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The Effects of Combined Aerobic and Resistance Exercise Training on Obese Adults, Northwest Ethiopia

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Abstract

Obesity has reached epidemic proportion in both developed and developing countries in the world. Physical inactivity is a contributing factor for obesity epidemic. Studies have done to investigate the independent effect of aerobic and resistance exercise training on obesity. However, there are no sufficient evidences to explain the combined effect of aerobic and resistance exercise in a workout on obesity. The aim was to assess the effect of combined aerobic and resistance exercise training (CART) on weight control and body composition, blood and metabolic variables, muscle strength and cardio respiratory fitness in obese adults. We examined the 12 weeks combined aerobic and resistance exercise training on 30 obese Ethiopian adults (mean age 45.2±5.4). Baseline and after12 weeks training test included anthropometric, Body composition, fasting blood glucose and total cholesterol, blood pressure, VO2max and muscular strength (1RM) were done by using standard techniques. Incremental treadmill running test protocol and 1 RM were employed for VO2max and strength test. Data was analyzed by using SPSS statistical package software (version 16.0 for window). Paired sample T test was employed for pre and post test difference assessment. After 12 weeks training significant ($p<0.001$) reduction was observed on body weight (6.1%), BMI (6.3%), body fat percentage (11.6%),Visceral fat(10.8%), systolic BP (1.97%), blood pressure, Fasting blood glucose (5.9%) and total cholesterol (4.3%). The intervention brought significant ($p<0.001$) greater change on Skeletal muscle percentage (10.4%), VO2max (71.5%) and on 1RM (26.3 %,) from baseline. In conclusion, intervening CART in every training session brought significant improvement on weight loss and body fat control, Fasting Blood Glucose and Total cholesterol. Moreover, significant parallel improvement on cardio-respiratory and muscular strength fitness was resulted due to combined exercises intervention. Combining the two types of exercises in a session gives a chance the participants to enhance their aerobic and strength fitness simultaneously.

Keywords: Intervention, aerobic exercise, resistance exercise, combined exercise, obesity.

Introduction

Obesity is a serious public health problem in both developed and developing countries. According to world health organization, Overweight and obesity, had taken the fifth rank of leading risk factors cause of death in 2004[1]. A healthy body requires a minimum amount of fat for the proper functioning of the hormonal, reproductive, and immune systems. Fat is essential for physiological homeostasis, not only as a source of energy but also to synthesize cell membranes and facilitate intracellular reactions. Fats play a vital role in maintaining healthy skin and hair, insulating body organs against shock, maintaining body temperature, promoting healthy cell function and serve as energy stores for the body. Despite the fact that fat is required for the proper functioning of our body, too much storage of fat above the required amount can cause the rise of metabolic abnormalities called metabolic syndrome.

Being obese refers to an excess accumulation of body fat, which is defined by a Body Mass Index of 30 and above[2]. Body mass index (BMI) is the method used to assess the body fat content which is defined as a person's weight in kilograms divided by the square of height in meters. Based on fat distribution obesity classified in to general and abdominal obesity. General obesity is characterized by the distribution of fat to all parts of the body and Abdominal (central) obesity is the excessive accumulation of fat in the abdominal region which resulting in an increase of waist size. A central distribution of body fat is associated with a higher risk of morbidity and mortality than a more peripheral distribution[3]. Most obesity expert considered that abdominal body fat is the main predictor of obesity-related disease especially metabolic disorder and cardiovascular disorder. Persons become overweight or obese as they get older, which is associated with a decrease in physical activity and basal metabolism, and a body fat redistribution to the abdominal area[4].

Physical inactivity is one of the factors for the increases of obesity and its complications. Physical inactivity levels are rising in many countries with major implications for increases in the prevalence of noncommunicable diseases and the general health of the population worldwide[1]. In addition to its contribution for obesity prevalence, physical inactivity is estimated as being the principal cause for approximately 21–

25% of breast and colon cancer burden, 27% of diabetes and approximately 30% of ischemic heart disease burden[5]. According WHO report physical inactivity has been identified as the fourth leading risk factor for global mortality[1]. People who are insufficiently physically active have a 20% to 30% increased risk of all cause mortality.

Urbanization, industrialization and globalization are today contributes for the socioeconomic change in the society. Lifestyle change, Dietary habits change and reduction in physical activity are the associated outcomes which contribute for the increasing prevalence of obesity in Ethiopia especially in the urban areas. These changes associated with urbanization and industrialization has got no attention due to the fact that attention has given to infectious and communicable diseases. To date, physical activities have not received much importance in the daily life of the urban population. Awareness towards the healthy effect of regular physical activity has not created in the people so that it is considered only for sport competition, rather than an integral part of healthy living amongst the general public. To the author's knowledge no studies have conducted in Ethiopia to evaluate the effect of combined aerobic and resistance exercise training on obesity.

Aerobic training is characterized by the execution of cyclic exercises that carried out with large muscle groups contracting at mild to moderate intensities for a long period of time. On the other hand resistance exercise training is characterized by the execution of exercises in which muscles from a specific body segment are contracted against a force that opposes the movement. Substantial documented evidences have shown that Aerobic and Resistance exercise trainings have independent effects on obesity. But limited studies were conducted in developed countries to examine the effect of aerobic and resistance exercise combination in a training program on obesity .The combination of exercise in the training programme was in different days. There is no study conducted on this issue in Ethiopia. Therefore, it needs to be tested in the Ethiopian context because there are differences in lifestyle, genetic variations, environment and demographic characteristics.

This study aims to determine the effect of combined aerobic and resistance exercise training on anthropometric, body composition, cardio-respiratory and muscular endurance, cardiovascular and metabolic variables to prevent and control obesity. In addition, the research attempts to evaluate whether the effect of combined aerobic and resistance exercise training explained in various studies around the world are equally relevant to Ethiopian setting or not.

Methodology

This study was conducted in Gondar town, North West Ethiopia. Obese individuals (men and women) whose BMI $\geq$ 30 and who have had no regular participation in physical exercise training for six months before the study were included. Individuals who were with heart disease, pulmonary disease, uncontrolled hypertension, kidney failure, musculoskeletal and/or neurological limitations to exercise and those who were participating in another research study were excluded. Ethical clearance was obtained from the institutional review board committee of the University of Gondar. For each individual, all pre- and post-tests were performed at the same time of the day.

Sample Size was calculated by taking the mean difference of waist circumference of the resistance training group from previously conducted study [6]. 90 % power was assumed to detect true mean difference at 5% level of significance and 15% dropout rate was expected. By using snow ball sampling techniques we were approached 45 individuals. 35 subjects were screened and recruited at baseline. Written consent obtained from all participants. Subjects were included after explaining the details of the objective of the study. Participants were encouraged to continue their normal nutritional habits during the study period.

Data was collected through Anthropometric measurements which was done by using standardized technique and calibrated equipments. Body composition (Body fat percentage, skeletal muscle percentage, subcutaneous fat percentage, and visceral fat) and resting blood pressure (systolic and diastolic) were taken by using sensitive body composition analyzer and Mercury sphygmomanometer respectively. Fasting blood glucose and total cholesterol level were analyzed by using Life scan glucometer and AMS Vegasys Blood chemistry analyzer. The test were done in the morning after at least eight hour fasting. Data obtained from the subjects were coded and locked in a safe place.

Exercise training procedure: In the 12-weeks period, the subjects were performed four exercise sessions per week; three supervised by the study investigators in the research Fitness center and one performed at home or in a gym, according to instructions. In every workout both aerobic and resistances exercises were combined. Sequentially, aerobic exercises were given first and resistance exercises followed[7]. During the first two visits all subjects were familiarized with the training as well as the equipments. Prior to the start of the training programme orientation was given to the participants on the overall activities they performed.

Aerobic exercise training: Aerobic exercise was performed on treadmill (Trimline 7800 treadmill, USA) and stationary bicycle. After a 10 minute warming up exercise participants were instructed to perform aerobic training before resistance training. Aerobic exercise intensity was adjusted based on maximum heart rate (220 - age =MHR). Table-1 shows the timeline of the intervention. For the first two weeks the target intensity was 50-60% of maximum heart rate (MHR). From the 3rd week onwards, the intensity progressively increased to moderate level 60-85% MHR. 15 minute was given for the first

two weeks and increased to 20 minute from the third week onwards.

Table-1
Timeline of intervention

Duration (week)	Workout Time line (in minute)					Frequency/ week	Intensity description
	Warm-up	Aerobic exercise	Resistance exercise	Cool-down	Seated resting		
1st and 2nd week	10	10-25	25-40	40-45	45-50	3	AE-50-60 % mHR, RE- 30-50% 1RM, 1-2 set, 5-8 reps. 6 exercises.
3rd and 12th weeks	10	10-30	30-50	50-55	55-60	4	AE- 60-85% mHR, RE-50-60% 1RM, 2-3set, 8-12 reps,7 exercises

AE-aerobic exercise, RE-resistance exercise, mHR-maximum heart rate, RM-repetition Maximum

Resistance exercise training: Resistance exercise training was performed after aerobic exercise. Circuit training was employed. Subjects were guided to perform sensible resistance exercise with major body muscles. Sensible resistance training is characterized by lifting lighter weights for a higher number of repetitions, moving continuously and breathing throughout each exercise. Seven different exercises (Upper body: biceps curl, bench press; Core body: sit-ups or curl-up; Lower body: squat, leg press, leg extension, leg curl) were conducted by using dumbbells, weight bench, and multipurpose studio-6 equipment. A one repetition of the maximum (1RM) was used to assess loading capabilities for each Subject. After two weeks of familiarization both the intensity, duration of a session and frequency per week were increased. From the third week onwards number of session was increased to four times per week which was arranged for every other day. All workouts were preceded by a 10 minute warm-up which consisted of stretching of the major muscle groups and slow walking around the gym.

Baseline and after 12 weeks training measurements: All tests and measurements described below were performed before and after the training period. The test was done in the morning in similar time of a day. Tests were made according to the standard.

Anthropometric Measurements: Anthropometric Measurements were taken by using standardized techniques and calibrated equipments. Body Mass Index calculated by dividing the weight in kilograms to the height in meters squared (kg/m^2). Participants were weighed to the nearest 0.1kg by Omron digital weigh machine and height was by using Stadiometer to the nearest 0.5cm recorded while wearing light indoor clothe with no shoes. Waist and hip circumference were measured at the midpoint of the lowest rib and the iliac crest at the end of a gentle expiration. Hip circumference was taken at the maximum circumference of the hip. In both case the measurement recorded to the nearest 0.5cm by using a flexible plastic tape. The average of two measurements was taken. Sensitive Body composition analyzer (Omron Body Composition Monitors Digital Weighing Scale, HBF-362 model) were used for body composition assessment. Body fat percentage, whole skeletal muscle, whole subcutaneous fat and visceral fat were analyzed.

Resting Blood pressure: Resting Blood pressure was taken by using Standardized Mercury sphygmo manometer. Measurement was taken from left arm. The subject was asked to remove all clothing that covers the location of cuff placement. The individual was comfortably seated, with the legs uncrossed, and the back and arm supported such that the middle of the cuff on the upper arm was at the level of the right atrium (the mid-point of the sternum). Before taking the first reading the subject ordered to take a 5 minutes rest while sitting with the arm resting on a table and the arm where the cuff rap was slightly bent. During measurement the subjects instructed to relax as much as possible and to not talk during the procedure. Before one day of the measurement the subjects were instructed to come without doing exercise and without having alcohol and beverage.

Cardio-respiratory and Muscular Strength test: peak oxygen consumption (Vo2max) was calculated with Incremental treadmill protocol test[8]. The treadmill running time recorded in minute and used to compute peak oxygen consumption volume by the formula used for men and women[9,10]. Maximum muscular strength was assessed by using one repetition maximum (1RM) testing. Maximal load calculation was employed to determine the 1 RM[11]. Dominant hand Biceps curl and seated leg press test was done by using dumbbell (free weight) and inclined leg press multi exercise unit to evaluate the 1 RM. The pre and post training test were done in similar time by the same person.

Laboratory determinants: Fasting Blood glucose level test was done by using commercially available Lifescan Glucometer (one touch ultra-2). Total cholesterol, was done by using AMS Vegasys blood chemistry analyzer at Gondar university referral Hospital laboratory. The test was done in the morning after at least 8 hour overnight fasting.

Statistical Analysis and data Interpretation: The statistical computation of the data was analyzed by using SPSS statistical package software (version 16.0). Descriptive statistics (mean

and standard deviation) was used to analyze continuous variables. Paired sample T test was used to compare the difference between baseline and after 12 weeks intervention. Differences were considered statistically significant at p-values < 0.05. Pearson correlation coefficient was used to assess the relationship between body composition and metabolic parameters at baseline.

Results and Discussion

Results: A total of 30 (85.7%) adult obese subjects (age 45.2±5.4 y; weight 86.8 ± 3.0 kg; BMI 30.4 ± 0.7 kg/m2,) were completed the 12 weeks intervention study. The descriptive characteristics of the subjects at baseline and after 12 weeks are summarized in table 2. A paired sample T test between baseline and after training was done. After 12 weeks intervention statistically significant changes were observed in all variables from baseline.

Anthropometric and body compositions outcomes: At the end of the training programme, significant (p<0.001) reduction from baseline was observed on body weight (6.1%), waist circumference (3.8%) and waist-hip ratio (2.9%), body fat % (11.2%), subcutaneous fat % (8.6%), visceral fat (10.8%). Given the reductions on the above variables, an increasing of records from baseline was observed on skeletal muscle % (10.4%, p<0.001).

Cardio vascular and metabolic variables change: At the end of the training statistically significant(p<0.001) reduction was observed on systolic blood pressure (1.97%) and diastolic blood pressure (1.8%), resting heart rate (2.1%), fasting blood glucose (5.9%) and total cholesterol (4.3%).

Cardio-respiratory and muscular strength outcomes: Table-2 shows the means value for treadmill running time, VO2max and total one repetition maximum at baseline and after training. After the 12 weeks intervention of combined aerobic and resistance exercises training, significant (p<0.001) greater change was observed on treadmill running time (59.5%), Vo2max (71.5%) and total 1RM (26.3%).

Baseline correlations between variables: As it is depicted in table-3, Substantial positive correlations were observed between systolic BP and body mass index (r=0.507, p<0.01), between fasting blood glucose and waist circumference (r=0.552, p<0.01), between fasting blood glucose and body fat percentage (r = 0.564, p <0.01) and between total 1RM and skeletal muscle percentage (r= 0.570, p < 0.001). High negative correlation was observed between total 1Repetion maximum and subcutaneous fat (r= -0.710, p < 0.001).

Table-2
Baseline and after 12 weeks exercise training changes of all variables

Variable	Base line	After 12 weeks	Mean difference	Change (%)
• Age, in year	45.2±5.4	nil	nil	nil
• Subjects, N (M/F)	30(27/3)	nil	nil	nil
Anthropometric and Body composition				
• Weight(kg)	86.8± 3.0	81.46±2.96*	5.32± 1.2	6.1
• Waist circumference (cm)	111± 2.7	106.7± 2.7*	4.2± 1.1	3.8
• Waist-hip ratio	1.05± 0.04	1.01± 0.04*	0.03± 0.01	2.9
• BMI (kg/m^2)	30.4± 0.7	28.5±0.7*	1.9± 0.5	6.3
• Body fat percentage	37.2± 3.3	32.8± 3.2*	4.3± 1.1	11.6
• skeletal muscle %	27.0± 1.9	29.8± 2.1*	2.8± 0.9	10.4
• subcutaneous fat %	25.6± 4.6	23.5± 4.4*	2.2± 0.6	8.6
• Visceral fat	15.7± 1.9	14.0± 1.7*	1.7± 0.6	10.8
cardiovascular and Metabolic variables				
• Systolic BP(mmHg)	126.4± 5.8	123.9± 5.2*	2.5± 1.7	1.97
• Diastolic BP (mmHg)	81.3± 3.8	79.8± 3.9*	1.5± 0.9	1.8
• Resting heart rate(bpm)	70.1± 3.6	68.8± 3.9*	1.4± 0.7	2.1
• Fasting BG (mg/dl)	107.4± 6.4	101.1± 4.7*	6.2± 3.2	5.9
• Total cholesterol (mg/dl)	194.9±16.2	186.7± 12.8*	8.3±4.8	4.3
Cardio respiratory and strength capacity				
• Running time(minute)	8.9± 0.74	14.0± 0.8*	5.3± 0.9	59.5
• VO2max(ml/min/kg)	30.5± 2.9	51.9± 3.5*	21.8± 4.4	71.5
• Total 1RM (kg)	55.3± 6.0	69.8± 7.1*	14.5± 3.5	26.3

Data is presented in mean **±** SD. M/F-male/female, RM-repetition maximum, BMI- body mass index, BG-blood glucose, VO2max-volume of maximum oxygen consumption. *p<0.001 vs. baseline

Table-3
Baseline Pearson product moment correlation of body composition with cardiovascular, metabolic variable and aerobic and strength capacity

Variable	Age	Weight	BMI	WC	WHR	BF	SKM	SCF	VF
Systolic BP	.414*	.304	.507**	.263	.355	.243	-.157	.091	.109
Sig. (2-tailed)	.023	.102	.004	.160	.054	.195	.406	.633	.566
Diastolic BP	.412*	.090	.436*	.218	.129	.395*	-.475**	.285	-.145
Sig. (2-tailed)	.024	.638	.016	.248	.498	.031	.008	.127	.445
Resting HR	-.499**	-.407*	-.385*	-.221	.014	-.209	.405*	-.302	-.151
Sig. (2-tailed)	.005	.026	.036	.241	.943	.267	.026	.105	.427
Fasting BG	-.059	.190	.344	.552**	.331	.546**	-.333	.256	.177
Sig. (2-tailed)	.758	.315	.063	.002	.074	.002	.072	.171	.348
Total Cholesterol	-.048	-.031	.152	.336	.140	.186	-.433*	.307	.044
Sig. (2-tailed)	.802	.871	.422	.069	.461	.326	.017	.099	.819
VO2max	-.334	-.038	-.118	-.177	.021	-.055	.281	-.111	.226
Sig. (2-tailed)	.071	.841	.536	.349	.913	.773	.133	.561	.231
Total 1RM	-.031	.381*	-.019	.297	-.086	-.103	.570**	-.710**	.082
Sig. (2-tailed)	.870	.038	.920	.111	.650	.586	.001	.000	.666

*. P< 0.05 level (2-tailed), **. P< 0.01 level (2-tailed). BMI-body mass index, WC-waist circumference, WHR-waist–hip ratio, BF-body fat, SKM-skeletal muscles, SCF-subcutaneous fat, VF- visceral fat, BP-blood pressure, HR-heart rate.

Substantial studies have documented that independently both aerobic exercise training and resistance exercise trainings have made significant changes on body weight and body composition variable in obese individuals. Exercises have been useful as a way of controlling body weight. In our study a 12 weeks intervention of combined aerobic and resistance exercise training showed significant lowering changes on body weight, body mass index, waist circumference, percent body fat, fasting blood glucose, total cholesterol, systolic and diastolic blood pressure. Baseline and after 12 weeks training test variable has shown in table-2.

After 12 weeks intervention mean body weight of the group significantly decreased from 86.8±3.0 kg to 81.5±2.96 kg ($p<0.001$). A 6.1 % weight reduction from baseline was observed at the end of the training. Our result supports the weight reduction role of physical activities on obese participants. A research was conducted to examine the effects of aerobic and resistance exercises independently in obese women[6]. It was conducted for 12 weeks with 3 days/wk. Their result showed a 3.4% ($p=0.002$) and 4.02% ($p<0.001$) weight reduction from baseline in resistance and aerobic exercise training group respectively. 6 weeks related intervention study was conducted to evaluate the effects of aerobic versus resistance training on cardiovascular fitness in obese sedentary females[12]. The result of the study showed a significant reduction of body weight in aerobic (3.75%) and resistance (2.2%) training groups.

On the other hand, substantial studies conducted to assess the effect of combined intervention of diet and exercise on body weight reduction in obese participants. Results from short-term interventions, which are typically 6 months or less in duration, have shown the magnitude of weight loss that is achievable with exercise alone compare with diet alone or the combination of diet plus exercise. A 12 weeks intervention study was conducted by a group of researchers to examine the effects of resistance verses aerobic training combined with an 800 calorie liquid diet on lean body mass and resting metabolic rate[13]. Twenty subjects (17 women, 3 men) with a mean age of 36.7±611.5 years, weight of 95.16±13.0 kg, and a BMI of 35.26±2.9 kg/m2 were participated in their study. The resistance group was performed 3 days per week while the aerobic group 4 days per week. At the end of the study their result showed a 19.3 % and 14.7% weight loss in aerobic and resistance groups respectively. On the other hand, a related study with 8 weeks duration 3 days /week was conducted to examine the effect of strength or aerobic training on body composition, resting metabolic rate and peak oxygen consumption in obese dieting subjects[14]. On this study, the result shows significant weight reduction (7.7%, 10% and 9.7%) in resistance, aerobic and diet only groups respectively.

A paired sample T test was conducted to evaluate the effect of combined aerobic and resistance exercise training on waist circumference, waist-hip ratio, and BMI. The result showed significant difference on WC (111±2.7 cm to106±2.7cm, $p<0.001$), waist-hip ratio (1.05±0.04 to 1.01±0.04, $p<0.001$) and BMI (30.4±0.7 to 28.5±0.7, $p<0.001$). The percent reduction from baseline was 3.8 %, 2.9% and 6.3% respectively for waist circumference, waist-hip ratio and BMI. Related studies showed significant changes on these variables. Even though, the duration of intervention is different significant changes was

observed. A related previous study reported a 4.07 %(p<0.001) and 3.35 %(p=0.002) decrease on BMI in aerobic and resistance group respectively[6]. On another previous study a 5.04% and 2.24% reduction on BMI in aerobic and resistance group respectively was observed[12]. Given the decreasing effects of the independent intervention, our result showed relatively greater changes (6.3%, p<0.001). On the other hand, significant differences also observed between our result and previously done independent aerobic and resistance training intervention on waist circumference. Waist circumference is one of the indicators of cardiovascular disorders. In the present study after intervention significant reduction (3.8%, p<0.001) in waist circumference was resulted. In the previous related study a significant waist circumference reduction was reported in aerobic (5.86%, p<0.001) and resistance (2.32%, p=0.03) training groups[6].

Physical activities have impacts on energy expenditure due to its effect on resting metabolic rate and muscular strength and muscle mass. In the present study after 12 weeks training significant (p<0.001) changes were observed on body composition variables: body fat percentage, subcutaneous fat and visceral fat from baseline records. Conversely, significant (p<0.001) increasing change of skeletal muscle percentage was resulted. Both body weight, waist circumference and body fat percentage showed significant reduction from baseline records. This reduction shows the presence of a positive association between these three variables.

The role of aerobic and resistance exercise training on cardiovascular diseases is well documented. Studies have conducted to examine the effect of physical activities on blood pressure and metabolic variable. Independently the effect of aerobic training and resistance training on these variables was assessed. After intervening independent aerobic and resistance training a significant reduction is reported in systolic (p=0.004) and diastolic (p=0.002) blood pressure in aerobic group and systolic (p=0.002) and diastolic (p=0.007) blood pressure in resistance group after the intervention[6]. A consistent result was observed in our study. At the end of the training a significant reduction in systolic (p<0.001) and diastolic (p<0.001) blood pressure was resulted. Moreover, we were assessed the effects of the intervention on metabolic variables. Pre and post training test was done on these metabolic variables. The result showed Significant (p<0.001) reduction change on both fasting blood glucose (5.9%) and total cholesterol (4.3%) at the end of the intervention. The result supports the previous studies that advocate the preventative and/or curative effects of regular physical training on type 2 diabetes and cardiovascular disease.

Sedentary lifestyle is one of the risk factors for obesity epidemic. Many studies revealed that physical activities made significant improvement on aerobic performance and strength capacity. Aerobic exercise training mainly focused on aerobic performance. In our study, significant (p<0.001) increase in treadmill running time (8.9±0.74 to 14±0.8 minute), VO2max (30.5±2.9 to 51.9±3.5 ml/kg/min) and total 1RM (55.3±6 to 69.8 ±7.1 kg) was observed at the end of the training. Independent studies have conducted to examine the effect of aerobic and resistance exercise training[6, 15]. In these studies, aerobic training group showed greater VO2max and less 1RM record than the resistance group. The present intervention addressed both cardio-respiratory and strength training simultaneously unlike independent aerobic and resistance training intervention. The combination of the two training type in a session contributed to the concurrent improvements for aerobic performance and Muscular strength capacity to the participants.

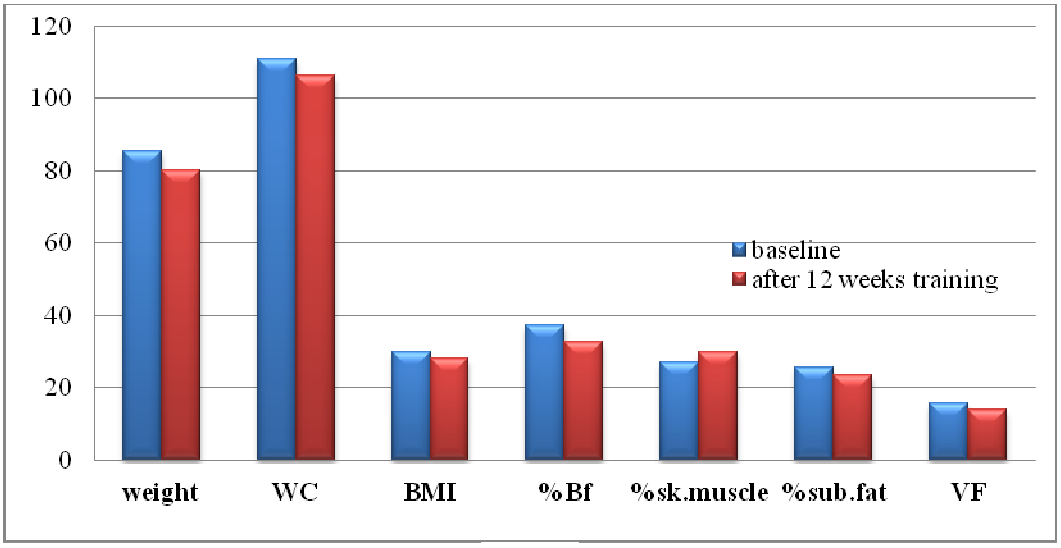

Figure-1
Baseline and after 12 weeks training test values of Anthropometric and Body composition variables

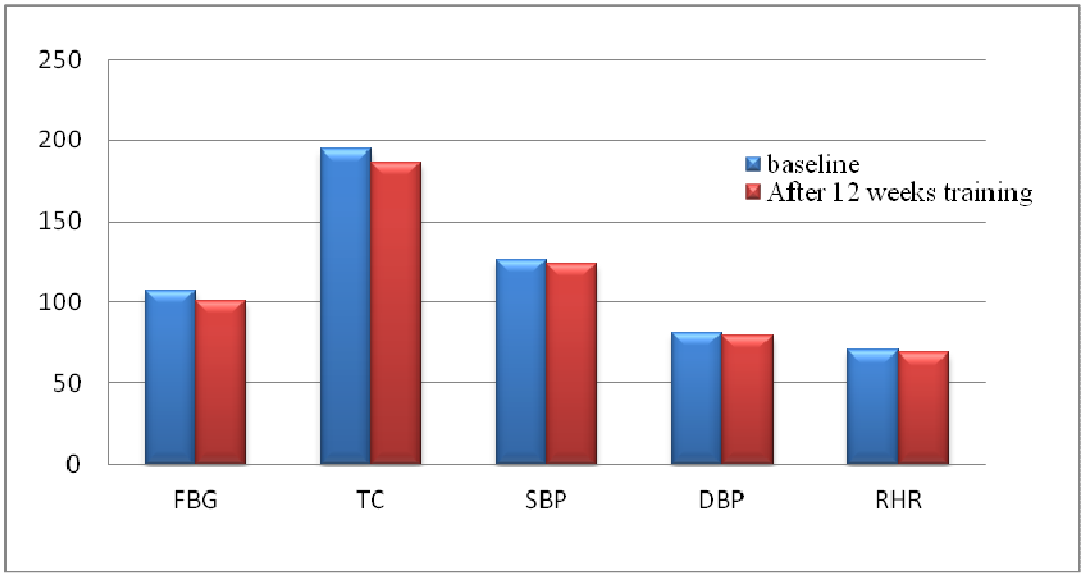

Figure-2
Baseline and after 12 weeks training test values of fastening blood glucose, total cholesterol, blood pressure and resting heart rate

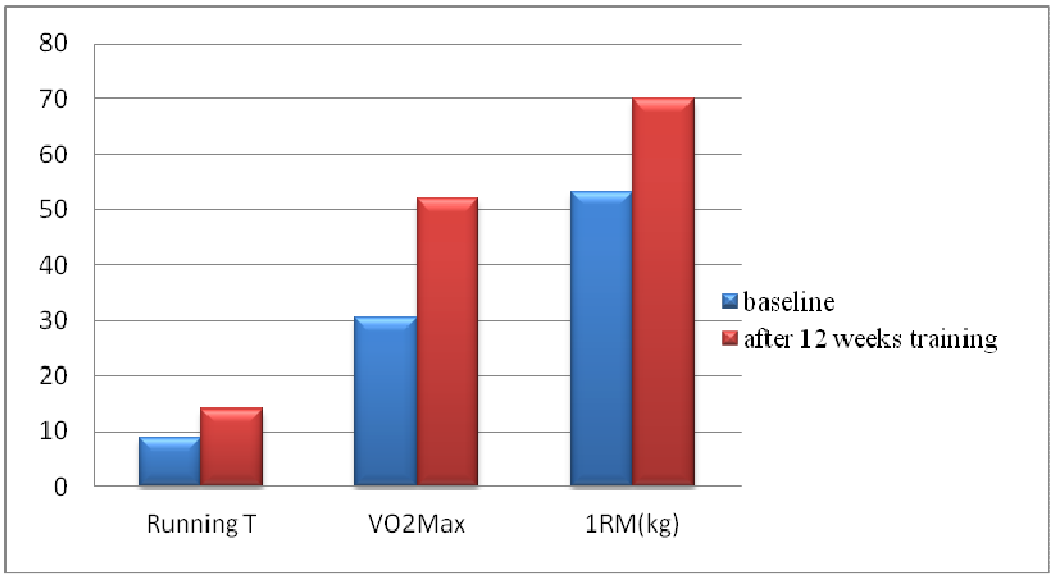

Figure-3
Baseline and after 12 weeks training test values of aerobic and muscular strength performance

Conclusion

Intervening combining aerobic and resistance exercise training for 12 weeks resulted significant improvement on body weight, body fat percentage, systolic and diastolic blood pressure, fasting blood glucose and total cholesterol, aerobic performance and muscular strength capacity in obese individuals. Adhering only on one type training (aerobic or resistance) will not be guaranteed to address different health related fitness components concurrently. Based on our study result, it is therefore recommended that obese individuals should perform regular physical training by combining aerobic and resistance exercises so that the body improves both cardio-respiratory fitness and muscular strength capacity simultaneously. Further studies need to be done how the combination of combined exercise training and diet restriction affects body weight and body compositions on obese individuals.

Limitation: There are limitations in our study. One limitation is that there was no control group to compare the effect of the intervention with the non exerciser (control). The second limitation was only total cholesterol test value was used for analysis due to incomplete data of the other lipid components.

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