Effects of Hip Strengthening Exercises on Pelvic Floor Muscle Strength – A Randomized Controlled Trial

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KEYWORDS
Pelvic floor muscle, exercises, hip muscle strength, abdominal exercises, Ortiz scale, Oxford scale.

ABSTRACT
Background: The pelvic floor muscle provides stability and mobility to the contents of the pelvis. When, the pelvic floor is not effective in providing their function, it leads to pelvic floor dysfunction. A study performed in 2020 quoted the prevalence rate of pelvic floor dysfunction to be 34% in rural India. The pelvic floor muscle thus plays an essential function in maintaining a good quality of life among women.
Aim: The aim of this study is to assess the effect of hip muscle strengthening exercises in improving pelvic floor muscle strength.
Methodology: The study was conducted at Sri Ramachandra Hospital, Chennai. Subjects were included in the study after satisfying the inclusion and exclusion criteria. An informed consent was obtained from the participants who are willing to participate in the study. Subjects were randomly allotted into two groups. Pretest measures of OTRIZ SCALE and OXFORD MMT for pelvic floor was obtained Control group received abdominal strengthening exercise and pelvic floor muscle training and intervention group received hip muscle strengthening exercises, Abdominal strengthening exercise and pelvic floor muscle training. The post-test measurements were taken at the end of 12 weeks of intervention.
Result and Discussion: Within group analysis shows a significant improvement in Otriz and Oxford scale after intervention in both groups ($p<0.05$).Between group analysis shows shows no statistically significant difference in Otriz and Oxford scale between control and intervention groups ($P>0.05$)
Conclusion: Twelve weeks of hip strengthening exercise has no significant effect on OTRIZ scale and OXFORD scale among women.

1. Introduction

The pelvic floor muscles provide stability to the contents of the pelvis such as the uterus, bladder and rectum. The main functions of pelvic floor muscles are support, sphincter and sexual.[1]

A study from 2019 performed among the south Indian women and documented the prevalence of pelvic floor dysfunctions as 54.7%, and similar studies performed across the entire country recorded a prevalence of pelvic floor dysfunctions to be 38% - 50.8% among the rural women.[2]

The functional and structural alterations related to uro-gynecological dysfunctions support the widespread recommendation that pelvic floor muscle (PFM) training should be the first-line conservative management for women with a variety of Pelvic floor dysfunctions.

Pelvic floor muscle exercises have been shown to strengthen the PFM, improve quality of life and reduce symptoms such as incontinence, prolapse and even post gynecological surgeries such as hysterectomy.[3]

Pelvic floor muscles suffer a major trauma during child birth. The lengthening of pelvic floor muscles during pregnancy and its disruption during a normal vaginal delivery cannot be returned to its original health, like just before pregnancy. Multipara women will have a weak pelvic floor muscles than primi para, also assisted delivery like forceps because of more injury to pelvic floor muscles.[2]

But pelvic floor muscles are exercised only when the subjects complain incontinence or a prolapse. This may be due to the reduced awareness of pelvic floor muscle importance for healthy lifestyle.[3] Kegels exercises, the most common pelvic floor muscle exercises imparted to subjects who complain problems associated with PFM. But many research reports less compliance to these exercises.

A study reported that of 250 eligible females: 24% of them were unable to correctly perform the pelvic muscle exercises initially. Of the participants who reported current practice of pelvic muscle exercises, 23% of them performed the exercise incorrectly.[(4)]

Identifying commonly performed exercises that can also effectively activate the pelvic muscles, even if the patient is not aware of pelvic floor muscles, would be an important contribution.Various studies have found that the surrounding musculature supports the effective functioning of the pelvic floor, particularly the obturator internus (OI) muscle that functions as a hip external rotator.[(7)]

This need triggered the interest to find the effect of hip muscle training over the Pelvic floor muscle strength in middle aged women which was least studied.

2. Materials and Methods

The study participants were women aged between 25 – 59 years of age with pelvic floor muscle weakness in Gynaecology outpatient at Sri Ramanchandra Hospital, Chennai, India. The sample size was calculated using G-power as 80 with a confidence interval of 95%, alpha error of 0.05 and beta error of 0.80

Inclusion Criteria:

Primiparous and Multiparous women between the age of 25 – 59 years of age, attending outpatient Gynaecology department at Sri Ramachandra Hospital, Chennai, India with a OTRIZ score above 1 and OXFORD score <3 and >5, who consented to participate in the study.

Exclusion Criteria:

Nulliparous Women, women with past or current history of traumatic injury to pelvis and lower limb, history of surgeries of the pelvic floor, hysterectomy, osteoarthritis of the lower limb, mental illness and chronic disease including severe cardiovascular problems, neurological issues, severe musculoskeletal problems, severe hypertension and diabetes mellitus, history of carcinoma ovary, cervix, endometrium.

3. Procedure

In the first phase of this study-women aged 30 - 59 years, were recruited via offline session conducted across Sri Ramachandra Hospital, Obstetrics and Gynecological outpatient department. A total of 115 female were screened at the first level. Out of 155 patients screened, 80 patients were included on the basis of inclusion and exclusion criteria, they were explained about the study in detail and 33 of 155 patients refused consent for the study. Randomization was done with sealed envelope method for control and interventional group allocation after obtaining the consent form each participant to take part in the study.

A assessment sheet with 3 sections was created and filled by the assessor.Section 1 consist of demographic data in the form of name, age, educational qualification, any hormonal or metabolic condition (thyroid diseases, anemia, childhood diabetic), menstrual history –age of menarche, regularity, length and frequency of cycle, specific complaints if any (clots, intense pain, vomiting), history of childbirth, number of children, history of past hip and/or pelvic floor surgeries, history of incontinence.

Section 2 consisted of menstrual history –age of menarche, regularity, length and frequency of cycle, specific complaints if any (clots, intense pain, vomiting), history of childbirth, number of children, history of past hip and/or pelvic floor surgeries, history of incontinence.

Section 3 consisted of the quantitative values of hip muscle strength on the basis of Manual muscle testing and pelvic floor muscle strength on the basis of OTRIZ and OXFORD scale.

Control Group: Group A is Control group received abdominal activation exercises along with pelvic floor muscle training.

Modes	Exercises	Time (secs/min)	Reps, Sets and Rest period
Kegels	Starting in a supine position, then progressing to a sitting position and standing position	30 minutes	First 4 weeks Supine: 10 contractions of 5 secs, 15 contractions of 3 secs, 20 contraction of 1 sec., 5 contractions while coughing. Next 4 weeks: Supine Position: 10 contractions of 5 secs, 15 contractions of 3 secs, Sitting: 20 contractions of 2 seconds, 20 contraction of 1 sec., 5 contractions while coughing. Following 4 weeks: Sitting: 10 contractions of 5 secs, 15 contractions of 3 secs, Standing: 20 contractions of 2 seconds, 20 contraction of 1 sec., 5 contractions while coughing. Last 4 Weeks: Standing Position: 10 contractions of 5 secs, 15 contractions of 3 secs, 20 contractions of 2 seconds, 20 contraction of 1 sec., 5 contractions while coughing.
Abdominals	Teach correct activation of the abdominal muscles retraction of the abdomen performed during the expiration while the pelvic and torso area remained stable. Activation exercises of the transversus abdominis muscle performed in different positions: with the subject lying on the back with bent and straight legs; lying on the abdomen; on the knees with the hands placed on the ground; standing with the body and shins insignificantly bent and with the arms resting on the thighs; walking; and climbing the stairs.	30 minutes	2 times per day

EXPERIMENTAL GROUP: Group B is Experimental group: received abdominal activation exercises and pelvic floor muscle training along with hip strengthening exercises.

Modes	Exercises	Time (secs/min)	Reps, Sets and Rest period
Kegels	Starting in a supine position, then progressing to a sitting position and standing position	30 minutes	First 4 weeks Supine: 10 contractions of 5 secs, 15 contractions of 3 secs, 20 contraction of 1 sec., 5 contractions while coughing. Next 4 weeks: Supine Position: 10 contractions of 5 secs, 15 contractions of 3 secs, Sitting: 20 contractions of 2 seconds, 20 contraction of 1 sec., 5 contractions while coughing. Following 4 weeks: Sitting: 10 contractions of 5 secs, 15 contractions of 3 secs, Standing: 20 contractions of 2 seconds, 20 contraction of 1 sec., 5 contractions while coughing. Last 4 Weeks: Standing Position: 10 contractions of 5 secs, 15 contractions of 3 secs, 20 contractions of 2 seconds, 20 contraction of 1 sec., 5 contractions while coughing.
Abdominals	Teach correct activation of the abdominal muscles retraction of the abdomen performed during the expiration while the pelvic and torso area remained stable. Activation exercises of the transversus abdominis muscle performed in different positions: with the subject lying on the back with bent and straight legs; lying on the abdomen; on the knees with the hands placed on the ground; standing with the body and shins insignificantly bent and with the arms resting on the thighs; walking; and climbing the stairs.	30 minutes	2 times per day
Hip*	Clamshells, Isometric hi external rotation, Monster Walks (with resistance bands)	5 minutes	10 Repitions 3 sets

*Source: Marques, S. A. A., Silveira, S. R. B. D., Pássaro, A. C., Haddad, J. M., Baracat, E. C., & Ferreira, E. A. G. (2020). Effect of Pelvic Floor and Hip Muscle Strengthening in the Treatment of Stress Urinary Incontinence: A Randomized Clinical Trial. Journal of manipulative and physiological therapeutics, 43(3), 247-256. https://doi.org/10.1016/j.jmpt.2019.01.007

4. Results and Discussion

Results:

Statistical analysis was performed by SPSS software version 28.0. Descriptive statistics were calculated for baseline characteristics. Shapiro wilk test was done for the test of normality. . The post test comparison between both the groups was calculated with Mann Whitney U test and significance level is taken at 5% for OTRIZ and OXFORD.

In our study, 80 subjects with weak pelvic floor muscles were randomly allocated into two groups. 40 subjects to Intervention Group received hip strengthening exercises along with abdominal activation exercises and pelvic floor muscle training and 40 subjects to Control Group received abdominal activation exercises and pelvic floor muscle training.

Table 1 describes baseline characteristic of control and intervention group. The mean Body Mass Index in control group is 45.40 (7.510) Mean age of the participants belonging to control group is 26.223 (2.730). Mean of Intervention group Body Mass Index is 27.030 (3.366) and age is 45.60 (7.078).

Graph 1 shows that the Ortiz scale mean rank is improved from 1.54 to 3.16 and Oxford scale mean rank is improved from 2.23 to 3.08 which shows a statistically significant improvement($p<0.05$) in control group.

Graph 2 shows that the Ortiz scale mean rank is improved from 1.16 to 2.86 and Oxford scale mean rank is improved from 2.35 to 3.63 which shows a statistically significant improvement ($p<0.05$) in interventional group.

Table 2& Graph 3&4 shows that there is no significant difference in oxford score and Ortiz score ($p>0.05$) between the groups and intervention group shows more improvement in pelvic floor strength than control group.

Discussion:

Women especially in India are not aware of PFM health and if so, they do exercises only when some PFM dysfunction is present with least compliance. PFM strength is also very important in contributing core stability support to visceral organs and enhancing spine action.

The results of the study show that there is a significant increase in PFM strength post pelvic floor muscle training along with abdominal and hip exercises for a period of 12 weeks.Pelvic floor muscles are thin, with small physiological cross sectional area. So their force production can oppose the tension created in standing or sitting, but when it comes to demanding task like coughing or jumping it calls for an additional support which comes mainly from obturator internus muscle. Thus pelvic floor muscles are augmented by obturator internus through its connections with Arcus Tendinous Levator Ani (ATLA)[7]

FosterS.N.et.al. concluded that women with weak lower urinary tract frequency and urgency symptoms had weaker hip external rotator and abductor muscles this can be better explained by anatomical correlation, the Obturator internus muscle. (Hip external rotator) is attached to the pelvic floor muscle.[6]

The co-contraction could have improved the pelvic floor muscle strength effectively and this result goes in hand with Tuttle et.al. who, concluded that following hip external rotator programme PFM strength increases up to 50%.[8]

Simon A. et,al. concluded that the Hip abductor and extensor strengthening exercises helps to reduce the symptoms of SUI via synergistic muscle action.[1]

The results of this study show a significant improvement in PFM strength after twelve week of training of abdominal and PFM muscles. These outcomes can be better explained by the anatomical

relationship of abdomen and pelvic floor, where the rectus abdominis and its fascial system merge at the level of pubic symphysis with the adductor muscles, both activated by the contraction of the pelvicfloor[2].

The results of this study are further supported by B.Kucukkaya et.al. who observed that there was a significant increase in PFM strength by end of 4th week in the group that received AT along with PFMT[4]Previous studies established that strengthening abdominal increases PFM strength, Nevin T., et.al was successful in proving that abdominal strengthening exercises improves pelvic floor strength as it moves cranio-caudally on contraction.[11]

The current study showed no significant difference in the between group analysis in ortiz score and oxford score.These results can be further supported by Amorium who concluded that isometric hip abduction or adduction combined with PFM did not significantly increase intra vaginal pressure.[12]Also Wang and colleagues (2021) reported that conscious activation of PFM produced a greatest lift in bladder base in ultrasound thus he supported that hip muscle activation does not improve PFM function in any way if included in protocol.[16]

On contradictory, Tuttle et al concluded that PFM pressure increased by almost 50 percent after training with hip external rotator strengthening.[8]

The clinical improvement indicates that hip muscle does influence pelvic floor muscle strength, but in this study increase in hip muscle strength was not measured, may be a better improvement in hip muscle strength could have yielded a better PFM strength measurement.

Hip muscle assessment and strengthening may do contribute to PFM training because co contraction happens in PFM even though patient does not consciously contract PFM. These exercises can be better used to augment PFM training especially when patient has less PFM strength to do a voluntary contraction of PFM Muscle.

Figures:

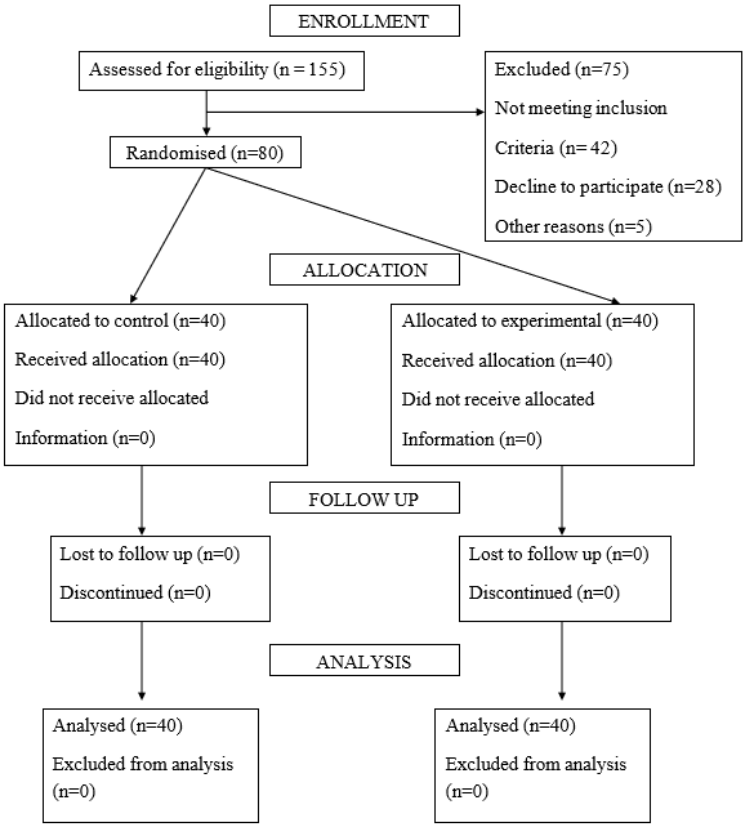
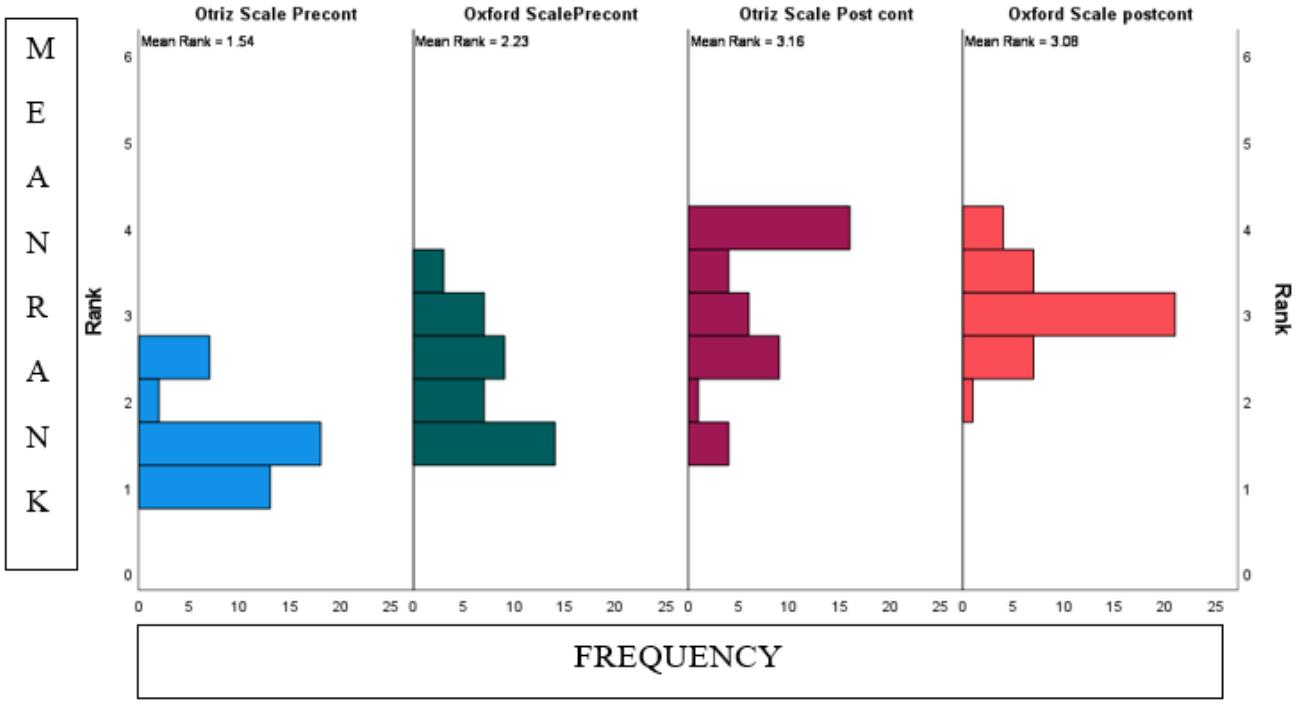
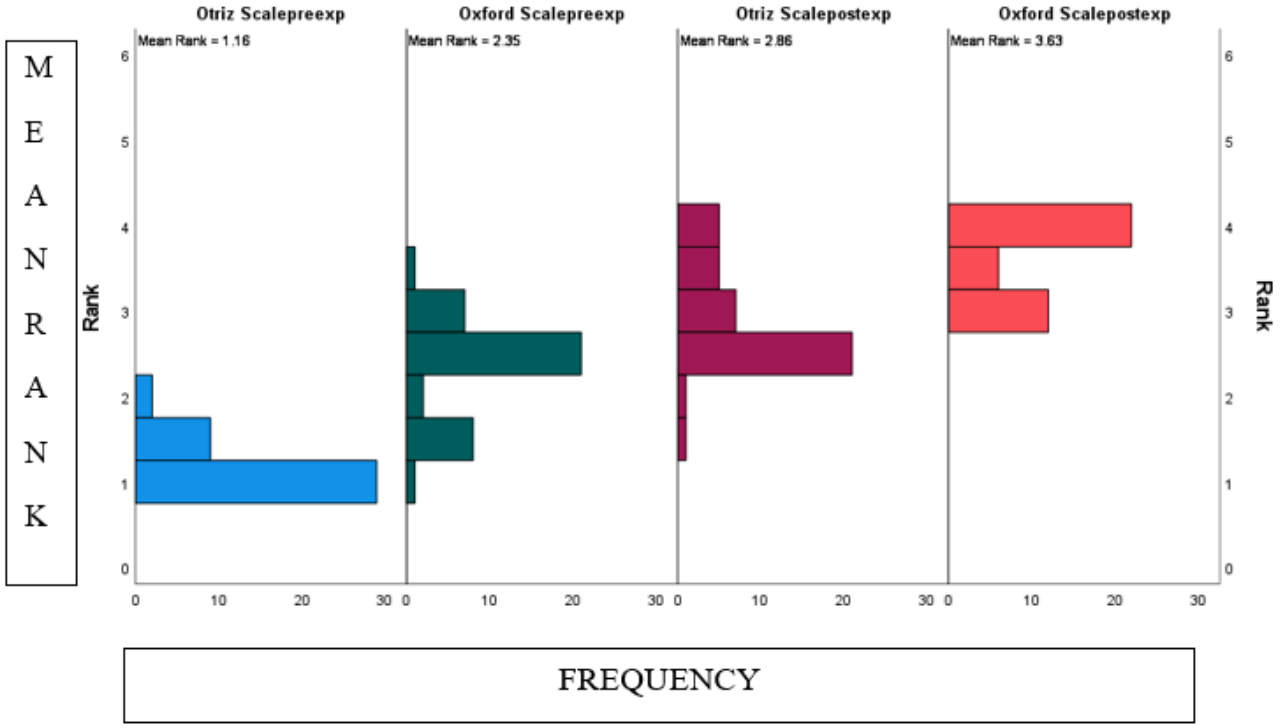


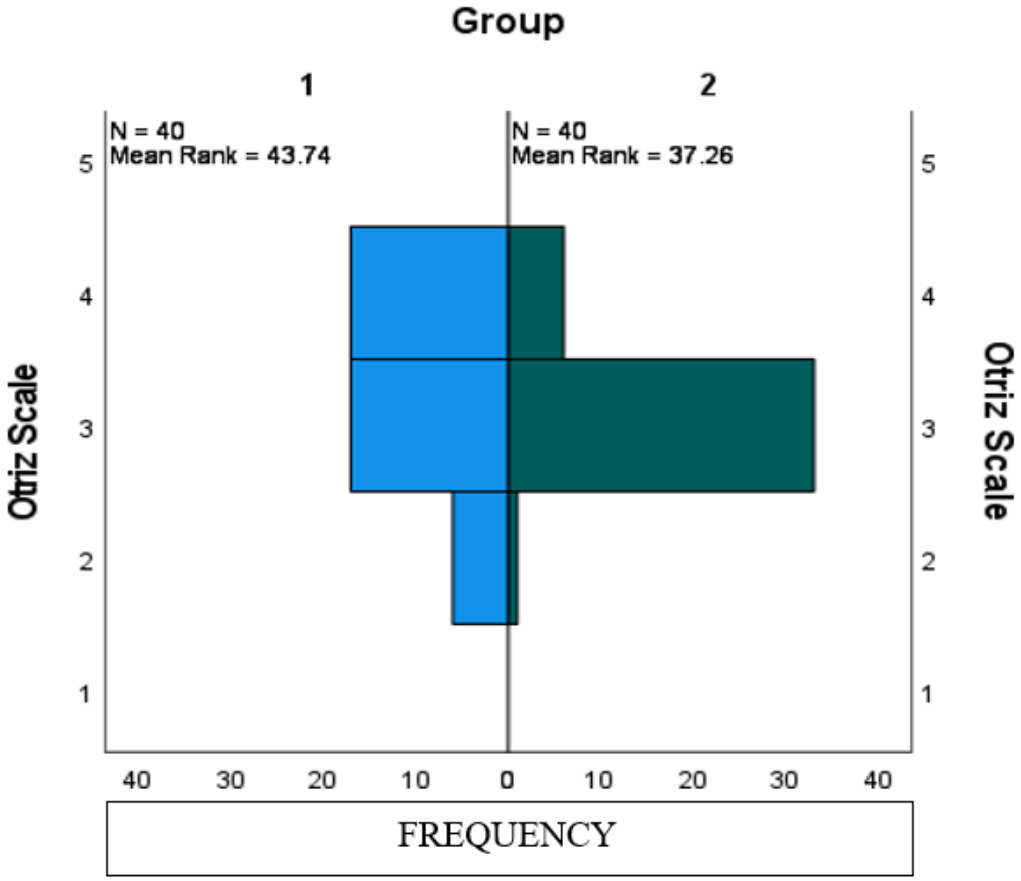
Figure 1: Consort Chart



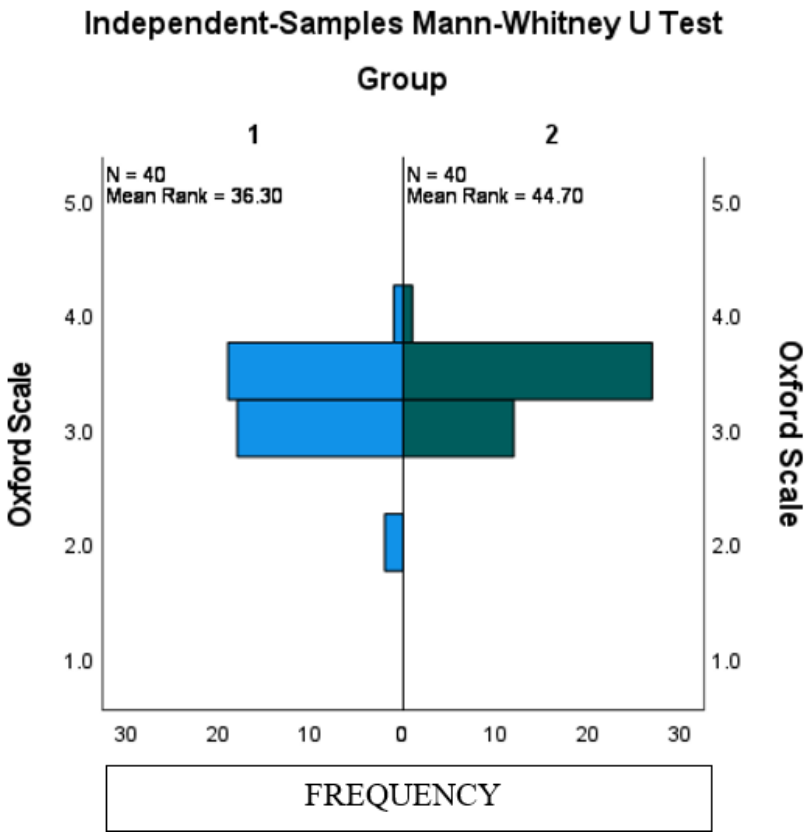
Graph 1: Pre and Post test measures of OTRIZ SCALE and OXFORD SCALE in control group



Graph 2: Pre and Post test measures of OTRIZ SCALE and OXFORD SCALE in interventional group



Graph 3: Between group analysis for post test for OTRIZ SCALE



Graph 4: Between groups Analysis of Post test of Oxford Scale

Tables:

Table 1. Baseline Characteristic of Body Mass Index (BMI), Education status, occupation and knowledge of PFM

Variable n = 40		n	Control Group		Experimental group	
			Mean	Standard deviation	Mean	Standard deviation
Age		40	45.40	7.510	45.60	7.078
BMI		40	26.223	2.730	27.030	3.366
N = 80		40	Frequency			
Education	Uneducated	40	18 (45%)		17 (42.5%)	
	High School	40	16 (40%)		18 (45%)	
	Graduate	40	6 (15%)		5 (12.5%)	
Occupation	Employment	40	17 (42.5%)		16 (40%)	
	Un Employment	40	23 (57.5%)		24 (60%)	
Knowledge of PFM	Yes	40	3 (7.5%)		4 (10%)	
	No	40	37 (92.5%)		36 (90%)	

Table 2: Comparison of post test measures OTRIZ AND OXFORD SCALE between control and intervention groups

Variable		Between group		Z value	P value
		Median	SE		
Ortiz	Pre-test	2.7	81.474	580	.007
	Post-test	1.4	88.886	670	.145
Oxford	Pre-test	27	70.437	780	.782
	Post-test	1.8	90.434	632	.063

$P<0.05$

5. Conclusion

Hip muscle strengthening exercise programme may not have a significant effect on the pelvic floor strength. There exists a clinical improvement of Pelvic floor muscle strength with hip strengthening, which really will benefit the patients.

References:

[1] Marques, S. A. A., Silveira, S. R. B. D., Pássaro, A. C., Haddad, J. M., Baracat, E. C., & Ferreira, E. A. G. (2020). Effect of Pelvic Floor and Hip Muscle Strengthening in the Treatment of Stress Urinary Incontinence: A Randomized Clinical Trial. Journal of manipulative and physiological therapeutics, 43(3), 247-256. https://doi.org/10.1016/j.jmpt.2019.01.007

[2] Toprak, N., Sen, S., & Varhan, B. (2022). The role of diaphragmatic breathing exercise on urinary incontinence treatment: A pilot study. Journal of bodywork and movement therapies, 29, 146-153. https://doi.org/10.1016/j.jbmt.2021.10.002

[3] Soriano, L., González-Millán, C., Álvarez Sáez, M. M., Curbelo, R., & Carmona, L. (2020). Effect of an abdominal hypopressive technique programme on pelvic floor muscle tone and urinary incontinence in women: a randomised crossover trial. Physiotherapy, 108, 37-44. https://doi.org/10.1016/j.physio.2020.02.004

[4] Kucukkaya, B., & Kahyaoglu Sut, H. (2021). Effectiveness of pelvic floor muscle and abdominal training in women with stress urinary incontinence. Psychology, health & medicine, 26(6), 779-786. https://doi.org/10.1080/13548506.2020.1842470

[5] Ptak, M., Ciećwież, S., Brodowska, A., Starczewski, A., Nawrocka-Rutkowska, J., Diaz- Mohedo, E., & Rotter, I. (2019). The Effect of Pelvic Floor Muscles Exercise on Quality of Life in Women with Stress Urinary Incontinence and Its Relationship with Vaginal Deliveries: A Randomized Trial. BioMed research international, 2019, 5321864. https://doi.org/10.1155/2019/5321864

[6] de Souza Abreu, N., de Castro Villas Boas, B., Netto, J. M. B., & Figueiredo, A. A. (2017). Dynamic lumbopelvic stabilization for treatment of stress urinary incontinence in women: Controlled and randomized clinical trial. Neurourology and urodynamics, 36(8), 2160-2168. https://doi.org/10.1002/nau.23261

[7] Raizada, V., & Mittal, R. K. (2008). Pelvic floor anatomy and applied physiology. *Gastroenterology clinics of North America*, *37*(3), 493–vii. https://doi.org/10.1016/j.gtc.2008.06.003

[8] Grimes, W. R., & Stratton, M. (2023). Pelvic Floor Dysfunction. In *StatPearls*. StatPearls Publishing.

[9] Vijayalakshmi R1, Kanchana S2. (2019). Prevalence of Pelvic Floor Dysfunction among Women in South India. *International Journal of Nursing Education*, *11*(4), 171– 175. https://doi.org/10.37506/ijone.v11i4.4034.

[10] Amorim, A. C., Cacciari, L. P., Passaro, A. C., Silveira, S. R. B., Amorim, C. F., Loss, J. F., & Sacco, I. C. N. (2017). Effect of combined actions of hip adduction/abduction on the force generation and maintenance of pelvic floor muscles in healthy women. *PloS one*, *12*(5), e0177575. https://doi.org/10.1371/journal.pone.0177575

[11] Lammers, K., Prokop, M., Vierhout, M. E., Kluivers, K. B., & Fütterer, J. J. (2013). A pictorial overview of pubovisceral muscle avulsions on pelvic floor magnetic resonance imaging. *Insights into imaging*, *4*(4), 431–441. https://doi.org/10.1007/s13244- 013-0261-9

[12] Dumoulin, C., Cacciari, L. P., & Hay-Smith, E. J. C. (2018). Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women. *The Cochrane database of systematic reviews*, *10*(10), CD005654. https://doi.org/10.1002/14651858.CD005654.pub4

[13] Kandadai, P., O'Dell, K., & Saini, J. (2015). Correct performance of pelvic muscle exercises in women reporting prior knowledge. *Female pelvic medicine & reconstructive surgery*, *21*(3), 135–140. https://doi.org/10.1097/SPV.0000000000000145

[14] Marques, S. A. A., Silveira, S. R. B. D., Pássaro, A. C., Haddad, J. M., Baracat, E. C., & Ferreira, E. A. G. (2020). Effect of Pelvic Floor and Hip Muscle Strengthening in the Treatment of Stress Urinary Incontinence: A Randomized Clinical Trial. *Journal of manipulative and physiological therapeutics*, *43*(3), 247–256. https://doi.org/10.1016/j.jmpt.2019.01.007

[15] Lori J. Tuttle, Taylor Autry, Caitlin Kemp, Monique Lassaga-Bishop, Michaela Mettenleiter, Haley Shetter & Janelle Zukowski (2019): Hip exercises improve intravaginal squeeze pressure in older women, Physiotherapy Theory and Practice, DOI:10.1080/09593985.2019.1571142

[16] Zachovajeviene, B., Siupsinskas, L., Zachovajevas, P., Venclovas, Z., & Milonas, D. (2019). Effect of diaphragm and abdominal muscle training on pelvic floor strength and endurance: results of a prospective randomized trial. *Scientific reports*, *9*(1), 19192. https://doi.org/10.1038/s41598-019-55724-4