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Original Research Article

Pelvic Floor Muscle Anatomy and Its Correlation with Pelvic Organ Prolapse Severity in Reproductive-Age Women

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Name of Author:
Somtochukwu Judith Okafor[1], Dr Yasmeen Nawaz khooharo[2], Dr. Shazia Saaqib[3], Dr Naeem Shahzad[4], Dr Sadia Dilawar[5], Muhammad Shahzad Chohan[6] and Dr Zahra Ali[7]

Affiliation: *[1]Department of Surgery, University of Debrecen, Debrecen, Hungary*
[2]MBBS, FCPS Professor Obstetrics and Gynaecolgy, Muhammad Medical College .Ibn e Sina University,
[3]Assistant Professor Obstetrics & Gynecology, Allama Iqbal Medical College/Jinnah Hospital, Lahore
[4](MBBS, MPhil Anatomy) Assistant Professor of Anatomy, M Islam Medical and Dental College, Gujranwala
[5]Assistant Professor Obstetrics and Gynaecology, Abbottabad International Medical College, Abbottabad
[6]Assistant Professor Anatomy and Histology Department of BioMedical Sciences King Faisal University, Al ahsa Saudi Arabia
[7]Postgraduate Resident Obstetrics and Gynaecolgy, Sir Ganga Ram Hospital, Lahore.

Corresponding Author:
Dr Zahra Ali

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Abstract: ***Background***: Pelvic organ prolapse (POP) is a common gynecological disorder resulting from weakening of pelvic floor muscles and connective tissue supports. Objective: To evaluate pelvic floor muscle anatomy and determine its correlation with the severity of pelvic organ prolapse in reproductive-age women. ***Methodology***: This retrospective analytical cross-sectional study was conducted at the Department of Obstetrics and Gynaecolgy of Jinnah Hospital, Lahore from December 2024 to May 2025. Medical records of 125 reproductive-age women diagnosed with pelvic organ prolapse were reviewed. Demographic and obstetric variables were recorded. Prolapse severity was assessed using the Pelvic Organ Prolapse Quantification (POP-Q) system. ***Results***: The mean age was 32.8 ± 6.4 years, and most participants were multiparous with predominantly vaginal deliveries (72.0%). Stage II prolapse was the most frequent (40.0%). Pelvic floor muscle strength decreased progressively with increasing prolapse stage (3.9 ± 0.8 in Stage I vs 1.6 ± 0.7 in Stage IV; $p < 0.001$). Levator hiatus area significantly increased (13.4 ± 1.9 cm² vs 21.6 ± 2.8 cm²), while muscle thickness decreased across stages ($p < 0.001$). A strong negative correlation was observed between muscle strength and prolapse severity ($r = -0.72$), whereas hiatus area showed a strong positive correlation ($r = +0.76$). ***Conclusion***: It is concluded that pelvic floor muscle weakness and anatomical deterioration are significantly associated with increasing severity of pelvic organ prolapse.

Keywords: Pelvic organ prolapse, pelvic floor muscles, levator ani, pelvic anatomy, POP-Q, muscle strength.

INTRODUCTION

Pelvic floor disorders are an important but not well-recognized cause of morbidity in women across the globe, impacting physical and psychological health, as well as the quality of life [1]. Pelvic organ prolapse (POP) is a gynecological condition in which pelvic organs, such as the bladder, uterus, rectum, or apex of the vaginal canal, are displaced through the vaginal canal due to weakening of the pelvic floor support structures [2]. Even though traditionally, pelvic organ prolapse is a disorder of postmenopausal or elderly women, it is now becoming common in women of childbearing age, especially in areas with high parity, early delivery, and inaccessible preventive health services [3]. Prolapse in younger women not only influences daily functioning but can also disrupt sexual health, fertility, and psychosocial well-being, and, therefore, early identification and management are critical matters [4]. The pelvic floor is a multifaceted anatomical and functional structure that consists of muscles, ligaments, connective tissues, as well as fascial supports, which as a group, keep the position of organs of the pelvis and continence intact [5]. The major muscular element is the levator ani group, or pubococcygeus, puborectalis, and iliococcygeus muscles, and the coccygeus muscle. The muscles form a dynamic, hammock-like system that lifts the pelvic viscera and resists increases in intra-abdominal pressure during coughing, sneezing, lifting, and birth. These muscles need adequate tone, strength and coordination to ensure continence and prevent organ descent [6].

The disruption or weakness of the pelvic floor muscles may be caused by a number of factors, such as pregnancy, vaginal birth, the length of labor, obstetric trauma, chronic straining, obesity, aging, and connective tissue disorders [7]. Contractile dysfunction in the levator ani muscles can result from repetitive stretching or direct trauma during childbirth, which may lead to muscle avulsion, nerve damage, or loss of contractility, thereby impairing pelvic support. Such changes might cause a gradual slackening of the pelvic floor and result in pelvic organ prolapse [8]. It has been believed that the degree of muscular and fascial damage is associated with the severity of prolapse, but this has not always been measured, especially in young women. In anatomy, the pelvic organ support requires both active and passive elements [9]. The active component comprises the pelvic floor muscles, which provide dynamic contraction and resistance, whereas the passive component comprises connective tissues, including the endopelvic fascia, uterosacral ligaments, cardinal ligaments, and perineal body [10]. Any disruption or weakness of either of the components could predispose women to prolapse. The growing evidence, however, indicates that muscular defects, especially levator ani muscle injury, are pertinent in the pathogenesis of POP [11]. Widening of levator hiatus and muscle detachment greatly decrease pelvic organ support, which permits even the presence of intact connective tissues to allow descent. Thus, evaluating the integrity and functional capacity of these muscles is a crucial step in understanding the degree of prolapse. Biomuscularly, the pelvic floor must work in constant opposition to gravitational forces and to acute changes in intra-abdominal pressure during daily activities such as coughing, laughing, lifting heavy objects, or defecation [12]. With insufficient muscle rest, repeated mechanical stress conditions may result in progressive fatigue and microtrauma. Pregnancy itself in reproductive-age women exerts long-term pressure on the pelvic floor because of the expansion of the uterus and changes in hormones that cause softening of connective tissues [13]. Also, vaginal birth might lead to excessive stretching or tearing of muscles and fascia, which makes one more vulnerable to subsequent prolapse. Women who have more than one or even closely conceived pregnancies are thus at high risk [14].

Objective

To evaluate pelvic floor muscle anatomy and determine its correlation with the severity of pelvic organ prolapse in reproductive-age women.

METHODOLOGY

This retrospective analytical cross-sectional study was conducted at the Department of Obstetrics and Gynaecolgy of Jinnah Hospital, Lahore from December 2024 to May 2025. A sample of 125 eligible patient records was used in the final analysis. The sample was chosen by non-probability consecutive sampling of hospital records which fulfilled the eligibility criteria set. The inclusion criteria were medical records on women with pelvic organ prolapse aged 18-45 years. Only the cases that had full documentation of the clinical findings of pelvic examination, staging of prolapse and pelvic floor muscle evaluation (clinical or imaging-based) were eligible to be analyzed. Patients who were postmenopausal, pregnant during the evaluation period, or had previous pelvic reconstructive or prolapse surgery, or were exposed to conditions that might have an independent influence on the integrity of the pelvic floor muscle were also not included in the records. The incomplete or missing data records were also eliminated to be accurate in the analysis.

Data Collection

The retrospective data collection used a structured data extraction form to obtain information from hospital medical records, examination notes, and imaging reports. Demographic data were collected, including age, parity, body mass index, obstetric history, and mode of delivery. Available clinical symptoms of pelvic floor dysfunction, including vaginal bulge, urinary issues, or bowel issues, were also mentioned. The severity of pelvic organ prolapses had already been evaluated and recorded using the standardized Pelvic Organ Prolapse Quantification (POP-Q) system. On the basis of these findings, patients were divided into various prolapse stages (Stage 0-IV), which obtained a status of the key measurement of the severity of prolapse. The pelvic floor muscle was assessed for anatomy and function based on the documented results of clinical examination and available imaging studies. Pelvic muscle strength of the pelvic floor had been documented with the help of digital pelvic examinations that were conducted by gynecologists with the help of the Modified Oxford Grading Scale.

Secondly, imaging data of transperineal or transvaginal ultrasonography and/or magnetic resonance imaging were reviewed to determine measurements of levator ani muscle thickness, levator hiatus size, and muscle defects or avulsion. The main finding was the association between the anatomical features of the pelvic floor muscles and the extent of pelvic organ prolapse. The secondary outcomes were evaluation of the relationships between demographic and obstetric factors (parity, mode of delivery and body mass index) and prolapse stage.

Statistical Analysis

All extracted data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 26.0. Continuous variables were summarized as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Comparisons of pelvic floor muscle parameters across prolapse stages were performed using an independent-samples t-test or a one-way analysis of variance (ANOVA), as appropriate. Correlation between pelvic floor muscle measurements and prolapse severity was assessed using Pearson's or Spearman's correlation coefficients. A p-value ≤ 0.05 was considered statistically significant.

RESULTS

Data were collected from 125 patients, mean age was 32.8 ± 6.4 years, with the largest proportion belonging to the 30–39-year age group (44.0%), followed by 18–29 years (33.6%) and 40–45 years (22.4%). The average body mass index was 27.3 ± 3.8 kg/m², indicating that most participants were overweight. The mean parity was 3.1 ± 1.5, reflecting multiparity as a common characteristic. Vaginal delivery was the predominant mode of childbirth, observed in 72.0% of women, whereas 28.0% had cesarean deliveries. Most participants were homemakers (62.4%), whereas 37.6% were employed or engaged in manual labor.

Table 1. Baseline Demographic, Obstetric Characteristics and Prolapse Severity of Participants (n = 125)

Variable	Category	n (%) / Mean ± SD
Age (years)	—	32.8 ± 6.4
	18–29	42 (33.6)
	30–39	55 (44.0)
	40–45	28 (22.4)
BMI (kg/m²)	—	27.3 ± 3.8
Parity	—	3.1 ± 1.5
Mode of delivery	Vaginal	90 (72.0)
	Cesarean	35 (28.0)
Occupation	Household work	78 (62.4)
	Employed/manual labor	47 (37.6)
POP-Q Stage	Stage I	30 (24.0)
	Stage II	50 (40.0)
	Stage III	35 (28.0)
	Stage IV	10 (8.0)
Total	—	125 (100)

Women with Stage I prolapse demonstrated near-normal strength (3.9 ± 0.8), while Stage II showed moderate reduction (3.1 ± 0.9). Strength decreased further in Stage III (2.3 ± 0.8) and was lowest in Stage IV (1.6 ± 0.7).

Table 2. Pelvic Floor Muscle Strength (Modified Oxford Scale) Across Prolapse Stages

Prolapse Stage	Mean Strength Score ± SD	Minimum–Maximum	p-value*
Stage I	3.9 ± 0.8	3–5	
Stage II	3.1 ± 0.9	2–4	
Stage III	2.3 ± 0.8	1–3	
Stage IV	1.6 ± 0.7	1–2	**<0.001**

The levator hiatus area progressively enlarged from 13.4 ± 1.9 cm² in Stage I to 21.6 ± 2.8 cm² in Stage IV. Similarly, the hiatal diameter increased steadily from 3.6 ± 0.5 cm to 5.3 ± 0.8 cm. Conversely, levator ani muscle thickness declined from 1.12 ± 0.21 cm to 0.64 ± 0.18 cm with advancing prolapse. All differences were highly significant ($p < 0.001$).

Table 3. Pelvic Floor Anatomical Measurements by Prolapse Severity

Parameter	Stage I	Stage II	Stage III	Stage IV	p-value*
Levator hiatus area (cm²)	13.4 ± 1.9	15.9 ± 2.1	18.8 ± 2.4	21.6 ± 2.8	<0.001
Levator ani thickness (cm)	1.12 ± 0.21	0.98 ± 0.20	0.81 ± 0.19	0.64 ± 0.18	<0.001
Hiatal diameter (cm)	3.6 ± 0.5	4.1 ± 0.6	4.7 ± 0.7	5.3 ± 0.8	<0.001

Correlation analysis demonstrated a strong negative association between pelvic floor muscle strength and prolapse severity ($r = -0.72$, $p < 0.001$), meaning weaker muscles were linked with more advanced prolapse. Levator hiatus area showed a strong positive correlation ($r = +0.76$, $p < 0.001$), indicating that larger hiatal dimensions corresponded to higher prolapse stages. Muscle thickness also exhibited a significant negative correlation ($r = -0.68$, $p < 0.001$). Additionally, parity showed a moderate positive correlation ($r = +0.52$, $p = 0.002$), while BMI demonstrated a weaker but significant positive association ($r = +0.34$, $p = 0.01$).

Table 4. Correlation Between Pelvic Floor Parameters and Prolapse Severity

Variable	Correlation Coefficient (r)	p-value
Muscle strength	–0.72	<0.001
Levator hiatus area	+0.76	<0.001
Muscle thickness	–0.68	<0.001
Parity	+0.52	0.002
BMI	+0.34	0.01

Women with mild prolapse had better muscle strength (3.4 ± 0.9 vs 2.1 ± 0.8), smaller hiatus area (15.2 ± 2.3 vs 19.7 ± 2.6 cm^2), and greater muscle thickness (1.01 ± 0.20 vs 0.74 ± 0.18 cm) compared to those with advanced prolapse. These differences were statistically significant ($p < 0.001$).

Table 5. Comparison of Pelvic Floor Muscle Characteristics (Mild vs Moderate–Severe Prolapse)

Variable	Stage I–II (n=80) Mean ± SD	Stage III–IV (n=45) Mean ± SD	p-value*
Muscle strength score	3.4 ± 0.9	2.1 ± 0.8	<0.001
Hiatus area (cm^2)	15.2 ± 2.3	19.7 ± 2.6	<0.001
Muscle thickness (cm)	1.01 ± 0.20	0.74 ± 0.18	<0.001

DISCUSSION

Pelvic organ prolapse (POP) is also an important source of gynecological morbidity in reproductive age women, who experience aging-associated weakening of the support of the pelvic floor muscles and connective tissue. The current retrospective analytical study examined the association between pelvic floor muscle anatomy and the severity of pelvic organ prolapse in 125 women. The results showed a close, statistically significant correlation between pelvic floor muscle weakness, changes in anatomical parameters, and the increasing severity of prolapse. These findings support the idea that impairments in the functional as well as structural pelvic floor, are at the center of the pathophysiology and pathogenesis of POP. The participants in the present research were of an average age of 32.8 +- 6.4, with the majority of the participants being within 30-39 years. This brings out the fact that pelvic organ prolapse is not a purely postmenopausal disorder, but also affects women in the reproductive age, especially those who have had multiple childbirths [15]. The fact that the majority of our population is multiparty (mean parity 3.1 +- 1.5) and that most vaginal births (72%) are carried out also confirms the established correlation between obstetric trauma and pelvic floor injuries. It is known that repeated stretching, denervation, and mechanical strain during vaginal birth weaken levator ani muscles and fascial supports, making women vulnerable to prolapse even at an earlier age. The same type of associations has been found in the studies conducted in the past, where parity and vaginal delivery were defined as the most predictive factors of pelvic floor dysfunction. Regarding prolapse distribution, Stage II prolapse was most common, followed by Stage III [16]. This trend implies that the majority of women address medical care when the symptoms have reached moderate or severe levels. Mild prolapse is frequently asymptomatic or underreported; consequently, disease presentation and course are delayed. The discovery is consistent with earlier clinical evidence that symptomatic severity, rather than anatomical stage, is the primary determinant of healthcare use [17].

The finding that pelvic floor muscle strength declines over time as prolapse severity increases was among the most significant discoveries in the study. Stage I prolapse women exhibited muscle contraction that was almost normal (3.9±0.8), whereas contractile strength was significantly lower in Stage IV (1.6±0.7). The negative correlation of -0.72 ($p<0.001$) provides strong evidence that pelvic muscle weakness is directly associated with organ descent. Decreased muscle tone impairs the hammock-like support function of the levator ani, preventing it from counteracting intra-abdominal pressure and resulting in pelvic organ displacement. This functional degradation likely contributes to the formation and subsequent development of the prolapse [18]. The current research is significant to management strategies. Establishing pelvic floor muscle support through structured physiotherapy programs, biofeedback, and lifestyle modifications may help prevent disease onset. Also, routine pelvic floor examination should be integrated into gynecological examinations to enhance early diagnosis and treatment, especially in high-risk women, such as multiparous women. Along with these significant results, certain limitations must be acknowledged. The study is retrospective, based on potentially biased recorded clinical and imaging data in the past, and thus subject to documentation bias [19]. No obvious causal relationships are discernible. Additionally, the research was conducted at a single center, which may not be generalizable. However, the relatively large sample size and the use of standardized POP-Q staging and objective anatomical measures enhance the reliability of the study's outcomes [20, 21]. In general, the results of the current research indicate that the severity of prolapse is closely related to the strength of the pelvic floor muscles and their anatomical integrity. These findings indicate that early evaluation and preventive measures can be used to ensure pelvic floor functionality and lessen the burden of pelvic organ prolapse in women of reproductive age.

CONCLUSION

It is concluded that pelvic floor muscle anatomy is significantly correlated with the severity of pelvic organ prolapse in reproductive-age women. Reduced pelvic floor muscle strength, increased levator hiatus dimensions, and decreased levator ani muscle thickness were strongly associated with higher stages of prolapse. Both functional impairment and structural deterioration of the pelvic floor contribute substantially to the development and progression of the condition. Obstetric factors, particularly multiparity and vaginal deliveries, were also found to play an important role in weakening pelvic support structures.

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