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The Risk Factor Associated with Stress Urinary Incontinence (SUI) Severity: a Cross-Sectional Multi-centered Study

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ABSTRACT

Background: Stress urinary incontinence is defined as involuntary loss of urine on effort or exertion or with coughing or sneezing. SUI affects as many as 75% of older women, 44-57% of middle-aged, and 25% of young women. Risk factors include age, parity, vaginal birth, menopause, obesity, body mass index, diabetes, hysterectomy, chronically increased abdominal pressure, genetic factors, physical activity level, smoking, diet, and family history. Our purpose was to determine which risk factors are associated with the severity of stress urinary incontinence using a 1-hour pad test.
Method: This cross-sectional multicentered study was performed on 178 women who complained of incontinence and had completed QUID for SUI. We collected data using a pad test, and we classified those women into two main groups, women with mild SUI with 1-hour pad test results 1-10 g and women with moderate and severe SUI with 1-hour pad test results more than 10 g. We use Phi and Cramer's V to calculate the effect size of each risk factor.
Results: There were 20 women with moderate and severe SUI, and 158 had mild SUI. We analyzed the risk factors associated with moderate-severe SUI women and found that age (p=0.03), perineometer result (p = 0.04), and level of education (p=0.02) are statistically significant.
Conclusion: The severity of stress urinary incontinence is related to age, perineometer result, and level of education.

Keywords: pad test, risk factors, severity, stress urinary incontinence.
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INTRODUCTION

Stress urinary incontinence (SUI) is defined as any involuntary loss of urine on effort or exertion or with coughing or sneezing.[1,2] SUI affects as many as 75% of older, 44-57% of middle-aged, and 25% of young women. Urinary incontinence can affect 40-50% of women in the United States.[3] This disease negatively impacts the quality of life, interfering with social life and intimate relationship.[2,3] Women often avoid participating in exercise and social activities outside the home. This condition results in the expense of billions of dollars in health care costs each year. For example, Sweden's urinary incontinence annual fee accounts for approximately 2% of the healthcare budget.[3]

Multiple risk factors may precipitate SUI, including age, parity, vaginal birth, menopause, obesity, body mass index, socioeconomic status, comorbidities (diabetes, urinary tract infection, ischemic heart disease, chronic illness, etc.), hysterectomy, chronically increased abdominal pressure (chronic obstructive pulmonary disease, constipation), genetic factors (race, connective tissue disorders), physical activity level, smoking, diet, and medication such as diuretics.[1,3-5] Nevertheless, there are limited studies that explore the risk factor that associated with the SUI severity. Understanding those factors is vital since the severity of the UI may affect the women's quality of life, treatment choice, and prognosis.

There are many instruments to asses SUI severity, from simple ones such as UDI-6, KHQ, IIQ-7, and I-QOL to sophisticated methods such as urodynamic studies.[6] But, one standardized method to diagnose and measure SUI severity is a 1-hour pad test. The technique involves women wearing a pad and doing some activities for one hour that exert pressure on the bladder. Then, we measured the weight of the pad and classified the severity.[7] Finally, this study aims to investigate which risk factors that associated with the severity of SUI based on the 1-hour pad test.

RESEARCH DESIGN AND METHOD

This cross-sectional multicentered study was conducted between September 2020 – August 2022 at Dr. Cipto Mangunkusumo National General Hospital, Fatmawati General Hospital, and YPK Mandiri hospital, Buah Hati Pamulang, and Ciputat Hospital. The Ethics Committee of the Faculty of Medicine Universitas Indonesia approved our study.

The population of our study is women aged 25 – 65 years experiencing stress urinary incontinence based on the QUID questionnaire. A consecutive sampling was used to recruit the sample. The inclusion criteria are participants with

good cognitive function and willing to sign the informed consent form. We excluded patients with urgency/mixed urinary incontinence, high-degree prolapse, pelvic malignancy, and who had surgery before since it may significantly affect patient distress and quality of life.

A general practitioner collected the demographic data of the patient (age, body mass index (BMI), level of education, job), obstetrics and gynecology history (parity status, delivery method, degree of perineal rupture, and baby's birth weight), and past medical and surgical history from an interview and through medical records. A general practitioner did a general physical examination, and a urogynecologist/gynecologist performed the vaginal examination and the POP-Q test.

Our main parameter is the severity of SUI measured by a 1-hour pad test. Our 1-hour Pad Test protocol was; first, women wear a pre-weighed pad and drink 500 ml of sodium-free liquid in 15 minutes. Then, they are instructed to exercise for 30 minutes, including walking, climbing up and down one flight of stairs, standing up from sitting (10x), coughing vigorously (10x), walking on the spot for 1 minute, bending to pick up an object from the floor (5x) and washing hands for 1 minute in running water. After the exercise, the women rest for fifteen minutes before taking off the pad. Before and after the test, the pad's weight was measured using a digital balance.[7] Then, we classify those women into two main groups, women with mild SUI with 1-hour pad test results of 1-10 g and women with moderate and severe SUI with 1-hour pad test results of more than 10 g. The pad test was done by a urogynecologist/gynecologist with the help of a general practitioner

We also measured the women's pelvic floor muscle strength using a perineometer by peritron™. The women contracted their pelvic floor muscles tightly and held them for 2-3 seconds. Three measurements with a 10 seconds interval between contractions were taken, and the average value of the measurement was noted. A urogynecologist/gynecologist conducted the perineometer measurement. We will categorize the perineometer result based on Moegni et al. study into two groups, weak and strong contraction. Weak contraction had a contraction range of 0.01 – 22.49 cmH_2O, and strong contraction was > 22.49 cmH_2O.[8]

Patients' demographic and characteristic data were presented in descriptive statistics according to their distribution. We categorize the factors to be analyzed further. We used National Health and Nutrition Examination Survey (NHANES) III to rank it low, medium, and high for the occupational level.[9] Normal distribution variables will be presented as mean with standard deviation value. On the other hand, data that are not distributed normally will be presented as median with min-max value. We use Chi-square/Fisher to evaluate risk factors associated with the pad test's severity and then use Phi and Cramer's V to calculate the effect size of each risk factor. Based on the SPSS statistics, 21.0 were used for data analysis with the cut-off for statistical significance of $p < 0.05$ with 95% CI.

RESULTS

We recruited 178 women who complained of incontinence and had completed QUID for SUI. As we all know, the risk factors of SUI are old age, obesity, menopause, smoking, and having a vaginal delivery. Our demographic data showed that most of these women were obese and had had a vaginal delivery. However, our mean age of women is 44.3 years old, and most did not have diabetes or stroke. The details are in Table 1.

Then we classify those women into two main groups, women with mild SUI with 1-hour pad test result of 1-10g and women

Table 1. Demographic characteristics of the subjects.

Demographic Characteristic	N = 178
Age, year, mean (SD)	44.3 (10.2)
20 – 40	67 (37.6%)
41 – 60	104 (58.4%)
> 60	7 (3.9%)
IMT, kg/m^2, median (IQR)	26.2 (18.4-50.5)
< 24.9	58 (32.6%)
25 – 29.9	86 (48.3%)
≥ 30	34 (19.1%)
Level of education	
None	2 (1.1%)
Elementary School	4 (2.2%)
Middle School	19 (10.7%)
High School	93 (52.2%)
College or Higher	60 (33.7%)
Job	
Light Occupational activities	124 (69,7%)
Medium Occupational activities	54 (30,3%)
Diabetes Mellitus, no. (%)	9 (5.1%)
Stroke, no. (%)	2 (1.1%)
Obstetric Factor	
Nulliparity	11 (6.2%)
Primipara	31 (17.4%)
Multiparity	136 (76.4%)
Vaginal delivery only	115 (64.6%)
Cesarean Section only	25 (14.0%)
VD + CS	29 (16.3%%)
Max Birth Weight, g, median (IQR)	3200 (0-5000)
< 2500 g	18 (10.1%)
2500 – 4000 g	147 (82.6%)
> 4000 g	13 (7.3%)
Perineometer Result, cmH_2O, mean (SD)	23.2 (12)
Weak Contraction (0.01 – 22.49 cmH_2O)	100 (56.2%)
Strong Contraction (> 22.5 cmH_2O)	78 (43,8%)

with moderate and severe SUI with 1-hour pad test result > 10 g. Thirty-two women had moderate and severe SUI, and 146 had mild SUI.

We analyzed the risk factors associated with moderate-severe SUI women. We found that age (p = 0.03), level of education (p = 0.02), menopause status (p = 0.01), and perineometer result (p = 0.04) were statistically significant. We elaborate further to find the effect size of those risk factors. We use Phi and Cramer's V to calculate the effect size of each risk factor. According to Cramer's V calculation, age is related to moderate effect size (df = 2 ES = 0.22). Furthermore, level of education, menopause status, and perineometer results have a small effect size. The details for other risk factors are in Table 2.

DISCUSSION

Stress urinary incontinence can be frustrating for women since it may affect many aspects of their quality of life.[10] Some studies reviewed risk factors associated with the incidence of SUI or other pelvic floor dysfunction.[11,12] However, there are still not many known factors that affect the severity of SUI based on the pad test. Thus we identify some demographic factors or characteristics that may influence the SUI severity.

Our study demonstrated that patients with severe SUI (> 10 g pad test) were associated with older age (p = 0.03), a lower level of education (p = 0.02), menopause (p = 0.01), and pelvic floor muscle strength measured by perineometer (p = 0.04). A cohort study from Milsom et al. found that the prevalence of urinary incontinence increased linearly from 12.1% in women 46 to 24.6% in women 86 years of age.[13] According to Gasquet et al., women with a mean age of 54.5 significantly increased the severity of SUI symptoms (p = 0.001).[14] Women with older age experience a decrease in muscle mass by 1 – 2% at an annual rate after the age of 50. It is related to the urethral sphincter causing less support on the pelvic floor in older women and causing SUI.[15]

We found that women with higher education (college or above) were associated with less severe symptoms of SUI (p= 0.02). Elliott et al. found that patients with higher educational levels tend to seek healthcare providers for low- and high-impact symptoms.[16] Other studies also found that higher academic level has a lower frequency of severe symptoms of SUI (p = 0.001).[14] Thus, people with higher education tend to examine themselves when they experience unusually mild symptoms. At last, low health literacy due to a lower level of education tends to normalize UI as a natural symptom of aging.[17] So, the SUI symptoms is commonly found incidentally in those particular group of women and tend to come in a more severe state of disease.

Menopause is a significant risk factor for SUI severity in women.[18] In post-menopausal women, around 50% suffer from urinary incontinence.[19] This result is supported by our study that menopause (p = 0.01) is associated with the severity of SUI. During menopause, estrogen deficiency leads to atrophy of the urethral mucosa. At the same time, estrogen deficiency also affects the synthesis of collagen fibers, the main components of supportive tissues of the pelvic floor. Compositional changes in collagen could weaken supporting tissues of the pelvic organs, thereby increasing the risk of SUI.[20]

Our study found that BMI is not associated with the severity of SUI (p = 0.86), although it is widely known as a risk factor for SUI incidence. In other studies, High BMI (>30 kg/m^2) was associated with increased urge and mixed urinary incontinence incidence, while obesity was a predictor of stress incontinence.

Table 2. Risk factors associated with moderate-severe SUI.

Risk Factor	SUI		p	Effect size
	Mild	Moderate Severe		
Age			**0.03**	**0.22**
20 – 40	61	6		
41 – 60	82	22		
> 60	3	4		
BMI			0.86	
≤ 24.9	47	11		
25.0 – 29.9	70	16		
≥ 30.0	29	5		
Education			**0.04**	**-.15**
Low	92	26		
High	54	6		
Occupational activity			0.11	
Low	98	26		
Medium	48	6		
Parity			0.84	
Nulli/primipara	34	8		
Multipara	112	24		
Mode of delivery*			0.15	
VD only	91	24		
CS only	22	3		
VD + CS	27	2		
Baby birth weight*			0.07	
< 2500 g	3	3		
2500 – 3999 g	122	25		
≥ 4000 g	12	1		
Menopause			**0.01***	**0.19**
Not yet	107	16		
Yes	39	16		
Perineometer Result			**0.04**	**-.15**
Weak Pressure	77	23		
Good Pressure	69	9		

*Fischer exact test

Several mechanisms may explain the association between obesity and UI. Fat deposits in the central adipose tissue will increase abdominal pressure. Also, obesity produces a high level of oxidative stress that may injure endothelium vessels and cause tissue ischemia and dysfunction of the sphincter and detrusor muscle.[21,22]

Pelvic floor muscles are an essential factor in maintaining urinary continence.[23] The levator ani muscles have an important role in supporting the pelvic floor; however, this function decreases after delivery.[24] The pelvic floor muscle strength examination can be done using a perineometer. A study found that women with continence significantly had a more muscular contraction than those with incontinence $p < 0.001$.[25] This result is similar to our findings ($p = 0.04$).

The sample of this study is large, with 178 SUI women from various centers. Thus, we could analyze and extrapolate conclusions from many factors between both groups. Moreover, only a few studies conducted perineometer measurements in SUI patients. Most studies used Modified Oxford Scale (MOS) to measure pelvic floor muscle strength. However, MOS is subjective and needs some experience to correctly measure pelvic floor muscle strength. Perineometer is easier to use, with an objective result, so it is easier to interpret and evaluate.

There are several limitations to our study. First, other variables might affect the severity of stress urinary incontinence that we did not evaluate, such as perineal laceration history. SUI severity is not only measured by urine leakage. Other aspects could also be analyzed, such as distress and the impact on quality of life, using UDI-6 and IIQ-7. At last, further studies with prospective design are necessary to strengthen the risk factors that correlate with SUI's severity and evaluate its effect on the patient's prognosis.

CONCLUSION

The risk factors associated with SUI severity are age ($p = 0.03$), level of education ($p = 0.02$), menopause status ($p = 0.01$), and perineometer result ($p = 0.04$). Therefore, it is necessary to do early detection and a comprehensive evaluation of women with risk factors.

DISCLOSURE

The patient's informed consent was obtained directly.

ETHICAL APPROVAL

The Ethics Committee of the Faculty of Medicine Universitas Indonesia approved our study, with number ND-828/UN2.FI/ETIK/PPM.00.02/2021.

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CONFLICT OF INTEREST

None.

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