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Correlation Between Perceived Stress (PSS-10) and Pelvic Floor Muscle Tone in Nulliparous Females: A Cross-Sectional Study Utilizing the Reissing Scale

Rutuja Shardul[1]; Payal P. Sancheti[2*]

[1]Physiotherapist; [2]Assistant Professor; Department of Community Physiotherapy, Dr. Ulhas Patil College of Physiotherapy Jalgaon, Maharashtra, India

Corresponding Author: Payal P. Sancheti[2]

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Abstract: Pelvic floor muscle dysfunction in nulliparous women frequently manifests as resting hypertonicity and impaired voluntary relaxation driven by stress-mediated somatic guarding. Because conventional clinical scales assess only active contractile strength, the relationship between perceived stress and resting pelvic floor tone remains unquantified. To evaluate the correlation between perceived stress (Cohen Perceived Stress Scale [PSS-10]) and resting pelvic floor muscle tone and relaxation capacity (Reissing Digital Palpation Scale) in nulliparous females. In this cross-sectional study, 120 nulliparous women (aged 18–30 years) completed the PSS-10. An independent, blinded pelvic health physical therapist performed internal digital examinations to grade resting tone (-3 to +3) and post-contraction voluntary relaxation (prompt, delayed, or absent) using the Reissing protocol. Associations were analyzed via Spearman's rank correlation (ρ), Kruskal-Wallis, and Chi-square tests. The mean PSS-10 score was 20.4 ± 6.9. Overall, 52.5% (n = 63) of participants exhibited resting hypertonicity (Reissing score ≥ +1). PSS-10 scores correlated moderately-to-strongly with resting tone ($\rho = 0.564$, $p < 0.001$). Compared to the low-stress group (10.7%), participants in the highstress tier (PSS-10 ≥ 27) demonstrated significantly higher median tone ($H = 38.41$, $p < 0.001$) and marked post-contraction relaxation impairment (76.7% delayed or absent vs. 10.7%, $\chi^2 = 34.12$, $p < 0.001$). Elevated perceived stress correlates directly with higher resting pelvic floor muscle tone and impaired voluntary relaxation in nulliparous women. Clinical assessments in young females should integrate stress and resting-tone evaluations to prevent contraindicated muscle-strengthening prescriptions.

Keywords: *Non-Relaxing Pelvic Floor, Nulliparous, Pelvic Floor Hypertonicity, Perceived Stress Scale (PSS-10), Reissing Scale, Somatic Guarding.*

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I. INTRODUCTION

Pelvic floor dysfunction (PFMD) has traditionally been approached through a biomechanical model centered on muscle weakness, tissue stretching, and anatomical avulsion. As a result, clinical research has focused predominantly on parous and postmenopausal populations, where obstetric events such as vaginal delivery, instrumental assistance, and perineal lacerations represent the primary etiologies of stress urinary incontinence and pelvic organ prolapse [1], [2].

In contrast, an increasing number of young, nulliparous women present to outpatient physiotherapy clinics with pelvic floor complaints—such as dyspareunia, non-bacterial urinary urgency, chronic pelvic pain, and obstructive defecation—in the complete absence of obstetric trauma [3]. In this population, the underlying neuromuscular pathology is rarely hypotonia or muscle weakness. Instead, it is predominantly characterized by hypertonicity, chronic resting tension, and an inability to voluntarily relax or derecruit the levator ani complex, clinically classified by the International Continence Society (ICS) as a "non-relaxing pelvic floor" [4], [5].

The primary mechanism hypothesized to drive non-relaxing pelvic floor states in anatomically intact women is the neuropelvic stress axis. The pelvic diaphragm receives dense somatomotor and autonomic innervation, functionally responding as an unconditioned target for central nervous system arousal. Landmark electromyographic studies have demonstrated that psychological threat and acute mental

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distress trigger an immediate, involuntary increase in baseline pelvic floor muscle activity [6]. Under chronic, unmanaged life stress, this temporary defensive response evolves into habitual somatic guarding—a persistent state of low-level motor unit recruitment analogous to stress-induced bruxism (jaw clenching) or upper trapezius tension. Over time, sustained mechanical contraction leads to local muscle ischemia, reduced tissue compliance, and the development of tender myofascial trigger points within the puborectalis and pubococcygeus muscles [5], [7].

Despite this clear neurobiological link, evaluating stressinduced pelvic muscle guarding in clinical practice has been hampered by a key diagnostic limitation: conventional assessment tools evaluate only active contraction. The Modified Oxford Scale (MOS), which is standard in pelvic physiotherapy, scores muscle function on a 0 to 5 continuum based strictly on voluntary inward squeeze and lift against an examiner's finger [8]. The MOS has no parameters to grade baseline resting tone, involuntary tightness, or postcontraction derecruitment.

To address this gap, Reissing and colleagues [9] developed and validated a specialized 7-point digital palpation scale (-3 to +3) specifically designed to grade resting tone from flaccid hypotonia to severe hypertonic spasm, while also standardizing criteria for post-contraction relaxation latency, an approach subsequently corroborated for evaluating pelvic hypertonia and provoked pelvic pain syndromes [10].

Furthermore, while severe clinical anxiety and psychiatric mood disorders have been linked to chronic pelvic pain syndromes, the relationship between everyday perceived psychological stress—the subjective appraisal that life demands are unpredictable, uncontrollable, and overloading—and physical pelvic muscle tone remains unquantified [11]. Nulliparous women represent the ideal cohort to isolate this question, as their pelvic musculature is entirely unaffected by the anatomical trauma of childbirth.

Therefore, the primary objective of this cross-sectional study was to investigate the direct correlation between perceived psychological stress (PSS-10) and pelvic floor muscle resting tone and voluntary relaxation capability (measured via the Reissing Scale) in nulliparous females using a lean, twoinstrument clinical protocol.

II. MATERIALS AND METHODS

➢ *Study Design and Setting*

This was a prospective, cross-sectional observational study conducted at an academic outpatient physiotherapy and pelvic health center between April 2025 and November 2025. All participants provided written informed consent prior to enrollment.

➢ *Participants*

Nulliparous women were recruited from local university campuses, hospital administrative staff, and outpatient physiotherapy clinics via informational flyers and digital announcements.

- *Inclusion Criteria:*

✓ Biological females aged 18 to 30 years.
✓ Nulliparous status (gravida 0, para 0; verified by medical intake).
✓ Willingness to undergo an internal digital vaginal examination.

- *Exclusion Criteria:*

✓ Prior history of pelvic, lower abdominal, or gynecological surgery (uncomplicated diagnostic laparoscopy > 12 months prior was permitted).
✓ Current pregnancy.
✓ Active genitourinary infection (confirmed via negative point-of-care urinalysis).
✓ Diagnosed systemic connective tissue disease, neurological motor disorders, or active pelvic inflammatory disease.
✓ Use of systemic muscle relaxants, oral antispasmodics, or tricyclic antidepressants within the past 30 days.

➢ *Experimental Procedure*

To eliminate diagnostic confirmation bias, the protocol followed a strict two-step sequence with complete examiner blinding:

- Step 1: Psychometric Evaluation (Self-Administered): Participants completed the 10-item Cohen Perceived Stress Scale (PSS-10) privately in a digital portal. Baseline age and Body Mass Index (BMI) were recorded. Scores were stored securely and remained inaccessible to the clinical examiner [12].
- Step 2: Standardized Internal Digital Examination: A single licensed pelvic health physical therapist, blinded to all survey scores, performed an internal digital vaginal examination using the standardized Reissing protocol to grade resting tone (-3 to +3) and post-contraction relaxation latency (prompt, delayed, or absent).

➢ *Measurement Instruments*

- *Exposure Measure: Cohen Perceived Stress Scale (PSS10)*

The PSS-10 is a validated 10-item self-report questionnaire measuring the degree to which life situations over the previous month are perceived as unpredictable, uncontrollable, and overwhelming [11]. Each item is rated on a 5-point Likert scale (0 = Never, 1 = Almost Never, 2 = Sometimes, 3 = Fairly Often, 4 = Very Often). Items 4, 5, 7, and 8 are reverse-scored. Cumulative scores range from 0 to 40, categorized into three clinical tiers:

✓ Low Stress: 0–13
✓ Moderate Stress: 14–26
✓ High Stress: 27–40

- *Outcome Measure: The Reissing Digital Palpation Scale*

Pelvic floor muscle tone and relaxation were assessed via digital vaginal examination performed by a single licensed pelvic health physical therapist with over seven years of clinical experience. The examiner was strictly blinded to the participant's PSS-10 score.

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The participant was positioned in the dorsal lithotomy position with feet flat, knees flexed at approximately 60°, and the head supported at 30° on a pillow. A single, gloved, lubricated index finger was introduced 3 to 4 cm past the introitus, palpating the bilateral puborectalis and pubococcygeus muscle bellies along the posterior-lateral vaginal wall [9].

✓ Part A: Resting Tone: Following 60 seconds of quiet diaphragmatic breathing to allow neuromuscular accommodation [13], baseline resting tone was graded on the 7-point Reissing Scale:

- -3 = Severe hypotonia (flaccid, complete absence of resistance)
- -2 = Moderate hypotonia
- -1 = Mild hypotonia
- 0 = Normal physiological tone (soft, compliant, nontender tissue)
- +1 = Mild hypertonicity (slight resistance; sluggish passive give)
- +2 = Moderate hypertonicity (firm resistance, palpable taut bands, mild tenderness)
- +3 = Severe hypertonicity (rigid, unyielding resistance; marked tenderness/spasm)

✓ Part B: Voluntary Relaxation Capability: The participant performed a 3-second maximal voluntary contraction (MVC): "Squeeze and lift your pelvic floor around my finger." Immediately following 3 seconds, the examiner instructed: Now let it completely go and relax." Relaxation was categorized as:

- Prompt / Complete: Immediate return to baseline resting tone within ≤ 2.0 seconds.
- Delayed / Incomplete: Sluggish descent taking > 2.0 seconds, or failure to return fully to baseline.
- Absent (Non-relaxing): Inability to release; the muscle remains contracted in persistent spasm or contracts paradoxically.

➢ *Statistical Analysis*

Data were analyzed using SPSS version 29.0 The normality of continuous variables was assessed using the Shapiro-Wilk test. Continuous data were summarized as mean ± standard deviation (SD) or median [interquartile range, IQR], and categorical variables as counts and percentages (n, %).

- Primary Correlation: Evaluated using Spearman's rank correlation coefficient (ρ) between continuous PSS-10 scores and ordinal Reissing resting tone scores.
- Group Comparisons: Differences in Reissing tone scores across the three PSS-10 strata (Low vs. Moderate vs. High) were analyzed using the Kruskal-Wallis H-test with post-hoc pairwise Bonferroni adjustments. Differences in categorical relaxation capacity (prompt vs. delayed vs. absent) were tested using the Pearson Chi-square (χ^2) test.
- Sample Size Calculation: Based on an expected correlation of $\rho = 0.35$, an alpha level of $\alpha = 0.05$ (twotailed), and statistical power of 90% ($\beta = 0.10$), the minimum required sample size was N = 82. To account for potential protocol deviations and ensure robust group cell counts, target recruitment was set to N = 120.

III. RESULTS

➢ *Cohort Characteristics and Stress Stratification*

A total of 126 women were screened; 6 were excluded (active candidiasis: n = 2; prior pelvic surgery: n = 1; declined digital exam: n = 3), yielding a final analytical sample of N = 120. The mean age was 23.6 ± 3.1 years, and the mean BMI was 22.1 ± 2.8 kg/m². The mean continuous PSS-10 score was 20.4 ± 6.9 (range: 6–36). Stratification by stress tiers allocated 28 participants (23.3%) to Low Stress (PSS-10 ≤ 13), 62 participants (51.7%) to Moderate Stress (PSS-10: 14–26), and 30 participants (25.0%) to High Stress (PSS-10 ≥ 27).

➢ *Pelvic Floor Resting Tone Distribution*

No participants exhibited pelvic floor hypotonia (Reissing scores -1, -2, -3). Normal physiological resting tone (score 0) was documented in 57 participants (47.5%). Resting hypertonicity (Reissing score ≥ +1) was present in 52.5% (n = 63) of the cohort:

- Grade +1 (Mild hypertonia): n = 34 (28.3%)
- Grade +2 (Moderate hypertonia): n = 21 (17.5%)
- Grade +3 (Severe hypertonia / spasm): n = 8 (6.7%)

As detailed in Table 1, resting tone differed significantly across the three perceived stress tiers ($H = 38.41$, $p < 0.001$). In the Low Stress tier, 85.7% (n = 24) exhibited normal resting tone, and none exhibited Grade +2 or +3 hypertonia. In the High Stress tier, only 10.0% (n = 3) had normal resting tone, while 43.3% (n = 13) demonstrated Grade +2 and 26.7% (n = 8) demonstrated Grade +3 hypertonicity.

Table 1 Demographic Characteristics and Pelvic Floor Measures Across Stress Tiers

Clinical Parameter	Full Cohort (N = 120)	Low Stress (n = 28)	Moderate Stress (n = 62)	High Stress (n = 30)	Test Statistic	p-value
Age (years), mean ± SD	23.6 ± 3.1	24.1 ± 3.0	23.4 ± 3.2	23.5 ± 3.0	F = 0.58	0.562
BMI (kg/m²), mean ± SD	22.1 ± 2.8	21.8 ± 2.6	22.2 ± 2.9	22.3 ± 2.8	F = 0.29	0.748
PSS-10 Score, mean ± SD	20.4 ± 6.9	10.1 ± 2.2	20.2 ± 3.4	30.4 ± 2.8	F = 352.1	< 0.001
Reissing Tone Grade, n (%)					$\chi^2 = 56.84$	< 0.001

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Grade 0 (Normal Tone)	57 (47.5%)	24 (85.7%)	30 (48.4%)	3 (10.0%)		
Grade +1 (Mild Hypertonia)	34 (28.3%)	4 (14.3%)	24 (38.7%)	6 (20.0%)		
Grade +2 (Mod. Hypertonia)	21 (17.5%)	0 (0.0%)	8 (12.9%)	13 (43.3%)		
Grade +3 (Sev. Hypertonia)	8 (6.7%)	0 (0.0%)	0 (0.0%)	8 (26.7%)		
Relaxation Status, n (%)					$\chi^2 = 34.12$	< 0.001*
Prompt (≤ 2.0 s)	71 (59.2%)	25 (89.3%)	39 (62.9%)	7 (23.3%)		
Delayed (> 2.0 s)	38 (31.7%)	3 (10.7%)	20 (32.3%)	15 (50.0%)		
Absent (Non- relaxing)	11 (9.2%)	0 (0.0%)	3 (4.8%)	8 (26.7%)		

Statistically Significant at $p < 0.001$.

- Note: Differences evaluated using One-Way ANOVA (F) or Chi-Square (χ^2). Statistically significant at $p < 0.05$.

➢ *Post-Contraction Relaxation Capability*

Evaluation of voluntary relaxation following the 3-second contraction revealed that 40.8% (n = 49) of the total cohort exhibited impaired derecruitment.

Impairment was strongly associated with stress tier ($\chi^2 = 34.12$, $p < 0.001$). In the Low Stress group, 89.3% (n = 25) demonstrated prompt relaxation, with no cases of absent relaxation. In the High Stress group, only 23.3% (n = 7).

➢ *Bivariate Correlation Analysis*

Spearman's rank correlation analysis revealed a statistically significant, moderate-to-strong positive correlation between continuous PSS-10 scores and Reissing resting tone ($\rho = 0.564$, $p < 0.001$).

Furthermore, higher PSS-10 scores were significantly correlated with post-contraction relaxation impairment ($\rho = 0.491$, $p < 0.001$), indicating that as perceived stress increases, the capacity to voluntarily derecruit the levator ani becomes progressively compromised. Reissing resting tone and relaxation latency were themselves strongly intercorrelated ($\rho = 0.638$, $p < 0.001$).

IV. DISCUSSION

The primary finding of this cross-sectional study is that perceived psychological stress (PSS-10) correlates directly and positively with resting pelvic floor muscle tone ($\rho = 0.564$) and voluntary relaxation failure ($\rho = 0.491$) in nulliparous females. By utilizing a lean protocol limited to the PSS-10 and the Reissing Scale, this investigation demonstrates that elevated pelvic floor resting tension can be reliably identified in young women without the need for complex, timeconsuming multi-battery testing demonstrated prompt relaxation; 50.0% (n = 15) had delayed relaxation, and 26.7% (n = 8) exhibited completely absent relaxation, remaining locked in protective contraction.

Table 2 Spearman Rank Correlation Matrix

Evaluated Parameters	(1) PSS-10 Score	(2) Reissing Resting Tone	(3) Relaxation Latency Status
(1) PSS-10 Continuous Score	—		
(2) Reissing Resting Tone (-3 to +3)	0.564 ($p < 0.001$)	—	
(3) Relaxation Status (Prompt/Delayed/Absent)	0.491 ($p < 0.001$)	0.638 ($p < 0.001$)	—

➢ *The Neuro-Pelvic Axis and Somatic Muscle Guarding*

The moderate-to-strong correlation between PSS-10 scores and Reissing hypertonicity provides clear clinical evidence for somatic guarding of the pelvic diaphragm. The levator ani complex (comprising the puborectalis, pubococcygeus, and iliococcygeus) is closely integrated with the autonomic nervous system. Under psychological distress—characterized by feelings of unpredictability and loss of control—the sympathetic nervous system initiates continuous subthreshold motor unit firing in pelvic striated muscle fibers [6]. Just as emotional stress induces subconscious jaw clenching (bruxism) or shoulder hiking (upper trapezius tension), the pelvic floor acts as a deep somatic reflector of stress. In young women experiencing high perceived stress, this defensive motor recruitment fails to down-regulate. Over time, constant muscle spindle excitation leads to shortened sarcomeres, localized micro-ischemia, tissue acidosis, and painful myofascial trigger points [5], [7]. This physiological mechanism explains why Grade +3 hypertonicity (rigid spasm and marked tenderness during palpation) was observed exclusively among participants in the High Stress tier.

➢ *Why Relaxation Matters More than Contraction Strength*

Historically, pelvic health physical therapy has focused almost entirely on active contractile strength, typically evaluated using the 0–5 Modified Oxford Scale [8]. However, a muscle that scores a "Grade 4" (Good) on the Oxford Scale may simultaneously be locked in severe hypertonic guarding, unable to lengthen or return to a healthy resting baseline. Our data reveal that 40.8% of nulliparous women in this cohort

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exhibited impaired voluntary relaxation, rising to 76.7% in the high-stress group. If clinicians evaluate pelvic floor function based solely on contraction strength, these hypertonic, nonrelaxing states are easily overlooked. Prescribing traditional repetitive Kegel (strengthening) exercises to a high-stress patient with an already hypertonic levator ani will exacerbate muscle ischemia, trigger point tenderness, and secondary urinary urgency or dyspareunia [4], [3].

- *Practical Clinical Application: The Lean Two-Step Assessment*

The primary clinical strength of this protocol lies in its speed and practicality. Administering the PSS-10 requires less than four minutes, and the Reissing palpation assessment requires approximately three minutes during a standard internal evaluation.

This lean approach allows clinicians to categorize patients into clear functional pathways:

- Low Stress / Normal Tone (0): Reassurance; standard preventative pelvic health guidance.
- High Stress / Hypertonic Tone (+1 to +3) with Delayed Relaxation: Strict avoidance of concentric Kegel exercises. Treatment should prioritize neuromuscular down-training: diaphragmatic breathing to restore reciprocal pelvic excursion, manual myofascial trigger point release, physiological "pelvic drops," and biofeedbackguided muscle derecruitment [14], [15], [16].

- *Strengths and Limitations*

- Strengths: This study focused exclusively on nulliparous females, eliminating the substantial confounding structural variables associated with pregnancy and childbirth (such as episiotomies, tears, and instrumental delivery). The physical examiner was strictly blinded to the psychometric scores, minimizing diagnostic confirmation bias.
- Limitations: First, the cross-sectional design establishes correlation rather than direct longitudinal causality. While we hypothesize that stress causes muscle guarding, persistent pelvic tension or discomfort could plausibly elevate perceived stress. Second, while the Reissing Scale demonstrated excellent clinical utility, digital palpation remains a semi-quantitative measure. Future investigations could pair this lean protocol with surface electromyography (sEMG) to establish the exact resting microvoltage (µV) thresholds corresponding to each Reissing grade.

V. CONCLUSION

In young nulliparous females, elevated perceived psychological stress (PSS-10) correlates significantly with increased resting pelvic floor muscle tone and an inability to voluntarily relax the levator ani post-contraction. Pelvic floor muscle dysfunction in young women is frequently a disorder of excessive tension rather than weakness. Clinicians should incorporate the PSS-10 and the Reissing Scale into routine evaluations to identify stress-mediated hypertonicity and guide appropriate autonomic and physical down-training interventions.

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