

## Research Article

## Pelvic Floor Muscle Strength Stress Urinary Incontinence

### *Kekuatan Otot Dasar Panggul dan Stres Inkontinensia Urin*

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#### Abstract

**Objective:** To examine the relationship between muscle strength and muscle thickness of levator ani with Stress Urinary Incontinence (SUI) in women.

**Methods:** This study uses a comparative cross-sectional study design. We collected 82 women who visiting the Obstetrics and Gynecology clinic of RSUPN Dr. Cipto Mangunkusumo with the study group were subjects with positive cough tests while the control group were subjects with negative cough tests. The data obtained in the form of history taking, Questionnaire for Urinary Incontinence Diagnosis (QUID), physical examination (POPQ), cough test, perineometer, and ultrasound.

**Results:** We found no significant difference between the levator ani muscle thickness to the incidence of SUI with the median levator ani muscle thickness 0.63 cm (range 0.31-1.02 and  $p = 0.897$ ). While levator ani muscle strength against SUI has a median of 19.5 (range 4.6-88.6 and  $p = 0.001$ ). In multivariate analysis it was found that purely SUI, prolapse and age had no significant effect on the strength of levator ani muscles with a  $p$ -value of 0.243; 0.844; 0.903.

**Conclusions:** There is no significant difference in levator ani muscle thickness between women who experience SUI compared to those who do not. Women with SUI have weaker levator ani muscle strength than those who do not experience but are not statistically significant. And there is no correlation between muscle strength and levator ani muscle thickness in women with SUI.

**Keywords:** muscle strength, muscle thickness, perineometer, stress urinary incontinence, ultrasound.

#### Abstrak

**Tujuan:** Untuk mengkaji hubungan antara kekuatan otot dan ketebalan otot levator ani dengan keluhan IU-T pada perempuan.

**Metode:** Penelitian ini menggunakan desain perbandingan potong lintang dengan melibatkan 82 perempuan yang berkunjung di poliklinik Obstetri dan Ginekologi RSUPN Dr. Cipto Mangunkusumo dengan kelompok studi adalah subyek dengan tes batuk positif sedangkan kelompok kontrol adalah subyek dengan tes batuk negatif. Data yang diperoleh berupa hasil anamnesis, Questionnaire for Urinary Incontinence Diagnosis (QUID), pemeriksaan fisik (POPQ), tes batuk, perineometer, dan USG.

**Hasil:** Hasil penelitian ini didapatkan tidak ada perbedaan bermakna antara ketebalan otot levator ani terhadap kejadian IUT dengan median ketebalan otot levator ani 0,63 cm (jarak 0,31-1,02 dan  $p=0,897$ ). Sedangkan kekuatan otot levator ani terhadap IUT memiliki median 19,5 (jarak 4,6-88,6 dan  $p=0,001$ ). Pada analisis multivariat didapatkan bukti bahwa secara murni IUT, prolaps dan usia tidak mempunyai pengaruh bermakna terhadap kekuatan otot levator ani dengan nilai  $p$  masing-masing 0,243; 0,844; 0,903.

**Kesimpulan:** Tidak terdapat perbedaan yang bermakna pada ketebalan otot levator ani antara perempuan yang mengalami IU-T dibanding yang tidak mengalami. Perempuan IU-T mempunyai kekuatan otot levator ani yang lebih lemah dibanding yang tidak mengalami, namun tidak bermakna secara statistik. Tidak terdapat hubungan korelasi antara kekuatan otot dan ketebalan otot levator ani pada perempuan yang mengalami IU-T.

**Kata kunci:** inkontinensia urin jenis tekanan, ketebalan otot, kekuatan otot, perineometer, USG.

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## INTRODUCTION

The International Continence Society (ICS) defines stress urinary incontinence (SUI) as a state of urine that cannot be controlled when intra-abdominal pressure is increased, for example when coughing, sneezing, lifting weights, or exercising<sup>1</sup>. Considering the magnitude of the impact caused it can cause a decrease in the quality of life physically, mentally, and socially so special attention and treatment are needed for this problem<sup>2</sup>.

In general, the prevalence of IU in adult women is estimated to be 23-55%, the most obtained is the type of SUI which is 49% followed by Mixed type IU with 29% and finally IU type Urge with 21 %<sup>3</sup>.

One of the multifactorial causes is pelvic floor weakness. Urinary incontinence (IU) is related to the levator ani muscle contractility function because the muscle plays the biggest role in maintaining the stability of the pelvic floor<sup>4</sup>. After about 50 years of age, muscle mass will decrease 1-2% per year<sup>5</sup>, while muscle strength will experience a decrease of 3% thereafter<sup>6</sup>. Under these circumstances, it can cause a decrease in muscle strength and a decrease in muscle thickness. Muscle thickness is related to muscle strength. The relationship between thickness and muscle strength has previously been shown in women with SUI, but not in women with pelvic organ prolapse. Manometry and ultrasound can measure various aspects of the pelvic floor. Both of these methods are important in understanding the morphology and function of the pelvic floor muscles<sup>7</sup>.

So far there have not been many studies linking muscle strength and levator ani muscle thickness to the incidence of SUI. Based on this, this study aims to determine the relationship of muscle strength and levator ani muscle thickness with the incidence of SUI. By knowing this relationship, researchers expect to know the pathophysiology of the type of pressure IU better so that early treatment with more targeted promotive, preventive, curative and rehabilitative efforts will improve the management of SUI in the future.

## METHODS

Using a cross-sectional comparative research design. The study was conducted at the Obstetrics and Gynecology Clinic, Universitas Indonesia - RSUPN Dr. Cipto Mangunkusumo and RSCM Kintani from August to November 2019. Criteria for Inclusion: for the study group were subjects with positive cough tests and the control group were subjects with negative cough tests. Exclusion Criteria Obesity, pregnant women, previous history of pelvic floor dysfunction, history of surgery and spinal cord trauma, radiation, malignancy, subjects unable to contract pelvic floor muscles, subjects who have received therapy for SUI, avulsion subject. With a total sample of 82 subjects. The method of selecting research subjects is consecutive sampling, where each research subject that meets the inclusion criteria and does not meet the exclusion criteria is selected until the number of research subjects is met. Work procedures, after the subject sign the informed consent, the subject will complete the basic data and risk factor interviews and QUID questionnaires. The QUID assessment for SUI is if the total value of questions 1, 2, and 3 is  $\geq 4$ . For MUI is determined if questions are 4,5, and 6 is  $\geq 6$ . UUI is a combination of the two SUI scores and MUI. Physical examination includes a cough test should be performed when the bladder of the full subject is approximately 150-200 mL followed by an ultrasound assessment by measuring bladder volume with the Koelbel formula (length x width x thickness x 0.7). SUI can be expressed if urine seeps from the urethra when the patient coughs.

The examination can be repeated in a standing position with legs spread as wide as the shoulder if urine seepage is not visible when the patient is lying down. The findings obtained from the results of the physical examination are adjusted to the findings from the interview. Then measuring the thickness of the pelvic floor muscles (levator ani) during contraction is to measure the maximum diameter of the pelvic floor muscles (pubovisceral) in two locations bilaterally, two measurements on the right muscle and two measurements on the left muscle and the mean are calculated. Continuing with the perineometer is inserted into the vaginal canal until the compressible portion is above the hymenal ring. Before a contraction is performed, the number on the perineometer is made zero, then the pressure or contraction of the pelvic floor muscles will be recorded. Subjects

were asked to contract pelvic floor muscles and hold with maximum effort for 2 to 3 seconds. Three times the experiment will be carried out with a rest for 10 seconds between contractions. (The highest data that will be taken).

**Statistical Analysis**

Analysis of statistic using SPSS version 20 for analyzing the relationship between the variables. We analyze the relationship between muscle strength and levator ani muscle thickness with confounding variables and the incidence of SUI.

**RESULTS**

The subjects in this study were women who visited the Obstetrics and Gynecology polyclinic of RSUPN Dr. Cipto Mangunkusumo with a positive cough test, with a total of 51 subjects and 10 exclusion subjects due to subjects who could not contract pelvic floor muscles, subjects who have received therapy for SUI such as Kegel exercise, obesity and a history of previous pelvic floor surgery.

The controls in this study were women who visited the Obstetrics and Gynecology polyclinic of RSUPN Dr. Cipto Mangunkusumo with a negative cough test with a total of 50 subjects and 9 exclusion subjects due to subjects who could not contract pelvic floor muscles and obesity.

**Table 1.** Characteristics Subjek

Characteristics	Research Group		P-value
	SUI (%)	Control (%)	
<b>Age (years)</b>			
< 50	11 (26.9)	36 (87.8)	0.001
> 50	30 (73.1)	5 (12.2)	
<b>BMI</b>			
Under/Normal ≤25)	23 (56.1)	17 (41.4)	0.185
Over (>25)	18 (43.9)	24 (58.6)	
<b>Education</b>			
Low	6 (14.6)	3 (7.3)	0.065
Middle	25 (61.0)	18 (43.9)	
High	10 (24.4)	20 (48.8)	
<b>Parity</b>			
Nuli/Primi para	5 (12.2)	10 (24.4)	0.207
Multipara	36 (87.8)	31 (75.6)	
<b>Mode of Delivery</b>			
None	3 (7.3)	3 (7.3)	0.046
Vacuum #)	1 (2.5)	0 (0.0)	
SC #)	0 (0.0)	8 (19.5)	
Spontaneous	37 (90.2)	30 (73.2)	
<b>Menopause</b>			
Yes	28 (68.3)	4 (9.8)	0.001
No	13 (31.7)	37 (90.2)	
<b>Degree of prolapse</b>			
0-1	4 (9.8)	30 (73.2)	0.001
2-4	37 (90.2)	11 (26.8)	

Note: #) combined in the Chi-Square statistical test

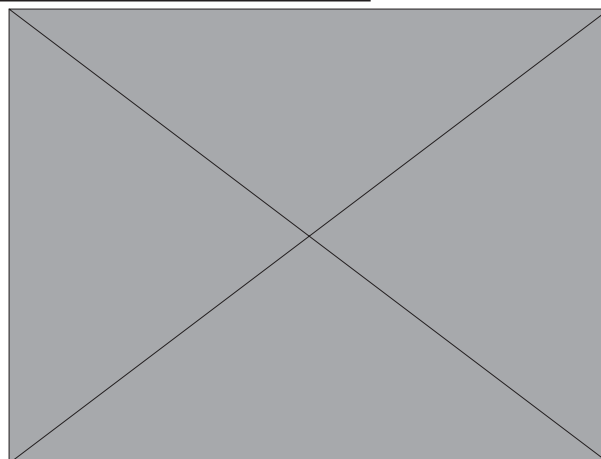
**Table 2.** Median Differences in Thickness and Muscle Strength between the SUI and Control Groups

Parameter	SUI (n=41)		Control (n=41)		P-value
	Median	Range	Median	Range	
Muscle Thickness	0.63	0.31-1.02	0.60	0.41-0.93	0.897
Muscle Strength	19.5	4.6-88.6	34.0	12.5-67.1	0.001

Note: Mann Whitney Test

**The Strength of Relationship between Thickness and Strength of Pelvic Floor Muscles**

The strength of the relationship between muscle strength and levator ani muscle thickness both of which are numerical data was calculated by the Spearman correlation test. This analysis was conducted to test hypothesis <sup>3</sup>. It was found that no correlation was found between the strength and thickness of pelvic floor muscles with the incidence of SUI with p = 0.581.



**Figure 1.** Diagram of muscle thickness and muscle strength of the levator ani

**Table 3.** Multivariate Analysis with the Anova Two Way Method Against Muscle Strength

Variable Independen	Bivariate	Multivariate
SUI	0.001	0.243
Prolapse	0.016	0.844
Age	0.009	0.903

## DISCUSSION

In this study, we get significantly different characteristics between the SUI and control groups: age, mode of delivery, menopause, and the degree of prolapse. For this reason, further analysis is carried out. Multivariate analysis demonstrated that age was not significant for muscle strength. This shows that the relationship between independent variables is very strong so that each other influences each other and causes interaction between variables to be lost. The age group > 50 years in the SUI group was 73.1% compared to the control of 26.9%. Some researchers suggest that the age of most SUI sufferers is indeed in the fifth decade.<sup>8</sup> The same thing was stated that women aged 50 to 54 years had a 1.81 chance of severe incontinence compared to women who were 40 years old (95% CI, 1.66-1.97)<sup>9</sup>. The odds are increasing to 2.8 times and 3.4 times at the age of 50 and 60 years<sup>10</sup>. An intrinsic factor in the appearance of SUI and pelvic organ prolapse. Older age has been thought to be related to increased pelvic dysfunction. This increase in pelvic dysfunction with increasing age is thought to be due to several factors including a decrease in estrogen during the postmenopausal period, as well as normal physiological changes in the pelvic floor components<sup>11</sup>.

Different characteristics were also found in the mode of delivery in which the majority of subjects in the study had a history of spontaneous labour in the two groups, whereas a history of SC delivery was only found to be 19.5% in controls. The delivery method is one of the risk factors for the occurrence of IUT<sup>12</sup>. However, in this study, no further analysis was carried out because it did not meet the requirements where the number of cells that had an expected value of less than 5, a maximum of 20% of the number of cells that did not meet. The protective effect of SC delivery from IUT events. In his study of 4,458 women, the incidence rate of IUT in women who were

nulliparous, SC, and spontaneous labour were 8%, 11%, and 18% ( $p < 0.05$ ). The spontaneous labour group had a significantly higher prevalence of any pelvic floor disorders when compared to the nulliparous and cesarean groups<sup>13</sup>. Pregnancy and childbirth can damage the pudendal nerve, levator ani muscles, endopelvic fascia, and external and internal sphincter. This damage reduces the strength of the PFM (Pelvic Floor Muscle) and can cause increased mobility of the urethrovesical junction<sup>14</sup>. The fact that labour has improved all types of pelvic floor dysfunction. Instrumental vaginal delivery can increase the risk of pelvic floor morbidity<sup>14</sup>.

In this study, subjects who experienced SUI with menopause were significantly higher than the control group. But when further analysis is carried out between strengths to menopause are not significant. So that menopause does not become a confounder for this study. Menopause is one of the predisposing factors for SUI, where estrogen deficiency can cause changes in the atrophy of the urethral mucosa and can cause the urethral tissue to become weaker and thinner<sup>15-17</sup>. This is consistent with the results of previous studies that show the relationship between ageing and menopause with the incidence of urinary incontinence. Urinary incontinence has been found in 50% of postmenopausal women. The high incidence of urinary incontinence in menopausal women is due to estrogen deficiency<sup>18</sup>.

In this study, it was found that in patients with SUI accompanied by POP grades 2-4 higher than those in the control group. After further analysis, the prolapse variable is not significant with the muscle strength variable. This shows that the relationship between independent variables is very strong so that they influence each other. Muscle strength in SUI sufferers who experience POP grade 2-4 is weaker compared to non-prolapse. Fifty per cent of women who experience urogenital prolapse have symptoms of SUI<sup>19</sup>. States the severity of POP has no relationship with the incidence of SUI, this is indicated by the prevalence of SUI in POP grades 1-2 (43.8%) differing significantly with POP degrees 3-4 (53.6%)<sup>20</sup>.

In this study found no significant differences between the two groups in terms of BMI.

These results differ from several previous epidemiological studies which found that obesity is a risk factor for urinary incontinence. The difference in the results of this study can be explained by the exclusion of subjects with obesity or BMI  $\geq 30$  kg / m<sup>2</sup>. The possibility of overweight aetiology for SUI especially with central adiposity increases intra-abdominal pressure and thus pressure on the bladder and pelvic support structures also increase, resulting in the severity of IU also higher<sup>21</sup>.

### **Relationship between Levator Ani Muscle Thickness with SUI**

In this study, there was no significant difference between levator ani muscle thickness and the incidence of SUI. While the literature states that there is muscle thinning in women SUI. But this damage does not necessarily worsen. Muscles will first pass through several stages to end at atrophy, starting from normal muscle, then gradually experiencing insufficiency, until denervation<sup>22</sup>. This is consistent with this study that 80.5% of subjects are still in the category of mild SUI.

Levator ani muscle thickness also has a role in the occurrence of pelvic floor dysfunction. Shobeiri and Berger conducted a study in patients with pelvic floor dysfunction in the form of pelvic organ prolapse. They get an association between levator ani deficiency and pelvic floor dysfunction. Their research states that from evaluating levator ani thickness using the Levator ani deficiency (LAD) scoring system, LAD scores of 3 or more have an increased occurrence of pelvic organ prolapse. The study analyzed levator ani muscle thickness by 3-dimensional ultrasound examination and MRI. It is assumed that the more severe levator ani muscle damage (levator ani deficiency), the higher the degree of pelvic floor dysfunction<sup>23</sup>.

Denervation of the levator ani muscle causes muscular atrophy which subsequently results in the appearance of pelvic organ prolapse and a decrease in the bladder neck which results in SUI. In the levator, ani denervation, myocyte loss, fat infiltration and fibrosis occur. Pelvic floor muscle weakness is caused by a decrease in myocyte diameter, followed by a decrease in levator ani muscle mass<sup>24</sup>.

In the results of this study, the median pelvic floor muscle thickness was 0.63 cm in patients with SUI and 0.60 cm in statistically insignificant controls. This result is different from the results obtained (1.02 cm)<sup>25</sup>. Explanation of possible differences is the difference in methodology, ultrasound equipment used, and nutrition. The absence of a pelvic floor format on USG in Bernstein's research could also make a difference with this study that uses Mindray's USG with the pelvic floor format.

### **Relationship of Levator Ani Muscle Strength with SUI**

The function of the pelvic floor muscles is to contract and relax. In a state of relaxation, pelvic floor muscles help hold the pelvic organs. When there is an increase in intra-abdominal pressure, the pelvic floor muscles contract to hold the pelvic organs. Contractions in the pelvic floor muscles are very important to prevent urinary incontinence and alvi<sup>26</sup>.

This study found that subjects with SUI had a significantly lower median muscle strength value compared to the control group. These results are in accordance with the explanation which explains that continental women have a higher maximum vaginal squeeze pressure compared to women who are<sup>27</sup>. The perineometer that the strength of PFM in women experiencing continence was significantly higher when compared with those incontinent with  $p < 0.00138$ <sup>28</sup>.

To assess the decrease in pelvic floor muscle strength, the examination can be done using finger palpation, perineometer, and transperineal ultrasound. A perineometer is a manometric tool for assessing intravenous pressure, and this quantitative method has been used widely. Transperineal ultrasound had a strong correlation with perineometer and finger palpation to assess pelvic floor muscle contraction ( $p < 0.001$ )<sup>29</sup>. The study found that the perineometer correlated with proportional changes in the hiatal area and anteroposterior diameter on ultrasonography.

Perineometer Peritron is said to have good interrater reliability. However, only a few studies have stated this. The Peritron manometer has high interrater reliability, but not all subjects are evaluated by the same examiner, and this

researcher states that interrater assessments should be carried out by all examiners<sup>30-32</sup>.

### Other Factors that Influence Levator Ani Muscle Strength

In a multivariate analysis, pure SUI, prolapse and age of levator ani muscle strength were not significant. This shows that the relationship between independent variables is very strong so that each other influences each other and causes interaction between variables to be lost. Perrucini et al found that with age there was a decrease in muscle fibre to the ratio of connective tissue and diameter of muscle fibres in the urethral sphincter. Thus, age-related changes cause worse support on the pelvic floor in older women<sup>14</sup>. This will result in reduced muscle strength which eventually results in pelvic organ prolapse and SUI.

### CONCLUSION

There is no significant difference in levator ani muscle thickness between women who experience SUI compared to those who do not. Women with SUI have weaker levator ani muscle strength than those who do not experience but are not statistically significant. There is no correlation between muscle strength and levator ani muscle thickness in women with SUI.

### CONFLICT of INTEREST

None to declare

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