

A Urodynamic Study On The Prevalence And Patterns Of Bladder Dysfunction In Rural Postmenopausal Women With Lower Urinary Tract Symptoms



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INTRODUCTION

Lower urinary tract symptoms (LUTS) are highly prevalent among women and increase substantially with advancing age, often leading to social embarrassment, psychological distress, and deterioration in overall quality of life. LUTS encompass storage, voiding, and post-micturition symptoms, including urgency, frequency, nocturia, weak stream, and incomplete emptying. Globally, up to 70% of adult women report at least one LUTS, with the prevalence rising sharply in postmenopausal groups due to hormonal, anatomical, and neuromuscular changes affecting the bladder and urethra.[1]

The menopausal transition is characterized by estrogen deficiency, which affects the lower urinary tract epithelium, urethral vascularity, and collagen composition. This collective condition is now described as Genitourinary Syndrome of Menopause (GSM), encompassing urinary frequency, urgency, incontinence, and recurrent urinary infections.[2] Estrogen deficiency leads to diminished urethral closure pressure, altered detrusor contractility, and reduced compliance—predisposing to detrusor overactivity, detrusor underactivity, or stress incontinence.[3]

The International Continence Society (ICS) provides standardized definitions for LUT dysfunction, classifying detrusor overactivity (DO), detrusor underactivity (DU), bladder outlet obstruction (BOO), intrinsic sphincter deficiency (ISD), and urethral hypermobility as distinct urodynamic entities.[4] Despite overlapping symptomatology, accurate differentiation among these conditions requires urodynamic study (UDS), the current gold standard for assessing bladder and urethral function. Clinical symptoms alone are unreliable predictors of the underlying pathophysiology; hence, objective urodynamic evaluation is essential to guide tailored therapy.[5]

Studies demonstrate that 30–40% of women with overactive bladder (OAB) symptoms do not exhibit detrusor overactivity on UDS, while others show BOO or compliance disorders instead.[6] Similarly, detrusor underactivity—often underdiagnosed in females—accounts for 10–20% of cases with voiding difficulty, especially in elderly and diabetic women.[7] Accurate phenotyping helps avoid empirical treatments (such as unnecessary antimuscarinics) and improves outcomes through personalized management strategies.

RATIONALE

While LUTS are widely recognized in urban populations, their burden among rural postmenopausal women remains poorly studied, particularly in Tamil Nadu. Factors such as high parity, early menopause, pelvic organ prolapse, prolonged manual labor, and lack of awareness may predispose rural women to bladder dysfunction. Social stigma, limited urological facilities, and the misconception that urinary leakage is “normal with age” often delay diagnosis.

Existing data from India largely rely on questionnaires like the UDI-6 or ICIQ-SF, which identify symptoms but not underlying urodynamic types. Consequently, women with different pathophysiologies—such as detrusor overactivity, urethral hypermobility, or atonic bladder—are often grouped together, leading to suboptimal therapy. Hence, a systematic urodynamic evaluation is essential to delineate true prevalence and patterns of bladder dysfunction in this under-represented population.

Local Epidemiology (Tamil Nadu Context)

In Tamil Nadu, community-based studies indicate a high prevalence of urinary incontinence and LUTS among women, particularly after menopause. A cross-sectional outpatient study from Chennai

reported that nearly one-third of women attending gynecology clinics had urinary leakage, urgency, or nocturia, with the prevalence significantly higher in postmenopausal women.[8] Another survey from urban Chidambaram found that 27.1% of adult women had urinary incontinence, of which 43.7% were stress type, 25% urge type, and 31.2% mixed type—highlighting the multifactorial nature of the problem.[9]

In a geriatric population from Kanyakumari district, the prevalence of UI reached 81% among elderly women residing in old-age homes, with parity, mode of delivery, urinary tract infection history, and age as significant predictors.[10] Comparable findings from other South Indian states suggest that many rural women silently suffer from LUTS, attributing symptoms to aging or childbirth. Limited pelvic-floor rehabilitation services, poor access to urogynecologic care, and lack of awareness amplify the disease burden.

Despite the high symptom prevalence, urodynamic data from Tamil Nadu are scarce. Most studies stop at clinical diagnosis without evaluating detrusor contractility or outlet function objectively. Therefore, this study aims to fill the evidence gap by using urodynamic evaluation to identify the true prevalence and pattern of bladder dysfunction among rural postmenopausal women with LUTS, thereby contributing to evidence-based, locally applicable management guidelines.

OBJECTIVES

Primary Objective

- To determine the prevalence of various bladder dysfunction patterns on urodynamic evaluation among rural postmenopausal women presenting with lower urinary tract symptoms.

Secondary Objectives

- To classify and quantify specific urodynamic abnormalities (detrusor overactivity, detrusor underactivity, bladder outlet obstruction, urethral sphincter deficiency, urethral hypermobility) in this cohort.
- To correlate urodynamic findings with clinical symptom subtypes (storage vs. voiding), demographic parameters (age, parity, BMI), and comorbidities (diabetes, hypertension).
- To identify rural-specific risk factors—such as physical workload, pelvic trauma, or sanitation constraints—associated with bladder dysfunction.
- To propose a practical diagnostic and management algorithm based on urodynamic phenotypes tailored to rural healthcare settings.

MATERIALS AND METHODS

Study Design

This was a hospital-based cross-sectional observational study conducted in the Department of Obstetrics and Gynaecology and Department of Urology, in collaboration with the Department of Anaesthesiology, at Karpaga Vinayaga Institute of Medical Sciences and Research Centre (KIMS & RC), Chengalpattu District, Tamil Nadu. The study period extended from January 2024 to December 2024, following approval from the Institutional Ethics Committee

Study Population

The study included postmenopausal women (≥ 45 years of age) residing in rural areas and attending the uro-gynecology or gynaecology outpatient departments with symptoms suggestive of lower urinary tract dysfunction.

Inclusion Criteria

1. Women with natural menopause (≥ 1 year since last menstrual period).
2. Complaints of one or more LUTS such as urgency, frequency, nocturia, dysuria, hesitancy, poor stream, or urinary leakage.
3. Willingness to undergo urodynamic evaluation and provide informed consent.

Exclusion Criteria

1. Women with pelvic malignancy or previous pelvic radiotherapy.
2. Active urinary tract infection (confirmed by urine culture).
3. Neurological disorders affecting bladder function (e.g., spinal cord injury, Parkinson's disease, multiple sclerosis).
4. Previous anti-incontinence or prolapse surgery.
5. Use of antimuscarinic or diuretic therapy within the past two weeks.

Sample Size

Based on prior studies showing a LUTS prevalence of approximately 25–30% among postmenopausal women, the sample size was calculated using the formula $n = Z^2 pq / d^2$, with 95% confidence level, 8% absolute precision, and estimated prevalence ($p = 0.30$). The minimum sample size derived was **110 subjects**, and **120 women** were ultimately enrolled to compensate for potential dropouts.

Data Collection Procedure

After obtaining informed consent, each participant underwent:

- Detailed history focusing on urinary symptoms, obstetric history, menopausal duration, comorbidities, and medication use.
- Physical examination including BMI, abdominal, and pelvic examination to detect cystocele, uterine descent, or rectocele.

- Routine urine analysis and culture.
- Symptom scoring using the International Consultation on Incontinence Questionnaire–Short Form (ICIQ-SF) and Urinary Distress Inventory-6 (UDI-6).

Urodynamic Evaluation

Urodynamic studies were performed using an MMS Solar Urodynamic System (Enschede, Netherlands) under aseptic precautions. Procedures included:

1. Uroflowmetry – measuring maximum (Q_{max}) and average (Q_{avg}) flow rate and post-void residual urine (PVR).
2. Filling cystometry – bladder filling with normal saline at 50 mL/min to record first sensation, first desire, strong desire, and maximum cystometric capacity (MCC).
3. Pressure-flow studies – to assess detrusor pressure (P_{det}Q_{max}) during voiding.
4. Valsalva leak point pressure (VLPP) – evaluated in cases with stress leakage.

The findings were interpreted in accordance with the ICS 2023 standards.

Urodynamic diagnosis was categorized as:

- Detrusor Overactivity (DO) – involuntary detrusor contractions during filling.
- Detrusor Underactivity (DU) – low detrusor pressure and flow during voiding with elevated residual urine.

- Bladder Outlet Obstruction (BOO) – high detrusor pressure with low flow.
- Urethral Sphincter Deficiency (ISD) – low VLPP (<60 cm H₂O).
- Urethral Hypermobility – positive Q-tip test (>30° excursion).
- Normal Urodynamics.

Statistical Analysis

Data were compiled in Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp, USA). Categorical variables were expressed as frequencies and percentages; continuous variables as mean ± standard deviation. Chi-square or Fisher's exact test was applied to determine associations between urodynamic diagnosis and clinical parameters (age, parity, BMI, duration of menopause, comorbidities). A *p*-value < 0.05 was considered statistically significant.

RESULTS

Table 1 - A total of 120 rural postmenopausal women were evaluated. The mean ± SD age was 56.8 ± 6.4 years (range 45–72). The majority (62.5%) were multiparous (≥3 deliveries). The mean BMI was 27.4 ± 4.1 kg/m²; 34% were overweight and 18% obese. The mean duration since menopause was 8.6 ± 5.2 years.

Parameter	Mean ± SD / n (%)
Age (years)	56.8 ± 6.4
Duration since menopause (years)	8.6 ± 5.2
Parity ≥ 3	75 (62.5%)
BMI ≥ 25 kg/m ²	63 (52.5%)
Diabetes mellitus	32 (26.6%)
Hypertension	38 (31.6%)

Table - 1: Demographic Characteristics

Symptom Profile

- Storage symptoms (frequency, urgency, nocturia) were present in 81 (67.5%) women.
- Voiding symptoms (hesitancy, weak stream, straining) in 39 (32.5%).
- Mixed symptoms in 23 (19.2%). Mean ICIQ-SF score: 13.1 ± 3.8 (moderate severity).

Table - 2: Urodynamic Findings

Urodynamic Diagnosis	Frequency (n = 120)	Percentage
Detrusor Underactivity (DU)	43	35.8 %
Detrusor Overactivity (DO)	28	23.3 %
Urethral Hypermobility (with SUI)	16	13.3 %

Urodynamic Diagnosis	Frequency (n = 120)	Percentage
Intrinsic Sphincter Deficiency (ISD)	8	6.6 %
Bladder Outlet Obstruction (BOO)	7	5.8 %
Normal study	18	15.0 %

Table 2 - Out of 120 participants, 102 (85%) showed abnormal urodynamic patterns. The distribution was as follows: The most common urodynamic abnormality was detrusor underactivity, followed by detrusor overactivity. Mean maximum cystometric capacity was 320 ± 65 mL, and mean Qmax was 15.4 ± 5.2 mL/s. Mean post-void residual (PVR) was 68 ± 45 mL.

Associations

- Age > 60 years and menopause > 10 years were significantly associated with detrusor underactivity ($p = 0.02$).
- High parity (≥ 3) correlated with urethral hypermobility ($p = 0.04$).
- Diabetes mellitus was a strong predictor of DU ($p < 0.01$).
- No significant association was found between BMI and detrusor overactivity.

Summary of Key Findings

- LUTS are common among rural postmenopausal women (100% symptom presence).
- Urodynamic abnormalities were observed in 85% of symptomatic women.
- Detrusor underactivity emerged as the predominant pattern, followed by overactivity and stress incontinence.
- Increasing age, longer menopause duration, multiparity, and diabetes were significant correlates.

Interpretation

The findings demonstrate that a large proportion of rural postmenopausal women with LUTS exhibit objective bladder dysfunction, predominantly hypocontractile detrusor patterns. This contrasts with the traditional assumption that urgency and frequency in this group are purely overactive bladder syndromes. Hence, urodynamic evaluation is indispensable before instituting empirical therapy, especially in diabetic and elderly populations, where detrusor underactivity is frequent. The results highlight the necessity for early screening, pelvic-floor rehabilitation, diabetic control, and the availability of basic urodynamic facilities in rural healthcare systems.

DISCUSSION

In this rural, postmenopausal cohort with LUTS, 85% demonstrated objective urodynamic abnormalities,

with detrusor underactivity (DU) the predominant pattern (35.8%), followed by detrusor overactivity (DO) and stress incontinence-related phenotypes. This distribution contrasts with many symptom-based series that assume storage pathology predominates in older women, and it underscores the risk of misclassification when relying solely on questionnaires. Contemporary large cohorts report DU in roughly 10% of women referred for evaluation, with bladder outlet obstruction (BOO) around 4%; our higher DU proportion likely reflects age structure, diabetes burden, and referral patterns in a resource-limited rural setting.[7]

Our DU signal aligns with recent syntheses noting wide prevalence ranges (≈ 15 –54%) across female populations depending on definitions and inclusion criteria; heterogeneity stems from non-uniform urodynamic thresholds and variable consideration of pelvic organ prolapse and neurologic disease. The ICS continues to emphasize standardized terminology and trace interpretation to reduce such variability, supporting cautious cross-study comparisons.[11] In our series, older age, longer menopausal duration, and diabetes correlated with DU—associations echoed in recent age-stratified urodynamic work and multivariable models where age and reduced voided volume predict DU.[12]

For DO, our prevalence sits within published ranges for women with overactive bladder (OAB) symptoms, but importantly, not all women labelled “OAB” manifest DO on testing. A 2025 analysis reiterates that only about one-third of symptomatic OAB patients show DO on urodynamics, with a meaningful minority exhibiting BOO or compliance abnormalities—findings that, as in our cohort, can redirect therapy away from empiric antimuscarinics toward targeted interventions.[13]. This phenotype heterogeneity underpins current guideline advice to reserve urodynamics for refractory/complex LUTS and to interpret symptoms within a standardized framework.[14]

The guideline context is relevant for rural practice. The 2024 EAU Female LUTS guideline broadens scope beyond incontinence to non-neurogenic LUTS, endorsing structured history, pelvic examination, and selective UDS when diagnoses are uncertain or invasive treatments are contemplated. The AUA/SUFU 2024 OAB guideline similarly promotes stepwise, shared decision-making, with UDS considered for atypical, complicated, or refractory

cases. Our data—showing high DU and mixed pathophysiology—support that pre-procedure UDS can be pivotal before irreversible interventions (e.g., sling), particularly where urethral hypermobility coexists with impaired detrusor contractility.[14]

The local epidemiology also contextualizes our findings. Recent South-Indian/Tamil Nadu reports describe substantial urinary incontinence prevalence in peri- and postmenopausal women attending outpatient clinics, and broader Indian series re-affirm high symptom loads with mixed subtypes. Yet, most rely on symptom instruments without urodynamic confirmation—leaving the true mechanistic mix unresolved. By adding UDS granularity in a rural cohort, our study helps bridge this gap and may partially explain why symptom-only programs have inconsistent outcomes.[15]

Clinical implications are threefold. First, the prominence of DU in older, diabetic women argues for caution with antimuscarinics and for emphasis on bladder emptying strategies (timed voiding, intermittent catheterization when indicated) alongside diabetes optimization. Second, identifying urethral hypermobility vs intrinsic sphincter deficiency (ISD) matters for counseling regarding pelvic-floor therapy versus sling candidacy, mindful that coexisting DU may worsen postoperative voiding. Third, recognition of covert BOO—present in a subset here—supports conservative measures (address constipation, modify precipitating drugs) and informs procedural choices should prolapse or outlet narrowing be contributors. These practice points are consistent with current EAU and AUA/SUFU guidance.[14]

Strengths of this work include standardized ICS-based UDS interpretation and focus on an under-represented rural population where care-seeking is delayed and symptom normalization common. Limitations include single-center design, potential selection bias (referral for UDS), and absence of longitudinal outcomes to verify whether phenotype-guided management improved symptoms and quality of life. Future work should incorporate prospective treatment pathways stratified by urodynamic phenotype (e.g., DU-tailored regimens vs DO-directed therapy), assess cost-effectiveness in district-level hospitals, and validate simple screening heuristics (e.g., uroflow voided volume thresholds) that recent studies suggest can enrich for DU/BOO before formal UDS—valuable where equipment is scarce.[7]

In summary, this study demonstrates that urodynamic heterogeneity—particularly a high DU burden—characterizes rural postmenopausal women with LUTS in Tamil Nadu. Embedding selective urodynamics within guideline-concordant care pathways could reduce mis-treatment, align

therapies to mechanism, and improve outcomes in resource-limited settings.[14]

CONCLUSION

Urodynamic evaluation revealed a high prevalence of detrusor underactivity among rural postmenopausal women with LUTS, often coexisting with overactivity and stress incontinence. Age, diabetes, and multiparity were key risk factors. Objective urodynamic assessment is essential for accurate diagnosis and personalized management, ensuring rational, evidence-based care in resource-limited rural settings.

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