WOMEN'S SEXUAL HEALTH

Relationship Between Sexual Function and Pelvic Floor and Hip Muscle Strength in Women With Stress Urinary Incontinence

U.J. Hwang, PhD, PT,[1] M.S. Lee, PhD, MD,[2] S.H. Jung, PhD, PT,[1] S.H. Ahn, MS, PT,[1] and O.Y. Kwon, PhD, PT[3]

ABSTRACT

Introduction: The pelvic floor muscle (PFM) could affect female sexual functions. The hip muscles are morphologically and functionally linked to PFM and are important elements of female sexual attraction.

Aim: To determine the relationship between female sexual function and hip muscle strength and PFM functions in women with stress urinary incontinence (SUI).

Methods: A total of 42 women with SUI were recruited in this study. Female sexual function was measured using the pelvic organ prolapse urinary incontinence sexual function questionnaire (PISQ). PFM functions were measured using a perineometer. Hip muscle strength was measured using a Smart KEMA tension sensor. The relationship between female sexual function and PFM function and hip muscle strength was assessed using Pearson correlation coefficients and multiple regression analyses with forward selection.

Main Outcome Measures: PISQ score, PFM functions (strength and endurance), and strength of hip extensor, abductor, and adductor were the main outcome measures.

Results: For the behavioral/emotive domain in the PISQ, hip extensor strength (r = 0.452), PFM strength (r = 0.441), PFM endurance (r = 0.362), and hip adductor strength (r = 0.324) were significantly correlated and hip extensor strength emerged in multiple regression. For the physical domain in the PISQ, hip abductor strength (r = 0.417), PFM endurance (r = 0.356), hip adductor strength (r = 0.332), and PFM strength (r = 0.322) were significantly correlated and hip abductor strength entered in multiple regression. For partner-related domain in the PISQ, hip adductor (r = 0.386) and abductor strength (r = 0.314) were significantly correlated and hip adductor strength appeared in multiple regression. For the PISQ total score, hip extensor strength (r = 0.484), PFM endurance (r = 0.470), hip adductor strength (r = 0.424), hip abductor strength (r = 0.393), and PFM strength (r = 0.387) were significantly correlated and hip extensor strength and PFM endurance emerged in multiple regression.

Conclusion: The female sexual function could be related to not only PFM functions but also hip muscle strength in women with SUI. **Hwang UJ, Lee MS, Jung SH, Ahn SH, Kwon OY. Relationship Between Sexual Function and Pelvic Floor and Hip Muscle Strength in Women With Stress Urinary Incontinence. Sex Med 2021;9:100325**.

Key Words: Buttocks; Pelvic floor muscles; Sexual dysfunction; Strength; Stress urinary incontinence

INTRODUCTION

As defined by the International Continence Society, stress urinary incontinence (SUI) is an involuntary loss of urine on an increasing intra-abdominal pressure, such as coughing, sneezing, or physical exertion [1,2]. Pelvic floor muscles (PFMs) support the bladder or urethra and control bladder neck hypermobility; weak or damaged PFM and connective tissues could cause SUI. Previous studies suggested that SUI could negatively affect female sexual function [3–5]. In addition, female sexual dysfunction is frequently prevalent among women with PFM dysfunction, such as SUI. Female sexual dysfunction could contribute to embarrassment due

Received November 9, 2020. Accepted January 12, 2021.

[1]Department of Physical Therapy, Graduate School, Yonsei University, Wonju, South Korea;

[2]Sophie-Marceau Women's Clinic, Daegu, South Korea;

[3]Department of Physical Therapy, College of Health Science, Laboratory of Kinetic Ergocise Based on Movement Analysis, Yonsei University, Wonju, South Korea

https://doi.org/10.1016/j.esxm.2021.100325

to displeased odor, psychological distress, and fear of incontinence during vaginal intercourse [6,7].

PFM functions are related to sexual function, such as the degree of sensation experienced by women during vaginal intercourse and the contraction experienced by her partner [8]. The PFMs, especially the iliococcygeus and pubococcygeus, generate involuntary rhythmic contractions during an orgasm. PFM training suggested a positive effect on female sexual function in women with PFM dysfunction [9,10].

Female sexual functions could be affected by musculoskeletal conditions, other muscles, and PFM, although existing research on how particular musculoskeletal conditions limiting mobility and strength affect sexual activity is still limited [11,12]. In particular, hip muscles may be associated with sexual functions. The gluteus maximus muscle and PFM are morphologically and functionally connected,[13] and the hip adductor and gluteus muscle contractions facilitate the synergic contraction of the PFM and striated urethral wall muscle [14]. The hip external rotator muscle connects a fascial attachment with the PFM, giving it the potential to be an integral player in PFM function [15]. In addition, the gluteus muscles are an important element of female sexual attraction and a major component of the concept of beauty in most cultures and ethnic groups [16]. The demand for a better definition of the body and the buttock area has been increasing, [17] and women focus more on the hip muscles and lower body than men with respect to exercise behaviors and motivations [18]. The musculoskeletal conditions involved in the hip muscles are associated with specific challenges to sex, such as decreased ability to provide sexual stimulation to one's partner or to comfortably position oneself during sexual intercourse [11].

Despite the reasonable suspicion that it is related to the hip muscles and female sexual function, previous studies have suggested an association between female sexual function and only PFM [14,19–23]. Proper function is assessed via strength, endurance, and coordination testing of not only the PFM but also hip muscles in physical therapy and rehabilitation for sexual health [12]. However, to our knowledge, no studies have investigated the relationship between hip muscle strength and female sexual function in women with SUI.

Thus, the present study aimed to determine the relationship between sexual function measured by the pelvic organ prolapse urinary incontinence sexual function questionnaire (PISQ) and hip muscle strength (hip extensor, abductor, and adductor strength) and PFM functions (strength and endurance) in women with SUI. We hypothesized that hip muscle strength as well as PFM function would show a significant correlation with female sexual function.

METHODS

Participants

This study was conducted in a laboratory setting from August to December 2018. The sample size was calculated using the G*power (version 3.1.3; University of Trier, Trier, Germany) of a priori power analysis for a power of 0.80, an α level of 0.05, and an effect size |r| of 0.44, using pilot data (33 participants) about the coefficient between the PISQ score and hip extensor strength. At least 35 participants were needed to detect significant correlations between sexual function and hip extensor strength. Participants were recruited through advertisements that provided a telephone and e-mail contact; all participants were requested to visit the urogynecology clinic in Seoul, Korea for the diagnosis of SUI and were assessed using the inclusion and exclusion criteria.

Table 1. Inclusion and exclusion criteria

Inclusion criteria
Age between 30 and 60 years
Body mass index < 30 kg/m^2
Leakage episode recorded more than once a week
SUI diagnosed by a urogynecologist
Successful completion of the medical screening questionnaire
Not addicted to alcohol or drugs
Exclusion criteria
Not meeting the inclusion criteria
Pregnant/planning to become pregnant
Pelvic or abdominal surgery within the last 6 months
Urinary tract infection
Neurological or psychiatric disease

Table 1 shows the inclusion and exclusion criteria. The characteristics of 42 participants recruited in in this study are shown in Table 2. Before conducting this study, all experimental protocols were explained to the participants who provided written informed consent in a form approved by the Institutional Review Board of Yonsei University Mirae Campus (approval no. 1041849-201806-BM-056-02).

Procedures

Female sexual function and PFM functions were assessed at the urogynecology clinic in Seoul, South Korea, and hip muscle strength was measured in a laboratory setting. First, PFM strength was measured, followed by PFM endurance by a urogynecologist. Hip extensor, abductor, and adductor strength were

Table 2. Participant characteristics

Characteristics	Women with stress urinary incontinence (n = 42)
Age (y)	42.9 ± 8.1
BMI (kg/m^2)	23.0 ± 3.4
Duration of symptoms (y)	8.7 ± 7.3
Number of deliveries	1.8 ± 0.9
Vaginal deliveries	34/42
Cesarean section	5/42
Menopause	8/42

measured in a random order by a physical therapist. Then, hip muscle strength was also measured in a random order generated by www.randomization.com.

Pelvic Organ Prolapse Urinary Incontinence Sexual Function Questionnaire

Female sexual function was assessed using the Korean version of the PISQ [24]. The PISQ comprises a 31-item questionnaire with a five-point scale [25] and is categorized into t3 domains: behavior/emotive (15 items), physical (10 items), and partner related (6 items) of female sexual function and overall total score. The behavioral emotive domain evaluates the frequency of sexual activity, sexual desire, and orgasm. The physical domain assesses sexual function affected by UI. The partner-related domain measures the participant's perception of her partner's response to the effect of the participant's PFM disorder on not only her partner's sexual function but also her and her partner's sexual function. Three domain scores are calculated by adding scores for individual items in each domain. The overall total score ranges from 0 to 125; the physical domain scores, 0 to 40; behavioral emotive, 0 to 61; and partner related, 0 to 24. Higher scores on 3 domains and overall total score indicate better female sexual function.

Measurement of PFM Functions

The present study measured PFM functions using a VVP-3000 perineometer (QLMED Ltd, Gyeonggi-do, South Korea) in hook-lying position for all participants [26]. The vaginal probe of a perineometer (diameter, 24 mm; length, 115 mm; and inserted vaginal active length, 66 mm) was connected to a microprocessor with latex tubing for the pressure transmission in the vaginal probe, which is compressed by the vaginal wall. The volume of the vaginal probe was modulated in individuals according to the participant's vaginal volume. The baseline pressure as mm Hg was recorded in the resting PFM and then zeroed. We requested to contract and squeeze the subject's PFM with maximum voluntary contraction perceived effort for 3 seconds. Participants were asked to pull their PFM in and up as much as possible without using abdominal and hip muscle contraction, and the tester confirmed the compensation contraction using palpation on the abdominal and hip muscles.[27] PFM strength was defined as pressure from the baseline pressure until the maximal pressure, which was reported as the mean of 2 maximum voluntary contractions and recorded as mm Hg.[28] PFM endurance was measured for the mean contraction pressure for 10 seconds, during one attempt, and recorded as mm Hg.

Measurement of Hip Muscle Strength

The hip muscle isometric strength was measured by Smart KEMA tension sensor (KOREATECH Co., Ltd., Seoul, South Korea), and initial tension was controlled on belt by 3 kgf.[29] The force data were recorded in the form of maximal voluntary isometric contraction of the hip extensor, abductor, and adductor strength. The force data measured by sensors were transmitted to a tablet and calculated with the Smart KEMA application (KOREATECH Co., Ltd., Seoul, South Korea).

Hip muscle strength measured by the Smart KEMA tension sensor showed excellent intrarater (ICC3,1 > 0.95) and interrater (ICC2,1 > 0.95) test reliability [29]. The belt length was adjusted in the start position to measure the hip muscle strength. Participants were instructed to hold maximal strength for 5 seconds, and the middle 3 seconds was analyzed to generate an average. The average values of 3 trials were applied for data analyses. Participants rested for 30 seconds after each trial and for 5 minutes between hip muscle strength measurement to prevent muscle fatigue. The hip extensor, abductor, and adductor strength were calculated as average values of both sides. All data were divided according to participant's weight for normalization. Table 3 shows the strap placement, measurement position, and procedure for hip muscle strength test.

Statistical Analysis

The Kolmogorov–Smirnov Z-test was performed to determine the normality of the data distribution. Pearson's correlation coefficients were calculated to determine the relationships between female sexual and PFM functions and hip extensor, abductor, and adductor strength. A correlation coefficient (r) of >0.75 was considered "good to excellent," 0.50–0.75 was "moderate to good," 0.25–0.50 was "fair," and 0.00–0.25 was "little or no" relationship [30]. Multiple regression models with forward selection procedure included the 5 independent variables (PFM strength and endurance, the strength of hip extensor, abductor, and adductor), with PISQ domains (behavior/emotive, physical, partner related, and total score) used as dependent variables. The determination coefficient (R^2) represented the explanatory power of the variables. All statistical analyses were performed using the SPSS software (ver. 18.0; SPSS Inc., Chicago, IL, USA) with alpha set at 0.05.

RESULTS

Table 4 shows the average and standard deviation for all variables. Table 5 shows the correlation coefficients between the score of the 3 domains and the overall total score in the PISQ and PFM strength and endurance and hip muscle strength (hip extensor, abductor, and adductor). Significant correlations were observed between the behavioral/emotive domain score in the PISQ and hip extensor strength (r = 0.452), PFM strength (r = 0.441), PFM endurance (r = 0.362), and hip adductor strength (r = 0.324) (Table 4). Significant correlations were observed between the physical domain score in the PISQ and hip abductor strength (r = 0.417), PFM endurance (r = 0.356), hip adductor strength (r = 0.332), and PFM strength (r = 0.322) (Table 5). The partner-related score in the PISQ was significantly related to hip adductor (r = 0.386) and abductor strength

Table 3. Description of hip muscle strength measurements

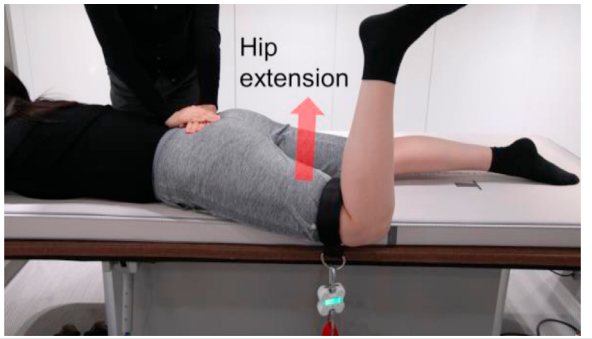
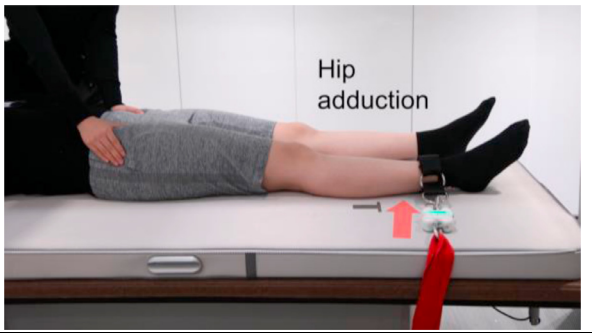
Strength measurements	Strap placement	Position	Procedure	Figure
Hip extensor	Distal thigh	Prone	The examiner controlled the participant's lumbopelvic rotation (pelvic anterior tilting) during hip extension. Participants performed hip extension against a strap to maximal voluntary isometric contraction (MVIC).	
Hip abductor	Ankle	Supine	The examiner controlled the participant's lumbopelvic side-bending during hip abduction. The hip and knee joint of the dominant leg was extended to 0°. Participants performed hip abduction against a strap to MVIC.	
Hip adductor	Ankle	Supine	The examiner controlled the participant's lumbopelvic side-bending during hip adduction. The hip and knee joint of the dominant leg was extended to 0°. Participants performed hip adduction against a strap to MVIC.	

Table 4. Descriptive statistics of pelvic organ prolapse urinary incontinence sexual function questionnaire, pelvic floor muscles functions, and hip muscle strength

Variables		Mean	SD	Range
PISQ	Behavioral/emotive domain	27.64	13.22	4–53
	Physical domain	32.45	4.59	22–39
	Partner-related domain	18.55	2.40	14–22
	Total score	78.64	15.89	47–113
PFM functions (mm Hg)	Strength	30.20	14.79	4.70–62.10
	Endurance	21.65	11.59	2.35–48.80
Hip muscles strength (%) (kg/body weight)	Extensor	30.85	11.17	13.73–61.41
	Abductor	10.72	3.39	2.95–17.14
	Adductor	8.26	2.82	1.47–14.56

Table 5. Correlation coefficients between pelvic organ prolapse urinary incontinence sexual function questionnaire and pelvic floor muscle functions and hip muscle strength

	PFM strength		PFM endurance		Hip extensor strength		Hip abductor strength		Hip adductor strength	
	r	*P*	r	*P*	r	*P*	r	*P*	r	*P*
PISQ: behavioral/emotive domain	0.362*	.019	0.441*	.003	0.452*	.003	0.271	.083	0.324*	.037
PISQ: physical domain	0.332*	.037	0.356*	.021	0.296	.057	0.417*	.006	0.332*	.032
PISQ: partner related domain	−0.047	.767	−0.003	.987	0.147	.354	0.314*	.043	0.386*	.011
PISQ: total score	0.387*	.011	0.470*	.002	0.484*	.001	0.393*	.010	0.424*	.005

PFM = pelvic floor muscles; PISQ = pelvic organ prolapse urinary incontinence sexual function questionnaire.
*$P > .05$.

(r = 0.314). The overall total score in the PISQ was significantly associated with hip extensor strength (r = 0.484), PFM endurance (r = 0.470), hip adductor strength (r = 0.424), hip abductor strength (r = 0.393), and PFM strength (r = 0.387) (Table 5).

Forward multiple regression analyses were performed to identify variables that contributed significantly to PISQ domains (Table 6). Hip extensor strength emerged as the only significant independent variable for behavioral/emotive domain score in the PISQ (P= .003, R^2 = 20.4%). Hip abductor strength entered as the only significantly independent variable for physical domain score in the PISQ (P = .006, R^2 = 17.4%). Hip adductor strength appeared as the only significantly independent variable for partner-related domain score in the PISQ (P = .011, R^2 = 14.9%). For overall total score in the PISQ, hip extensor strength (P = .030) and PFM endurance (P = .045) emerged as the significantly independent variable in the forward multiple regression model (R^2 = 31.0%).

DISCUSSION

Many women have strengthened their hip muscles for body beauty, sexual attractiveness, or musculoskeletal health [18]. The present study was performed under a reasonable suspicion that hip muscles as well as PFM may be related to female sexual function. Our main results support our hypothesis, which shows significant correlations between female sexual function and not only PFM functions but also hip muscle strength in women with SUI. Although this was an observational cross-sectional study and, therefore, it was not possible to establish causality, we carefully extrapolated that the reduced PFM and hip muscle strength may be related to reduced female sexual function. Thus, when selecting a training target muscle to improve female sexual function, not only the PFM but also the hip muscles can be considered.

For instrumentation, we applied perineometer to measure PFM functions. As research in this field evolved new methods (dynamometry, electromyography or imaging tools, eg, ultrasound and magnetic resonance imaging) of measuring PFM functions have emerged, however, there is no present gold standard methodology for quantifying PFM functions [31]. The most common and oldest method is digital palpation closely followed by perineometer designed by Kegel [27,31], However, because perineometer do not measure directly force, perineometer is an indirect measurement of PFM strength generated through change in vaginal pressure. Also, we used the Smart KEMA tension sensor connected strap to measure hip muscle strength. Hand-held dynamometers are relatively simple and small to use for quantitatively measuring hip muscle strength and generally held in the tester's palm and pressed directly against the part of the body under measurement (breaking

Table 6. Results of multiple regression with forward selection analyses: coefficients of independent variables in models

Dependent variables	Model	Independent variables	R^2	*P*	Unstandardized coefficients B	Unstandardized coefficients Standard error	Standardized coefficients β	t	*P*
PISQ: behavioral/ emotive domain	1	Hip extensor strength	0.204	0.003	0.535	0.167	0.452	3.206	.003
PISQ: physical domain	1	Hip abductor strength	0.174	0.006	0.566	0.195	0.417	2.905	.006
PISQ: partner related domain	1	Hip adductor strength	0.149	0.011	0.328	0.124	0.386	2.650	.011
PISQ Total score	1	Hip extensor strength	0.234	0.001	0.689	0.197	0.484	3.497	.001
	2	Hip extensor strength	0.310	0.001	0.482	0.214	0.338	2.249	.030
		PFM endurance			0.427	0.206	0.312	2.071	0.045

PISQ = pelvic organ prolapse urinary incontinence sexual function questionnaire; PFM = pelvic floor muscles.

method) [32]. However, breaking method requires the tester to have sufficient strength to hold the hand-held dynamometer steady, which could be difficult measuring isometric hip muscle strength, especially if the subject is strong and the tester is weak [32,33]. Thus, we used making method performing isometric movements by pushing or pulling subject's body part being measured against the tension sensor connected by strap to secure reliable hip muscle strength data.

PFM has been postulated to play an important role in female sexual function [34] and is accountable for involuntary contractions during an orgasm.[19,34,35] In 40 nulliparous women, a significant relationship was observed between higher scores on the desire domain and total scores in female sexual function index and higher PFM strength.[36] The present study determined that behavioral/emotive, physical, and total domain scores in the PISQ were associated with PFM strength and endurance in women with SUI. There is a possible reason for the correlation between PFM (strength and endurance) and female sexual functions. The etiology of sexual dysfunction in SUI could be caused by embarrassment due to odor, psychological disinterestedness, and fear of incontinence during intercourse.[37] Incontinence occurring during penetration is more likely to occur with SUI.[38] Thus, higher behavioral emotive and physical domains could be associated with lesser incontinence during intercourse and better arousal, satisfaction, and orgasm due to the greater PFM strength in women with SUI. In addition, the greater PFM endurance could perform a longer "hold" sensation while descending the clitoral body to within close proximity from the distal portion during intercourse [39] and the more repetition over a period of time can help achieve a sexual orgasm.[40] Thus, our findings can also be used to improve female sexual function through PFM training in women with SUI.

However, our findings cannot be directly compared to those of previous studies because no study has been conducted on the relationship between female sexual function and hip muscle strength. However, several possible reasons for the association between female sexual function and hip muscle strength can be reasonably deduced.

First, hip muscles could co-contract with PFM related to female sexual function. Electromyography and magnetic resonance imaging have determined that the PFM, fossa ischioanalis, and gluteus maximus muscles are functionally and morphologically correlated.[13] The hip adductor and gluteus muscle contraction facilitates the co-contraction of PFM activity.[14] The obturator internus could perform the role of myofascial force transmission, as deep hip external rotator and abductor muscles, and be associated with PFMs. The rotator cuff in the hip joint, such as the gluteus maximus and gluteus medius tendons, is associated with the hip joint and pelvis. Strengthening the hip muscles has been recommended as a component of intervention improvement because the hip abductor, adductor, extensor, and external rotator muscles co-contract with PFM contraction. [14,15,41,42] Thus, co-contraction between the PFM and hip muscles could affect the relationship with female sexual function.

Second, the hip muscle strength could be associated with specific challenges to sex, such as the ability to provide sexual stimulation to one's partner or to comfortably position oneself for sexual intercourse. In addition, the hip muscles could play a role in maintaining and moving the pelvic position and lumbopelvic stabilizer during sexual intercourse in various sexual positions. Underwood et al. determined that hip abduction strength differed between women with and without SUI.[42] Previous studies have suggested a relationship between female sexual satisfaction and fitness level [43] and an association between higher levels of general physical activity and better female sexual function.[44,45] As previous studies focused on the general physical activity and fitness level, comparing our data on the relationship between hip muscle strength and female sexual function is difficult. In addition, precisely interpreting whether female sexual function is related to the overall physical activity and specific hip muscle strength is also difficult.

Third, body perception about buttock physical appearance may affect the relationship between hip muscle strength and female sexual function.[46] The effect of musculoskeletal conditions on contributing to both physiological and psychological elements of sexual functioning is essential.[11] Women concentrate more on the hip muscles and lower body than men during exercise behaviors and motivations [18] because the hip muscle strength might contribute to buttock appearance. The hip muscles are an important element of body perception and sexual attraction in women.[47] A positive body image was related to female sexual function [46] Body perceptions about their own physical appearance should be considered to improve female sexual dysfunction.[48,49] However, concretely explaining whether female sexual function is related to the overall body perception and specific hip muscle strength is difficult.

In multiple regression analyses, the positive slope indicated that PISQ scores increased as hip muscle strength and PFM endurance increased. Though it is difficult to explain cause and effect, greater hip muscle strength and PFM endurance could be related to greater female sexual function. In further study, prospective longitudinal studies or clinical trials of interventions would be needed to determine effect of hip muscle strengthening on female sexual function. Although our findings show that PFM function and hip muscle strength were similarly correlated with female sexual function as fair grade, whether the hip muscles directly affect female sexual function unlike other skeletal muscles in women with SUI remains to be confirmed. Because weakness or damaged PFM could cause SUI, women with SUI may use other muscles, such as the hip muscles, and it may be difficult to contract selectively PFM. Thus, further studies are needed to confirm whether female sexual function is related to specific hip muscle strength in healthy women. However, to our knowledge, this is the first study to confirm the relationship between female sexual function and hip muscle strength, and our findings may be useful data for sexual dysfunction rehabilitation training in women with SUI.

Our study is limited due to the small sample size and the lack of information about other psychological or social factors that may cause female sexual dysfunction. Also, we included women with both pre- and postmenopausal women. We did not examine the relationship between hip muscle strength and body perception as a contributing factor to female sexual function. Considering such information would have allowed us to more precisely identify the relationship between hip muscle strength and female sexual function. We also cannot comment on the possible consequences of sexual abuse, the diagnoses of depression or anxiety, or the sexual dysfunction of partners and factors that are commonly investigated by other kinds of clinicians, such as sexual counselors and psychologists. Potential mechanisms of SUI in individuals may have been informative, such as chronic cough, constipation, or parturition which could decrease support of the bladder neck and the urethra. Also, although impaired sphincter functioning due to intrinsic sphincter deficiency could be potential mechanism of SUI, we did not confirm information of potential mechanism of SUI. Finally, the overall physical condition or various other muscles strength should be measured in order to determine whether female sexual function is related to the specific hip muscle strength or the overall physical condition.

CONCLUSION

Results of this study confirm that PFM functions and hip muscle strength are related to female sexual function in women with SUI. The relationship between female sexual function and PFM function and hip muscle strength was fairly correlated. Also, greater hip muscle strength and PFM endurance were associated with greater female sexual function. Thus, further randomized controlled trials are needed to establish cause−effect relationships between hip muscle strength and female sexual function in women with SUI.

ACKNOWLEDGMENTS

We would like to thank all of the participants for their time and commitment to the present study.

Corresponding Author: Oh-yun Kwon, PhD, PT, Laboratory of Kinetic Ergocise based on Movement Analysis, Department of Physical Therapy, Graduate School, Yonsei University, 234 Maeji-ri, Heungeop-Myeon, Wonju, Kangwon-Do, 220-710, Wonju, South Korea. Tel: 82-33-760-2721; Fax: 82-33-760-2496; E-mail: kwonoy@yonsei.ac.kr

Ethical Approval: The present study approved by the Institutional Review Board of Yonsei University Mirae Campus (Wonju, Korea) (approval no. 1041849-201806-BM-056-02). The study protocol was registered with the Clinical Research information Service (KCT0003357).

Conflict of Interest: The authors declare that they have no potential conflicts of interest with respect to the research, authorship,

and publication of this article. The results are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation. Ui-jae Hwang, none to report. Min-seok Lee, none to report. Young-shin Lee, none to report. Sung-hoon Jung, none to report. Oh-yun Kwon, none to report.

Funding: Yonsei University Research Fund (grant numbers: 2018−51−0213 and 2020−52−0016) provided funding for this study.

STATEMENT OF AUTHORSHIP

UJ Hwang: Conceptualization, Project administration, Writing-original draft; MS Lee: Data curation, Investigation, Methodology; SH Jung: Formal analysis, Methodology, Software; SH Ahn: Data curation, Formal analysis, Investigation, Methodology; OY Kwon: Conceptualization, Funding acquisition, Project administration, Writing-original draft.

REFERENCES

1. Buckley BS, Lapitan MCM. Prevalence of urinary incontinence in men, women, and children—current evidence: findings of the Fourth International Consultation on Incontinence. **Urology 2010;76:265–270.**
2. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. **Neurourol Urodyn 2002;21:167–178.**
3. Coyne K, Zhou Z, Thompson C, et al. The impact on health-related quality of life of stress, urge and mixed urinary incontinence. **BJU Int 2003;92:731–735.**
4. Handa VL, Zyczynski HM, Burgio KL, et al. The impact of fecal and urinary incontinence on quality of life 6 months after childbirth. **Am J Obstet Gynecol 2007;197:636.e1–636.e6.**
5. Yip S-K, Chan A, Pang S, et al. The impact of urodynamic stress incontinence and detrusor overactivity on marital relationship and sexual function. **Am J Obstet Gynecol 2003;188:1244–1248.**
6. Barber MD, Visco AG, Wyman JF, et al. Sexual function in women with urinary incontinence and pelvic organ prolapse. **Obst Gynecol 2002;99:281–289.**
7. Rogers G, Villarreal A, Kammerer-Doak D, et al. Sexual function in women with and without urinary incontinence and/or pelvic organ prolapse. **Int Urogynecol J 2001;12:361–365.**
8. Graber B, Kline-Graber G. Female orgasm: role of pubococcygeus muscle. **J Clin Psychiatry 1979;40:348–351.**
9. Bø K, Talseth T, Vinsnes A. Randomized controlled trial on the effect of pelvic floor muscle training on quality of life and sexual problems in genuine stress incontinent women. **Acta Obstet Gynecol Scand 2000;79:598–603.**
10. Zahariou AG, Karamouti MV, Papaioannou PD. Pelvic floor muscle training improves sexual function of women with stress urinary incontinence. **Int Urogynecol J 2008;19:401–406.**
11. Rosenbaum TY. Musculoskeletal pain and sexual function in women. **J Sex Med 2010;7:645–653.**
12. Stein A, Sauder SK, Reale J. The role of physical therapy in sexual health in men and women: evaluation and treatment. **Sex Med Rev 2019;7:46–56.**
13. Soljanik I, Janssen U, May F, et al. 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 2012;286:931–938.**
14. Bø K, Stien R. 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. **Neurourol Urodyn 1994;13:35–41.**
15. Tuttle LJ, Autry T, Kemp C, et al. Hip exercises improve intravaginal squeeze pressure in older women. **Phyiother Theory Pract 2019:1–8.**
16. Cuenca-Guerra R, Lugo-Beltran I. Beautiful buttocks: characteristics and surgical techniques. **Clin Plast Surg 2006;33:321–332.**
17. Cárdenas-Camarena L, Arenas-Quintana R, Robles-Cervantes J-A. Buttocks fat grafting: 14 years of evolution and experience. **Plast Reconstr Surg 2011;128:545–555.**
18. Jonason PK. An evolutionary psychology perspective on sex differences in exercise behaviors and motivations. **J Soc Psychol 2007;147:5–14.**
19. Shafik A. The role of the levator ani muscle in evacuation, sexual performance and pelvic floor disorders. **Int Urogynecol J 2000;11:361–376.**
20. Beji NK, Yalcin O, Erkan HA. The effect of pelvic floor training on sexual function of treated patients. **Int Urogynecol J 2003;14:234–238.**
21. Rosenbaum TY. REVIEWS: Pelvic floor involvement in male and female sexual dysfunction and the role of pelvic floor rehabilitation in treatment: a literature review. **J Sex Med 2007;4:4–13.**
22. Brækken IH, Majida M, Engh ME, et al. Can pelvic floor muscle training improve sexual function in women with pelvic organ prolapse? A randomized controlled trial. **J Sex Med 2015;12:470–480.**
23. Ferreira CHJ, Dwyer PL, Davidson M, et al. Does pelvic floor muscle training improve female sexual function? A systematic review. **Int Urogynecol J 2015;26:1735–1750.**
24. Yoo E, Suh J, SK L. Translation and Linguistic validation of Korean version of short form of PFDI (pelvic floor distress inventory) and PISQ (pelvic organ prolapse and incontinence sexual questionnaire). In: Proceedings of the 94th Congress of the Korean Society of Obstetrics and Gynecology, 94; 2008. p. 184.
25. Rogers RG, Kammerer-Doak D, Villarreal A, et al. A new instrument to measure sexual function in women with urinary incontinence or pelvic organ prolapse. **Am J Obs Gynecol 2001;184:552–558.**
26. Mohseni-Bandpei MA, Rahmani N, Behtash H, et al. The effect of pelvic floor muscle exercise on women with chronic non-specific low back pain. **J Bodywork Mov Ther 2011;15:75–81.**

27. Bø K, Kvarstein B, Hagen R, et al. Pelvic floor muscle exercise for the treatment of female stress urinary incontinence: I. Reliability of vaginal pressure measurements of pelvic floor muscle strength. **Neurourol Urodyn 1990;9:471–477.**
28. Tennfjord MK, Engh ME, Bø K. An intra-and interrater reliability and agreement study of vaginal resting pressure, pelvic floor muscle strength, and muscular endurance using a manometer. **Int Urogynecol J 2017;28:1507–1514.**
29. Ahn S-H, Hwang U-J, Jung S-H, et al. Hip external rotator strength and compensatory movement in three different positions. **Health (N Y) 2018;10:132.**
30. Portney LG, Watkins MP. Foundations of clinical research: applications to practice. Upper Saddle River, NJ: Pearson/Prentice Hall; 2009.
31. Deegan EG, Stothers L, Kavanagh A, et al. Quantification of pelvic floor muscle strength in female urinary incontinence: a systematic review and comparison of contemporary methodologies. **Neurourol Urodyn 2018;37:33–45.**
32. Katoh M, Yamasaki H. Comparison of reliability of isometric leg muscle strength measurements made using a hand-held dynamometer with and without a restraining belt. **J Phys Ther Sci 2009;21:37–42.**
33. Katoh M, Hiiragi Y, Uchida M. Validity of isometric muscle strength measurements of the lower limbs using a hand-held dynamometer and belt: a comparison with an isokinetic dynamometer. **J Phys Ther Sci 2011;23:553–557.**
34. de Menezes Franco M, Driusso P, Bø K, et al. Relationship between pelvic floor muscle strength and sexual dysfunction in postmenopausal women: a cross-sectional study. **Int Urogynecol J 2017;28:931–936.**
35. Lowenstein L, Gruenwald I, Gartman I, et al. Can stronger pelvic muscle floor improve sexual function? **Int Urogynecol J 2010;21:553–556.**
36. Martinez CS, Ferreira FV, Castro AA, et al. Women with greater pelvic floor muscle strength have better sexual function. **Acta Obstet Gynecol Scand 2014;93:497–502.**
37. Salonia A, Zanni G, Nappi RE, et al. Sexual dysfunction is common in women with lower urinary tract symptoms and urinary incontinence: results of a cross-sectional study. **Eur Urol 2004;45:642–648.**
38. Giuseppe PG, Pace G, Vicentini C. Sexual function in women with urinary incontinence treated by pelvic floor transvaginal electrical stimulation. **J Sex Med 2007;4:702–707.**
39. Foldes P, Buisson O. Reviews: the clitoral complex: a dynamic sonographic study. **J Sex Med 2009;6:1223–1231.**
40. Huey CJ, Kline-Graber G, Graber B. Time factors and orgasmic response. **Arch Sex Behav 1981;10:111–118.**
41. Marques SA, da Silveira SR, Pássaro AC, et al. Effect of Pelvic Floor and Hip Muscle Strengthening in the Treatment of Stress Urinary Incontinence: A Randomized Clinical Trial. **J Manipulative Physiol Ther 2020;43:247–256.**
42. Underwood DB, Calteaux TH, Cranston AR, et al. Hip and pelvic floor muscle strength in women with and without stress urinary incontinence: a case-control study. **J Womens Health Phys Ther 2012;36:55–61.**
43. Bortz 2nd W, Wallace DH. Physical fitness, aging, and sexuality. **West J Med 1999;170:167.**
44. Dąbrowska J, Drosdzol A, Skrzypulec V, Plinta R. Physical activity and sexuality in perimenopausal women. **Eur J Contracept Reprod Health Care 2010;15:423–432.**
45. Cabral PUL, Canário ACG, Spyrides MHC, et al. Physical activity and sexual function in middle-aged women. **Rev Assoc Méd Bras 2014;60:47–52.**
46. Erbil N. The relationships between sexual function, body image, and body mass index among women. **Sex Disabil 2013;31:63–70.**
47. Chatzioglou GN, Govsa F, Bicer A, et al. Physical attractiveness: analysis of buttocks patterns for planning body contouring treatment. **Surg Radiol Anat 2019;41:133–140.**
48. Wiederman M. Body image and sexual functioning. Encyclopedia of body image and human appearance. Elsevier; 2012. p. 287–294.
49. Cash TF, Pruzinsky T. Future challenges for body image theory, research, and clinical practice. Body image: a handbook of theory, research, and clinical practice; 2002509–516.