

STORAGE LOWER URINARY TRACT SYMPTOMS AMONG FEMALE MEDICAL STUDENTS: PREVALENCE, SUBJECTIVE BOTHER, AND ASSOCIATED FACTORS

Nguyen Le Kha Han, Nguyen Trung Hieu*, Nguyen Thanh Dat, Huynh Nguyen Nhu Anh, Phan Khanh Toan

Can Tho University of Medicine and Pharmacy

*Corresponding author: nthieu@ctump.edu.vn

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ABSTRACT

Background: Storage lower urinary tract symptoms (storage LUTS) may result in considerable subjective bother and negatively affect quality of life. Female medical students may be particularly vulnerable to these symptoms due to academic demands, physical exhaustion, and lifestyle-related factors. However, the prevalence and correlates of storage LUTS in this population remain insufficiently explored. **Objectives:** 1. To describe the prevalence and characteristics of storage LUTS and their associated subjective bother among female medical students at Can Tho University of Medicine and Pharmacy in 2026; 2. To identify factors associated with storage LUTS symptom scores in this population. **Materials and methods:** A cross-sectional study was conducted among 173 full-time female medical students at Can Tho University of Medicine and Pharmacy from January 3 to February 13, 2026. Lower urinary tract symptoms were assessed using the ICIQ-FLUTS Long Form. **Results:** The prevalence of storage LUTS was 17.9%, defined as the presence of at least one storage symptom with a frequency score of ≥ 2 . Using the same threshold, nocturia and urgency were the most prevalent storage symptoms, each reported by 5.8% of participants. Storage symptom scores showed a moderate positive correlation with total bother scores ($r_s = 0.676$, $p < 0.001$). In multiple linear regression analysis ($R^2 = 0.287$; Adjusted $R^2 = 0.261$), higher storage LUTS symptom scores were independently associated with high salt intake, exhaustion, caffeine consumption, physical activity and masturbation frequency, whereas LUTS awareness was inversely associated with symptom scores ($p < 0.05$). **Conclusions:** Storage LUTS are relatively common among female medical students and are associated with considerable subjective bother. Improving awareness and promoting appropriate lifestyle practices may help reduce the symptom burden in this population.

Keywords: Lower urinary tract symptoms, Bother, ICIQ-FLUTS Long Form, Young women; Urinary symptoms, Cross-sectional study.

I. INTRODUCTION

Lower Urinary Tract Symptoms (LUTS), particularly the storage symptom subgroup (storage LUTS), are common among women and may significantly impair quality of life. According to the definition of the International Continence Society (ICS) [1], storage LUTS include urgency, increased daytime urinary frequency, and nocturia, with or without urinary incontinence. These symptoms not only cause physical inconvenience but are also associated with impaired daily functioning, academic performance, and psychological well-being [2].

Among young women, female medical students may be particularly vulnerable to these symptoms due to the demanding nature of their training programs, including heavy academic workloads, prolonged examination pressure, and physical exhaustion. In addition, lifestyle-related factors such as caffeine consumption to maintain alertness, unhealthy

dietary habits, or delayed voiding behaviors due to dense academic and clinical schedules may contribute to the occurrence and severity of storage symptoms [2], [3].

Despite their potential negative impact, the burden of storage LUTS among medical students remains insufficiently investigated. Previous studies have mainly focused on older or parous women, while evidence regarding storage LUTS among younger, nulliparous women remains limited [4], [5], [6], [7]. In Vietnam, data regarding the prevalence, symptom characteristics, and associated factors of storage LUTS among young women remain scarce. This knowledge gap highlights the need for further research in this population.

Therefore, this study was conducted to: 1) describe the prevalence and characteristics of storage LUTS as well as the subjective bother among female medical students at Can Tho University of Medicine and Pharmacy in 2026; 2) identify several factors associated with storage LUTS symptom scores in this population.

II. MATERIALS AND METHODS

2.1. Participants

A descriptive cross-sectional study with analytical components was conducted among female medical students at Can Tho University of Medicine and Pharmacy during the 2025-2026 academic year.

- **Study Population:** The study population consisted of full-time female medical students enrolled at CTUMP during the 2025-2026 academic year.

- **Inclusion criteria:** Female students currently enrolled at CTUMP who voluntarily agreed to participate in the study.

- **Exclusion criteria:** Students on academic leave and those with a previously diagnosed history of kidney or urinary tract diseases.

2.2. Research methods

- Sample Size and Sampling

$$n = \frac{Z_{1-\alpha/2}^2 \cdot p(1-p)}{d^2}$$

The sample size was calculated using the single population proportion formula. The minimum required sample size was 171 participants. A total of 208 responses were collected. After screening for eligibility and completeness, 173 valid responses were included in the final analysis.

Participants were recruited using a convenience sampling method.

- Data Collection and Variables

Data were collected using a structured self-administered questionnaire comprising 3 sections:

- 1) Demographic characteristics (age, academic year, body mass index)
- 2) Lifestyle-related factors included: Dietary habits; Physical activity levels; Mental health status; Masturbation frequency and awareness of LUTS
- 3) Storage LUTS and subjective bother were assessed using the International Consultation on Incontinence Questionnaire - Female Lower Urinary Tract Symptoms (ICIQ-FLUTS Long Form).

- **Outcome Definition:** The primary outcome was the prevalence of storage LUTS. Storage LUTS was defined as reporting a symptom score of ≥ 2 ("sometimes" or more

frequently) on at least one storage symptom item of the ICIQ-FLUTS Long Form. Participants meeting this criterion were classified as having storage LUTS. Storage LUTS symptom scores derived from the ICIQ-FLUTS questionnaire were also used as continuous outcome variables in correlation and regression analyses.

- **Statistical Analysis:** Data were analyzed using SPSS version 26.0. Descriptive statistics summarized participant characteristics and storage LUTS prevalence (with 95% CIs). Spearman's rank correlation assessed associations between continuous variables and symptom scores. Multiple linear regression, including variables with univariate $p < 0.20$, was used to identify independent factors associated with symptom scores. Results were reported using adjusted R^2 , unstandardized B, and standardized β . $p < 0.05$ was considered statistically significant.

- **Ethical Approva:** This study was approved by the Institutional Review Board of Can Tho University of Medicine and Pharmacy (Approval No. 25.142.SV/PCT-HDDD, dated November 26, 2025).

III. RESULTS

3.1. The prevalence and characteristics of storage LUTS among study population

The participants had a mean age of 21.94 ± 2.29 years. Anthropometric data showed an average height of 158.72 ± 5.48 cm and a weight of 53.91 ± 8.35 kg, with a mean Body Mass Index (BMI) of 21.38 ± 2.95 kg/m². Regarding LUTS awareness, 70 students (40.5%) had little to no knowledge of LUTS, while 103 (59.5%) reported being familiar with the condition. Additionally, the average frequency of masturbation among the students was 0.21 ± 0.77 times per week (median = 0).

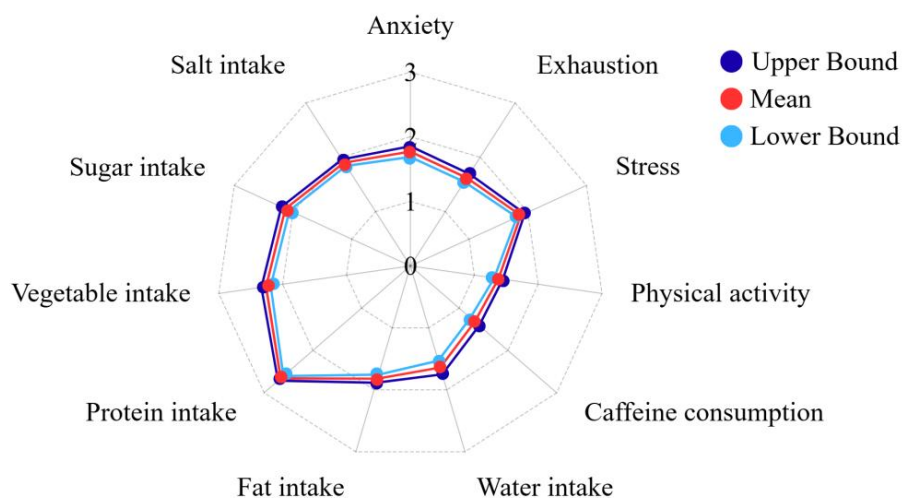


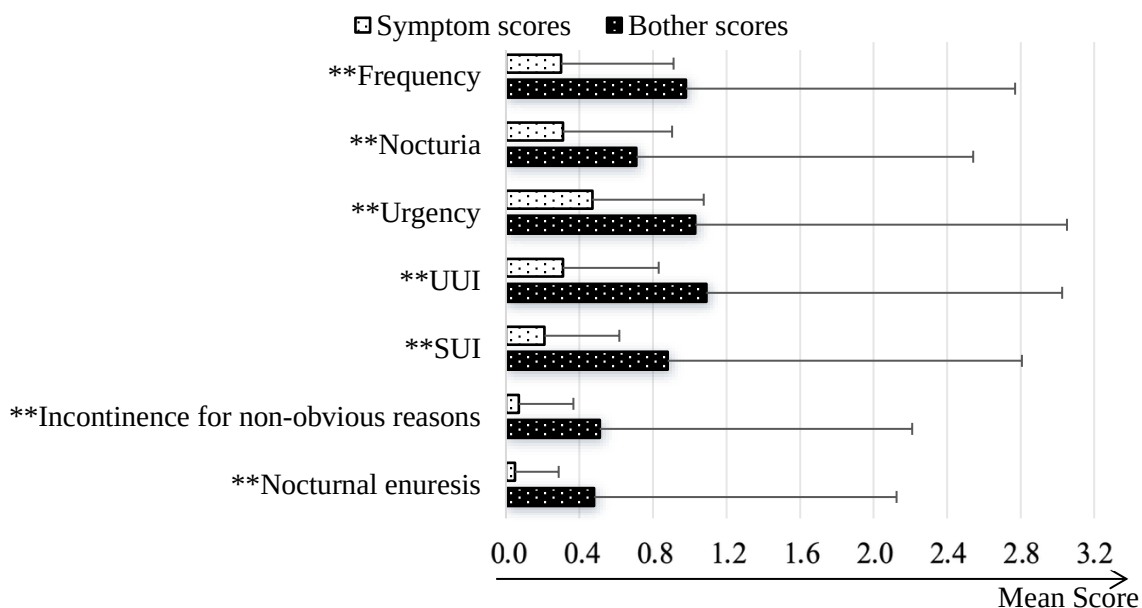
Figure 1. Descriptive assessment of lifestyle and psychosocial characteristics

As illustrated in Figure 1, values are presented as mean scores derived from a 5-point Likert scale (0 = "Never" to 4 = "Very Often"), and all variables were treated as continuous for descriptive purposes. The outer range of the radar chart represents variability around the mean (± 1 standard deviation). Characteristics of the study population revealed relatively high levels of anxiety and psychological stress among medical students (approximately 2.0), whereas health-protective factors, such as physical activity and vegetable intake, demonstrated lower mean scores.

Table 1. Distribution of storage symptoms based on the ICIQ-FLUTS Long Form questionnaire (n=173)

	Frequen- cy	Nocturia	Urgency	UII	SUI	Incon- tinence for non- obvious reasons	Noctur- nal enuresis
0 Never	132 (76.3%)	131 (75.7%)	102 (59.0%)	125 (72.3%)	137 (79.2%)	163 (94.2%)	166 (96%)
1 Occasionally	32 (18.5%)	32 (18.5%)	61 (35.3%)	43 (24.9%)	36 (20.8%)	8 (4.6%)	6 (3.5%)
2 Sometimes	8 (4.6%)	9 (5.2%)	10 (5.8%)	5 (2.9%)	-	2 (1.2%)	1 (0.6%)
3 Most of the time	-	1 (0.6%)	-	-	-	-	-
4 All of the time	1 (0.6%)	-	-	-	-	-	-
≥2 Having symptom	9 (5.2%)	10 (5.8%)	10 (5.8%)	5 (2.9%)	-	2 (1.2%)	1 (0.6%)

Storage symptoms were assessed according to the International Continence Society (ICS) classification using the ICIQ-FLUTS Long Form [1]. Among 173 participants, the mean total storage symptom score was 1.71 ± 1.67 . Overall, 31 female students reported at least one storage symptom, yielding a prevalence of 17.9% (95% CI: 12.7%-24.3%). Nocturia and urgency were the most prevalent symptoms, each affecting 5.8% of participants. No cases of clinically significant stress urinary incontinence (score ≥ 2) were identified. Detailed frequencies and prevalence rates are presented in Table 1.



The relationship between variables was assessed using Spearman's rank correlation coefficient.

** indicates statistical significance at $p < 0.01$.

Figure 2. Comparison of Mean Storage Symptom Scores and Subjective Bother Scores

Spearman's rank correlation analysis revealed a strong positive correlation between the total storage symptom score and the total bother score ($r_s = 0.676$, $p < 0.001$). Furthermore, all individual storage symptoms were significantly and positively associated with their corresponding bother scores (all $p < 0.01$). The strongest correlations were observed for stress urinary incontinence ($r_s = 0.763$), urge urinary incontinence ($r_s = 0.721$), and urgency ($r_s = 0.701$). Moderate positive correlations were found for incontinence for non-obvious reasons ($r_s = 0.640$) and nocturia ($r_s = 0.577$), whereas frequency ($r_s = 0.377$) and nocturnal enuresis ($r_s = 0.318$) showed weaker but still significant correlations with bother scores. The mean scores for these symptoms and their associated bother are compared in Figure 2, with error bars representing the standard deviations.

3.2. Several factors associated with storage LUTS symptom scores

Table 2. Multiple linear regression analysis of factors associated with storage LUTS

Model	B	Std. Error	Beta	t	Sig.	VIF
Constant	-0.315	0.430	-	-0.733	0.465	-
Salt intake	0.517	0.147	0.240	3.520	<0.001	1.082
Caffeine consumption	0.247	0.094	0.177	2.634	0.009	1.052
Masturbation frequency	0.379	0.145	0.175	2.614	0.010	1.044
Exhaustion	0.411	0.119	0.236	3.461	<0.001	1.084
Physical activity	0.262	0.125	0.141	2.090	0.038	1.054
Awareness of LUTS	-0.658	0.232	-0.194	-2.835	0.005	1.087

Stepwise multiple linear regression identified six factors associated with storage LUTS scores. The final model was significant ($F(6,166) = 11.136$, $p < 0.001$) and explained 26.1% of the variance (Adjusted $R^2 = 0.261$). Salt intake, exhaustion, caffeine consumption, masturbation frequency, and physical activity were positively associated with symptom scores, whereas LUTS awareness showed a negative association ($\beta = -0.194$). No multicollinearity was detected (all VIFs ≤ 1.10).

IV. DISCUSSION

4.1. The prevalence and characteristics of storage LUTS among study population

The prevalence of at least one storage LUTS, defined by a threshold of ≥ 2 points (from "Sometimes" onwards), in this study was 17.9%. This estimate is substantially lower than those reported in large-scale population-based surveys such as the RISE FOR HEALTH project in the United States (79%) [8], the Chinese community survey conducted by Wang *et al.* (61.1%) [4], as well as investigations among medical students in the Netherlands by Van Breda (40.9% from "occasionally") [9] and in Saudi Arabia by Alzammam (52.7%) [2]. Such variation may partly reflect differences in the demographic composition of the study populations, as the present sample primarily consisted of young, nulliparous women, whereas prior studies frequently included participants across a wider age spectrum and reproductive history [4], [5]. Nevertheless, given that this study was not designed to enable direct population-level comparisons, it is not feasible to isolate the relative contributions of demographic versus methodological determinants to the observed disparity in prevalence estimates. In addition, differences in symptom classification thresholds (≥ 2 in the present study versus ≥ 1 in many previous investigations) should be taken into account, as such definitional criteria may substantially influence reported

prevalence rates [4], [9]. These methodological discrepancies may therefore partly explain the comparatively conservative prevalence observed in the current analysis.

A detailed examination of the seven storage symptom domains in accordance with the International Continence Society (ICS) standards [1] indicated that nocturia and urgency were the most frequently reported symptoms, each affecting 5.8% of participants. Increased daytime urinary frequency was reported by 5.2% of students, which is lower than the 16.4% documented in Zhang's study [3] and markedly lower than the 78.83% observed in Negi's investigation [6]. Although the prevalence of stress urinary incontinence (SUI) and urge urinary incontinence (UII) was relatively modest, these manifestations demonstrated the strongest positive correlations with subjective bother scores, particularly SUI ($r_s = 0.763$, $p < 0.01$) and UII ($r_s = 0.721$, $p < 0.01$). Notably, while no participants met the predefined prevalence threshold for SUI (score ≥ 2), 20.8% reported experiencing this symptom occasionally. Therefore, the observed correlation reflects variation across the full range of symptom scores rather than the prevalence threshold used to define clinically significant symptoms. This finding is consistent with the structural framework of the ICIQ-FLUTS Long Form questionnaire, wherein each symptom item is accompanied by a corresponding bother assessment, highlighting that even infrequent or low-level symptoms may impose a considerable perceived burden. Consequently, symptom frequency alone may not adequately capture the extent of functional or psychological impact experienced by affected individuals.

4.2. Several factors associated with storage LUTS symptom scores

The association between dietary stimulants and storage LUTS observed in this study is consistent with findings reported by Alzammam in Saudi Arabia [2] and Zhang in China [3], both of whom identified caffeine-containing beverages and irritative foods as major risk factors for overactive bladder. From a physiological perspective, caffeine may increase urine production and enhance bladder sensory activity, while high salt intake may promote thirst and fluid consumption, resulting in greater urine output. These mechanisms may increase bladder filling frequency and contribute to urgency-related symptoms through heightened detrusor activity. However, due to the cross-sectional design of the present study, these associations reflect covariance rather than directional causation. It is therefore plausible that individuals experiencing symptoms may subsequently modify their dietary habits, introducing the possibility of reverse associations.

Exhaustion was positively associated with higher symptom scores, consistent with the findings of Bilgic and Özcan, who reported strong correlations between stress-related psychological states and elevated LUTS scores in young women [10], [11]. Within the context of medical education, academic workload and performance expectations may act as stressors contributing to these symptoms. However, as our study did not evaluate physiological mechanisms, this observed association should be interpreted primarily as a statistical relationship requiring further investigation.

Regarding physical activity, our findings differed from Alhababi (2019) [7], where exercise was a protective factor in middle-aged women. This positive association in our cohort may occur because physically active students are more "in tune" with their bodily functions, thereby noticing and reporting mild symptoms more readily. Furthermore, certain exercises may increase intra-abdominal pressure, placing transient stress on the pelvic floor. Similarly, masturbation frequency was positively associated with symptom scores, aligning with Zhang's observations regarding sexual activity [3]. However, as our cross-sectional

study did not directly measure intra-abdominal pressure or specific physiological mechanisms, these behavioral associations preclude causal inferences and require longitudinal verification.

LUTS awareness emerged as the only variable demonstrating an independent negative association with storage symptom scores ($\beta = -0.194$; $p = 0.005$). Despite participants being medical students, insufficient knowledge was observed in 40.5% of the sample, reinforcing Van Breda's characterization of LUTS as "hidden symptoms," even among highly educated populations [9]. This finding may suggest a potential role for health literacy in shaping dietary and lifestyle-related behaviors relevant to urinary health. Conversely, it is also possible that symptomatic individuals actively seek information regarding their condition, thereby producing a bidirectional association. Regardless of directionality, this observation highlights a meaningful knowledge gap within the medical student population.

From an application standpoint, modifiable factors such as dietary habits, exhaustion levels, and particularly LUTS awareness suggest the feasibility of integrating urinary health education into formal curricula or extracurricular activities for medical students. Enhancing awareness could promote appropriate self-care behaviors, support early symptom detection, and encourage timely healthcare-seeking when necessary. Behavioral interventions implemented at both individual and institutional levels may represent low-cost and scalable strategies to reduce subjective symptom burden in academic settings. Such initiatives may also contribute to broader preventive health promotion among future healthcare professionals.

Several limitations should be considered when interpreting these findings. First, the cross-sectional design precludes causal inference. Second, the use of convenience sampling may introduce possible selection bias. Third, reliance on self-reported questionnaires may introduce information bias and potential social desirability bias for sensitive variables. Fourth, there is a lack of validation for lifestyle and psychosocial predictors, as these items were self-developed. Fifth, the use of a single-institution sample results in limited external validity beyond one institution. Finally, although multiple linear regression analysis was applied, there is a possible violation of assumptions for linear regression if not tested, and unmeasured factors may still contribute to variability in storage LUTS scores ($\text{Adj } R^2 = 0.261$). Future multicenter studies with larger and more diverse samples are therefore warranted to validate these observations.

V. CONCLUSION

The prevalence of storage LUTS among female medical students was 17.9%, with nocturia and urgency being the most common symptoms. Higher intake of salt and caffeine, increased levels of exhaustion, masturbation frequency, and physical activity were found to be positively associated with symptom severity, while LUTS awareness demonstrated an independent negative association. These findings highlight the potential role of modifiable lifestyle factors and health literacy in influencing symptom burden. Promoting behavioral modifications and improving awareness may contribute to reducing storage LUTS-related discomfort in this population.

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