EFFECTIVENESS OF THERABAND EXERCISES VERSUS PILATES EXERCISES ALONG WITH BASIC ABDOMINAL EXERCISES IN REDUCTION OF ABDOMINAL BELLY

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(Registration No-11300922)

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CERTIFICATE

This is to certify that the dissertation work entitled **"Effectiveness of Theraband Exercises versus Pilates Exercises along with Basic Abdominal exercises in reduction of Abdominal Belly"** has been carried out by **Ms. Vinita Verma, Registration No. 11300922,** Department of Physiotherapy, Lovely Professional University, towards partial fulfillment of the requirements of **Master of Physiotherapy (Orthopaedics) degree programme.**

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CERTIFICATE

This is to certify that Ms. Vinita Verma, Registration No: 11300922, has completed MPT Dissertation titled **"Effectiveness of Theraband Exercises versus Pilates Exercises along with Basic Abdominal exercises in reduction of Abdominal Belly"** under my guidance and supervision. I certify that this is her bonafide work. To the best of my knowledge, the present work is the result of her original investigation and study and has not been submitted for any degree to this or any other university.

The dissertation is fit for the submission and the partial fulfillment of the conditions for the award of MPT (Orthopaedics).

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DECLARATION

I hereby declare that the dissertation entitled **"Effectiveness of Theraband Exercises versus Pilates Exercises along with Basic Abdominal exercises in reduction of Abdominal Belly"** submitted for the **MPT Degree** is entirely my original work and all ideas and references have been duly acknowledged. I have adequately cited and referenced the original sources. I also declare that I have stick to the principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea, data, fact or source in my submission. I understand that any violation of the above will be cause for disciplinary action by the school and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed. It does not contain any work for the award of any other degree or diploma.

This thesis encompasses the information generated by me based on experiment work carried out in the institute. I assure and hold full responsibility for its genuineness.

Vinita Verma

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DEDICATION

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CHAPTER - 1

INTRODUCTION

There are many important functions of abdominal muscles including coughing, breathing and sneezing. They also play a major role in maintaining the posture and speech in a number of species. There are four muscle which together forms the anterior abdominal wall. They are- Rectus abdominis, Internal and External obliques and Transverse abdominis. The internal oblique and the Transverse abdominis which are the Internal muscles of abdomen respond more to increase in chemical or volume related drive as compared to the Rectus abdominis and External oblique which are the external muscles of abdomen[(1)].

When unwarranted abdominal fat around the abdomen has built up to the level that it may cause a negative impact on the heath of a person is known as Abdominal obesity. The synonyms of abdominal obesity are beer belly, pot belly or central obesity[(2)].

Usually obesity is reported in body mass index (BMI) whereas abdominal obesity in waist circumference (WC). According to recent studies which used Indian specific criteria for abdominal obesity, the waist circumference should be more than 35.37 inches (90 cm) in men and 31.44 inches (80cm) in women[(3,4)].

Women have higher rates for abdominal obesity (women: 56% and men: 35%). Abdominal obesity was found with normal BMI among 5% of men and 14% of women which is known as isolated abdominal obesity[(3)].

Abdominal obesity does not occur only in elderly and obese people[(5)]. A strong correlation has been found between the central obesity and cardiovascular diseases[(6)]. It is also related to the Alzheimer's disease as well as other metabolic and vascular diseases[(7)]. There is also a strong association of abdominal obesity and Type 2 diabetes[(8)] and high blood pressure, regardless of total body fat[(9)]. There is a term known as Diabesity which refers to the obesity found in Type-2 diabetic patients which is a very common observable fact. Metabolic syndrome includes many conditions like obesity, diabetes and hypertension[(10)].

The proportion of obese women who are married between 15-49 years of age increased from 11% to 15% according to 'National Family Health Survey'(NFHS) from NFHS-2 to NFHS-3. Under nutrition is more prevailing in rustic areas whereas obesity in metropolitan areas. Lack of physical activity in urban areas may be one of the reason. The rate of under nutrition and obesity, both are higher for women than men[(11)].

Punjab is found to have the highest percentage of obese women(30%) followed by Kerala(28%) and then Delhi(26%)[12]. The increase in generalized obesity is significantly correlated with the hypertension, hypercholesterolemia, metabolic syndrome and diabetes whereas truncal obesity is less strongly correlated with the above risk factors. Thus in Asian Indian people, the increasing cardiovascular risk factors is correlating strongly with the increasing generalized obesity[13].

The prevalence of overweight was higher among the urban areas as compared to urbanizing rural population. But there is a rapid change in the rural population regarding the living conditions which has improved a lot. Improved medical care, transport facilities, educational system and family income along with easy access to city resulted in the changes of lifestyle[14].

A study done in the year 1989 showed that these changes had led to a significant increase in BMI along with abdominal obesity in both males and females. Change in the life style of rural people was said to be a factor for the rising rates of obesity and associated metabolic diseases. The prevalence of obesity increased from 2% - 17.1%[14].

According to the India NFHS, the prevalence of overweight was less than the under nutrition in the country, as obesity was more amongst the urban and high socioeconomic status, generally in women. Because of the less physical activity and amplified intake of energy dense diet, there is an increase in the rate of obesity in urban areas in developing countries[14].

According to a survey which was done to check the obesity differences between males and females in sample of Indian population with 577 adults (270 males and 307 females) between 25-60 years of age in Delhi, India. The correlation was calculated between the systolic and diastolic blood pressure along with other indices of obesity[15].

The result of the survey showed that the rate of hypertension and pre-hypertension was high amongst males and the obesity rate was higher in females. There was a significant correlation between the blood pressure and all the indices of obesity[15].

In a comparison of the two studies conducted by NFHS-2 in 1998-1999 and NFHS-3 in 2005-2006, there was an increased prevalence of obesity among Indian women specially of the age between 40-49 years (23.7%), who lives in a city (23.5%), have a high qualification (23.8%) and

belonging to Sikh community (31.6%). The problem of under nutrition is still present in India while the additional burden of obesity is really alarming in economically good areas[16].

The incidence of the disorders related to the standard of living changes in India is of concern that occurs either individually or in a combination. Increased tendency to premature coronary artery disease (CAD) and diabetes in Indians has been certified to the Asian Indian Phenotype which is characterized by less generalized obesity which is measured in terms of BMI and abdominal obesity by more waist circumference and waist-hip ratio[17].

In spite of having a lean BMI, an Indian adult has more probability of having central obesity. Indians have appreciably higher body fat percentage than a western with the same blood glucose level and BMI. It can be concluded that less muscle mass and increased body fat may explain the high risk of type-2 diabetes and high prevalence of hyperinsulinemia in Asian Indians[18].

The powerful and perceptive imaging techniques were discovered in the late 1980s and early 1990s that would help to progress our understanding about the health risks related with the buildup of the body fat. Techniques like CT Scan and MRI imaging made it possible to classify mass of adipose tissue located at the abdominal level into intra abdominal fat and subcutaneous fat[19].

Abdominal muscles can be build through the abdominal exercises which is essential for improving the performance with certain sports, back pain and for withstanding abdominal impacts like taking punches. A study was done in 2011 which showed that abdominal exercises increases the strength and endurance of the abdominal muscles[20].

In order to prevent obesity, regular physical activity is very important. It helps in improving the health and decreasing the visceral and abdominal subcutaneous adipose tissue. Specific training programs have resulted in the change in body composition. Endurance training along with resistance training helps in improving the body composition by reducing the fat mass and increasing the total lean mass[21].

A similar study done in the year 2006 showed that the abdominal exercises reduced the size of the subcutaneous abdominal fat cells as Type-2 diabetes is predicted by the size of a cell.

Moderate exercises helped to decrease the cell size by 18% in about 45 obese females over a 20 weeks period whereas diet alone did not found to be as effective to reduce the cell size[20].

A study showed that the indicators of metabolic syndrome can be improved like decrease in the blood sugar level and insulin level and increase in the physical fitness by performing the combined exercises which includes the resistance exercises and aerobic exercises for a middle aged women[22].

Theraband exercises has proved to increase the strength, mobility and function along with the decrease in the joint pain[75]. Therabands are colour coded bands which shows the level of resistance and according to it we can plan a treatment program depending upon an individual's strength. Change in the colour of the band signifies the progress and improvement in the strength of muscles[23].

There are studies which shows that the visceral adipose tissue(VAT) can be decreased in obesity independent of weight loss through the exercises[24,25]. The recent studies showed that the increase in the muscle mass can be attained through resistance training which helps in decreasing the insulin resistance[26], blood lipid profiles are also improved in obese patients with diabetes and cardiovascular diseases[27,28] and it also decreases the visceral fat[29].

Resistance band training improves the strength of a person according to the personal physical condition and provides a proper and individualized load by increasing the band resistance gradually as the muscle strength increases. Along with it, resistance band training is also found to be an effective exercise protocol in order to increase the muscle strength without putting much stress on each muscle or joint[30,31].

Pilates exercises are a form of body mind exercises where the focus is on the controlled movement , posture and breathing[32]. They help in improving the flexibility, strength and endurance in human body as a whole[33]. Pilates system allows the modification of different exercises by increasing their difficulty level form beginning to advanced. Intensity of the exercises can be increased as the body conditions adapts to the exercises[76].

Pilates builds endurance within individual exercises and also within workouts. These exercises focus on improving one's concentration in order to build the strength for both whereas endurance

is improved from mental strength and therefore require determination and persistence. Pilates strengthens the complete body targeting each muscle group with a mixture of dynamic and static strength training evenly. The muscles work from many different directions causing a uniform and very deep strength and tone even without using heavy weights [34].

1.2 Need of the study

No study has been done to compare the theraband and pilates exercises in reduction of abdominal belly, so present study was designed to find out the better exercise protocol to reduce abdominal belly and to improve strength and endurance of abdominal muscles.

1.3 Significance of the study

This research will help in giving some concrete baseline information about the effectiveness of theraband exercises versus pilates exercises in the reduction of abdominal belly and improving the abdominal muscles strength and endurance.

1.4 Aims and Objectives

- To find out the effectiveness of theraband exercises in reduction of abdominal belly and improving abdominal muscles strength and endurance.
- To find out the effectiveness of pilates exercises in reduction of abdominal belly and improving abdominal muscles strength and endurance.
- To compare the effectiveness of theraband exercises and pilates exercises in reduction of abdominal belly and improving abdominal muscles strength and endurance.

1.5 Hypothesis

1.5.1 Alternative hypothesis

There is significant difference between theraband exercises and pilates exercises in reducing the abdominal belly and improving the abdominal muscles strength and endurance.

1.5.2 Null hypothesis

There will be no significant difference between theraband exercises and pilates exercises in reducing the abdominal belly and improving the abdominal muscles strength and endurance.

1.6 Operational Definitions

1.6.1 Abdominal obesity

When excessive abdominal fat has built up around the abdomen in a way that it puts a negative impact on the health of a person[(2)].

1.6.2 Muscular strength

It is the ability of a muscle to produce tension and a resultant force according to the demands placed on the muscle[(35)].

1.6.3 Muscular endurance

It can be defined as the ability of a muscle in order to perform low intensity, repetitive or sustained activities over a prolonged period of time[35].

1.6.4 Theraband

Resistive exercises has proved to increase the strength, mobility and function along with the pain in the joint[75]. Therabands come in colour-coded resistance levels so we can plan a program and select the suitable resistance level. Colour change shows our progress, as we work our way through the different levels[23].

Colour	Resistance
Tan	extra thin
Yellow	Thin
Red	Medium
Green	Heavy
Blue	extra heavy
Black	special heavy
Silver	super heavy

1.6.5 Pilates exercises

They are a set of body mind exercises which focus on a controlled movement, posture and breathing[32]. They progress flexibility, develops control and endurance and builds strength[33]. Exercises can be modified from beginning to highly developed level of difficulty. As body conditions adapt to the exercises, the intensity of the exercises can be increased[76].

There were original six principles of pilates which includes concentration, control, center, flow, precision, and breathing[36].

1. **Concentration**

Intense focus is demanded in Pilates. Concentrate on what is done all the time and on your body for the smooth movements. The technique of exercises done is more important than the exercises themselves[37].

2. Control

All the exercises should be done with control with the muscles functioning against the gravity to lift[38].

3. Centering

To control the body during the exercises, starting place is needed: the center. The center a crucial point of the Pilates Method[39].

4. Flow or efficiency of movement

The aim of Pilates for the adequacy of movement, causing the flow during the use of appropriate transitions. Once accuracy has been achieved, the exercises are intended to flow within and into each other in order to build strength and stamina[40].

5. Precision

Precision is necessary to correct Pilates: concentrate on the proper movements each time you exercise, if you do them improperly and you lose all the vital benefits of their value [41].

6. Breathing

Breathing is essential in the Pilates method. Pilates saw the forced exhalation as the key to full inhalation. In Pilates exercises, the practitioner breathes out with the effort and in on the return[42].

1.6.7 Body fat percent

It is measured with the help of skin fold caliper. The skin fold thickness is taken from three sites and then put into the formula to measure body fat percent[43]. Formula for calculating body density is-

Men-

Three-Site Formula (chest, abdomen, thigh)

Body Density = 1.10938 - 0.0008267 (sum of three skinfolds) + 0.0000016 (sum of three skin folds)2 - 0.0002574 (age)

Women-

Three-Site Formula (triceps, suprailiac, abdominal)

Body Density = 1.089733 - 0.0009245 (sum of three skin folds) + 0.0000025 (sum of three skin folds)2 - 0.0000979 (age)

Formula for calculating body fat percent-

% Body Fat = 495/BD – 450

CHAPTER – 2

REVIEW OF LITERATURE

This chapter deals with the view of literature associated with the abdominal belly, the effect of theraband and pilates exercises on its reduction and improvement in the abdominal muscles strength and endurance. It also talks about the various strategies to reduce abdominal belly and improve endurance and strength.

Alexandre Wesley et al. (2015) studied about the pilates breathing technique increases the electromyographic amplitude level of the deep abdominal muscles in untrained people and concluded that the activation amplitude level of TrA/IO significantly increased compared with all the other muscles[(44)].

Jamil Natour et al. (2015) studied about the pilates improves pain, function and quality of life in patients with chronic low back pain and concluded that the pilates method can be used by patients with low back pain to improve pain, function and aspects related to quality of life (functional capacity, pain and vitality). Moreover, this method has no harmful effects on such patients[(45)].

Devon A Dobrosielski et al. (2014) studied about the Effect of exercise on abdominal fat loss in men and women with and without type 2 diabetes and concluded that participants with and without T2DM attained an exercise training effect as evidenced by increased fitness[(46)].

Jorge Perez-Gomez et al. (2013) studied the effect of endurance and resistance training on regional fat mass and lipid profile and concluded that ten weeks of endurance training decreased abdominal and body fat in young men, while 10-week of resistance training increased total lean mass[(21)].

M Fourie et al. (2013) studied the effects of a mat pilates programme on body composition in elderly women and concluded that mat pilates exercise programme may contradict or even reverse some of the most serious consequences of ageing associated with an increased fat mass and reduced lean body mass in elderly females[(47)].

Dalia M. Kamel et al. (2013) studied effect of abdominal versus pelvic floor muscle exercises in obese Egyptian women with mild stress urinary incontinence(SUI) and concluded that abdominal

muscle strength training programme is superior to pelvic floor strength training for the treatment of mild SUI in obese patients[48].

Evrim Cakmaker et al. (2012) studied the effects of 10 weeks pilates mat exercises program on weight loss and body composition for overweight Turkish women and concluded that modern pilates mat exercises contributed to increase quality of life for sedentary overweight women[49].

S. Venugopal et al. (2012) studied the effects of pilates training and yogic training with and without combination on selected physical fitness components among college level obese students and concluded that there was significant improvement on percent body fat and flexibility of experimental groups when compared to the control group[50].

Pardis Noormohammadpour et al. (2012) studied about the effect of abdominal resistance training and energy restricted diet on lateral abdominal muscles thickness of overweight and obese women and concluded that abdominal resistance training and energy restricted diet in addition to weight loss lead to improvement of transabdominal muscles thickness in obese and overweight people[51].

SoJung Lee et al. (2012) studied about the effects of aerobic versus resistance exercise without caloric restriction on abdominal fat, intrahepatic lipid, and insulin sensitivity in obese adolescent boys and concluded that both aerobic exercises and resistance exercises alone are effective for reducing abdominal fat and intrahepatic lipid in obese adolescent boys. Resistance exercises is also associated with significant improvements in insulin sensitivity[52].

Ian A.F. Stokes et al. (2011) studied whether the abdominal muscle activation increases lumbar spinal stability and concluded that abdominal muscle exercise regimens can be proposed for low back pain rehabilitation[53].

Duncan J. Critchley et al. (2011) studied the effect of pilates mat exercises and conventional exercise programmes on transversus abdominis and obliqus internus abdominis activity and concluded that there were no changes in muscle thickness at rest or during functional postures. Pilates training appears to increase TrA activity but only when performing pilates exercises[54].

Barbara Strasser et al. (2010) studied about the resistance training in the treatment of the metabolic syndrome and concluded that resistance training reduces total body fat mass and visceral adipose tissue independently from dietary restriction[55].

Hwi Ryun Kwon et al. (2010) studied the effects of resistance training on muscle and body fat mass and muscle strength in Type 2 Diabetic Women and concluded that the low intensity resistance training was effective in increasing muscle mass and strength and reducing total fat mass without change of insulin sensitivity in type 2 diabetic patients[56].

Cris A. Slentz et al. (2009) studied about the exercise, abdominal obesity, skeletal muscle, and metabolic Risk and concluded that exercise in sufficient amounts can lead to substantial decreases in body weight, total body fat, and visceral fat[57].

Suoma E. Saarni et al. (2009) studied about the association of smoking in adolescence with abdominal obesity in adulthood and concluded that Smoking is a risk factor for abdominal obesity among both genders and for over weight in women. The prevention of smoking during adolescence may play an important role inpromoting healthy weight and in decreasing the morbidity related to abdominal obesity[58].

Y Ye et al. (2009) studied about the identification of waist circumference cutoffs for abdominal obesity in the Chinese population and concluded that visceral adipose tissue(VAT) cutoff of 90 cm^2 is useful for defining visceral obesity in Chinese individuals. The appropriate waist circumference cutoff for abdominal obesity are 88 cm for men and 82 cm for women in Chinese population[59].

Crystal Man Ying Lee et al. (2008) studied about the indices of abdominal obesity are better discriminators of cardiovascular risk factors than BMI and concluded that the measures of central obesity especially waist to height ratio is superior for detecting cardiovascular risk factors in both men and women[60].

Betu l Sekendiza et al. (2007) studied the effects of Pilates exercise on trunk strength, endurance and flexibility in sedentary adult females and concluded that Modern Pilates mat exercises contributed to increased quality of life in sedentary adult females through improvements in abdominal and lower back strength, posterior trunk flexibility and abdominal muscular endurance[(61)].

Betul Sekendiz et al. (2007) studied about the effects of pilates exercises on trunk strength, endurance and flexibility in sedentary adult females and concluded that there is positive effect of pilates exercises on abdominal and lower back muscular strength and abdominal muscular endurance[(62)].

Bryan J. Taylor et al. (2006) studied about the Exercise-induced abdominal muscle fatigue in healthy humans and concluded that dynamic lower limb exercise elicits abdominal muscle fatigue in normal subjects with a broad range of fitness[(63)].

Aviva Must et al. (1999), a graded increase in the prevalence ratio (PR) was observed with increasing severity of overweight and obesity for all of the health outcomes except for coronary heart disease in men and high blood cholesterol level in both men and women. Based on the results, more than half of all US adults are considered overweight or obese. The prevalence of obesity-related comorbidities emphasizes the need for concerted efforts to prevent and treat obesity rather than just its associated comorbidities[(64)].

Melinda S. Sothern et al. (1999) studied about the inclusion of resistance exercises in a multidisciplinary outpatient treatment program for preadolescent obese children and concluded that it can safely be included in the treatment program[(65)].

Mohamed-Ali et al. (1998) concluded that the amount of visceral adipose tissue can be reduced by physical activity, which is also seen as an important mechanism of how physical activity is associated with a better cardiovascular risk factor profile[(66)].

***Tremblay (*1994)** studied impact of exercise intensity on body fatness and skeletal muscle metabolism who reported that high-intensity intermittent exercise training induced greater

subcutaneous fat loss compared to moderate-intensity exercise training under isocaloric training conditions[67].

CHAPTER – 3

MATERIALS and METHODS

3.1 Study Design

Experimental design with comparative in nature.

3.2 Study Setting

Department of Physiotherapy, Shri Baldev Raj Mittal Hospital, Lovely Professional University, Phagwara , Punjab .

3.3 Population and Sampling

Normal sedentary people with varying Body Mass Index (BMI) were taken. A sample of convenience of sixty adults took part in this study. Subjects who fulfilled the inclusion criteria and were ready to attend the exercise program regularly were selected. Subjects were divided into two groups- group A (n=30) and group B (n=30).

3.4 Selection Criteria

3.4.1 Inclusion criteria

- Waist circumference should be 35 inches in Males and 31 inches in Females.
- Healthy asymptomatic adults of age 20-40 years (males and females)
- Community dwelling adults and not institutionalized or hospitalized.
- Subjects who are able to ambulate independently without assistive devices.

3.4.2 Exclusion criteria

- Unstable and limiting cardiac disease, history of cardiac surgery
- History of Neurological disease with residual impairments
- Permanent history of dizziness.
- Subjects who had uncorrected hearing or visual impairment.
- Subjects who were receiving physical therapy or any exercise programme at the same time.
- Irregular to attend the exercise programme.

3.5 Parameters

- Body fat percent
- Waist Circumference
- Waist-Hip ratio
- Strength of abdominal muscles
- Endurance of abdominal muscles

3.6 Instruments and Tools

- Weighing machine
- Standardized measuring tape
- Skin fold caliper - It is usually the least expensive and is generally available. The specific areas of skin are pinched(and fat) all through the body and then converted to body fat percentage.

  The reliability coefficients ranged from 0.62 to 0.85 for the individual sites and from 0.79 to 0.91 for the sums of the three measurements and for the estimates of the percentage of body fat[(68)].

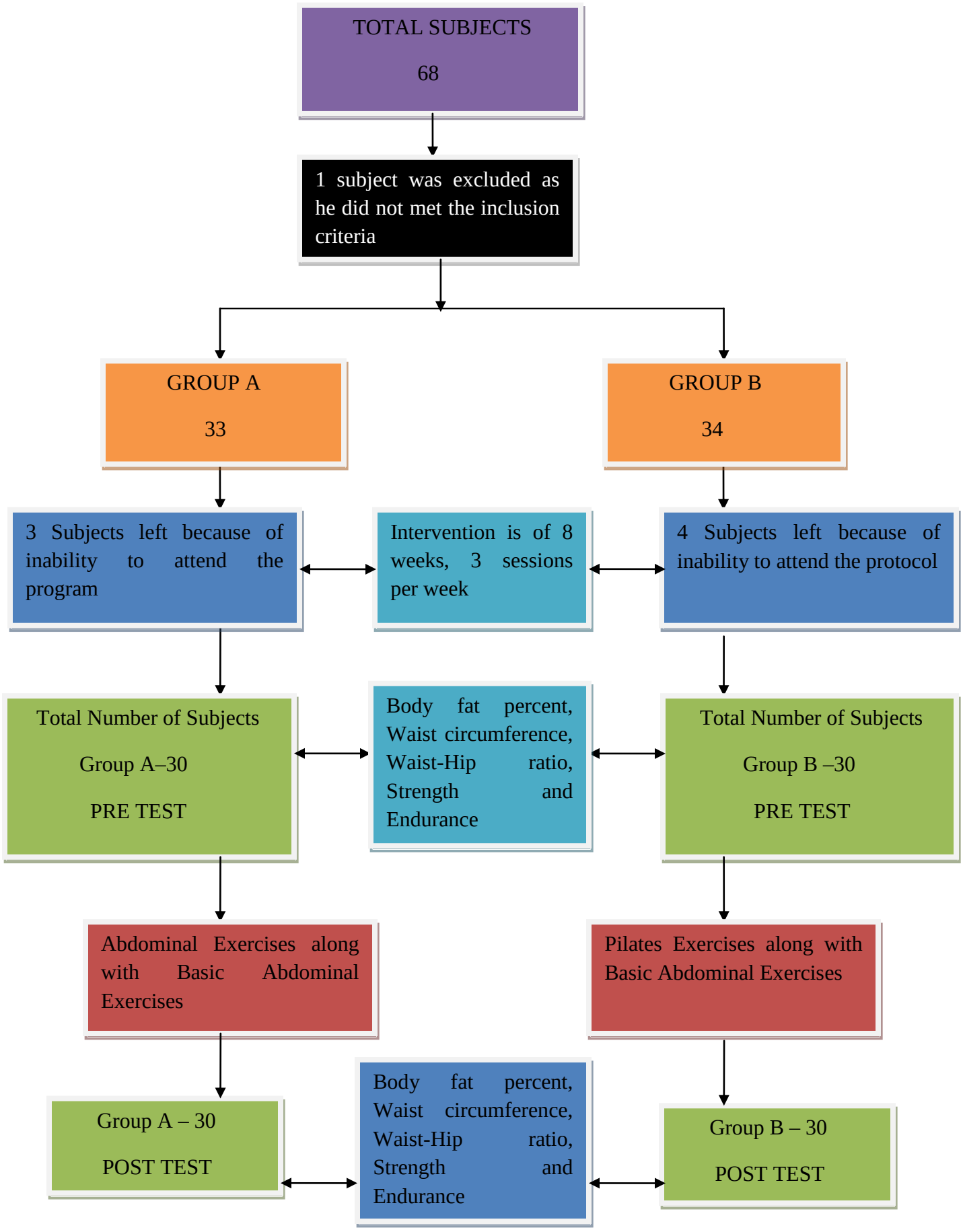
- Therabands

3.7 Procedure

The study was designed in which 60 subjects with significant abdominal belly were included in the study after taking a consent form from them. Subjects were assessed for the inclusion and exclusion criteria and were divided into 2 groups – group A and group B by convenient sampling.

Group A received theraband exercises along with basic abdominal exercises and Group B received pilates exercises along with basic abdominal exercises.

The pretest readings of body fat percent, waist circumference, waist-hip ratio, abdominal strength and endurance were recorded before giving the intervention. Then the intervention was given for eight weeks; 3 days a week. After the intervention posttest readings of body fat percent, waist circumference, waist-hip ratio, abdominal strength and endurance were recorded and compared.


TOTAL SUBJECTS
68
1 subject was excluded as he did not met the inclusion criteria
GROUP A
33
GROUP B
34
3 Subjects left because of inability to attend the program
Intervention is of 8 weeks, 3 sessions per week
4 Subjects left because of inability to attend the protocol
Total Number of Subjects
Group A–30
PRE TEST
Body fat percent, Waist circumference, Waist-Hip ratio, Strength and Endurance
Total Number of Subjects
Group B –30
PRE TEST
Abdominal Exercises along with Basic Abdominal Exercises
Pilates Exercises along with Basic Abdominal Exercises
Group A – 30
POST TEST
Body fat percent, Waist circumference, Waist-Hip ratio, Strength and Endurance
Group B – 30
POST TEST

Group A : Theraband exercises

Serial no.	Theraband exercises	Repetitions
1	Lunge	10
2	Squat	10
3	Lower Abdominal Crunch	10
4	Trunk Curl- up	10
5	Side Bend	10

Lunge

• Lie the band on the floor and stand in the middle of the band with one foot. The ends of the band is grasped around the hands at the chest level with the elbows slightly bent.

• The other leg should be placed behind with knee slightly bent.

• Bent the front knee while keeping the trunk straight and then lower the body downward.

• Return to the upright position slowly and then repeat it again.

Squat

• Stand upright on both legs.

• The band is placed under the feet.

• The ends of the band is held in both the hands with elbow straight.

• Knees to be bent upto 90º.

• In order to put more tension, pull the band.

• Then the knees are straightened.

• Repeat it slowly.

Lower Abdominal Crunch

• Lie on your back keeping both the knees and hips flexed. Take the band stretching it over the knees and then cross it beneath.

• The ends of the band are held in both the hands keeping the elbow straight and arms at the sides.

• Hips are lifted upward off the floor along with the knees.

• Hold the position and then return to the starting position slowly.

Trunk Curl-up

• The ends of the band are firmly fixed to a still entity near the floor.

• With the knees bent, lie on the floor and holding the ends of the band in both the hands with the elbow straight and arms in front.

• Lift the shoulder blades off the floor, curling the trunk upward while keeping both the hands together.

• Hold the position and then return slowly to the starting position.

Side Bend

• If we are bending towards the left side, then stand upright with one end of the band under the right foot and the other end grasped around hand of the same side.

• While keeping the elbow straight bent towards the left side.

• Then return to the starting position and repeat again.

Group B : Pilates exercises

Serial no.	Pilates exercises	Repetitions
1	Double Leg Stretch	10
2	Mat Roll up	5
3	Four Point Kneeling Opposite Arm & Leg Raise	10
4	Upper Body Extension (Dart)	10
5	Criss Cross	10

Double Leg Stretch

- Lie on your back keeping the legs straight. Arms should be rested along the sides and the shoulders should touch the ground.
- Draw abs and inhale deeply. Bend the head forward till the chin rests on the chest and at the same time lift both the legs for about 2-6 inches from the floor. Take both the arms above the head in line with the ears.
- During exhalation, bring both the knees towards the chest grasping around with both the hands.
- Then again go for inhalation and return to the extended position.

Mat - Roll Up

- Keeping both the arms in extended position above the head, lie down on your back.
- Then inhale deeply and lift the arms above the floor and then exhale and sway into a C curve.
- Inhale while returning back to the extended position.

Four Point Kneeling Opposite Arm & Leg Raise

- The starting position is a four point kneeling position. Draw the abdominals and inhale.
- Extend one leg behind and exhale simultaneously. Keep the trunk straight. Extend the leg as much possible, then gently bring the leg to the starting position and inhale.
- After the 5 leg lifts on each side, lift the arm at the same time. If the left leg is lifted then simultaneously lift the right arm.
- Maintain the position along with the drawing of the abdominals.

Upper Body Extension (Dart)

- Lie on front with forehead touching the mat.
- Arms are relaxed at the sides.
- Lift the navel from the mat along with the hands and reach to the wall behind.
- While lifting the chest inhale.

Criss Cross

- Lie on the floor with both the knees extended and arms resting at the sides. Shoulders are relaxed completely.
- Inhale while drawing the abdominals and bent both the knees in such a position that both the knees make an angle of 90º.
- Consign the hands behind your head, elbows should be straight. Lift the head forward such that the shoulder blades lift off the floor.
- Deeply exhale and then extend the left leg keeping it raised off the mat. Rotate the trunk towards right in such a way that the left armpit reaches towards the right knee.

- Inhale while coming back to the starting position.
- Repeat it with the opposite leg.

Group A and B: Basic Abdominal exercises

Serial no.	Abdominal exercises	Repetitions	Hold time
1	Pelvic Tilting	10	5 sec.
2	Partial Abdominal Curls	10	3 sec.
3	Diagonal Abdominal Curls	10	3 sec.
4	Lower Abdominal Exercise	10	5 sec.

We will increase the number of sets to 3 as the lower abdominal muscles become stronger.

Pelvic Tilting

- Lie on back with both the knees bent and feet flat on the floor.
- Lightly draw the abdominal muscles in order to press the arch of the back into the floor.
- This position is held for 5 seconds.
- Repeat it for 10 times.

Partial Abdominal Curls

- Lie straight with the back on the floor, both the knees bent and feet flat on the floor.
- Grasp both the hands behind the neck with both the elbows straight.
- Gradually lift the shoulder blades off the floor and tighten the abdominal muscles. The neck should not bend.
- The position is held for 3 seconds.
- Then slowly return to the starting position.Slowly
- Repeat this for 10 times.

Diagonal Abdominal Curls

- Lift the shoulder blades off the floor keeping the abdominal muscles tight and then rotate the trunk towards left side.
- Hold this position for 3 seconds.
- Return to the starting position slowly.
- Repeat this with the rotation towards the opposite side.
- Repeat this for 10 times on each side.

Lower Abdominal Exercise

- Lie on back with both the knees bent and feet flat on the floor.
- The feet are lifted off the floor in such a way that the knees face the ceiling.
- Lower the right foot slowly that it hardly touches the floor.
- Again bring the right foot back up.
- Repeat this with the other foot for 10 times with each foot.

Figure 3.1- Patient performing squat with the theraband

Figure3.2- Patient performing lunges with the theraband

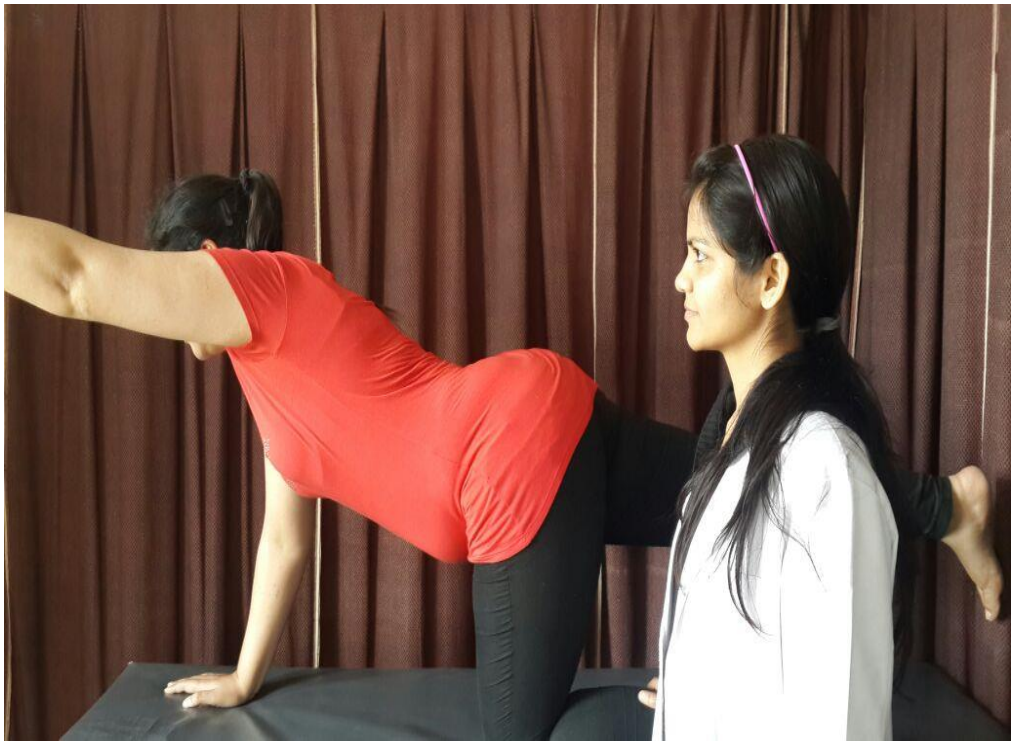


Figure3.3- Patient performing four point kneeling with opposite arm and leg raise

3.8 Statistical Tool

Statistics were performed using SPSS 19 software. To analyze the difference between the reduction of the abdominal belly in Group A and Group B, a student's t-test was used. Intra-group analysis between the pre intervention and post intervention scores was also done for both the groups. A significance level of $p < 0.05$ was fixed.

Mean: Using statistical formula for the mean, for a given number of subjects, mean of different age groups and parameters were calculated by:

$\bar{X}=\sum X/n$

Where, n= number of subjects

X=each subjects value

Standard deviation (σ):

$s= \sqrt{\sum x^2}/N$

x = deviation of score from mean

N= number of subjects

Paired t-test: For within group comparison

Formula :

$t=(\bar{X}_D-\mu_0)/(s_D/\sqrt{n})$

X_D= average

s_D= standard deviation

μ_0=constant

Unpaired t-test : for between group analysis

Formula :

$t = \bar{X}_1 - \bar{X}_2 / S_{X1X2} \cdot \sqrt{1/n_1 + 1/n_2}$

S_{X1X2}=standard deviation

n_1 = number of participants in group 1

n_2 = number of participants in group 2

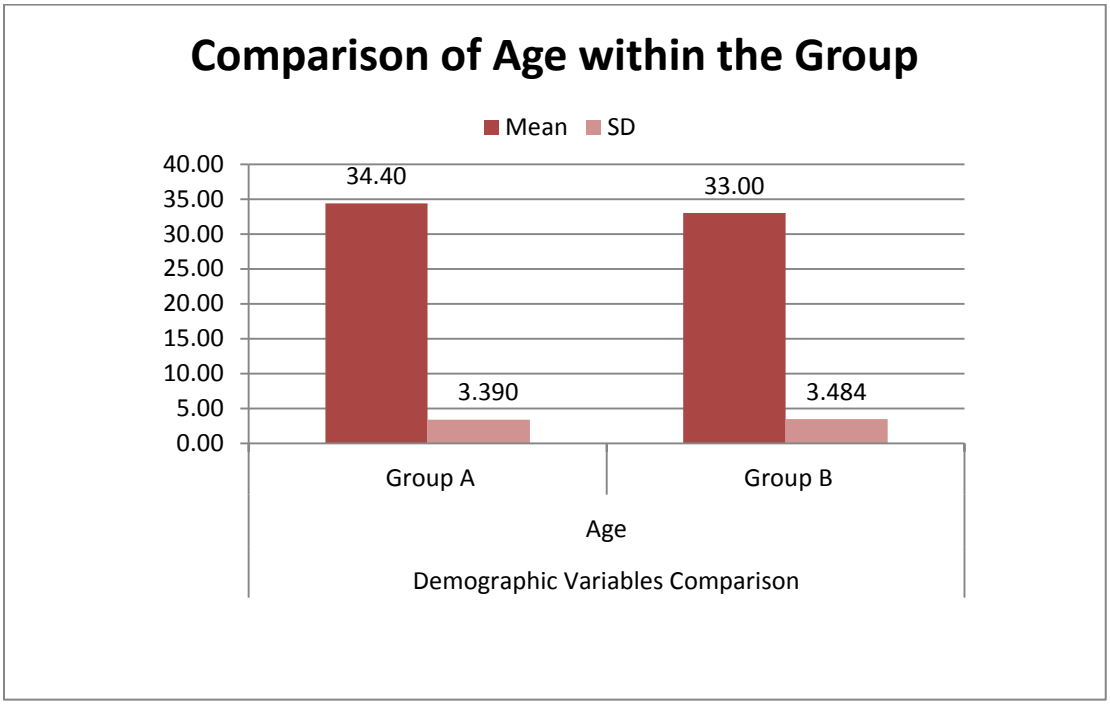
CHAPTER – 4

DATA ANALYSIS AND RESULTS

Table 4.1: Mean and SD of age for the subjects of Group A and Group B

Variable	Group	Mean	S.D.	t- value	P value	Result
Age	Group A	34.40	3.390	1.580	0.1201	Not-Significant
	Group B	33.00	3.484			

Comparison of mean and standard deviation of subject's age between the Group A (Theraband exercises Group) and Group B (Pilates exercises Group). The mean age of group A was 34.40±3.39 and that of group B was 33.00±3.48 respectively. The unpaired t test value was 1.580 ($p>0.05$). There was no significant difference in the age group.

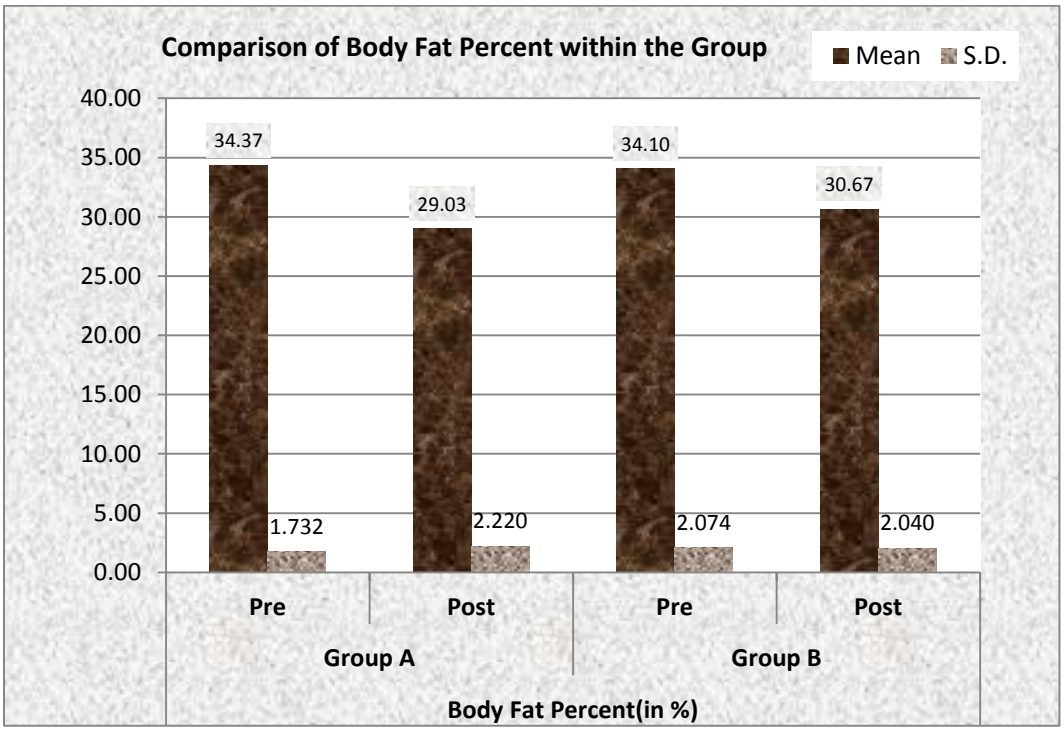


Graph 4.1: Demonstrates the comparison of mean value and standard deviation of age between Group A and Group B.

Table 4.2: Mean and SD of body fat percent within the Group A and Group B

Body fat percent		Mean±SD	t- Value	P Value	Result
Group A	Pre Test	34.37±1.732	22.100	0.0000	Significant
	Post Test	29.03±2.220			
Group B	Pre Test	34.10±2.074	23.010	0.0000	Significant
	Post Test	30.67±2.040			

Paired T Test was done to check the changes within the groups (Group A and Group B). For Group A mean and S.D value of body fat percent for Pre Test was 34.37±1.732 and for Post Test was 29.03±2.220. For Group B, mean and S.D values of body fat percent for Pre Test was 34.10±2.074 and for Post Test was 30.67±2.040. The results for the variables were significant which showed that there was significant changes within the Group A and Group B.

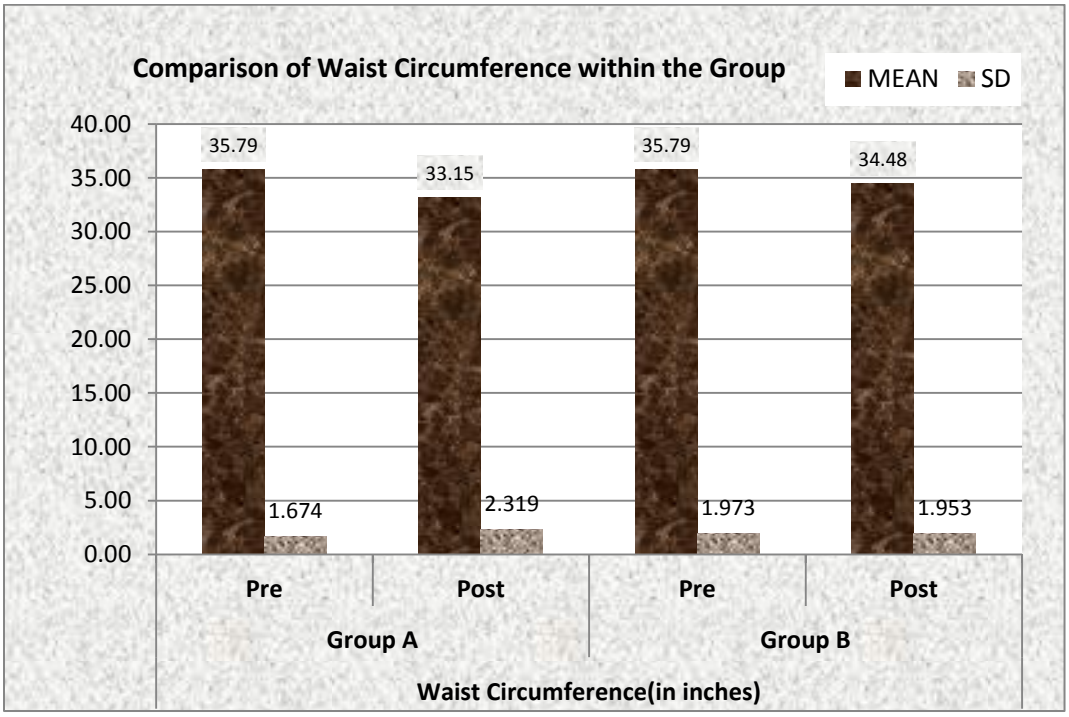


Graph 4.2: Demonstrates the comparison of mean value and standard deviation of body fat percent within the Group A and Group B.

Table 4.3: Mean and SD of waist circumference within the Group A and Group B

Waist circumference		Mean±SD	t- Value	P Value	Result
Group A	Pre Test	35.79±1.674	9.940	0.0000	Significant
	Post Test	33.15±2.319			
Group B	Pre Test	35.79±1.973	8.750	0.0000	Significant
	Post Test	34.48±1.953			

Paired T Test was done to check the changes within the groups (Group A and Group B). For Group A mean and S.D values of waist circumference for Pre Test was 35.79±1.674 and for Post Test was 33.15±2.319. For Group B, mean and S.D values of waist circumference for Pre Test was 35.79±1.973 and for Post Test was 34.48±1.953. The results for the variables were significant which showed that there was significant changes within the Group A and Group B.

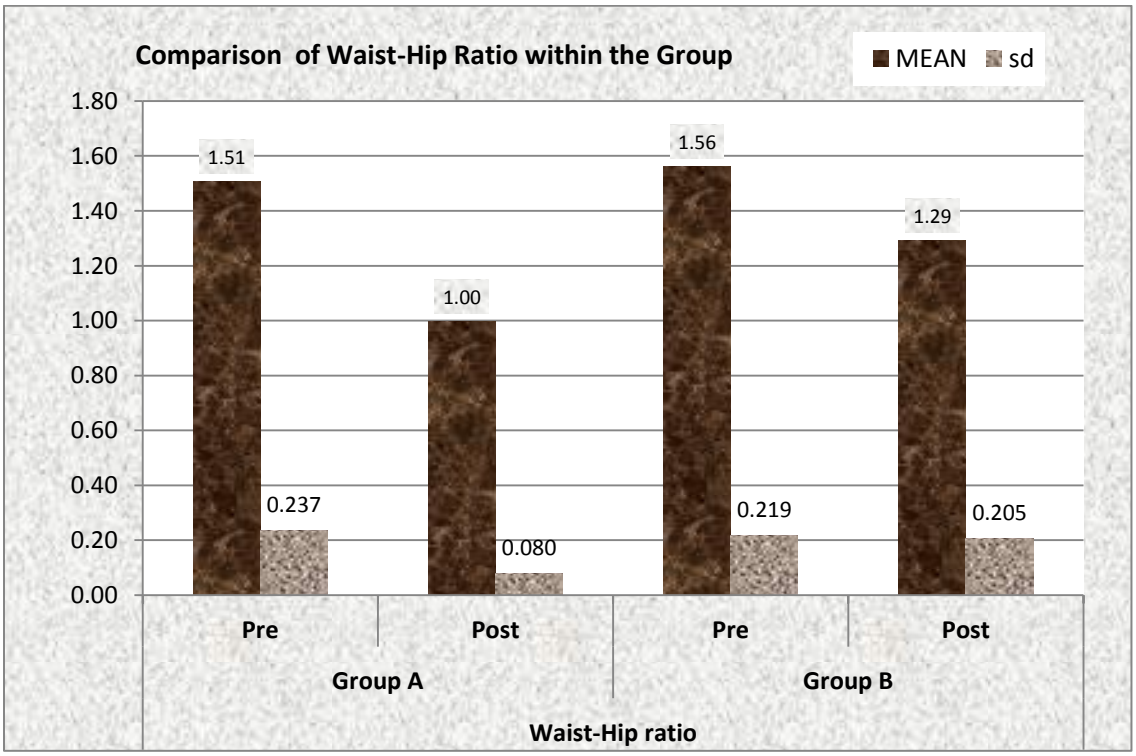


Graph 4.3: Demonstrates the comparison of mean value and standard deviation of waist circumference within the Group A and Group B.

Table 4.4: Mean and SD of waist-hip ratio within the Group A and Group B

Waist-Hip ratio		Mean±SD	t- Value	P Value	Result
Group A	Pre Test	1.51±0.237	12.050	0.0000	Significant
	Post Test	1.00±0.080			
Group B	Pre Test	1.56±0.219	6.670	0.0000	Significant
	Post Test	1.29±0.205			

Paired T Test was done to check the changes within the groups (Group A and Group B). For Group A mean and S.D values of waist-hip ratio for Pre Test was 1.51±0.237 and for Post Test was 1.00±0.080. For Group B, mean and S.D values of waist-hip ratio for Pre Test was 1.56±0.219 and for Post Test was 1.29±0.205. The results for the variables were significant which showed that there was significant changes within the Group A and Group B.

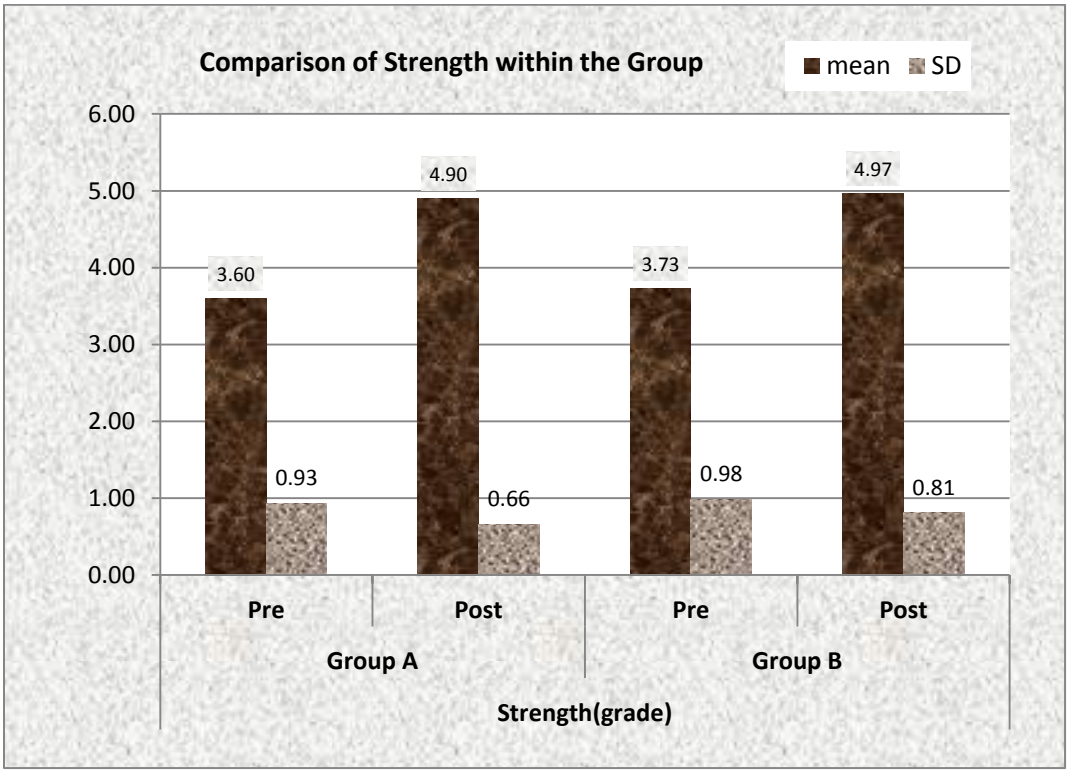


Graph 4.4: Demonstrates the comparison of mean value and standard deviation of waist-hip ratio within the Group A and Group B.

Table 4.5: Mean and SD of strength within the Group A and Group B

Strength		Mean±SD	t- Value	P Value	Result
Group A	Pre Test	3.60±0.93	8.120	0.0000	Significant
	Post Test	4.90±0.66			
Group B	Pre Test	3.73±0.98	9.950	0.0000	Significant
	Post Test	4.97±0.81			

Paired T Test was done to check the changes within the groups (Group A and Group B). For Group A mean and S.D values of strength for Pre Test was 3.60±0.93 and for Post Test was 4.90±0.66. For Group B, mean and S.D values of strength for Pre Test was 3.73±0.98 and for Post Test was 4.97±0.81. The results for the variables were significant which showed that there was significant changes within the Group A and Group B.

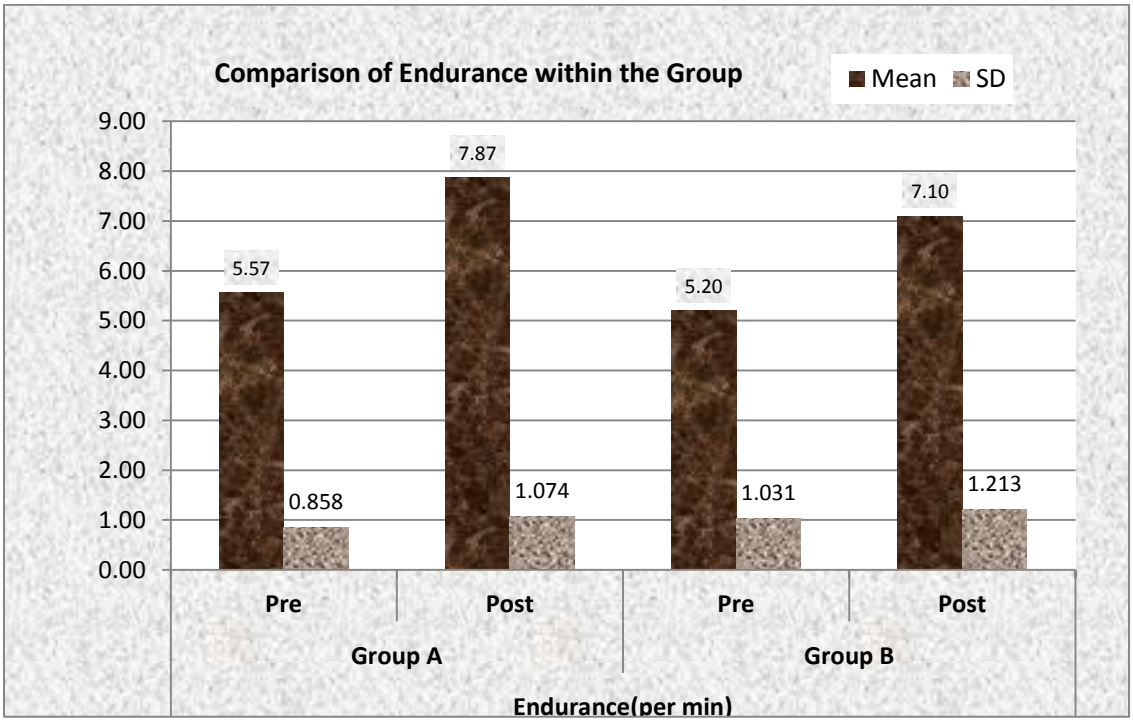


Graph 4.5: Demonstrates the comparison of mean value and standard deviation of strength within the Group A and Group B.

Table 4.6: Mean and SD of endurance within the Group A and Group B

Endurance		Mean±SD	t- Value	P Value	Result
Group A	Pre Test	5.57±0.858	13.760	0.0000	Significant
	Post Test	7.87±1.074			
Group B	Pre Test	5.20±1.031	9.250	0.0000	Significant
	Post Test	7.10±1.213			

Paired T Test was done to check the changes within the groups (Group A and Group B). For Group A mean and S.D values of endurance for Pre Test was 5.57±0.858 and for Post Test was 7.87±1.074. For Group B, mean and S.D values of endurance for Pre Test was 5.20±1.031 and for Post Test was 7.10±1.213. The results for the variables were significant which showed that there was significant changes within the Group A and Group B.

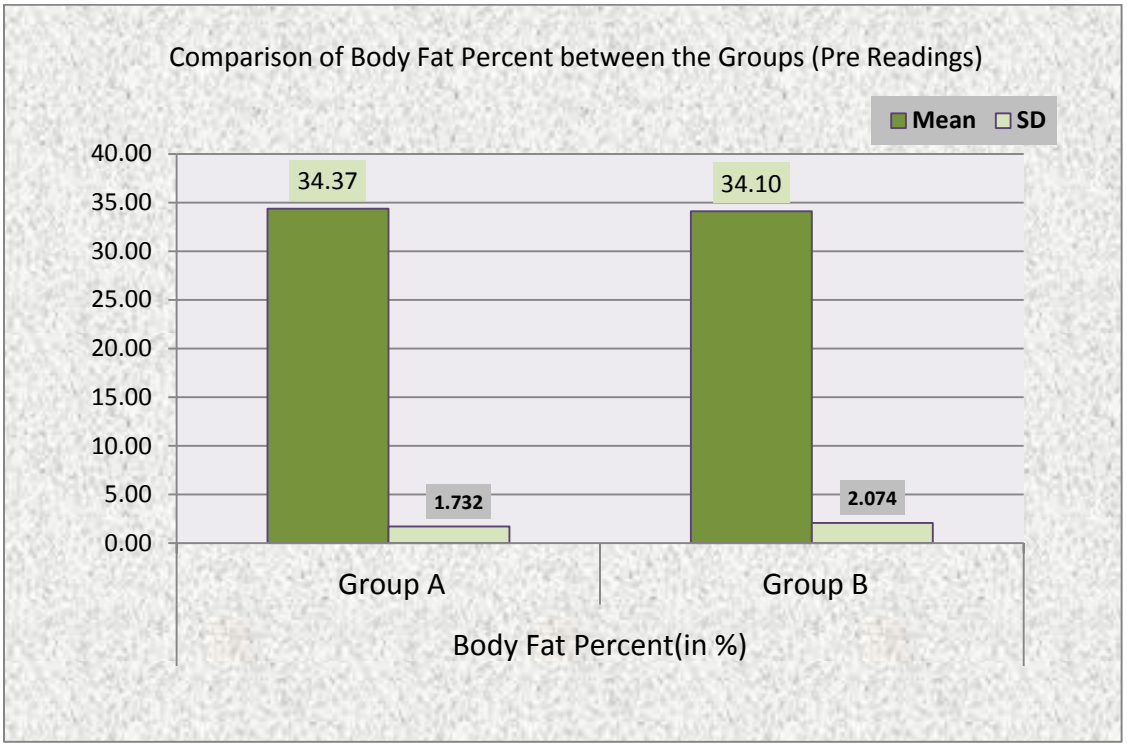


Graph 4.6: Demonstrates the comparison of mean value and standard deviation of endurance within the Group A and Group B.

Table 4.7: Mean and SD of body fat percent for the subjects of Group A and Group B (Pre Readings)

Pre test	Group	Mean	S.D.	t- value	P value	Result
Body Fat Percent (in %)	Group A	34.37	1.732	0.540	0.5908	Not-Significant
	Group B	34.10	2.074			

Comparison of mean and standard deviation of body fat percent between the pre readings of Group A and Group B. The mean of body fat percent of group A was 34.37±1.73 and of group B was 34.10±2.07 respectively. The unpaired t- test value was 0.540 ($p>0.05$). There was no significant difference in the body fat percent between the groups.

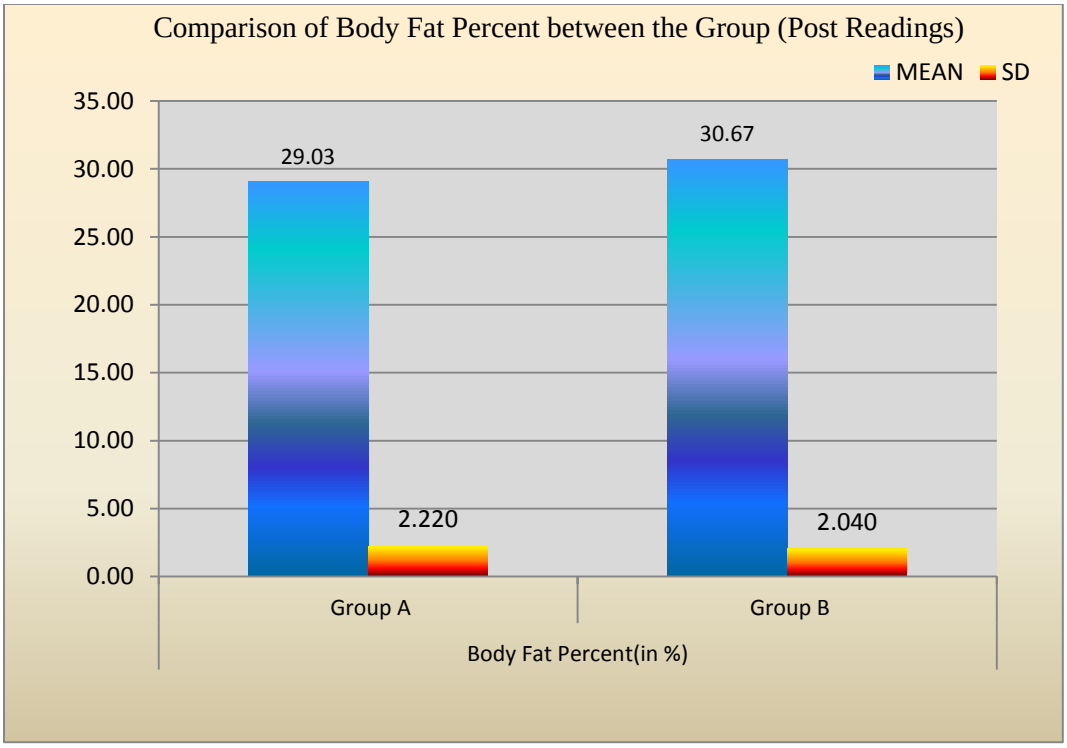


Graph 4.7: Demonstrates the comparison of mean value and standard deviation of body fat percent between Group A and Group B.

Table 4.8: Mean and SD of body fat percent for the subjects of Group A and Group B (Post Readings)

Post test	Group	Mean	S.D.	t- value	P value	Result
Body Fat Percent (in %)	Group A	29.03	2.220	2.970	0.0044	Significant
	Group B	30.67	2.040			

Comparison of mean and standard deviation of body fat percent between the post readings of Group A and Group B. The mean of body fat percent of group A was 29.03±2.22 and of group B was 30.67±2.04 respectively. The unpaired t- test value was 2.970 ($p<0.05$). There was significant difference in the reduction of body fat percent between the groups.

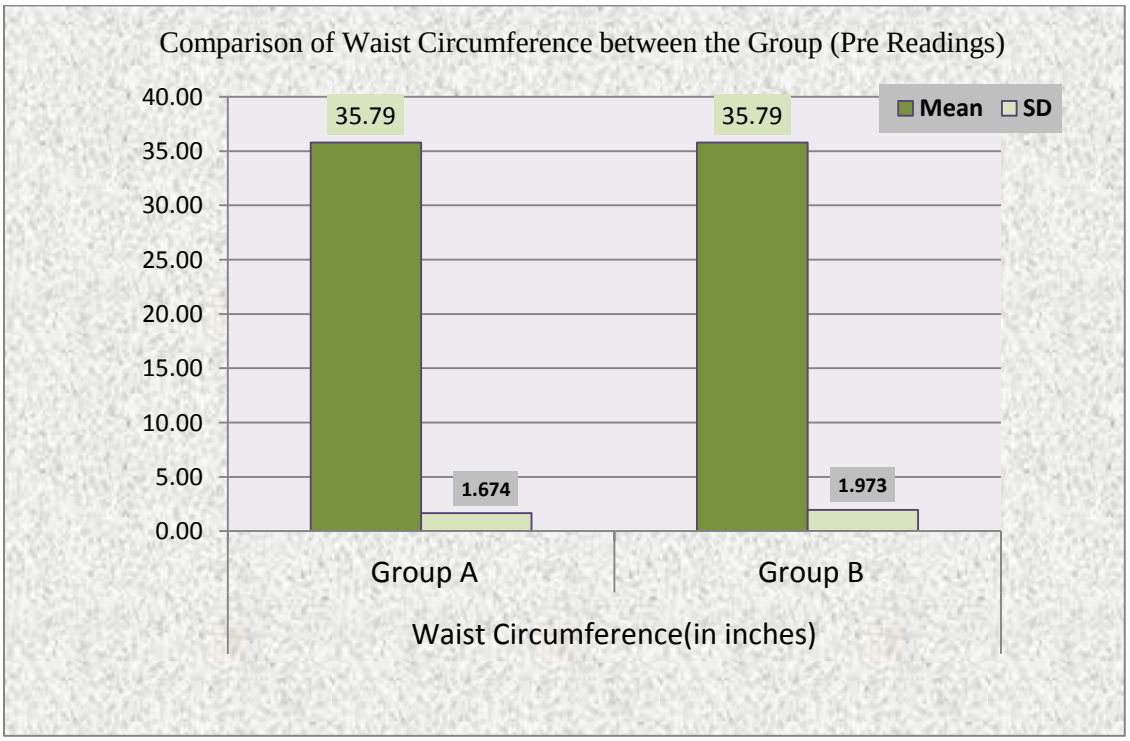


Graph 4.8: Demonstrates the comparison of mean value and standard deviation of body fat percent between Group A and Group B.

Table 4.9: Mean and SD of body fat percent for the subjects of Group A and Group B (Pre Readings)

Pre test	Group	Mean	S.D.	t-value	P value	Result
Waist Circumference (in inches)	Group A	35.79	1.674	0.010	0.9944	Not-Significant
	Group B	35.79	1.973			

Comparison of mean and standard deviation of waist circumference between the pre readings of Group A and Group B. The mean of waist circumference of group A was 35.79±1.67 and of group B was 35.79±1.97 respectively. The unpaired t- test value was 0.010($p>0.05$). There was no significant difference in the waist circumference between the groups.

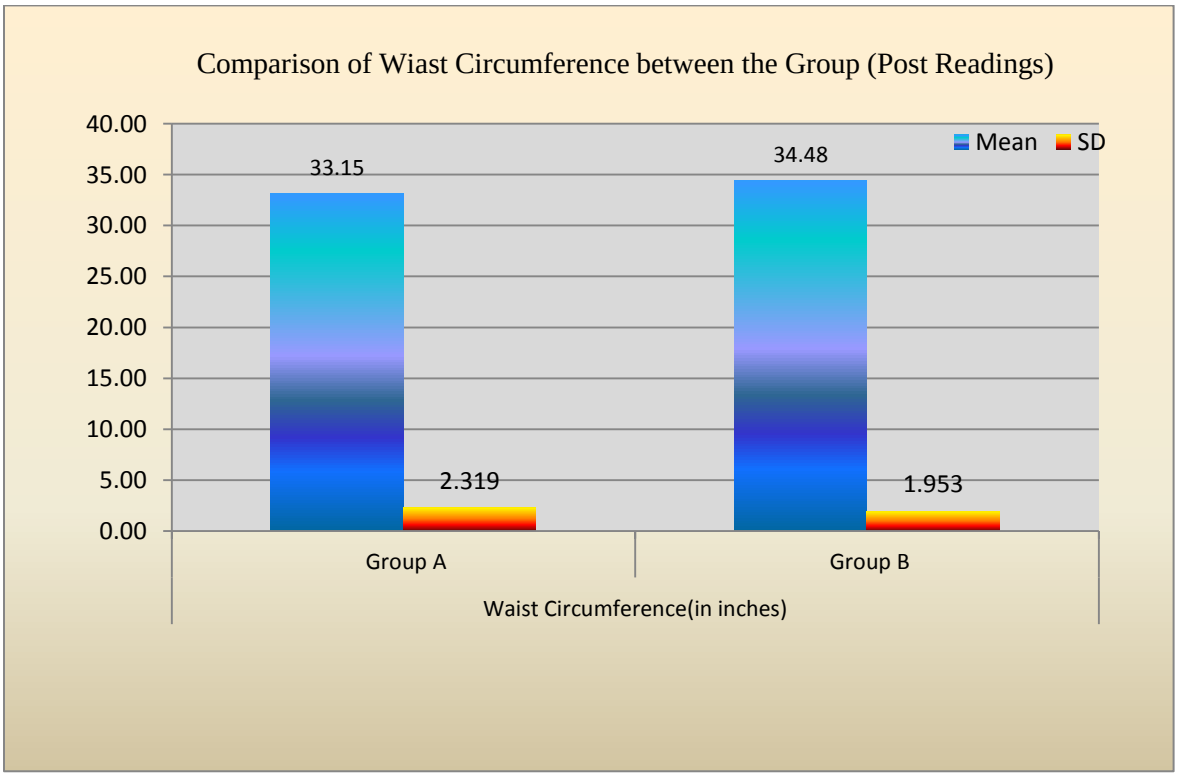


Graph 4.9: Demonstrates the comparison of mean value and standard deviation of waist circumference between Group A and Group B.

Table 4.10: Mean and SD of waist circumference for the subjects of Group A and Group B (Post Readings)

Post test	Group	Mean	S.D.	t- value	P value	Result
Waist Circumference (in inches)	Group A	33.15	2.319	2.400	0.0195	Significant
	Group B	34.48	1.953			

Comparison of mean and standard deviation of waist circumference between the post readings of Group A and Group B. The mean of waist circumference of group A was 33.15±2.32 and of group B was 34.48±1.95 respectively. The unpaired t- test value was 2.400($p<0.05$). There was significant difference in the reduction of waist circumference between the groups.

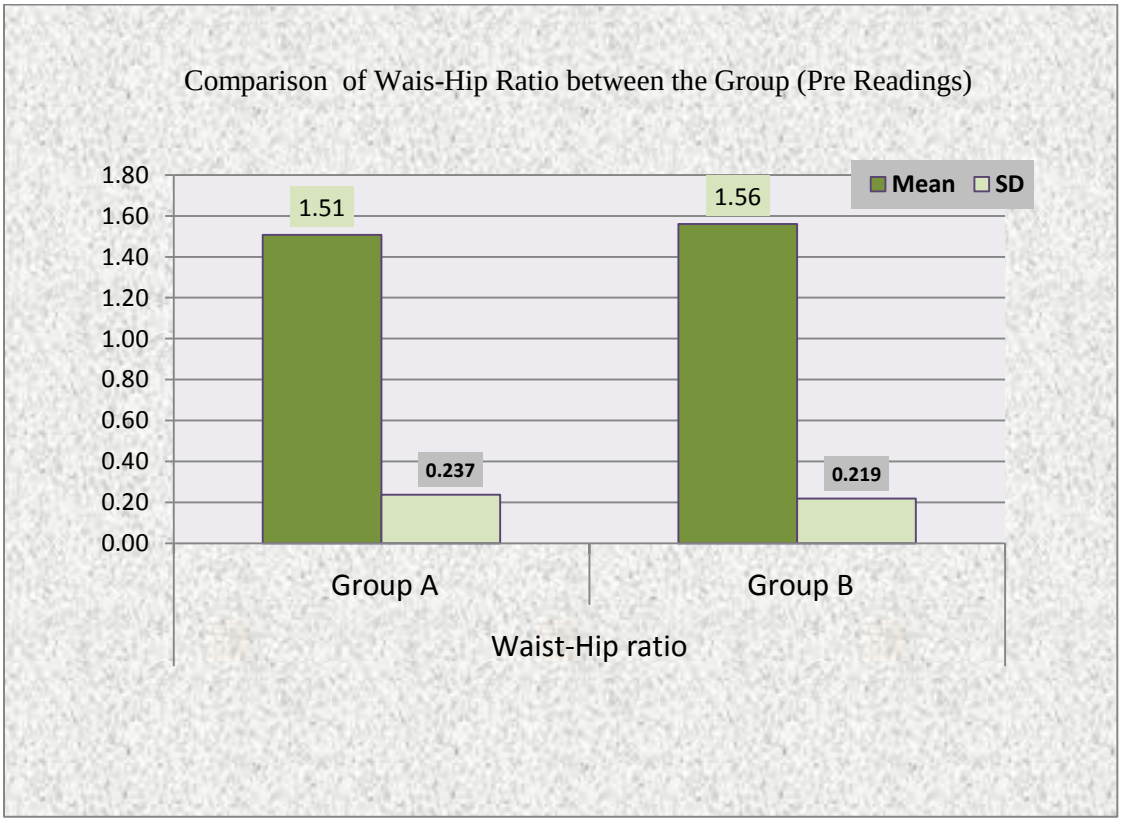


Graph 4.10: Demonstrates the comparison of mean value and standard deviation of waist circumference between Group A and Group B.

Table 4.11: Mean and SD of waist-hip ratio for the subjects of Group A and Group B (Pre Readings)

Pre test	Group	Mean	S.D.	t- value	P value	Result
Waist-Hip ratio	Group A	1.51	0.237	0.900	0.3727	Not-Significant
	Group B	1.56	0.219			

Comparison of mean and standard deviation of waist-hip ratio between the pre readings of Group A and Group B. The mean of waist-hip ratio of group A was 1.51±0.24 and of group B was 1.56±0.21respectively. The unpaired t- test value was 0.900($p>0.05$). There was no significant difference in the waist-hip ratio between the groups.

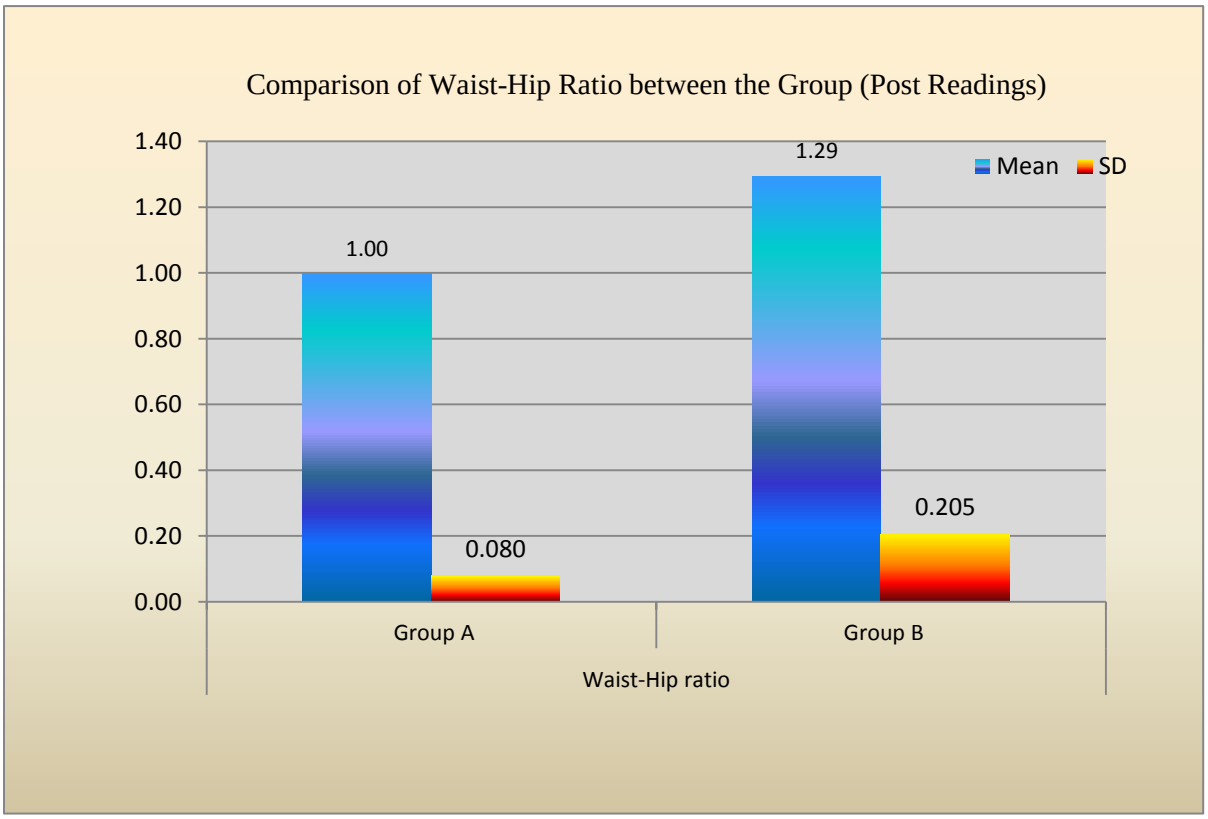


Graph 4.11: Demonstrates the comparison of mean value and standard deviation of waist-hip ratio between Group A and Group B.

Table 4.12: Mean and SD of waist-hip ratio for the subjects of Group A and Group B (Post Readings)

Post test	Group	Mean	S.D.	t- value	P value	Result
Waist-Hip ratio	Group A	1.00	0.080	7.340	0.0000	Significant
	Group B	1.29	0.205			

Comparison of mean and standard deviation of waist-hip ratio between the post readings of Group A and Group B. The mean of waist-hip ratio of group A was 1.00±0.08 and of group B was 1.29±0.21 respectively. The unpaired t- test value was 7.340($p<0.05$). There was significant difference in the reduction of waist-hip ratio between the groups.

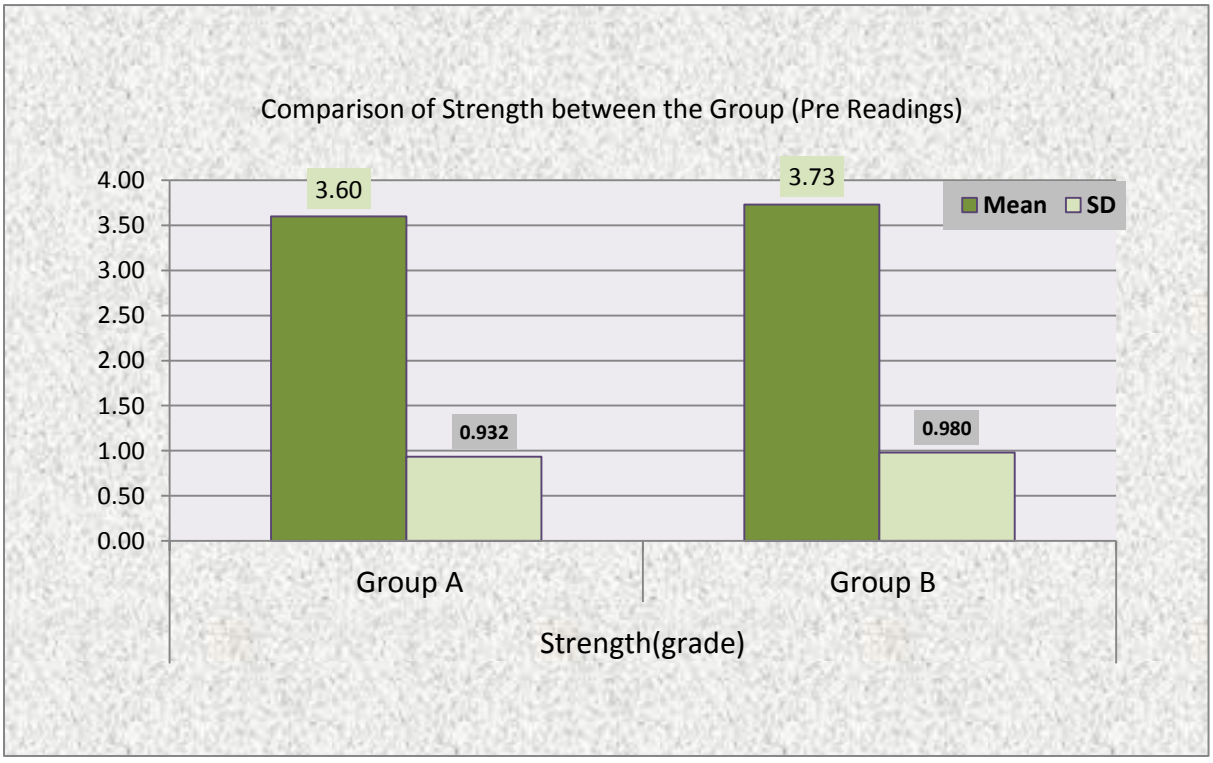


Graph 4.12: Demonstrates the comparison of mean value and standard deviation of waist-hip ratio between Group A and Group B.

Table 4.13: Mean and SD of strength for the subjects of Group A and Group B (Pre Readings)

Pre test	Group	Mean	S.D.	t- value	P value	Result
Strength (grade)	Group A	3.60	0.932	0.540	0.5914	Not-Significant
	Group B	3.73	0.980			

Comparison of mean and standard deviation of strength between the pre readings of Group A and Group B. The mean of strength of group A was 3.60±0.93 and of group B was 3.73±0.98 respectively. The unpaired t- test value was 0.540($p>0.05$). There was no significant difference in the strength between the groups.

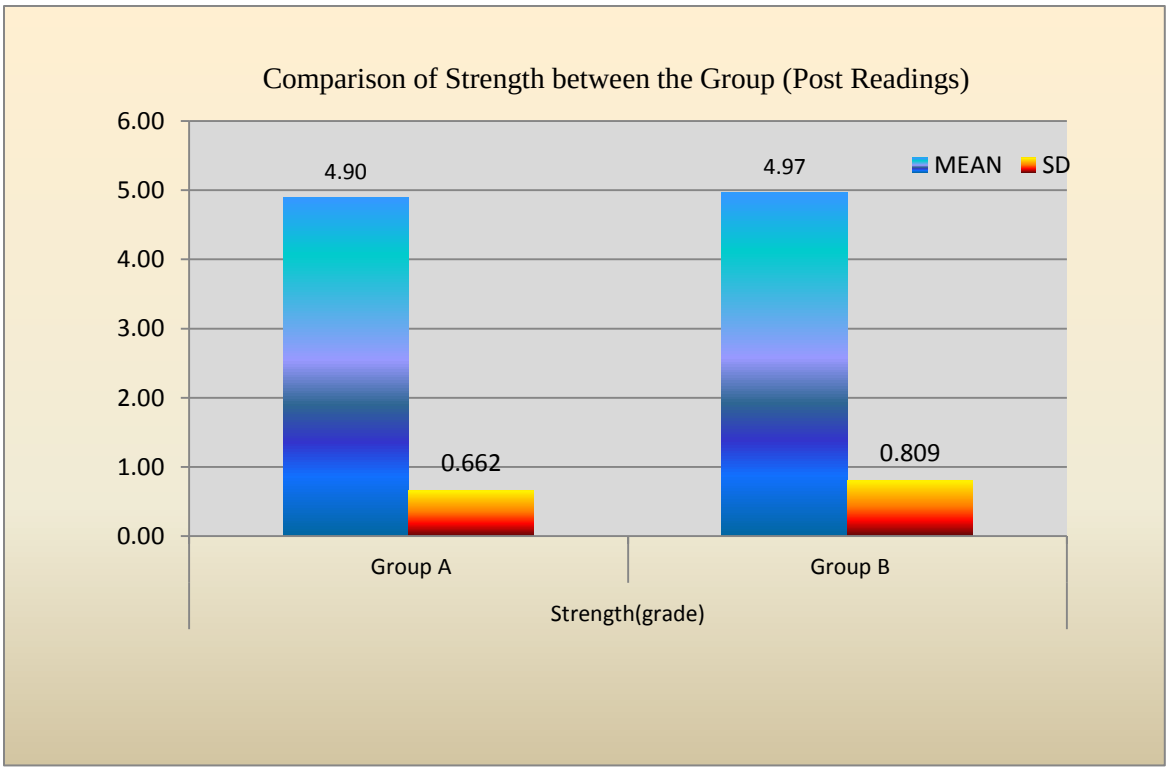


Graph 4.13: Demonstrates the comparison of mean value and standard deviation of strength between Group A and Group B.

Table 4.14: Mean and SD of strength for the subjects of Group A and Group B (Post Readings)

Post test	Group	Mean	S.D.	t- value	P value	Result
Strength (grade)	Group A	4.90	0.662	0.350	0.7280	Not-Significant
	Group B	4.97	0.809			

Comparison of mean and standard deviation of strength between the post readings of Group A and Group B. The mean of strength of group A was 4.90±0.66 and of group B was 4.97±0.80 respectively. The unpaired t- test value was 0.350($p>0.05$). There was no significant difference in the improvement of the strength between the groups.

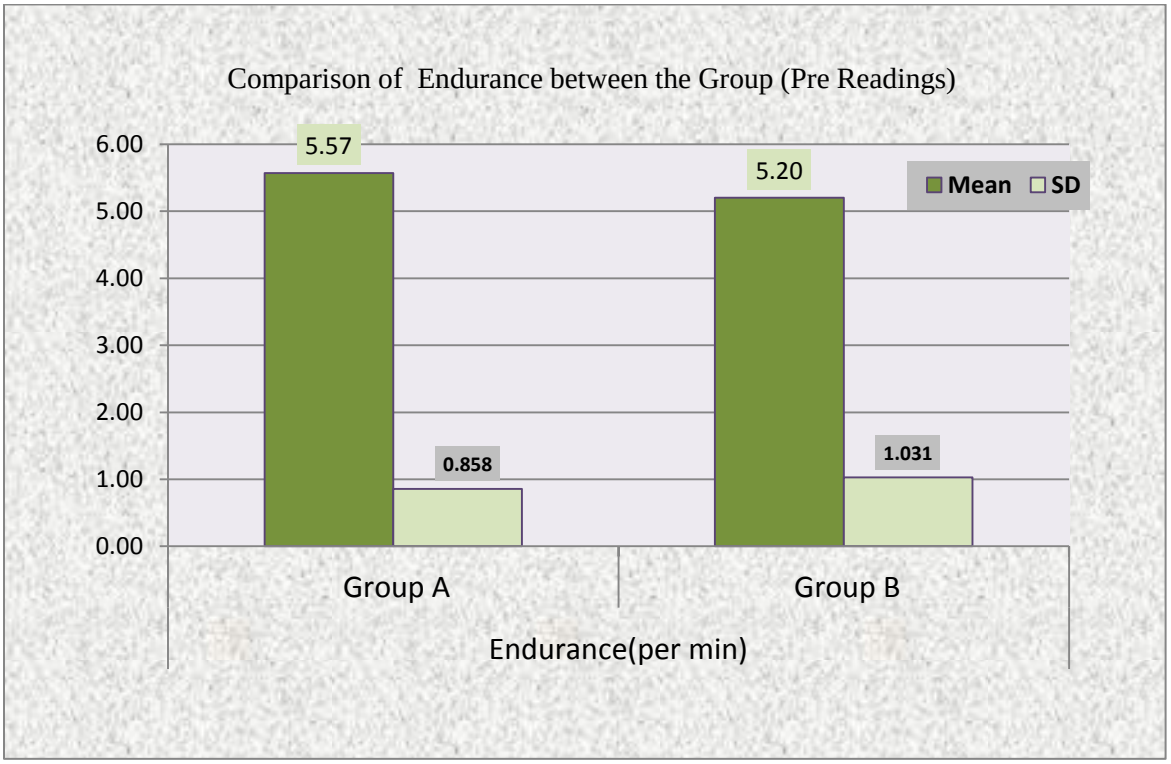


Graph 4.14: Demonstrates the comparison of mean value and standard deviation of strength between Group A and Group B.

Table 4.15: Mean and SD of endurance for the subjects of Group A and Group B (Pre Readings)

Pre test	Group	Mean	S.D.	t-value	P value	Result
Endurance (per min)	Group A	5.57	0.858	1.500	0.1397	Not-Significant
	Group B	5.20	1.031			

Comparison of mean and standard deviation of endurance between the pre readings of Group A and Group B. The mean of endurance of group A was 5.57±0.86 and of group B was 5.20±1.03 respectively. The unpaired t- test value was 1.500($p>0.05$). There was no significant difference in the improvement of the endurance between the groups.

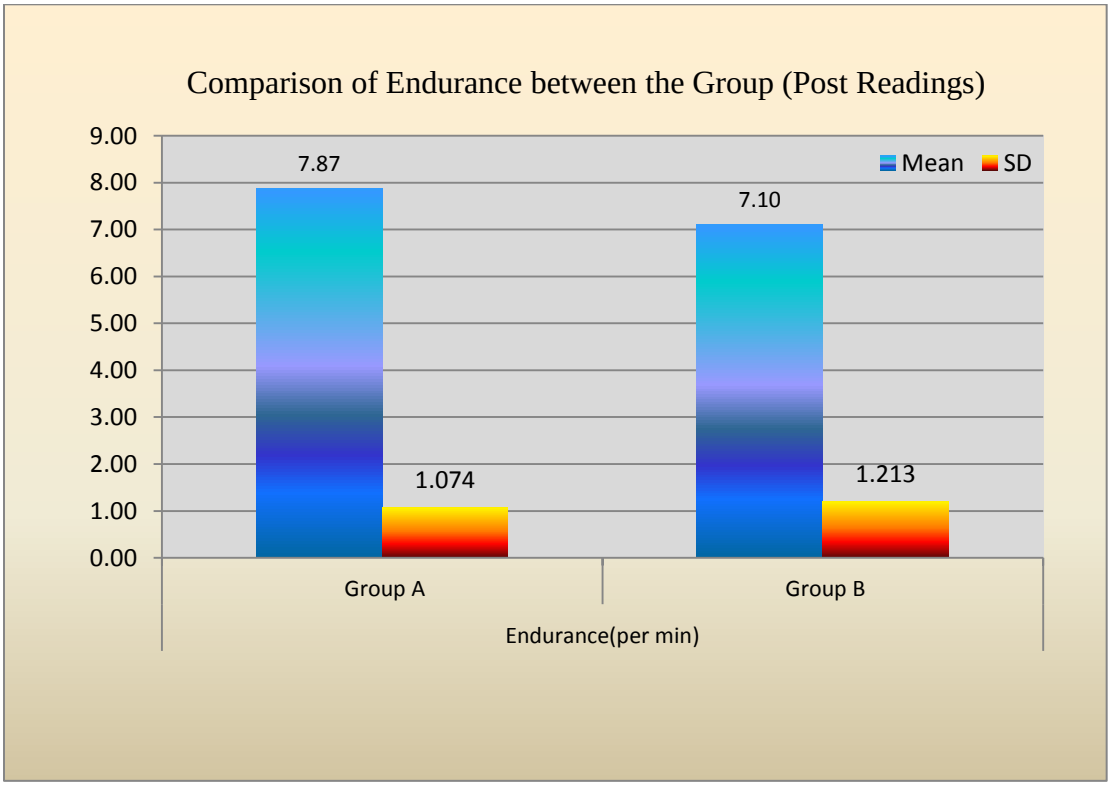


Graph 4.15: Demonstrates the comparison of mean value and standard deviation of endurance between Group A and Group B.

Table 4.16: Mean and SD of endurance for the subjects of Group A and Group B (Post Readings)

Post test	Group	Mean	S.D.	t- value	P value	Result
Endurance (per min)	Group A	7.87	1.074	2.590	0.0121	Significant
	Group B	7.10	1.213			

Comparison of mean and standard deviation of endurance between the post readings of Group A and Group B. The mean of endurance of group A was 7.87±1.07 and of group B was 7.10±1.21 respectively. The unpaired t- test value was 2.59($p<0.05$). There was significant difference in the improvement of the endurance between the groups.



Graph 4.16: Demonstrates the comparison of mean value and standard deviation of endurance between Group A and Group B.

RESULTS

Total 68 subjects were taken but one subject was excluded as he did not met the inclusion criteria so, the total number of subjects were 67 with 33 subjects in Group A which received Theraband exercises for abdominal obesity and 34 subjects in Group B which received Pilates exercises for abdominal obesity (3 days per week for total 8 weeks). 3 subjects from Group A and 4 subjects from Group B left the treatment protocol in between because of inability to attend it regularly.

Comparison of mean and standard deviation of subject's age(20-40) between the group A(Theraband Exercises) and group B(Pilates Exercises).The mean age of group A was 34.40 ± 3.390 and that of group B was 33.00±3.484 respectively . The unpaired t-test value was 1.580($p>0.05$). No significant difference was there in the age group.

The mean and standard deviation of the variable body fat percent within the group A was 34.37 ± 1.732 and 29.03 ± 2.220 respectively. Paired t-test was done within group A for the variable body fat percent to check the changes within the group. The t-value for body fat percent was 22.100($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable waist circumference within the group A was 35.79 ± 1.674 and 33.15 ± 2.319 respectively. Paired t-test was done within group A for the variable waist circumference to check the changes within the group. The t-value for waist circumference was 9.940($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable waist-hip ratio within the group A was 1.51 ± 0.237 and 1.00 ± 0.080 respectively. Paired t-test was done within group A for the variable waist-hip ratio to check the changes within the group. The t-value for waist-hip ratio was 12.050($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable strength within the group A was 3.60 ± 0.93 and 4.90 ± 0.66 respectively. Paired t-test was done within group A for the variable strength to check

the changes within the group. The t-value for strength was 8.120($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable endurance within the group A was 5.57 ± 0.858 and 7.87 ± 1.074 respectively. Paired t-test was done within group A for the variable endurance to check the changes within the group. The t-value for endurance was 13.760($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable body fat percent within the group B was 34.310 ± 2.074 and 30.67 ± 2.040 respectively. Paired t-test was done within group B for the variable body fat percent to check the changes within the group. The t-value for body fat percent was 23.010($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable waist circumference within the group B was 35.79 ± 1.973 and 34.48 ± 1.953 respectively. Paired t-test was done within group B for the variable waist circumference to check the changes within the group. The t-value for waist circumference was 8.750($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable waist-hip ratio within the group B was 1.56 ± 0.219 and 1.29 ± 0.205 respectively. Paired t-test was done within group B for the variable waist-hip ratio to check the changes within the group. The t-value for waist-hip ratio was 6.670($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable strength within the group B was 3.73 ± 0.98 and 4.97 ± 0.81 respectively. Paired t-test was done within group B for the variable strength to check the changes within the group. The t-value for strength was 9.950($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

The mean and standard deviation of the variable endurance within the group B was 5.20 ± 1.031 and 7.10 ± 1.213 respectively. Paired t-test was done within group B for the variable endurance

to check the changes within the group. The t-value for endurance was 9.250($p<0.05$).The result for the variable was significant which showed that there were significant changes within the group.

Unpaired t-test was done for the pre-readings of body fat percent between the group A and B to check the changes between the groups. The t-value for body fat percent was 0.540($p>0.05$). The result for the variable was not significant.

Unpaired t-test was done for the pre-readings of waist circumference between the group A and B to check the changes between the groups. The t-value for waist circumference was 0.010($p>0.05$). The result for the variable was not significant.

Unpaired t-test was done for the pre-readings of waist-hip ratio between the group A and B to check the changes between the groups. The t-value for waist-hip ratio was 0.900($p>0.05$). The result for the variable was not significant.

Unpaired t-test was done for the pre-readings of strength between the group A and B to check the changes between the groups. The t-value for strength was 0.540($p>0.05$). The result for the variable was not significant.

Unpaired t-test was done for the pre-readings of endurance between the group A and B to check the changes between the groups. The t-value for endurance was 1.500($p>0.05$). The result for the variable was not significant.

Unpaired t-test was done for the post-readings of body fat percent between the group A and B to check the changes between the groups. The t-value for body fat percent was 2.970($p<0.05$). The result for the variable was significant which showed that there were significant changes between the groups.

Unpaired t-test was done for the post-readings of waist circumference between the group A and B to check the changes between the groups. The t-value for waist circumference was 2.400($p<0.05$). The result for the variable was significant which showed that there were significant changes between the groups.

Unpaired t-test was done for the post-readings of waist-hip ratio between the group A and B to check the changes between the groups. The t-value for waist-hip ratio was 7.340($p<0.05$). The result for the variable was significant which showed that there were significant changes between the groups.

Unpaired t-test was done for the post-readings of strength between the group A and B to check the changes between the groups. The t-value for strength was 0.350($p>0.05$). The result for the variable was not significant.

Unpaired t-test was done for the post-readings of endurance between the group A and B to check the changes between the groups. The t-value for endurance was 2.590($p<0.05$). The result for the variable was significant which showed that there were significant changes between the groups.

CHAPTER - 5

DISCUSSION

The study was designed to evaluate the comparative effect of Theraband exercises and Pilates exercises in abdominal obesity. 60 subjects were taken and divided into 2 groups, 30 patients in each group. Group A received Theraband exercises for abdominal obesity (3 days per week) and Group B received Pilates exercises for abdominal obesity (3 days per week), for total 8 weeks.

The selected parameters were Body Fat Percent, Waist Circumference, Waist-Hip Ratio, Strength and Endurance. Data was collected at baseline (day 0) and after 8 weeks of treatment to evaluate the changes in the mentioned parameters.

The findings of the present study show that there is a significant difference in the reduction of body fat percent, waist circumference, waist-hip ratio and improvement in the strength and endurance of abdominal muscles within the groups. Significant difference was found between the groups on the 8^{th} week of protocol in all the parameters except for the improvement in the strength of abdominal muscles. But there was appreciably more significant difference in the group with the treatment protocol of theraband exercises than the group with pilates exercises.

Abdominal obesity occurs when there is excessive deposition of fat around the abdomen which causes negative impact over the health[(2)]. Abdominal obesity is usually measured in terms of waist circumference[(3,4)]. It has been found that the abdominal obesity is one of the leading cause of cardiovascular diseases along with metabolic diseases[(5, 14)].

Abdominal muscles are considered as operational stability system for the spine which protect it from several injuries and hence the weakness of these muscles can result into the decreased spinal stability[(44)]. There are abdominal exercises which build up the abdominal muscles in order to improve their performance and along with this they also increase the strength and endurance of the abdominal muscles[(20)].

Theraband exercises reduces the total fat mass and glycosylated hemoglobin, decreases the abdominal fat and insulin resistance by increasing the muscle mass and also improves the blood lipid profiles in abdominal obesity. When compared with theraband exercises, aerobic exercises reduces visceral fat and decreases insulin resistance but there is no effect on the mass of a abdominal muscles and hence the muscle strength reduces at a greater rate[(56)].

Dynamic resistance training program with the use of free weights put more stress over the skeletal muscle and can cause injuries. Theraband training control the strength as per the person's physical condition and provides proper individualized load by increasing the band resistance gradually as there is increase in the muscle strength[56].

Theraband provides resistance based on the amount that the band is stretched. This resistance can be calculated in pounds of force which depends on the percentage the band is stretched from its resting length which is known as 'Force Elongation'. Therabands provide a strength curve (torque) similar to human strength curve and isotonic resistance exercises (bell shaped curve) which occurs because of the angle created between the band and the lever arm and the angle is known as 'Force Angle'[69].

Theraband does not rely on gravity and provides continuous tension to the muscles which are being trained. It provides linear variable resistance which means as we increase range of motion of the exercise, the resistance offered by the band is also increased. Therefore, there is more increase in the muscle strength as more muscle fibres are used during the training[69].

There are many forms of dance, movement education along with several rehabilitation methods which are influenced by the Pilates method. It has also become a part of the exercise prescription in many of the bodywork fields[70].

Pilates is a fitness program of mind and body that incorporates breathing and movement to achieve balance and body awareness[50]. Pilates exercises can be performed in group or private settings with and without apparatus. Pilates exercises focus upon the core musculature eg. Abdominal muscles, back, hips and shoulder girdle. The movements rely upon correct positioning of the body relative to the gravity as well as limb length alterations to develop the core muscles[49].

A few research had mentioned that the physical activity has been commonly used and studied as a health related factor and it is also mentioned that there is significant influence of regular physical activity on health. Moreover, Pilates is popular amongst women and it has also given a new way to physiotherapy[71].

Pilates exercises increases the insulin sensitivity through the reduction of body fat percentage and fat deposition in the waist region which results in decreased leptin levels through regulation of insulin and in turn fat is distributed[72].

Triber FA et al.(1998) conducted a study to determine the effect of a 4 week isotonic resistance training program with the help of theraband on concentric shoulder rotator strength in tennis players and found that internal rotation torque at both slow and fast speeds and also in external rotation torque at fast speed is improved. Hence concluded that resistance training have beneficial effects on strength and functional performance, the result of the present study was supported by the results of Triber FA in increased strength of core muscles by use of therabands[69] . The same findings were also concluded by Varun Naik in a non-published thesis on athletes with low back pain which showed the improvement in core strength with therabands[69].

Baldi and Snowling did a study and found that even though 10 weeks of resistance training decreased the insulin level, insulin resistance was not changed. This concluded that the effectiveness of resistance training on improving insulin resistance vary according to the frequency, intensity and duration of training[56].

Therefore low intensity exercise should be done during the early stages of resistance training daily and then doing them for 3 days a week[56]. The results from these studies support our study for the improvement of strength of abdominal muscles.

Another study did a research to find the effect of 12 week pilates exercise program for overweight women and they found that skin fold thickness and BMI was reduced . This result showed that the pilates exercise program had potential to improve performance in many physiological variables for overweight women. Ramezankhany et al. (2010) compared low calorie diet, aerobic and pilates exercises in sedentary women and found the significant changes in waist-hip ratio and weight loss[49].

Ferreira et al. (2009) checked the effect of pilates exercises on body composition for sedentary women and no statistically significant difference was found among the exercise group and control group at baseline. It was thought that the frequency and intensity may be the cause as the subjects participated in pilates program for only 2 hours in each weak[49].

Barbara Strasser et al. studied about the evidence of resistance training in the treatment of obesity and concluded that resistive exercises mobilizes the visceral and subcutaneous adipose tissue in the abdominal region. It is also reported that when resistive exercises are performed with sufficient intensity and regularly, it stimulates the skeletal muscle to synthesize new muscle proteins[55]. This study is in the support of our study which showed that theraband exercises are beneficial in the reduction of body fat percent, waist circumference and waist-hip ratio in abdominal obesity.

A recent study did examination about the effects of systematic resistance training in aged people and found that the training having 2 sessions per week was as proficient as the training involving 3 sessions per week but the number of sets should be equally done[55].

However, these findings contradict the results of earlier study which had concluded that 3 sessions of training per week has more strength gain when compared to the resistance training given for 2 sessions a week[55] and it also supports our present study as the treatment protocol for the reduction of abdominal obesity taken in the study was 3 sessions per week for 8 weeks.

The previous studies showed that the resistance training helps to reduce the glycosylated hemoglobin levels in people with abnormal glucose metabolism and consequently improves the lipoprotein lipid profiles. In people with metabolic risks, decreased fat mass, improved blood lipid profiles and glycemic control are essential to decrease micro and macro vascular complications[55].

Based on the findings of all these studies, the resistance training is well thought-out to be a potential addition in the treatment of metabolic disorders by decreasing the risk factors for metabolic syndromes. The study also concluded that the resistance training can be used or suggested in managing the obesity and metabolic disorders [52]. The results from these studies further support our present study that theraband exercises are more effective and beneficial in reducing the body fat percent, waist circumference, waist-hip ratio and improving the endurance and strength of abdominal muscles.

Muscle endurance can be defined as the ability of a muscle to produce and maintain force production for prolonged periods of time. Research has shown that resistance training protocols improves the muscular endurance with high repetition. Campos et al. found that higher

repetitions (2 sets of 20-28 repetitions with 1 minute rest period starting with 2 days/week) increased muscle endurance. Marx et al. found that after the initial 12 weeks of training results in a threefold decrease in body fat and an increase in muscle endurance with significant increase in lean body mass [73]. This supports the present study as muscle endurance is significantly improved with the theraband exercises protocol.

Resistance training affects the amount of fat mass as a result of the direct effect of the training on energy consumption. Lower volume training burns less calories as compared to the higher volume training. Also the resistance training increases the energy consumption during the recovery period between training sessions further causing the fat loss [74].

In the study, the theraband exercises come out with more effectiveness than the Pilates exercises because the resistance provided by the theraband is based on the amount of stretching of band. The beginning of the exercise is done with the color band providing the appropriate resistance according to the strength of a person and is increased gradually as the strength increases of abdominal muscles whereas Pilates exercises are based on certain principles which had to be followed effectively while performing exercises like breathing, concentration etc. in order to gain more efficiency.

5.1 LIMITATIONS

- Convenient sampling was used.
- Absence of control group.
- Subjects were not asked for any sort of diet control.
- Follow up was not taken to check retention effect of the treatment.

CHAPTER – 6

CONCLUSION

The present study concluded that there is a significant difference in the reduction of body fat percent, waist circumference, waist-hip ratio and improvement in the endurance of the abdominal muscles but no significant difference has been seen in the improvement of abdominal muscle strength between the Group A and Group B.

FUTURE SCOPE OF THE STUDY

- Gender specific studies can be done to see the effect of intervention protocol.
- Studies to check the effect of diet control along with exercises on reduction of abdominal obesity can be done as a future scope.
- A long term follow-up of the study is recommended for a more comprehensive analysis of recovery.
- The strength of abdominal muscles can also be investigated through electromyographyic findings.

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CHAPTER-8

APPENDICES

8.1 INFORM CONSENT

I, _____ (name of the patient) willingly and voluntarily agree to participate in the research study under the directions of the Vinita Verma. I understand that the purpose of the study is to see the "**Effectiveness of Theraband Exercises versus Pilates Exercises along with Basic Abdominal exercises in reduction of Abdominal Belly**". I understand there is no risk involvement to my health and if any, it is being explained to me. I understand that I have the right to seek information regarding the study and can contact Vinita Verma. I understand that my confidentiality and anonymity is protected and further I have the right to terminate my participation at any time. I have read and received a copy of this consent.

Signature of the subject

Name:

Address:

Date:

I have explained the procedure with details to which the subject has consented to participate.

Signature of the researcher

Name: **Vinita Verma** **Residence address:**

MPT Orthopaedic

4th Semester

8.2 ASSESSMENT FORM

Patient code: Date of assessment:

Name-

Age-

Gender-

Occupation-

Height-

Weight-

Body Mass Index-

Waist Circumference-

Waist-Hip Ratio-

Address:-

- Whether the patient is hospitalized: YES…… NO……
- Whether the patient is using any assistive devices: YES…… NO……
- Whether the patient is having any cardiac disease or had undergone for any cardiac surgery: YES……. NO……
- Whether the patient is having any history of neurological disease: YES…… NO…….
- Whether patient is having the history of permanent dizziness: YES…… NO……
- Whether patient is having any uncorrected hearing or visual impairment: YES…… NO…….

On Examination:-

- Lumbar Spine Range of Motion-

Flexion	Extension	Side Flexion (To Right)	Side Flexion (To Left)	Rotation (To Right)	Rotation (To Left)

- Lumbar Spine MMT

Flexors	Extensors	Side Flexors	Rotators

- Abdominal muscles MMT –

8.3 MASTER CHART

Group A (Theraband Exercises)

Sr.No	Age(yrs.)	Gender	PRE- TEST READING					POST-TEST READING				
			Body fold percent(%)	Waist circumference (in inches)	Waist-Hip ratio	Strength (grade)	Endurance (per min)	Skin fold percent (%)	Waist circumference (in inches)	Waist-Hip ratio	Strength(grade)	Endurance(per min)
A1	35	M	33	41	1.11	3	6	28	39.3	1	3	8
A2	38	F	31	37	1.6	3	7	27	35.3	0.97	3+	9
A3	36	M	33	40	1.11	3	8	27	38.5	1	3	9
A4	28	F	35	36	1.5	2	5	28	34.5	0.97	3	7
A5	27	F	30	34	1.5	3	7	25	32.8	0.98	3+	9
A6	32	F	34	36	1.5	2	6	27	34.2	0.97	2+	7
A7	33	F	35	38	1.9	2	5	28	34	0.99	2+	7
A8	33	F	33	35.4	1.7	2	5	25	34.5	0.97	3	8
A9	39	F	32	34.2	1.8	3	5	24	32.2	0.99	3+	9
A10	39	F	36	37	1.4	2	6	31	34.1	0.97	3	8
A11	38	M	33	36.1	1.2	3	5	31	33.2	0.95	4	9
A12	35	F	35	35	1.8	2	7	31	31.6	0.98	3	8
A14	30	F	34	33.5	1.6	2	6	29	31.2	1	3	9

A15	38	M	37	36	1.11	2	5	32	34.2	1.2	3	9
A16	36	F	35	34.2	1.6	2	5	30	31	1.1	2+	5
A17	34	F	35	35	1.5	2	6	29	33.3	0.98	3	8
A18	41	F	33	34.8	1.6	3	5	28	31.2	1.1	3+	9
A19	37	M	36	36	1.9	2	6	31	34	0.94	3	8
A20	33	F	34	33.4	1.8	2		30	30.1	0.97	3	8
A21	32	F	36	35.1	1.3	2	5	31	33.1	0.93	2+	7
A22	34	F	35	36	1.5	2	5	29	36.5	0.95	3	8
A23	36	M	37	36.2	1.9	2	5	32	33.1	1.3	3	7
A24	31	M	36	35	1.6	2	5	31	32	0.98	3	7
A25	32	F	34	35.1	1.3	2	5	29	33	0.94	2+	6
A26	34	M	36	37	1.5	2	5	33	34.2	0.97	3	7
A27	37	F	35	35.2	1.6	2	5	28	31	0.99	2+	6
A28	31	F	36	36.4	1,4	2	5	31	31.4	0.97	3	8
A29	38	F	34	34.2	1.3	2	5	29	32.4	0.96	3	8
A30	34	M	32	35.4	1.2	3	7	27	29.5	0.93	3+	9

Group B (Pilates Exercises)

S.No	Age (in yrs)	Gender	PRE TEST READING					POST TEST READINGS				
			Body fold percent (%)	Waist circum ference (in inches)	Waist-Hip ratio	Strength(grade)	Endurance (per min.)	Skin fold percent(%)	Waist circumference	Waist-Hip ratio	Strength (grade)	Endurance (per min)
B1	36	F	34	35	1.3	3	7	30	34.1	0.98	3+	8
B2	37	F	36	38	1.7	2	5	31	37.2	1.2	3	7
B3	37	M	33	40	1.1	3	7	28	39	1.6	4	9
B4	27	F	35	37	1.6	2	5	30	36.1	1.1	3	8
B5	31	F	32	36	1.5	3	6	28	35.1	1.2	3+	8
B6	35	M	36	36.5	1.4	2	4	33	36	1.3	2+	5
B7	25	F	35	35	1.8	2	6	31	34.1	1.3	2+	6
B8	31	M	36	35	1.9	2	5	32	34	1.7	2+	6
B9	36	F	31	34.7	1.7	3	7	28	33.2	1.5	3	7
B10	31	M	35	36	1.5	2	5	31	35.5	1.4	2+	5
B11	34	F	38	35.2	1.9	2	5	34	34.1	1.5	3	7
B12	36	F	34	34.1	1.7	2	5	30	33.4	1.3	2+	5
B13	31	M	36	36.2	1.5	2	6	32	35.5	1.2	3	8
B14	34	F	31	33	1.5	3	7	28	32.5	1.1	3+	8

B15	32	F	36	35	1.7	2	4	33	34.3	1.4	3	7
B16	31	F	35	34.5	1.6	2	4	33	33.8	1.3	2+	5
B17	38	F	31	33.8	1.5	3	6	28	32.5	1.2	3+	8
B18	35	F	31	34.5	1.5	3	6	27	33.6	1.4	3+	8
B19	31	F	35	35	1.7	2	4	32	34.4	1.5	3	8
B20	35	F	36	35.1	1.6	2	4	33	34	1.4	3	7
B21	36	F	31	34.6	1.5	3	5	33	33.8	1.3	3+	5
B22	34	M	35	36	1.7	2	4	28	32.5	1.2	3	8
B23	36	F	31	34.4	1.6	3	5	27	33.6	1.4	3+	8
B24	33	F	36	36	1.8	2	4	32	34.4	1.5	2+	8
B25	34	F	35	38	1.9	2	5	33	34	1.4	2+	7
B26	38	F	34	34.2	1.3	3	6	29	33	1.3	3+	8
B27	30	M	33	40	1.11	2	4	32	35.1	1.4	3	7
B28	26	M	36	41	1.11	3	6	28	32	1.3	3+	8
B29	28	F	31	33	1.5	2	4	33	35	1.7	2+	5
B30	32	M	35	37	1.6	2	5	32	36	0.99	3	7

8.4 TREATMENT PROTOCOL

Group A : Theraband exercises

Serial no.	Theraband exercises	Repetitions
1	Lunge	10
2	Squat	10
3	Crunch	10
4	Trunk Curl Ups	10
5	Side Bend	10

Group B : Pilates exercises

Serial no.	Pilates exercises	Repetitions
1	Double Leg Stretch	10
2	Roll Up	5
3	Four Point Kneeling Opposite Leg and Arm Raise	10
4	Upper Body Extension (Dart)	10
5	Criss Cross	10

Group A and B: Basic Abdominal exercises

Serial no.	Abdominal exercises	Repetitions	Hold time
1	Pelvic Tilting	10	5 sec.
2	Partial Abdominal Curls	10	3 sec.
3	Diagonal Abdominal Curls	10	3 sec.
4	Lower Abdominal Exercise	10	5 sec.

8.5 ASSESSMENT TOOLS

- Standardized measuring tape
- Skin fold caliper
- Weighing machine

Figure 8.5.1- showing the skin caliper and measuring tape

Figure 8.5.2- Weighing machine

ABSTRACT

EFFECTIVENESS OF THERABAND EXERCISES VERSUS PILATES EXERCISES ALONG WITH BASIC ABDOMINAL EXERCISES IN REDUCTION OF ABDOMINAL BELLY

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Background and Purpose: Abdominal obesity is when excessive abdominal fat around the stomach and abdomen has built up to the extent that may have a negative impact on health. The purpose of this study is to find out the better exercise protocol to reduce abdominal belly and to improve strength and endurance of abdominal muscles.

Materials and Method: Sixty adults (20-40 yrs of age) were evaluated through measuring tape and skin fold caliper. These subjects were conveniently allocated to one of the two groups: Group A (n=30) was administered with the theraband exercises along with the basic abdominal exercises and Group B (n=30) was administered with the pilates exercises along with the basic abdominal exercises.

Results: The Mean (SD) age is 34.40±3.39 (years) for Group A and the Mean (SD) age is 33.00±3.48 (years) for Group B. There was significant differences between Group A and Group B for the reduction of body fat percent, waist circumference, waist-hip ratio and improvement in abdominal muscle endurance ($p<0.05$) but there was no significant difference between Group A and B for strength improvement of abdominal muscle in the posttest ($p>0.05$).

Conclusion: There is a significant difference in the reduction of body fat percent, waist-hip ratio, waist circumference and improvement in the abdominal muscle endurance but no significant difference has been seen in muscle strength improvement of abdominal muscle between Group A and Group B.

Keywords: Abdominal Belly, Theraband Exercises and Pilates Exercises