IMPACT OF AEROBIC EXERCISE ON OBESITY AMONG FEMALE UNDERGRADUATES OF LADOKE AKINTOLA UNIVERSITY OF TECHNOLOGY, OGBOMOSO, NIGERIA

ABSTRACT

Introduction: According to the World health organization, obesity is an abnormal or excessive fat accumulation which impairs health, and is caused by imbalance between calories intake and calories expended. In the 21st century, overweight and obesity were only problems of developed countries which have increased due to sedentary life styles, behavioral changes, and genetic modifications. Obesity is dominating as a global epidemic as it increases risk of human life which is directly related to some diseases such as hypertension, cardiovascular diseases, musculoskeletal disorders, certain cancer types and diabetes. Hence the need for effective solution for obesity has led to the recommendation of aerobic exercises that help in weight reduction via increasing the body's ability to utilize oxygen efficiently. This study aimed to evaluate the effect of aerobic exercise on obesity and weight management body in female obese subjects (undergraduates) of Ladoke Akintola University of Technology Ogbomoso.

Forty (40) female obese subjects were randomly selected for this study. Subjects were undergraduate students from Ladoke Akintola University of Technology (LAUTECH), within the age range of about (18-30) years. All subjects signed the written consent form prior to the study and health status questionnaire to gather demographic information and data on lifestyle for the study. The subjects were randomly grouped into 2 (n=20); Control group that did not perform any exercise and experimental group that performed aerobic exercise with 60% exercise intensity according to the 'Karovonen' formulae for 50minutes daily which lasted for 3 days and for 50minutes weekly which lasted for 8weeks.

Pre- and post- anthropometric measurement (body weight, height, body mass index, circumferential and skinfold measurements), cardiovascular characteristics (heart rate and blood pressure), and biochemical assays [blood glucose level, triglyceride, cholesterol, low density lipo-protein and high density lipo-protein] were done on both control and experimental subjects to assess the effect of aerobic exercise on obesity. Statistical analysis of data was done using SPSS to determine the mean and the standard deviation, T-test was done to determine *P*-value, which was set as $P<0.05$ which determine the level of significant in the two groups.

The control group maintains its average body weight of 80.80 kg, height of 1.622m and BMI of 30.75; blood pressure and heart rate of control subjects of 134.1/73.20mmHg and 72beat/minute; average blood glucose level of (112.6±12.04); lipid profile levels, circumferential and skinfold measurement throughout the study. However, experimental group showed significant reduction in: the average body weight and BMI of experimental subjects from 86.25kg and 33.00kg/m^2 to 77.65and 29.45 respectively (p=0.000001 and 0.000014), Blood pressure from 133.1/73.40mmHg to 115.1/64.25mmHg (p=0.00017), the average blood glucose level from 111.0/dl to 80.70g/dl (p=0.000001), [LDL, TRIG, and Cholesterol levels] (p=0.000001), circumferential and skinfold measurement and of certain body parts at the end of the aerobic exercise and when compared to control subjects ($p<0.05$).

Conclusion: Aerobic exercise significantly reduces body excess compositions, blood glucose level, body mass index, blood pressure lipid profile except for high density lipo-protein, showing that aerobic exercise is of great health benefit.

Key words: Aerobic exercise, heart rate and blood pressure, body compositions, obesity.

INTRODUCTION

Obesity is a condition characterized by accumulation of excessive amount of body fat beyond the biological need of an individual. Obesity is a principle public health concern ranked as the fifth foremost reasons for global mortality (WHO, 2016). From the last 40years, obesity is dominating as a global epidemic and is raising non communicable diseases such as type 2 diabetes, hypertension, metabolic syndrome, certain type of cancer and cardiovascular diseases that threaten human health globally (Lee *et al.*; 2013). In 2017 more than 15% of deaths were related to obesity in many developing countries such as Eastern Europe, Central Asia, North Africa and western Africa and Latin America. Obesity is a manifestation of a positive energy balance that has been sustained over an extended period of time. Although, human genome has not changed substantially; but the rise in obesity most likely reflects changes in the environment and/or behavior. In the 20st century overweight and obesity were only problems of developed countries but in the 21st century ,these are increased in lower developed and developing countries due to the popularity of junk foods, changing lifestyles, increasing incomes, urbanization and aggressive marketing (Ng and Popkin, 2012). Mechanization has impinged upon our modes of living in diverse ways and energy expenditure required for daily living has consequently declined. A recent study showed that in the US, daily energy expenditure due to work related physical exercise has decreased by more than 100 kcal during last 50 years in both men and women, and this reduction is associated with the increase in mean body weight during this time frame (Church *et al.,* 2005). Similar trends have also been observed in Finland, where daily energy expenditure during work reportedly decreased by more than 50 kcal between 1982 and 1992 (Fogelholm *et al.,* 1996). Substantial reductions in daily energy expenditure have also occurred in developing countries such as China and Brazil, which have the highest absolute and relative rates of decline in total energy expenditure due to restrictions of movement at work (Ng and Popkin, 2012). Based on these reports, it is believed that the obesity epidemic has also penetrated the low-income countries, particularly in the urban areas, and will continue to spread for the foreseeable future (Prentice, 2006).

Thus, there is a need to reverse this modern epidemic and public health actions to reduce obesity have mostly advised obese individuals to eat healthier and to exercise more. However, these approaches are failing as not a single country has succeeded in reducing obesity rates in the past 30 years (Ng *et al.,* 2014). It is yet to be determined whether this is due to failure to restrict energy intake or to maintain high levels of energy expenditure (Blair *et al.,* 2013; Hill and Peters, 2013; Luke and Cooper, 2013). Domestic mechanization of daily tasks (use of labor-saving devices such as washing machines and dishwashers) has reduced energy expenditure over the years (Archer *et al.,* 2013). Domestic mechanization has also contributed to increased sedentariness, as time spent in house work has been replaced by sedentary activities such as watching television, and the use of smart phones and computers (Archer *et al.,* 2013). Passive transportation has also been linked to be a major cause of excessive weight gain (Thorp *et al.,* 2011; Rhodes *et al.,* 2012; McCormack *et al.,* 2014). Participation in leisure-time physical activity (LTPA) on a secular basis with unhealthy eating habit are not enough to offset sedentary behavior (Ng and Popkin, 2012). Hence the need for effective solution for obesity has led to the recommendation of aerobic exercises that help in weight reduction. Aerobic exercise, a type of physical activity involves the continuous and rhythmic movement of large muscle groups to improve the efficiency of the cardiovascular and respiratory systems in delivering oxygen to the body (Stasiulis *et al*., 2004). Types of aerobic exercise include; walking, jogging, swimming, skipping and cycling. These physical activities enable rapid breathing, rapid heartbeat and sweating to increase the body's ability to utilize oxygen efficiently. In this study, the role of aerobic exercise in obesity and weight management was explored.

MATERIALS AND METHOD

Materials and chemicals

Yoga mat, bicycle ergometer, skipping rope, treadmill, multi-gym equipment, hand grip exerciser, Avery-weighing machine, measuring tape, meter rule, automatic blood pressure monitor, centrifuge machine, micro pipette, test tubes, needle and syringe, hand gloves, methylated spirit and cotton wool.

Study Area

This research study was carried out in the sport and exercise gym of the department of physiology, faculty of Basic Medical Sciences, Ladoke Akintola University of Technology.

Ethical Approval

Ethical Approval was obtained from the Ministry of Health Agodi, Ibadan, Oyo state, with Ethical Research Approval Number: **NHREC/OYOSHRIEC/10/11/22**

Subjects

Forty (40) female obese subjects were randomly selected for this study. Subjects were undergraduate students from Ladoke Akintola University of Technology (LAUTECH), within the age range of about (18-30) years. All subjects were aware of the risk and requirement of participating in the study and they all signed the written consent form prior to the study. The subjects filled health status questionnaire to gather demographic information, as well as data on lifestyle for the study. With the use of health status questionnaire and physical examination, individuals with underlying heart, lungs, and systemic diseases were excluded. Alcoholics and cigarette smokers were also excluded.

Subject Grouping

Forty obese female subjects were randomly grouped into 2 (n=20):

Group 1: Control group: The subjects in this group did not perform any exercise.

Group 2: Experimental group: The subjects in this group performed aerobic exercise with 60% exercise intensity according to the 'Karovonen' formulae for 50minutes daily which lasted for 3 days (Willis *et al.*, 2012) and for 50minutes weekly which lasted for 8weeks (Aghaei *et al.*, 2018). The subjects were dressed in sports kits so as to aid easiness of performing the exercise.

Upon their arrival to the laboratory, they were made to sit for 10minutes to normalize their heart rate and blood pressure, after which the physical characteristics and the cardiovascular characteristics of the experimental and control subjects were taken before the experimental subject began exercising.

Aerobic Exercise Types

The aerobic exercises carried out in this study include: Yoga, cycling, skipping, running and grip strength training. The subjects were monitored when carrying out the exercise to ensure adherence to the exercise regimen

Pre- and Post- Anthropometric Measurement of Subjects

1. ***Body Mass Index (BMI)***

Body Mass Index (BMI), is a measure of body fat based on height and weight is calculated by the use of this formula (WHO, 2008):

BMI=weight (kg)/ height^2 (m)

i. ***Height Measurement***

The standing position of the subjects was measured in meter on a Stadiometer [accuracy of 0.01m] with bare feet, person looking straight ahead, positioning the head in the Frankfort plane, with relaxed shoulders, the scapula, buttocks and heels should be touching the wall, arms on each side of the body, legs straight and together to face.

ii. ***Body Weight Measurement***

Body weight of the subjects (in kg) was measured using weighing scale with a precision of ±0.1kg. The subject was allowed to stand on the weighing scale with bare feet and face up for full body weight measurement.

2. ***Circumferential Measurement***

The burst, chest, abdomen, hip, thigh (right and left), calf (right and left), upper arm (right and left), lower arm (right and left) was measured in inches with a non-elastic tape rule.

3. ***Skinfold Measurement***

The thickness of skinfold of the biceps (right and left), triceps (right and left), chest, abdomen, bi- iliac, sub-scapular, inner thigh (left and right) and calf (left and right) was measured in millimeter with a digital caliper. Anthropometric measurement like circumferential measurement and skinfold measurement were conducted for both experimental and control for pre-test and post-test.

Calculation of exercise intensity in participants

Exercise intensity and target heart rate was calculated using the 'Karovonen' formula (Karovonen *et al*., 1957): Target Heart Rate = [(max HR − resting HR) × %Intensity] + resting HR. (Exercise intensity= 60%)

Cardiovascular characteristics

Pre- and post- Heart rate and blood pressure was measured using a digital sphygmomanometer (Omron Automatic Digital Sphyg.) while the subject is in sitting position and cuff tied round the arm at 4cm above the cubital fossa.

Sample Collection

A 2ml of blood were collected from both control and experimental subjects before performing exercise for biochemical determination (pre-test). The blood samples were collected into heparinized sample bottles, centrifuged at 3000R for 10minutes to obtain plasma that was collected into plain tubes for biochemical assays [blood glucose level, triglyceride, cholesterol, low density lipo-protein and high density lipo-protein]. After the last day of the exercise, biochemical analysis was done on the subject blood samples (post-test) similar to that of pre-test.

Method of Statistical Analysis

Data from all participants were analyzed using SPSS and were recorded as Means ± SD; while the T-test for paired samples was applied to test for differences on data obtained from aerobics exercise. The statistical level of significance was accepted at $p < 0.05$.

RESULTS

1. **Pre-test and post-test of physical characteristics (table 1a-d):** The control subjects maintain the average body weight of 80.80 kg, height of 1.622m and BMI of 30.75 throughout the study. However, table 2 shows a significant reduction in the average body weight and BMI of experimental subjects from 86.25kg and 33.00kg/m^2 to 77.65and 29.45 respectively (P=0.000001 and 0.000014) at the end of the aerobic exercise. Although, there was no significant difference in the BMI of control and experimental subjects, but there was a significant reduction in the average body weight of experimental subjects compared to control subjects (p=0.0364)
2. **Pre-test and post-test of cardiovascular function (table 2a-d)**: Blood pressure and heart rate of control subjects remain constant at 134.1/73.20mmHg and 72beat/minute throughout the study duration. Whereas, experimental subjects showed decreased Blood pressure from 133.1/73.40mmHg to 115.1/64.25mmHg (P<0.05) (P=0.00017) at the end of the aerobic exercise and constant heart rate of 72.40beat/minute. Compared to control subjects, experimental subjects showed decreased Blood pressure (P=0.000319) at the end of the aerobic exercise.
3. **Pre- and post-glucose test (table 3a-d):** There was no significant difference in the average blood glucose level of control subjects before (112.6±12.04) and after (110.2± 12.57) the study. On the contrary, the average blood glucose level of experimental subjects significantly decreased from 111.0/dl to 80.70g/dl at the end of the aerobic exercise and when compared with control subjects, p=0.000001.
4. **Pre- and post- training lipid profile (table 4a-d):** The control subjects show no significant difference in the lipid profile before and after the study. However, experimental subjects show significant increase in HDL at the end of the aerobic exercise (0.014563) and when compared to control subjects (0.000001), as well as a significant decrease in LDL, TRIG, and Cholesterol levels at the end of the aerobic exercise (p=0.000001) and when compared to control subjects (p=0.000001).
5. **Pre- and post- circumferential measurement (table 5a-d):** The control subjects show no significant difference in the circumferential measurement throughout the study duration. Nonetheless, experimental subjects show significant reduction in circumferential measurement of certain body parts at the end of the aerobic exercise and compared to control subjects (p<0.05).
6. **Pre- and post- skinfold measurement (table 6a-d):** The control subjects show no significant difference in the skinfold measurement throughout the study duration. However, experimental subjects show significant reduction in skinfold measurement of body parts with high subcutaneous tissue at the end of the aerobic exercise and compared to control subjects (p<0.05).

Table 1a: Pre-test of physical characteristics of control subjects

S/N	Age (yrs)	Weight (kg)	Height (m)	BMI (Kg/M^2)
1	18	85	1.70	29.41
2	24	75	1.57	30.42
3	24	91	1.61	35.10
4	18	82	1.55	34.13
5	19	72	1.62	27.43
6	20	80	1.65	29.38
7	27	75	1.60	29.29
8	19	73	1.54	30.74
9	25	78	1.67	27.96
10	20	85	1.66	30.84
11	20	84	1.56	34.51
12	25	79	1.67	28.32
13	19	85	1.54	35.84

Table 1b: Post-test of physical characteristics of control subjects

S/N	Age (yrs)	Weight (kg)	Height (m)	BMI (Kg/M^2)
1	18	85	1.70	29.41
2	24	75	1.57	30.42
3	24	91	1.61	35.10
4	18	82	1.55	34.13
5	19	72	1.62	27.43
6	20	80	1.65	29.38
7	27	75	1.60	29.29
8	19	73	1.54	30.74
9	25	78	1.67	27.96
10	20	85	1.66	30.84
11	20	84	1.56	34.51
12	25	79	1.67	28.32
13	19	85	1.54	35.84

14	27	80	1.69	28.01		14	27	80	1.69	28.01
15	20	80	1.65	28.68		15	20	80	1.65	28.68
16	19	87	1.62	33.15		16	19	87	1.62	33.15
17	18	82	1.65	30.11		17	18	82	1.65	30.11
18	24	90	1.61	34.63		18	24	90	1.61	34.63
19	24	73	1.57	29.61		19	24	73	1.57	29.61
20	18	80	1.70	27.68		20	18	80	1.70	27.68
Mean ±SD	**21.20± 3.139**	**80.80± 5.49**	**1.622± 0.0532**	**30.75± 2.776**		**Mean ±SD**	**21.20± 3.139**	**80.80± 5.49**	**1.622± 0.0532**	**30.75± 2.776**

Data were presented as mean ± standard deviation (SD)
Statistical significance set at p<0.05

Table 1c: Pre- test physical characteristic of experimental subjects **Table 1d: Post- test physical characteristic of experimental subjects**

S/N	Age (yrs)	Weight (kg)	Height (m)	BMI (Kg/M^2)		S/N	Age (yrs)	Weight (kg)	Height (m)	BMI (Kg/M^2)
1	27	88	1.67	31.56		1	27	80	1.67	28.68
2	22	90	1.51	39.47		2	22	82	1.51	35.96
3	24	85	1.58	34.04		3	24	70	1.58	28.04
4	19	86	1.67	30.83		4	19	80	1.67	28.68
5	19	90	1.66	32.66		5	19	80	1.66	30.48
6	24	81	1.61	31.24		6	24	75	1.61	28.93
7	27	90	1.66	32.66		7	27	80	1.66	29.03
8	18	75	1.56	30.81		8	18	70	1.56	28.76
9	19	80	1.59	31.64		9	19	75	1.59	29.66
10	24	85	1.67	30.47		10	24	75	1.67	26.89
11	28	82	1.62	31.24		11	28	76	1.62	28.95
12	23	79	1.56	32.46		12	23	70	1.56	28.76
13	20	85	1.58	34.04		13	20	75	1.58	30.04
14	27	90	1.66	32.66		14	27	82	1.66	29.75
15	24	81	1.61	31.24		15	24	70	1.61	27.00
16	22	90	1.62	34.29		16	22	85	1.62	32.38
17	26	95	1.67	34.06		17	26	87	1.67	31.19
18	29	98	1.68	34.72		18	29	87	1.68	30.82
19	29	90	1.51	39.41		19	29	80	1.51	28.56
20	27	85	1.67	30.47		20	27	74	1.67	26.53
Mean ±SD	**23.90± 3.567**	**86.25± 5.618**	**1.618± 0.0545**	**33.00± 2.586**		**Mean ±SD**	**23.90± 3.567**	**77.65± 5.489*#**	**1.618± 0.0545**	**29.45± 2.104***

Data were presented as mean ± standard deviation (SD)
**= statistically significant at p<0.05when compared with pre-test of experimental subjects*
#= statistically significant at p<0.05when compared with post-test of control subjects

Table 2a: Pre- test characteristics of blood pressure and heart rate of female obese control subjects **Table 2b: Post- test characteristics of blood pressure and heart rate of female obese control subjects**

S/N	SYSTOLIC BLOOD	DIASTOLIC BLOOD	RESTING HEART		S/N	SYSTOLIC BLOOD	DIASTOLIC BLOOD	RESTING HEART

	PRESSURE (mmHg)	PRESSURE (mmHg)	RATE (beat/minutes)
1	135	75	72
2	132	72	72
3	137	70	72
4	138	75	72
5	130	70	72
6	136	74	72
7	132	72	72
8	138	78	72
9	131	74	72
10	130	72	72
11	133	71	72
12	137	74	72
13	132	70	72
14	136	78	72
15	130	74	72
16	130	72	72
17	139	74	72
18	138	79	72
19	132	70	72
20	136	70	72
Mean ±SD	**134.1± 3.19**	**73.20± 2.821**	**72± 0.00**

	PRESSURE (mmHg)	PRESSURE (mmHg)	RATE (beat/minutes)
1	135	75	72
2	132	72	72
3	137	70	72
4	138	75	72
5	130	70	72
6	136	74	72
7	132	72	72
8	138	78	72
9	131	74	72
10	130	72	72
11	133	71	72
12	137	74	72
13	132	70	72
14	136	78	72
15	130	74	72
16	130	72	72
17	139	74	72
18	138	79	72
19	132	70	72
20	136	70	72
Mean ±SD	**134.1± 3.19**	**73.20± 2.821**	**72± 0.00**

Data were presented as mean ± standard deviation (SD)
Statistical significance set at $p<0.05$

Table 2c: Pre- test characteristics of blood pressure and heart rate of female obese experimental subjects

S/N	SYSTOLIC BLOOD PRESSURE (mmHg)	DIASTOLIC BLOOD PRESSURE (mmHg)	RESTING HEART RATE (beat/minutes)
1	135	73	72
2	130	72	72
3	133	72	79
4	138	75	72
5	132	70	72
6	136	77	72
7	137	75	72
8	130	74	72
9	139	74	72
10	138	75	72
11	139	70	72
12	130	72	72
13	132	71	72
14	133	74	73
15	134	72	73

Table 2d: Post- test characteristics of blood pressure and heart rate of female obese experimental subjects

S/N	SYSTOLIC BLOOD PRESSURE (mmHg)	DIASTOLIC BLOOD PRESSURE (mmHg)	RESTING HEART RATE (beat/minutes)
1	110	60	72
2	116	62	72
3	117	65	72
4	112	60	72
5	118	65	72
6	123	63	72
7	119	69	72
8	120	63	72
9	117	64	72
10	112	60	72
11	120	69	72
12	118	67	72
13	118	69	72
14	115	68	72
15	113	65	72

16	136	80	72		16	114	64	72
17	130	75	72		17	112	60	72
18	131	70	72		18	116	67	72
19	134	75	72		19	118	65	72
20	130	72	72		20	113	60	72
Mean ± SD	**133.1± 3.233**	**73.40± 2.521**	**72.40± 1.56**		**Mean ± SD**	**115.1± 3.364** $^{*\#}$	**64.25± 3.226** $^{*\#}$	**72± 0.00**

Data were presented as mean ± standard deviation (SD)

**= statistically significant at p<*0.05*when compared with pre-test of experimental subjects*

$^{\#}$*= statistically significant at p<*0.05*when compared with post-test of control subjects*

Table 3: the pre and post of blood glucose level of female obese control and experimental subjects

S/N	PRE GLUCOSE LEVEL OF CONTROL SUBJECTS (mmHg)	POST GLUCOSE LEVEL OF CONTROL SUBJECTS (mmHg)	PRE GLUCOSE LEVEL OF EXPERIMENTAL SUBJECTS (mmHg)	POST GLUCOSE LEVEL OF EXPERIMENTAL SUBJECTS (mmHg)
1	115.09	118.66	118.66	80.53
2	124.25	114.43	114.43	75.53
3	118.66	117.40	117.40	73.19
4	114.43	109.70	109.70	83.67
5	117.96	116.82	116.82	79.20
6	123.09	124.74	124.74	79.20
7	114.25	125.63	125.63	83.67
8	118.66	113.40	113.40	73.19
9	84.43	109.70	109.70	75.19
10	87.96	116.82	116.82	90.53
11	93.09	124.74	124.74	79.20
12	124.25	125.63	125.63	83.60
13	122.66	100.40	100.40	83.90
14	98.43	109.70	109.70	75.53
15	110.96	116.82	116.82	90.53
16	113.09	84.74	84.74	85.19
17	124.25	95.63	95.63	83.67
18	112.66	100.40	100.40	75.53
19	115.43	109.70	109.70	79.20
20	117.96	96.82	96.82	85.53
Mean± SD	**112.6± 12.04**	**110.2± 12.57**	**111.0± 11.66**	**80.70± 5.184** $^{*\#}$

Data were presented as mean ± standard deviation (SD)

**= statistically significant at p<*0.05*when compared with pre-test of experimental subjects*

$^{\#}$*= statistically significant at p<*0.05*when compared with post-test of control subjects*

Table 4a: Pre- and post-training Lipid profile of obese female control and experimental subjects

S/N	Control pre-HDL	Control post-HDL	Exp Pre-HDL	Exp Post-HDL	Control pre-LDLP	Control post-LDLP	Exp pre-LDLP	Exp post-LDLP
1	65.65	65.65	59.81	95.27	119.13	119.13	129.13	69.35

2	40.79	40.79	40.79	92.79	122.28	122.28	132.28	65.27
3	36.44	36.44	38.44	87.85	124.94	124.94	126.94	60.15
4	34.11	34.11	39.11	78.46	119.09	119.09	119.09	75.99
5	38.13	3 8.13	45.13	78.42	118.23	118.23	128.23	67.27
6	37.81	37.81	37.81	75.27	131.13	131.13	131.13	69.35
7	33.79	33.79	48.79	76.79	122.28	122.28	132.28	66.27
8	36.44	36.44	40.44	74.85	124.94	124.94	124.94	60.15
9	36.07	36.07	39.07	74.46	129.09	129.09	129.09	68.99
10	37.13	37.13	34.13	80.42	121.23	121.23	131.23	69.27
11	34.81	34.81	39.81	97.27	131.13	131.13	131.13	69.35
12	34.79	34.79	42.79	76.79	122.28	122.28	127.28	66.27
13	34.44	34.44	40.44	79.85	124.94	124.94	128.94	60.15
14	32.11	32.11	32.11	87.46	139.09	139.09	139.09	70.99
15	35.13	35.13	45.13	78.42	131.23	131.23	131.23	79.27
16	36.81	36.81	39.81	79.27	131.13	131.13	131.13	69.35
17	33.79	33.79	39.79	86.79	122.28	122.28	132.28	76.27
18	33.79	33.79	40.44	73.85	124.94	124.94	127.94	60.15
19	34.11	34.11	39.11	94.46	129.09	129.09	129.09	80.99
20	35.13	35.13	54.13	78.42	131.23	131.23	131.23	79.27
Mean± SD	**37.25± 6.966**	**37.25± 6.966**	**37.25± 6.96**	**41.85± 6.361**$^{*\#}$	**126.0± 5.439**	**126.0± 5.439**	**129.7± 3.818**	**69.21± 6.510**$^{*\#}$

Data were presented as mean ± standard deviation (SD)
**= statistically significant at $p<0.05$when compared with pre-test of experimental subjects*
$^{\#}$= statistically significant at $p<0.05$when compared with post-test of control subjects

Table 4b : Pre- and post- training lipid profile of obese female control and experimental subjects.

S/N	Control pre- TRIG	Control post- TRIG	Exp pre- TRIG	Exp post- TRIG	Control pre- CHOL	Control post- CHOL	Exp pre- CHOL	Exp post- CHOL
1	189.27	189.27	189.27	124.57	214.48	214.48	217.48	190.53
2	228.60	228.60	228.60	106.96	220.03	220.03	229.03	180.45
3	260.84	260.84	261.84	122.44	241.71	241.71	237.71	182.49
4	242.54	242.54	244.54	135.33	281.75	281.75	281.75	178.52
5	240.01	240.01	239.01	145.06	215.38	215.38	225.38	170.70
6	329.27	329.27	329.27	114.57	214.48	214.48	214.48	179.53
7	198.60	198.60	198.60	106.96	210.03	210.03	240.03	180.45
8	260.84	260.84	260.84	142.44	211.71	211.71	216.71	192.49
9	342.54	342.54	342.54	125.33	213.75	213.75	217.75	188.52
10	330.01	330.0 1	330.01	115.06	198.38	198.38	210.38	196.70
11	239.27	239.27	239.27	134.57	214.48	214.48	214.48	210.53
12	318.60	318.60	318.60	106.96	228.03	228.03	218.03	180.45
13	360.84	360.84	360.84	122.44	222.71	222.71	222.71	192.49
14	242.54	242.54	242.54	145.33	221.75	221.75	212.75	198.52
15	250.01	250.01	250.01	135.06	213.38	213.38	213.38	200.70
16	299.27	299.27	289.27	144.57	208.00	208.00	208.00	199.53
17	318.60	318.60	318.60	106.96	246.03	246.03	206.03	198.45

18	360.84	360.84	362.84	142.44	208.71	208.71	248.71	192.49
19	242.54	242.54	242.54	125.33	234.75	234.75	244.75	189.52
20	387.01	387.01	387.01	125.06	244.38	244.38	244.38	200.02
Mean± SD	**282.1± 57.69**	**282.1± 57.69**	**281.8± 57.67**	**126.4± 13.7*#**	**223.2± 18.84**	**223.2± 18.84**	**226.2± 18.53**	**190.2± 9.986*#**

Data were presented as mean ± standard deviation (SD)

**= statistically significant at p<0.05when compared with pre-test of experimental subjects*

#= statistically significant at p<0.05when compared with post-test of control subjects

Table 5a: Pre-test circumferential measurement of control subjects

S/N	Burst (cm)	Chest (cm)	Abdomen (cm)	Waist (cm)	Hip (cm)	Thigh L (cm)	Thigh R (cm)	Calf L (cm)	Calf R (cm)	Upper Arm L (cm)	Upper Arm R (cm)	Upper Arm R (cm)	Lower Arm R (cm)
1	121	109	112	118	114	67	69	43	43	41	40	30	30
2	99	90	90	108	111	57	58	37	38	30	29	26	25
3	118	102	106	118	125	59	62	45	43	37	37	29	30
4	99	92	85	107	111	62	64	39	39	34	34	28	27
5	88	84	73	94	89	53	53	33	33	26	27	25	25
6	78	90	84	115	119	65	65	41	41	31	32	28	28
7	91	87	83	111	113	66	66	41	41	33	34	22	24
8	120	110	112	116	117	70	68	47	47	37	38	19	19
9	92	89	79	105	108	57	62	38	38	30	30	22	25
10	110	100	98	120	120	69	68	36	36	39	38	18	18
11	110	100	98	120	120	69	68	36	36	39	38	18	18
12	92	89	79	105	108	57	62	38	38	30	30	22	25
13	120	110	112	116	117	70	68	47	47	37	38	19	19
14	91	87	83	111	113	66	66	41	41	33	34	21	24
15	78	90	84	115	119	65	65	41	41	31	32	28	28
16	88	84	73	94	89	53	53	33	33	26	27	25	25
17	99	92	85	107	111	62	64	39	39	34	34	28	27
18	118	102	106	118	125	59	62	45	43	37	37	29	30
19	99	90	90	108	111	57	58	37	38	30	29	26	25
20	121	109	112	118	114	67	69	43	43	41	40	30	30
Mean± SD	**101.6± 14.56**	**95.30± 9.027**	**91.60± 13.84**	**111.2± 7.743**	**112.4± 9.282**	**62.50± 5.624**	**63.30± 5.583**	**40.00± 4.155**	**33.30± 5.059**	**33.60± 4.500**	**33.90± 3.959**	**24.70± 4.131**	**25.10± 3.959**

Table 5b: Post-test circumferential measurement of control subjects

S/N	Burst (cm)	Chest (cm)	Abdomen (cm)	Waist (cm)	Hip (cm)	Thigh L (cm)	Thigh R (cm)	Calf L (cm)	Calf R (cm)	Upper Arm L (cm)	Upper Arm R (cm)	Upper Arm R (cm)	Lower Arm R (cm)
1	120	110	113	140	135	88	89	45	45	44	43	16	16
2	99	90	84	122	118	32	32	36	34	36	34	19	19
3	120	105	108	113	109	66	68	44	44	35	36	17	17
4	100	95	87	119	113	64	65	40	40	30	31	15	17

5	90	87	75	113	115	67	66	41	40	37	36	26	27
6	80	91	85	100	116	62	62	40	41	31	31	18	20
7	92	88	115	98	100	55	55	36	36	27	27	19	20
8	125	112	79	107	102	61	61	39	40	30	32	26	26
9	92	89	98	111	107	65	65	41	41	30	32	26	28
10	112	101	98	115	100	60	60	39	39	33	32	25	25
11	112	101	79	115	100	60	60	39	39	31	32	25	25
12	92	89	115	111	107	65	65	41	41	30	32	26	28
13	125	112	85	107	102	61	61	39	40	30	32	26	26
14	92	88	85	98	100	55	55	36	36	27	27	19	20
15	80	91	75	100	116	62	62	40	41	31	31	18	20
16	90	87	87	113	115	67	66	41	40	37	36	26	27
17	100	95	108	119	113	64	65	40	40	30	31	15	17
18	120	105	84	113	109	66	68	44	44	35	36	17	17
19	99	90	99	122	118	32	32	36	34	36	24	19	19
20	120	110	122	140	135	88	89	45	45	44	43	16	16
Mean± SD	**103.0± 14.94**	**96.80± 9.220**	**92.90± 14.14**	**112.5± 8.185**	**113.6± 9.247**	**63.00± 5.089**	**63.30± 5.411**	**40.80± 4.324**	**33.00± 3.613**	**34.00± 4.401**	**34.20± 4.250**	**24.60± 4.109**	**25.10± 3.905**

Data were presented as mean ± standard deviation (SD)

Statistical significance set at $p<0.05$

Table 5c: Pre-test circumferential measurement of experimental subjects

S/N	Burst (cm)	Chest (cm)	Abdomen (cm)	Waist (cm)	Hip (cm)	Thigh L (cm)	Thigh R (cm)	Calf L (cm)	Calf R (cm)	Upper Arm L (cm)	Upper Arm R (cm)	Upper Arm R (cm)	Lower Arm R (cm)
1	126	113	126	142	138	90	91	47	48	48	46	18	19
2	113	102	100	124	118	69	68	36	34	38	37	18	18
3	110	107	105	116	113	68	70	46	47	37	39	19	19
4	112	104	107	121	117	65	67	44	43	33	35	17	19
5	109	101	101	115	114	64	56	43	41	35	35	18	19
6	194	90	93	117	121	63	65	42	41	34	32	18	18
7	193	88	79	101	102	54	58	39	3 7	29	29	21	23
8	117	105	98	104	107	61	62	40	41	34	35	28	28
9	191	87	83	109	113	64	65	43	42	32	33	22	22
10	196	90	78	114	119	65	65	41	41	29	29	26	26
11	196	90	78	114	119	65	65	41	41	29	29	26	26
12	191	87	83	109	113	64	65	43	42	32	33	22	22
13	117	105	98	104	107	61	62	40	42	34	35	28	28
14	193	88	79	101	102	54	58	39	37	29	29	21	23
15	194	90	93	117	121	63	65	42	41	34	32	18	18
16	109	101	101	115	114	64	56	43	41	35	35	118	19
17	112	104	107	121	117	65	67	44	43	33	35	17	19
18	110	107	105	116	113	68	70	46	47	37	39	19	19
19	113	102	100	124	118	69	68	36	34	38	37	18	18
20	126	113	126	142	138	90	91	47	48	48	46	18	19
Mean± SD	**106.1± 11.56**	**98.70± 8.945**	**97.00± 14.25**	**116.3± 11.18**	**116.2± 9.30**	**66.30± 9.039**	**66.7± 9.314**	**42.10± 3.194**	**41.50± 4.007**	**34.90± 5.320**	**35.00± 4.877**	**20.70± 3.678**	**21.50± 2.614**

Table 5d: Post-test circumferential measurement of experimental subjects

S/N	Burst (cm)	Chest (cm)	Abdomen (cm)	Waist (cm)	Hip (cm)	Thigh L (cm)	Thigh R (cm)	Calf L (cm)	Calf R (cm)	Upper Arm L (cm)	Upper Arm R (cm)	Upper Arm R (cm)	Lower Arm R (cm)

1	120	110	122	140	135	88	89	45	45	44	43	16	16
2	110	100	99	122	118	32	32	36	34	36	34	19	19
3	100	105	100	113	109	66	68	44	44	35	36	17	17
4	110	99	102	119	113	64	65	40	40	30	31	15	17
5	103	86	97	113	115	67	66	41	40	37	36	26	27
6	89	85	84	100	116	62	62	40	41	31	31	18	20
7	90	100	78	98	100	55	55	36	36	27	27	19	20
8	115	110	95	107	102	61	61	39	40	30	32	26	26
9	87	82	81	111	107	65	65	41	41	30	32	26	28
10	93	87	84	115	100	60	60	39	39	33	32	25	25
11	93	87	84	115	100	60	60	39	39	31	32	25	25
12	87	82	81	111	107	65	65	41	41	30	32	26	28
13	115	110	95	107	102	61	61	39	40	30	32	26	26
14	90	100	78	98	100	55	55	36	36	27	27	19	20
15	89	85	84	100	116	62	62	40	41	31	31	18	20
16	103	86	97	113	115	67	66	41	40	37	36	26	27
17	110	99	102	119	113	64	65	40	40	30	31	15	17
18	100	105	100	113	109	66	68	45	44	35	36	17	17
19	110	100	99	122	118	32	32	36	34	36	24	19	19
20	120	110	122	140	135	88	89	45	45	44	43	16	16
Mean± SD	**101.7± 11.15*#**	**95.40± 9.338***	**94.20± 12.75*#**	**113.3± 11.44***	**115.5± 10.31#**	**61.80± 13.49*#**	**62.30± 13.58***	**40.10± 2.845***	**40.00± 3.179#**	**33.40± 4.706**	**33.40± 4.309***	**20.70± 4.402#**	**21.10± 4.431#**

Data were presented as mean ± standard deviation (SD)
**= statistically significant at* $p<0.05$ *when compared with pre-test of experimental subjects*
#= statistically significant at $p<0.05$ *when compared with post-test of control subjects*

Table 6a: Pre-test skin-fold measurement of control subjects

S/N	Biceps L (mm)	Biceps R (mm)	Triceps L (mm)	Triceps R (mm)	Chest (mm)	Abdomen (mm)	Bi-iliac (mm)	Sub-Scapular (mm)	Inner Thigh L (mm)	Inner Thigh R (mm)	Calf L (mm)	Calf R (mm)
1	35.7	40.0	32.4	29.8	27.6	32.9	35.5	21.1	18.8	15.3	17.4	18.4
2	35.9	41.9	26.6	21.0	35.5	25.3	30.1	25.8	18.4	16.7	13.2	14.6
3	31.8	32.3	18.7	20.1	31.5	19.0	24.9	18.9	18.6	16.0	19.6	16.5
4	26.5	27.5	23.1	23.0	32.3	29.9	32.3	28.7	20.2	19.9	13.4	13.3
5	45.2	35.1	38.2	27.8	29.6	41.3	38.4	25.0	30.9	31.0	12.6	16.3
6	33.1	37.1	22.7	26.3	34.0	37.1	26.5	23.1	18.2	14.6	11.0	11.8
7	34.2	22.9	18.6	25.6	25.0	23.9	34.5	30.7	32.0	28.1	18.9	19.6
8	40.5	36.7	19.0	17.0	27.2	32.5	30.2	21.0	18.8	22.0	15.8	19.0
9	28.0	30.5	25.1	20.0	26.4	26.0	27.0	24.7	17.1	16.4	18.6	16.6
10	32.4	29.0	26.3	26.1	27.0	27.8	30.0	27.5	20.5	22.0	13.5	12.1
11	32.4	29.0	26.3	26.1	27.0	27.8	30.0	27.5	20.5	22.0	13.5	12.1
12	28.0	30.5	25.1	20.1	26.4	26.0	27.0	24.7	17.1	16.4	18.6	16.6
13	40.5	36.7	19.0	17.0	27.2	32.5	30.2	21.0	18.8	22.0	15.8	19.0
14	34.2	22.9	18.6	25.6	25.0	23.9	34.5	30.7	32.0	28.1	18.9	19.6
15	33.1	37.1	22.7	26.3	34.0	37.1	26.5	23.1	18.2	14.6	11.0	11.8
16	45.2	35.1	38.2	27.8	29.6	41.3	38.4	25.0	30.9	31.0	12.6	16.3
17	26.5	27.5	23.1	23.0	32.3	29.9	32.3	28.7	20.2	19.9	13.4	13.3
18	31.8	32.3	18.7	21.0	31.5	19.0	24.9	18.9	18.6	16.0	19.6	16.5
19	35.9	41.9	26.6	21.0	35.5	25.3	30.1	25.8	18.4	16.7	13.2	14.6
20	35.7	40.0	32.4	29.8	27.6	32.9	35.5	21.1	18.8	15.3	17.4	18.4
Mean± SD	**34.33± 5.367**	**33.30± 5.779**	**25.03± 6.101**	**23.67± 3.966**	**29.74± 3.429**	**29.40± 6.452**	**30.94± 4.165**	**24.65± 3.165**	**21.35± 5.271**	**19.70± 5.169**	**15.40± 2.973**	**15.82± 2.718**

Table 6b: Post-test skin-fold measurement of control subjects

S/N	Biceps L (mm)	Biceps R (mm)	Triceps L (mm)	Triceps R (mm)	Chest (mm)	Abdomen(mm)	Bi-iliac (mm)	Sub-Scapular (mm)	Inner Thigh L (mm)	Inner Thigh R (mm)	Calf L (mm)	Calf R (mm)
1	30.0	26.9	22.7	19.2	28.9	19.8	30.8	23.1	18.2	20.4	15.8	17.0
2	35.0	40.7	25.0	22.4	40.1	27.0	34.5	24.4	18.9	18.0	14.2	15.8
3	32.5	40.1	20.7	30.5	37.8	25.1	30.4	27.9	18.5	16.8	21.5	19.0
4	27.4	30.2	25.0	27.0	40.2	32.9	37.4	31.2	21.9	20.0	15.6	15.5
5	38.4	39.3	40.1	32.8	30.6	39.3	40.3	27.1	30.9	32.7	15.4	18.2
6	32.3	39.1	30.1	28.3	41.7	39.1	28.8	27.3	20.2	18.2	12.1	12.8
7	34.5	27.0	20.6	27.0	30.5	29.3	37.5	32.1	30.2	28.3	19.6	20.4
8	41.0	39.9	22.0	24.5	27.2	32.5	30.2	27.0	18.9	22.1	19.0	20.9
9	30.5	36.7	27.1	25.2	34.4	28.9	30.0	28.7	20.0	22.6	21.6	18.6
10	35.4	32.0	26.8	26.3	30.7	28.7	40.1	29.5	22.5	23.0	17.5	12.1
11	35.4	32.0	26.8	26.3	30.7	28.7	40.1	29.5	22.5	23.0	17.5	12.1
12	30.5	36.7	27.1	25.2	34.4	28.9	30.0	28.7	20.0	22.6	21.6	18.6
13	41.0	39.9	22.0	24.5	27.2	32.5	30.2	27.0	18.9	22.1	19.0	20.9
14	34.5	27.0	20.6	27.0	30.4	29.3	37.5	32.1	30.2	28.3	19.6	20.4
15	32.3	39.1	30.1	28.3	41.7	39.1	28.8	27.3	20.2	18.2	12.1	12.8
16	38.4	39.3	40.1	32.8	30.6	39.3	40.3	27.1	30.9	32.7	15.4	18.2
17	27.4	30.2	25.0	27.0	40.2	32.9	37.4	31.2	21.9	20.0	15.6	15.5
18	32.5	40.1	20.7	30.5	37.8	25.1	30.4	27.9	18.5	16.8	21.5	19.0
19	35.0	40.7	25.0	22.4	40.1	27.0	34.5	24.4	18.9	18.0	14.2	15.8
20	30.0	26.9	22.7	19.2	28.9	19.8	30.8	23.1	18.2	20.4	15.8	17.0
Mean ±SD	**34.33± 5.367**	**33.30± 5.779**	**25.03± 6.101**	**23.67± 3.966**	**29.74± 3.429**	**29.40± 6.452**	**30.94± 4.165**	**24.65± 3.612**	**21.35± 5.271**	**19.70± 5.169**	**15.40± 2.973**	**15.82± 2.718**

Data were presented as mean ± standard deviation (SD)

Statistical significance set at p<0.05

Table 6c: Pre-test skin-fold measurement of experimental subjects

S/N	Biceps L (mm)	Biceps R (mm)	Triceps L (mm)	Triceps R (mm)	Chest (mm)	Abdomen (mm)	Bi-iliac (mm)	Sub-Scapular (mm)	Inner Thigh L (mm)	Inner Thigh R (mm)	Calf L (mm)	Calf R (mm)
1	37.0	23.8	20.1	17.2	27.2	26.07	37.6	17.0	14.5	22.7	20.3	17.0
2	28.0	26.9	18.1	19.2	42.9	25.8	30.8	20.5	23.3	20.3	19.5	19.5
3	37.8	25.4	20.0	19.0	27.0	30.0	28.2	20.0	15.2	15.2	15.0	17.8
4	20.5	20.0	23.2	20.3	23.0	30.8	34.5	20.7	18.0	18.0	17.1	17.8
5	32.3	31.6	26.4	25.6	28.4	34.8	28.4	20.7	16.8	16.8	16.5	13.2
6	36.4	31.1	21.9	24.4	36.9	35.5	32.5	20.6	22.1	22.1	11.4	13.6
7	30.0	29.4	22.4	20.9	24.0	20.7	25.5	22.9	14.7	14.7	15.8	15.6
8	20.9	20.6	29.8	17.0	28.9	19.8	20.0	17.9	19.9	19.9	18.0	20.4
9	34.2	22.9	18.6	26.6	35.1	35.9	28.5	20.7	32.0	32.0	10.4	12.8
10	33.1	37.1	22.7	26.3	34.0	37.1	34.8	23.1	18.2	18.2	10.6	16.6
11	33.1	37.1	22.7	26.3	34.0	37.1	34.8	23.1	18.2	18.2	10.6	16.6
12	34.2	22.9	18.6	17.0	35.1	35.9	28.5	20.7	32.0	32.0	10.4	12.8
13	20.9	20.6	29.9	20.9	28.9	19.8	20.0	17.9	19.9	19.9	18.0	20.4
14	30.0	29.4	22.4	24.4	24.0	20.7	25.5	22.9	14.7	14.7	15.8	15.6
15	36.4	31.1	21.9	25.6	36.9	35.5	32.5	20.6	22.1	22.1	11.4	13.6
16	32.3	31.6	26.4	20.3	28.4	34.8	28.4	20.7	16.8	16.8	16.5	13.2
17	20.5	20.0	23.2	19.0	23.0	30.8	34.5	20.7	18.0	18.0	17.1	17.8
18	37.8	25.4	20.0	19.2	27.0	30.0	28.2	20.0	15.2	15.2	15.0	17.8
19	28.0	26.9	18.1	17.2	42.9	25.8	30.8	20.5	23.3	20.3	19.5	19.5
20	37.0	23.8	20.1	118	27.2	19.9	37.6	17.0	14.5	22.7	20.3	17.0

Mean± SD	**31.02± 6.070**	**26.68± 5.283**	**22.32± 3.489**	**21.65± 3.644**	**30.74± 6.123**	**35.2± 6.805**	**30.08± 4.986**	**24.41± 1.830**	**19.43± 5.327**	**20.78± 4.266**	**18.67± 3.590**	**16.81± 2.616**

Table 6d: Post-test skin-fold measurement of experimental subjects

S/N	Biceps L (mm)	Biceps R (mm)	Triceps L (mm)	Triceps R (mm)	Chest (mm)	Abdomen (mm)	Bi-iliac (mm)	Sub-Scapular (mm)	Inner Thigh L (mm)	Inner Thigh R (mm)	Calf L (mm)	Calf R (mm)
1	37.2	23.8	20.5	18.5	29.5	21.6	39.5	18.1	16.5	22.7	22.5	18.2
2	32.4	27.8	26.3	26.1	26.8	26.8	35.5	23.3	18.4	17.4	23.7	17.1
3	26.7	40.7	19.4	14.0	27.1	32.9	20.2	21.1	15.8	15.3	15.1	19.2
4	18.1	23.0	25.3	20.5	25.0	24.1	36.1	34.3	20.0	22.6	18.6	14.1
5	27.5	26.5	21.8	19.8	27.9	33.6	28.4	28.8	18.8	20.0	20.3	21.1
6	28.7	27.5	18.4	14.6	27.5	29.2	24.2	21.9	14.9	12.9	12.2	12.0
7	27.0	30.3	24.9	20.0	24.4	24.1	25.2	23.7	15.8	15.3	18.6	16.6
8	20.9	22.6	17.3	17.5	30.2	19.8	22.5	17.9	21.3	21.5	21.3	18.4
9	21.4	20.8	15.9	24.5	25.0	23.6	34.5	32.9	29.0	21.3	18.9	19.6
10	26.1	17.8	17.4	15.5	26.9	18.0	26.5	22.2	10.7	14.6	11.0	11.8
11	26.1	17.8	17.4	15.6	26.9	18.0	26.5	22.2	10.7	14.6	11.0	11.8
12	21.4	20.8	15.9	24.5	25.0	23.6	34.5	32.9	29.0	21.3	18.9	19.6
13	20.9	22.6	17.3	17.5	30.2	19.8	22.5	17.9	21.3	21.5	21.3	18.4
14	27.0	30.3	24.9	20.0	24.4	24.1	25.2	23.7	15.8	15.3	18.6	16.6
15	28.7	27.5	18.4	14.6	27.5	29.2	24.2	21.9	14.9	12.9	12.2	12.0
16	27.5	26.5	21.8	19.8	27.9	33.6	28.4	28.8	18.8	20.0	20.3	21.1
17	18.1	23.0	25.3	20.5	25.0	24.1	36.1	34.3	20.0	22.6	18.6	14.1
18	26.7	40.7	19.4	14.0	27.1	32.9	20.2	21.1	15.8	15.3	15.1	19.2
19	32.4	27.8	26.3	26.1	26.8	20.63s	35.5	23.3	18.4	17.4	23.7	17.1
20	37.2	23.8	20.5	18.5	29.5	21.6	39.5	18.1	16.5	22.7	22.5	18.2
Mean± SD	**26.60± 5.462*#**	**26.08± 6.155#**	**20.72± 3.611*#**	**19.25± 3.767*#**	**27.25± 3.52*#**	**29.03± 4.471***	**29.26± 6.458**	**20.41± 5.543*#**	**18.12± 4.717#**	**18.36± 3.578***	**15.4± 3.96***	**16.43± 2.61**

Data were presented as mean ± standard deviation (SD)
**= statistically significant at* $p<0.05$ *when compared with pre-test of experimental subjects*
#= statistically significant at $p<0.05$ *when compared with post-test of control subjects*

Discussion

This study showed that aerobic exercise significantly decreased body mass index (BMI) and body composition measurement which include circumferential measurement, skinfold measurement, weight, height, heart rate and blood pressure in the experimental subjects compare to the control subjects that did not partake in the intervention program (aerobic exercise). The decrease could have occurred due to reduction in body fat mass and decreased body weight and body mass index (BMI) caused by exercise this is in line with study carried out by (Stasiulis *et al*, 2010). Previous study has also shown that aerobic exercise reduces body mass index, body fat mass, and body mass in which aerobic exercise causes the capability of the body to use fat as a substrate to increase the total fat oxidation (Chiu *et al*, 2017). Aerobic exercise lower blood pressure by improving circulation, strengthening the heart, and reducing stress exercise improves circulation which can lower blood pressure and heart rate. Exercise triggers nitric oxide production to promote cardiovascular health via inducing vasodilation and reducing atherosclerosis (Li *et al*., 2021). Aerobic exercise activates lipoprotein lipase and increased lipoprotein lipase activities play an important role in reducing insulin resistance during aerobic exercise in line with the study carried out by (Fenkcis *et al*.,2006). In obese individual aerobic exercise plays an s important role in reducing body fat by enhancing oxygen utilization by combining with glucose to release energy in form of adenosine triphosphate when glucose is being exhausted, the body make use of fat through gluconeogenesis process to generate energy which helps in reducing body fat in line with the study carried out by (Plowman and Smith, 2007)

This study revealed that there was an increase in blood glucose in both control and experimental subjects during pre-test period. This could be as a result of excess glucose being stored in the skeletal muscle and the liver, this process is mediated by the hormone insulin. Exercise enhances insulin sensitivity by activating 5’ AMP-activated protein kinase (AMPK) for glucose absorption (Mann *et al.*, 2014). During aerobic exercise, the glucose stored in the muscle and the liver in form of glycogen is broken down to serve as energy in form of adenosine triphosphate (ATP) to fuel the physical exercise (Alghannam *et al.*, 2021). The breakdown of glycogen into glucose in the skeletal muscle (gluconeogenesis) and liver is regulated by the hormone insulin and glucagon.

This study reveals that blood glucose was lowered with aerobic exercise in female obese experimental subjects than the female obese control subjects. Previous studies showed that aerobic exercise is an effective strategy for improving glucose metabolism outcome (Poehlman *et al* 2000, Rahimi *et al*., 2020). Also previous study reported that aerobic exercise improves muscle capillary which helps glucose to diffuse from capillary into muscle cells, changes the muscle fibre type, favouring substrate oxidation and increases the quantity and size of mitochondria (Haas and Nwadozi, 2015). Aerobic exercise increases the expression and activity of key signaling protein involved in the regulation of glucose uptake and metabolism in skeletal muscle(such as GLUT4 translocation mediated by AMPK) and increases lipid oxidation (Hawley *et al*., 2008).

This study revealed that aerobic exercise decrease lipid profile (triglyceride, low-density lipo-protein, and total cholesterol and increase high density lipoprotein which is a good cholesterol in the experimental subjects but the reverse is the case in obese control subjects who do not participate in the aerobic exercise. Previous evidence shows that exercise have been found to positively affect lipid metabolism by improving lipid profile parameters such as triglyceride, low density lipo- protein, high density lipo-protein, and total cholesterol this is in line with study carried out by (Gordon *et al*., 2014).Aerobic exercise has been shown to enhance insulin sensitivity in obese individual ,improved insulin sensitivity helps to regulate blood glucose levels and reduces the production of triglyceride and very low density lipo-protein in the liver ,leading to favorable changes in the lipid profile (Bird and Hawley, 2017). Aerobic exercise can potentially reduce visceral fat stored around the organs in the abdominal area. visceral fats is metabolically active and contributes to increased triglyceride and low density lipo-protein levels often called bad cholesterol, exercise can improve the lipid profile by reducing visceral fat and decreasing triglyceride and low density lipo-protein (Neeland *et al*., 2024). Regular exercise including aerobic exercise has increased the level high density lipo-protein level, commonly known as good cholesterol. High density lipo-protein help in transport excess cholesterol from the peripheral tissues to the liver for excretion, thus reducing the risk of cardio vascular diseases. Exercise can modify the size and density of low level density lipo- protein particles making them less atherogenic that less likely to cause plague build up in the arteries (Franczyk *et al*., 2023). Following Aerobic exercise the mechanism responsible for the acute rise in high density lipo-protein is likely associated with the catabolism of lipo-proteins rich triglyceride through lipo-protein lipase LPL (Ahotupa, 2024). Increase activity of lipo-protein lipase following exercise results in hydrolysis of chylomicron and very low density lipo-protein, thereby decreasing plasma triglyceride (Calder and Yaqoob, 2023), and subsequently surface remnants are converted into nascent high density lipo-protein, following the exercise the levels of high density lipo-protein can increase. Aerobic exercises primarily utilize fat as fuel for exercise by increasing the intensity and duration of exercise, patients can enhance fat oxidation, reducing overall body fat and improving their lipid profile (Talanian *et al*., 2007).

conclusion

Aerobic exercise reduced body weight, lipid profile and blood glucose levels by making use of stored glucose and fats in the body as source of energy for the physical activities thereby reducing the risk factors associated with obesity, cardiovascular diseases and lots more.

This study confirms the data in the literature on the adverse effect of sedentary lifestyle on the body system.

Also, it revealed the significance of aerobic exercise in reducing body weight and risk of obesity, cardiovascular diseases, hypertension, stroke and lots more. Exercise, if it can be process into drugs informs of capsules, syrup and injection it could be used as therapeutic agent to prevent and cure several many diseases.

Future studies could consider more diverse populations, other types of aerobic exercise and qualitative insights for better establishment of the impact of physical activities on obesity management.

Disclaimer (Artificial intelligence)

Option 1:

We hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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