Frontiers in Health Informatics ISSN-Online:2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 3
Open Access

Effect of Hip Strengthening Exercises and Pelvic Floor Exercises on Stress Urinary Incontinence in Postnatal Women

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Cite this paper as: Mai Mohamed Sherif Mohamed, Hala Mohamed Hanafy, Mohamed Ahmed Awad, Sameh Hussien Samir (2024) Effect of Hip Strengthening Exercises and Pelvic Floor Exercises on Stress Urinary Incontinence in Postnatal Women. *Frontiers in Health Informatics, 13* (3),8755-8765

Abstract:

Introduction: *The most prevalent type of UI, known as stress urinary incontinence (SUI), occurs when urine leaks out with exertion including when they cough, sneeze, or are physically active. Physical therapy is an effective treatment for postpartum urinary incontinence, a prevalent problem in women. This study was done to examine the impact of hip strengthening exercises and pelvic floor exercises on SUI in postnatal women.* ***Material and methods:*** *One hundred twenty multiparous women, suffering from mild or moderate degree of SUI, age 30 to 35, BMI<30 kg/m^2 , were randomized into four equivalent groups: control group with no intervention, three study groups received the procedures as the following hip exercises group received hip strengthening exercises for abductors, adductors, external rotators and hips extensors, pelvic floor exercises group received pelvic floor exercises, combined exercises group received hip strengthening exercises in addition to pelvic floor exercises as the same way of the other two study groups together. All groups were assessed for maximum vaginal squeeze by using Biofeedback (Myomed 632v) and Urogenital Distress Inventory Questionnaire - Short Form (UDI-6) prior to and post treatment.* ***Results:*** *Groups (B), (D), and (C) had significantly different maximal vaginal squeeze and UDI-6 values compared to group (A), with a p-value of 0.001 for each. However, there was no significant difference in UDI-6 among groups (B) and (D). None of the other groups showed statistically significant differences in these measures.* ***Conclusions:*** *from the obtained results, it could be concluded that one part of a strategy that can help improve SUI is strengthening the hip muscles as it improves PFM power and reduces leakage in those with SUI and may be considered a starting point for those women who find PFM contractions difficult to perform.*

Keywords*: stress urinary incontinence, maximum vaginal squeeze, hip strengthening exercises, pelvic floor exercises, post-natal.*

1. Introduction

There are primarily three forms of urinary incontinence (UI) in adults: stress UI (SUI), urge UI (UUI), as well as mixed UI (MUI) **(Gacci et al., 2022)**. Although UI does not provide a life-threatening threat, it does have a large impact on patients' quality of life (QoL). According to **Milsom and Gyhagen (2019)**, the worldwide incidence of UI ranges from 5% to 69% across a woman's lifetime, with an even higher incidence among older age groups **(Milsom and Gyhagen, 2019)**. The majority of UI cases include SUI, which is characterized as urine leakage during exertion, including when one is coughing, sneezing, or exercising **(Casey and Temme, 2017)**. The pelvic floor muscles (PFMs) become weaker, and SUI begins after many vaginal deliveries. According to reports, 12.2% of women who have given vaginal delivery experience SUI. This rate is 2.4% greater than what is seen in women who have had a caesarean section. According to **Rattveit et al. (2003)**, around 2% of cases experience SUI

following vaginal delivery that lasts longer than 2 months **(Rortveit et al., 2003)**. According to reports, 27% of Egyptian women experience UI, making it a significant problem in the country. Most people with UI have never sought medical help for their condition, despite the fact that it greatly reduces their QoL **(Soliman et al., 2020).** Pelvic floor muscle training (PFMT) is a common first-line treatment for SUI **(Amin et al., 2018).** PFMT are used to increase (maximal) strength, endurance, timing, explosive strength, and muscle coordination. PFMT includes passive, active-assisted, active-resisted, and simple contraction exercises with or without electrical stimulation, biofeedback therapy, and vaginal weights **(Moroni et al., 2016).** Treatment for lower urinary tract symptoms (LUTS) does not always take hip muscle strength into account. Hip muscle performance has been the subject of an increasing amount of research that links pelvic floor diseases (LUTS included) with PFMs problems **(Hartigan et al., 2019)**. Arcus tendineus fasciae pelvis (arcus tendineus) is the mechanism by which the obturator internus is attached to the PFMs. Due to their small physiological cross-sectional area, PFMs are believed to need enough tension in the arcus tendinous as well as obturator internus muscles to generate forces linked to normal use. This connection among the two muscles is therefore crucial **(Tuttle et al., 2014)**. An additional muscle group that was studied was the hip abductors, which help support the hip in the transverse plane **(Wente and Spitznagle, 2017)**. Patients with SUI had significantly weaker hip external rotators as well as abductors as compared to asymptomatic subjects **(Hartigan et al., 2019).** According to Hartigan et al. (2019), patients who have and do not have UI have different strengths and ranges of motion (ROM) in the hip. Given that the obturator internus muscle attaches the hip to the PFMs, hip posture may influence LUTS. It is usual for patients experiencing urine urgency to bend at the hips. The obturator internus muscle, which is lengthened in the adducted hip posture, might undergo tissue alterations and the development of trigger points if this position is repeatedly used. The symptoms of frequent or urgent urination may be exacerbated by PFM trigger points **(Erbes et al., 2021).**

So, this study was performed to examine the impact of hip strengthening exercises and PFMT on SUI in postnatal women.

2. Materials and methods

- ***Participants***

An overall of 134 post-natal women with SUI participated in this study. Referral pf patients was done by a gynecologist (Figure 1). **Firstly,** 134 people were assessed for eligibility. Before the start of the program, an informed consent session was held after explaining the study purpose and procedure to the patients. **Then** 126 participants signed the informed consent to join the study, where six patients declined to participate. **Finally,** 120 patients completed the study program. The data of the 120 participants were included in the analysis. Utilizing a closed-envelope random assignment technique, they were divided into four groups. The following were the criteria for inclusion: The participants' ages varied from 30 to 35, and their BMI did not exceed 30 kg/m2. The women in this study were all multipara, had normal vaginal births, and were all free of any pathological disorders that could have impacted the outcome of the study. The gynecologist had diagnosed them with mild to moderate SUI. Repeated urinary tract infections, high blood pressure, diabetes mellitus, an intrauterine device, or a hysterectomy excluded female from participation.

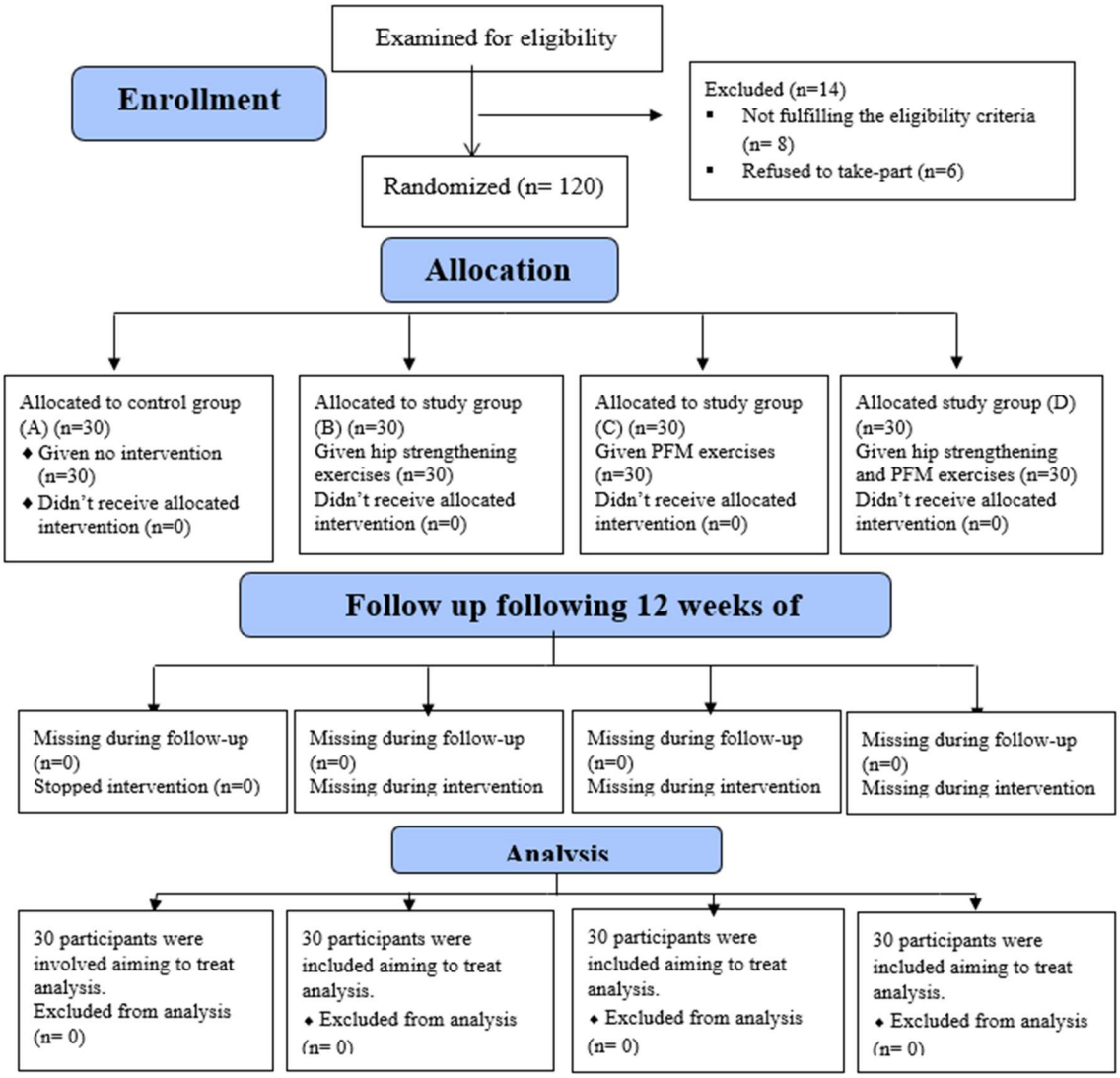

Fig. (1): The participants' flow chart throughout the study

- ***Procedures***

The closed envelope approach was used to accomplish sample randomization. Individuals were randomly assigned to one of four groups, with thirty individuals in each. The patients were informed of every procedure before the trial started, and they signed an informed consent form afterward. The Faculty of Physical Therapy Ethical Review Board of Cairo University in Egypt gave its approval to this study. No: P.T.REC/012/003888. Additionally, the study was registered with ClinicalTrials.gov (protocol number: NCT06269016).

- ***Outcome measures***

- ***Maximal squeeze pressure:*** Biofeedback (Myomed 632v) utilized for measurement of squeeze pressure (vaginal pressure) prior to and following treatment for all participant in four groups. Enraf-Nonius B.V. is the manufacturer, and the serial number is 12.509. A tiny cushion was put under the individual's lower back and hips, and a soft pillow was positioned behind their head to create the lithotomy posture, which was then used for the measurement. The next step was to attach the vaginal pressure sensor into the vaginal perfusion

catheter. A sterile gel was used for lubrication the pressure sensor's tip. Approximately three to four centimeters from the introitus, with one centimeter remaining outside in which its sensitive area traverses the muscle sheet of PFM, the vaginal pressure sensor was simply introduced to assess the amount of pressure during vaginal closure and to determine the strength of the deeper internal PFM in hectopascals (hPa). One hPa is equal to 100 Pascal, which is 0.7501 millimeters of mercury, or 10.2 millimeters of water. The vaginal pressure sensor was inserted by slowly infusing air into the catheter through a syringe until the female could feel the pressure inside her. Then, the pressure was set to zero to begin the measurements, which lasted for one minute and reached a maximum of 120 hPa. The maximal pressure PFM contraction was measured by having the patient squeeze their muscles forcefully for three sets of ten seconds each of them with 10 seconds between each set. The baseline along with follow-up scores for each female were calculated by taking the average of these three peak values. It was used before and after treatment.

- ***Urogenital Distress Inventory Questionnaire - Short Form (UDI-6):*** The UDI-6 is a series of six questions designed to measure symptoms associated with LUTS, particularly SUI (0 = not at all; 1 = slightly; 2 = moderately; 3 = greatly). Then, multiply the sum of all the responses by 25. The possible range of scores is 0-100. Greater symptom distress is indicated by higher scores. It was used before and after treatment for all participants in four groups.

- ***Interventions***
  - ***Hip Muscles strengthening exercise*:** It was used for treatment of all participants in group B and D. Hip exercises include exercises for strengthening the hip abductor, hip adductor, hip external rotator, as well as gluteus maximus muscles as a following:

- *Hip abduction exercise*: The patient was standing when they were asked to abduct their hips, which they did by moving them away from their midline and against an elastic resistance.
- ***Hip adduction exercise*:** The patient stands up straight and moves their hips adduction while facing an elastic barrier across their body's midline.
- ***Hip external rotation exercise*:** The patient was at side lying position, with medial hip rotation, and carried out hip external rotation with 90° knee flexion.
- ***Gluteus maximus muscles*:** The patient was in prone lying position with a pillow placed the hip (make semi flexion hip) with flexed knee and performs hip extension.

In each session the patient will perform each exercise 3 set with 10 repetitions for all muscles with one-minute break between each set, 3 sessions per week for 3 months.

- **PFM exercises*:*** It was used for treatment of all patients in **group C** and **D**. the participants were noted to evacuate of the bladder before starting PFMT, while exercising the muscles in your pelvic floor, remember to maintain muscles of the abdominal, buttocks, and thigh relaxed. Patients were doing these exercises while doing her ADL at any time and place. Patients was instructed to perform 2 sets with 10 exercises per session, at a frequency of 3 times per week, 5 times per day for 15 minutes for 3 months as following:

- ***Step (1) slow contractions*:** From siting, standing, or lying down with legs slightly apart, gradually tighten and pull up the PFMs to her maximum ability. Encourage the patient to raise and squeeze them for as much time as she can. Take a four-second break and then do it again. Strengthen her muscles until she can maintain a slow contraction for ten seconds at a time, while taking a 4-second break in between.

- ***Step (2) quick contractions*:** Contracting the pelvic floor muscles, hold for only one second, and then release. Ten rapid contractions in a row should be enough to tighten the muscles significantly. Step one would involve gradual contractions, while step two would involve fast contractions.

- ***General advice:*** All patients in all groups were follow the following advice: A healthy lifestyle includes avoiding constipation and straining, treating the underlying cause of chronic coughs and infections of the urethra or bladder, quitting smoking, keeping to a healthy weight, not lifting heavy objects too often (or

too quickly), lifting with a bent knee instead of a straight back, drinking plenty of water and other healthy fluids, eliminating caffeine as well as acidic and spicy foods, and so on.

- ***Statistical analysis:***

The results are presented as the mean plus or minus the standard deviation. In order to determine the true impact of various physical therapy techniques, the mean difference is determined by subtracting the baseline values from the post-treatment values, or, when applicable, subtracting the post-treatment values from the baseline values. The overall distribution of the data was measured using the Kolmogorov-Smirnov test, which is a test for normality. So, one-way analysis of variance (ANOVA) was used to compare normally distributed variables in each of the four categories. The Kruskal-Wallis test was used to compare variables in the four groups with non-normally distributed data. If significant findings were reported, the Mann Whitney test was then applied. The Wilcoxon Sign Ranks test was used to compare data measured before and after treatment in the same group. The data was analyzed using the Statistical Package for the Social Sciences (SPSS) software, specifically version 20 for Windows. An important result was defined as a P value < 0.05.

3. Results:

No statistically significant difference was observed in the mean value of the Demographic characteristics (age, height, weight and BMI) between the four groups **(Table 1).**

Table (1): Demographic characteristics of our studied groups:

	Group A (n= 30)	**Group B (n= 30)**	**Group C (n= 30)**	**Group D (n= 30)**	**F value**	**p value[#]**
Age (yrs.)	32.73 ± 1.82	32.47 ± 1.89	32.03 ± 1.88	32.37 ± 1.71	0.752	0.523
Weight (kg.)	70.47 ± 6.47	70.10 ± 5.90	71.10 ± 5.78	69.47 ± 4.72	0.423	0.737
Height (m)	1.62 ± 0.05	1.63 ± 0.06	1.62 ± 0.05	1.63 ± 0.04	0.209	0.890
BMI (kg/m^2)	26.98 ± 1.46	26.55 ± 2.23	26.93 ± 1.39	26.26 ± 1.64	1.155	0.330
Data are expressed as mean ± SD; [#]= One-way ANOVA test; p> 0.05= not significant						

At pre-treatment: The four groups did not differ significantly in terms of maximal vaginal squeeze or UDI-6 at the pre-treatment stage. After the therapy, the post hoc test revealed that group (B), group (C), and group (D) had significantly different values compared to group (A). Additionally, when comparing groups (B), (C), and (D), the maximal vaginal squeeze value was significantly greater in group (B). There was a statistically significant difference between the two groups with respect to UDI-6; group (D) had a much higher value than group (C) (Fig. 2), but groups (B) and (D) had much lower values. There was no statistically significant difference in its value among the B and D groups (Fig. 3).

Within group comparison: When comparing the baseline and post-treatment values of the UDI-6 as well as maximal vaginal squeeze in the control group (A), no statistically significant difference was detected. The mean values of maximal vaginal squeeze as well as UDI-6, as assessed following treatment compared to their corresponding values before treatment, were significantly different in the other three groups (p= 0.001).

Table (2): Comparison between values of maximal vaginal squeeze and UDI-6 in the four studied groups:

Max. vaginal squeeze	**Group A (n= 30)**	**Group B (n= 30)**	**Group C (n= 30)**	**Group D (n= 30)**	**Overall p value #**
Pre-TTT	21.88 ± 7.48	26.81 ± 16.09	30.05 ± 15.66	24.97 ± 9.97	0.517
Post-TTT	21.87 ± 7.59	39.28 ± 20.59	32.14 ± 16.30	29.85 ± 11.13	----
MD	-0.01 ± 0.51	12.47 ± 5.74	2.09 ± 1.53	4.88 ± 2.41	0.001*
p value vs group A ##	----	0.001*	0.001*	0.001*	
p value vs group B ##	----	----	0.001*	0.001*	
p value vs group C ##	----	----	----	0.001*	
UDI- 6	**Group A (n= 30)**	**Group B (n= 30)**	**Group C (n= 30)**	**Group D (n= 30)**	**Overall p value #**
Pre-TTT	41.87 ± 5.41	41.77 ± 6.43	41.50 ± 4.58	43.87 ± 1.74	0.093
Post-TTT	41.57 ± 5.43	28.80 ± 3.31	38.23 ± 5.21	31.80 ± 3.16	----
MD	0.30 ± 0.99	12.97 ± 5.85	3.27 ± 3.54	12.07 ± 3.75	0.001*
p value vs group A ##	----	0.001*	0.001*	0.001*	
p value vs group B ##	----	----	0.001*	0.694	
p value vs group C ##	----	----	----	0.001*	

#= Kruskal Wallis ANOVA test; ##= Mann-Whitney test; p> 0.05= not significant; *p≤ 0.05= significant.

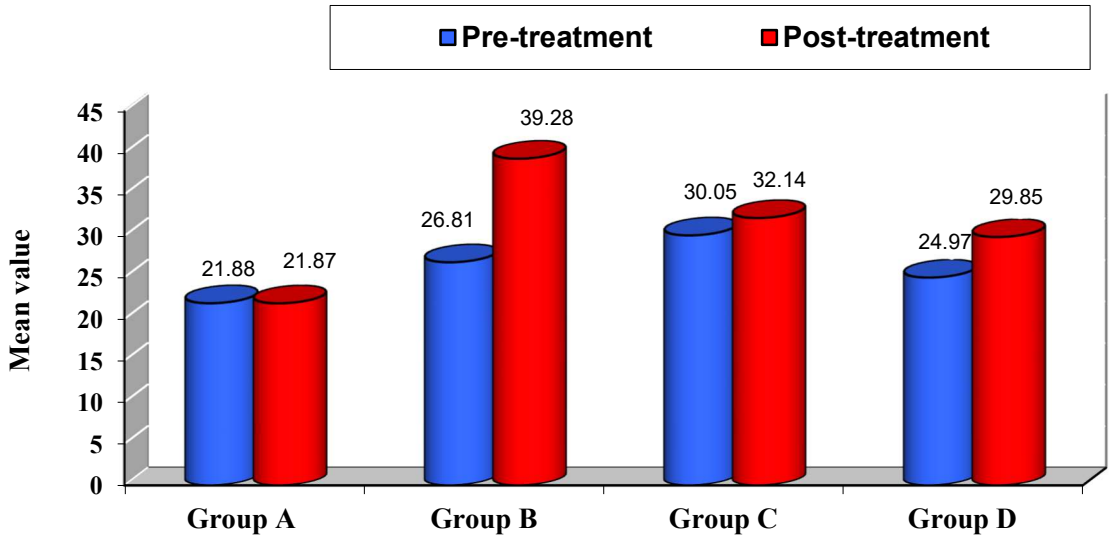

Fig. (2): mean values of max. Vaginal squeeze in the four groups

Table (3): Comparison between pre- and post-treatment values of maximal vaginal squeeze and UDI-6 in each group of different studied groups

Max. vaginal squeeze	**Group A (n= 30)**	**Group B (n= 30)**	**Group C (n= 30)**	**Group D (n= 30)**
Pre-treatment	21.88 ± 7.48	26.81 ± 16.09	30.05 ± 15.66	24.97 ± 9.97
Post-treatment	21.87 ± 7.59	39.28 ± 20.59	32.14 ± 16.30	29.85 ± 11.13
Mean difference	- 0.01	12.47	2.09	4.88
% change	0.05 ↓↓	46.51 ↑↑	6.96 ↑↑	19.54 ↑↑
p value vs pre-treatment $	0.875	0.001*	0.001*	0.001*
UDI-6	**Group A (n= 30)**	**Group B (n= 30)**	**Group C (n= 30)**	**Group D (n= 30)**
Pre-treatment	41.87 ± 5.41	41.77 ± 6.43	41.50 ± 4.58	43.87 ± 1.74
Post-treatment	41.57 ± 5.43	28.80 ± 3.31	38.23 ± 5.21	31.80 ± 3.16
Mean difference	0.30	12.97	3.27	12.07
% change	0.72 ↓↓	31.05 ↓↓	7.88 ↓↓	27.51 ↓↓
p value vs pre-treatment $	0.066	0.001*	0.001*	0.001*

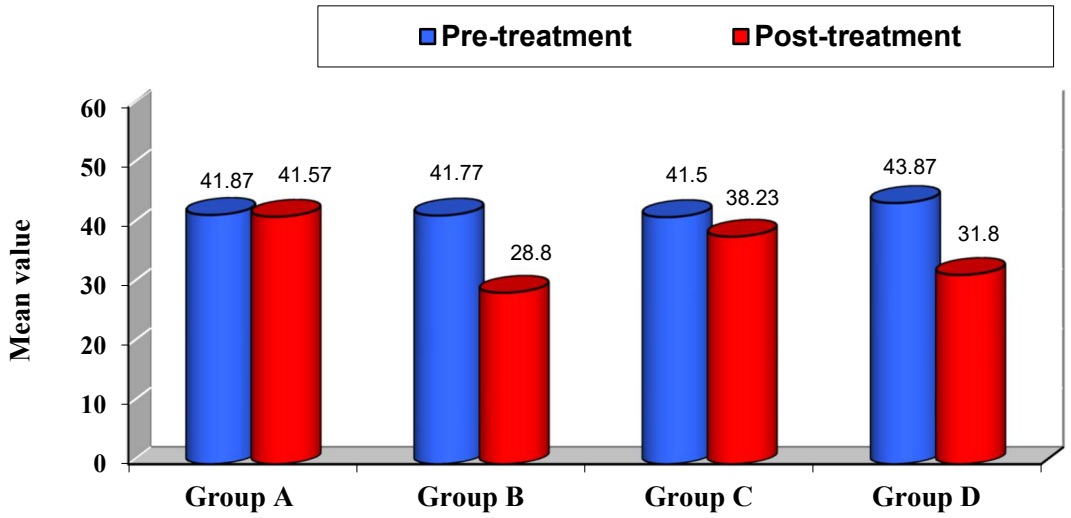

Fig. (3): Mean values of UDI-6 in the four studied groups measured pre- and post-treatment.

4. Discussion

This study was done to examine the impact of hip strengthening exercises and PFMT on SUI in postnatal women. The findings of this study showed that there was a statistically significant difference in the value of difference in maximal vaginal squeeze and UDI-6 within group (B); group (C) as well as

group (D). on the contrary, there was a statistically non-significant difference in maximal vaginal squeeze and UDI-6 within group (A). *By Comparison* between the four groups (A; B; C and D) before starting the study showed that there was a statistically no significant difference between them. *By regarding to maximal vaginal squeeze* post treatment, there was statistically significant improvement (p= 0.001) in maximal vaginal squeeze value in favor to group (B); group (D) and group (C) respectively when compared with group (A). **By regarding to UDI-6** values, there was statistically significant increase (p= 0.001) in the value of mean difference in UDI-6 value in favor to group (B); group (D) and group (C) respectively when compared with group (A), while no significant difference was observed in its value between groups (B) and (D).

*Regarding to the effect of hip strengthening exercises on SUI***,** This study's findings corroborated those of Tuttle et al. (2016), who discovered that strengthening the deep rotators of the hip, namely OI, around the PFM increases PFM strength in young, healthy women. During the training period, there was a significant 50% improvement in pelvic floor force generation as assessed by a Peritron perineometer, along with a 20% improvement in lateral rotator strength.

Also, this study's findings were in agreement with those of Tuttle et al. (2020), who looked at how well a hip exercise program could increase intravaginal squeeze pressure and found that exercises that hip lateral rotation exercise could work as a substitute for PFM by reducing pressure inside the vagina by about 35% on average.

Moreover, the results of this study were in agreement with those of a study that compared the seated PFMT program against a seated resisted hip external rotation strengthening protocol **(Jordre and Schweinle, 2014)**. Both groups experienced comparable reductions in SUI symptoms, however the hip training group reported a little faster reduction in leaks per week.

The results of this study contradict those of Kruger et al. (2019), who revealed that PFM pressures produced by concentrated conscious contraction of the PFM were 30% higher than those produced by activating the hip muscles. It is not obvious if the hip exercises were performed at maximal contractions because the intensity of the contractions wasn't specified. The researchers came to the conclusion that the pelvic floor needs to be activated in order for training to have an effect, and that strengthening just the hip muscles wouldn't be enough.

Regarding to the effect of PFM exercises on SUI, the findings of this study agreed with **El-Morsey et al., (2024)** who studied the impact of PFMT on QoL among women with SUI and concluded that the training program have been helpful in improving the knowledge of the women studied concerning SUI. Additionally, it was shown that the PFMT program improved the quality of life and reduced SUI. Also, this study agreed with **Bottini et al., (2024)** who studied impact of PFMT versus hypopressive abdominal gymnastics (HAG) on SUI and concluded that the benefits of PFMT on SUI through a rise in the PFM force, endurance, resistance, as well as power. From the previous literatures, the present study suggested possible explanation for the effect of hip exercises on PFM as follows: There is a possibility that the hip muscles and PFM could both contract simultaneously. There is a functional and structural correlation between the PFM, fossa ischioanalis, as well as gluteus maximus muscles, according to EMG and MRI **(Soljanik et al., 2012).** According to Bø and Stien (1994), the simultaneous contraction of PFM activity is made possible by the hip adductor and gluteus muscles. As deep hip lateral rotator as well as abductor muscles, the obturator internus may be involved with PFMs and act as a myofascial force transmitter. Connected to the hip and pelvis are the rotator cuff tendons, which include the gluteus medius along with maximus. Hip abductors, adductors, extensors, and external rotators all work along with PFM contraction, hence strengthening these muscles has been suggested as a way to enhance interventions

(Marques et al., 2020).

Regarding to the effect of PFM exercises combining with hip strengthening exercises on SUI, Consistent with a previous study by **Nipa et al. (2022)**, this one found that training the PFM and hip synergic muscles together improved daily urine loss frequency more than training the PFM alone. However, neither group demonstrated any significant improvement in strength, perineometer readings, or QoL compared to the control group that did only PFM exercises.

In addition, the results of this study came in agreement with the study of **Marques et al., (2020)** who studied the effect of pelvic floor and hip muscle strengthening in the treatment of SUI indicated that strengthening the PFM in conjunction with the hip synergic muscles produced superior outcomes for the frequency of daily urinary output throughout the sessions and proposed that including hip muscle exercises into PFM strengthening exercises would help enhance the function of the PFM. Additionally, the present study's findings ran counter to those of **Kamio et al. (2022)**, who examined the effects of hip adduction/abduction contraction on the pelvic floor in young, healthy women and came to the conclusion that maximally adducting and abducting the hip joint during PFM group training could limit the motion of the PFM muscles.

- **Strengths and limitations**

Over the course of the study, no adverse consequences were noted. There are limitations to our research that make pelvic floor and hip exercises a potentially beneficial treatment method for women with SUI. These limitations include things like patients' lack of compliance and psychiatric state as well as the lack of follow-up care. To determine the effect of hip strengthening activities on PFM in SUI over the long term, more research is needed. To expand upon these preliminary findings, future studies should include longer time periods and a wider range of participants.

- **Clinical implications**

Postnatal women with SUI can benefit greatly from physical therapists recommending this combination exercise program, according to the study's strong evidence. The promising results in maximal vaginal squeeze and UDI-6 show that this intervention has the ability to enhance health condition for this population by reducing the negative consequences of SUI.

Conclusion

From the obtained results, it could be concluded that one part of a strategy that can help improve SUI is strengthening the hip muscles as it improves PFM power and reduces leakage in those with SUI and may be considered a starting point for those women who find PFM contractions difficult to perform.

Acknowledgments

The research team acknowledges the crucial role played by all women who participated in this study. This work was completed without designated funding from governmental, commercial, or non-profit sources.

References

Amin, K.; Janssen, K. and Kobashi, K. 2018: AUA guidelines on stress urinary incontinence: what is new in the guidelines? Curr Bladder Dysfunct Rep.; 13(3):85-92.

Bø, K. and Stien, R. 1994: Needle EMG registration of striated urethral wall and pelvic floor muscle activity patterns during cough, Valsalva, abdominal, hip adductor, and gluteal muscle contractions in nulliparous healthy females.

Neurourology and Urodynamics; 13(1): 35-41.

Bottini, D.; Silva, D.; Filho, R.; Lúcio, A.; Saiki, F. and Pegorare, A. 2024: Effects of pelvic floor muscle training versus hypopressive abdominal gymnastics (HAG) on stress urinary incontinence in climacteric women: randomized clinical trial Fisioter Pesqui.; 31: e23000824en

Casey, E. and Temme, K. 2017: Pelvic floor muscle function and urinary incontinence in the female athlete. Physician Sportsmed.; 45: 399–407.

El-Morsey, AM.; Ramadan, SA.; El-Refay, WE.; Ibrahim, SS.; El-Aty, EM. 2024: Assessment of Stress Urinary Incontinence and Health Related Quality of Life among Women in Port Said CityPort Said Scientific Journal of Nursing, 11(1): 1-22.

Erbes, N.; Foster, S.; Harris-Hayes, M.; Spitznagle, T. 2021: Movement Impairments in Women with and without Urinary Urgency/Frequency. J Womens Health Phys Therap.;45(4):164-173.

Gacci, M.; Sakalis, V.; Karavitakis, M.; Cornu, J.; Gratzke, C.; Herrmann, T.; Kyriazis, I.; Malde, S.; Mamoulakis, C.; Rieken, M.; Schouten, N.; Smith, E.; Speakman, M.; Tikkinen, K. and Gravas, S. 2022: European Association of Urology Guidelines on Male Urinary Incontinence. Eur Urol.; 82(4): 387-398.

Hartigan, E.; McAuley, J.; Lawrence, M.; Keafer, C.; Ball, A.; Michaud, A. and DeSilva, M. 2019: Pelvic Floor Muscle Performance, Hip Mobility, and Hip Strength in Women with and Without Self-Reported Stress Urinary Incontinence. J Women's Heal Phys Ther., 43(4): 160-170.

Jordre B and Schweinle W. 2014: Comparing resisted hip rotation with pelvic fl oor muscle training in women with stress urinary incontinence: a pilot study. J Womens Health Phys Ther.; 38(2):81–89.

Kamio, H.; Maruyama, H.; Ito, N.; Kunieda, M.; Chiba, A. and Furukawa, Y. 2022: Effect of hip adduction/abduction contraction on pelvic floor in young healthy women J Phys Fitness Sports Med, 11 (1): 29-34.

Kruger J, Budgett D, Goodman J and Bø K. 2019**:** Can you train the pelvic floor muscles by contracting other related muscles? Neurourol Urodyn.; 38(2):677-683.

Marques, S.; Silveira, S.; Pássaro, A.; Haddad, J.; Baracat, E. and Ferreira, E. 2020: Effect of Pelvic Floor and Hip Muscle Strengthening in the Treatment of Stress Urinary Incontinence: A Randomized Clinical Trial. J Manipulative Physiol Ther.; 43(3): 247-256.

Milsom, I. and Gyhagen, M. 2019: The prevalence of urinary incontinence. Climacteric.; 22(3): 217-222.

Moroni, R.; Magnani, P.; Haddad, J.; Castro, A. and Brito, L. 2016: Conservative treatment of stress urinary incontinence: a systematic review with meta-analysis of randomized controlled trials. Rev Bras Ginecol Obstet.; 38(2): 97-111.

Nipa SI, Sriboonreung T, Paungmali A and Phongnarisorn C. 2022**:** The Effects of Pelvic Floor Muscle Exercise Combined with Core Stability Exercise on Women with Stress Urinary Incontinence following the Treatment of Nonspecific Chronic Low Back Pain. Adv Urol. Sep 5; 2022:2051374.

Rortveit, **G and Daltveit, A.** 2003: Urinary incontinence after vaginal delivery or cesarean section. N Engl J Med.; 348:900–7Hokinson EC. Measurement of pain. The Lancet.; 2(7889):1127-1131.

Soliman, S.; Hassan, H.; El Azab, A. and Zarzour, A. 2020: Urinary Incontinence among Women Attending Primary Health Center at El-Kharaga City, New Valley, Egypt Egyptian Family Medicine Journal (EFMJ), 4(2): 112-124

Soljanik I, Janssen U, May F, Fritsch H, Stief CG, Weissenbacher ER, Friese K, Lienemann A. 2012: Functional interactions between the fossa ischioanalis, levator ani and gluteus maximus muscles of the female pelvic floor: a prospective study in nulliparous women. Arch Gynecol Obstet.; 286(4):931-938

Tuttle L, DeLozier E, Harter K, Johnson S, Plotts C and Swartz J. 2016: The role of obturator internus muscle in pelvic floor function. J Womens Health Phys Ther.; 40 (1): 15 – 19.

Tuttle LJ, Autry T, Kemp C, Lassaga-Bishop M, Mettenleiter M, Shetter H and Zukowski J. 2020: Hip exercises improve intravaginal squeeze pressure in older women. Physiother Theory Pract.; 36(12):1340-1347

Tuttle, L.; Nguyen, O.; Cook, M.; Alperin, M.; Shah, S.; Ward, S. and Lieber, R. 2014: Architectural design of the pelvic floor is consistent with muscle functional subspecialization, International Urogynecology Journal 25: 205–212.

Wente, K. and Spitznagle, T. 2017: Movement-Related Urinary Urgency. J Women's Heal Phys Ther.; 41(2): 83–90.