of hypertension [Guagnano et al.,2001].In individuals continued hypertension has a bad effect on the lower extremities, aorta, heart, brain, kidneys, and retina [Parkinson,2012].

Physical inactivity is also a main determinant of health for increasing CVD [Whooley et al., 2008]. Leading sedentary lifestyle increases CVD risk, mostly hypertension [Ferrari, 2008]. Numerous persistent diseases share the risk factor of sedentary lifestyle, which is placed among the ten leading contributors to the worldwide trouble of disease [Lim et al., 2010].Fitness levels below optimum in adolescents'

and adults are related with an increased occurrence for risk factors of CVD.

At present time in Ethiopia because of awareness problem proper attention is not given for the importance of exercise training for the people living in unbans [Belay et al.,2012].Therefore, rising levels of exercise training in the public is an important ambition with main health and financial enhancement [Annemans et al.,2007].

According to, Thompson et al. [2001] performing exercise training continuously is very crucial for hypertensive patients, because blood pressure reduction is an accumulative occurrence from several times hypotensive phenomena established following one time exercise training. It is possible to reduce the risk of hypertension associated with overweight and obesity by increasing levels of physical activity [Wenzhen et al., 2017]

Increasing levels of physical activity are related with reduced incidence of high blood pressure [Wassertheil-Smoller et al., 2000]. For patients with mild hypertension from the cardiovascular point of view Resistance exercise training (RET) is harmless [Dos Reis et al., 2014]. RET is advisable and can be component of the non-drug treatment approach to avoid and fight hypertension [Cornelissen and Fagard, 2005].

According to researchers knowledge study was not conducted in Ethiopia about resistance exercise training as an alternative therapeutic approach for hypertensive patients, in particular in the current area of study. Thus the aim of the study was to determine the effect of resistance exercise training on body mass index (BMI) and waist circumference (WC) among hypertensive patients.

II. MATERIALS AND METHODS

The study was registered in clinical trials.gov with registration number: NCT03029767. The study was done in the period between 20/02/2017 to 17/06/2017 at Hawassa University referral hospital. This study was approved by Mekelle University Health Sciences College Health Research Ethics Review Committee with Ref.ERC07752016. After reading and explaining of information sheets in their local language (Amharic) regarding procedures, confidentiality and risks of the study from all study participants before continuing the study written informed consent was obtained.

A. Study Participants

The current study was part of a larger study. Forty six mild hypertensive patients age ranges between 31 to 45 years, persons who provided written informed consent, and individuals who live in the study area for the period of the study were included in the study. Whereas participants with cardiac and renal diseases, pregnant women, diabetic patients, participants who have co morbidities and secondary hypertension, participants who use lipid-altering medications and took part in structured exercise program before the study were excluded from the study.

B. Procedures

After obtaining of written informed consent study participants were randomly assigned to resistance exercise group (REG) and control group (CG) using stratified random sampling method. The REG engaged in resistance exercise training for 16 consecutive weeks. But the CG did not take part in any designed exercise training program, but they continued their usual activities every day during the period of study and were requested to complete medical symptoms questionnaire forms each month.

RET was conducted for16 successive weeks, three sessions per week (Mondays, Wednesdays and Fridays) and eight different exercises per session. Before starting the intervention program two sessions of familiarization were carried out by that participant of the study. Exercise physiologist supervised the RET. The eight resistance exercises performed by REG participants were: biceps curl, heel raise, shoulder press, curl-up, squat, lower leg lift, triceps extension, and side leg raises. In each exercise session before starting the workout period eight minutes warm up exercises was done and after completion of workout period seven minutes cool down exercise was done by REG participants. One set of eight different types of resistance exercises training was performed from 1st to 4th week and two sets of eight different types of resistance exercises training was performed from 5th week to 16th week. Participants were exercised at 30% to 40% low intensity of one repetition maximum (1RM) for upper body and 50% to 60% moderate intensity of 1RM for lower body. To allow for adequate rest between exercises RET were performed alternating between lower-body and upper- body works. Between exercises there was one minute interval rest. The intensity of RET was progressively increased. Intensity of upper body part resistance exercise training from first to second week was30-32% of 1RM, from third to eight weeks was 33-36% of 1RM, from ninth to twelfth weeks was 37-38% of 1RM,from thirteenth to sixteenth weeks was 39-40% of 1RM. Lower body part intensity of RET from first to second week was50-52% of 1RM, from third to eight weeks was 53-56% of 1RM, from ninth to twelfth weeks was 57-58% of 1RM,from thirteenth to sixteenth weeks was 59-60% of 1RM.

Pre-intervention data was collected after 12 hours overnight fasting by applying proper clinical procedures. A senior nurse who was working at Hawassa University referral hospital of chronic diseases follow-up clinic recorded the BMI and WC measurements. Body weight and height of the study participants was measured by using standardized techniques and calibrated equipments when participants stood without shoes and wearing light cloths. Body weight (in kilogram) was measured to the nearest 0.1 kg, and height

(in meter) was measured by stadiometer to the nearest 0.1 cm while wearing light cloths. BMI was calculated by dividing the weight in kilogram to the height in meters squared. Furthermore, WC was measured at the end of expiration at the navel using a non-stretched tape to the nearest 0.1 cm with participant's upright position. First two measurements are taken and the average was calculated if the measurements are within 1 cm one another. But if the difference between the two measurements goes above 1 cm, the measurements were repeated.

After 16 weeks of resistance exercise training post intervention data was collected after 48 hours of the last exercise intervention in similar way with pre-intervention data collection.

C. Statistical Analysis

Data entry and analysis were done using Statistical Package for Social Sciences (SPSS) Version 20. Categorical variables were summarized as frequencies, and change was summarized in percentages, while mean values, and standard deviations were tabulated for continuous variables. Comparison of quantitative variables at the pre-intervention and after post-intervention of the same group was analyzed with paired t-test. Comparison of continuous variables in between intervention and control group was performed by using independent t test. Finally in all situations, significance level was set at $p<0.05$.

III. RESULTS

A. Baseline Characteristics of Study Participants

Twenty females and twenty four males totally forty four mild hypertensive patients completed the study in REG (males 12, females 10) and in CG (males 12, females 10) baseline data is analyzed and revealed in Table 1

Variables	REG	CG	p-value
Mean age in years	39.3(±4.2)	38.3(±4.2)	0.44
Mean BMI in kg/m^2	27.3(±1.6)	27.1(±1.5)	0.69
Mean WC in cm	99.9(±5.5)	101.5(±6.6)	0.39

Table 1:- Pre intervention between groups' comparison of BMI and WC of the study participants

BMI= body mass index; CG=Control group; cm= centimeter; kg/m^2=kilogram over meter squared; REG = resistance exercise group; WC= waist circumference

Table 1 shows that the mean values of age, BMI,WC of REG were not significantly differed when compared to CG during pre intervention (P-value >0.05) .

➢ *Within group comparisons of BMI and WC in REG participants*

Post test was conducted after 16 weeks and found significant mean decrease in WC by 0.33 cm (P=0.001) in REG (Table 2).

Variables	REG		Change	P value
	Pre-intervention	Post- intervention	Mean deference	
Mean BMI in kg/m^2	27.3(±1.6)	27.2(±1.6)	-0.12	0.054
Mean WC in cm	99.9(±5.5)	99.6(±1.5)	-0.33	0.001

Table 2:- Within a group comparison of BMI and WC of REG study participants

BMI= body mass index; cm= centimeter; kg/m^2=kilogram over meter squared; REG = resistance exercise group; WC= waist circumference

Table 2 shows that in BMI within group comparison was not significant (P>0.05) in REG, whereas in WC in REG significant mean reduction is found in within group comparison after 16 weeks of post intervention ($p<0.05$).

➢ *Within group comparisons of BMI and WC in CG participants*

At the end of 16 weeks of the study post test result indicate in BMI and WC were significantly increased in CG, which is unfavorable or negative change (Table 3).

Variables	CG		Change	p-value
	Pre-intervention	Post-intervention	Mean difference	
Mean BMI in kg/m^2	27.1(±1.5)	27.6(1.6)	0.42	<0.0001
Mean WC in cm	101.5(±6.6)	101.9(6.8)	0.4	0.01

Table 3:- Within a group comparison of BMI and WC of CG study participants

BMI= body mass index; CG=Control group; cm= centimeter; kg/m^2=kilogram over meter squared; WC= waist circumference

➢ *Comparisons of between groups BMI and WC in participants of the study*

At the end of 16 weeks of the study post test result indicated BMI and WC were significantly decreased in REG when compared to CG (Table-4).

Variables	REG		CG		p-value
	Pre-intervention	%change	Pre-intervention	%change	
Mean BMI in kg/m^2	27.3(±1.6)	0.4 ↓	27.1(±1.5)	1.5 ↑	0.002
Mean WC in cm	99.9(±5.5)	0.3 ↓	101.5(±6.6)	0.4 ↑	0.002

Table 4:- Between groups' comparisons of BMI and WC data of study participants

BMI= body mass index; CG=Control group; cm= centimeter; kg/m^2=kilogram over meter squared; REG = resistance exercise group; WC= waist circumference

IV. DISCUSSION

The aim of the study was to determine the effect of RET on BMI and WC among hypertensive patients.

➢ *WC and BMI*

Findings from the current study revealed a significant mean decrease in WC in REG compared to baseline and CG. Results of this study are similar to previous studies who also found significant mean reduction in WC compared to control group in REG [Tseng et al., 2013; Sigal et al. et al., 2014].

Tseng et al. [Tseng et al., 2013] conducted a study to determine the effect exercise training on obese individuals aged 18 to 29 years was in line with present study .They reported that at the end of the study in REG found a significant within group and between group mean reduction in WC ($p<0.0001$) . In control group the mean change was not significant at the end of the study.

Sigal et al. [2014] conducted a study to determine the effects of different exercise modalities on percentage body fat in adolescents who are overweight and obese .Three hundred four study participants randomly assigned into aerobic group (n=75), REG (n=78) combined exercise group (n=75) and CG (n=76).Study participants age was between 14 to 18 years .The study was conducted for 22 weeks. They reported a significant within group and between group decrease in WC of the participants of the study in REG at $P<0.05$ and $P<0.001$, respectively compared to the CG participants.

Findings from the present study showed a significant mean decrease in BMI compared to CG in REG. Results of this study are similar to previous studies who also found significant mean reduction in BMI compared to CG in REG [Tseng et al., 2013; Chaudhary et al., 2010]. Findings from the current study revealed insignificant within group mean change in REG. Results of this study is in line with study of [Bateman et al., 2011; Sigal et al., 2014] who found also insignificant within group mean reduction in BMI REG.

The possible explanation for improvement of BMI and WC in REG may be that resistance exercise training helps the body in expending calories through rising in lean body mass and basal metabolism by this it plays role in the prevention programs of cardiovascular disease [Pollock et al.,2000; William et al.,2007].

V. CONCLUSION

Sixteen weeks of low to moderate intensity RET decreases BMI and WC in mild hypertensive patients compared to CG. Therefore participants with mild hypertension should be encouraged to engage in low to moderate intensity dynamic RET program. Low to moderate intensity dynamic RET is safe and hypertensive patients should be encouraged to engage in dynamic RET on regular basis. Further study may be undertaken by using different intensities, frequencies and sets of RET in mild and moderate hypertensive patients.

➢ *Abbreviations*

BMI= body mass index; CG=Control group; cm= centimeter; kg/m^2=kilogram over meter squared; RM=repetition maximum; REG = resistance exercise group; WC= waist circumference

CONFLICTS OF INTERESTS

There is no any conflict of interest.

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REFERENCES

[1]. Annemans, L., Lamotte, M., Clarys, P., Van den, A.E. (2007). Health economic evaluation of controlled and maintained physical exercise in the prevention of cardiovascular and other prosperity diseases. Eur J Cardiovasc Prev Rehabil 14:815–824.

[2]. Bateman, L.A., Slentz, C.A., Willis, L.H., Shields, T., Piner, L.W., Bales, C.W., et al. (2011). Comparison of Aerobic Versus Resistance Exercise Training Effects on Metabolic Syndrome (from the Studies of a Targeted Risk Reduction Intervention through Defined Exercise - STRRIDE-AT/RT). Am J Cardiol, 108:838 –844.

[3]. Belay, M.A., Reddy, R.C., Syam, B.M. (2012). The Effects of Combined Aerobic and Resistance Exercise Training on Obese Adults, Northwest Ethiopia.

[4]. Bulhoes , K., and Araujo, L.(2007). Metabolic Syndrome in Hypertensive Patients. Diabetes Care. 30(6): 2624-1626.

[5]. Carnethon, M.R., Gulati, M., Greenland, P. (2005).Prevalence and cardiovascular disease correlates of low cardio respiratory fitness in adolescents and adults. JAMA, 294(23):2981-8.

[6]. Chaudhary, S., Kang, M.K., Sandhu, J.S. (2010). The Effects of Aerobic Versus Resistance Training on Cardiovascular Fitness in Obese Sedentary Females. Asian J Sports Med, 1(4): 177–184.

[7]. Cornelissen, V.A., and Fagard, R.H. (2005). Effect of resistance training on resting blood pressure: a meta-analysis of randomized controlled trials. J Hypertens, 23 (2):251– 259.

[8]. Cutler, J.A., Thom, T.J., Roccella, E. (2006). Leading causes of death in the United States. JAMA, 295: 383-384.

[9]. Dos Reis, J. P. C., Almeida, K., da Silva., Souza, R.A., da Silva. , de Sousa, M.S. (2014) .Effect of resistance training with different intensities on blood pressure in hypertensive patients http://www.dx.doi.org/10.5935/2359-4802.20150005.

[10]. Ehrman, J.K., Gordon, P.M., Visich, P.S., Keteyian ,S.J.(2013). Clinical exercise physiology.3rd ed.

[11]. Falkner, B. (2017). Monitoring and management of hypertension with obesity in adolescents. Integr Blood Press Control, 10: 33–39.

[12]. Ferrari, C. K. B. (2008). Metabolic syndrome and obesity: Epidemiology and Prevention by physical activity and exercise. J Exerc Sci Fit, 62:87-96.

[13]. Galassi, A., Reynolds, K., He Jang (2006). Metabolic Syndrome and Risk of Cardiovascular Disease: A Meta Analysis. Am J Med, 119 (10): 812-829.

[14]. Guagnano, M., Ballone, E., Colagrande, V., Della, R.V., Manigrasso, M.R., Merlitte, D., et al. (2001). Large waist circumference and risk of hypertension. International Journal of Obesity 25, 1360–1364.

[15]. Kannel, W.B. (2000). Risk stratification in hypertension: New insight from the Framingham study. Am J Hypertens, 13: 3S–10.

[16]. Lim, S.S., Vos, T., Flaxman, A.D., Danaei, G., Shibuya, K., Adair-Rohani, H., et al. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990-2010: a systematic analysis for the Global Burden of Disease Study 2010, Lancet 380:2224–2260.

[17]. Mancia, G., Fagard, R., Narkiewicz, K., ESH/ESC Task Force for the Management of Arterial Hypertension (2013) .2013 Practice guidelines for the management of arterial hypertension of the European Society of Hypertension (ESH) and the European Society of Cardiology (ESC): ESH/ESC Task Force for the Management of Arterial Hypertension. J Hypertens, 31(10):1925–1928.

[18]. Moeini, M., Zahra, S., Sadeghi, M., Kargarfard, M., Salehi, K. (2015). The effect of resistance exercise on mean blood pressure in the patients referring to cardiovascular research center. Iran J Nurse Midwifery Res, 20(4): 431–435.

[19]. Mungreiphy, N.K., Kapoor, S., Sinha, R. (2011). Association between BMI, Blood Pressure and Age: Study among Tangkhul Naga Tribal Males of North east India. J Anthropol. doi:10.1155/2011/748147.

[20]. Parkinson, C.F. (2012). Study Guide for Understanding Pathophysiology. 5th ed. Elsevier.

[21]. Pescatello, L.S., MacDonald, H.V., Lambeti, L., Johnson, B.T.(2015). Exercise for Hypertension: A Prescription Update Integrating Existing Recommendations with Emerging Research Curr Hypertens Rep, 17(87):1-10.

[22]. Pollock, M.L., Franklin, B.A., Balady, G.J., Chaitman, B.L., Fleg, J.L., Fletcher, B., et al. (2000).Resistance Exercise in Individuals With and Without Cardiovascular Disease Circulation: Benefits, Rationale, Safety, and Prescription An Advisory From the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association, 101, 828-833.
[23]. Sigal, R.J., Alberga, A.S., Goldfield, G.S., Prud'homme, D., Hadjiyannakis, S., Gougeon, R.,et al. (2014). Effects of Aerobic Training, Resistance Training, or Both on Percentage Body Fat and Cardio metabolic Risk Markers in Obese Adolescents: The Healthy Eating Aerobic and Resistance Training in Youth Randomized Clinical Trial. JAMA Pediatr, 168 (11):1006-1014.
[24]. Suman, D., Monika, D., Pankhuri, S., Meenal, D., Stawanti, K. (2014). Body Mass Index Relates to Blood Pressure among Adults. N Am J Med Sci 6(2): 89–95.
[25]. Thompson, P.D., Crouse, S.F., Goodpaster, B., Kelley, D., Moyna, N., Pescatello, L. (2001). The acute versus the chronic response to exercise. Med Sci Sports Exerc, 33(6 Suppl):S438–445.
[26]. Tseng, M.L., Ho, C.C., Chen, S.C., Huang, Y.C., Lai, C.H., Liaw, Y.P. (2013). A Simple Method for Increasing Levels of High-Density Lipoprotein Cholesterol: A Pilot Study of Combination Aerobic- and Resistance-Exercise Training. International Journal of Sport Nutrition and Exercise Metabolism, 23: 271 - 281.
[27]. Wassertheil-Smoller , S., Anderson, G., Psaty, B.M., Black, H..R, Manson, J., Wong, N., et al. (2000).Hypertension and its treatment in postmenopausal women: baseline data from the women's health initiative. Hypertension, 36: 780–789.
[28]. Wenzhen,L.,Dongming,W.,Chunme,S.,Yanfeng,Z.,Zux un,L.(2017).The effect of body mass index and physical activity on hypertension among Chinese middle-aged and older population.Scientific Reports, 7(10251).
[29]. Whooley, M.A., de Jonge, P., Vittinghoff, E., Otte, C., Moos, R., Carney, R.M.,et al.(2008). Depressive symptoms, health behaviors, and risk of cardiovascular events in patients with coronary heart disease. Journal of the American Medical Association, 300, 2379–2388. PubMed doi:10.1001/jama.2008.711.
[30]. William, M.A., Haskell, W.L., Ades, P.A.(2007). Resistance Exercise in Individuals with and Without Cardiovascular Disease. A Scientific Statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. Circulation, 116: 572-84.