ijlpr 2023; doi 10.22376/ijlpr.2023.13.6.L510-L521

International Journal of Life science and Pharma Research

ISSN 2250-0480

Research Article



# The Effects of Pilates and Conventional Treatment Methods in The Management of Stress Urinary Incontinence Among Women

**Veena Kirthika.S[1*], Swetha.M[2], Selvaraj Sudhakar[3], J. Arunselvi[4], Saravanan.V[5], G.Rajalakshmi [6]and Bharaneedharan.T[7]**

[1-6] *Faculty of Physiotherapy, Dr. M. G. R. Educational and Research Institute, Maduravoyal, Chennai – 600095*

[7] *Sri Venkateshwara College of Physiotherapy, Puducherry.*

**Abstract:** Stress Urinary Incontinence is a common condition among women that requires attention. The main aim of this study was to compare the effects of Pilates and conventional treatment methods in managing stress urinary incontinence among women. This study is an experimental design, comparative pre-post-test type. 30 female subjects with stress urinary incontinence were randomly divided into groups, Group A and Group B, with 15 subjects in each group. Group A received Pilates exercises, and Group B subjects received conventional Kegel's exercises. The study duration was 12 weeks. The pad test, cough stress test, and International Consultation on Incontinence (ICIQ) Questionnaire were outcome measures. The results of this study revealed that on comparing the Mean values of Group A & Group B on the International Consultation on Incontinence Questionnaire (ICIQ) and Pad test, Group A (Pilates Exercise) showed 4.46 and 4.93 post-test values which were more effective than Group B (Conventional kegel's Exercise) at 8.60 and 9.46 at P ≤ 0.001. The Pilates group experienced a highly significant improvement on the cough stress test compared to the conventional group at P< 0. 001.Pilates exercises were proven highly effective in managing stress urinary incontinence among women. This study is one of its kind, which demonstrated the effect of Pilates and its clinical usage for the effective management of Stress Urinary Incontinence.

**Keywords:** Pelvic floor muscles, Pilates, stress urinary incontinence, kegel's exercises, Cough stress test.

***Corresponding Author**

**Veena Kirthika.S , Faculty of Physiotherapy, Dr. M. G. R. Educational and Research Institute, Maduravoyal, Chennai – 600095**

**Received On** 23 January 2023

**Revised On** 28 September 2023

**Accepted On** 12 October 2023

**Published On** 01 November 2023

**Funding** This research did not receive any specific grant from any funding agencies in the public, commercial or not for profit sectors.

**Citation** Veena Kirthika.S, Swetha.M, Selvaraj Sudhakar, J. Arunselvi, Saravanan.V, G.Rajalakshmi and Bharaneedharan.T , The Effects of Pilates and Conventional Treatment Methods in The Management of Stress Urinary Incontinence Among Women.(2023).Int. J. Life Sci. Pharma Res.13(6), L510-L521 http://dx.doi.org/10.22376/ijlpr.2023.13.6.L510-L521

## 1. INTRODUCTION

Urinary incontinence, the involuntary leakage of urine, is often underdiagnosed and undertreated[1]. The prevalence of urinary incontinence in women varies across regions and populations, ranging from 10.8% to 79% among adults [2]. The most common reason for its occurrence in women is stress urinary incontinence, i.e., exerting pressure on the abdominal region, sneezing, coughing, laughing, or doing sports; in cases of overactive bladder, with urge incontinence, it occurs with a strong, uncontrollable urge to urinate, with a high chance of losing urine if a restroom is not found. Mixed incontinence occurs when there is loss of urine associated with both situations, i.e., it is preceded by efforts and symptoms of urgency [3]. The Pelvic floor muscles comprise a three-layer muscular plate that expands from the pubic symphysis along the sidewalls of the ileum towards the coccyx. The different muscles have different fiber directions, each with different functions. However, the only known voluntary function of the PFM is mass contraction, best described as an inward lift and squeeze around the urethra, vagina and rectum [4]. Potential risk factors for urinary incontinence are increasing age, parity, vaginal deliveries, obesity, pelvic surgery, diabetes mellitus, depression, constipation, and chronic respiratory problems. This problem leads to many women adapting their lifestyle to avoid social and sexual activities[5,6]**.**The mechanism underlying the development of stress urinary incontinence is urethral hypermobility resulting from the loss of support of the bladder, neck, and urethra and weakness of the urinary sphincter itself [7].200 different operations are used to treat stress urinary incontinence in women, such as anterior repair, retro pubic approach; Marshall-Marchetti Krantz (MMT), Burch colpo suspension, vaginal approach, sling: autologous, cadaveric, synthetic, vaginal wall, artificial urinary sphincter, bulk injectables and radiofrequency. When determining the optimal surgical therapy for patients with stress urinary incontinence, many factors should be considered, including the type of SUI, bladder capacity, the severity of leakage, associated conditions such as vaginal prolapse, and concurrent abdominal or pelvic pathology requiring surgical correction[8]. Surgical treatment adds an extra burden on the subjects, and rehabilitation after surgery. Surgery carries risks like infection, problems caused by mesh, trouble urinating, and injury to the bladder and pelvic organs. Conservative treatments, a nonsurgical therapy, include improving the lifestyle (i.e., Weight loss, dietary changes, fluid intake, reduction in caffeinated, carbonated, and alcoholic drinks; avoidance of constipation; stopping smoking; and physical activity), bladder training, pelvic floor muscle exercises, biofeedback, and electrical stimulation of pelvic muscles[9].The oldest form of Pelvic floor muscle training (PFMT) is Kegels exercises, named after the urologist Arnold Kegel, who first described this in 1948. It consists of 8-12 pelvic floor contractions that must be sustained for 10 seconds. These exercises require discipline and perseverance of the patients as they should be repeated multiple times a day for 4-5 months[10]. Kegels exercises are the most popular method of reinforcing pelvic floor muscles and are non-invasive treatments such that they do not involve the placement of any vaginal weights/cones[11]. Pilates has been used by health care professionals to integrate the mind and body of subjects, resulting in improved fitness and body consciousness. The method features ground and apparatus-based exercises created by Joseph Pilates. Pilates has six key features: concentration, control, precision, fluidity of movement, breathing, and centre of strength[12]. The Pilates method consists of training against resistance, involving integrated and controlled exercises to improve the whole body's strength and flexibility. Exercises are focused on pelvic stability, mobility, body alignment, and the maintenance of intra-abdominal pressure and respiratory mechanics[13]. It is an effective treatment for women with mild and moderate stress urinary incontinence, according to Gomes et al. (2018)[14]. Although many interventions are reported in the literature, there is a need to find the most effective intervention. Hence, this study compared the effects of Pilates and conventional Kegel exercises so that a more effective treatment protocol can be devised by combining treatments more optimally for managing stress urinary incontinence.

## 2. MATERIALS AND METHODS

This experimental comparative pre-post-test study was conducted at the outpatient physiotherapy department, Faculty of Physiotherapy, DR MGR educational and research institute. The institutional review board approved the study (A-31/Physio/IRB/2018-2019). The study duration was 12 weeks, from January 2019 to March 2019.

### *2.1. Participants*

The samples were recruited from the outpatient Physiotherapy department, DR.MGR Educational and Research Institute, University. Subjects were selected by a simple random sampling method, which enables an equal chance of selection for the subjects[16]. Women aged 30-45 years with symptoms of moderate to severe-predominant stress urinary incontinence, willing and able to undergo an extensive physical function evaluation, leakage of at least 10 grams of urine per 24 hours (based on pad weight test), free of impassable urethral strictures, trauma or necrosis, confirmation of stress urinary incontinence during the gynaecological examination was included in study and subjects who are unsafe to exercise, history of recurrent lower urinary tract infection, hysterectomy within 12 months, urogenital fistula, prior surgical intervention for urinary incontinence with the past 12 months were excluded from the study. Hence, 30 female subjects diagnosed with stress urinary incontinence were randomly divided into two groups.

### *2.2. Sample Size Calculation*

The priori sample size has been estimated based on the anticipated effect size of at least ES=0.4 using G * Power 3.1.9.4 software[17]. Thus, the sample size has been estimated to be 30, with an attrition rate of 10%. So, n=15 in each group was taken, and the minimum sample size required, which includes both groups, is 30.

### *2.3. Randomization*

Randomisation of the groups adopted a Simple Randomisation process, which involved a lottery-style method in which individuals selected folded slips containing random numbers ranging from 1 to 30. If a subject picked a slip with an even number, they were assigned to Group A; if an odd number was chosen, they were assigned to Group B. This selection process was conducted with the subjects blindfolded.

### *2.4. Outcome Measures*

Group A received Pilate's exercises, and Group B subjects received conventional Kegel's. The study duration was 12 weeks. The pad test is one of the outcome measures, a non-invasive test for measuring urinary incontinence, where an absorbent pad is given to the subject to wear after being weighed. The subject is asked to drink water, and after 1 hour, the pad is weighed again to identify the leakage of urine[18], cough stress test in the standing position with a bladder volume of around 300 ml[19], International Consultation on Incontinence (ICIQ) Questionnaire which clinicians commonly use to screen incontinence consists of 4 items on urinary incontinence frequency, urine leakage amount, overall impact and self-diagnostic item[20]. The scoring is from 0-21, with a higher score indicating more severity was used as an outcome measure.

### *2.5. Intervention*

Subjects in Group A received Pilates exercises, initial principal integration(supine), Basic bridging, bent knee fall out(supine), adductor squeeze(supine), Side-lying (lateral), Supine arm series, roll down series, Quadruped, Standing leg pump with band resistance (standing), Assisted squats in pairs(standing) were given[21]. Group B received conventional Kegel's exercises: sit n' squeeze, Kegel Bridge, side clamshell, sumo squat with pelvic floor lift, plank, bird dog, toe taps, dead bug crunch, single leg circles. All the exercises were performed for 10 repetitions with a hold time of 10 seconds daily for 12 weeks. They were instructed not to perform any other exercises during the intervention period.

**Table 1: Group A Exercise Description**

| Name and Position of the Exercise | Description |
|---|---|
| Initial principal integration (supine) | Subjects performed breathing coordination with neutral spine, transverse abdominals, and pelvic floor activation. |
| Basic bridging | Subjects elevated the Pelvis with segmental flexion of the spine |
| Bent knee fallout (supine) | Subjects performed Unilateral abduction of an inferior limb with pelvic stabilization. |
| adductor squeeze (supine) | Subjects performed squeeze of adductors muscles with a ball between the knees |
| Supine arm series | Subjects performed Arm work out flexion, abduction, and rotation with trunk stabilization. |
| Roll down series | Subjects performed Segmental flexion of the spine |
| Quadruped | Subjects performed Contralateral limb dissociation with trunk stabilization. |
| Assisted squats in pairs(standing) | Subjects performed lower limb Squats with band resistance in pairs. |
| Home exercises | Basic bridging with adductor squeeze + assisted squats + standing leg pump. |

**Fig 1: Basic Bridging**

**Fig-2 Bent Knee Fallout**

Fig-3: Supine Arm Series Fig-4: Adductor Squeeze

Fig-5: Quadruped Fig-6: Roll Down Series

Fig-7: Assisted Squats

Group B subjects received conventional Kegel's exercises. Kegel's exercises strengthen the pelvic floor muscles, which support the uterus and bladder. The exercises were given for twice- weekly up to 12 weeks.

**Table 2 Group B Exercise Description**

| Name Of The Exercises | Description |
|---|---|
| Sit N' Squeeze | Subjects squeezed the gluteal and pelvic floor region while seated on a chair. |
| Kegel Bridge | Subjects elevated the Pelvis with gluteal and pelvic floor muscles squeezing. |
| Side Clamshell | In side lying, Subjects performed top knee lifting with feet together until it was parallel to the hip. The knee is lowered again. |
| Sumo Squat with Pelvic Floor Lift | Subjects performed legged squats by squeezing pelvic floor muscles up and in. |
| Plank | Subjects performed plank by resting body weight on their elbows in the prone position and then contracting their gluteal and core muscles. |
| Bird Dog | Subjects performed alternate arm and leg raises while holding engaging abdominals and core muscles. |
| Toe Taps | Subjects performed the exercise supine with legs in a tabletop position and then tapped one toe down the floor, keeping the knee bent and then raising their leg back to the tabletop position. |
| Dead Bug Crunch | Subjects performed supine exercise with hips and knees at right angles and palms pressed to thighs above knees. Abdominal muscles are contracted and pulled towards the spine, then arms and legs are extended. |
| Single Leg Circles | Subjects lifted one leg with controlled breathing, made five to eight circles, and lowered down the leg. |
| Dead Bug Crunch | Subjects performed supine exercise with hips and knees at right angles and palms pressed to thighs above knees. Abdominal muscles are contracted and pulled towards the spine, then arms and legs are extended. |

Fig-8: Sit N'squeeze

Fig-9: Kegel Bridge

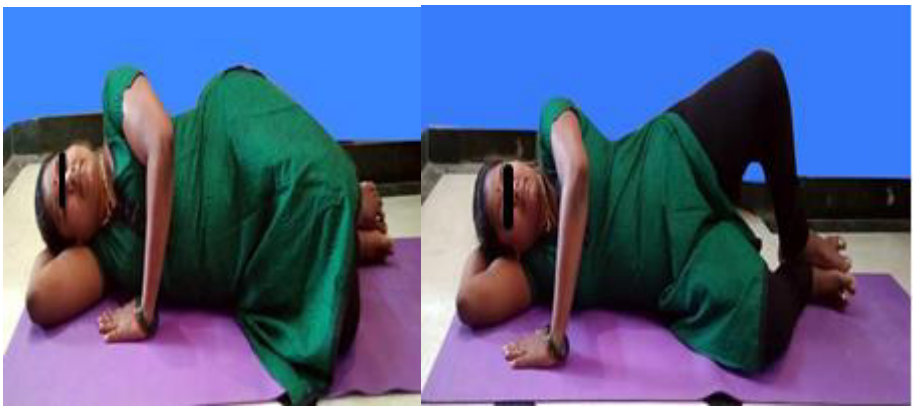

Fig-10: Side Claim shell

Fig-11: Plank

Fig-12: Sumo Squat with Pelvic Floor Lift

Fig-13: Bird Dog

Fig-14: Toe Taps

Fig-15: Dead Bug Crunch

Fig-16: Single Leg Circles

### *2.6. Ethical Statement*

This experimental comparative pre-post-test study was conducted at the outpatient physiotherapy department, Faculty of Physiotherapy, DR MGR educational and research institute. The institutional review board approved the study (A-31/Physio/IRB/2018-2019). Written informed consent was obtained from the subjects for their willingness and exercise intervention to be done for this study before any procedure was initiated. Consent was also obtained from the subjects for using their photos and data, which will be used when the study is published. The study was done in accordance with the guidelines of the Helsinki Declaration, revised in 2013, adopted by the World Medical Association[15].

## 3. RESULTS

The collected data were tabulated and analysed using descriptive and inferential statistics using Statistical Package for Social Science (SPSS) version 24.

### *3.1. Baseline characteristics of the study population*

There were no significant differences in mean and standard deviation for age and height. Weight, BMI, and Waist circumference indicated that both groups were similar at baseline, and randomisation was effective. To determine normality, these data were assessed statistically using the Shapiro-Wilktest. In this study, the Shapiro-Wilk test showed that the data were normally

distributed. Hence, a Paired t-test was adopted to find the statistical difference within the groups & and an Independent t-test (Student t-test) was adopted to find the statistical difference between the groups.

**Table 3 Summary of Characteristics of the study population**

| Parameters | Group A | Group B | Significance |
|---|---|---|---|
| N | 15 | 15 | - |
| Age | 35.30±1.29 | 36.43±0.90 | .796* |
| Height (cm) | 155.93±2.93 | 156.53±3.74 | .531* |
| Weight (kg) | 68.16±2.60 | 67.43±2.15 | .569* |
| BMI ($Kg/m^2$) | 27.81±0.84 | 27.59±1.07 | .764* |
| Waist Circumference (cm) | 104.30±5.57 | 103.56±4.04 | .482* |

***Abbreviations: cm-centimetre; kg-kilogram; BMI-Body Mass Index, (*- p > 0.05)***

The above Table gives the demographic characteristics of the subjects in Group A and Group B. A total of 30 subjects were assessed for the demographic characteristics.

**Table 4 Comparison of ICIQ Questionnaire Between Group – A and Group - B in Pre and Post-Test**

| #ICIQ | #GROUP - A | | #GROUP - B | | t - TEST | Df | Significance |
|---|---|---|---|---|---|---|---|
| | MEAN | S.D | MEAN | S.D | | | |
| PRE-TEST | 10.26 | 1.83 | 10.13 | 2.19 | .180 | 28 | .858* |
| POST-TEST | 4.46 | 1.55 | 8.60 | 1.88 | -6.56 | 28 | .000*** |

***#Group A – Pilates Exercise, # Group B – Conventional Exercise (*- p > 0.05), (***- p ≤ 0.001)***

The above table reveals the Mean, Standard Deviation (S.D), t-test, degree of freedom(df), and *p*-value between (Group A) & (Group B) in the pretest and post-test weeks. This table shows no significant difference in pretest values between Group A & Group B (**p*> 0.05). This table shows a statistically highly significant difference in post-test values between Group A & Group B (***- *p* ≤ 0.001) (FIG –17)

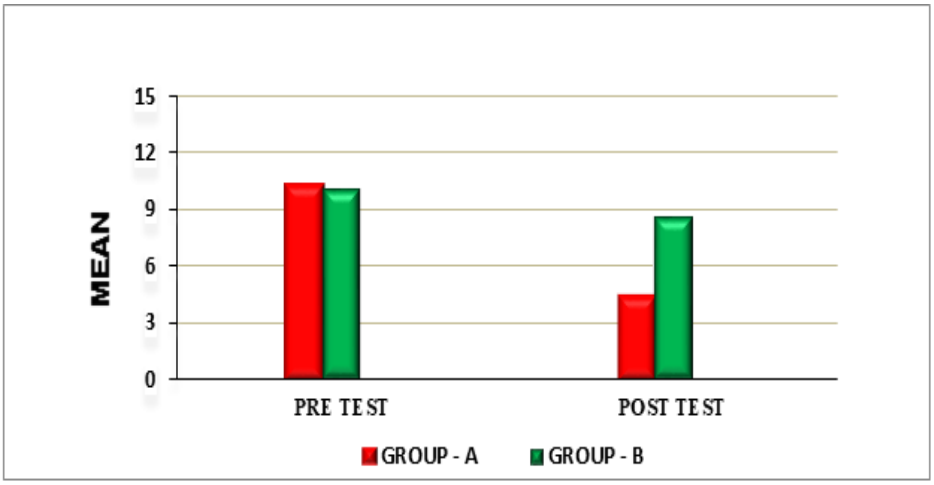


**Fig -17 Comparison of ICIQ Questionnaire Between Group – A and Group - B in Pre and Post-Test**

**Table – 5Comparison of Pad Test Between Group – A and Group - B in Pre and Post-Test**

| #PAD TEST | #GROUP - A | | #GROUP - B | | t - TEST | Df | Significance |
|---|---|---|---|---|---|---|---|
| | MEAN | S.D | MEAN | S.D | | | |
| PRE-TEST | 12.40 | 1.45 | 11.93 | 1.33 | .916 | 28 | .368* |
| POST-TEST | 4.93 | .798 | 9.46 | 1.12 | -12.72 | 28 | .000*** |

***#Group A – Pilates Exercise, # Group B – Conventional Exercise (*- p > 0.05), (***- p ≤ 0.001)***

The above table reveals the Mean, Standard Deviation (S. D), t-test, degree of freedom(df), and *p*-value between (Group A) & (Group B) in pre-test and post-test weeks. This table shows no significant difference in pre-test values between Group A &

Group B (*$p$> 0.05). This table shows a statistically highly significant difference in post-test valuesbetween Group A & Group B (***- $p$≤ 0.001) (FIG-18)

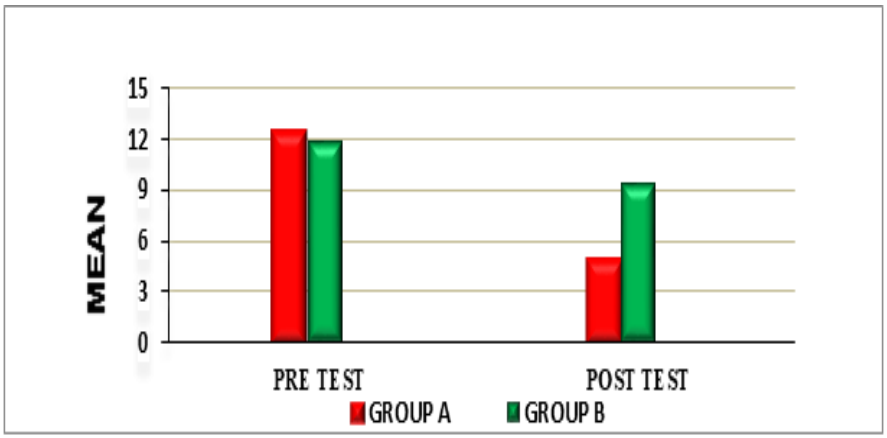


**Fig-18 Comparison of Pad Test Between Group – A and Group - B in Pre and Post-Test**

**Table 6 Comparison of ICIQ Questionnaire Within Group – A &Group – B Between Pre & Post-Test Values**

| #ICIQ | PRE-TEST | | POST-TEST | | t - TEST | |
|---|---|---|---|---|---|---|
| | MEAN | S.D | MEAN | S.D | | Significance |
| PRE-TEST | 10.26 | 1.83 | 4.46 | 1.55 | 40.06 | .000*** |
| POST-TEST | 10.13 | 2.19 | 8.60 | 1.88 | 7.12 | .000*** |

***(***- P ≤ 0.001)***

The above table reveals the Mean, Standard Deviation (S.D), t-value, and $p$-value between the pre-test and post-test within Group – A & Group – B. A statistically significant difference exists between the pre-test and post-test values within Group A and Group B (***-$p$≤ 0.001).(FIG-19)

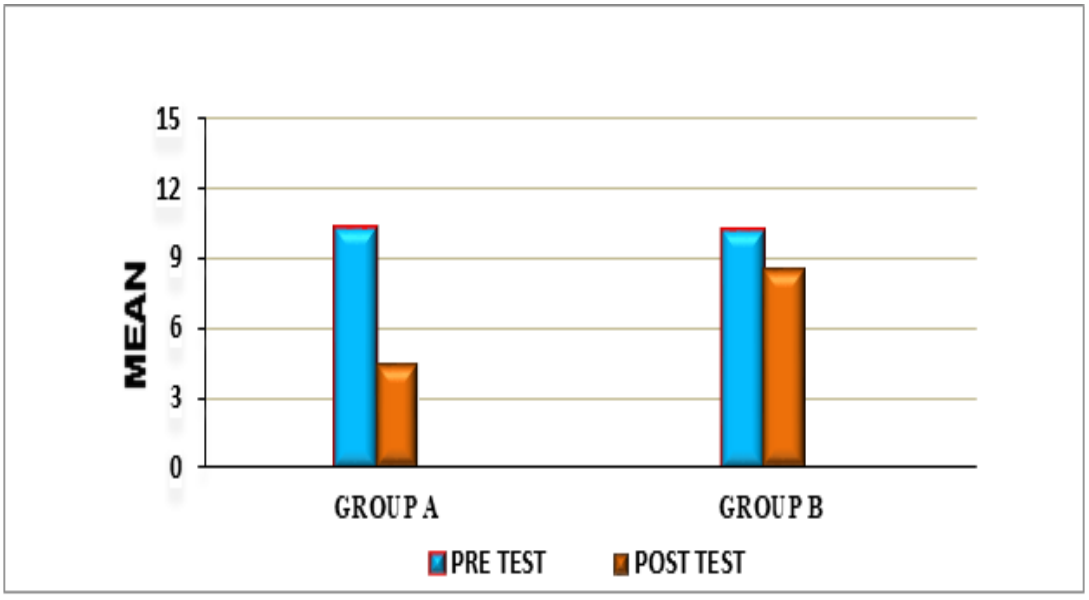


**Fig-19 Comparison of ICIQ Questionnaire Within Group – A & Group – B Between Pre & Post-Test Values**

**Table – 7Comparison of Pad Test Within Group – A & Group – B Between Pre & Post Test Values**

| #PAD TEST | PRE-TEST | | POST-TEST | | t - TEST | |
|---|---|---|---|---|---|---|
| | MEAN | S.D | MEAN | S.D | | Significance |
| PRE-TEST | 12.40 | 1.45 | 4.93 | .798 | 27.27 | .000*** |
| POST-TEST | 11.93 | 1.33 | 9.46 | 1.12 | 8.04 | .000*** |

***(***- p ≤ 0.001)***

The above table reveals the Mean, Standard Deviation (S. D), t-value, and *p*-value between the pre-test and post-test within Group – A & Group – B.A statistically significant difference exists between the pre-test and post-test values within Group A and Group B(***- $p \leq 0.001$).(FIG-20)

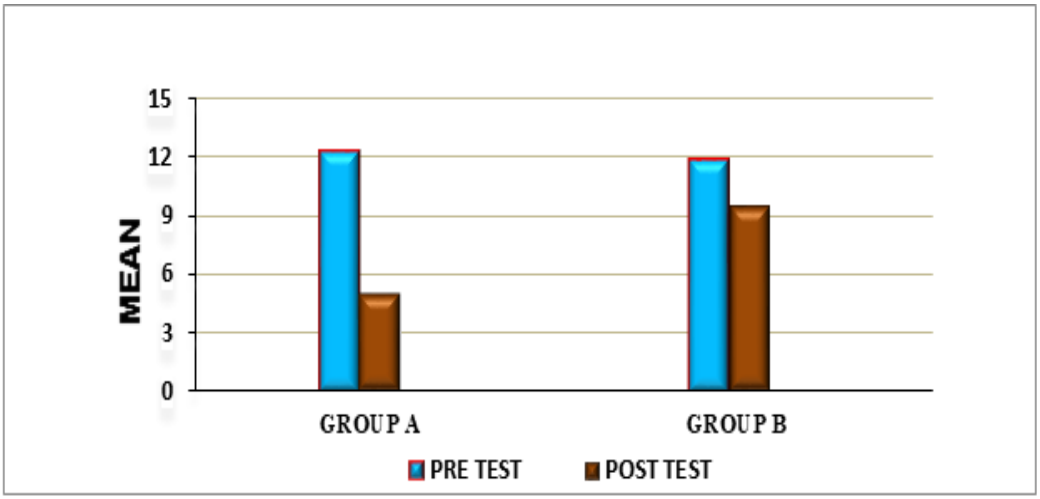


**Fig-20 Comparison of Pad Test Within Group – A & Group – B Between Pre & Post Test Values**

**Table – 8Comparison of Cough Stress Test Between Group – A and Group - B in Pre and Post-Test**

| #CST | GROUP- A | | GROUP - B | |
|---|---|---|---|---|
| | Positive | Negative | Positive | Negative |
| PRE-TEST | 100% | -- | 100% | -- |
| POST-TEST | -- | 100% | 66.6% | 33.3% |

The above table reveals the percentage of cough stress tests between groups.

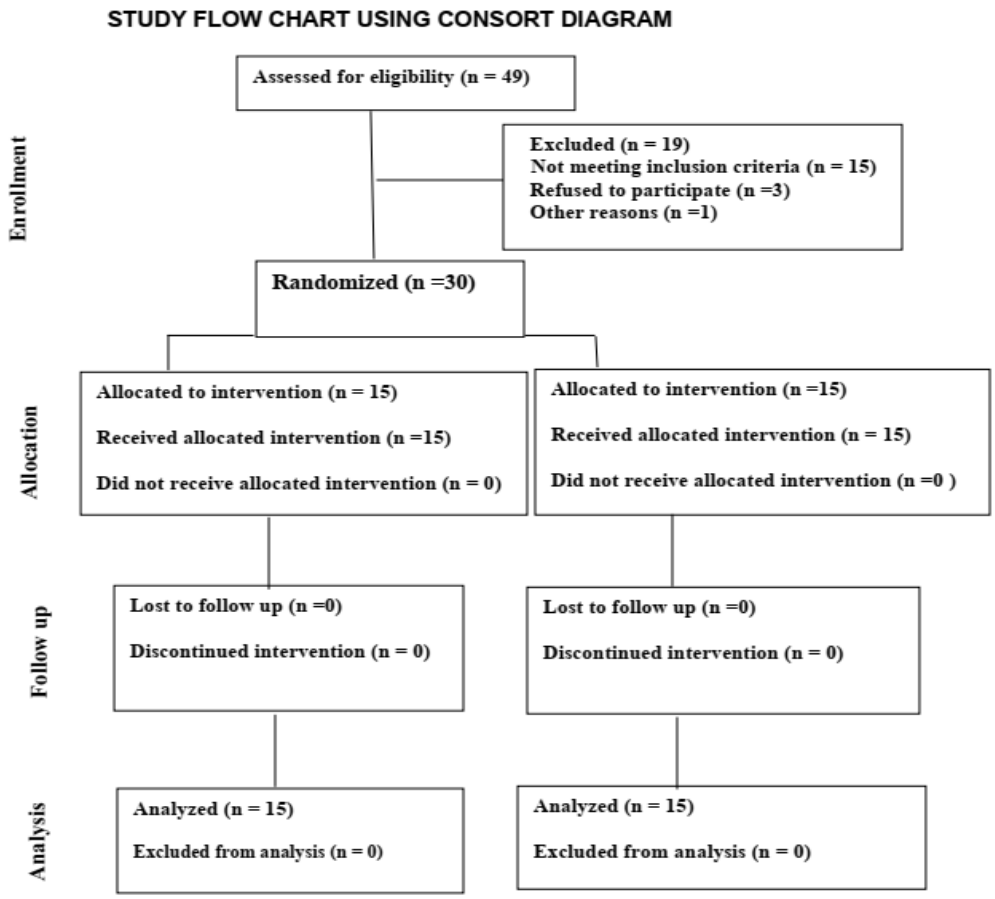


**Fig 21: Consort Diagram**

## 4. DISCUSSION

This study aimed to determine the effectiveness of Pilates and conventional treatment methods in managing stress urinary incontinence among women. This study was conducted among 30 female subjects with stress urinary incontinence. Subjects in Group A were intervened with Pilates exercises and Group B with Conventional Kegel's exercises. Outcome measures were the ICIQ Questionnaire, pad test, and cough stress test measured before the treatment and at the end of 12 weeks. It was noticed that there was improvement in the above parameters in all the two groups. Group A showed significant changes due to the effect of Pilates. A randomized study by Culligan et al. revealed comparable improvements in pelvic floor muscle strength after a Pilates exercise program and pelvic floor muscle training[23]. Group B also showed mild changes due to the effects of conventional kegel exercises. Kegel exercises were originally devised by Dr. Arnold Kegel in 1948 to prevent urinary incontinence in postpartum women, and they are one of the safest behavioral therapies without side effects and complications[24]. Pilates improves pelvic floor muscle strength, prevents urine leakage, and improves urinary incontinence among pregnant women[25]. This study supports the findings of Balarin et al. (2013) that Pilates is an effective method for the treatment of stress urinary incontinence[26] and Wells et al. (2012) that the Pilates method works with the concept of core stability, flexibility, muscle control, posture, and breathing[27].Our study agrees with Yu-Hsiu Kao et al (2014) that the Pilates method improves muscle strength and trunk flexibility in women [28]. This study also agrees with Partrick et al (2009) that Pilates of two mechanisms that develop a knack for consciously contracting the pelvic floor muscles before and during increases in abdominal pressure and strengthening the muscles can build up the structural support to the pelvic floor[29] and Pedriali et al. (2013) that Pilates increases the muscle strength and presented with potential advantages in the endurance of pelvic floor muscle contraction[30].The continence mechanism of the lower urinary tract relies on a complex interaction of anatomy, tissue integrity, and nerve reflexes. The purpose of the urethra is to provide a conduit from the bladder to the outside[31]. Pilate's method focuses on pelvic stability, mobility, body alignment, intra-abdominal pressure maintenance, and respiratory mechanisms[32]. It is a form of exercise involving a range of movements that strengthen and increase the flexibility of the whole body[33]. The exercises incorporate a series of poses and plyometric exercises to compliment pelvic floor muscle training[34]. In these exercises, the engagement of the hip rotators, adductors of the thigh, transverse abdominis, and gluteal muscles facilitate or induce pelvic floor activation[35]. Kegel's exercises strengthen the muscles of the pelvic floor, such as pubococcygeus, lliococcygeus, coccygeus, ischiocavernosus, and bulbospongiosus by holding the urine and thus stop the leakage of urine[36]. The subjects were asked to perform exercises such as to hold the urine and to avoid defecation by contraction of the urethra and the anal spincter[37]. In the ICIQ Questionnaire, the post-test means of Group A (4.46) showed a better reduction in stress urinary incontinence than Group B (8.60). In the pad test, the post-test mean of Group A (4.93) showed a better reduction in stress urinary incontinence than Group B (9.46).In the cough stress test, the post-test mean of Group A showed 100% improvement than Group B with 33.3%. This study showed that the two groups improved in all the parameters after intervention. When the groups were compared, Pilates was more effective than conventional kegel exercises in managing stress urinary incontinence among women.

## 5. STRENGTHS AND LIMITATIONS

This is a new study that assessed the efficacy of Pilates in the management of UI among women. The study provides additional insights into the possible excellent effects of adding Pilates as an intervention for the clinical management of stress urinary incontinence in women. However, the sample size needs to be sufficiently powered to generalize the results, and the effects could have been because of statistical analysis rather than based on clinical significance. Moreover, the duration of the intervention was short.

## 6. CONCLUSION

The present research concludes that stress urinary incontinence among women is very common and needs definitive treatment to avoid long-term consequences. This study's results show that it can be treated with Pilates and conventional Kegel's exercises. When the groups were compared to find the most appropriate intervention, Pilates showed marked improvement in the ICIQ Questionnaire, pad test, and cough stress test than conventional Kegel's exercises in subjects with stress urinary incontinence. Hence, Pilates exercise has superior benefits, which can be added to conventional exercises for better outcomes.

## 7. AUTHORS CONTRIBUTION STATEMENT

The principal investigator, Dr. Veena Kirthika, conceptualized, designed the study, and prepared the original draft. Ms. Swetha helped to collect data, and Dr. Sudhakar helped with the statistical analysis. Dr. Arunselvi worked out the methodology and exercise protocol. Dr. Saravanan helped in getting all the review of literature for the study. Dr. Rajalakshmi helped prepare the original draft, and Dr. Bharaneedharan gave valuable inputs for writing the manuscript.

## 8. ACKNOWLEDGEMENT

The authors extend sincere thanks to the management of Dr.MGR Educational and Research Institute, deemed to be University, for providing all the research facilities to carry out this research.

## 9. CONFLICT OF INTEREST

Conflict of interest declared none.

## 10. REFERENCES

1. Lukacz ES, Santiago-Lastra Y, Albo ME, Brubaker L. Urinary incontinence in women: a review. JAMA. 2017 Oct 24;318(16):1592-604. doi: 10.1001/jama.2017.12137, PMID 29067433.

2. Zhou HH, Shu B, Liu TZ, Wang XH, Yang ZH, Guo YL. Association between parity and the risk for urinary incontinence in women: A meta-analysis of case–control and cohort studies. Medicine. 2018

Jul;97(28):e11443. doi: 10.1097/MD.0000000000011443, PMID 29995798.
3. Guin G, Choudhary A, Dadhich R. Prevalence of stress urinary incontinence and its associated risk factors amongst females attending tertiary referral centre[1]ournal of Reproduction, Contraception. Int J Reprod Contracept Obstet Gynecol. 2018 Jun 1;7(6):2115-20. doi: 10.18203/2320-1770.ijrcog20181978.
4. Bø K. Pelvic floor muscle training is effective in treatment of female stress urinary incontinence, but how does it work? Int Urogynecol J Pelvic Floor Dysfunct. 2004 Apr;15(2):76-84. doi: 10.1007/s00192-004-1125-0, PMID 15014933.
5. Agarwal BK, Agarwal N. Urinary incontinence: prevalence, risk factors, impact on quality of life and treatment seeking behaviour among middle aged women. Int Surg J. 2017 May 24;4(6):1953-8. doi: 10.18203/2349-2902.isj20172131.
6. Sharma T, Mittal P. Risk factors for stress urinary incontinence in women. Int J Contemp Med Res. 2017 Oct;4(10):2031-5.
7. Aoki Y, Brown HW, Brubaker L, Cornu JN, Daly JO, Cartwright R. Urinary incontinence in women. Nat Rev Dis Primers. 2017 Jul 6;3(1):1-20. doi: 10.1038/nrdp.2017.42.
8. Rovner ES, Wein AJ. Treatment options for stress urinary incontinence. Rev Urol. 2004;6;Suppl 3:S29-47. PMID 16985862.
9. Faiena I, Patel N, Parihar JS, Calabrese M, Tunuguntla H. Conservative management of urinary incontinence in women. Rev Urol. 2015;17(3):129-39. PMID 26543427.
10. De Vries AM, Heesakkers JPFA. Contemporary diagnostics and treatment options for female stress urinary incontinence. Asian J Urol. 2018 Jul 1;5(3):141-8. doi: 10.1016/j.ajur.2017.09.001, PMID 29988831.
11. Park SH, Kang CB. Effect of Kegel exercises on the management of female stress urinary incontinence: a systematic review of randomized controlled trials. Adv Nurs. 2014 Dec 30;2014:1-10. doi: 10.1155/2014/640262.
12. Kastelein AW, Dicker MFA, Opmeer BC, Angles SS, Raatikainen KE, Alonso JF et al. Innovative treatment modalities for urinary incontinence: a European survey identifying experience and attitude of healthcare providers. Int Urogynecol J. 2017 Nov;28(11):1725-31. doi: 10.1007/s00192-017-3339-y, PMID 28432409.
13. Souza LM, Pegorare AB, Christofoletti G, Barbosa SRM. Influence of a protocol of Pilates exercises on the contractility of the pelvic floor muscles of non-institutionalized elderly persons. Rev Bras Geriatr Gerontol. 2017 Jul;20(4):484-92. doi: 10.1590/1981-22562017020.160191.
14. Gomes CS, Pedriali FR, Urbano MR, Moreira EH, Averbeck MA, Almeida SHM. The effects of Pilates method on pelvic floor muscle strength in patients with post-prostatectomy urinary incontinence: A randomized clinical trial. Neurourol Urodyn. 2018 Jan;37(1):346-53. doi: 10.1002/nau.23300, PMID 28464434.
15. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013 Nov 27;310(20):2191-4. doi: 10.1001/jama.2013.281053, PMID 24141714.
16. Meng X. Scalable simple random sampling and stratified sampling. In: International Conference on Machine Learning; 2013 May 26. p. 531-9. PMLR.
17. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. Behav Res Methods. 2009 Nov;41(4):1149-60. doi: 10.3758/BRM.41.4.1149, PMID 19897823.
18. Krhut J, Zachoval R, Smith PP, Rosier PF, Valanský L, Martan A et al. Pad weight testing in the evaluation of urinary incontinence. Neurourol Urodyn. 2014 Jun;33(5):507-10. doi: 10.1002/nau.22436, PMID 23797972.
19. Price DM, Noblett K. Comparison of the cough stress test and 24-h pad test in the assessment of stress urinary incontinence. Int Urogynecol J. 2012 Apr;23(4):429-33. doi: 10.1007/s00192-011-1602-1, PMID 22086265.
20. Abrams P, Avery K, Gardener N, Donovan J, ICIQ Advisory Board. The international consultation on incontinence modular questionnaire: www. iciq. net. J Urol. 2006 Mar;175(3 Pt 1):1063-6; discussion 1066. doi: 10.1016/S0022-5347(05)00348-4, PMID 16469618.
21. Pedriali FR, Gomes CS, Soares L, Urbano MR, Moreira EC, Averbeck MA et al. Is Pilates as effective as conventional pelvic floor muscle exercises in the conservative treatment of post-prostatectomy urinary incontinence? A randomised controlled trial. Neurourol Urodyn. 2016 Jun;35(5):615-21. doi: 10.1002/nau.22761, PMID 25809925.
22. Cavkaytar S, Kokanali MK, Topcu HO, Aksakal OS, Doğanay M. Effect of home-based Kegel exercises on quality of life in women with stress and mixed urinary incontinence. J Obstet Gynaecol. 2015 May 19;35(4):407-10. doi: 10.3109/01443615.2014.960831, PMID 25264854.
23. Culligan PJ, Scherer J, Dyer K, Priestley JL, Guingon-White G, Delvecchio D et al. A randomized clinical trial comparing pelvic floor muscle training to a Pilates exercise program for improving pelvic muscle strength. Int Urogynecol J. 2010 Apr;21(4):401-8. doi: 10.1007/s00192-009-1046-z, PMID 20094704.
24. Park SH, Kang CB. Effect of Kegel exercises on the management of female stress urinary incontinence: a systematic review of randomized controlled trials. Adv Nurs. 2014;2014:1-10. doi: 10.1155/2014/640262.
25. Pavithralochani V, Thangavignesh R, Saranya P, Ramanathan K. Efficacy of kegel's exercise vs Pilates in subject with urinary incontinence during pregnancy. Res J Pharm Technol. 2019;12(12):5943-6. doi: 10.5958/0974-360X.2019.01031.X.
26. Balarin CD, Godoy AC, Kasawara KT, Isaias TO, Vanini TM, Oliveira MM. Effect of Pilates in strengthening pelvic floor muscles of patients with stress urinary incontinence. InJOURNAL of womens health 2013 Mar 1 (Vol. 22, No. 3, pp. 3-3). 140 HUGUENOT STREET, 3RD FL, NEW ROCHELLE, NY10801. MARY ANN LIEBERT Publishing INC.
27. Wells C, Kolt GS, Marshall P, Hill B, Bialocerkowski A. The effectiveness of Pilates exercise in people with chronic low back pain: a systematic review. PLOS ONE. 2014;9(7):e100402. doi: 10.1371/journal.pone.0100402, PMID 24984069.
28. Kao YH, Liou TH, Huang YC, Tsai YW, Wang KM. Effects of a 12-week Pilates course on lower limb

muscle strength and trunk flexibility in women living in the community. Health Care Women Int. 2015 Mar 4;36(3):303-19. doi: 10.1080/07399332.2014.900062, PMID 24611630.

29. Culligan PJ, Scherer J, Dyer K, Priestley JL, Guingon-White G, Delvecchio D et al. A randomized clinical trial comparing pelvic floor muscle training to a Pilates exercise program for improving pelvic muscle strength. Int Urogynecol J. 2010 Apr;21(4):401-8. doi: 10.1007/s00192-009-1046-z, PMID 20094704.
30. Pedriali FR, Gomes CS, Soares L, Urbano MR, Moreira EC, Averbeck MA et al. Is Pilates as effective as conventional pelvic floor muscle exercises in the conservative treatment of post-prostatectomy urinary incontinence? A randomised controlled trial. Neurourol Urodyn. 2016 Jun;35(5):615-21. doi: 10.1002/nau.22761, PMID 25809925.
31. DeLancey JO. Stress urinary incontinence: where are we now, where should we go? Am J Obstet Gynecol. 1996 Aug 1;175(2):311-9. doi: 10.1016/s0002-9378(96)70140-0, PMID 8765247.
32. Latey P. The Pilates method: history and philosophy. J Bodyw Mov Ther. 2001 Oct 1;5(4):275-82. doi: 10.1054/jbmt.2001.0237.
33. Mazzarino M, Kerr D, Wajswelner H, Morris ME. Pilates method for women's health: systematic review of randomized controlled trials. Arch Phys Med Rehabil. 2015 Dec 1;96(12):2231-42. doi: 10.1016/j.apmr.2015.04.005, PMID 25912668.
34. Ferla L, Paiva LL, Darki C, Vieira A. Comparison of the functionality of pelvic floor muscles in women who practice the Pilates method and sedentary women: a pilot study. Int Urogynecol J. 2016 Jan;27(1):123-8. doi: 10.1007/s00192-015-2801-y, PMID 26245725.
35. Dias NT, Ferreira LR, Fernandes MG, Resende APM, Pereira-Baldon VS. A Pilates exercise program with pelvic floor muscle contraction: is it effective for pregnant women? A randomized controlled trial. Neurourol Urodyn. 2018 Jan;37(1):379-84. doi: 10.1002/nau.23308, PMID 28543751.
36. Kolcaba K, Dowd T, Winslow EH, Jacobson AF. Kegel exercises. Strengthening the weak pelvic floor muscles that cause urinary incontinence. AJN. Am J Nurs. 2000 Nov 1;100(11):59. doi: 10.1097/00000446-200011000-00048, PMID 11103639.
37. Aslan E, Komurcu N, Beji NK, Yalcin O. Bladder training and Kegel exercises for women with urinary complaints living in a rest home. Gerontology. 2008;54(4):224-31. doi: 10.1159/000133565, PMID 18483451.