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Effect of Abdominal Muscle Exercise on Peak Expiratory Flow Rate in Overweight/Obese Post-Menopausal Women

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ABSTRACT

BACKGROUND & OBJECTIVES: Menopause is a natural process that occurs when a woman's menstrual period stops, and post-menopause occurs when she hasn't had a period for at least a year. Along with a myriad of symptoms, women following menopause are more likely to gain weight, particularly around the abdomen. Their lung function is compromised, and central obesity increases the chance of acquiring a number of disorders, including cardiovascular and neurological illnesses. The goal of the study was to see how abdominal muscle exercise affected PEFR, Waist-Hip ratio, and abdominal strength in postmenopausal women who were overweight or obese.
METHODOLOGY: A total of 30 subjects were selected based on inclusion and exclusion criteria, then divided into two groups. Group A (Experimental group n= 15) received abdominal muscle exercise, Group B (control group n=15) did not receive any sort of exercise and went about their daily routines as usual. For six weeks, the exercise programme was held three times a week on alternate days (35 minutes). PEFR, waist hip ratio, and abdominal strength were measured using a Peak flow meter, inch tape method, and abdominal MMT at the start and six weeks following intervention, respectively.
RESULTS: Peak Expiratory Flow Rate, Waist Hip Ratio, and Abdominal Strength all improved among and between groups, according to the data (using paired and unpaired t test respectively). When compared to the control group, the Experimental group exhibited significantly greater improvement in all three parameters.
CONCLUSION: In obese/overweight postmenopausal women, a well-planned exercise intervention programme containing abdominal muscle exercise is helpful in improving Peak Expiratory Flow Rate, Waist Hip Ratio, and Abdominal strength.

KEY WORDS: Post menopause, Abdominal muscle exercise, PEFR, Abdominal strength, Waist Hip Ratio

INTRODUCTION

Menopause is a stage in a woman's life when she transforms from being a fertile to a non-fertile woman. Post-menopause refers to the time period following the last menstrual period, regardless of whether the menopause was natural or induced. (1)

Hot flashes, mental issues, sleep abnormalities, and recurrent infections of the urogenital tract are just a few of the debilitating symptoms that women experience during menopause. Furthermore, plenty of metabolic issues occur during this period, including weight gain, insulin resistance, and disruptions in glucose, lipid

metabolism etc. As a result, the risk of type 2 diabetes, osteoporosis, cardiovascular disease, and cancer rises. Among the many signs and symptoms of menopause, Obesity is one of the most significant since it is both a medical and a social and economic problem. [2]

Overweight and obesity are defined by the World Health Organization (WHO) as an abnormal or excessive fat buildup that may be harmful to one's health (WHO, Obesity and overweight fact sheet, updated June 2016). Obesity-related morbidities include reduced glucose tolerance and diabetes, hypertension, heart disease, and cerebrovascular disease, to name a few. [3]

Women after menopause have a higher risk of acquiring weight. Although it is unknown if the menopausal transition causes weight gain, it is known that the physiological withdrawal of estrogen produces changes in fat distribution, which, in combination with physical inactivity, are most likely the principal reasons of this phenomena. [4] In post-menopausal women, increased body weight has a substantial impact on respiratory functioning. Obesity produces diaphragm, lung, and chest cavity mechanical compression, which can lead to restrictive pulmonary disease. Likewise, extra fat decreases total respiratory system compliance, increases pulmonary resistance, and reduces respiratory muscle strength. There is a clear link between lung function and body fat distribution in obese and overweight people, with worsening lung function when fat concentrates in the chest and abdomen. [5]

Peak Expiratory Flow Rate (PEFR) is the simplest of the pulmonary function indices for assessing ventilatory capacity. "Its highest expiratory flow rate attained with a maximally forced effort from a point of maximum inspiration, given in liters/min," according to the definition. PEFR measurement is helpful in assessing respiratory disorders, particularly in distinguishing between obstructive and restrictive diseases. [6]

According to studies, PEFR in postmenopausal women is lower than in premenopausal women. [7] In addition, PEFR decreases with age due to degenerative changes in the musculoskeletal system, resulting in a decrease in respiratory muscle strength. Furthermore, PEFR shows some deterioration with increasing BMI in the senior age group. [8]

The diaphragm is the main muscle used for inspiration, and it is an active process. Expiration is usually a passive process, with vigorous muscle contractions required for more forceful motions like coughing or sneezing. Rectus Abdominis, Transverse Abdominis, and Internal & External Oblique, which constitute the muscular corset of the abdominal wall, are the main muscles involved in expiration. During expiration, contraction of these muscles pulls the lower rib borders downward, compressing the abdominal compartment and generating upward movement of the diaphragm into the thoracic cavity, increasing the internal pressure and forcing air out of the lungs. During any workout or when forceful breathing is required, these abdominal muscles are crucial. [9]

It is thought that when the lungs' ventilatory capacities are hampered, the individual's respiratory functions are disrupted, and he or she will use the abdominal muscles to induce expiration, allowing for better inspiration activity. It's also thought that abdominal muscles could be strengthened to help with the breathing process. [10]

Around the fifth and sixth decades of life, women's muscle power begins to deteriorate. Several studies have found that between the ages of 25 and 55, women's strength drops by 21%. Muscle strength reduction appears to be linked to the onset of menopause, just as it is with muscle mass loss. [11] Excess body fat also has a severe impact on health, generally resulting in weakened abdominal muscles and respiratory systems. As a result, abdominal muscles must be strengthened in order to improve the strength and function of respiratory muscles. [12]

MMT (Manual Muscle Testing) is a diagnostic technique. Practitioners use it as one of the most prevalent types of muscle testing. [13] Abdominal MMT is used to evaluate the abdominal muscles' strength.

A study conducted by Giovana B Donato et al (2006) on the Association between menopause status and central adiposity measured at different cutoffs of waist circumference and waist-to-hip ratio, concluded that the Postmenopausal women are at greater risk of central adiposity as detected by both waist circumference and waist-to-hip ratio. [14]

The waist hip ratio (WHR) is the ratio of waist circumference to hip circumference. According to the standard defined by World Health Organization (WHO) in 1999 about metabolic syndrome, in which type 2 diabetes mellitus, glucose tolerance, and insulin resistance are required items, obesity is defined as WHR >0.9 in men and WHR >0.85 in women (World Health Organization, 1999). [15]

The study published in the American Journal of Respiratory and Critical Care Medicine, conducted by Natalie Leone et al, revealed that excessive fat accumulation, especially around the waist may drastically hamper your ability to take deep breaths.

There are several studies on the effect of abdominal exercise in improving lung function in different populations. But there is a scarcity of literatures on the effect of abdominal muscle exercise in improving lung function and abdominal strength in overweight/obese post-menopausal women. This study emphasis on filling up the desolate in literature.

RELEVANCE OF THE STUDY

Post – menopausal women are at high risk for a variety of health conditions due to a number of circumstances, including a lower amount of estrogen. According to studies, majority of them lead a sedentary lifestyle with limited physical activity, which leads to a slew of health issues such as obesity, anxiety and depression, as well as decreased hormone levels contribute to a reduction in lung capacity and pulmonary function. They suffer from the problems of post-menopausal weight gain, such as tiredness, hypertension, fatty liver, possibly heart and neuro issues etc., among other symptoms.

Previously, the role of abdominal exercise in improving lung functions and abdominal strength and reducing central adiposity has been poorly understood in post-menopausal women and there is scarcity of literatures regarding the same. This study will help in understanding the role of physiotherapy interventions in post-menopausal period. This study's finding will directly aid post-menopausal women in terms of enhancing their PEFR, abdominal strength and waist – hip ratio.

METHODOLOGY

STUDY DESIGN: Experimental study
SAMPLING METHOD: Convenient sampling
STUDY SETTING: Community level in South Paravoor, Ernakulam.
SAMPLE SIZE: N = 30
STUDY DURATION: 6 months
INTERVENTION PERIOD: 6 weeks
Frequency: 3days/ week

Inclusion criteria:

- Age: >50 years
- Post-menopausal women
- BMI: More than 25
- Waist hip ratio: greater than 0.85
- Abdominal muscle strength less than or equal to grade 3
- Sedentary women

Exclusion criteria:

- Cardio pulmonary pathology
- Individuals undergoing any exercise program
- History of old fracture, Musculo-skeletal injuries or recent surgeries
- Hernia
- History of back pain or abdominal pain in last 3 months
- Cognitive or memory deficit

Materials Used

Inch tape, Weighing machine, Peak Expiratory Flow Meter, Yoga Mat, Stethoscope, Mouth piece, Sphygmomanometer, Stadiometer

Outcome measures and Tools of Data Collection

- **Peak Expiratory Flow Meter – to find out PEFR**

A compact, portable instrument that measures a person's ability to exhale air. It determines the amount of airflow across the bronchi and hence the degree of airway blockage. Martin Wright developed the PFM in 1956.

- **Inch tape method – to measure Waist hip ratio**

It is the ratio of the circumference of waist to that of hips. This is calculated as waist circumference divided by hip circumference (W/H). Waist and hip circumference were measured in centimeters.

Waist circumference: The subjects stood upright and relaxed. A horizontal measurement was taken at 1 inch above the umbilicus.

Hip circumference: under similar conditions, the hip circumferences of the subjects were measured around the largest area of the subject's hip and buttocks.

- **MMT for abdominal muscle – to assess abdominal muscle strength**

The manual muscle testing is a system that grades muscle strength on a scale of 0 to 5 based on how well muscles are able to resist gravity or manual pressure exerted by an examiner. Graded abdominal muscle exercises include;

Starting position-The subjects were instructed to lie in supine with the hips at 45 degree and knees at 90 degree and hand at sides. In all these activities subjects were instructed to keep the low back flat.

Grade 0- No palpable or observable muscle contraction

Grade 1-subjects were asked to perform the curl ups by contracting abdominal muscles and then lifting the head off table with flexed knees.

Grade 2-the progression was made by lifting the shoulders until the top of scapulae lift from table, keeping the arms extended towards knees.

Grade 3- The next progression was done by lifting the shoulders until the scapulae clear table, keeping the arms horizontal.

Grade 4- The subjects were asked to progresses further by keeping the arms crossed over chest, until scapulae clear table.

Grade 5- The subjects were asked to progress the difficulty of the curl ups by having the subject change the arm position from horizontal and then to behind the neck, until scapulae clear table.

SAMPLING PROCEDURE

30 subjects were recruited from the community according to the inclusion and exclusion criteria. The subjects are divided equally into two groups, Group A and Group B.

- **Group A:** Considered as the experimental group, consist of 15 subjects, received abdominal muscle exercise (10 min warm up and cool down exercise also included), 3 Sessions/week on alternate days for 6 weeks.
- **Group B:** Considered as the control group, consist of 15 subjects. Maintained routine activities.

PRE – INTERVENTION PROCEDURE

The proposed title and procedure were approved by ethical committee members. After discussing the study's goal, the flow meter and the test technique, participants who met the inclusion and exclusion criteria signed an informed written consent form. They were randomly selected for experimental group (Group A, n = 15) and control group (Group B, n=15).

Pre intervention evaluation of each group was done. The evaluation included the

subject's Peak Expiratory Flow Rate (PEFR), Height(m), Weight(kg), BMI (kg/m2), abdominal muscle strength (using MMT), Waist and hip circumferences and Waist Hip Ratio (by inch tape method). Instructions were given to all participants in the study about the usage of peak flow meter. Disposable mouth pieces were also provided to each subject for prevention of cross infection.

Instructions for using Peak Flow meter:
Move the marker on the device to bottom of the numbered scale. Stand up straight. Take a deep breath. Fill your lungs completely. Hold the breath while you place the mouth piece in your mouth between your teeth. Close your lips around it. Blow out as hard and fast as possible in a single blow, the final position is the indicator of peak flow. Move the marker back to the bottom and repeat all these steps 2 more times. The highest of the 3 values is considered as the PEFR.

WARM UP AND COOL DOWN SESSION
Deep breathing exercise and general upper and lower body stretching were given to the subjects as warm up and cool down exercise for a total of 10 minutes.

STUDY PROCEDURE (INTERVENTION)

✓ **Control Group**

They did not receive any form of exercise, but they maintained routine activities.
Consents were provided and assured that, if the result of the study is satisfactory, the control group will also receive same interventions provided to the exercise group after the study duration.

✓ **Experimental Group**

The participants were taught about the importance of exercise for improving their lung function, abdominal strength, quality of life and reducing the risk of development of complications associated with Menopause and Post – menopausal overweight/obesity. They were familiarized with the exercise testing protocol by going through the preliminary exercise test.

Guidelines

→ Do not perform exercise immediately after meals
→ If at any time the participant experience intense discomfort, discontinue the practice.

Abdominal Exercise Protocol
Six weeks of abdominal muscle exercise program included 5 minutes of initial warm up exercises which included deep breathing exercise and general body stretching exercises. Abdominal exercise lasted for 20-25 minutes including rest period which included upper and lower abdominal exercises. Each exercise was performed as 2 sets of 10 repetitions each. One minute rest period was given between each set and 30 seconds between each exercise. The cool down phase included 5 minutes of deep breathing and stretching exercise. The exercise was performed for thirty-five minutes, thrice weekly on alternate days for 6 weeks.

Upper abdominal exercises:

1. Crunches: Crook lying position. Have the subject lift the head off the mat. This will cause a stabilizing contraction of abdominal muscle. Lifting the shoulders until the spine of scapulae and thorax clear the mat keeping the arms horizontal. The patient does not come to a full sit up because once the thorax clears the mat the rest of motion is performed by hip flexors.
2. Hip rolls: Supine lying position. Knees are flexed keeping feet firmly on the ground. Lower the knees to one side turning at the waist. Aim is to allow the thigh to touch the floor then slowly repeat again on the other side. Avoid lifting the shoulders to come up from the floor.


Upper abdominal exercise: Crunches & Hip rolls

Lower abdominal muscle exercise

1. Double knee to chest: Crook lying position. Having the subject set a posterior pelvic tilt bring both knees to the chest and return.
2. Leg lowering movement: Supine lying and forearms are folded across the chest to ensure that elbows are not resting on the mat for support. Subject enable to keep low back flat to the table while lowering the legs to table level, the legs are elevated a few degrees.


Lower abdominal exercise: Double knee to chest & Leg lowering movement

Frequency: 35 mins/day, 3 days/week on alternate days including warm up and cool down period.
Duration: 6 weeks

POST INTERVENTIONAL PROCEDURE

The outcomes were measured after 6 weeks using Peak expiratory flow meter, abdominal MMT and Waist hip ratio by inch tape method.

RESULTS

The present study was designed to explore the effectiveness of abdominal muscle exercises on peak expiratory flow rate in over weight/ obese post-menopausal women.

DATA 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;

$$\text{Sample } n \geq 2\,\sigma\,\frac{(z\beta+z\alpha/2)^2}{\text{Difference}^2}$$

- n- Sample size in each group (assumes equal sized groups)
- σ Standard deviation of the outcome variable • $z\alpha$-Represents the desired

level of statistical significance (typically1.96)

- zβ- Represents the desired power (typically 0.84 for 80%power)
- Differences- Effect size (the difference in mean)

Independent Variable: Abdominal muscle exercises

Dependent Variables: Peak expiratory flow rate, waist – hip ratio, abdominal muscle strength

COMPARISON WITHIN GROUP (paired t test)

COMPARISON OF PRE- TEST AND POST TEST VALUES OF PEAK EXPIRATORY FLOW RATE IN GROUP A (EXPERIMENTAL GROUP)

Test	Mean	SD	Mean improvement	n	T	df	p value
Pre - test	318	28.08	20	15	10.25	14	p < 0.001
Post - test	338	26.78					

Table 1- shows paired t test for PEFR in group A (experimental group)

Since the t-value 10.25 shows p < 0.001, there is a significant difference existing between the pre-test and post-test Peak Expiratory Flow Rate scores among post - menopausal women in the Experimental group. This proves the effect of abdominal muscle exercise in Peak Expiratory Flow Rate scores among post - menopausal women in the Experimental group.

COMPARISON OF PRE- TEST AND POST TEST VALUES OF PEAK EXPIRATORY FLOW RATE IN GROUP B (CONTROL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre - test	319.33	23.44	-6.66*	15	2.197	14	p<0.05
Post – test	312.66	26.31					

Table 2 – shows paired t test for PEFR in group b (control group)

* The negative symbol indicates that the change in PEFR is in reverse order. i.e. there is a slight decrease in the average score of PEFR.

Since the t-value 2.197 shows p<0.05, we can conclude that the change in Peak Expiratory Flow Rate scores among post - menopausal women in the Control group is significant. By using paired t-test, it is seen that the Experimental group is having a significant increase in PEFR among post-menopausal women whereas the Control group is having a significant decrease in PEFR. So we can conclude that abdominal muscle exercise is very much effective in improving PEFR in overweight/obese post-menopausal women.

COMPARISON OF PRE- TEST AND POST TEST VALUES OF WAIST – HIP RATIO IN GROUP A (EXPERIMENTAL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre - test	0.96	0.025	0.019	15	1.76	14	p < 0.001
Post - test	0.94	0.022					

Table 3 – shows paired t test for Waist Hip ratio in group A (experimental group)

Since the t-value 1.76 shows p < 0.001, there is a significant difference existing between the pre-test and post-test Waist – Hip ratio scores among post - menopausal women in the Experimental group. This proves the effect of abdominal muscle exercise in Waist – Hip ratio scores among post - menopausal women in the Experimental group.

COMPARISON OF PRE- TEST AND POST TEST VALUES OF WAIST – HIP RATIO IN GROUP B (CONTROL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre - test	0.96	0.026	0.005	15	1.22	14	p = 0.24
Post – test	0.96	0.018					

Table 4 – shows paired t test for Waist Hip ratio in group B (control group)

Since the t-value 1.22 shows p >0.05, there is no significant difference existing between the pre-test and post-test Waist – Hip ratio scores among post - menopausal women in the control group.

COMPARISON OF PRE- TEST AND POST TEST VALUES OF ABDOMINAL MMT IN GROUP A (EXPERIMENTAL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre - test	2.53	0.52	0.87	15	9.54	14	p < 0.001
Post – test	3.40	0.63					

Table 5 – shows paired t test for abdominal mmt in group A (experimental group)

Since the t-value 9.54 shows p < 0.001, there is a significant difference existing between the pre-test and post-test Abdominal MMT scores among post - menopausal women in the Experimental group. This proves the effect of Abdominal muscle exercise in Abdominal MMT scores among post - menopausal women in the Experimental group.

COMPARISON OF PRE- TEST AND POST TEST VALUES OF ABDOMINAL MMT IN GROUP B (CONTROL GROUP)

Test	Mean	SD	Mean improvement	n	t	df	p value
Pre - test	2.53	0.52	0.07	15	1	14	p = 2.14
Post – test	2.47	0.52					

Table 6 – shows paired t test for abdominal mmt in group B (control group)

Since the t-value 1 shows p >0.05, there is no significant difference existing between the pre-test and post-test Abdominal MMT scores among post - menopausal women in the control group.

COMPARISON BETWEEN GROUPS (Independent 't' test)
COMPARISON OF PRE-TEST PEFR BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Test	Mean	SD	Mean improvement	n	t	df	p value
Group A	318	28.08	1.33	15	0.14	14	p=2.05
Group B	319.33	23.44					

Table 7 – shows independent t test for pre-test test PEFR score between group A (experimental group) and group B (control group)

Since the t-value 0.14, shows p-value > 0.05, there is no significant difference in pre-test PEFR scores between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

COMPARISON OF POST-TEST PEFR BETWEEN GROUP A AND GROUP B (EXPERIMENTAL AND CONTROL GROUPS)

Test	Mean	SD	Mean improvement	N	T	df	p value
Group A	338	26.78	25.33	15	2.61	14	p < 0.05
Group B	312.66	26.31					

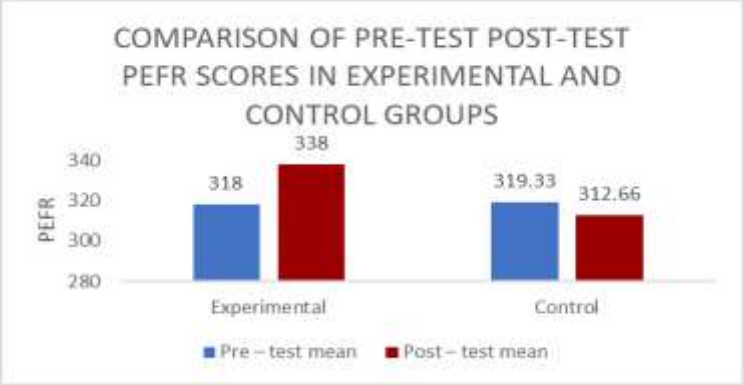
Table 8 – shows independent t test for post-test test PEFR score between group A (experimental group) and group B (control group)

Since the t-value 2.61 shows p-value < 0.05, there is a significant difference in post-test PEFR score between the experimental and the control groups. The scores in the experimental group are significantly higher than that in the control group. Hence abdominal muscle exercise is effective in PEFR among post-menopausal women.

COMPARISON OF PRE-TEST & POST – TEST PEFR BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Group	Pre – test mean	SD	Post – test mean	SD
Experimental	318	28.08	338	26.78
Control	319.33	23.44	312.66	26.31

Table 9 – shows comparison of pre-test post-test PEFR in group A (experimental group) and group B (control group)



Graph 1 - graphical representation of pre-test post-test PEFR in group A (experimental group) and group B (control group).

COMPARISON OF PRE-TEST WAIST – HIP RATIO BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Test	Mean	SD	Mean improvement	n	t	df	p value
Group A	0.96	0.025	0.007	30	0.74	28	p = 0.46
Group B	0.97	0.026					

Table 10 – shows independent t test for pre-test test waist – hip ratio score between group A (experimental group) and group B (control group)

Since the t-value 0.74, shows p-value > 0.05, there is no significant difference in pre-test waist – hip ratio scores between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

COMPARISON OF POST-TEST WAIST – HIP RATIO BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Test	Mean	SD	Mean improvement	n	t	df	p value
Group A	0.94	0.022	0.0165	30	2.24	28	p < 0.05
Group B	0.96	0.018					

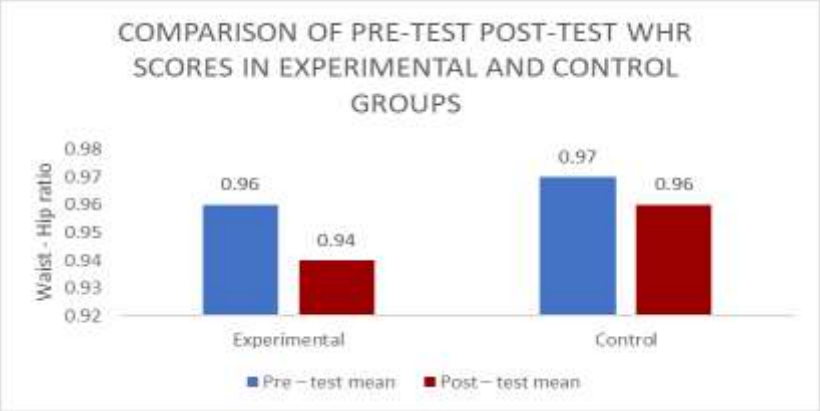
Table 11 – shows independent t test for post-test test waist – hip ratio score between group A (experimental group) and group B (control group)

Since the t-value, 2.24 shows p-value < 0.05, there is a significant difference in post-test waist – hip ratio score between the experimental and the control groups. The scores in the experimental group are significantly higher than that in the control group. Hence abdominal muscle exercise is effective in waist – hip ratio among post-menopausal women.

COMPARISON OF PRE-TEST & POST – TEST WAIST – HIP RATIO BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Group	Pre – test mean	SD	Post – test mean	SD
Experimental	0.96	0.025	0.94	0.022
Control	0.97	0.026	0.96	0.018

Table 12 – shows comparison of pre-test post-test WHR in group A (experimental group) and group B (control group)



Graph 2 - graphical representation of pre-test post-test WHR in group A (experimental group) and group B (control group)

COMPARISON OF PRE-TEST ABDOMINAL MMT BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Test	Mean	SD	Mean improvement	n	t	df	p value
Group A	2.53	0.52	0	30	0	28	p = 1
Group B	2.53	0.52					

Table 13 – shows independent t test for pre-test test abdominal mmt score between group A (experimental group) and group B (control group)

Since the t-value 0, shows p-value > 0.05, there is no significant difference in pre-test Abdominal MMT scores between the experimental and the control groups. So, we can consider the groups as homogenous in the baseline level.

COMPARISON OF POST-TEST ABDOMINAL MMT BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Test	Mean	SD	Mean improvement	n	t	df	p value
Group A	3.4	0.63	0.93	30	4.27	28	p < 0.001
Group B	2.47	0.52					

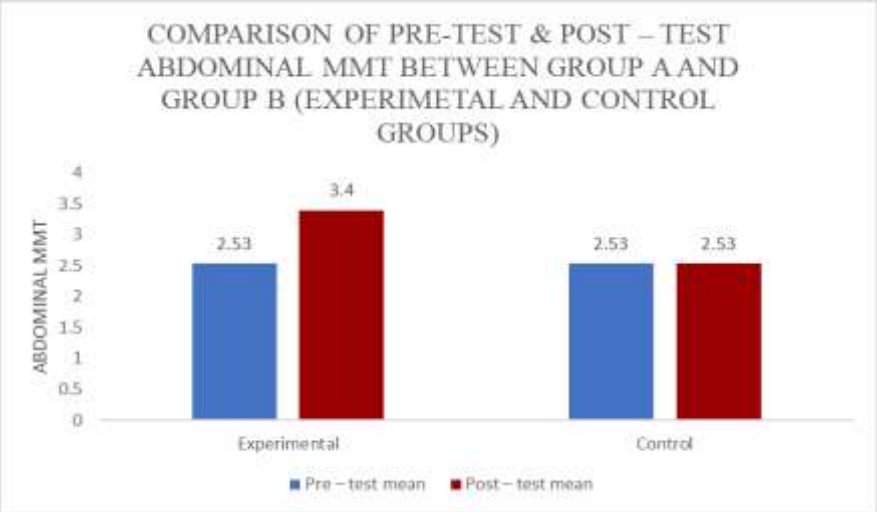
Table 14 – shows independent t test for post-test test abdominal mmt score between group A (experimental group) and group B (control group)

Since the t-value, 4.27 shows p-value < 0.001, there is a significant difference in post-test Abdominal MMT score between the experimental and the control groups. The scores in the experimental group are significantly higher than that in the control group. Hence abdominal muscle exercise is effective in Abdominal MMT among post-menopausal women.

COMPARISON OF PRE-TEST & POST – TEST ABDOMINAL MMT BETWEEN GROUP A AND GROUP B (EXPERIMETAL AND CONTROL GROUPS)

Group	Pre – test mean	SD	Post – test mean	SD
Experimental	2.53	0.52	3.4	0.63
Control	2.53	0.52	2.53	0.52

Table 15 – shows comparison of pre-test post-test Abdominal MMT in group A (experimental group) and group B (control group)



Graph 3 - graphical representation of pre-test post-test abdominal MMT in group A (experimental group) and group B (control group).

DISCUSSION

When a woman has gone a year without having her period, she is called postmenopausal. Menopause brings with it a number of unpleasant symptoms, including fatigue, hot flashes, mood swings, sleep difficulties, vaginal dryness etc. Kawaljit Kaur Khokhar et al. (2010) also discovered that postmenopausal women have greater rates of overweight and obesity than premenopausal women. Postmenopausal women are more likely to have central adiposity which can be measured by waist circumference and waist-to-hip ratio, according to Giovana B Donato et al. (2006).

Menopause related hormonal changes have been linked to systemic inflammation, which has been linked to a decline in lung function. Amar K Karia et al, (2017) found that when menopause approaches, lower hormonal levels lead to a reduction in lung capacity, as evidenced by pulmonary function tests. Cheryl M Salome et al, (2010) investigated the physiology of obesity and implications on lung function and found that obesity has an impact on lung function.

In this study, post-menopausal women who met the inclusion & exclusion criteria were given a 6-week; 3 days per week, abdominal strengthening regimen. The sample size was 30. They were divided into two groups, Group A and B (consisting of 15 subjects each) using simple randomization method. The PEFR, waist hip ratio and abdominal muscular strength were measured before and after the intervention program. For within group comparisons, the paired 't' test was used, and for between group comparisons, the independent 't' test was used. Significance level is kept as p value <0.05. The goal was to see how abdominal muscle exercises affect PEFR, waist hip ratio and abdominal muscle strength in post-menopausal women who were overweight/ obese.

The experimental group outperformed the control group in all three variables, in this study. These findings imply that abdominal muscle exercise can help obese/overweight post-menopausal women to improve their PEFR, Waist Hip Ratio and Abdominal muscle strength.

In the case of PEFR, an intra-group comparison of pre- and post- test data of experimental group showed a substantial rise in the paired 't' test with a mean difference of 20 at level of significance less than 0.05. The control group, on the other hand, showed a considerable drop. After utilizing an independent 't' test to compare the experimental and control groups' post-test PEFR scores, it was observed that the experimental group's scores were considerably higher than the control group's score (mean difference, 25.33).

The increase in peak expiratory flow rate in the experimental group is most likely due to abdominal muscle strengthening exercises and the facilitator function of abdominal muscles, which improves the diaphragm's ability to create pressure during respiration. The diaphragm merely relaxes during expiration, and the elastic recoil of the lung, chest wall, and abdominal tissues compresses the lungs and expels the air. However, during heavy breathing, the elastic forces are insufficient to induce the required quick expiration, therefore extra effort is provided mostly by abdominal muscle contractions, which push the abdominal contents upward against the bottom of the diaphragm, compressing the lungs.

This study is supported by the findings of Dr. Shradha Sawant Deshpande et al., who found that abdominal muscle exercise improves forced expiratory flow rate in healthy people. [16]

PEFR was found to be somewhat lower in the control group. The decrease in PEFR in the control group could have been driven by seasonal variation. According to a study by Mateus Dias et al, (2019) summer is the season with the lowest PEF. They claim that rising temperatures have an effect on respiratory system, and that chance of acquiring inflammatory of infectious disorders are higher during the summer. [17]

The Waist – hip ratio was used to measure central adiposity. It is the ratio of waist circumference to hip circumference. The reliability and criterion validity of self-measured waist, hip and neck circumferences were studied by Pamela Barrios et al (2016) and found to be reliable.

Within group comparison of pre- and post-test data among experimental group revealed a significant difference in the paired 't' test with a mean difference of 0.005 at level of significance less than 0.05 in the case of waist hip ratio. The control group's pre- and post-test scores were not substantially different. After comparing the experimental and control groups' post-test waist hip ratio scores using an independent 't' test, it was discovered that the experimental group's scores were significantly higher than the control group's score (mean difference, 0.0165).

Physical activity improves WHR and WHR has a higher link with Physical activity level, according to Linda Burke et al. (2012) [18] and Gornale VK et al. (2022). [19] The improvement in WHR in this study could be attributed to the participant's increased physical activity as a result of their frequent abdominal exercises.

An intra-group comparison of pre- and post-test data from experimental group showed a significant improvement in the paired 't' test with a mean difference of 0.87 at level of significance less than 0.05 in the instance of abdominal strength. In contrast, the control group showed no significant improvement. After comparing the experimental and control groups' post-test abdominal strength scores with an independent 't' test, it was identified that the experimental group's results were considerably higher than the control group's results (mean difference, 0.93).

The increase in abdominal strength in the experimental group could be attributable to the fact that strength training strains the body's musculoskeletal system, causing muscle fibres to expand and neurological control of muscular activity to improve, resulting in increased muscular strength. Strength training also results in larger individual muscle fibres by increasing the size and number of myofibrils. The findings of Sudhan SG et al., who discovered that abdominal strengthening exercises improve cardiovascular responses and abdominal strength, confirm this result. [20]

STRENGTH OF THE STUDY

- Number of participants were equal in both groups
- Cost effective programme.
- Can be performed anywhere without any barrier.
- 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 females were included, which may affect the outcome measures.
- There was no follow up.

FUTURE RESEARCH

- The sample size of the study can be increased; hence it may lead to better reliability.
- The study duration can be increased.
- Can be administered in other populations.
- A follow-up study could ensure the long-term effect of the intervention programme

CONCLUSION

When the values from the above study were evaluated, it was discovered that there is a substantial difference between the experimental and control groups. Improvements in the study's parameters may aid in resolving current issues and preventing potential postmenopausal difficulties in the future.

The analysis of Peak Expiratory Flow Rate, Waist Hip Ratio and Abdominal MMT shows improvement within the group as well as between the groups. Since the Experimental group shows significantly higher improvement in all the three parameters when compared to the control group, it can be concluded that a well-planned exercise intervention programme containing abdominal muscle exercise is effective in improving Peak Expiratory Flow Rate, Waist Hip Ratio and Abdominal MMT in obese/overweight post – menopausal women. We may also believe that because pulmonary function and abdominal strength, both of which are important in this population, have improved, this study is advantageous to them.

Declaration by Authors

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