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Effect Of Functional Resistance Training Vs Aerobics On Cardiometabolic Parameters In Obese Young Women

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ABSTRACT

Aim & Background: Obesity is one of the major public health concerns as globally inactivity and obesity are on the rise. According to World Health Organization Obesity is defined as abnormal or excessive fat accumulation that presents a risk to health. Obesity is largely associated with a decrease in life expectancy and the effect of obesity is greater among younger adults. The aim of study aims to compare the Functional Resistance Training and aerobics on cardiometabolic parameters in obese young women.

Methods: The study was conducted at Sri Ramachandra Institute of Higher Education and Research, Chennai. Subjects was divided into two groups by a pre-test measurement of HDL, LDL, TG, TC and FBG was taken. One group was trained with Functional Resistance Training (FRT), physical activity and diet advices while the other group received Aerobic Training (AT), physical activity and diet advices. The post-test measures were taken following six weeks of intervention.

Results: There is no statistically significant difference between pretest and post-test measures of HDL, LDL, TG, TC and FBG values in both Functional Resistance Training and Aerobic training ($p > 0.05$). There was statistically significant difference between pre-test and two post-test measures of BMI and WHR in FRT ($p < 0.05$). when both the groups are compared there was no significant difference between then ($p>0.05$).

Conclusion: This study shows no significant difference in effect of Functional Resistance Training over Aerobic training on cardiometabolic parameters in obese young women.

Clinical Significance: FRT is found to be clinically effective in BMI and WHR, thus quite beneficial in improving obesity. Future studies with longer duration can bring a better understanding of Functional Resistance Training which the patient found comfortable to exercise for prolonged time and had less fatigue too.

Clinical trial number: REF/2022/06/055810

Keywords: *High density lipoprotein, Low density lipoprotein, Triglycerides, Total Cholesterol, Fasting Blood Glucose, Obesity,RCT.*

1. INTRODUCTION

Obesity is one of the major public health concerns as globally inactivity and obesity are on the rise[1]. According to World Health Organization Obesity is defined as abnormal or excessive fat accumulation that presents a risk to health[2]. The most commonly used method for body fat measurement is Body Mass Index (BMI) although specialized types of equipment like Magnetic Resonance Imaging, and Dual-energy X-ray absorptiometry machines are available[3]. Individuals with a 25 to 30 kg/m2 BMI range are classified as overweight and persons with a BMI range of 40 kg/m2 and above are considered morbid obesity[4].

The prevalence of overweight is higher in men whereas the prevalence of obesity is higher in women[5]. The global prevalence of obesity has doubled since 1980, it has increased in all ages and sexes although the prevalence is generally greater in the geriatric population and women[6]. In India about 135 million people were found to be obese the prevalence varies due to age, gender socioeconomic status, etc., and obesity is one of the important financial burdens for the government[7]. Prevalence of obesity in India is 40.3%, higher in women (41.88%) than men (34.58 %) this shows the obesity level in India is quite high, especially among women[8].

Obesity is largely associated with a decrease in life expectancy and the effect of obesity is greater among younger adults. The metabolic syndrome with a combination of abdominal obesity, dyslipidemia, hyperglycemia, and hypertension is a major global challenge[9]. Obesity doubles the risk of metabolic syndrome which in turn increases the risk of diabetes, cardiovascular diseases, and other comorbidities[10].

Globally about 300 million women are thought to be obese. Alterations in the reproductive cycle are related to obesity among females. Fertility is highly compromised with an increased risk of polycystic ovarian syndrome and anovulation which is closely related to their Body Mass Index. The menstrual irregularities may lead to ovarian, breast, and endometrial cancer. Obesity during pregnancy gives rise to spontaneous miscarriage, gestational hypertension, gestational diabetes, and adverse maternal outcomes making labor difficult. Obese women are likely to have a healthy postpartum period with an increased risk of breastfeeding problems, increased risk of infection, and thromboembolism[11]. So, it becomes evident that obesity should be addressed in females even before becoming pregnant and also after delivery to maintain a healthy life.

Obesity can be managed through changes that involve energy intake and energy expenditure, thus diet and exercise used to be the best method of managing obesity. Different types of exercise programs like endurance training, resistance training, and high-intensity interval training have been proven effective in various research[12]. Reduction in daily calorie intake high in simple sugar or fat and behavioral modification which demands a breaking of a sedentary lifestyle and poor dietary choices help in the reduction of body weight. This comprehensive approach of diet, exercise, and behavioral modification will provide the individuals with weight loss[13].

Traditionally aerobic activity like walking, swimming, and treadmill training was found to be the best option for obesity management but recent studies show resistance exercise also play an efficient role in successful weight management among obese individuals[14]. Aerobic and resistance exercises are widely researched but only few studies exist on the effect of functional training with people with obesity. This type of training is multi articular, multi segmental, integrated exercises which have multi system adaptation. This type of exercises elicits accurate improvement in fitness level and also may affect glucose uptake.

The intensity of this training will determine different types of adaptations. It also has greater muscle recruitment than simple aerobic exercises[15]. So this study aims to compare the Functional Resistance Training and aerobics over cardiometabolic parameters in obese young women.

2. MATERIALS & METHODS

The experimental randomized control study was approved by the Ethics Committee for Students proposals (CSP/22/JUN/111/333),"Sri Ramachandra Medical College and Research Institute" (Deemed to be University). The subjects were conducted ar Sri Ramachandra Institute of Higher Education and Research. [Deemed to be University]. Initially, a Screening was done in the young female population aged between 18 to 24 years (306 subjects) for their BMI, about 24 subjects were found with a BMI of above 30.

The research study was explained to all 24 members who were above the BMI of 30 and those who are willing to participate are obtained with informed consent. Out of 24, 13 subjects were not willing to participate in the study because of timing issues and not interested to do exercises, 11 gave their consent and were included in the study. Demographic data age, height, weight, Body Mass Index, Waist Hip Ratio were documented.

All the subjects were initially screened for Metabolic parameters, Blood pressure, Oxygen saturation, IPAQ and vo2 max by a second assessor who is blinded to the type of intervention that the 11 subjects will be receiving. As a pretest measurement

of metabolic parameters, blood sample was taken from all the subjects and the following were measured for which 50% of concession was sponsored by Sri Ramachandra Institute of Higher Education and Research.

1. High Density Lipoprotein (HDL)
2. Low Density Lipoprotein (LDL)
3. Triglycerides (TG)
4. Total cholesterol (TC)
5. Fasting Blood Glucose (FBG)

Blood pressure was evaluated with sphygmomanometer and Oxygen saturation with pulse oximeter. Vo2 max is measured with step test. Diet education were given (low fat high carb) diet by Dietitian (Annexure 1)

DEPARTMENT OF CLINICAL NUTRITION

7 DAY DIET PLAN FOR PCOS(Polycystic Ovarian Syndrome)

	Morning	Breakfast	Mid-morning	Lunch	Snacks	Dinner
Day 1	Cinnamon tea and walnuts	Multigrain porridge with (skimmed milk) boiled egg	Horse gram sundal Vegetable salad	Plain rice with thin dal gravy boiled vegetables boiled egg white	Apple Chia seed pudding	Chapathi Thin dhal Cucumber
Day 2	Turmeric tea and almonds	Red rice flakes with nuts ,orange,boiled egg white	Butter milk with flax seeds , black channa boiled	Plain rice , thin dal , ridge gourd poriyal, boiled egg white	Curd chia seeds	Idiyappam roasted bengal gram chutney /mint , cucumber Boiled egg white
Day 3	Ginger tea and walnut	Pear millet dosa Channa curry Vegetable salad Boiled egg white	Tender coconut water Chia seed Nuts salad	Plain rice, fish curry, boiled egg white, cucumber and carrot salad	Puffed rice with roasted bengal gram and groundnut Guava	Egg dosa Channa curry Vegetable salad
Day 4	Green tea and walnuts	Pesarattu with horsegram chutney,boiled egg white	Green gram sprouts,sesame seed balls	Plain rice, rasam, bottle gourd poriyal,boiled egg white	Pears ,vegetable soup	Poha with nuts
Day 5	Dry ginger coffee, almonds, walnuts	Multigrain adai Boiled egg white	Vegetable soup	Sambar rice withboiled egg and raita	Puffed rice ball pomegranate	Idiyappam Roasted bengal gram chutney or mint Cucumber Boiled egg white
Day 6	Green tea Almond	Wheat dosa and tomato chutney	Tender coconut water and chia seeds	Plain rice, thin dhal boiled egg white and beans poriyal	Peanut masala ,watermelon	Green gram sundal Boiled egg white
Day 7	Cinnamon tea with walnuts	Multigrain porridge with skimmed milk,boiled egg white	Plain rice,chicken gravy,cucumber,boiled egg white	Fruit salad,chia seed pudding	Chapathi,thick dal,boiled egg white	Skimmed milk

Then the samples were randomly allocated to two groups by computer generated simple random sampling method.6 subjects were allocated to Functional Resistance Training (FRT) and 5 subjects were allocated to Aerobic training (AT).

Step test:

Resting heart rate: After 20 minutes upon arrival to the demonstration area, heart rate was monitored and documented.

Equipment required: Step height-16 inches, stopwatch, and metronome

Procedure: Subjects were given instructions about the procedure and given a trial to do the step up and down with the beat of metronome (84 bpm). The subjects were instructed to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The subjects stop immediately on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds

of recovery. Multiplying 15 second readings by 4 will give the beats per minute (bpm) value to be used in the calculation below. (Reliability: r = 0.92 validity r = -0.75).

Scoring: VO2max(ml/kg/min) = 65.81 - (0.1847 x heart rate (bpm))

Physical Activity levels – IPAQ questionnaire was used to evaluate the subject's physical activity level and scoring was calculated and they were categorized in to Low, Moderate and High physical activity grades (Annexure-2)

Then 12 subjects were given explanation again of objectives, procedures, benefits of the study and was randomly divided in to two groups by computer generated method. One group was trained with Functional Resistance Training (FRT) while the other group will be receiving Aerobic training (AT) in treadmill.

3. FUNCTIONAL RESISTANCE TRAINING (FRT):

The resistance of 40 to 60% of 1RM was chosen for training. The 1 RM is the maximum weight that is lifted by the person in one repetition.

Warm-up

Marching in place	15 counts
Unilateral reaches(unweighted)	15 counts
Side-step lunges (unweighted).	15 counts
High knees	15 counts
Repeated for 5 minutes	

The exercises which were performed, in order,

1. Squats
2. Wood Chopping
3. Side Step Squat, Bent Row
4. Reverse Lunge with Rotation
5. Triceps Dip
6. Deadlift
7. Modified Pushups
8. Chest Raise

Subjects were given 3 minutes of rest between each set.

The progression of the exercise:

1-2 weeks	2 sets of 5-8 repetition
Week 3	3 sets of 7 repetition
Week 5	4 sets of 7 repetition
Week 6	4 sets of 9- 10 repetition

Cool-down exercises

1. Forward Bend
2. Hamstring Stretch
3. Toe Touch
4. Shoulder Cross Stretch

Moderate intensity steady state training 60 to 70%

Warm up

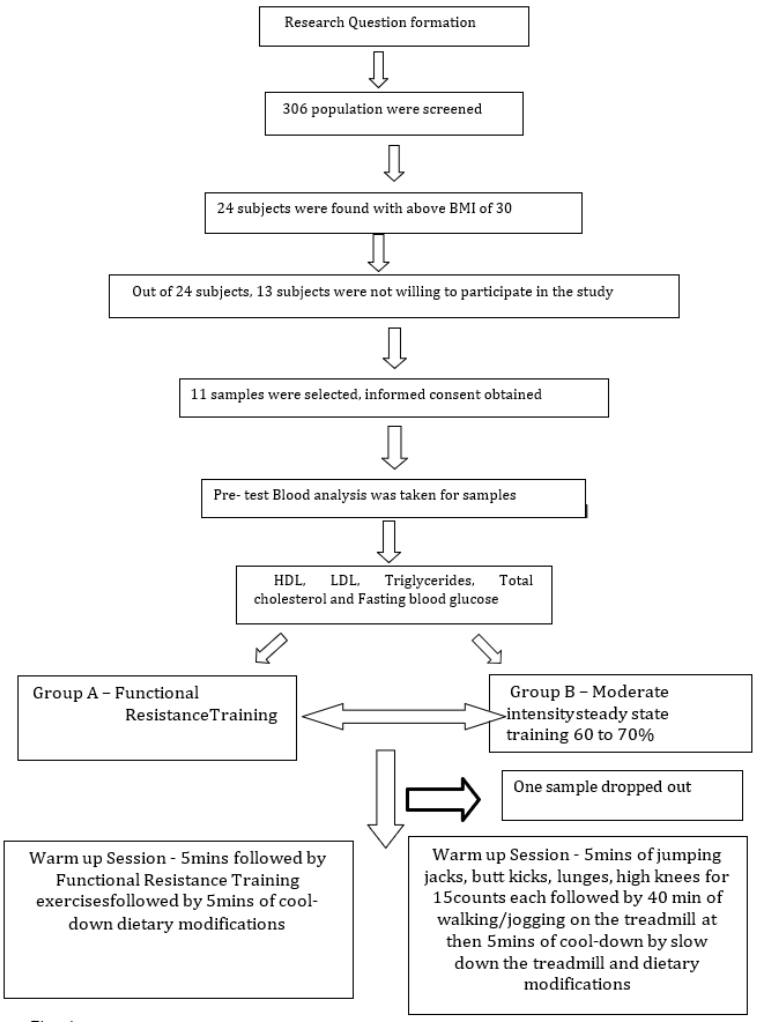
Jumping jacks	15 counts
butt kicks	15 counts
lunges	15 counts
high knees	15 counts
Repeated for 5 minutes	

Treadmill training

40 min of walking on the treadmill at 60–70% HRmax as calculated individually using Karvonen formula, and followed by 5 mins of cool-down by slowing down the treadmill.

The post-test measures will be taken following six weeks of intervention.

1. High Density Lipoprotein (HDL)
2. Low Density Lipoprotein (LDL)
3. Triglycerides (TG)
4. Total cholesterol (TC)
5. Fasting Blood Glucose (FBG)



Flowchart

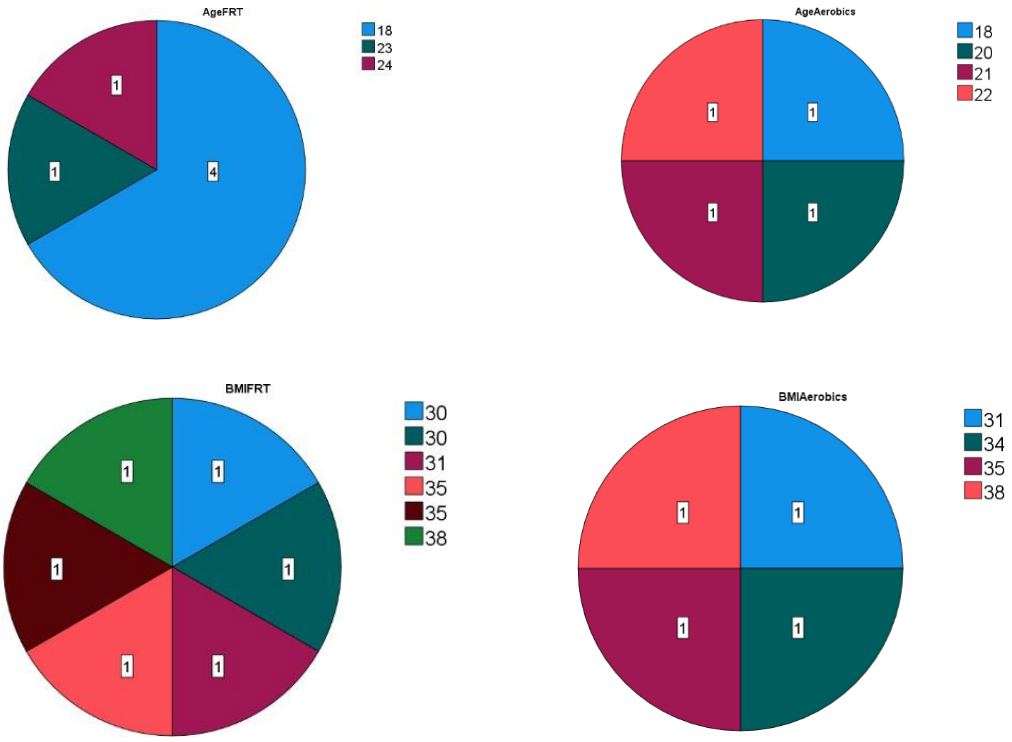
4. STATISTICAL ANALYSIS

Statistical analysis was performed by SPSS software version 16.0. Descriptive statistics were calculated for baseline characteristics, Wilcoxon signed ranked test is used to find the significant difference between the pre and post test scores and Mann Whitney is used to assess the difference between two different groups post-test measures of HDL, LDL, TG, TC and FBG. Significance level is taken at 5%

TABLE 1 Baseline characteristics of Functional Resistance Training Group and Moderate Intensity Steady State Training group

Variable	FRT	AEROBICS
	M±SD	M±SD
Age	19.83±2.85	20.25±1.70
BMI	32.98±3.23	34.50±3.00
IPAQ	1.17±0.408	1.50±0.57
Nulliparous	100%	100%

Figure 1 Baseline characteristics of Functional Resistance Training Group and Moderate Intensity Steady State Training group



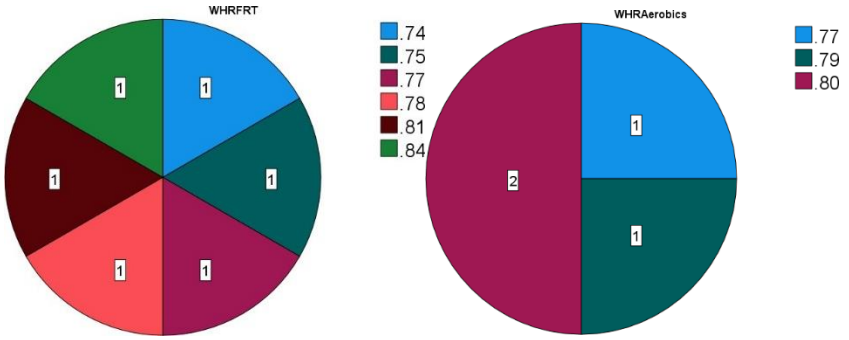


Table 2 Pre-test and Post-test measures of High-Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Triglycerides (TG), Total Cholesterol (TC), Fasting Blood Glucose (FBG) in Functional Resistance Training (FRT) group.

Variables	Pretest	Postest	Z	P value
	Mean (SD)	Mean (SD)		
High Density Lipoprotein	41.33(6.12)	41.66(7.00)	-.135b	.893
Low Density Lipoprotein	117.00(37.35)	123.66(36.68)	-1.483b	.138
Triglycerides	114.33(63.45)	98.33(47.70)	-1.572c	.116
Total Cholesterol	183.33(48.23)	191.66(45.72)	-1.367b	.172
Fasting Blood Glucose	92.16(2.71)	90.50(6.12)	-.680c	.496

Table 3 Pre-test and Post-test measures of High-Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Triglycerides (TG), Total Cholesterol (TC), Fasting Blood Glucose (FBG) in Aerobic Training (FRT) group.

Variables	Pretest	Postest	Z	P value
	Mean (SD)	Mean (SD)		
High Density Lipoprotein	42.5 (6.13)	43.50(7.41)	-.552b	.581
Low Density Lipoprotein	103.25(26.23)	103.50(25.83)	-.184b	.854
Triglycerides	75.50(32.58)	67.75(27.94)	-.730c	.465
Total Cholesterol	166.75(34.75)	169.50(38.59)	-.730b	.465
Fasting Blood Glucose	97.25(2.36)	91.75(5.37)	-1.841c	.066

Table 4 Pre-test and Post-test measures of Body Mass Index (BMI), Waist Hip Ratio (WHR, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) in Functional Resistance Training (FRT) group.

Variables	Pretest	Postest	Z	P value
	Mean (SD)	Mean (SD)		
BMI	32.98 (3.234)	32.56(3.64)	-.944b	.345
WHR	.7817(.0376)	.7683(.0491)	-1.510b	.131
Systolic BP	119.00(8.80)	119.00(5.79)	-.524b	.600

Diastolic BP	75.16(9.98)	79.66(4.67)	-1.156c	.248

Table 5 Pre-test and Post-test measures of Body Mass Index (BMI), Waist Hip Ratio (WHR, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) in Aerobic Training group.

Variables	Pretest	Postest	Z	P value
	Mean (SD)	Mean (SD)		
BMI	34.50(3.008)	34.12(2.74)	-.730b	.465
WHR	.7900(3.00)	.7850(.0404)	-.184b	.854
Systolic BP	118.75(11.61)	123.75(6.02)	-.730c	.465
Diastolic BP	84.25(4.57)	80.50(5.50)	-.730b	.465

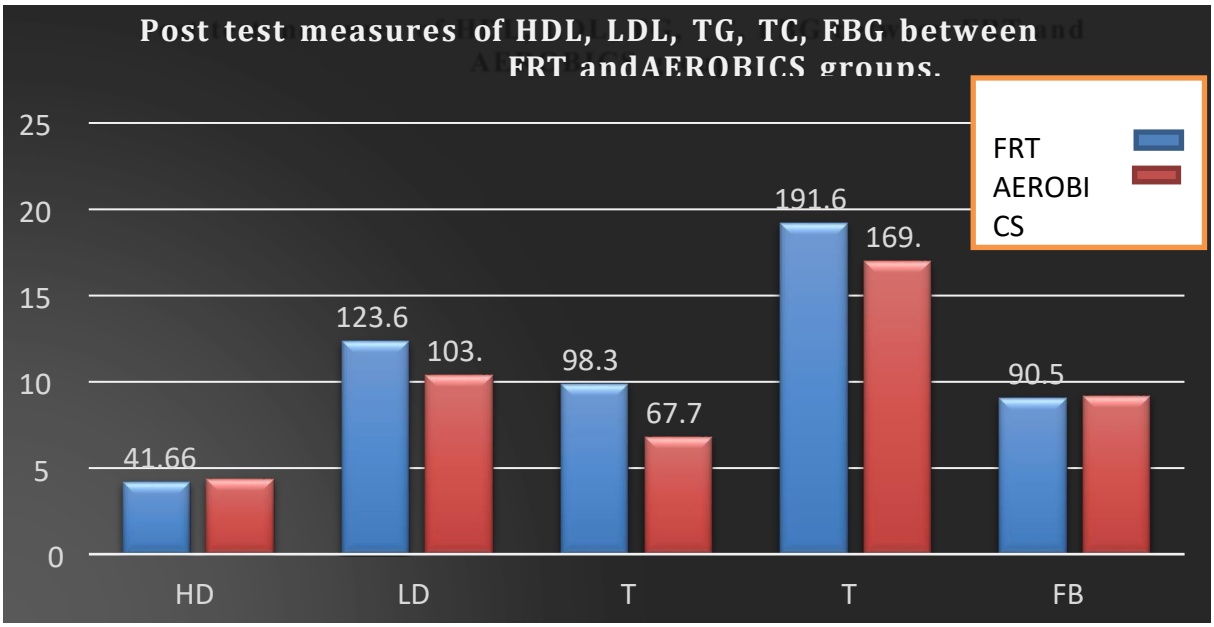
Table 6 Comparison of Post-test measures High Density Lipoprotein (HDL), Low Density Lipoprotein (LDL), Triglycerides (TG), Total cholesterol (TC), Fasting Blood Glucose (FBG) between Functional Resistance Training group (FRT) and Moderate Intensity Steady State Training group (MIST).

Variables	FRT	MIST	Z	P value
	Mean rank	Mean rank		
High Density Lipoprotein	5.08	6.13	-.536	.592
Low Density Lipoprotein	6.08	4.63	-.748	.454
Triglycerides	6.50	4.00	-1.279	.201
Total Cholesterol	6.00	4.75	-.640	.522
Fasting Blood Glucose	5.17	6.00	-.429	.668

Table 7 Comparison of Post-test measures Body Mass Index (BMI), Waist Hip Ratio (WHR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP) between Functional Resistance Training group(FRT) and AEROBICS training group

Variables	FRT	AEROBICS	Z	P value
	Mean rank	Mean rank		
BMI	4.50	7.00	-1.279	.201
WHR	5.00	6.25	-.650	.516
Systolic BP	4.58	6.88	-1.176	.240
Diastolic BP	5.33	5.75	-.215	.830

Figure 2



5. RESULTS

1. 11 obese young women were included in this study. The mean age of obese women was 20 years. Mean BMI is about 32.98 among women in FRT where as it is about 34.50 among women in AEROBICS. Mean IPAQ in FRT is about 1.17 and in AEROBICS is 1.50. The women are nulliparous in both the group (Table 1)
2. In FRT there is 4 samples in age of 18, 1 sample in age of 23 and 1 sample in age of 24.and in Aerobics there is 1 sample in age of 18, 1 sample in age of 20, 1 sample in age of 21 and 1 sample in age of 22. The FRT group consisted of 2 sample in BMI of 30, 1 sample in BMI of 31, 2 samples in BMI of 35 and 1 sample in BMI of 38 and the Aerobics group consisted of 1 sample in BMI of 31, 1 sample in BMI of 34, 1 sample in BMI of 35 and 1 sample in BMI of 38. In both groups obese class 1 and 2 is included. In FRT group there is 1 sample in WHR .74, 1 sample in WHR .75, 1 sample in WHR .77, 1 sample of WHR .78, 1 sample in WHR .81 and 1 sample of WHR .84 is included and in Aerobics 1 sample in WHR .77, 1 sample in WHR is .79 and 2 samples in WHR is .80.
3. The pre and post-test of HDL, LDL, TG, TC and FBG in Functional Resistance Training group is done by Wilcoxon signed rank test which shows the mean of HDL is in pretest 41.33 and mean of HDL in post-test 41.66, its Z value is -.135b and P value is .893 and therefore it shows the result is non- significant ,the mean of LDL in pretest is 117.00 and the mean of LDL in post-test is 123.66 ,its Z value is -1.483b and P value is .138 so the result is non-significant , the mean of TG is 114.33 in pretest and mean of TG in post-test is 98.33, its Z value is -1.572c and P value is .116 so the result is non-significant, the mean of TC in pretest is 183.33 and the mean of TC in post-test is 191.66, its Z value is -1.367b and P value is .172 therefore the result is non-significant, the mean of FBG in pretest is 92.16 and the mean of FBG in post-test is 90.50, its Z value is -.680c and P value is .496 therefore the result is non-significant and the Wilcoxon analysis shows the pre and posttest of HDL, LDL, TG, TC and FBG in Functional Resistance training group are non-significant (> 0.05). (Table 2)
4. The pre and post-test of HDL, LDL, TG, TC and FBG in AEROBIC Training group is done by Wilcoxon signed rank test which shows the mean of HDL is in pretest is 42.5 and mean of HDL in post-test is 43.50, its Z value is -.552b and P value is .581 and the results are non-significant, the mean of LDL in pretest is 103.25and the mean of LDL in post-test is 103.50, its Z value is -.184b and P value is .581 and the results are non-significant, the mean of TG is 75.50 in pretest and mean of TG in post-test is 67.75, its Z value is -.730c and P value is .465 therefore results are non-significant, the mean of TC in pretest is 166.75 and the mean of TC in post-test is 169.50 , its Z value is - .730 b and its P value is .465 therefore the results are non-significant , mean of FBG in pretest is 97.25 and the mean of FBG in post-test is 91.75, Z value is -1.841c and P value is .465 therefore the results are non-significant and the Wilcoxon analysis shows the pre and posttest of HDL, LDL, TG, TC and FBG in Aerobic training are non- significant (> 0.05). (Table 3)
5. The comparison of post-test measures of HDL, LDL, TG, TC and FBG in both Functional Resistance Training and Aerobic Training group is done by Mann-Whitney test and it shows the mean rank of HDL in FRT is 5.08 and HDL in AEROBICS is 6.13 , Z value is -.536 and P value is .592 therefore the results are non-significant , mean rank of

LDL in FRT is 6.08 and LDL in AEROBICS is 4.63, Z value is -.748 and P value is .454 hence the results are non-significant, mean rank of TG in FRT is 6.50 and mean rank of TG in AEROBICS is 4.00, Z value is -1.279 and P value is .201 therefore the results are non-significant, mean rank of TC in FRT is 6.00 and mean rank of TC in AEROBICS is 4.75, Z value is -.640 and P value is .522 therefore the results are non-significant, mean rank of FBG in FRT is 5.17 and mean rank of AEROBICS is 6.00, Z value is -.429 and P value is .668 therefore the results are non- significant and the Mann Whitney analysis shows the posttest of HDL, LDL, TG, TC and FBG in both Functional Resistance and Aerobic training group are non-significant (> 0.05). (Table 4)

6. Post-test measures of HDL, LDL, TG, TC and FBG between FRT and AEROBIC Training group. In which the mean of HDL is greater in Aerobics (43.5) than FRT (41.66), LDL is greater in FRT (123.66) than Aerobics (103.5), TG is greater in FRT (98.33) than Aerobics (67.75), TC is greater in FRT (191.66) than Aerobics (169.5) and FBG is greater in Aerobics (91.75) than FRT (90.5).

6. DISCUSSION

Exercises are the drug free. cheap mode of training to alter the metabolic parameters in obese population. So, this study was designed to compare the benefits of functional resisted training and Aerobics among obese women.

In this study out of 24 women identified with obesity only 11 were willing to participate and rest 13 were not ready to take part in research, the main barriers that they reported through their words are lack of confidence, fear of body pain, fear of injury, lack of support of family members, feeling lazy to exercise, not sure whether will be able to follow the diet.

HDL

The results of this six weeks training program constitute FRT for one group and Aerobic exercises for the other. FRT and aerobics had not shown any statistical difference between pretest and posttest values of HDL($p>0.05$). HDL otherwise known as good cholesterol has the important role of sending lipids back to liver for recycling by increasing cholesterol acyl trans known as “reverse cholesterol transport”[36,37].

Annoying evidence here is all the 10 subjects have HDL values in range of 40-50 mg/dl which shows a high risk at this young age of 19-25 years which is quite alarming. Nearing 10% of total population studied (340 subjects) fall in class I &II obesity in this young age which should be given special care.

In FRT group ,there were 4 subjects of class I obesity found to have intermediate levels of HDL(40-60 mg/dl) among which 2 subjects got increase in level and other two got a decline in levels pot training and diet .The other two subjects of this group were one in class I and other in class II obesity and they both are found to have high level (<40 mg/dl) of HDL values ,post intervention there was a reduction in HDL values in class II obesity and other remained with no change. So intermediate level of HDL and class I obesity is found to have a better benefit in HDL values after Functional resisted training.

This result goes in hand with Prabakaran et al concluded that low to moderate intensity resistance training is found to have better influence on lipid profile[38]. Vatani et al in contradictory to this study results proposed a definite decrease in HDL after six weeks of resistance training program[39].

In Aerobics group, three subjects were found to have intermediate values of HDL,in which 2 fall in to Class I obesity and I in Class II obesity,High values of HDL is found in one subject and she is in class I obesity. Post aerobic and diet intervention there is no significant changes in HDL values ($p>0.05$).

Halverstadt A proposed a significant reduction in HDL values after 24 weeks of endurance exercise training independent of diet[40]. Also, a research quotes that training at 85%HRMAX aerobic training for a period of 10 weeks produce a significant change in HDL level.

These results may not be statistically significant, but clinically out of 6 sample 2 sample has found to have elevated HDL after 6 weeks of FRT and in aerobics out of 5 sample, one dropped out due to lack of time and in rest only two reported elevations in HDL levels which can be explained by small sample size and duration of training protocol.

LDL

Six weeks of FRT or Aerobic training had not shown statistically significant reduction of LDL in posttest measures ($p>0.05$). LDL is type of lipoprotein which takes the cholesterol to various body parts and deposit the excess cholesterol in arterial wall which will increase the risk of cardiovascular complications[41]. In FRT group,3 is found to have intermediate levels and 3 were found to have optimal level of LDL levels where as in Aerobics group one is found with high level and other three subjects are found with optimal levels of LDL.

Six weeks training of aerobics or FRT had shown an increase in LDL levels. In FRT group there was an increase in LDL in three subjects, one shown a reduction of LDL and one has not shown with any change. In Aerobics group two subjects had shown an increase and two subjects had shown a reduction in LDL values. In both the groups an interesting correlation exist

,there was an increase in LDL values when there is a reduction or no change in weight where as in subjects who had a gain in weight found to have reduced LDL values post exercise sessions of FRT or Aerobics. Limitation of this study is the size of the LDL particle is not measured,small dense LDL particles are more related with heart disease and this increase in LDL measures of this day does not say about the size of the particles[42].

Varady et al concluded that even after aerobic training of few month LDL may not be decreases, but the small dense LDL particles would have reduced whereas there might be an increase in average size of LDL particle[43].

Also, few studies quote that LDL particle size changes only after 24 weeks of training and this study has only 6 weeks of training and also moderate intensity training (60-75% of HR max) been targeted here but few research says more than 75% produces changes in LDL.

Physiologically cholesterol levels rise while there is a reduction in weight as fat cells shrink which causes fat and cholesterol to be displaced. Thus, they get released in to blood stream which shows a high cholesterol level. This strongly support this study results where there is an increase in LDL values with a reduction in weight in both the groups. Diet would not have influenced the increase in LDL as we had followed high carbohydrate and low cholesterol diet.

TG

Triglycerides is the variable that has reduced well in both the groups even though the post test results had not shown an statistical significant difference in both the groups ($p>0.05$).All 4 subjects were found to have normal triglycerides value in aerobics group while in FRT 4 subjects were fund with normal and one with intermediate and one with high TG values.

In FRT group except one all other 5 subjects have a drastic lowering of TG levels ranging from 3 to 50 mg/dl where as in Aerobics group, TG was reduced only in 2 subjects among four.

Unused calories are stored in the body in form of triglycerides to allow body to use in time of need. But very high triglycerides causes hardening of arteries which would eventually lead to cardiovascular and cerebrovascular diseases. BMI and TG value reduction are not corresponding which shows the effect of exercises on Triglyceride values.

Wang y shen said that aerobic exercises improves the lipid profile by reducing triglycerides. Apolipoprotein c3 is found to reduce TG lipoprotein, so high apoc3 is correlated with reduced TG hydrolysis.Aerobic exercises target this protein and bring it down which indirectly cause a reduction in values of TG.This explains a clinical significant reduction in TG after six weeks of aerobic training[44].

Staron et al concluded that resistance training increases oxidative capacity, fat oxidation and mitochondria[45]. Texeria discussed that FRT shows a very great effect over TG ,it may be due to the fact that FRT increases the total energy expenditure as they involves more of functional movement with major muscle groups in the body working. Which contributes to the improvement in fitness level[46].

TC

In this study,three subjects are with normal or optimal TC values where as other 3 found to have intermediate values where as in Aerobics group 3 subjects were found to have normal value where as one found to have intermediate values of TC. There exist no statistical significant difference between pretest and posttest in both groups after training ($p>0.05$).

Leon et al said that total cholesterol remains unchanged even after 12 weeks of aerobic training which is in concordance with the result of this study[47].An interesting note is TG is elevated in all the subjects for whom LDL was found raised after both the training. This may be explained by exchange of ester and lipoproteins to HDL marks the change in total cholesterol, thus in this study as LDL is found to get elevated and less change to HDL happens which marks the change in TC similar to LDL.

FBG

All subjects in both the group had normal blood glucose level except for one who had high fasting blood sugar and she was in Aerobics group. There was no statistically significant difference among pretest and posttest measures of FBG in both groups($p>0.05$).

FBG values reduced for all in Aerobics group while in FRT group three subjects reported reduction,2 reported increase and one reported no change in FBG values after 6 weeks of respective training. Jenkins et al concluded that there was a rise in fasting blood glucose level after six month of aerobic training which is in quite contradictory to this result study.

Resisted exercises increase the muscle mass thus usage of glucose is increased and need for more insulin is also reduced.

BMI & WHR

There is no statistical difference between pretest and posttest measure of Body Mass Index and Waist Hip Ratio($p>0.05$). This can be explained by the fact that resisted exercise results in fat mass reduction, muscle hypertrophy due to increased fat oxidation. Thus, BMI and HR stand as a weak outcome measure as they include muscle mass only as assessment.

On individual basis, out of 6 subjects 4 subjects (67%) shown a reduction in BMI in FRT group where as in Aerobics group 3 out of 4(75%) had shown a reduction in BMI, where as in WHR there is a good outcome post FRT with reduction in measurements in 5 subjects out of 6 (83%) and in Aerobics groups two showed a measurement reduction out of 4 subjects (50%).

SBP&DBP

Systolic and Diastolic Blood pressure of the subjects were mostly found be normal values with except for one who is found with increased systolic blood pressure. There is no statistically significant difference between pre and posttest values of SBP&DBP post FRT OR Aerobic training($p>0.05$).

The increase in blood pressure is highly related with sympathetic overactivity and extra load placed over the heart which is quite common among overweight and obese females. In FRT group systolic and diastolic blood pressure values reduced in 4 subjects (1-8 mmHg SBP/ 5-19 mmHg DBP) and increased in 2 subjects which bought their blood pressure level normal. In Aerobics group three subjects showed an increase in blood pressure and one showed a reduction but totally all the subjects were normalized nearing 120/80 mm Hg.

Between groups there is no significant difference between groups in measures of HDL, LDL, TG, TC, FBG, BMI, WHR, and SBP&DBP. So far, many studies have found the effect of aerobics over cardio metabolic parameters but to our knowledge no study has found the effect of functional resisted training on cardio metabolic parameters in young obese women. Although no statistical significant results can be identified in any of the parameters, clinically FRT proves to be the best for LDL, TG, BP, whereas Aerobics was found to have a better benefit on FBG.

According to effect size calculation FRT is found to have a trivial effect over HDL (0.16),LDL(0.22),TC(0.19),FBG(0.12),WHR(0.19),DBP(0.06) whereas moderate effect over TG(0.38),BMI(0.38),SBP(0.35).

The limitations of this study were small sample size, duration of the study,Most of the research had said that LDL changes need three months of training,Diet advices are not followed properly which is next major limitation of the study.Future studies can be planned to do for a longer duration and also the outcome LDL particle size can also be determined.

The Functional resisted training was found to have produces a better improvement in TG and BMI which is quite important and shows to be of great benefit in managing obesity. Although this study had not yielded a statistically significant result in proving FRT efficiency, subjects found FRT training fulfilled and strong adherence and no drop out was noted in this group and also ease of providing training for more people at same time is yet another positive note to add.

7. CONCLUSION

This study shows no significant difference in effect of Functional Resistance Training over Aerobic training on cardiometabolic parameters in obese young women.

Clinical Significance

FRT is found to be clinically effective in BMI and WHR, thus quite beneficial in improving obesity. Future studies with longer duration can bring a better understanding of Functional Resistance Training which the patient found comfortable to exercise for prolonged time and had less fatigue too.

List of Abbreviations

FRT – Functional resistance training

AT – Aerobic training

BMI – body mass index

WHR – waist hip ratio

HDL - High Density Lipoprotein

LDL - Low Density Lipoprotein

TG - Triglycerides

TC - Total cholesterol

FBG - Fasting Blood Glucose

SBP - Systolic Blood pressure

DBP - Diastolic Blood pressure

BP – blood pressure

HRMAX – heart rate maximum

IPAQ- international physical activity questionnaire

REFERENCES

[1] Laskowski E. The effect of exercise in the treatment of obesity. Ann Phys Rehabil Med. 2018 Jul 1;61:e396.

[2] WHO. Health Topics: Obesity [Internet]. 2019

[3] Obesity Definition | Obesity Prevention Source | Harvard T.H. Chan School of Public Health [Internet].

[4] Niemiro GM, Rewane A, Algotar AM. Exercise and Fitness Effect on Obesity. 2023 Nov 17. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan–. PMID: 30969715.Statistics NC for H. Health, United States, 2016, with chartbook on Long-term trends in health. 2017

[5] Chooi YC, Ding C, Magkos F. The epidemiology of obesity. Metabolism. 2019 Mar;92:6-10. doi: 10.1016/j.metabol.2018.09.005. Epub 2018 Sep 22. PMID: 30253139.

[6] Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. Diabetes Metab Syndr. 2019 Jan-Feb;13(1):318-321. doi: 10.1016/j.dsx.2018.08.032. Epub 2018 Sep 21. PMID: 30641719..

[7] Venkatrao M, Nagarathna R, Majumdar V, Patil SS, Rathi S, Nagendra H. Prevalence of Obesity in India and Its Neurological Implications: A Multifactor Analysis of a Nationwide Cross-Sectional Study. Ann Neurosci. 2020 Jul;27(3-4):153-161. doi: 10.1177/0972753120987465. Epub 2021 May 29. PMID: 34556954; PMCID: PMC8455012.

[8] Engin A. The Definition and Prevalence of Obesity and Metabolic Syndrome. Adv Exp Med Biol. 2017;960:1-17. doi: 10.1007/978-3-319-48382-5_1. PMID: 28585193.

[9] Han TS, Lean ME. A clinical perspective of obesity, metabolic syndrome and cardiovascular disease. JRSM Cardiovasc Dis. 2016 Feb 25;5:2048004016633371. doi: 10.1177/2048004016633371. PMID: 26998259; PMCID: PMC4780070.

[10] Bhaskaran K, Douglas I, Forbes H, dos-Santos-Silva I, Leon DA, Smeeth L. Body-mass index and risk of 22 specific cancers: a population-based cohort study of 5·24 million UK adults. Lancet. 2014 Aug 30;384(9945):755-65. doi: 10.1016/S0140-6736(14)60892-8. Epub 2014 Aug 13. PMID: 25129328; PMCID: PMC4151483.

[11] Petridou A, Siopi A, Mougios V. Exercise in the management of obesity. Metabolism. 2019 Mar;92:163-169. doi: 10.1016/j.metabol.2018.10.009. Epub 2018 Oct 29. PMID: 30385379.

[12] Sword, David O. PT, DPT, CSCS. Exercise as a Management Strategy for the Overweight and Obese: Where Does Resistance Exercise Fit in?. Strength and Conditioning Journal 34(5):p 47-55, October 2012

[13] Feito Y, Patel P, Sal Redondo A, Heinrich KM. Effects of Eight Weeks of High Intensity Functional Training on Glucose Control and Body Composition among Overweight and Obese Adults. Sports (Basel). 2019 Feb 22;7(2):51. doi: 10.3390/sports7020051. PMID: 30813279; PMCID: PMC6409795.

[14] La Scala Teixeira CV, Caranti DA, Oyama LM, Padovani RDC, Cuesta MGS, Moraes ADS, Cerrone LA, Affonso LHL, Gil SDS, Dos Santos RVT, Gomes RJ. Effects of functional training and 2 interdisciplinary interventions on maximal oxygen uptake and weight loss of women with obesity: a randomized clinical trial. Appl Physiol Nutr Metab. 2020 Jul;45(7):777-783. doi: 10.1139/apnm-2019-0766. Epub 2020 Jan 23. PMID: 31971832.

[15] Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. Diabetes Metab Syndr. 2019 Jan-Feb;13(1):318-321. doi: 10.1016/j.dsx.2018.08.032. Epub 2018 Sep 21. PMID: 30641719.

[16] Ruiz-García A, Arranz-Martínez E, Morales-Cobos LE, García-Álvarez JC, Iturmendi-Martínez N, Rivera-Teijido M; en representación del Grupo de Investigación del Estudio SIMETAP. Prevalence rates of overweight and obesity and their associations with cardiometabolic and renal factors. SIMETAP-OB study. Clin Investig Arterioscler. 2022 Nov-Dec;34(6):291-302. English, Spanish. doi: 10.1016/j.arteri.2022.03.006. Epub 2022 May 23. PMID: 35618556.

[17] Pasco JA, Nicholson GC, Brennan SL, Kotowicz MA. Prevalence of obesity and the relationship between the body mass index and body fat: cross-sectional, population-based data. PLoS One. 2012;7(1):e29580. doi: 10.1371/journal.pone.0029580. Epub 2012 Jan 13. PMID: 22253741; PMCID: PMC3258232.

[18] Arroyo-Johnson C, Mincey KD. Obesity Epidemiology Worldwide. Gastroenterol Clin North Am. 2016

Dec;45(4):571-579. doi: 10.1016/j.gtc.2016.07.012. PMID: 27837773; PMCID: PMC5599163.

[19] Kovesdy CP, Furth SL, Zoccali C; World Kidney Day Steering Committee. Electronic address: myriam@worldkidneyday.org; World Kidney Day Steering Committee. Obesity and kidney disease: hidden consequences of the epidemic. Kidney Int. 2017 Feb;91(2):260-262. doi: 10.1016/j.kint.2016.10.019. Epub 2016 Dec 20. PMID: 28010887.

[20] Park HY, Jung WS, Kim SW, Jung K, Lim K. Comparison of Vascular Function, Cardiometabolic Parameters, Hemorheological Function, and Cardiorespiratory Fitness Between Middle-Aged Korean Women With and Without Obesity-A Pilot Study. Front Physiol. 2022 Mar 29;13:809029. doi: 10.3389/fphys.2022.809029. PMID: 35422707; PMCID: PMC9002013.

[21] Ferreira JRD, Aleluia MM, Figueiredo CVB, Vieira LCL, Santiago RP, da Guarda CC, Barbosa CG, Oliveira RR, Adorno EV, Gonçalves MS. Evaluation of Cardiometabolic Parameters among Obese Women Using Oral Contraceptives. Front Endocrinol (Lausanne). 2017 Sep 29;8:256. doi: 10.3389/fendo.2017.00256. PMID: 29033897; PMCID: PMC5626867.

[22] Bondyra-Wiśniewska B, Myszkowska-Ryciak J, Harton A. Impact of Lifestyle Intervention Programs for Children and Adolescents with Overweight or Obesity on Body Weight and Selected Cardiometabolic Factors-A Systematic Review. Int J Environ Res Public Health. 2021 Feb 20;18(4):2061. doi: 10.3390/ijerph18042061. PMID: 33672502; PMCID: PMC7923753.

[23] Bobbioni-Harsch E, Pataky Z, Makoundou V, Laville M, Disse E, Anderwald C, Konrad T, Golay A; RISC Investigators. From metabolic normality to cardiometabolic risk factors in subjects with obesity. Obesity (Silver Spring). 2012 Oct;20(10):2063-9. doi: 10.1038/oby.2012.69. Epub 2012 Mar 16. PMID: 22421925.

[24] Burgos MS, Reuter CP, Possuelo LG, Valim AR, Renner JD, Tornquist L, Tornquist D, Gaya AR. Obesity parameters as predictors of early development of cardiometabolic risk factors. Cien Saude Colet. 2015 Aug;20(8):2381-8. doi: 10.1590/1413-81232015208.11672014. PMID: 26221803.

[25] La Scala Teixeira CV, Caranti DA, Oyama LM, Padovani RDC, Cuesta MGS, Moraes ADS, Cerrone LA, Affonso LHL, Gil SDS, Dos Santos RVT, Gomes RJ. Effects of functional training and 2 interdisciplinary interventions on maximal oxygen uptake and weight loss of women with obesity: a randomized clinical trial. Appl Physiol Nutr Metab. 2020 Jul;45(7):777-783. doi: 10.1139/apnm-2019-0766. Epub 2020 Jan 23. PMID: 31971832.

[26] Stavres, J.; Zeigler, M. P.; Bayles, M. P. Six Weeks of Moderate Functional Resistance Training Increases Basal Metabolic Rate in Sedentary Adult Women. *International journal of exercise science* **2018**, *11* (2), 32–41. https://doi.org/10.70252/fnik8317.

[27] Neves LM, Fortaleza AC, Rossi FE, Diniz TA, de Castro MR, de Aro BL, Freitas IF Jr. Efeito de um programa de treinamento funcional de curta duração sobre a composição corporal de mulheres na pós-menopausa [Effect of a short-term functional training program on body composition in postmenopausal women]. Rev Bras Ginecol Obstet. 2014 Sep;36(9):404-9. Portuguese. doi: 10.1590/so100-720320140005073. PMID: 25272361.

[28] Liao T, Li L, Wang YT. Effects of Functional Strength Training Program on Movement Quality and Fitness Performance Among Girls Aged 12-13 Years. J Strength Cond Res. 2019 Jun;33(6):1534-1541. doi: 10.1519/JSC.0000000000002190. PMID: 31125325.

[29] Suntisawee, S., Kritpet, T., Phongphibool, S., & Himathongkam, T. (2021). The Effects of Functional Exercise Training on Obesity with Impaired Glucose Tolerance. *Sport Mont*, *19*(3), 27-34. doi: 10.26773/smj.211007

[30] Westphal, G.; Baruki, S. B. S.; Mori, T. A. de; Montebello, M. I. de L.; Pazzianotto-Forti, E. M. Effects of Individualized Functional Training on the Physical Fitness of Women with Obesity. *Lecturas: Educación Física y Deportes* **2020**, *25* (268), 61–75. https://doi.org/10.46642/efd.v25i268.2084.

[31] Al Saif A, Alsenany S. Aerobic and anaerobic exercise training in obese adults. J Phys Ther Sci. 2015 Jun;27(6):1697-700. doi: 10.1589/jpts.27.1697. Epub 2015 Jun 30. PMID: 26180300; PMCID: PMC4499963.

[32] Berge J, Hjelmesæth J, Kolotkin RL, Støren Ø, Bratland-Sanda S, Hertel JK, Gjevestad E, Småstuen MC, Helgerud J, Bernklev T. Effect of aerobic exercise intensity on health-related quality of life in severe obesity: a randomized controlled trial. Health Qual Life Outcomes. 2022 Feb 24;20(1):34. doi: 10.1186/s12955-022-01940-y. PMID: 35209911; PMCID: PMC8876087.

[33] Said MA, Abdelmoneim MA, Alibrahim MS, Kotb AAH. Aerobic training, resistance training, or their combination as a means to fight against excess weight and metabolic syndrome in obese students - which is the most effective modality? A randomized controlled trial. Appl Physiol Nutr Metab. 2021 Aug;46(8):952-963. doi: 10.1139/apnm-2020-0972. Epub 2021 Feb 25. PMID: 33630712.

[34] Farbod, Maryam. Short Term Aerobic Training Improves Fasting Glucose and Beta Cell Function in Obese/Overweight Women. (2014).

[35] Calabresi L, Franceschini G. Lecithin:cholesterol acyltransferase, high-density lipoproteins, and atheroprotection in humans. Trends Cardiovasc Med. 2010 Feb;20(2):50-3. doi: 10.1016/j.tcm.2010.03.007. PMID: 20656215.

[36] Mann S, Beedie C, Jimenez A. Differential effects of aerobic exercise, resistance training and combined exercise modalities on cholesterol and the lipid profile: review, synthesis and recommendations. Sports Med. 2014 Feb;44(2):211-21. doi: 10.1007/s40279-013-0110-5. PMID: 24174305; PMCID: PMC3906547.

[37] Prabhakaran B, Dowling EA, Branch JD, Swain DP, Leutholtz BC. Effect of 14 weeks of resistance training on lipid profile and body fat percentage in premenopausal women. Br J Sports Med. 1999 Jun;33(3):190-5. doi: 10.1136/bjsm.33.3.190. PMID: 10378072; PMCID: PMC1756170.

[38] Sheikholeslami Vatani D, Ahmadi S, Ahmadi Dehrashid K, Gharibi F. Changes in cardiovascular risk factors and inflammatory markers of young, healthy, men after six weeks of moderate or high intensity resistance training. J Sports Med Phys Fitness. 2011 Dec;51(4):695-700. PMID: 22212275.

[39] Halverstadt A, Phares DA, Wilund KR, Goldberg AP, Hagberg JM. Endurance exercise training raises high-density lipoprotein cholesterol and lowers small low-density lipoprotein and very low-density lipoprotein independent of body fat phenotypes in older men and women. Metabolism. 2007 Apr;56(4):444-50. doi: 10.1016/j.metabol.2006.10.019. PMID: 17378998.

[40] Vella CA, Kravitz L, Janot JM. A review of the impact of exercise on cholesterol levels. IDEA Health & Fitness Source. 2001 Nov 1;19(10):48-54.

[41] Surampudi V, Biggs K, Li Z. Weight loss and transient LDL increase (P12-057-19). Current Developments in Nutrition. 2019 Jun;3(Supplement_1):nzz035-P12.

[42] Varady KA, St-Pierre AC, Lamarche B, Jones PJ. Effect of plant sterols and endurance training on LDL particle size and distribution in previously sedentary hypercholesterolemic adults. Eur J Clin Nutr. 2005 Apr;59(4):518-25. doi: 10.1038/sj.ejcn.1602106. PMID: 15674305.

[43] Wang Y, Shen L, Xu D. Aerobic exercise reduces triglycerides by targeting apolipoprotein C3 in patients with coronary heart disease. Clin Cardiol. 2019 Jan;42(1):56-61. doi: 10.1002/clc.23104. Epub 2018 Dec 21. PMID: 30511426; PMCID: PMC6436502.

[44] Stavres J, Zeigler MP, Bayles MP. Six Weeks of Moderate Functional Resistance Training Increases Basal Metabolic Rate in Sedentary Adult Women. International journal of exercise science [Internet]. 2018 Jan 1;11(2):32–41.

[45] Teixeira CV, Caranti DA, Oyama LM, da Costa Padovani R, Cuesta MG, dos Santos Moraes A, Cerrone LA, Affonso LH, dos Santos Gil S, Dos Santos RV, Gomes RJ. Effects of functional training and 2 interdisciplinary interventions on maximal oxygen uptake and weight loss of women with obesity: a randomized clinical trial

[46] Leon AS, Sanchez OA. Response of blood lipids to exercise training alone or combined with dietary intervention. Med Sci Sports Exerc. 2001 Jun;33(6 Suppl):S502-15; discussion S528-9. doi: 10.1097/00005768-200106001-00021. PMID: 11427777.

[47] Misra A, Alappan NK, Vikram NK, Goel K, Gupta N, Mittal K, Bhatt S, Luthra K. Effect of supervised progressive resistance-exercise training protocol on insulin sensitivity, glycemia, lipids, and body composition in Asian Indians with type 2 diabetes. Diabetes Care. 2008 Jul;31(7):1282-7. doi: 10.2337/dc07-2316. Epub 2008 Mar 3. PMID: 18316394; PMCID: PMC2453659.