



Efficacy of Pilates and Aerobic Exercise on Body Composition in Obese Women

K. Madhumathi* and J. Pavatharani

Assistant Professor, SOPT, VISTAS, Thalambur, Chennai – 603103

SOPT, VISTAS, Thalambur, Chennai - 603103

Received: 10 Oct 2018 / Accepted: 8 Nov 2018 / Published online: 1 Jan 2019

*Corresponding Author Email: madhu.sp@velsuniv.ac.in

Abstract

Introduction: Obesity is a major health issue around the world, it has tripled since 1975. Once considered a high-income country problem, overweight and obesity are now on the rise in low- and middle-income countries. overweight and obesity is a condition of abnormal or excessive fat accumulation in adipose tissue that may impair health. The prevalence of obesity is increasing in urban women in India. Obesity in women is related to polycystic ovary syndrome, diabetes and increased the risk of cardiovascular disease, postmenopausal breast cancer and endometrial cancer. **Aim:** The main aim of the study is to determine the efficacy of Pilates exercise and Aerobic exercise on body composition in sedentary obese women. **Methods and Materials:** Female participants with BMI 30.0-39.9 kg/meter squared between the age group 40-49 year with sedentary lifestyle and without any history of pathologic orthopedics conditions were selected. Exercise intolerance, Women with cardiovascular, musculoskeletal, respiratory or any other chronic diseases, menstrual irregularities are excluded from this study. The subjects are divided into two groups, Group A (Pilates) and Group B (Aerobic). The interventions are formulated for 8- week series of 60 minutes. Pilates mat exercise and aerobic exercise program performed for three days per week. Weight, Body Mass Index, Skinfold Thickness, Waist circumference, Waist-to-hip ratio are used as the outcome measure before and after the treatment. **Results:** The Pilates and aerobic exercise showed significant difference in the outcome measures. **Conclusion:** This study would provide an alternate treatment protocol to reduces the weight in female population.

Keywords

Obesity, Pilates, Aerobic exercise, Overweight.

INTRODUCTION

Obesity is a major health issue around the world, it has tripled since 1975. World Health Organization stated that there were about 13% of the world's adult population (11% of men and 15% of women) were obese in 2016. Once considered a high-income country problem, overweight and obesity are now on the rise in low- and middle-income countries,

particularly in urban settings. The author F. Ofei in 2007 defined overweight and obesity as a condition of abnormal or excessive fat accumulation in adipose tissue that may impair health

Body mass index (BMI) is a simple index of weight for height that is commonly used to classify overweight and obesity in adults. It is defined as a person's weight in kilograms divided by the square of height

in meters. Overweight is a body mass index greater than or equal to 25 and obesity is a body mass index greater than or equal to 30.

The fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended. The author Rajendra Pradeepa stated that 'rise in obesity prevalence could be attributed to the increasing urbanization, use of mechanical transport, increasing availability of processed and fast foods, increased television viewing, adoption of less physical active lifestyles and consumption of more "energy-dense and nutrient-poor" diets in India'. Social inequalities in overweight and obesity are strong, especially among women. People in low-income groups typically live in neighborhoods with a denser supply of fast food outlets, less availability of fresh vegetables and fruit, and unsafe spaces for physical activity, especially for women and children.

Sedentary Lifestyle is type of lifestyle which an individual or group adopt that do not permit regular physical activity. Sedentary behavior is a state when the women engaged in minimal body movement and energy expenditure (the time spent by the women sitting or reclining or doing activities that require minimal or no physical movement or engagement).

The author Pradeepa P. Shinde, in 2013 showed that increase in prevalence of overweight and obese with increase in age group of 40 to 49 had highest 40.49% prevalence of obesity. The prevalence of obesity is increasing in urban women in India. Improving socio-economic status and sedentary lifestyle along with advancing age group are major risk factors for development of obesity.

Obesity in women is strongly related to polycystic ovary syndrome. Obese women are particularly susceptible to diabetes and diabetes in turn puts women at dramatically increased the risk of cardiovascular disease. It also leads to postmenopausal breast cancer and endometrial cancer.

Types of Female Obesity -

Android is called as apple shape. The person stores fat around his or her abdominal region. Android obesity manifested in other areas of the neck, and even the shoulders. Female android obese usually have more fat than men suffering the same. **Gynoid** is called as pear shape. The excess fat is being deposited somewhere at the hip and thigh areas. Their hips are rounded, and their buttocks generally look larger than normal. **Mixed** is body looks like a barrel and movement is restricted.

Effects of Obesity –

Overweight or obese is stigmatized i.e. individuals are exposed to the consequences of public disapproval of their fatness. This stigma occurs in education, employment, health care and elsewhere. Obese women appeared to be greater risk of psychological dysfunction than obese men, due to increased societal pressures on women to be thin

Physical Effects -

Being overweight or obese can have a serious impact on health. Carrying extra fat leads to health consequences such as cardiovascular disease (mainly heart disease and stroke), type 2 diabetes, musculoskeletal disorders like osteoarthritis, and cancers (endometrial, breast and colon). These conditions cause substantial disability and death

Psychosocial Effects -

Obese people have more difficulties in finding a job, have a lower income, and are less often seen in leadership positions, lower educational attainment. In society, individuals affected altogether leading to chronic stress, problems with self-esteem and perception of loss of control and increased risk of developing serious psychological problems such as affective and anxiety disorders

Emotional Effects -

Society places immense pressure on people to look good, stay thin, and fit into a certain size. Feelings of shame, rejection, low self-esteem, and depression are common in obese adults and even overweight children. Loneliness is another psychological obesity effect. All these effects can impact physical health and even reduce a person's lifespan.

Physical activity is a necessary basic function for the healthy development of the human organism. The author Akgun stated that the importance of physical activity for middle-aged and elderly people has been systematically studied in the last 20 years. As exercise on a regular basis changes will occur gradually in body composition.

Pilates or physical mind method is a series of non-impact exercises designed by Joseph Pilates to develop strength, flexibility, balance and inner awareness. This method strengthens and lengthens the muscles without creating bulk. The exercises are designed to increase muscle strength and endurance, as well as flexibility and to improve posture and balance. All Pilates exercises flow from the five essentials – breathing, cervical alignment, rib and scapular stabilization, pelvic mobility and utilizing the transverses abdominis. Each exercise is initiated by stabilizing the core musculature, which includes the abdominal, gluteal and Para spinal muscles in particular, and then proceeds through a controlled

range of motion. Many traditional methods of muscle conditioning require participants to perform maximum voluntary contractions. In Pilates, the focus is on the most effective recruitment of motor units which places the emphasis on energy efficiency and quality of performance. Each exercise is repeated a few times, usually three to five, rarely more; so, the body is constantly being exposed to new muscular and kinesthetic challenges.

Pilates exercises can be performed both on a mat or a Swiss ball. In the mat class, participants typically sit or lie supine or prone and use gravity to help stabilize the core. Body weight is the main resistance that is used throughout the series of Pilates mat exercises. Changes in body position occur (i.e., longer limb levers or increased extension) in individual exercises and changes in the lever lengths of limbs can continue to challenge participants as their fitness levels increase. The additional psychological element of Pilates is evident in the additional focus on breathing and concentration during the execution of these exercises.

Aerobic means with oxygen. In order to perform hard work for extended periods of time, the body derives energy from the oxidative metabolism of fat and carbohydrate. Aerobic fitness is defined as the maximal capacity to take in, transport, and utilize Oxygen. It indicates the functional capacity of the respiratory system (take in oxygen), the circulatory system (transport oxygen), and the muscles (utilize oxygen) [Aerobic Fitness and Work Capacity]. Physical activity such as walking, jogging, indoor cycling, or aerobic dancing are all examples of aerobic exercise that strengthen the heart and lungs, therefore improving your body's utilization of oxygen. For general health, aim for a 30-minute workout (or three 10-minute workouts per day) three to five days a week at moderate intensity. For weight loss, gradually work up to 45 minutes or longer at moderate to vigorous intensity.

In India, most of the studies are reported that there is higher prevalence of obesity among women. So far, studies related to Pilates exercise and aerobic exercise on body composition is scarce. Obesity leads to infertility, depression, cancers, etc. So, this is high time to evaluate the efficacy of Pilates and aerobic exercise in the reduction of body weight especially in sedentary obese women.

In this study, the focus is to explore the effectiveness of both aerobic and Pilates exercise on body composition in sedentary obese women.

AIM OF THE STUDY

The main aim of the study is to determine:

- To find the efficacy of Pilates exercise on body composition in sedentary obese women.
- To find the efficacy of Aerobic exercise on body composition in sedentary obese women.

MATERIALS AND METHODS

Study Design : Experimental study

Study Type : Comparative study

Sample Size : 60 participants

Duration : 3 days per week for 8 weeks.

Population : Women's (sedentary obese)

Inclusion Criteria -

- Age: 40-49 years
- Only female participants with BMI 30.0-39.9 kg/meter squared.
- Subjects with sedentary lifestyle
- Interest in participation
- Healthy subjects without any history of pathologic orthopedics limitation

Exclusion Criteria -

- Exercise intolerance
- Currently engaged in any other exercise program
- Menstrual irregularities
- Using medications (E.g. beta blockers)
- Women with cardiovascular, musculoskeletal, respiratory or any other chronic diseases that might limit training.

Outcome Measures -

- ✓ Weight
- ✓ Body Mass Index
- ✓ Skinfold Thickness
- ✓ Waist circumference
- ✓ Waist-to-hip ratio

All subjects were measured by these standardized equipment's in pre and post exercise programs.

PROCEDURE

They were divided into Group A [Pilates] and Group B [aerobics].

To measure these parameters, all subjects were performed a series of standard fitness test to evaluate BMI, Waist circumference, Waist to hip ratio, Skinfold thickness which involve biceps (anterior surface of the biceps midway between the anterior axillary fold and the antecubital fossa), triceps (vertical fold on the posterior midline of the upper arm halfway between the acromion and olecranon process), subscapular (fold on the diagonal line come in from the vertebral border to between 1 and 2 cm from the inferior angle of the scapulae) and supra iliac (diagonal fold above the iliac crest even with the anterior axillary line).

The measurements were taken twice before and after an 8- week series of 60 minutes Pilates mat exercise and aerobic exercise program performed by three days per week. A 1-2 sec break was given after each motion and a 2-minute break after each set to minimize muscle fatigue.

Carvonen method was used for intensity of exercise program. Initially, according to carvonen's formula, maximal heart rate as estimated to be 60-70 % of for exercise program. The target then became to raise their heart rate to 80-85%

The Carvonen Method:

Maximum heart rate = 220 – Age

Heart rate reserve (HRR) = Heart rate maximum – heart rate rest (resting heart rate)

%60 target heart rate = (0.60 × HRR) + heart rate rest

GROUP A: The Pilates training program consisted of 8-week series of one-hour Pilates exercise 3 days per week were performed on a mat. For all participants training were provided by verbal and tactile clues were given during each Pilates exercise. At the beginning of the program, while the intensity of exercise was 40%, it was gradually increased to 60% in the eighth week. The Pilates training program was given in the following.

The group **A** performed Pilates exercise protocol:

WARM UP:

- Breathing
- Imprint and release
- Hip rolls
- Spinal rotation
- Cat stretch
- Scapulae rotation
- Arm circle.

EXERCISES	REPETITIONS
The hundred	8
Shoulder bridge	8
Single leg circle	8
Doubling leg stretch	8
Lie back stretch	8
Rolling like a ball	8
Leg pull down	8
Pelvic curl	8
Leg pull up	8
Side bend	8
Side kick front	8
Side kick back	8
The saw	8
Roll-up	8
Spine stretch and spine stretch forward	8
Bent knee bride	8

GROUP B: The aerobic training program consisted of 8-week series of one hour aerobic exercise 3 days per week were performed and the program consists of 3 steps warm up (10 minutes), aerobic training (45 minutes) and cool down (5 minutes). At the

beginning of the program, while the intensity of exercise was 40%, it was gradually increased to 60% in the eighth week. The aerobic training program was given in the following:

The group **B** performed aerobic exercise protocols:

WEEKS	EXERCISE	EXERCISE PERIOD (MIN)	DISTANCE (KM)	FREQUENCY (DAY/WEEK)
1-2	Warm up	10	4	3
	Training period	45		
	Cool down	5		
3-4	Same with first week	60	5	3
5-6	Same with first week	60	6	3
7-8	Same with first week	60	6	3

Warm-up (10 minutes)

- Light tempo 5minutes Jog, direction changing walks.
- Warm-up and stretching exercises for the muscle groups to be used in the exercises.

Training period (45 minutes)

- Walking
- Running
- Cycling
- Jumping rope
- Climbing stairs.

Cool-down period (5 minutes)

- Light tempo jogging
- Minimal stretching

STATISTICAL ANALYSIS:

Statistical analysis consisted of basic statistics to determine pre- and post-test means and standard deviations. An un-paired samples t-test was used to determine if a significant change took place in the measurements at post-test in weight, body mass index, waist circumference, waist-hip ratio and skinfold calliper thickness.

RESULT

60 obese sedentary women aged (41-49 years), Body mass index (30.0 to 39.9 kg/meter squared) entered into the study. The main aim of this study was to investigate the effect of aerobic versus pilates exercise on body composition for sedentary obese women. The details of anthropometry measures are as follows:

Weight

Table 1 shows the pre and post-test values of weight for group A and Group B. There was significant difference among both groups. Body weight decreased from 71.6 to 67.03, $p < 0.0001$ (group A) and 69.2 to 66.13, $p < 0.001$ (group B). Body weight were decreased in group A than the group B.

Therefore, aerobic exercise was more effective on reduction of body weight.

Body Mass Index

Table 2 shows the pre and post-test values of body mass index for group A and Group B. There was significant difference among both groups. Body mass index decreased from 31.7 to 29.7, $p < 0.0001$ (group A) and 31.03 to 29.64, $p < 0.001$ (group B). Body mass index were decreased in group A than the group B. Therefore, aerobic exercise was more effective on body mass index.

Waist Circumference

Table 3 shows the pre and post-test values of waist circumference for group A and Group B. There was significant difference among both groups. Waist circumference decreased from 40.9 to 37.9, $p < 0.0165$ (group A) and 36.27 to 33.87, $p < 0.0002$ (group B). Waist circumference were decreased in group A than the group B. Therefore, aerobic exercise was more effective on waist circumference.

Waist-Hip Ratio

Table 4 shows the pre and post-test values of waist-hip ratio for group A and Group B. There was significant difference among both groups. Waist-hip ratio decreased from 0.95 to 0.92, $p < 0.0027$ (group A) and 0.95 to 0.92, $p < 0.00025$ (group B). Waist-hip ratio were decreased in group A than the group B. Therefore, aerobic exercise was more effective on waist-hip ratio.

Skinfold Caliper Thickness

Table 5 shows the pre and post-test values of skinfold caliper thickness for group A and Group B. There was significant difference among both groups. Skinfold caliper thickness decreased from 33.6 to 32.9, $p < 0.0027$ (group A) and 33.6 to 32.6, $p < 0.00025$ (group B). Skinfold caliper thickness were decreased in group A than the group B. Therefore, aerobic exercise was more effective on skinfold caliper thickness.

TABLE 1 shows the mean, SD, t-value and p-value of weight for aerobic and Pilates groups

GROUPS	MEAN		STANDARD DEVIATION		P VALUE	T VALUE
	PRE	POST	PRE	POST		
AEROBIC	71.60	67.03	3.90	3.88	0.0001	4.5454
PILATES	69.20	66.13	3.63	3.86	0.0024	3.1699

TABLE 2 shows the mean, SD, t-value and p-value of body mass index for aerobic and Pilates groups

GROUPS	MEAN		STANDARD DEVIATION		P VALUE	T VALUE
	PRE	POST	PRE	POST		
AEROBIC	31.7063	29.6733	1.4125	1.3452	0.0001	5.7087
PILATES	31.030	29.640	0.928	1.019	0.0001	5.5236

TABLE 3 shows the mean, SD, t-value and p-value of waist circumference for aerobic and Pilates groups

GROUPS	MEAN		STANDARD DEVIATION		P VALUE	T VALUE
	PRE	POST	PRE	POST		
AEROBIC	40.90	37.90	4.66	4.74	0.0165	2.47
PILATES	36.27	33.87	2.29	2.42	0.0002	3.9491

TABLE 4 shows the mean, SD, t-value and p-value of waist-hip ratio for aerobic and Pilates groups

GROUPS	MEAN		STANDARD DEVIATION		P VALUE	T VALUE
	PRE	POST	PRE	POST		
AEROBIC	0.9537	0.9227	0.0506	0.0519	0.0027	2.3416
PILATES	0.9563	0.9200	0.0360	0.04	0.0005	3.6999

TABLE 5 shows the mean, SD, t-value and p-value of skinfold caliper thickness for aerobic and Pilates groups

GROUPS	MEAN		STANDARD DEVIATION		P VALUE	T VALUE
	PRE	POST	PRE	POST		
AEROBIC	33.603	32.853	1.049	0.867	0.0038	3.0187
PILATES	33.607	32.603	1.048	0.689	0.0001	4.3802

GRAPHICAL REPRESENTATION:

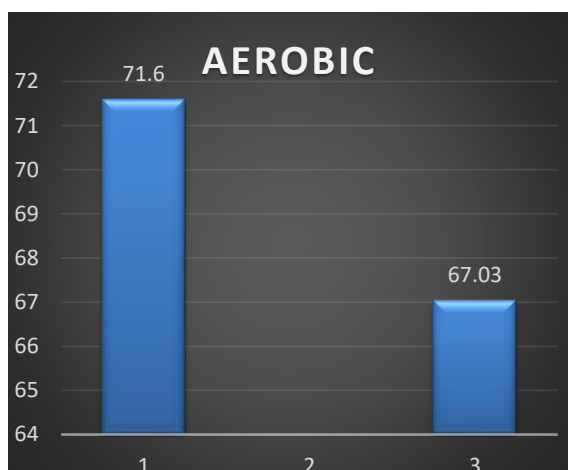


Figure 1: Mean value for weight in aerobic exercise

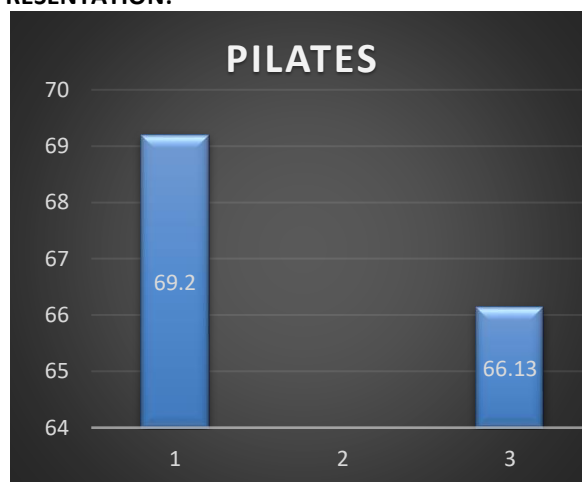


Figure 2: mean value for weight in pilates

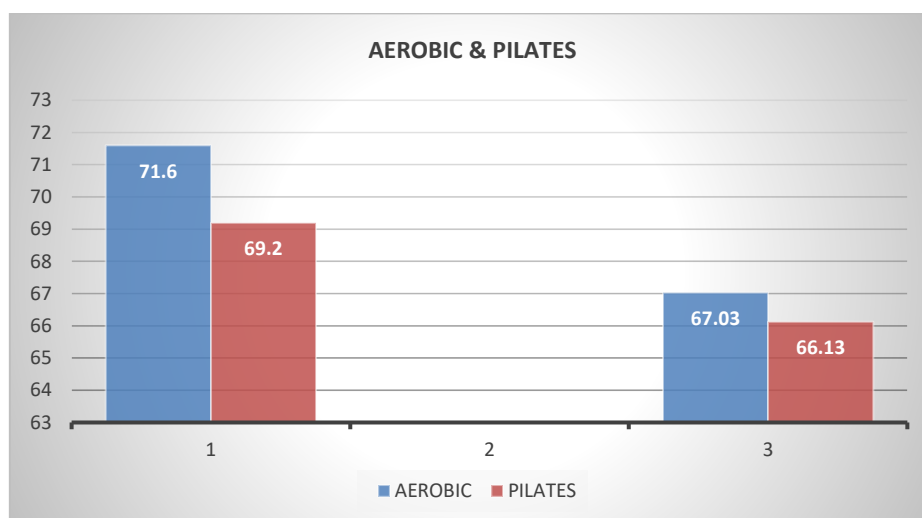


Figure 3: Comparison of pre and post values of aerobic and pilates exercise for weight.

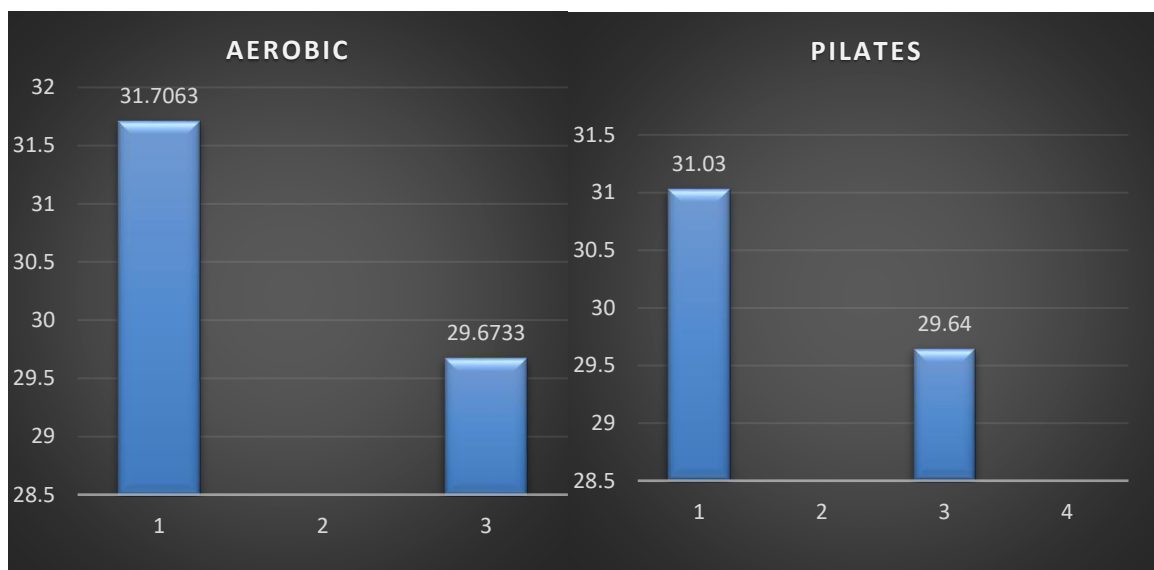


Figure 4: Mean values for body mass index in aerobic exercise

Figure 5: Mean values for body mass index in pilates exercise

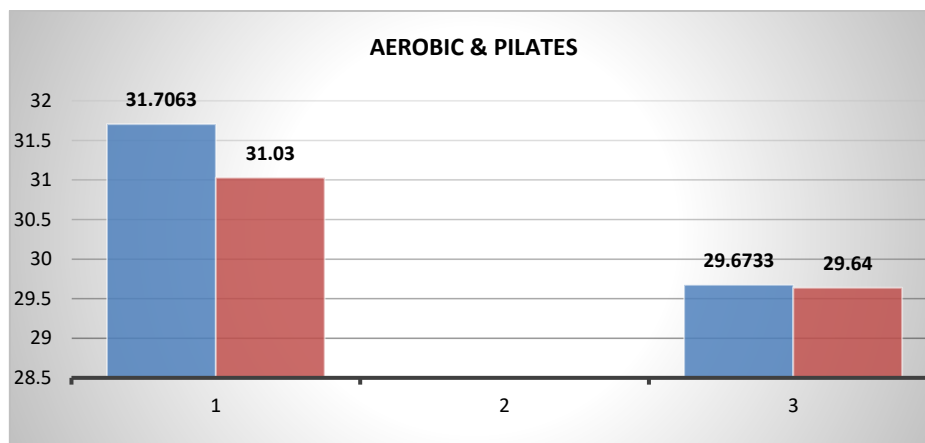


Figure 6: Comparison of pre and post values of aerobic and pilates exercise for body mass index.

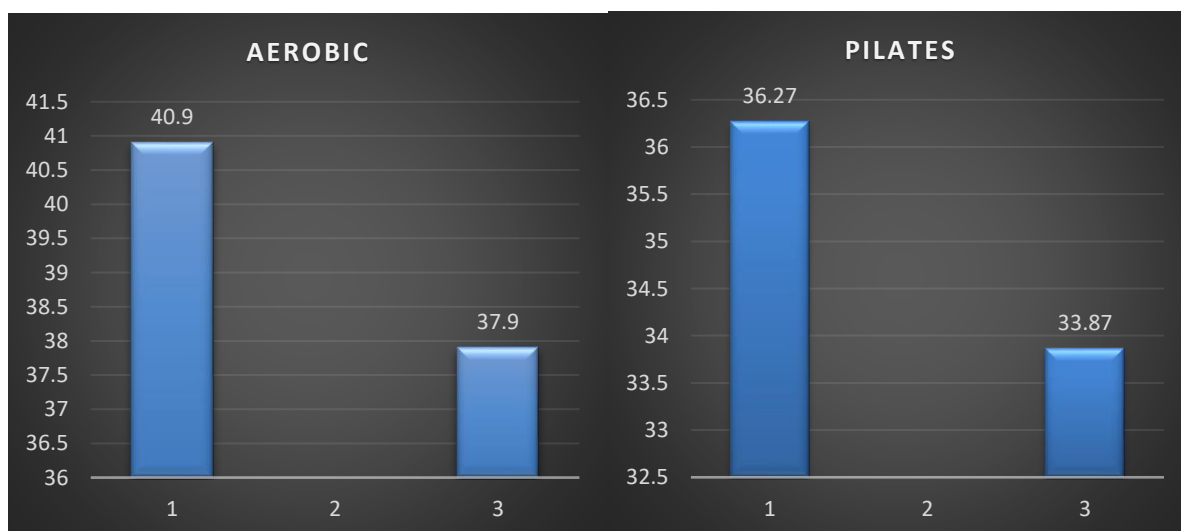


Figure 7: Mean values for waist circumference in aerobic exercise

Figure 8: Mean values for waist circumference in pilates exercise

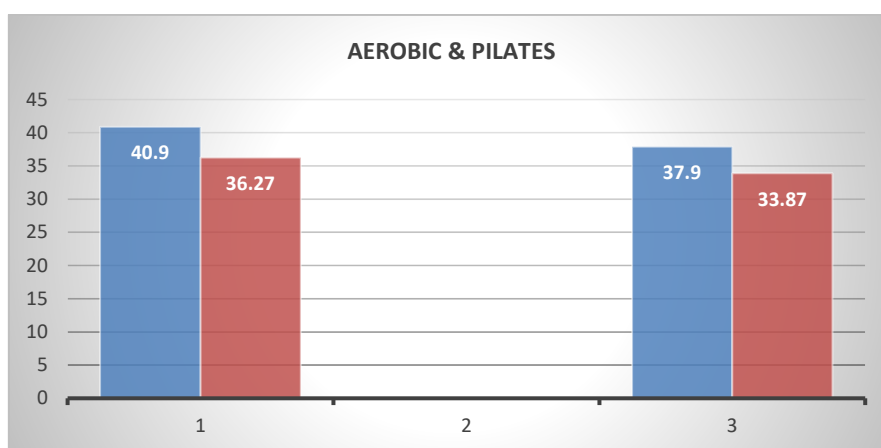


Figure 9: Comparison of pre and post values of aerobic and pilates exercise for waist circumference.

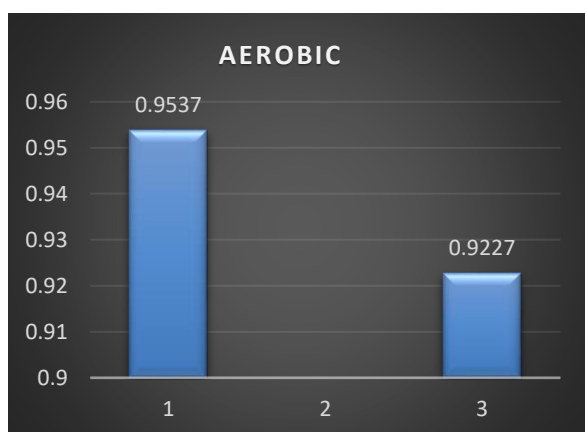


Figure 10: Mean values for waist-hip ratio in aerobic exercise

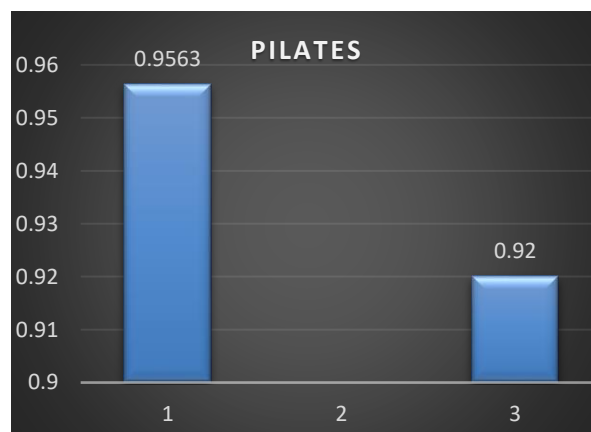


Figure 11: Mean values for waist-hip ratio in pilates exercise

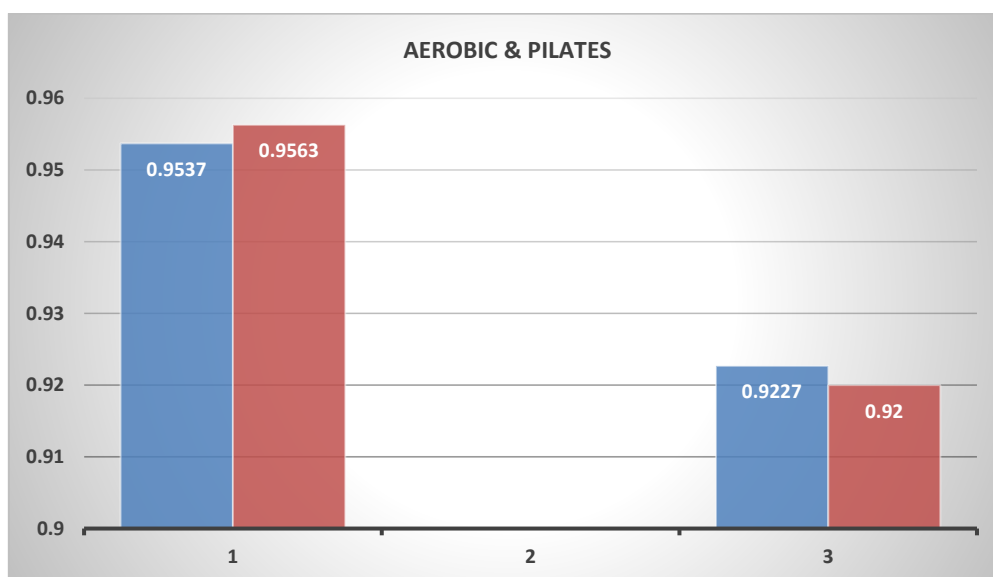


Figure 12: Comparison of pre and post values of aerobic and pilates exercise for waist-hip ratio

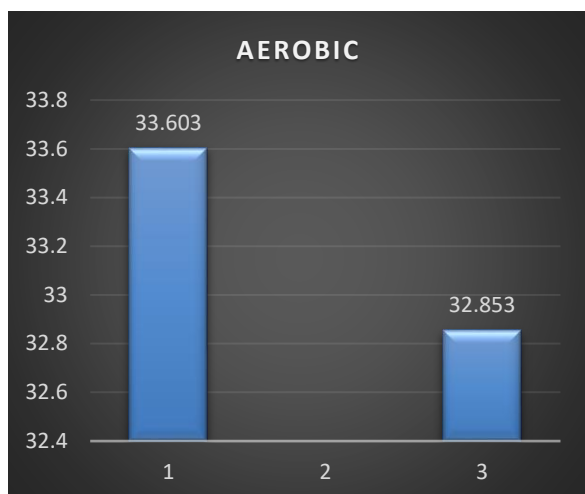


Figure 13: Mean values for skinfold caliper thickness in aerobic exercise

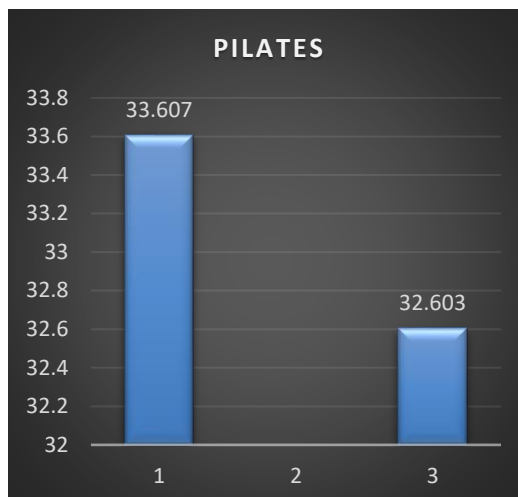


Figure 14: Mean values for skinfold caliper thickness in pilates exercise

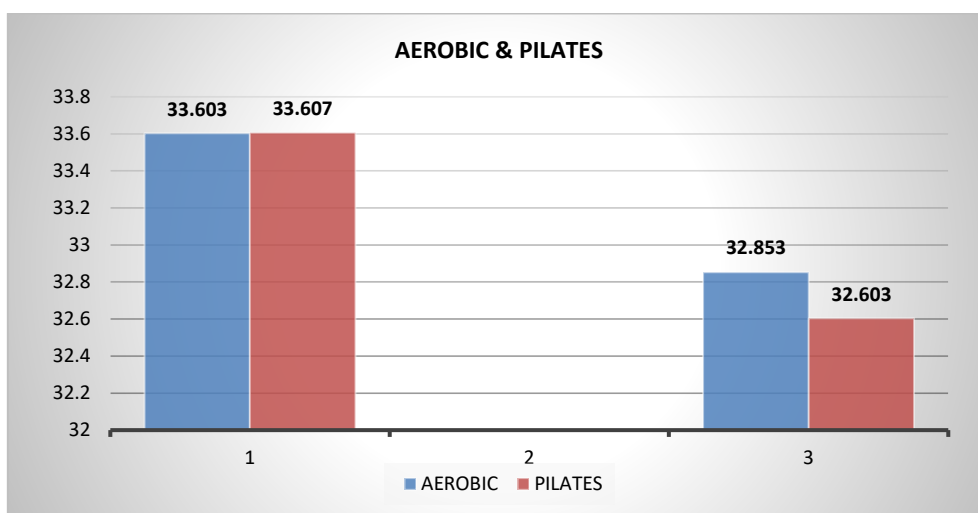


Figure 15: Comparison of pre and post values of aerobic and pilates exercise for skinfold caliper thickness.

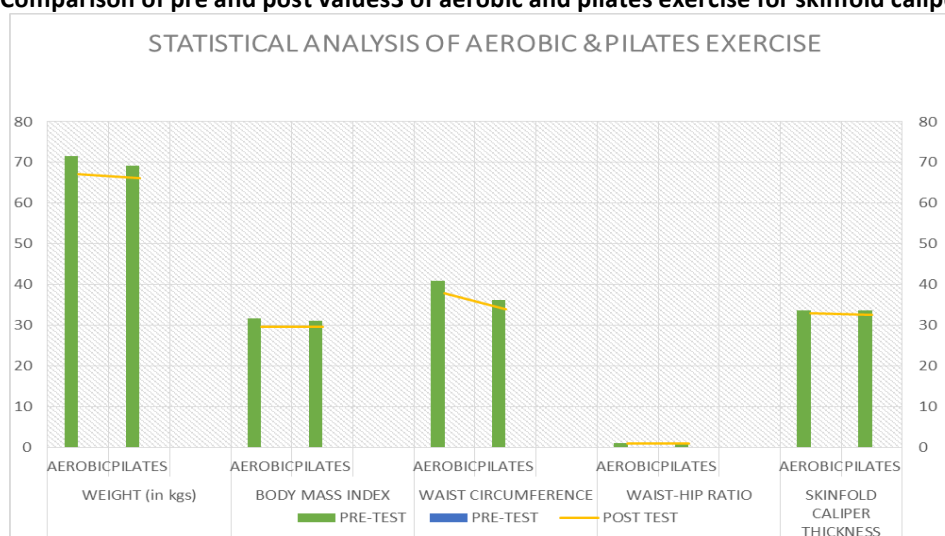


Figure 16: Comparison of pre and post values of weight, body mass index, waist circumference, waist-hip ratio and skinfold caliper for both the groups.

DISCUSSION

This study was done to find the effects of the pilates and aerobic exercise on body composition in sedentary obese women. The pilates and aerobic exercise showed significant increase in the outcome measures i.e. weight, body mass index, waist circumference, waist-hip ratio and skinfold caliper thickness.

Pilates exercises increases body awareness, posture control, correct muscle activation and improve motor skills such as strength, flexibility, agility and speed. Recent scientific studies usually implement 6-8 weeks exercise programs that aim to improve body posture, muscle strength, back activation, body stamina, body composition and physical characteristics. Pilates exercise is isometric strength exercises improving skeleton-muscle system. Regular physical activity enhances metabolic fitness parameters including glucose tolerance, insulin sensitivity and lipid metabolism. The body starts mobilizing stored body fat from fat cells and burning this fat for energy instead of glucose.

Segal et al. (2004) examined that the effect of pilates exercise on flexibility and body composition. In this study participated 31 female and 1 male adult and pilates exercise was performed one hour per week for 6 months. After 2, 4 and 6 months the test was performed three times. They found a significant increase after 6 months with initial results in flexibility but didn't find a significant change in body composition. In our study has proved that the eight – week pilates exercise to be effective in both flexibility and body composition parameters. And a second important finding of this study was that independent measures of central obesity (abdominal and supra iliac skinfolds and waist circumference and waist-hip ratio) demonstrated a strong response to effect of pilates training program and the improvements in these measures. Pilates helps to tone the core muscles especially around midsection and increasing flexibility. This shapes body and gives a leaner appearance. From the tables (anthropometry measures) we find the significant difference between pretest and posttest for weight, body mass index, waist circumference, waist-hip ratio and skinfold caliper thickness in the group A. Aerobic exercise plays a role in significant changes in body mass index, body fat mass and body mass. Aerobic adds up the exercise capability of the body to use fat as a substrate increases and total fat oxidation. In addition, there is a high correlation between the content within the muscle and insulin resistance. It may be suggested that the body mass

increases due to increased blood flow and capillary in skeletal muscle and adipose tissue.

Aerobic exercise burns up calories, which in turn help to shed excess weight. Aerobic exercise also tones muscles and improve posture. Aerobics can be done for Reducing risk of obesity, improved immune system, Improved circulation, Increased Stamina, Improved Alertness, Strengthen Heart Muscle and More Energy.

From the tables (anthropometry measures) we find the significant difference between pretest and posttest for weight, body mass index, waist circumference, waist-hip ratio and skinfold caliper thickness in the group B.

As a result, the major finding of the present study was that there was a clear response to effect of eight weeks pilates and aerobic exercises on body composition values. Besides in this study indicated that pilates and aerobic exercise training had a positive effect on all measurements at sedentary obese women.

CONCLUSION

The result of the study indicates that participant in both groups had a positive effect on reduction in body composition for 8 week period were statistically similar and, we found that the participants who underwent aerobic exercise in group B is better than the participants who underwent in pilates exercise group A in body composition.

REFERENCE

1. Garrow JS. Obesity and Related Diseases. London: Churchill Livingstone; 1988.
2. Harish Ranjani, Rajendra Pradeepa, T. S. Mehreen, Ranjit Mohan Anjana, Krishnan Anand, Renu Garg, And Viswanathan Mohan. Determinants, Consequences and Prevention of Childhood
3. George A. Bray., Medical Consequences of Obesity. The Journal of Clinical Endocrinology And Metabolism, 89 (6): 2583-2589 (2004)
4. Roland Muller. Psychological Consequence of Obesity. Ther Umsch, 70(2): 87-91, (2013)
5. Fatma Ozturk, Ozhan Bavli., Investigation of The Effects Of Eight Weeks Of Pilates And Step-Aerobic Exercises On Physical Performance And Self-Esteem Scores Of Females. International Journal of Science Culture And Sport., 5(2): 76-86, (2017)
6. June Kloubec., Pilates: How Does It Work and Who Needs It. Muscles, Ligaments and Tendons Journal, 1(2): 61-66 (2011)
7. Cakmakci O., The Effect Of 8 Week Pilates Exercise on Body Composition In Obese Women. Coll Antropol, 35 (4): 045-50 (2001)

8. Hoseni Rastegar, Hoseni Zahra, Hoseni Mehry., Effects Of Aerobic Exercise Training On Body Composition And Metabolic Syndrome Factors In Obese Male College Student. *Biology Of Exercise*, 10(2): 57-68 (21014).
9. Savkin R, Aslan Ub., The Effect Of Pilates Exercise On Body Composition In Sedentary Overweight And Obese Women. *The Journal Of Sports Medicine And Physical Fitness*, 57(11): 1464-1470 (2016).
10. Erkal Arslanoglu, Omer Senel. Effects Of Pilates Training On Some Physiological Parameters And Cardiovascular Risk Factors Of Middle Aged Sedentary Women. *International Journal Of Sport Studies*,3(2): 122-129, 2013.
11. Hyo Taek Lee, Phd, Hyun Ok Oh, Phd, Hui Seung Han, MS Kwang Youn Jin, Phd, And Hyo Lyun Roh, Phd, PT., Effect Of Mat Pilates Exercise On Postural Alignment And Body Composition Of Middle-Aged Women. *Journal Of Physical Therapy Science*, 28(6):1691–1695, (2016).
12. Professor. Philip James., Overweight and Obesity Worldwide Now estimated To Involve 1.7 Billion People. *Obesity Surgery*,13: 329-330, (2003).
13. Sayyed Mohammad Marandi, Neda Ghadiri Bahram Abadi, Gholamali Ghasemi. Effects Of Intensity Of Aerobics On Body Composition And Lipid Profile In Obese/Overweight Females. *International Journal of Preventive Medicine*, 4 (1):118-S125, (2013)
14. Saulo Maia D'avila Melo, Valdinaldo Aragao Mello, Raimundo Sotero De Menezes Filho, Fabio Almeida Santos., Effects of Progressive Increase in Body Weight on Lung Function in Six Groups of Body Mass Index, *Rev Assoc Med Bras*, 57(5): 499-505, (2011)
15. Masoumeh Azizi., The Effects Of 8-Weeks Aerobic Exercise Training on Serum Leptin in Un-Trained Females. *Procedia-Social and Behavioral Sciences*. 15: 1630-1634, (2011).
16. Cheryl M. Salome, Gregory G. King, Norbert Berend., Physiology of Obesity and Effects on Lung Function., *J Appl Physiol* 108: 206 –211, (2010).
17. D. Paladini., Sonography in Obese and Overweight Pregnant Women: Clinical, Medicolegal and Technical Issues. *Ultrasound in Obstetrics and Gynecology*. 33(6): 720-729, (2009).
18. Winnick Jj, Et Al. Short-Term Aerobic Exercise Training In Obese Humans With Type 2 Diabetes Mellitus Improves Whole-Body Insulin Sensitivity Through Gains In Peripheral, Not Hepatic Insulin Sensitivity. *J Clin Endocrinol Metab*, 93(3):771-8, (2008).
19. Shenbagavalli,A And Mary R.D. ,Effect Of Aerobic Training On Body Mass Index On Sedentary Obese Men. *Journal of Exercise Science and Physiotherapy*, 4, (2):125-128, (2008).
20. Bettylou Sherry, Phd, RD; Maria Elena Jefferds, Phd; Laurence M. Grummer-Strawn, Phd., Accuracy of Adolescent Self-Report of Height and Weight in Assessing Overweight Status Literature Review. *Arch Pediatr Adolesc Med.*, 161(12):1154-1161 (2007).
21. Spencer EA, Appleby PN, Davey GK, Key TJ., Validity of Self-Reported Height and Weight In 4808 EPIC-Oxford Participants. *Public Health Nutr*0., 5(4):561-5 (2002).
22. Lisa Marie Bernadoo, Ph.D., The Effectiveness Of Pilates Training In Healthy Adults: An Appraisal Of The Research Literature. *Journal Of Body Movement Therapy*, 11(2):106-110, (2007)
23. Lawrence De Koning, Anwar T.Merchant, Janice Pogue, Sonia S.Anand. Waist Circumference and Waist-To-Hip Ratio as Predictors of Cardiovascular Events: Meta-Regression Analysis of Prospective Studies. *Eur Heart*, 28 (7):850-856, (2007)
24. George R.Bra,y. Medical Consequences of Obesity. *The Journal of Clinical Endocrinology and Metabolism*, 89(6):2583-2589, (2004).
25. Georgine Lamvu, MD, MPH, A, Denniz Zolnoun, MD, MPH, A John Boggess, MD,B John F. Steege, Mda., Obesity: Physiologic Changes And Challenges During Laparoscopy. *American Journal of Obstetrics And Gynecology* 191: 669-74, ((2004)
26. Nicole Coosrow, Bonita Falkner., Race/Ethnic Issues in Obesity and Obesity-Related Comorbidities. *The Journal of Clinical Endocrinology and Metabolism*, 89 (6)2590-2594 (2004).
27. Nancy D. Brenner, Ph.D., Tim McManus, M.S., Deborah A. Galuska, Ph.D., Richard Lowry, M.D., M.S., And Howell Wechsler, Ed.D., M.P.H., Reliability and Validity Of Self-Reported Height And Weight Among High School Students. *journal of adolescent health*, 32:281–287 (2003).
28. U Evers Larsson And E Mattson., Perceived Disability and Observed Functional Limitations in Obese Women. *International Journal of Obesity*, 25: 1705-1712 (2001)
29. Barry M.Popkin,Ph.D., And Colleen M.Doak,M.A. The Obesity Epidemic Is A Worldwide Phenomenon. *Nutrition Reviews*, 56(4)106-114 (1998).
30. Black, Donald W; Goldstein, Rise B; Mason, Edward E., Prevalence of Mental Disorder In 88 Morbidly Obese Bariatric Clinic Patients. *The American Journal of Psychiatry*, 149(2):227-34, (1992)
31. William H. Mueller, Robert M. Malina. Relative Reliability of Circumferences and Skinfolts As Measures Of Body Fat Distribution. *American Journal of Physical Anthropology*, 72(4): 437–439, (1987)