*International Journal of Health Sciences and Research*
*Vol.12; Issue: 4; April 2022*
*Website: www.ijhsr.org*
*Original Research Article* *ISSN: 2249-9571*

# Effectiveness of Calisthenics and Breathing Exercise on Physical Exercise Capacity, Thoraco-Abdominal Excursion and Flexibility in Sedentary Overweight Women

**Greeshma Girish[1], Princy Mathew[2]**

[1]P.G Student, (Cardio Respiratory), College of Physiotherapy, Medical Trust Institute of Medical Sciences, Kochi-682309
[2]Associate Professor, College of Physiotherapy, Medical Trust Institute of Medical Sciences, Kochi-682309

Corresponding Author: Princy Mathew

**DOI: https://doi.org/10.52403/ijhsr.20220423**

## ABSTRACT

**Background:** Overweight and obesity have become a major health problem in both developed and developing countries. Most of the world's population live in countries where over weight and obesity kills more people than underweight [(1)]. The major risk factor for developing over weight and obesity is the sedentary behavior. Overweight and physical inactivity can be considered as the precursor of many non-communicable diseases. The physically inactive candidates should need a structured exercise program for improving their overall health and quality of life. Specific exercise program for improving the quality of life of these population is a need of the day. The purpose of this study is to find out the effectiveness of low intensity calisthenics and breathing exercise on physical exercise capacity, thoraco-abdominal excursion and flexibility in sedentary overweight women

**Methodology:** A total of 16 subjects were selected based on the inclusion and exclusion criteria, then divided equally into two groups: Group A (Experimental Group: n=8) received low intensity calisthenics and breathing exercise and Group B (Control group: n=8) does not received any form of exercise. Structured exercise program was held for four days a week (for 45 minutes) for 6 weeks using google meet app. Physical exercise capacity, thoraco-abdominal excursion and flexibility were measured at the beginning and sixth week after intervention using,6-minute-walk-test, cirtometry and sit and reach box.

**Results:** The results were analysed using t- test. Paired t- test was used to compare the results within the group and independent t-test to compare results between the groups. Significance level kept as p value < 0.05. The post result in the case of physical exercise capacity p=0.001 shows, there is a significant difference in posttest physical exercise capacity scores between the experimental and the control groups.

The results in case of thoraco-abdominal excursion in axillary, xiphisternal and umbilical regions are p<0.001, p<0.001and p=0.00 1 respectively. There is a significant difference in post-test Thoracoabdominal excursion scores between the experimental and the control groups.

The results in case of flexibility p <0.01 shows There is a significant difference in posttest flexibility scores between the experimental and the control groups. In the paired 't' test Physical exercise capacity, Thoraco-abdominal excursion and Flexibility expressed significant improvement in experimental group. In case of un paired 't' test all the three parameters of the experimental group expressed significant improvement compared to the control group

**Conclusion:** The study concluded that, there is improvement in physical exercise capacity, thoraco-abdominal excursion (axillary, xiphisternal and umbilical region) and flexibility only in experimental group. The Experimental group shows significantly higher improvement in all the three parameters when compared to the control group.

***Keywords:*** Physical exercise capacity,6-minute walk test, cirtometry, thoraco-abdominal excursion (axillary, xiphisternal, umbilical) flexibility, sit and reach test.

## INTRODUCTION

The Overweight and obesity have become a major public problem in both developed and developing countries. More than 1.9 billion adults aged 18 years and older were overweight (39% of men and 40% of women were overweight) study conducted by WHO in 2016[(1)]. The prevalence of overweight and obesity has risen dramatically. The prevalence of obesity is higher among the urban populations, high socioeconomic states and also in South India. From 1998 to 2018, the prevalence of obesity is rapidly spurting due to sedentary life style and consumption of high calories food.

Most of the world's population live in countries where over weight and obesity kills more people than underweight [(1)]. The major risk factor for developing over weight and obesity is the sedentary behavior, an increase in intake of energy dense foods that are high in fat and sugars; and an increase in physical inactivity due to the increasingly sedentary nature of many forms of work, changing modes of transportation and increasing urbanization [(1)]. Diet and physical activity are recognized as the most proximal determinants of energy balance but there is growing recognition of the role of sedentary behaviours (e.g., sitting time), independent of physical activity[(3)].More recently, a role has also been suggested for sleep duration[(3)]

According to WHO (updated 2021) the fundamental cause of obesity and overweight is an energy imbalance between calories consumed and calories expended globally there has been, an increased intake of energy-dense foods that are high in fat and sugars; and an increase in physical inactivity[(1)].

Overweight and obesity are risk factors for cardiovascular disease, certain cancer (including endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon), diabetes and mortality in addition overweight also exacerbate many other chronic disease such as hypertension, osteoarthritis, gall stones, dyslipidaemia, PCOS and musculoskeletal problems[(13)]

Obesity results into various health problems which are having direct link to cardiovascular disease (CVDs). So, that it's time to focus on the problem and take necessary steps to overcome the problem[(2)]. Sedentary behaviour is a risk factor for several diseases including musculoskeletal and respiratory disorders. musculoskeletal changes inherent to the sedentary life style contribute to increase chest wall stiffness, hindered rib cage expansion, increased work of breathing, and reduced respiratory function[(4)].

Obesity can affect the thorax, diaphragm, and alterations in respiratory function even if the lungs are within normality. The respiratory compliance is very reduced by the increase in fat mass [(10)]. Excess of body fat is determined by multiple factors acting in combination, including genetic, metabolic and behavioral factors, as well as more upstream socio-economic influences and built environment characteristics. Socio-economic influences and built environment characteristics increasingly recognized as major upstream determinants of overweight. [(3)]

The purpose of Low intensity calisthenics and breathing exercise are, it's a form of dynamic exercise consisting of variety of simple, often rhythmical, movements generally using minimal equipment or apparatus. Exercises were performed in various body positions: supine, side-lying, sitting, kneeling and standing.

Calisthenics and breathing exercise in turn, are able to readjust the length tension-ratio of respiratory muscle, increase thoracoabdominal mobility, reduce the sensation of dyspnoea, and increase the capacity for exercise [(5)].

In the last decade, the 6-min walk test (6MWT) has been increasingly used to assess functional exercise performance

across various populations. 6MWT is self-placed and involves measuring the distance a patient can walk on level course in 6min [(6)].6-minute walk test is a very useful, reliable, safe and easy to administer assessment tool for the functional capacity of overweight and obese individuals [(7)].Previous studies have shown that 6MWT is reproducible in obese subjects, suggesting that it can be used to evaluate their "global" function.[(11)]

Measuring thoracoabdominal mobility has been considered as an important parameter to assess respiratory dysfunctions and to monitor training programs in different populations. Cirtometry, also known as thoraco-abdominal perimetry, consists of a set of measurements of thoracic and abdominal circumferences during respiratory movements, and it aims at quantifying the thoracoabdominal mobility in a simple manner, which is accessible and has low cost, therefore, only one metric tape is required for its performance. [(8)]

The Sit-and-Reach Test (SRT) is a common protocol used to assess hamstring and lower back flexibility. The Sit-and-Reach Test was designed by Wells and Dillon in 1952, and the protocol requires participants to sit on the floor and maximally flex the trunk while keeping their knees flat on the floor and ankles dorsiflexed at a 90-degree angle.

Numerous physical fitness measures and assessments include the SRT protocol as it is easy to administer and requires few materials. Two nationally recognized testing batteries, the Physical Best and FITNESSGRAM programs, utilize the SRT, as well as general fitness assessments by personal trainers and other healthcare professionals. [(9)]

Hence the title of the study is stated as 'Effectiveness of calisthenics and breathing exercise on physical exercise capacity, thoraco-abdominal excursion and flexibility in sedentary overweight women''

## NEED OF THE STUDY

Many studies show that increased sedentary behaviour and overweight can lead to obesity and may results in risk of development of cardiovascular, pulmonary as well as musculoskeletal problems, and thus reduce the quality of life. Specific exercise program for sedentary overweight individual may reduce the risk of development of obesity and associated problems, and improve the quality of life. The effectiveness of low intensity calisthenics and breathing exercise in sedentary overweight women has not been studied yet, these set of exercises are mainly given to COPD patients to improve their physical activity in daily living. so, the purpose of this study is to find out the effectiveness of calisthenics and breathing exercise on physical exercise capacity, thoraco-abdominal excursion and flexibility in sedentary overweight women.

## METHODOLOGY

**Study Design:** Pre-Post experimental study
**Study setting:**

- Medical trust institute of medical sciences, cochin
- Community (kudumbasree)

**Study Duration:** Six months- 4 days /week
**Sampling**
**Sampling Method:** Convenient sampling
**Sample Size:** n =16 (Group A -8 Group B-8)

**Inclusion**

- Women with BMI 23-27.5Kg /m² (ASIAN Classification)
- Sedentary women
- Age between 18-35 years
- International Physical Activity Questionnaire- Categorical Score: category1: Low
- Living independently in a community
- Without assistive aids
- Women without any known disease
- Subjects does not have a regular exercise habit

**Exclusion**

- BMI <23kg/m²
- Cardiovascular disorder
- COPD
- People with Regular exercise habit
- Cognitive and memory deficit
- Pregnancy

**Outcome Measurement**

- The Six Minute Walk Test for physical exercise capacity
- Cirtometry for thoraco-abdominal excursion
- Sit and reach box for flexibility

**Materials used**

Cones, colour tape, Meter measuring tape, Stopwatch, chair, Inch tape, Sit and reach box, Yoga mat or bed, Wand, Sphygmomanometer, Pulse oximetry, Stethoscope, Weighing machine, Stadiometer, Thermometer










## PROCEDURE

**Preintervention procedure**

Ethical approval was obtained from the Ethical Committee of Medical Trust Hospital, Cochin for conducting the study. A total of 60 International Physical Activity Questionnaire (IPAQ), were distributed to the community and a college, based on their

BMI, and were requested to fill the forms. Candidates who reached inclusion criteria were short listed.ie; IPAQ Categorical Score: category1: Low. informed consent form and description of the study were given. After signings the consent a total of 16 subjects were taken and divided into two groups. Pre intervention measurements were taken for both groups using 6-minute walk test, cirtometry, sit and reach box. The active intervention period last for 6 weeks

**Intervention**

- **Control group**
  Does not received any form of exercise. Consent were provided and assured that, if the result of the study is satisfactory, the control group will also receive the same intervention provided to the exercise group after the study duration.
- **Exercise group**
  The participants were taught about the importance of exercise for improving their quality of life and reduce the risk of development of diseases associated with sedentary lifestyle, overweight and obesity.

**GUIDELINES**

- Do not perform exercise immediately after the meals

**PROCEDURE**

The exercise group received three sets of low intensity calisthenics and breathing exercise for 6 weeks. Every 7th day of exercise, exercise group were received a new set of exercise. The exercise section was carried out via, Google Meet app, because of the rise in number of cases of pandemic COVID19.

The sessions were performed by each subject in every session. The frequency of exercise were 6 weeks (4 days/week; in alternate days), intensity were 1 set with 10 repetition and the time duration of exercise were 45 minutes.

**EXERCISE SET 1**

| | |
|---|---|
| Lateral decubitus | Diaphragmatic breathing exercise |
| Dorsal decubitus | Rectus abdominis: lower limbs in flexion and upper limbs resting along the body. move scapula from the bed during trunk flexion |
| | Abdominal obliques: lower limbs in flexion and upper limbs resting along the body. Lower limbs move to each side during expiration |
| Sitting | Diaphragmatic breathing |
| | Trunk rotation: lower limbs in extension.one upper arm in extension on the bed; the other moves to the opposite side, performing trunk rotation |
| Hand and knee position | Diaphragmatic breathing |
| On the knees | Lateral trunk flexion: upper limbs hold a stick behind the neck while performing trunk flexion |
| On the knees | Trunk rotation: upper limbs hold a stick behind the neck while performing the rotation |
| Standing | Lateral trunk flexion: lower limbs in extension and abduction.upper limbs beside the body.perform lateral trunk flexion while keeping the arms beside the body |
| Standing | Trunk rotation: lower limbs in extension and abduction.upper limbs beside the body.perform trunk rotation by touching one hand to the opposite knee |

**EXERCISE SET 2**

| | |
|---|---|
| Dorsal decubitus | Diaphragmatic breathing exercise |
| Lateral decubitus | Diaphragmatic breathing |
| Dorsal decubitus | Rectus abdominis: lower limbs in flexion and upper limbs extension along the body. move scapula from the bed during trunk flexion, moving both hands in the direction of the opposite knee |
| Dorsal decubitus | Abdominal obliques: lower limbs in flexion and upper limbs resting along the body.during trunk flexion, move one hand in the direction of opposite knee |
| Sitting | Trunk flexion and rotation: lower limbs in extension one upper arm in extension on the bed and other arm moves towards the opposite side, performing trunk flexion and rotation |
| | Trunk rotation: lower limb in extension and abduction and upper limbs in extension holding a stick in front of the chest. perform trunk rotation while keeping upper and lower limbs in extension |
| Hand and knee position | Equilibrium: lift one upper arm during each expiration.alternate arms |
| On the knees | Trunk rotation: upper limb holding a stick infront of the chest.perform trunk rotation keeping the arms in extension |
| Standing | Lateral trunk flexion: lower limbs in extension and abduction. upper limbs holding a stick above the head. perform lateral trunk flexion while keeping the arms in extension |
| Standing | Trunk rotation: lower limbs in abduction and extension.upper limb holding a stick above the chest. perform trunk rotation while keeping the arms and legs in extension |

**EXERCISE SET 3**

| | |
|---|---|
| Dorsal decubitus | Abdominal exercise: lower limb flexed and supported flex upper torso with upper limb behind the head |
| | Abdominal exercise: lower limb flexed and supported, drop lower limb to one side and then to other side |
| | Abdominal exercise: lower limb flexed and supported, extended a lower limb associated with upper limb contralateral elevation |
| Sitting on a chair | Push one hand against other at the midline and perform torso rotation |
| | Holding a bat with upper limb extended at the shoulder line, rotate the torso. |
| | Adduct and abduct the upper limb at horizontal in front of the torso |
| Standing | To hold the bat behind the head, perform torso rotation |
| | Hold the bat with upper limb extended at shoulder, adduct the scapula |

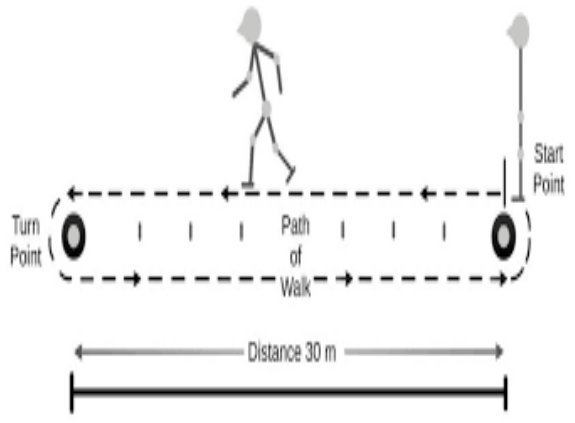
## POST INTERVENTION PROCEDURE

The outcomes were measured after 6 weeks using 6-minute walk test, cirtometry & sit and reach box

## THE SIX MINUTE WALK TEST

In 2002, the American thoracic Society endorsed and published guidelines for performing the 6MWT in clinical settings, also considering the impact of factors such as gender, height, age, length of the walkway on the distance walked.(21)

Subjects were instructed to walk as fast as they could along an even, undisturbed 30-m corridor marked every 5 m; and used a lap counter system and the complete distance walked during 6 min was measured using a tape measure. from the nearest marker with coloured tape on the floor. Encouragement was given every minute during the test until subject exhaustion using only standardized phrases as specified in the "ATS Statement: Guidelines for the Six-minute Walk Test". The distance covered in 6 min by each subject was used as variable for the analysis.




**6minute walk test**

The subject's pulse, respiratory rate, blood pressure, Oxygen saturation and perceived fatigue as assessed on the Borg's scale, were measured before the test and at test completion.

## THORACO-ABODOMINAL EXCURSION

Vikram Mohan et.al conducted study on "Intrarater Reliability of Chest Expansion Using Cloth Tape Measure Technique".120 healthy male and female were recruited in the study. And the result obtained were Cloth tape measurement was reliable at all three anatomical land marks of the chest.so can use as an outcome for chest expansion in different conditions. (12)

Cirtometry, also known as thoracoabdominal perimetry, consists of a set of measurements of thoracic and abdominal circumferences during respiratory movements, and it aims at quantifying the thoracoabdominal mobility in a simple manner, which is accessible and has low cost, therefore, only one metric tape is required for its performance. (8)

To start the procedure, learning maneuver was made to maximum inspiration and after maximum expiration, measuring the three regions:

1. axillary perimeter with a metric tape passing by axillary cavus;
2. xiphoid perimeter, passing on the xiphoid appendix at the level of the 7th costal cartilage;
3. abdominal perimeter, passing through the umbilicus.

Three measurements were carried out by noting the best value (greater difference between measures. (10).The

difference between measurements obtained in maximum inspiration and expiration in each anatomic level was considered as the thoracoabdominal mobility of each measured region. [8]

**Flexibility**

The Sit-and-Reach Test (SRT) is a common protocol used to assess hamstring and lower back flexibility. The Sit-and-Reach Test was designed by Wells and Dillon in 1952, and the protocol requires participants to sit on the floor and maximally flex the trunk while keeping their knees flat on the floor and ankles dorsiflexed at a 90-degree angle [22]

SIT AND REACH BOX, used to assess hamstring and lower back flexibility.

Participants performed short warm up stretch prior to test. Participant was instructed to remove their shoes. The participant was instructed to sit with the sole of the feet flat against the sit and reach box at 23 cm mark. Participants should slowly reach forward (no bouncing) with both hands as far as possible (to the point of mild discomfort), by keeping the knees extended, participant was instructed to place both hands superimposed, command was given to 'Reach forward with both hands as far as possible', and was asked to hold that position approximately 2 Sec. measurement was taken at the tip of middle finger.

***6MWT for physical exercise capacity***

***Cirtometry for TAE***

**SRT for flexibility**

However, participants should breathe normally during test and should not hold her breath anytime.

**Statistical Analysis And Interpretation**

The statistical analysis of the results was performed by using the SPSS Software (SPSS.20). Students t - test was used for the calculation of the results. Paired t test was used for the intra group comparison of pre- and post-test results. Independent t test was used for the inter group comparison. Significant level kept as $p<0.05$. Equations were used in:

$$\textbf{Samples} - \textbf{n} \geq \frac{2\sigma 2(z\beta + z\alpha/2)2}{\textbf{difference 2}}$$

- n- Sample size in each group (assumes equal sized groups)
- $\boldsymbol{\sigma}$- Standard deviation of the outcome variable

- $Z\alpha$ - Represents the desired level of statistical significance (typically 1.96)
- $Z\beta$ -Represents the desired power (typically 0.84 for 80% power)
- differences- Effect size (the difference in mean)

**Independent Variables:** Calisthenics and breathing exercise

**Dependent Variables:** Physical exercise capacity, thoraco-abdominal excursion, flexibility

## DEMOGRAPHIC INFORMATION

## AGE

**Table 1- Mean age in experimental group and control group**

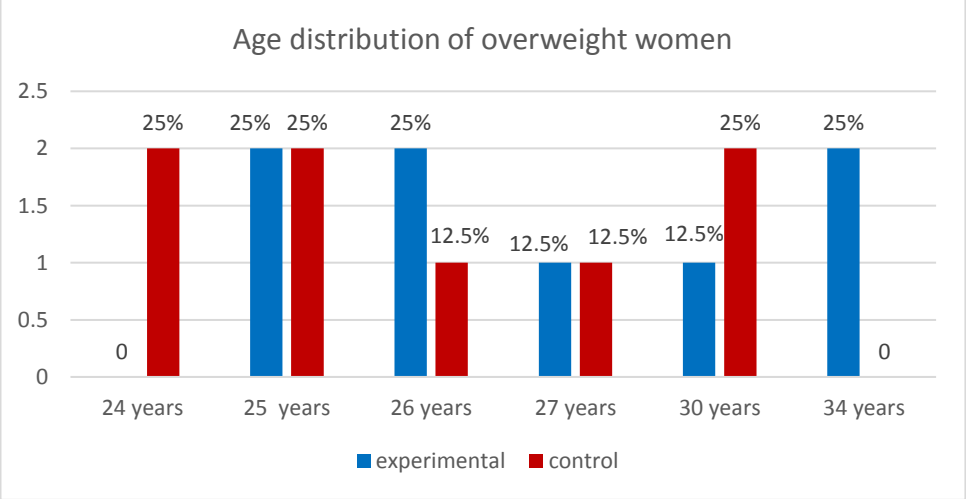
| | Mean age | Standard deviation | Minimum | Maximum |
|---|---|---|---|---|
| Experimental group | 28.37 | 3.81 | 18 | 35 |
| Control group | 26.37 | 2.44 | 18 | 35 |

The table1-shows, the age group taken for the study was between 18-35 years and the mean age of the experimental group was 28.37 with a standard deviation of 3.81 and the mean age of control group was 26.37 with a standard deviation of 2.44.

**Table 2-Frequency and percentage of age in experimental group and control group**

| Age | Experimental group | | Control group | |
|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage |
| 24 years | 0 | 0% | 2 | 25% |
| 25 years | 2 | 25% | 2 | 25% |
| 26 years | 2 | 25% | 1 | 12.5% |
| 27 years | 1 | 12.5% | 1 | 12.5% |
| 30 years | 1 | 12.5% | 2 | 25% |
| 34 years | 2 | 25% | 0 | 0% |

The table 2-shows the frequency and percentage of age in experimental group and control group.



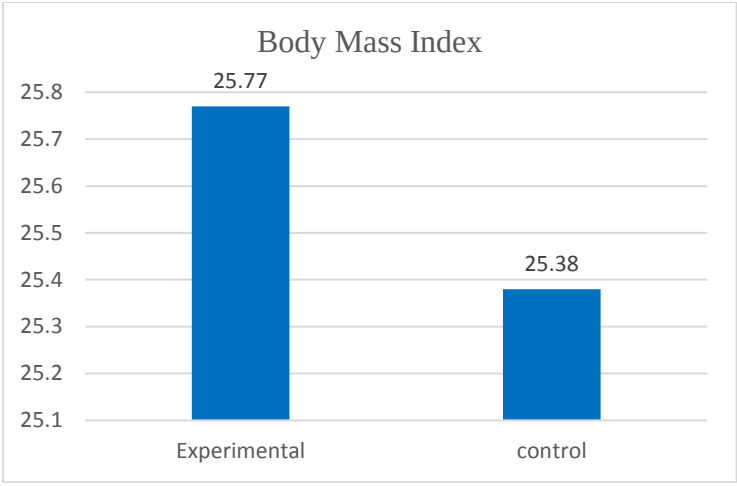

**Graph1-graphical representation of mean age in experimental group and control group**

## BODY MASS INDEX

**Table-3 Height, weight and BMI of subjects in experimental group and control group**

| | HEIGHT | WEIGHT | BMI |
|---|---|---|---|
| Experimental | 161.2±6.4 | 66.9±5.6 | 25.7±1.8 |
| Control | 158.3±5.8 | 63.7±3.7 | 25.3±1.4 |

Table 3 shows, mean and standard deviation height, weight and BMI of subjects in experimental group and control group




**Graph2-Graphical representation of BMI in experimental group and control group**

## COMPARISON WITHIN GROUP (paired t test)

## COMPARISON OF PRE- TEST AND POST TEST VALUES OF PHYSICAL EXERCISE CAPACITY IN GROUP A (EXPERIMENTAL GROUP)

**Table 4-shows paired t test for physical exercise capacity in group A(experimental group)**

| TEST | MEAN | SD | Mean Improvement | N | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 442.79 | 44.55 | 44.95 | 8 | 4.61 | 7 | <0.01 |
| POST-TEST | 487.74 | 49.97 | | | | | |

The mean column displays the mean pre-test and post-test physical exercise capacity scores in sedentary overweight women in the Experimental group. SD is the standard deviations of the physical exercise capacity in pre & post respectively. Mean change is 44.95 the difference between pre-test and post-test mean of physical exercise capacity scores (442.79-487.74). Since the *t-value* 4.61 shows $p < 0.01$, there is a significant difference existing between the pre-test and post-test physical exercise capacity scores in sedentary overweight women in the experimental group. This proves that there is an effect of calisthenics and breathing exercise on physical exercise capacity in sedentary overweight women.

## COMPARISON OF PRE- TEST AND POST TEST VALUES OF PHYSICAL EXERCISE CAPACITY IN GROUP B (CONTROL GROUP)

**Table5-shows paired t test for physical exercise capacity in group B (control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d *f* | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 427.87 | 50.02 | | 8 | 2.67 | 7 | <0.05 |
| POST-TEST | 397.80 | 44.65 | 30.06 | | | | |

The mean column displays the mean pre-test and post-test Physical exercise capacity scores in sedentary overweight women in the control group. SD is the standard deviations of the physical exercise capacity in pre & post respectively. Mean change is 30.06 the difference between pre test and post-test mean of physical exercise capacity scores (427.87-397.80). Since the *t-value* 2.67 shows $p < 0.05$, there is a significant reduction of physical exercise capacity score existing between the pre-test and post-test physical exercise capacity scores on sedentary overweight women in the control group.

## COMPARISON OF PRE- TEST AND POST-TEST VALUES OF THORACO-ABDOMINAL EXCURSION; AXILLARY REGION IN GROUP A(EXPERIMENTAL GROUP)

**Table 6-shows paired t test for thoraco-abdominal excursion; axillary region in group A (experimental group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 1.18 | 0.45 | 1.21 | 8 | 7.38 | 7 | <0.001 |
| POST-TEST | 2.4 | 0.37 | | | | | |

The mean column displays the mean pre-test and post-test thoraco-abdominal excursion; axillary region scores in sedentary overweight women in the Experimental group. SD is the standard deviations of the thoraco-abdominal excursion; axillary region in pre & post respectively. Mean change is 1.21 the difference between pre-test and post-test mean of thoraco-abdominal excursion; axillary region (1.18-2.2.4). Since the *t-value* 7.38 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test thoraco-abdominal excursion; axillary region scores in sedentary overweight women in the experimental group. This proves the effect of calisthenics and breathing exercise in thoraco-abdominal excursion; axillary region on sedentary overweight women.

## COMPARISON OF PRE- TEST AND POST-TEST VALUES OF THORACO-ABDOMINAL EXCURSION; AXILLARY REGION IN GROUP B (CONTROL GROUP)

**Table 7- shows paired t test for thoraco-abdominal excursion; axillary region in group B (control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 1.15 | 0.51 | 0.08 | 8 | 2.19 | 7 | 0.063 |
| POST-TEST | 1.06 | 0.50 | | | | | |

The mean column displays the mean pre-test and post-test thoraco-abdominal excursion; axillary region scores in sedentary overweight women in the control group. SD is the standard deviations of the thoraco-abdominal excursion; axillary region in pre & post respectively. Mean change is 0.08 the difference between pre-test and post-test mean of thoraco-abdominal excursion; axillary region scores (1.15-1.06). Since the *t-value* 2.19 shows $p > 0.05$, there is no significant difference existing between the pre-test and post-test thoraco-abdominal excursion; axillary region scores in sedentary overweight women in the control group.

## COMPARISON OF PRE- TEST AND POST-TEST VALUES OF THORACO-ABDOMINAL EXCURSION; XIPHISTERNAL REGION IN GROUP A(EXPERIMENTAL GROUP)

**Table 8-shows pired t test for thoraco-abdominal excursion; xiphisternal region in group A (experimental group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 1.43 | 0.60 | 0.95 | 8 | 6.54 | 7 | <0.001 |
| POST-TEST | 2.38 | 0.36 | | | | | |

The mean column displays the mean pre-test and post-test thoraco-abdominal excursion; xiphisternal region scores in sedentary overweight women in the Experimental group. SD is the standard deviations of the thoraco-abdominal excursion; xiphisternal region in pre & post respectively. Mean change is 0.95 the difference between pre-test and post-test mean of thoraco-abdominal excursion; xiphisternal region (1.43-2.38). Since the *t-value* 6.54 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test thoraco-abdominal

excursion; xiphisternal region scores in sedentary overweight women in the experimental group. This proves the effect of calisthenics and breathing exercise on thoraco-abdominal excursion; xiphisternal region in sedentary overweight women.

## COMPARISON OF PRE- TEST AND POST-TEST VALUES OF THORACO-ABDOMINAL EXCURSION; XIPHISTERNAL REGION IN GROUP B (CONTROL GROUP)

**Table 9-shows paired t test for thoraco-abdominal excursion; xiphisternal region in group B (control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 1.07 | 0.55 | 0.06 | 8 | 1.48 | 7 | 0.18 |
| POST-TEST | 0.01 | 0.49 | | | | | |

The mean column displays the mean pre-test and post-test thoraco-abdominal excursion; xiphisternal region scores in sedentary overweight women in the Control group. SD is the standard deviations of the thoraco-abdominal excursion; xiphisternal region in pre & post respectively. Mean change is 0.06 the difference between pre-test and post-test mean of thoraco-abdominal excursion; xiphisternal region (1.07-0.01). Since the *t-value* 1.48 show $p > 0.05$, there is no significant difference existing between the pre-test and post-test thoraco-abdominal excursion; xiphisternal region scores in sedentary overweight women in the control group.

## COMPARISON OF PRE- TEST AND POST-TEST VALUES OF THORACO-ABDOMINAL EXCURSION; UMBILICAL REGION IN GROUP A (EXPERIMENTAL GROUP)

**Table 10-shows paired t test for thoraco-abdominal excursion; umbilical region in group A (experimental group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 1 | 0.31 | 1.07 | 8 | 5.87 | 7 | <0.001 |
| POST-TEST | 2.07 | 0.63 | | | | | |

The mean column displays the mean pre-test and post-test thoraco-abdominal excursion; umbilical region scores in sedentary overweight women in the Experimental group. SD is the standard deviations of the thoraco-abdominal excursion; umbilical region in pre & post respectively. Mean change is 1.07 the difference between pre-test and post-test mean of thoraco-abdominal excursion; umbilical region (1-2.07). Since the *t-value* 5.87 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test thoraco-abdominal excursion; umbilical region scores in sedentary overweight women in the experimental group. This proves the effect of calisthenics and breathing exercise on thoraco-abdominal excursion; umbilical region in sedentary overweight women.

## COMPARISON OF PRE- TEST AND POST-TEST VALUES OF THORACO-ABDOMINAL EXCURSION; UMBILICAL REGION IN GROUP B (CONTROL GROUP)

**Table 11-shows paired t test for thoraco-abdominal excursion; umbilical region in group B (control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d *f* | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 0.98 | 0.37 | 0.02 | 8 | 0.79 | 7 | 0.45 |
| POST-TEST | 0.01 | 0.39 | | | | | |

The mean column displays the mean pre-test and post-test thoraco-abdominal excursion; umbilical region scores in sedentary overweight women in the control group. SD is the standard deviations of the thoraco-abdominal excursion; umbilical region in pre & post respectively. Mean change is 0.02 the difference between pre-

test and post-test mean of thoraco-abdominal excursion; umbilical region (0.98-0.01). Since the *t-value* 0.79 shows *p > 0.05,* there is no a significant difference existing between the pre-test and post-test thoraco-abdominal excursion; umbilical region scores in sedentary overweight women in the control group.

## COMPARISON OF PRE- TEST AND POST TEST VALUES OF FLEXIBILITY IN GROUP A (EXPERIMENTAL GROUP)

**Table 12-shows paired t test for flexibility in group A(experimental group)**

| TEST | MEAN | SD | Mean improvement | n | t | d *f* | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 17.93 | 1.63 | 3.87 | 8 | 9.0 | 7 | <0.001 |
| POST-TEST | 21.81 | 2.47 | | | | | |

The mean column displays the mean pre-test and post-test flexibility scores in sedentary overweight women in the Experimental group. SD is the standard deviations of the flexibility in pre & post respectively. Mean change is 3.87 the difference between pre-test and post-test mean of flexibility (17.93-21.81). Since the *t-value* 9.0 shows *p < 0.001,* there is a significant difference existing between the pre-test and post-test flexibility scores in sedentary overweight women in the experimental group. This proves the effect of calisthenics and breathing exercise on flexibility in sedentary overweight women.

## COMPARISON OF PRE- TEST AND POST TEST VALUES OF FLEXIBILITY IN GROUP B (CONTROL GROUP)

**Table 13- shows paired t test for flexibility in group B(control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| PRE-TEST | 18.31 | 2.08 | 0.06 | 8 | 0.28 | 7 | 0.78 |
| POST-TEST | 18.25 | 2.17 | | | | | |

The mean column displays the mean pre-test and post-test flexibility scores in sedentary overweight women in the Control group. SD is the standard deviations of the flexibility in pre & post respectively. Mean change is 0.06 the difference between pre-test and post-test mean of flexibility (18.31-18.25). Since the *t-value* 0.28 shows *p > 0.05,* there is no significant difference existing between the pre-test and post-test flexibility scores in sedentary overweight women in the control group.

## COMPARISON BETWEEN GROUPS (Independent t test)
## COMPARISON OF PRE-TEST PHYSICAL EXERCISE CAPACITY SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 14-shows independent t test for pre-test physical exercise capacity in between group A and group B(experimental group and control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d *f* | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 442.79 | 44.55 | 14.92 | 8 | 0.63 | 14 | 0.53 |
| Control | 427.87 | 50.02 | | | | | |

The Mean column in the t test table displays the mean pre-test physical exercise capacity scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (14.92) shows the difference between mean in two groups (442.79-427.87).Since the *t-value* 0.63, shows *p-value* > 0.05, there is no significant difference in pre-test physical exercise capacity scores between the experimental and the control groups .So we

can consider the groups as homogenous in the baseline level.

## COMPARISON OF POST-TEST PHYSICAL EXERCISE CAPACITY SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 15-shows independent t test for post-test physical exercise capacity in between group A and group B (experimental group and control group)**

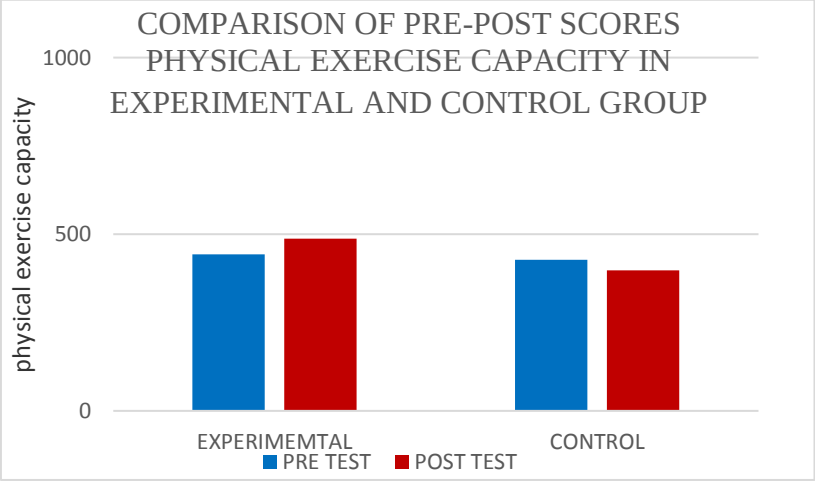
| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 487.74 | 49.97 | 89.94 | 8 | 3.79 | 14 | =0.001 |
| Control | 397.80 | 44.65 | | | | | |

The Mean column in the t test table displays the mean post-test physical exercise capacity scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (89.94) shows the difference between mean in two groups (487.74-397.80). Since the *t-value*, 3.79 shows *p-value* = 0.001, there is a significant difference in post-test physical exercise capacity scores between the experimental and the control groups. The scores in the experimental group is significantly higher than that in the control group. Hence calisthenics and breathing exercise are effective in improving physical exercise capacity in sedentary overweight women.

## COMPARISON OF PRE-POST SCORES PHYSICAL EXERCISE CAPACITY IN EXPERIMENTAL AND CONTROL GROUP

**Table 16-shows comparison of pre-post physical exercise capacity in group A and group B (experimental group and control group)**

| TEST | MEAN | SD | MEAN | SD |
|---|---|---|---|---|
| Experimental | 442.79 | 44.55 | 487.74 | 49.97 |
| Control | 427.87 | 50.02 | 397.80 | 44.65 |




**Graph 3-Graphical representation comparison of pre-post physical exercise capacity scores in group A and group B (experimental group and control group)**

## COMPARISON OF PRE-TEST THORACO-ABDOMINAL EXCURSION; AXILLARY REGION SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 17-shows independent t test for pre-test thoraco-abdominal excursion; axillary region in between group A and group B (experimental group and control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 1.18 | 0.45 | 0.37 | 8 | 0.15 | 14 | 0.88 |
| Control | 1.15 | 0.51 | | | | | |

The mean column in the t test table displays the mean pre-test thoraco-abdominal excursion; axillary region scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.37) shows the difference between mean in two groups (1.18-1.15). Since the *t-value* 0.15, shows *p-value* > 0.05, there is no significant difference in pre-test thoraco-abdominal excursion; axillary region scores between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

## COMPARISON OF POST-TEST THORACO-ABDOMINAL EXCURSION; AXILLARY REGION SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 18- shows independent t test for post-test thoraco-abdominal excursion; axillary region in between group A and group B (experimental group and control group)**

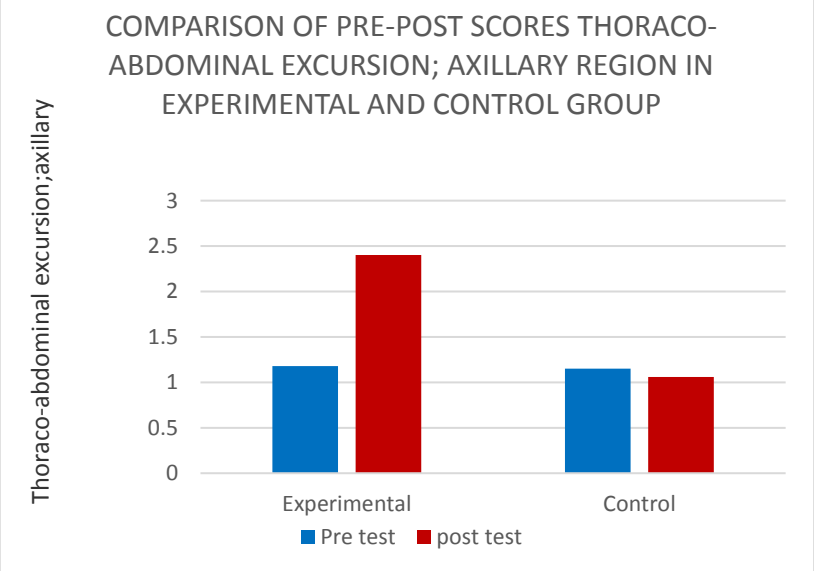
| TEST | MEAN | SD | Mean improvement | n | T | d f | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 2.4 | 0.37 | 1.33 | 8 | 6.07 | 14 | <0.001 |
| Control | 1.06 | 0.50 | | | | | |

The Mean column in the t test table displays the mean post-test thoraco-abdominal excursion; axillary region scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (1.33) shows the difference between mean in two groups (2.4-0.37). Since the *t-value*,6.07 shows *p-value* < 0.001, there is a significant difference in post-test thoraco-abdominal excursion; axillary region scores between the experimental and the control groups. The scores in the experimental group is significantly higher than that in the control group. Hence calisthenics and breathing exercise are effective in improving thoraco-abdominal excursion; axillary region in sedentary overweight women

## COMPARISON OF PRE-POST SCORES THORACO-ABDOMINAL EXCURSION; AXILLARY REGION IN EXPERIMENTAL AND CONTROL GROUP

**Table 19- shows comparison of pre-post thoraco-abdominal excursion; axillary region in group A and group B (experimental group and control group)**

| TEST | MEAN | SD | MEAN | SD |
|---|---|---|---|---|
| Experimental | 1.18 | 0.45 | 2.4 | 0.37 |
| Control | 1.15 | 0.51 | 1.06 | 0.50 |




***Graph 4-Graphical representation comparison of pre-post thoraco-abdominal excursion; axillary region in group A and group B (experimental group and control group)***

## COMPARISON OF PRE-TEST THORACO-ABDOMINAL EXCURSION; XIPHISTERNAL REGION SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 20-shows independent t test for pre-test thoraco-abdominal excursion;xiphisternal region in between group A and group B (experimental group and control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 1.43 | 0.60 | 0.36 | 8 | 1.24 | 14 | 0.23 |
| Control | 1.07 | 0.55 | | | | | |

The mean column in the t test table displays the mean pre-test thoraco-abdominal excursion; xiphisternal region scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.36) shows the difference between mean in two groups (1.43-1.07). Since the *t-value* 1.24, shows *p-value* > 0.05, there is no significant difference in pre-test thoraco-abdominal excursion; xiphisternal region scores between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

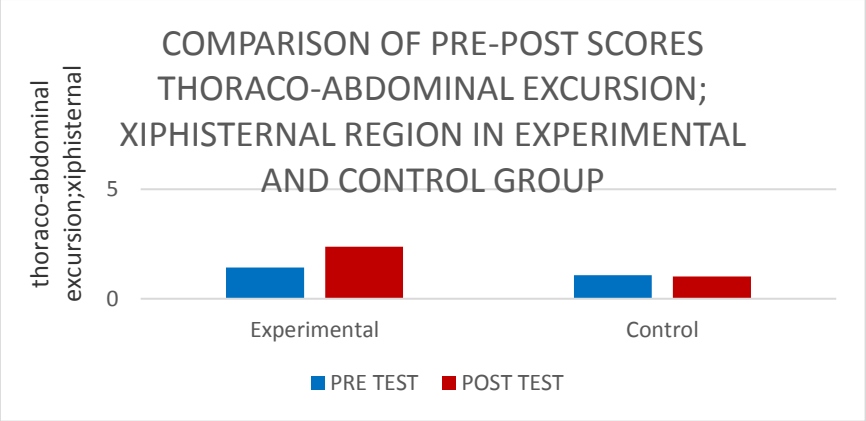
## COMPARISON OF POST-TEST THORACO-ABDOMINAL EXCURSION; XIPHISTERNAL REGION SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 21- shows independent t test for post-test thoraco-abdominal excursion; xiphisternal region in between group A and group B (experimental group and control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d *f* | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 2.38 | 0.36 | 1.37 | 8 | 6.31 | 14 | <0.001 |
| Control | 1.01 | 0.49 | | | | | |

The Mean column in the t test table displays the mean post-test thoraco-abdominal excursion; xiphisternal region scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (1.37) shows the difference between mean in two groups (2.38-1.01). Since the *t-value*,6.31 shows *p-value* < 0.001, there is a significant difference in post-test thoraco-abdominal excursion; xiphisternal region scores between the experimental and the control groups. The scores in the experimental group is significantly higher than that in the control group. Hence calisthenics and breathing exercise are effective in improving thoraco-abdominal excursion; xiphisternal region in sedentary overweight women

## COMPARISON OF PRE-POST SCORES THORACO-ABDOMINAL EXCURSION XIPHISTERNAL REGION IN EXPERIMENTAL AND CONTROL GROUP




**Graph 5-*Graphical representation comparison of pre-post thoraco-abdominal excursion;xiphisternal region in group A and group B (experimental group and control group)***

**Table 22-shows comparison of pre-post thoraco-abdominal excursion;xiphisternal region in group A and group B (experimental group and control group)**

| TEST | MEAN | SD | MEAN | SD |
|---|---|---|---|---|
| Experimental | 1.43 | 0.60 | 2.38 | 0.36 |
| Control | 1.07 | 0.55 | 1.01 | 0.49 |

## COMPARISON OF PRE-TEST THORACO-ABDOMINAL EXCURSION; UMBILICAL REGION SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 23-shows independent t test for pre-test thoraco-abdominal excursion; umbilical region in between group A and group B (experimental group and control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d *f* | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 1 | 0.31 | 0.01 | 8 | 0.07 | 14 | 0.94 |
| Control | 0.98 | 0.37 | | | | | |

The mean column in the t test table displays the mean pre-test thoraco-abdominal excursion; umbilical region scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.37) shows the difference between mean in two groups (1-0.98). Since the *t-value* 0.07, shows *p-value* > 0.05, there is no significant difference in pre-test thoraco-abdominal excursion; umbilical region scores between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

## COMPARISON OF POST-TEST THORACO-ABDOMINAL EXCURSION; UMBILICAL REGION SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 24-shows independent t test for post-test thoraco-abdominal excursion; umbilical region in between group A and group B (experimental group and control group)**

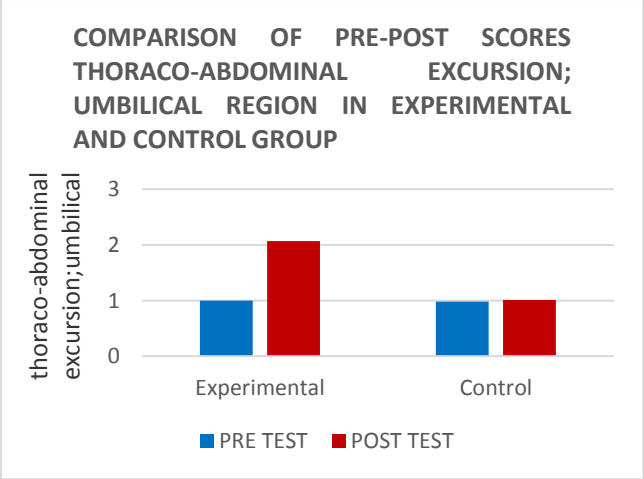
| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 2.07 | 0.63 | 1.06 | 8 | 4.02 | 14 | =0.001 |
| Control | 1.01 | 0.39 | | | | | |

The Mean column in the t test table displays the mean post-test thoraco-abdominal excursion; xiphisternal region scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (1.37) shows the difference between mean in two groups (2.38-1.01). Since the *t-value,* 6.31 shows *p-value* =0.001, there is a significant difference in post-test thoraco-abdominal excursion; umbilical region scores between the experimental and the control groups. The scores in the experimental group are significantly higher than that in the control group. Hence calisthenics and breathing exercise are effective in improving thoraco-abdominal excursion; umbilical region in sedentary overweight women

## COMPARISON OF PRE-POST SCORES THORACO-ABDOMINAL EXCURSION; UMBILICAL REGION IN EXPERIMENTAL AND CONTROL GROUP

**Table 25-shows comparison of pre-post thoraco-abdominal excursion; umbilical region in group A and group B (experimental group and control group)**

| TEST | MEAN | SD | MEAN | SD |
|---|---|---|---|---|
| Experimental | 1 | 0.31 | 2.07 | 0.63 |
| Control | 0.98 | 0.37 | 1.01 | 0.39 |




**Graph6-Graphical representation comparison of pre-post thoraco-abdominal excursion;umbilical region in group A and group B (experimental group and control group)**

## COMPARISON OF PRE-TEST FLEXIBILITY SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 26-shows independent t test for pre-test flexibility in between group A and group B (experimental group and control group)**

| TEST | MEAN | SD | Mean improvement | n | t | d f | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 17.93 | 1.63 | 0.37 | 8 | 0.40 | 14 | 0.69 |
| Control | 18.31 | 2.08 | | | | | |

The mean column in the t test table displays the mean pre-test flexibility scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (0.37) shows the difference between mean in two groups (17.93-18.31). Since the *t-value* 0.40, shows *p-value* > 0.05, there is no significant difference in pre-test flexibility scores between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

## COMPARISON OF POST-TEST FLEXIBILITY SCORES BETWEEN GROUP A AND GROUP B (EXPERIMENTAL GROUPS AND CONTROL GROUP)

**Table 27-shows independent t test for post-test flexibility in between group A and group B (experimental group and control group)**

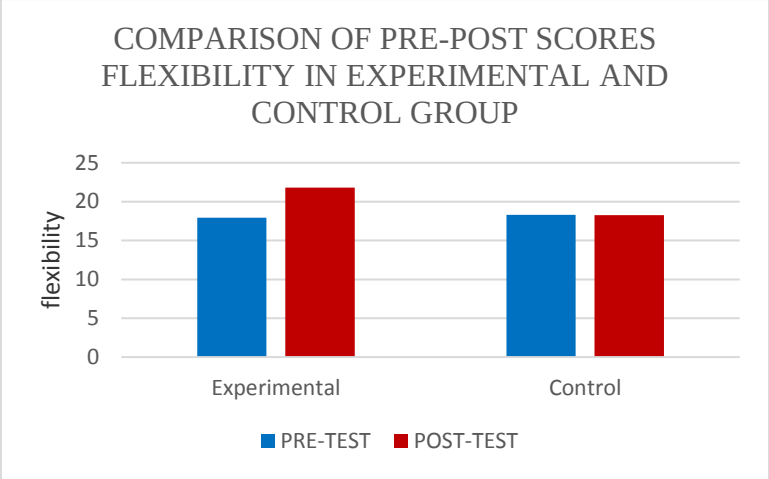
| TEST | MEAN | SD | Mean improvement | n | t | d *f* | p-value |
|---|---|---|---|---|---|---|---|
| Experimental | 21.81 | 2.47 | 3.56 | 8 | 3.05 | 14 | <0.01 |
| Control | 18.25 | 2.17 | | | | | |

The Mean column in the t test table displays the mean post-test flexibility scores in experimental and control group respectively. The standard deviation column displays the standard deviation of the scores in two groups. The difference (3.56) shows the difference between mean in two groups (21.81-18.25). Since the *t-value*,3.05 shows *p-value* < 0.01, there is a significant difference in post-test thoraco-abdominal excursion; umbilical region scores between the experimental and the control groups. The scores in the experimental group are significantly higher than that in the control group. Hence calisthenics and breathing exercise are effective in improving flexibility in sedentary overweight women

## COMPARISON OF PRE-POST SCORES FLEXIBILITY IN EXPERIMENTAL AND CONTROL GROUP

**Table 28-shows comparison of pre-post flexibility scores in group A and group B (experimental group and control group)**

| TEST | MEAN | SD | MEAN | SD |
|---|---|---|---|---|
| Experimental | 17.93 | 1.63 | 21.81 | 2.47 |
| Control | 18.31 | 2.08 | 18.25 | 2.17 |




**Graph 7-Graphical representation comparison of pre-post flexibility in group A and group B (experimental group and control group)**

## DISCUSSION

The prevalence of overweight and obesity is increasing worldwide. Several studies have shown that the prevalence of overweight is higher among women when compared to men in Asian Indian population and need to focus on prevention of non-communicable diseases[16]. The major risk factor for developing overweight and obesity is the sedentary behavior or the physical inactivity. Physical inactivity is now identified as the fourth leading risk factor for global mortality (WHO2010).[15] The physically inactive candidates should need a structured exercise program for improving their overall health and quality of life. Specific exercise program for improving the quality of life of these population is a need of the day. Engaging those overweight population in a structured exercise program will reduce the risk of development of certain noncommunicable diseases and also reduce the risk of development of obesity.[3]

Celina Roda et.al (2016) conducted study on Lifestyle correlates of overweight in adults: a hierarchical approach (the SPOTLIGHT project) The results were specifically point to the importance of sedentary habits as a key component to focus on when addressing the multiple factors associated with excess weight in preventive interventions.[3]

Physical activity during the last 7 days was documented using questions from the long version of the validated International Physical Activity Questionnaire (IPAQ)[17]. Good reliability (Spearman correlation coefficients ranged from 0.46 to 0.96) and acceptable criterion validity (median ρ of about 0.30) have been found for this questionnaire in a 12-country study.[18] Transport related and leisure time physical activity were estimated (in minutes per day − min/d) by multiplying the frequency (number of days in the last 7 days) and duration (average time/d).

Here in this study, the IPAQ Questionnaire-categorical score1(low) selected as the inclusion criteria for selecting the sedentary women.[19]

A total of 16 overweight women were selected on the basis of inclusion and exclusion criteria from Medical trust institute of medical sciences, cochin and community. They were equally divided into two groups, Group A and Group B. Group A received three sets of low intensity calisthenics and breathing exercise. Group B remained as control group does not received any form of exercise.

Pre and post-test measurements were done before and after the interventions. The outcome measures used were six-minute walk test, cirtometry and sit and reach box. The results were analysed using t- test. Paired t- test was used to compare the results within the group and independent t-test to compare results between the groups. Significance level kept as p value < 0.05.

The result in case of the Physical exercise capacity has shown that, in paired t test, since the *t-value*, 4.61 shows *p < 0.01*, there is a significant difference existing between the pre-test and post-test of the physical exercise capacity in the experimental group (group A). The *t-value*, 2.67 shows *p < 0.05*, there is a significant difference existing between the pre-test and post-test Physical exercise capacity in the control group (group B) also. The results showed improvement in both groups. In the independent t test, since the *t value* 3.79, shows *p-value = 0.001, (p=0.001)* there is a significant difference in post-test Physical exercise capacity between the experimental and the control groups. The mean difference, 89.94 shows the difference between mean in two groups (group A and B) 487.74 & 397.80 respectively. The scores in the experimental group were significantly higher than that of the control group.

In Calisthenics and breathing exercise, the calisthenics include continuous movement of the limbs which require more muscle work which in turn increase the need of O2 demand leading to increase in muscle strength, increase in the size and number of mitochondria and thus increases the myoglobin in turn improve the oxygen storage capacity and glycogen storage capacity which increases the ability to use fat as an energy source. An increase in submaximal exercise capacity can be achieved, with clinically important improvement in relation to general physical training and also add muscular and aerobic conditioning, helps the body to use the oxygen that breath for energy.

The result goes in hand with Renata P Basso.et.al (2016) concluded that the study provided clinically meaningful benefits; they increased physical exercise capacity.

The result in case of the Thoraco-abdominal excursion, has shown that in paired t test, since the *t-value*, in the axillary region 7.38 shows *p < 0.001*, there is a significant difference existing between the pre-test and post-test Thoraco-abdominal excursion in the axillary region in the experimental group. The *t-value*, 2.19 shows *p >0.05*, there is no significant difference existing between the pre-test and post-test Thoraco-abdominal excursion in the axillary region in the control group. The results showed improvement only in experimental group. In the independent t test, since the *t value* 6.07, shows *p-value < 0.001, (p=0.000002)* there is a significant difference in post-test Thoraco-abdominal excursion in the axillary region between the experimental and the control groups. The mean difference, 1.33 shows the difference between mean in two groups 2.4 & 1.33 respectively. The scores in the experimental group were significantly higher than that of the control group.

The results has shown that in paired t test, since the *t-value*, in the xiphisternal region 6.54 shows *p < 0.001*, there is a significant difference existing between the pre-test and post-test Thoraco-abdominal excursion in the xiphisternal region in the experimental group. The *t-value*, 1.48 shows *p >0.05*, there is no significant difference existing between the pre-test and post-test Thoraco-abdominal excursion in the xiphisternal region in the control group. The results showed improvement only in experimental group. In the independent t test, since the *t value* 6.31, shows *p-value < 0.001, (p=0.000001)* there is a significant difference in post-test Thoraco-abdominal excursion in the xiphisternal region between the experimental and the control groups. The mean difference, 1.37 shows the difference between mean in two groups 2.38 &1.01 respectively. The scores in the experimental group were significantly higher than that of the control group.

The result has shown that in paired t test, since the *t-value*, in the umbilical region 5.87 shows *p < 0.001*, there is a significant difference existing between the pre-test and post-test Thoraco-abdominal excursion in the umbilical region in the experimental group. The *t-value*,0.79 shows *p >0.05*, there is no significant difference

existing between the pre-test and post-test Thoraco-abdominal excursion in the xiphisternal region in the control group. The results showed improvement only in experimental group. In the independent t test, since the *t value* 4.02, shows *p-value =0.001, (p=0.001)* there is a significant difference in post-test Thoraco-abdominal excursion in the xiphisternal region between the experimental and the control groups. The mean difference, 1.06 shows the difference between mean in two groups 2.07 &1.01 respectively. The scores in the experimental group were significantly higher than that of the control group.

Musculoskeletal changes inherent to the sedentary lifestyle contribute to increased chest wall stiffness, hindered rib cage expansion, increased breathing work, and reduced respiratory function.[20] In this study, observed a significant increase in thoraco-abdominal excursion for all the three measured regions. Calisthenics and breathing exercise in turn, are able to readjust the length tension-ratio of respiratory muscle, hence increased the thoracoabdominal mobility, reduced the sensation of dyspnoea. Which allowed a greater rib cage motion.

The result goes in hand with Renata P Basso.et.al (2016) concluded that the study provided clinically meaningful benefits; they increased thoraco-abdominal mobility.[14]

The result in case of flexibility, it has shown that in paired t test, since the *t-value*, 9.0 shows *p < 0.001*, there is a significant difference existing between the pre-test and post-test flexibility in the experimental group. The *t-value*, 0.28 shows *p>0.05*, there is no significant difference existing between the pre-test and post-test Physical exercise capacity in the control group. The results showed improvement only in the experimental group. In the independent t test, since the *t value* 3.05, shows *p-value < 0.01, (p=0.008)* there is a significant difference in post-test Physical exercise capacity between the experimental and the control groups. The mean difference,3.56 shows the difference between mean in two groups 21.81 & 18.25 respectively. The scores in the experimental group were significantly higher than that of the control group.

The calisthenics and breathing exercise, calisthenics include torso exercises along with breathing exercise. Torso stabilizes the spine and allow movements by coordinating the pelvis muscle. Torso rotation exercise can improve movements involving flexion, extension and bending forward and backward and also enhance the movements of the joints and ability of the muscle to stretch through an entire ROM.

**Strength Of The Study**

- Number of participants were equal in both groups
- Participants independently committed to the exercise program and regularly present in the google meet session.
- Cost effective programme
- No equipment or apparatus needed for exercise

**Limitations Of The Study**

- As the measurements were taken manually, this may introduce human error, which could threat the reliability of the study.
- Only Asian classification of overweight were taken.
- Only overweight women were included.
- The exercise secession was carried out via google meet app.

**Future Research**

- The sample size of the study can be increased; hence it may lead to better results.
- Can be administered in other populations.
- A follow-up study could ensure the long-term effect of the treatment programme.
- Administering the interventions personally will improve the result

- Calisthenics and breathing exercise can be added to pulmonary rehabilitation program. Which may be beneficial

## CONCLUSION

From the above study, it was obtained that there is significant difference among the experimental and control groups when the values were analysed. The study concluded that the analysis of physical exercise capacity, thoraco-abdominal excursion and flexibility shows improvement within the group as well as between the groups. But the Experimental group shows significantly higher improvement in all the three parameters when compared to the control group. Hence, I concluded that a well-planned 6 weeks of exercise intervention programme including calisthenics and breathing exercise is effective in improving physical exercise capacity, thoraco-abdominal excursion and flexibility in sedentary overweight women.

**Acknowledgement:** None

**Conflict of Interest:** None

**Source of Funding:** None

**Ethical Approval:** Approved

## REFERENCES

1. World Health Organization. Obesity and Overweight. (Internet) 2021(Updated 2021 June 9). Available from https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight#:~:text=For%20adults%2C%20WHO%20defines%20overweight,than%20or%20equal%20to%2030.
2. Ahirwar R, Mondal PR. Prevalence of obesity in India: A systematic review. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2019 Jan 1;13(1):318-21.
3. Roda C, Charreire H, Feuillet T, Mackenbach JD, Compernolle S, Glonti K, Bárdos H, Rutter H, McKee M, Brug J, De Bourdeaudhuij I. Lifestyle correlates of overweight in adults: a hierarchical approach (the SPOTLIGHT project). International Journal of Behavioral Nutrition and Physical Activity. 2016 Dec;13(1):1-2.
4. Marizeiro DF, Florêncio AC, Nunes AC, Campos NG, de Paula Lima PO. Immediate effects of diaphragmatic myofascial release on the physical and functional outcomes in sedentary women: A randomized placebo-controlled trial. Journal of bodywork and movement therapies. 2018 Oct 1;22(4):924-9.
5. Probst VS, Kovelis D, Hernandes NA, Camillo CA, Cavalheri V, Pitta F. Effects of 2 exercise training programs on physical activity in daily life in patients with COPD. Respiratory care. 2011 Nov 1;56(11):1799-807.
6. Chetta A, Zanini A, Pisi G, Aiello M, Tzani P, Neri M, Olivieri D. Reference values for the 6-min walk test in healthy subjects 20–50 years old. Respiratory medicine. 2006 Sep 1;100(9):1573-8.
7. Ravi Manawat,Shweta.Effect of six minute walk test in obesity. International Journal of Medical Science and Public Health.2018 (7) ;4
8. Pedrini A, Gonçalves MA, Leal BE, Yamaguti WP, Paulin E. Comparison between the measures of thoracoabdominal cirtometry in supine and standing. Fisioterapia e Pesquisa. 2013;20:373-8.
9. French G, Grayson C, Sanders L, Williams T, Ward M. A comparative analysis of the traditional sit-and-reach test and the RS smith sit-and-reach design. The Corinthian. 2016;17(1):5.
10. Veloso AP, Cusmanich KG. Evaluation of the thoracoabdominal mobility of obese subjects in pre-bariatric surgery. ABCD. Arquivos Brasileiros de Cirurgia Digestiva (São Paulo). 2016;29:39-42.
11. Palo capodaglio et.al.Reference values for 6-min walking test in obese subjects.2013 jul;35(14):1199-203
12. Mohan V, Dzulkifli NH, Justine M, Haron R, Rathinam C. Intrarater reliability of chest expansion using cloth tape measure technique. Bangladesh Journal of Medical Science. 2012 Nov 13;11(4):307-11.
13. Field AE, Coakley EH, Must A, Spadano JL, Laird N, Dietz WH, Rimm E, Colditz GA. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. Archives of internal medicine. 2001 Jul 9;161(13):1581-6.

14. Basso-Vanelli RP, Di Lorenzo VA, Labadessa IG, Regueiro EM, Jamami M, Gomes EL, Costa D. Effects of inspiratory muscle training and calisthenics-and-breathing exercises in COPD with and without respiratory muscle weakness. Respiratory care. 2016 Jan 1;61(1):50-60.
15. World Health Organization. Global recommendations on physical activity for health. World Health Organization; 2010.(Internet).available from https://www.who.int/publications/i/item/9789241599979
16. Garawi f,devries k,Thorogood N,uauy R.Global difference between women and men in the prevalenceof obesity:is there an association with gender inequality.Europian journal of clinical nutrition.2014 oct;68(10):1101-6.
17. International physical activity questionnaire (October 2002) long last 7 days self-administered format. Available from https://cdn-links.lww.com/permalink/jcrp/a/jcrp_2016_04_12_kaminsky_jcrp-d-16-00031r1_sdc1.pdf
18. Craig CL,marshall AL,Sjostrom M,bauman AE,Booth ML,Ainsworth BE,Pratt mM,Ekelund UL,Yngve A,sallis JF,Oja P.International physical activity questionnaire;12 country study relability and validity.medicine and science in sports and exercise. 2013 september 35(8):1381-95
19. Dr Cuisle Forde. Scoring the international physical activity questionnaire (IPAQ). Available from https://ugc.futurelearn.com/uploads/files/bc/c5/bcc53b14-ec1e-4d90-88e3-1568682f32ae/IPAQ_PDF.pdf
20. Chen SM, Liu MF, Cook J, Bass S, Lo SK. Sedentary lifestyle as a risk factor for low back pain: a systematic review. International archives of occupational and environmental health. 2009 Jul;82(7):797-806.
21. American Thoracic Society. ATS statement: guidelines for the six-minute walk test. Am J Respir Crit Care Med. 2002;166:111-7.
22. Wells KF, Dillon EK. The sit and reach—a test of back and leg flexibility. Research Quarterly. American Association for Health, Physical Education and Recreation. 1952 Mar 1;23(1):115-8.

How to cite this article: Girish G, Mathew P. Effectiveness of calisthenics and breathing exercise on physical exercise capacity, thoraco-abdominal excursion and flexibility in sedentary overweight women. *Int J Health Sci Res.* 2022; 12(4): 174-195. DOI: *https://doi.org/10.52403/ijhsr.20220423*

******