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Comparison of the Effect of Aerobic Training and Resistance Training on Body Mass Index and Skinfold Thickness in Overweight and Obese Adults - An Experimental Study

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ABSTRACT

Introduction: The World Health Organization defines overweight and obesity as abnormal and excessive fat accumulation that may impair health. Exercise has shown to have a positive effect on mood and decreasing cardiovascular risk in normal people. Physical activity favorably alters the body composition. Aerobic exercise and resistance training, even without dietary restriction, may provide positive spin-off to the weight loss effort. Studies of aerobic versus resisted exercises in reduction of body weight is insufficient Indian population.
Method: Demographic and anthropometric data (Age, gender, Body mass index, VO2 max and skin fold thickness) was collected. Aerobic - Group A performed treadmill walking 6 days /week, 20mins / day, Resistance- Group B performed set 1 (Chest press, Arm extension, Leg extension, Quadriceps, Lower abdominals) and set 2 (Elbow flexion, Elbow extension, Retractors, Upper abdominals) on alternate days for 6 days/week. Outcome measures were taken pre and post intervention.
Results: Body mass index, skinfold thickness, aerobic capacity, rate pressure product and quality of life significantly improved $p < 0.001$. Post hoc Bonferroni test showed that aerobic training is better than resistance training for improving body mass index, aerobic capacity, rate pressure product and quality of life where as resistance training is better than aerobic and control group to reduce skinfold thickness.
Conclusion: Aerobic training is more effective than resistance training for body mass index, aerobic capacity, rate pressure product and quality of life where as resistance training is better than aerobic group to reduce skinfold thickness.

Key Words: Aerobic training, Resistance training, Vo_2max, SF36, Skinfold thickness

INTRODUCTION

Overweight and Obesity: The World Health Organization (WHO) defines overweight and obesity as abnormal and excessive fat accumulation that may impair health [(1).] Overweight is defined as a body weight that exceeds the normal or standard weight for a particular person based on height and frame size. Obesity refers to the condition of having an excessive amount of body fat [(2)]. which causes health problems [(3)] Increased physical activity is helpful in achieving weight loss and maintenance. [(4, 5, 6,7).]

Aerobic training and resistance training, even without dietary restriction, may provide positive spin-off to the weight loss effort [(8)]

Body mass index (BMI) is one of the most widely accepted means of assessing obesity

[9] Skinfold thickness is obtained from different sites of the body which can be a reliable estimate of fat distribution [10]

Chaudhary S et al found that aerobic training is more beneficial which can be used as a preventive measure in cardiovascular diseases due to obesity. There were statistically significant differences in recovery heart rate (HR) and in post-diastolic blood pressure (BP) improvements in aerobic and resistance training groups [11].

Studies comparing the roles of aerobic versus resisted exercises in reduction of body weight is insufficient especially in the Indian population and hence the need of the present study.

So, this study was undertaken to provide scientific evidence to compare the effect of resistance training and aerobic training on body weight and skinfold thickness in overweight and obese adults.

MATERIALS AND METHODS

Experimental study was done for 6 months with 6 weeks intervention on 45 (15 subjects in each group, power of study >80%) with Convenience sampling in College of physiotherapy, General hospital, Ahmedabad. Study was approved by ethics committee of the college. The nature of the study was being explained thoroughly to the subjects. Written informed consent was obtained from the subjects prior to the study. PAR-Q questionnaire was used for seeing preparedness for exercise participation [12]

INCLUSION CRITERIA:

 Overweight (BMI >22.9 and <25) and obese (BMI >25) [9] adults with willingness to participate with no other comorbidities

 Age between 19 to 30 years

EXCLUSION CRITERIA:

 History of musculoskeletal, neurological, cardiac conditions which do not allow performance of exercise.

 Involvement in regular resisted or aerobic exercise program regularly since 6 months before commencement of the study or at present doing regular work out.

 Smokers and drinkers

Eligible participants were randomly allocated into 3 different groups. (table 1). Demographic and anthropometric data (Age, gender, Body mass index, VO2 max and skinfold thickness) and SF36 was taken at baseline and after 6 weeks. BMI[9], Weight was measured by using weighing machine in kg with minimum possible clothes. Percentage of body fat calculated from skinfold [8, 12] with skinfold calliper from subscapular, pectoral and abdominal for males and triceps, suprailiac and thigh for females.VO2max[12-16] is calculated by Rockport One-Mile Fitness Walking Test. rate pressure product[17-18] was calculated by Systolic blood pressure and heart rate with the stethoscope.(RPP= SBP*HR).Quality of life[19-20] was calculated from SF36 scale.

Table 1: Protocol for 3 groups

Group A (Aerobic)	6 days/week, 20mins/day. 11-13 RPE Treadmill training including warm up and cool down 5 repetitions [11,12]
Group B (Resisted)	6days/week with 10 RM progress every 2 weeks with 4 sets of 10 RM Alternate McQueen technique [12,21,22]
Group C (Control)	Waiting period

RESULTS

The present study comprised of three groups of 15 subjects of overweight and obese adults each. Demographic data is shown in table 2. The data were collected pre and post intervention of 6 weeks. Group A was given aerobic training, group B was given resistance training and control group was in waiting period till 6 weeks. The pre and post results are shown in tables 3-7 and graphs 1 -12. All the subjects completed study.

TABLE- 2 BASELINE CHARACTERISTIC OF THREE GROUPS

AGE (years)	GROUP A (N=15)	GROUP B (N=15)	GROUP C (N=15)
Males	2	2	2
Females	13	13	13

Table 2a. MEAN (SD) AGE IN A, B, AND C GROUPS

AGE (years)	GROUP A (N=15)	GROUP B (N=15)	GROUP C (N=15)
MEAN ± SD	22.66 ± 1.49	21.8 ± 1.90	21.93 ± 1.38

Table 2b. GENTER DISTRIBUTION IN A, B, AND C GROUPS

TABLE- 3MEAN (SD) DIFFERENCE IN BMI (Kg / m 2) BETWEEN AND WITHIN A, B AND C GROUPS

BMI	PRE TRAINING	POST TRAINING	DIFF	F VALUE	P VALUE
A	28.46 ± 4.2	27 ± 4.23	1.26 ± 0.24	53.40	<0.001
B	27.99 ± 3.45	28.4 ± 3.57	- 0.34 ± 0.48		
C	30.19 ± 3.54	30.52 ± 3.57	- 0.43 ±1.13		

BMI was found to be significantly reduced in A and increased in B and C groups. Post hoc Bonferroni test showed statistically significant results within aerobic and resistance groups. Control group found to be statistically non-significant. Change in BMI in aerobic group is highly significant

Table 4. MEAN DIFFERENCE (SD) IN SKINFOLD THICKNESS (% FAT) BETWEEN AND WITHIN A, B AND C GROUPS

% FAT	PRE TRAINING	POST TRAINING	DIFFERENCE	p VALUE	F VALUE
	MEAN± SD				
GROUP A	37.78 ± 2.57	35.63 ± 2.66	2.07 ± 0.54	<0.001	42.52
GROUP B	37.4 ± 2.86	33.9 ± 2.92	3.5 ± 1.7		
GROUP C	36.46 ± 2.43	36.49 ± 2.5	0.02 ± 0.19		

Table 5. MEAN DIFFERENCE (SD) IN AEROBIC FITNESS (VO2MAX) BETWEEN AND WITHIN A, B AND C GROUPS

Vo_2 max	PRE TRAINING	POST TRAINING	DIFFERENCE	p VALUE	F VALUE
	MEAN± SD				
GROUP A	30.63± 6.84	40 ± 7.41	9.36 ± 1.19	<0.001	79.24
GROUP B	29.6 ± 6.01	31.53 ± 6.06	2.31 ± 1.85		
GROUP C	31.28 ± 6.45	31.2 ± 6.34	0.10 ± 0.33		

Table 6 MEAN DIFFERENCE (SD) IN RATE PRESSURE PRODUCT (RPP) BETWEEN AND WITHIN A, B AND C GROUPS

RPP	PRE TRAINING	POST TRAINING	DIFFERENCE	p VALUE	F VALUE
	MEAN± SD				
GROUP A	1194.76± 1.08	982.47 ± 9.16	663.35 ± 1.63	<0.001	209.2
GROUP B	1348.48 ± 9.61	1247.37 ± 9.24	152.38 ± 1.77		
GROUP C	1570.24 ± 1.01	1584.35 ± 1.01	-71.86 ± 36.26		

Table 7. MEAN DIFFERENCE (SD) IN Quality of life (QOL) BETWEEN AND WITHIN A, B AND C GROUPS

Domains	MEAN SD			p VALUE	F VALUE
	GROUP A	GROUP B	GROUP C		
PF	28.66 ± 2.66	8.66 ± 16.9	0.66 ± 25.9	0.005	6.03
RP	27.33 ± 34.1	17.45 ± 27.1	2.44 ± 7.77	0.03	3.9
RE	31.1 ± 37.2	22.23 ± 34.8	2.22 ± 15.25	0.046	3.3
V	19.07 ± 26.52	7.08 ± 11.09	1.6 ± 17.76	0.02	4.23
EH	20.86 ± 19.77	4.66 ± 12.16	0.86 ± 12.4	0.002	7.3
SF	17 ± 17.4	8.8 ± 12.8	0.4 ± 29.7	0.04	3.54
P	4.5 ± 10.5	3 ± 12.3	0.6 ± 13.71	0.23	1.53
GH	19.3 ± 15.74	3.31 ± 5.75	0.74 ± 9.9	<0.001	13.1

DISCUSSION

BMI, weight was reduced because of calory burn due to movement of limbs continuously [23]. In resistance training due to weight lifting more of muscle work against heavy weights resulted into weight gain to increase muscle mass.

Durham NC (2012) et al showed similar finding of this study that resistance training group actually gained weight due to an increase in lean body mass [23,24].

Willis LH et al showed similar finding of this study from the randomized control trial between AT, RT and AT/RT that AT reduced total body mass ($p < 0.05$) than RT, but they were not different from each other. RT increased lean body mass more than AT ($p < 0.05$). AT is the optimal mode of exercise for reducing body mass [25].

Skinfold thickness, law of conservation of mass, matter is neither created nor destroyed, but it may alter its form through chemical reaction. Essentially, that tells us that while we lose mass in our bodies by burning up fat, it does not just disappear. It simply changes form, like water and steam. Larger muscles burn more calories and fat.

Weight lifting produces more force than aerobic walking so conservation of mass is more in resistance training so found better results.[4]

Crewther BT (2013) et al showed similar finding of this study in significant reduction in body fat and an increase in fat-free mass with six weeks of resistance training. [26]

Aerobic fitness, Aerobic training elicits numerous changes in the components of the oxygen transport system that enable it to function more effectively.

Resistance training increases the contractility of left ventricle and enhances stroke volume.

Rhythmic, repetitive movements of the large muscle groups improve vo_2max by shunting the blood from the viscera to working skeletal muscle results in increase in oxygen extraction in aerobic training.[27]

Rate pressure product, exercise training creates an imbalance between the tonic activity of sympathetic accelerator and parasympathetic depressor neurons in favor of greater vagal dominance.

blood pressure during aerobic exercise is much lower than the response to resistance exercise. The results of the present study are in accordance with the above statement. Control group showed non-significant results, in fact there was increase in the rate pressure product which may be due to an increase in the peripheral resistance with less physical activity. [12]

Chaudhary S et al concluded that reduction in systolic blood pressure and heart rate was more after 6 weeks of aerobic than resistance training and control group .[11]

CONCLUSION

Aerobic training is effective in reducing body mass index, % fat, rate pressure product and improving aerobic capacity and quality of life where as resistance training is

effective in improving muscle mass, aerobic capacity, quality of life and reducing skinfold thickness and rate pressure product compared to control group.

In comparison, aerobic training is more effective than resistance training in reducing body mass index, improving aerobic capacity, rate pressure product and quality of life, whereas resistance training is more effective in reducing % fat in overweight and obese adults.

Clinical Implications

Aerobic and resistance training can be used to improve muscle mass; improve aerobic fitness, quality of life and to reduce body fat and rate pressure product. Clinically aerobic training can be used if body weight is a major concern to reduce body mass index, skinfold thickness, rate pressure product and improve aerobic fitness and quality of life safely. Resistance training can be used if only body fat is a major concern and it improves aerobic capacity, muscle mass, quality of life along with reduction in rate pressure product

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