

# The role of body mass index and age on pelvic floor muscle strength

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## Abstract

**Background** Pelvic floor is important in bladder and bowel control, supporting pelvic and abdominal organs, and also plays role in sexual response. Pelvic floor is made up of muscle bundles which cover the pelvic nethermost surface, acting as the base of the pelvic bowl. Pelvic floor muscle (PFM) strength can be decreased by several factors, such as Body Mass Index (BMI) and advanced age, yet there are still conflicting results regarding their correlation. The purpose of this study was to investigate whether age and BMI are correlated with the strength of PFM and to describe the percentage of PFM strength classification of healthy women in Yogyakarta, Indonesia according to the Angelo scale.

**Methods** This is a cross-sectional prospective observational study of 38 healthy women aged between 21 and 47 years-old. The pelvic floor muscles strength measurement was performed using perineometer. The measured PFM value was obtained from 3 maximal isometric contractions for 4 seconds period and were assessed using scale of manometry by Angelo. Body mass index were classified according to World Health Organization (WHO) and age was assessed by the demographic data of the subjects. Statistical analysis was completed with statistical software.

**Results** This study included 32 subjects in total. Median age was 39.50 years old. The mean BMI was 25.45 ( $\pm 4.74$ , CI 23.75-27.16) kg/m<sup>2</sup>, the median of sexual intercourse frequency was 2 ( $\pm 2$ , CI 1.57-2.61), and the mean perineometry score was 22.80 ( $\pm 9.76$ ; CI 18.76-25.0) cmH<sub>2</sub>O. According to Angelo scale, majority subjects had a weak PFM strength. There was no correlation found between PFM strength and age or BMI ( $p > 0.05$ ).

**Conclusion** Majority subjects of this study had a weak PFM strength according to Angelo scale. There was no significant correlation found between PFM strength in women and age or BMI.

## Key words

Pelvic floor muscles, strength, age, body mass index, perineometer.

## Introduction

Pelvic floor muscles are important in bladder and bowel control, supporting pelvic and abdominal organs, and also plays role in sexual response.<sup>1</sup> The prolapse of pelvic organ and the malfunctions of the continence mechanism is commonly described as pelvic floor dysfunction. This condition could cause significant sexual, physical, and social problems which deter the quality of life in women.<sup>2</sup> Pelvic floor is made up of a bundle of muscles that cover the pelvic

nethermost surface, acting as the base of the pelvic bowl. Musculus levator ani (also known as the “deep layer”), musculus perinei (also known as the “superficial layer”), musculus sphincter urethrae, and musculus sphincter ani are muscles which comprise the PFM. There are 2 types of pelvic floor muscle fibers; majority (66%) is the slow-twitch type I muscle fibers, and the rest (34%) is the fast-twitch type II muscle fibers. The type I muscle fibers are responsible for maintaining pelvic organs support at rest and maintaining the tone of

musculus levator ani. The type II muscle fibers sustain a shorter period of contraction than type I fibers and mainly used during sudden intra-abdominal pressure increase (such as sneezing, coughing, or straining) or during stressful condition. The PFM have an important role of maintaining continence by exerting anterior and cephalad actions to close the opening of the pelvic when contracting and by supporting the pelvic organs actively.<sup>3</sup>

Pelvic floor muscle strength can be decreased by several risk factors, including increasing age, number of vaginal deliveries, multipara, obesity and a protuberant stomach, history of episiotomy, abdominal surgeries, chronic respiratory conditions and recurrent urinary tract infections.<sup>4,5</sup> There are still conflicting results regarding the correlation of age and body mass index (BMI) with PFM strength. Data regarding PFM strength measurement with perineometer in Indonesia is still lacking. Some experts use perineometer for examining patients with urinary or fecal incontinence and the other use it for examining sexual dysfunction.<sup>1,6</sup>

This study was conducted to determine whether age and BMI are correlated with the strength of PFM. The other objective of this study is to describe how many percentage of volunteers have a weak, moderate, normal, strong, and very strong PFM strength according to the study protocols.<sup>4</sup>

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## Methods

This is a cross-sectional study which data was collected at Dermatology and Venereology Department, Universitas Gadjah Mada, Yogyakarta from December 2017 to January 2018. Convenient sampling technique was carried out by involving all patients who were willing to take part in the study at the specified location and time. The inclusion criteria of this study consisted of women with non-intact hymen, not experiencing gynecological bleeding, vaginal or urinary infection, or neurological disorders that might affect the cognitive ability, also without history of childbirth or underwent gynecological surgery in the past six months. Subjects who dropped out or canceled their consent to participate in this study, experienced unacceptable pain during vaginal probe insertion, failed to perform isolated PFM contraction or diagnosed to have late-staged pelvic organ prolapse during examination that caused PFM strength measurement painful or challenging were excluded from this study. Written informed consent was collected from all subjects and ethical approval of this study was obtained from Research Ethics Committee of Universitas Gadjah Mada, Yogyakarta. Perineometer (Pelvexiser IQ<sup>®</sup>, C-innovations) was used for PFM measurement in this study, as shown in **Figure 1**.



**Figure 1** Perineometer Pelvexiser IQ<sup>®</sup>

**Table 1** Demographic characteristics of the subjects.

Variables	Mean±SD	Median±IQR	N (%)
Age (years)		39.50±12	32 (100)
Age groups			4 (12.5)
- 18-29			12 (37.5)
- 30-38			16 (50.0)
- 39-49			
BMI (kg/m <sup>2</sup> )	25.45±4.74		32(100)
BMI groups			
- Underweight			3 (9.4)
- Normal			9 (28.1)
- Overweight			15 (46.9)
- Obese			5 (15.6)
PFM strength (cmH <sub>2</sub> O)	22.80±9.76		32
PFM strength group by Angelo <i>et al.</i> , <sup>8</sup>			
- Very weak (7.5-14.5 cmH <sub>2</sub> O)			8 (25)
- Weak (14.6-26.5 cmH <sub>2</sub> O)			13 (40.6)
- Moderate (26.6-41.5 cmH <sub>2</sub> O)			9 (28.1)
- Good (41.6-60.5 cmH <sub>2</sub> O)			2 (6.3)
- Strong (> 60.6 cmH <sub>2</sub> O)			0 (0)

For the ease of measurement, perineometer was equipped with a latex probe (diameter 25±90 mm, length 15 cm), covered with sterile lubricated condom for each measurement and was grade from 0-46 mmHg. All subjects were requested to urinate before the measurement. Subjects were positioned in lithotomy position during the PFM measurement. Brief information regarding PFM general concepts was given to the subjects, therefore they could understand and identify PFM isolated contraction. Perineometer was then inserted in the vaginal canal and after correctly positioned, the perineometer probe was inflated until its reached the sensitivity of each subjects and was maintained for a few seconds to comply with the body temperature of the subjects and to adjust the tool, therefore assuring that optimal setting of the probe was achieved while avoiding causing discomfort or pain for the subjects. The measured PFM value was obtained from 3 maximal isometric contractions for 4 seconds period with 6 seconds rest period between contractions.<sup>4,7</sup> The measurement results were then assessed using scale of manometry by Angelo *et al.*<sup>8</sup> Body mass index value was assessed by using the body weight and height value and was grouped in accordance

with World Health Organization (WHO) classification.<sup>9</sup> Age was assessed and grouped by the demographic data of the subjects.

## Results

The population of this study comprised of 38 women, 3 were excluded for having no noticeable muscle contraction (zero score on perineometer), and 3 for having zero degree of PFM strength based on Angelo classification (<7.5 cmH<sub>2</sub>O), leaving total 32 subjects to be included in the study. The demographic characteristics of this study subjects are presented in **Table 1**. The study participants were found to have median age of 39.50 years old (±12; CI 35.92-40.58), The mean BMI values was 25.45 kg/m<sup>2</sup> (±4.74, CI 23.75-27.16), the median of weekly sexual intercourse frequency was 2 (±2, CI 1.57-2.61), and the mean perineometry score was 22.80 cmH<sub>2</sub>O (±9.76; CI 18.76-25.0). According to Angelo scale, 40.6% (13) subjects had a weak strength, 28.1% (9) had a moderate strength, 25% (8) had a very weak PFM strength, 6.3% (2) had a good strength, and none of them had strong PFM strength.

**Table 2** Statistical analysis of the study.

		Age	BMI
PFM strength	r	-0.046	-0.045
	p	0.803	0.805

**Table 2** shows the correlation analysis results of this study. The table shows that there was no correlation found between age or BMI and PFM strength ( $p>0.05$ ).

## Discussion

This study was aimed to investigate the PFM strength of women using perineometer and the factors affecting it. As far as we can tell, this study is the first study regarding PFM strength classification using Angelo scale in Indonesia, specifically Yogyakarta. The mean PFM strength measurement using perineometer of subjects in this study were found to be weak. This result is consistent with a study from Yaman *et al.*, (2020) who reported that the mean PFM strength using perineometer of the women in Turkey can be classified as low.<sup>10</sup> However, this result is inconsistent with those presented by Angelo *et al.*, (2017) and Chevalier *et al.*, (2014) who both found that majority subjects of their study in Brazil and Spain, respectively, had a moderate PFM strength.<sup>8,11</sup> This discrepancy might be partly explained by the difference ethnicity between studies subjects, of which PFM strength was negatively correlated with dark-skinned ethnicity in the literature.<sup>12</sup> The other possible explanation is the difficulty to perform correct PFM contractions although instruction on the performance of this task had been given.<sup>3</sup>

The number of studies that have assessed the effect of age on the PFM strength in the absence of the disease is still lacking until now. In this study, we found no significant correlation between age and PFM strength. The result of study by Anggraeni *et al.*, (2020) in Jakarta, Indonesia confirmed our finding, showing that

age was not a significant risk factor for the decrease of PFM strength in women.<sup>13</sup> Similar results were obtained by Hwang *et al.*, (2019) and Sartori *et al.*, (2015), they concluded that PFM strength of healthy women had no significant association with their age.<sup>14,15</sup> Trowbridge *et al.*, (2007) also found no difference in PFM strength based on age of 20-70 years old nulliparous women.<sup>16</sup>

However, another studies confirmed different results. Demir and Comba (2021) found that increased age is a significant risk factor for decreased PFM strength in a study of 250 Turkey women.<sup>17</sup> Gumussoy *et al.*, (2021) and Yaman *et al.*, (2020) also confirmed that age of women had a significant inverse correlation with perineometer values of PFM.<sup>10,18</sup> Another study by Ozdemir *et al.*, (2017) also concluded that age 40 or higher was one of significant factors correlated with PFM weakness.<sup>2</sup>

The disparities observed between those study results might be correlated to the fact that a quite significant number of average women failed to correctly contracting their PFM voluntary during routine visit and this inability does not correlate with their age.<sup>16,19</sup> Many elderly women were found to have normal PFM function, therefore age might not be the sole risk factor of PFM strength change in elderly.<sup>15,19</sup> This could be partially explained by finding that levator ani muscles as the major part of PFM are mostly populated by type I muscle fibers which both their number and diameter are largely unaffected by age.<sup>3,16</sup>

This study also found no significant correlation between PFM strength measured by perineometer with BMI values. This is in accordance with study of Hwang *et al.*, (2019) who found no relation between PFM strength or endurance with BMI values of 125 parous middle-aged women in South Korea.<sup>14</sup> Sartori *et*

al., (2018) also concluded that BMI values did not significantly impact the PFM strength of 140 healthy women in Brazil.<sup>20</sup>

Different studies have reported contrast results according to the effect of BMI values on PFM strength in women. Some studies found that having BMI values  $\geq 30$  leads to weakening of the PFM strength in women over time.<sup>21,22</sup> Gumussoy *et al.*, (2021) also Demir and Comba (2021) further confirmed this finding by concluded that there was a inverse correlation between PFM strength and BMI values in Turkey women population.<sup>17,18</sup> Yaman *et al.*, (2020) in their study found that majority of women with very low perineometer values were found to have BMI values of  $\geq 30$ , and the correlation was statistically significant.<sup>10</sup> A study of Iranian middle-age women population also concluded that the increase in BMI value will accompanied with PFM strength decrease.<sup>23</sup>

The weakening of PFM strength in women might be caused several factors, one of which is intraabdominal pressure increase. This increased pressure will cause the damage of fascia, collagen, muscle and nerves of pelvic floor structures.<sup>10,21,23</sup> Intraabdominal pressure increase might be due to obesity.<sup>23</sup> Generally, obesity is considered to be caused by the excess of body fat which commonly interpreted as BMI values more than 30.<sup>23,24</sup> However someone might also get this BMI value due to having extra muscle, bone, or water in their body because BMI could no differentiate between fat and other body compounds which generate body weight. Measurement of total body percentage is considered more appropriate to establish obesity diagnosis when considering factors affecting PFM strength.<sup>24</sup>

The discrepancies between this study results with references might be partially explained by the various factor that potentially contributed in

PFM strength in women which need to be noted in mind such as parity, mode of delivery, estrogen deficiency, ethnicity, history of comorbidities and pelvic surgery.<sup>18,22,25</sup>

The strengths of this study included the objective measurement of PFM strength using perineometer making the muscle strength results more reliable. The results from our study also add importance findings in terms of PFM strength classification of Indonesian women and its correlation with several factors. The limitations of our study include small sample sizes and incomplete sociodemographic data of study population. Future larger sample size studies may assist to fortify our study results.

## Conclusion

The first conclusion of this study is that majority subjects had a weak PFM strength according to Angelo scale. The second conclusion is that there was no correlation found between PFM strength in women with age and BMI value.

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