



# Effects Of Fire Hydrants With Mountain Climbers Vs Quadruped Cross Crawl Exercises On Pelvic Floor Strengthening In Postmenopausal Women: A Randomized Clinical Trial

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## ARTICLE INFO

## ABSTRACT

**Background:** Menopause is a normal physiological process among aging women. Estrogen deficiency results in permanent cessation of menses identified as menopause. 1.5 million women every year experience menopause which involves troublesome symptoms. The pelvic floor weakness can be due to damage or increased risk of many factors such as pregnancy, childbirth, aging, menopause, etc.

**Methodology:** A total of 30 subjects within the age group of 45 and above were screened and assessed as per the inclusion and exclusion criteria. Group A subjects were assigned to Fire hydrants with mountain climbers exercise and Group B subjects to Quadruped cross crawl exercise.

**Results:** Based on the results of the test analysis at a 5% significance level, there is a significant statistically reliable difference between the pre and post-treatment values with a p-value is less than the 5% significance level (i.e.,  $0.001 < 0.05$ ) in the study and therefore it justifies the improvements in health outcome post-intervention.

**Conclusion:** The present study concluded that there was an improvement in pelvic floor muscle strength of post-menopausal women age group (45 and above) when treated with Group A and Group B. The study also concluded that Group A showed more significant improvement in pelvic floor muscle strengthening as compared to Group B in outcome measure Pelvic Floor Distress Inventory 20 (PFDI-20) and King's Health Questionnaire (KHQ).

**Keywords:** Menopause, Pelvic Floor Strengthening, Fire-Hydrants, Mountain Climbers, Quadruped Cross Crawl Exercise.

## 1. Introduction

Menopause is a normal physiological process among aging women, irrespective of any pathology. The estrogen deficiency results in permanent cessation of menses identified as menopause <sup>(1)</sup>. Menopause induces hormonal and social changes for women <sup>(2)</sup>. According to many researches women reach menopause at an average age of 50-51 years <sup>(1)(2)</sup>. Perimenopausal is the preceding state which has been characterized by the gradual loss of oocytes and a wide range of hormonal fluctuations along an altered response to gonadal steroidal feedback with irregular menstruation <sup>(3)</sup>. Ovarian and primary follicles are diminished, resulting in inadequate amounts leading to effects on the follicle-stimulating hormone (FSH). As a result, neither Luteinizing hormone (LH) surge nor ovulation takes place, hence resulting in the reduction of estrogen production and cessation of

menstruation. Also, LH and FSH are uninhibited and they remain at high levels for years after menopause starts. Adrenal glands release testosterone and its conversion produces low levels of estrogen which produces discontinuation of periods which may be minimal in some individuals. <sup>(1)</sup>

1.5 million women every year experience menopause which involves troublesome symptoms, which include vaginal dryness, vasomotor symptoms, decreased libido, insomnia, joint pain, and fatigue <sup>(4)</sup> Vasomotor symptoms have been experienced by many women along with menopause effects in the areas of the body such as urogenital, psychologic and cardiovascular<sup>(1)</sup> Lack of energy and fatigue are the symptoms experienced by 43.9-64.7% of menopausal women and are strongly associated with burnout and exhaustion which may compromise the quality of life of affected women. The production of cytokines and free radicals is boosted by emotional distress which is associated with menopausal symptoms. Weight gain and vasomotor symptoms contribute to mood dysregulation, sleep disturbance, fatigue, memory problems, and overall distress in menopausal women. A negative attitude towards menopause is correlated with symptoms of menopause and only vasomotor symptoms predict it. All these findings signify broad psychological distress in menopausal women <sup>(5)</sup>

In 2030 it is estimated that the world population of menopausal and post-menopausal women will increase to 1.2 billion with 47 million new entries every year <sup>(2)</sup>

The female pelvic floor consists of muscles and connective tissue which forms a 'sling' or Hammock across the floor of the pelvis. It is to keep the pelvic organs (rectum, uterus, bladder) in place and contribute to spinal and pelvic instability. Together the pubovisceral muscles (pubovaginalis, puborectalis, puboanalis) and iliococcygeus muscle form the major muscle that is levator Ani of the pelvic floor. For major pelvic floor exercises, the levator ani is the target muscle. The Pelvic floor weakness can be due to damage or increased risk of many factors such as Pregnancy and childbirth, chronic constipation, Factors that raise intraabdominal pressure, aging, and menopause. The effectiveness of sphincter muscles is enhanced by tightening the levator ani muscle which helps to prevent leakage and incontinence, especially in the case when intra-abdominal pressure is raised on exertion, coughing, sneezing, laughing, lifting, and straining <sup>(6)</sup>

Physiologically, there is a difference in the pelvic floor muscles and other skeletal muscles in which they present constant electrophysiologic activity unlike during voiding, defecation, and Valsalva maneuver. This property helps them to maintain tone even at rest, giving foremost support to pelvic components. When they are contracted voluntarily, the pelvic organs are pulled by muscles of the levator ani anteriorly against the pubic bone, which closes the pelvic organs. <sup>(7)</sup>

Perimenopausal and menopausal women frequently complain about stress urinary incontinence (SUI), pelvic organ prolapse, and chronic pelvic pain which causes insufficiency of the pelvic floor. It is believed that a significant role in pathogenesis is played by menopause. 50 % of women in this period experience symptoms related to the urogenital system. Indications for the main cause of the symptoms as the authors describe are low levels of estrogen A low number of estrogen receptors in urethral epithelia, bladder triangle, or vaginal mucosa are seen during menopause. <sup>(8)</sup>

With advancing age pelvic floor dysfunction and incontinence are more common age-related changes in body systems and organs. Due to loss of collagen resistance and the elasticity of pelvic floor muscles decrease, the pelvic floor becomes thinner, and drier and may become irritable and painful causing it to become uneasy. Thus, pelvic organ prolapse is more common in older women than younger counterparts – the pelvic area descends into the pelvic area due to thinner and weaker pelvic floor <sup>(6)</sup>

Severe neuropsychiatric symptoms may also signal the onset of age-related diseases such as cognitive impairment linked to dementia. Alzheimer's disease mainly during the primary stage may get misdiagnosed as symptoms of natural aging and go uncared for, and thus may lead to major health-related drawbacks. Menopausal women and women in the menopause transition report forgetfulness and impairments in attention, processing speed, and verbal fluency (measured by trouble finding words) as common cognitive issues. After vasomotor symptoms and joint stiffness, memory loss is the second most common menopausal symptom, and the severity of these symptoms can be rather concerning <sup>(5)</sup>

In this study, we took three different exercises that are Fire Hydrants exercise, the Mountain climbers exercise, and the Quadruped Cross Crawl exercise. Combining two exercises that is Fire Hydrants with Mountain climbers in one group and keeping the Quadruped cross crawl exercise in another group. We merged two exercises as a new exercise that is fire hydrants with mountain climbers to see its effect on pelvic floor strengthening in post-menopausal women and also the same for the Quadruped cross crawl exercise on another hand. Also, various rehabilitation techniques for pelvic floor strengthening exercises are Kegels exercises <sup>(9)</sup>, Crook lying in lying and standing <sup>(10)</sup>, Head lift and twisted curl up <sup>(11)</sup>, Pilates <sup>(12)</sup>, biofeedback, <sup>(13)</sup>, Paula exercise, Yoga, Tai Chi, Qigong exercises <sup>(14)</sup>. The Primary objective of our current study was to find the effect of Fire Hydrants with Mountain Climbers exercises in post-menopausal women and to find the effect of Quadruped cross-crawl exercises in post-menopausal women. The secondary objective was to compare the effect of Fire Hydrants with Mountain climbers versus Quadruped cross-crawl exercises in post-menopausal women.

## 2. Methodology

The methodological study was developed to find the Effect of Fire Hydrants with Mountain Climbers vs. quadruped Cross Crawl Exercises on Pelvic Floor Strengthening in Postmenopausal Women. A comparative study was conducted and was designed via a randomized clinical trial. Convenient Sampling was employed with a sample size of 30. MGM Sports Rehabilitation and Fitness Centre was used as the study setting with a duration of 12 months. Women of Age group 45 years and above who were willing to participate and sign consent forms, and Women diagnosed with menopause for more than 5 years were included in the study. Any women with neurological or orthopedic condition (that can interfere with the exercise), or with any other gynecological condition and whose BMI was 23 or above were excluded from the study. Thera-loop, Yoga Mat (Powermax fitness 6 mm thick with ultra-dense cushioning, Informed consent form, Data collection sheet, Paper, and Laptop HP were used as the materials for the study.

## 3. Procedure

Participants were selected based on inclusion and exclusion criteria, and then the test procedure was explained to the subject in her vernacular language. Informed consent was signed by subjects. Then the subjects were assessed for baseline data and were divided for group A and Group B randomly.

For group A, exercise was explained all norms and protocols of Fire hydrants with mountain climbers exercise and COVID-19 was advised to follow. The subject was asked to perform 5 minute warm-up exercise after which the subject will go on a yoga mat or floor and will start protocol of Fire hydrants with mountain climbers exercise. After the exercise phase subject was asked to do a cool-down exercise and terminate the exercise session. At the end of the session subject was assessed for any discomfort and if any advice for rest.

For group B, the exercise explained all norms and protocols of the Quadruped cross-crawl exercise and Covid-19 was advised to follow. The subject was asked to perform 5 minute warm-up exercise after which the subject will go on a yoga mat or floor and will start the protocol of Quadruped exercise. After the exercise phase subject was asked to do a cool-down exercise and terminate the exercise session. At the end of the session subject was assessed for any discomfort and if any advice for rest.

## 4. Intervention

Group-a: - fire hydrants with mountain climbers training. Exercise program/protocol

**Frequency:** 5 days/week.

**Duration:** 4 weeks

**GROUP A: -**

WEEKS	PROGRESSION
<b>WEEK 1</b>	Start with the quadruped position tighten your core and look down then lift her leg away from your body at 45 degrees and keep knee at 90 degrees. Then lower your leg to the starting position to complete 1 rep. Combined with mountain climbers which patient will have to pull the knee into chest as far as she can. Switch legs, pulling one knee out and bringing another knee in. Repetitions: - 5
<b>WEEK 2</b>	Start with the quadruped position tighten core and look down then lift her leg away from your body at 45 degrees and keep your knee at 90 degrees. Then lower your leg to the starting position to complete 1 rep. Combined with mountain climbers which patient will have to pull knee into chest as far as she can. Switch legs, pulling one knee out and bringing another knee in. Repetitions: - 8
<b>WEEK 3</b>	Start with the quadruped position tighten your core and look down then lift her leg away from your body at 45 degrees and keep knee at 90 degrees. Then lower your leg to the starting position to complete 1 rep. Combined with mountain climbers which patient will have to pull knee into chest as far as she can. Switch legs, pulling one knee out and bringing another knee in. Repetitions: - 10
<b>WEEK 4</b>	Start with the quadruped position tighten your core and look down then lift her leg away from your body at 45 degrees and keep your knee at 90 degrees. Then lower your leg to the starting position to complete 1 rep. Combined with mountain climbers which patient will have to pull knee into their chest as far as she can. Switch legs, pulling one knee out and bringing another knee in. Repetitions: - 12

**Group b:- quadruped cross crawl exercise, Exercise program/ protocol:**

**Frequency:** 5 days/week.

**Duration:** 4 weeks.

**GROUP B: -**

WEEK	PROGRESSION
WEEK 1	The patient has to start on her hands and knee. Then knee to opposite hand (elbow) and leg straight. Repetitions: 5
WEEK 2	Patient has to start on her hands and knee. Then knee to opposite hand (elbow) and leg straight. Repetitions: 8
WEEK 3	The patient has to start on her hands and knee. Then knee to opposite hand (elbow) and leg straight. Repetitions: 10
WEEK 4	The patient has to start on her hands and knee. Then knee to opposite hand (elbow) and leg straight. Repetitions: 12

**WEEK 1:**

Fig 1 A: Fire Hydrants Exercise.



Fig 1 B: Mountain Climber Exercise

**WEEK 2:**

Fig 2: Quadruped Cross Crawl Exercise.



Fig 3: Quadruped Cross Crawl Exercise.

**WEEK 3:**



Fig 4 A: Fire Hydrants Exercise.



Fig 4 B: Mountain Climbers Exercise.

**WEEK 4:**



Fig 5: Quadruped Cross Crawl Exercise.



Fig 6: Quadruped Cross Crawl Exercise

## 5. Outcome Measures

**1. Pelvic Floor Distress Inventory-20 (PFDI-20):** The PFDI-20 is comprised of 3 scales, which include the Urinary Distress Inventory-6 (UDI-6), Pelvic Organ Prolapse Distress Inventory-6 (POPDI-6), and the Colorectal-Anal Distress Inventory-8 (CRADI-8).

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Reliability: PFDI-20 ICC=0.93

UDI-6 ICC=0.82

POPDI-6 ICC=0.91

CRADI-8 ICC=0.84

The PFDI-20 demonstrates construct validity as it demonstrates significant association with appropriate measures of symptom severity and pelvic floor diagnoses <sup>(30)</sup>

**2. King's Health Questionnaire:** The King's Health Questionnaire (KHQ) was designed to evaluate the impact of urinary incontinence on the quality of life. Reliability >0.60

KHQ is a patient self-administered self-report and has 3 parts consisting of 21 items.

Part 1 contains general health perception and incontinence impact (one item each).

Part 2 contains role limitations, physical limitations, social limitations (two items each), personal relationships, emotions (three items each) and sleep/energy (two items), severity measures (four items).

Part 3 is considered a single item and contains ten responses about frequency, nocturia, urgency, urge, stress, intercourse incontinence, nocturnal enuresis, infections, pain, and difficulty in voiding <sup>(31)</sup>

## 6. Data Analysis

TABLE 1. Normality test using Shapiro-Wilk

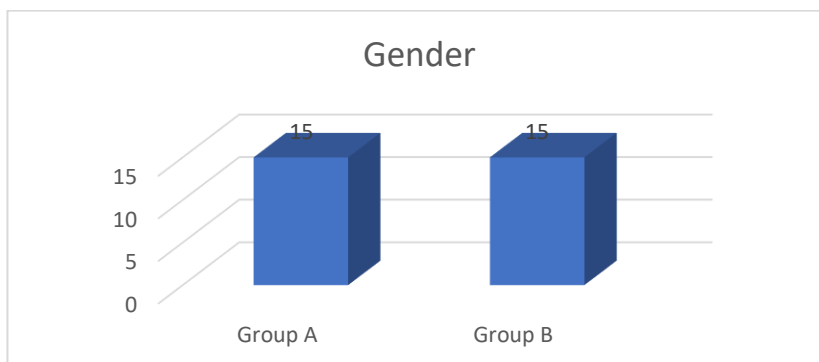
Variable	Time frame	Group A		Group B	
		z-value	p-value	z-value	p-value
PFDI20	Pre	0.916	0.169	0.949	0.503
	Post	0.929	0.260	0.948	0.491
	Diff	0.978	0.952	0.884	0.050
KHQ	Pre	0.961	0.709	0.947	0.485
	Post	0.958	0.052	0.947	0.482
	Diff	0.969	0.850	0.911	0.055

The data set is normally distributed as all the variables have indicated non-significant outcomes in the observation. The researcher shall use a parametric test for data analysis purposes in the following sections.

## 7. Results

Table 1: Total participants of Group A and Group B.

Particular		GROUP		Total
		Group A	Group B	
Gender	Female	15	15	30
Total		15	15	30



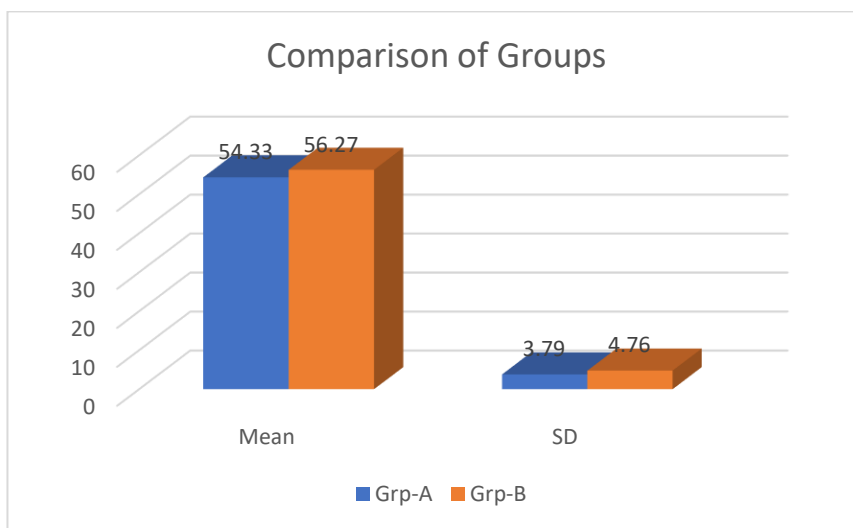
Graph 1: Total participants of Group A and Group B.

**Independent sample test**

Comparison of Groups with independent t-test

Table 2: Comparison of Groups with independent t-test.

Variable	Groups	Mean	SD	t-value	p-value
Age	Grp-A	54.33	3.79	1.231	0.229
	Grp-B	56.27	4.76		



Graph 2: Comparison of Groups with independent t-test.

**Within group Pre and post-test**

Comparison of pre-test and post-test scores of PFDI20 in two Groups by paired sample t-test.

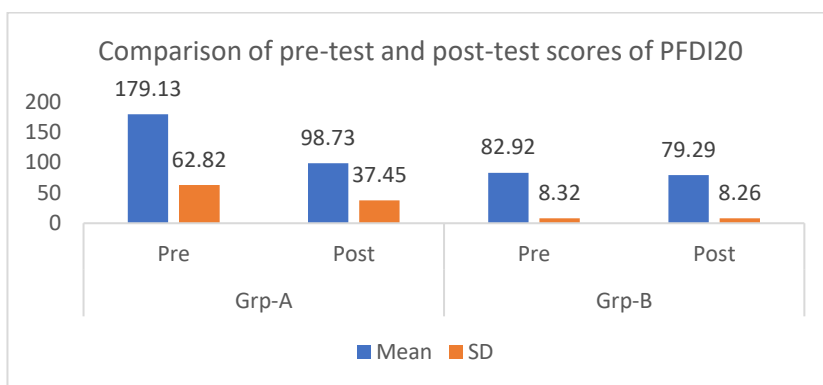
Table 3: Comparison of Pre-test and Post-test scores of PFDI-20 in two groups by paired sample t-test.

Groups	Times	Mean	SD	Mean Diff.	t-value	p-value
Grp-A	Pre	179.13	62.82	80.41	9.556	0.001*
	Post	98.73	37.45			
Grp-B	Pre	82.92	8.32	6.53	10.108	0.001*
	Post	79.29	8.26			

The mean value in group A indicated changes post-treatment and lower values are recorded for post-treatment outcomes also the standard deviation shows consistency with post treatment value which is less than the value. The effect size or Cohen’s D indicates a 2.47 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at a 5% significance level, there is a significant statistically reliable difference between the pre & post treatment values with a p-value less than the 5% significance level (i.e. 0.001 < 0.05) in the study and therefore it justifies the improvements in health outcome post-intervention.

The mean value in group B indicated changes in treatment and lower values are recorded for post treatment outcomes also the standard deviation shows limited consistency with post-treatment value which is more than the value. The effect size or Cohen’s D indicates a 2.61 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at a 5% significance level, there is a significant statistically reliable difference between the pre & post treatment values with a p-value less

than the 5% significance level (i.e.  $0.001 < 0.05$ ) in the study and therefore it justifies the improvements in health outcome post-intervention.



Graph 3: Comparison of pre-test and post-test scores of PFDI-20

**Within group Pre and post-test:**

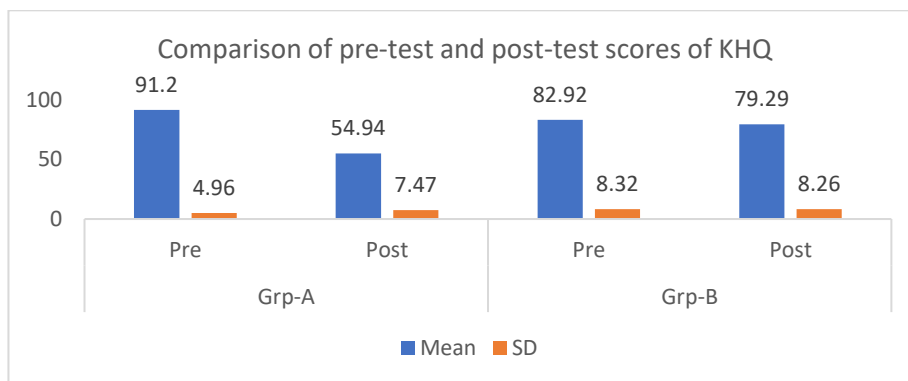
Comparison of pre-test and post-test scores of KHQ in two Groups by paired sample t-test

Table 4: Comparison of Pre-test and Post-test scores of KHQ in Two Groups by paired sample t-test.

Groups	Times	Mean	SD	Mean Diff.	t-value	p-value
Grp-A	Pre	91.20	4.96	36.26	18.442	0.001*
	Post	54.94	7.47			
Grp-B	Pre	82.92	8.32	3.63	9.732	0.001*
	Post	79.29	8.26			

The mean value in group A indicated changes in treatment and lower values are recorded for post treatment outcomes also the standard deviation shows limited consistency with post-treatment value which is more than the value. The effect size or Cohen’s D indicates a 4.76 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at a 5% significance level, there is a significant statistically reliable difference between the pre & post treatment values with a p-value less than the 5% significance level (i.e.  $0.001 < 0.05$ ) in the study and therefore it justifies the improvements in health outcome post-intervention.

The mean value in group B indicated changes post-treatment and lower values are recorded for post-treatment outcome also the standard deviation shows the consistency with post treatment value which is less than the value. The effect size or Cohen’s D indicates a 2.51 value which is assumed to be very high in effect size as per the standard parameters of reference. Based on the results of the test analysis at a 5% significance level, there is a significant statistically reliable difference between the pre & post treatment values with a p-value less than the 5% significance level (i.e.  $0.001 < 0.05$ ) in the study and therefore it justifies the improvements in health outcome post-intervention.



Graph 4: Comparison of pre-test and post-test scores of KHQ

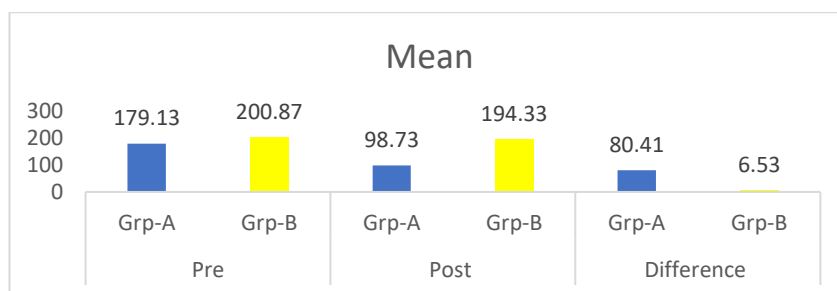
Between groups independent test for Group Statistics using independent t-test for PFDI20



Table 5: Independent test for Group statistics using the independent t test for PFDI-20

Time	Group	Mean	SD	t-value	p-value
Pre	Grp-A	179.13	62.82	0.958	0.346
	Grp-B	200.87	61.38		
Post	Grp-A	98.73	37.45	5.173	0.001*
	Grp-B	194.33	61.01		
Difference	Grp-A	80.41	32.59	8.754	0.001*
	Grp-B	6.53	2.50		

From the above table, it is observed that between-groups analysis is non-significant for the time frame at 5% level significance as the p-value is more than 5%. It shows non-significant differences between the groups. From the above table, it is observed that between-groups analysis is significant for a post time frame at 5% level significance as the p-value is less than 5%. It shows significant differences between the groups. From the above table, it is observed that between-groups analysis is significant for the difference at 5% level significance as the p-value is less than 5%. It shows significant differences between the groups.



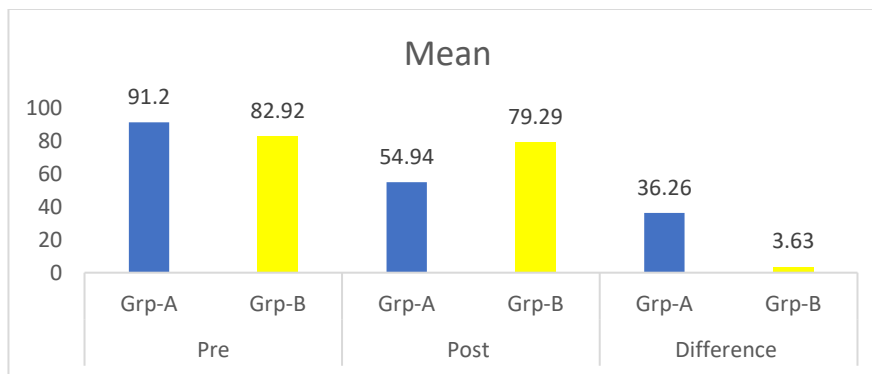
Graph 5: Mean score of Group A and Group B pre-test and post-test and their difference for PFDI-20.

**Between groups independent test for Group Statistics using the independent t test for KHQ**

Table 6: Independent test for group Statistics using independent t-test for KHQ.

Time	Group	Mean	SD	t-value	p-value
Pre	Grp-A	91.20	4.96	3.312	0.003*
	Grp-B	82.92	8.32		
Post	Grp-A	54.94	7.47	8.470	0.001*
	Grp-B	79.29	8.26		
Difference	Grp-A	36.26	7.62	16.308	0.001*
	Grp-B	3.63	1.44		

From the above table, it is observed that between-groups analysis is significant for the time frame at a 5% level of significance as the p-value is less than 5%. It shows significant differences between the groups. From the above table, it is observed that between-groups analysis is significant for a post time frame at 5% level significance as the p-value is less than 5%. It shows significant differences between the groups. From the above table, it is observed that between-groups analysis is significant for the difference at 5% level significance as the p-value is less than 5%. It shows significant differences between the groups.



Graph 6: Mean score for Group A and Group B pre-test and post-test and their difference for KHQ

**8. Discussion**

The pelvic floor is a functional unit and it involves various functions that extend beyond the support of pelvic organs. There is dysfunction of the pelvic floor which affects micturition, defecation, and also sexual activity.

Pelvic floor dysfunction like female pelvic organ prolapse (POP), urinary incontinence (UI), constipation, chronic obstruction defecation syndrome (OFD), etc. Their incidence increases with menopause and age. The primary aim of the present study was to evaluate and compare the effects of pelvic floor muscle training on pelvic floor muscle strength in postmenopausal women using Fire hydrants with mountain climber's exercise and Quadruped cross crawl exercise. The study found that 4 weeks of Pelvic floor muscle training produced a significant increase in (PFM) pelvic floor muscle strength.

Strength training has been shown to increase the number of satellite cells in the muscles of postmenopausal women, improving and preserving muscle mass and function.

The current study sustained an intensive (PFM) pelvic floor muscle training protocol for 4 weeks and obtained adherence from participants; these factors (adherence to training protocol and duration of the training program) influence the efficacy of pelvic floor muscle training (PFMT).

In our study, we took different age groups (45 and above) subjects and female gender in both groups. The group distribution was done by the chit method. Baseline data was entered after the explanation of the treatment procedure and signed informed consent then after post-treatment outcome measures were recorded at every level. Both the group treatment was beneficial and showed significant improvement in the pelvic floor strengthening training program. The most studied explanation for the positive results due to that both the treatment exercises help in the strength retraining program designed to prevent urinary incontinence (UI), pelvic organ prolapse (POP), chronic pelvic pain, decreased libido, vasomotor symptoms, fatigue, etc. in postmenopausal women to improve the strength of pelvic floor muscles, overall functional movement, improve balance, hip stability and strength of core muscles.

Though both the treatment programs were beneficial Group A program is Fire hydrants with mountain climbers exercise showed more significant improvement statistically when compared with Group B's Quadruped Cross Crawl exercise. The reason behind the fire hydrants with mountain climbers exercise also extends beyond the pelvic floor strengthening such as improving the fitness of the upper and lower body, coordination, decreased vasomotor symptoms, balance, stability to the hip joint, and strength of core muscles among the postmenopausal women.

Fire hydrant with mountain climber's exercise includes both physical and cognitive exercise as it can be performed as a group or single it potentially promotes social interaction.

Fire hydrants with mountain climber's exercise is a form of kneeling on floor exercise that can be easily performed at low cost because it does not require expensive equipment. It improves the strength of pelvic floor muscles, relieves urinary incontinence (UI), prevents pelvic organ prolapse (POP), and overall strength of core muscles.

## 9. Conclusion

The present study concluded that there was improvement in pelvic floor muscle strength age group (45 and above) when treated with Group A which is Fire hydrants with mountain climbers and Group B Quadruped cross crawl exercise. The study also concluded that Group A Fire-hydrants with mountain climbers showed more significant improvement in pelvic floor muscle strengthening as compared to Group B study that is Quadruped cross crawl exercise on outcome measure Pelvic Floor Distress Inventory (PFDI-20) and King's Health Questionnaire (KHQ).

## 10. Limitations of the Study

The present study could not cover a large number of sample size due to:

- Unwilling to participate.
- Lack of time.
- Lack of literature on Fire hydrants with mountain climber's exercise.
- There was difficulty in taking regular follow up of patients.

## 11. Future Scope of Study

1. After proper counseling on Fire hydrants with mountain climbers exercise sample size can be improved for better results at the community level.
2. A more detailed study can be initiated on Fire hydrants with mountain climber's exercise with advanced outcome effects.

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