



# Sex differences in lower urinary tract symptoms of Korean workers: Prevalence, mental health, and associated factors

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## ARTICLE INFO

### Keywords:

Anxiety  
Lower urinary tract symptoms  
Risk factors  
Stress urinary incontinence  
Urinary urgency  
Workers

## ABSTRACT

**Objectives:** Lower urinary tract symptoms (LUTS) in workers can aggravate mental health, lower quality of life, and decrease work productivity. We aimed to examine the prevalence of LUTS, sex-related differences in LUTS, mental health of workers with LUTS, and factors associated with LUTS in Korean workers.

**Methods:** This cross-sectional study included 192 workers from D city and the Gyeongbuk province of South Korea. LUTS were measured using self-reported questionnaires, and mental health was assessed for anxiety, depression, and perceived stress. Differences in characteristics between workers with and without LUTS were analyzed using the chi-square test or independent *t*-test. Multiple logistic regression analysis was performed to identify factors associated with LUTS.

**Results:** Urinary urgency (UU) was significantly more prevalent in men than in women; however, stress urinary incontinence (SUI) was more prevalent in women than in men. The average anxiety and perceived stress scores were significantly higher in men with UU than in men without UU. Men with hypertension or nocturia were more likely to have UU than those without hypertension or nocturia. The anxiety scores significantly increased the odds of UU in men. Advanced age significantly increased the odds of SUI in women. Blue-collar female workers were more likely to develop SUI than their white-collar counterparts.

**Conclusions:** Our study highlighted the prevalence and burden of LUTS among workers. Occupational health providers need to regularly assess workers' bladder storage problems and provide manageable interventions for UU in men and SUI in women.

## 1. Introduction

Lower urinary tract symptoms (LUTS) are bothersome in everyday life. LUTS are common in middle-aged individuals and increase with age (Nagai et al., 2021). The number of workers aged  $\geq 55$  years in Korea nearly doubled from 2012 to 2020 (Korean Statistical Information Service, 2021). LUTS are a disturbance to workers in their working lives. It can cause anxiety (Melotti et al., 2017), depression (Coyne et al., 2008; Rom et al., 2012), and stress (Kim et al., 2019), and affect work productivity (Coyne et al., 2008; Coyne et al., 2012; Lin et al., 2018). Occupational health practitioners should assess workers for urinary problems and help them in advance.

LUTS can be divided into storage, voiding, and postmicturition symptoms (Abrams et al., 2003); the prevalence of storage symptoms is higher than that of voiding or postmicturition symptoms (Bauer & Huebner, 2013). Bladder storage symptoms include frequency, nocturia, and urinary urgency (UU) with or without urinary incontinence (UI) (Haylen et al., 2010). Storage symptoms can cause various inconveniences for workers during their working hours. Occupational demands and work environments may limit access to toilets and can lead to poor bladder habits.

The characteristics of the men and women with LUTS differed slightly. First, according to Irwin et al. (2006b), men were significantly more likely than women to report UU impacting their daily work life,

**Abbreviations:** AUDIT, Alcohol Use Disorders Identification Test; DM, Diabetes Mellitus; HADS, Hospital Anxiety and Depression Scale; LUTS, Lower Urinary Tract Symptoms; OAB, Overactive Bladder; PSS-10, Perceived Stress Scale-10; QVD, Questionnaire-based Voiding Diary; SUI, Stress Urinary Incontinence; UI, Urinary Incontinence; UU, Urinary Urgency.

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<https://doi.org/10.1016/j.pmedr.2023.102470>

Received 17 April 2023; Received in revised form 3 October 2023; Accepted 10 October 2023

Available online 13 October 2023

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including decisions about work location and hours, worry about interrupting meetings, and voluntary termination or early retirement. Men with UU were 1.5 times more likely to be unemployed than those with no/minimal symptoms (Coyne et al., 2012).

In contrast, a meta-analysis of female workers reported that LUTS were significantly associated with activity impairment, presenteeism, and work productivity loss (Lin et al., 2018). In particular, nurses often experience restricted access to toilets at work, delayed voiding, and limited fluid intake to delay voiding at work (Pierce et al., 2019). The urgency to stay engaging in job-related tasks can override the internal sense of the need for emptiness. The behavior of infrequent emptying is referred to as “nurses’ bladder” (Palmer & Newman, 2015), and may have detrimental effects. Approximately 68 % of the female nurses in China have at least one LUTS, 50 % have incontinence symptoms, 40 % have filling symptoms, and 18 % have voiding symptoms (Wan et al., 2017).

Risk factors for LUTS include alcohol consumption (Kim et al., 2019; Wang et al., 2011), smoking, stress (Kim et al., 2019), and prolonged sitting time (Park et al., 2018). Robinson et al. (2017) reported an association between caffeine, carbonated drinks, and alcohol consumption and LUTS severity. Shift work was not associated with LUTS worsening (Sigalos et al., 2019); however, shift workers with shift work disorders, such as sleep disturbance, had clinically significantly higher prostate symptom scores than shift workers without shift work disorders.

LUTS have been reported to be associated with the mental health of workers. Workers with UU, UI, or other LUTS were identified to have aggravated depression levels in five countries (Coyne et al., 2008); depression reportedly enhanced the risk of LUTS in Chinese men (Xiong et al., 2020). According to a meta-analysis (Melotti et al., 2017), men with UU were more likely than women to have anxiety. In healthy male workers in Austria, LUTS, particularly prostate symptoms, were significantly associated with depression (Rom et al., 2012). Compared to the mild stress group, a relationship was discovered between storage symptoms in the moderate and severe stress groups (Kim et al., 2019). Further studies are needed to explore the relationship between mental health and LUTS in workers.

Few studies on LUTS among Korean workers have been conducted. Kim and Kwak (2017) reported that the prevalence of UI was 7.5 % among female workers and significantly associated with various occupational environments. However, there are few studies on the prevalence of LUTS among Korean workers, sex differences in LUTS, comparison with job classification, and the mental health of workers with LUTS. Therefore, we aimed to examine the prevalence of LUTS, sex-related differences in LUTS, and mental health of workers with LUTS and to analyze factors associated with LUTS among Korean workers.

## 2. Methods

### 2.1. Study design and sample

This was a cross-sectional study to investigate urinary health problems among Korean workers. The sample size and participant selection criteria were presented in a previous study (Lee & Noh, 2020). The sample size was calculated using G\* Power 3.1.7. As a reference (Yang, 2019), a medium effect size, significance level, and power of 0.15, 0.05, and 0.90 were considered for two-tailed tests, respectively. The minimum sample size was calculated to be 171; considering a 15 % drop-out rate, 201 participants were required.

We performed convenience sampling of workers at 11 workplaces and one worker’s health center located in D city and the Gyeongbuk province of South Korea. Regarding the recruitment process, we firstly contacted workplace by the total number of employees as well as the characteristics of the workplace. Thus, five workplaces with fewer than 50 employees, three with 50–249 employees, and three with more than 250 employees and one worker’s health center managing the health of workers less than 50 were selected for recruiting workers. Second, we

recruited workers aged  $\geq 19$  years through a recruitment announcement in collaboration with the health manager of each workplace. The exclusion criteria were employers, managers, or employees who had worked for less than 6 months at their company.

Data collection was performed from May 15 to July 2, 2019. Researchers explained the study purpose and procedures and the possibility of withdrawing from the study to the workers who voluntarily participated in the study. Only those who provided written consent were enrolled. A total of 201 questionnaires were distributed, and 192 surveys (men 102; women 90) were used for analyses, excluding nine surveys with incomplete or missing responses. This study was approved by the D University Institutional Review Board in Korea prior to data collection (CUIRB-2019-0002).

### 2.2. Measures

#### 2.2.1. LUTS

We asked the following question about UU: “In the past 7 days, have you had any experience of an unbearable urge to urinate?”. Participants who answered “yes” were considered to have UU. In addition, we asked regarding stress urinary incontinence (SUI): “In the last 7 days, have you had any symptom of urine leaking or dripping when coughing, sneezing, laughing, lifting something, or exercising?”. Participants who answered “yes” were considered to have SUI. We also asked about nocturia: “How often do you have to get up in the night to urinate after you have fallen asleep?”. Participants who answered “more than two times per night” were considered to have nocturia.

#### 2.2.2. Mental health

Symptoms of anxiety and depression were evaluated using the Korean version of the Hospital Anxiety and Depression Scale (HADS) by Oh et al. (1999). It was initially developed for inpatients; however, its reliability and validity have recently been verified for ordinary people, such as workers (Kang et al., 2016). The HADS is a self-rating scale consisting of 14 items on a 4-point scale, and it measures the presence and severity of anxiety and depression separately. In this study, the Cronbach’s  $\alpha$  scores for anxiety and depression were 0.82 and 0.80, respectively.

The Korean version of the Perceived Stress Scale-10 (PSS-10) by Lee et al. (2012) was administered to measure perceived stress in workers. The 10 items were answered on a 5-point scale (0 = never; 4 = very often). Accordingly, the total score ranged from 0 to 40, which implies that the higher the score, the higher the perceived stress. In this study, the Cronbach’s  $\alpha$  score for the PSS-10 was 0.80.

#### 2.2.3. Health-Related behaviors

We collected self-reported current smoking status and physician-diagnosed health problems, such as hypertension and diabetes mellitus (DM). Heavy drinking was evaluated using the Korean version of the Alcohol Use Disorders Identification Test (AUDIT) by Lee et al. (2000). The cutoff point was defined as a score  $\geq 10$  for men and  $\geq 6$  for women. Heavy drinking was considered to be above the cutoff point.

A questionnaire-based voiding diary (QVD) developed by Arya et al. (2008) was used to obtain information on the participants’ types and amounts of fluid intake. Fluid intake was based on a common paper cup (150 ml). We asked them how many cups they drank per day and what types of fluids, such as coffee, water or juice. The amount of caffeinated drinks consumed was calculated based on the QVD. Most participants used sticks of coffee mix, which contained an average of 52 mg of caffeine per stick (Park et al., 2019). Participants also drank caffeinated drinks called “Bacchus”, which contained 30 mg of caffeine per bottle. Thus, the total caffeinated drink consumption was obtained by summing the average daily intake of cups of coffee multiplied by 52 mg and the average daily intake of bottles of caffeinated drinks multiplied by 30 mg.

#### 2.2.4. Work-Related environments

Jobs were classified as white, pink, and blue collars. Managers, professionals, and clerks were classified as white-collar; service and sales jobs as pink-collar; and technical, machinery assembly, and operation jobs as blue-collar. We also assessed whether they did a shift work and how many hours per week they worked on average, including overtime.

Occupational environments determine whether workers are exposed to ergonomic and psychological hazards for more than half of their working hours. Ergonomic hazards included dragging, pushing, or moving heavy objects; maintaining a standing position; and repetitive hand or arm movements. Psychological hazard was determined based on whether they dealt directly with customers, not colleagues.

#### 2.3. Statistical analyses

Categorical data were presented as frequencies and proportions (%); conversely, continuous data were presented as means and standard deviations (SD). Missing data on general characteristics were considered “as is” in the analysis without replacement. The association between general characteristics or mental health and LUTS was analyzed using the chi-squared test or independent *t*-test. Variables confirmed to be significant factors for LUTS in a univariate analysis were used as independent variables in a multiple regression analysis. Multiple logistic regression analysis was performed to analyze factors associated with LUTS. Results were expressed as adjusted odds ratios (OR) with 95 % confidence intervals (CI). A value of  $p < .05$  was considered to be statistically significant. All statistical tests were performed using the SPSS version 25.0 software (IBM, Armonk, NY, USA).

### 3. Results

The general characteristics of the male and female participants are presented in Table 1. The average age of all participants was 44.6 years (SD, 11.3), and 36.4 % were  $\geq 50$  years. Approximately 60 % of the participants had a college or higher education degree, and 71.4 % had a spouse. Current smoking, hypertension, or fluid intake from caffeinated drinks or alcohol were more common in male workers than in female workers ( $p < .001$ , all). Nocturia, defined as voiding more than two times per night, affected 10.8 % of men and 8.9 % of women. However, there were no significant differences between the groups. UU was significantly more prevalent in men (15.7 %) than in women (5.6 %;  $p = .025$ ). However, SUI was more prevalent in women (14.4 %) than in men (2.0 %;  $p = .002$ ). Approximately 71 % of the participants worked in a manufacturing company, and 57.8 % were white-collar. There were no significant differences between ergonomics, psychological hazards, and sex.

The differences in characteristics and mental health between men with and without UU are presented in Table 2. The average age of men with UU was 52.1 years (SD, 7.1), which was significantly higher than the average age of men without UU (45.0 years;  $p = .003$ ). Hypertension or nocturia was more prevalent in men with UU than in men without UU ( $p < .001$ , both). Anxiety ( $p = .001$ ) and perceived stress ( $p = .029$ ) were significantly higher in men with UU than in men without UU.

Differences in characteristics and mental health between women with SUI and those without SUI are presented in Table 3. The average age of women with SUI was 50.8 years (SD, 3.2), which was significantly higher than that of women without SUI (41.6 years;  $p < .001$ ). All women with SUI were living with their spouses, and the prevalence of DM was significantly different between women with SUI and women without SUI ( $p = .019$ ). Approximately 57 % of women without SUI were white-collar, and 46.2 % of women with SUI were pink-collar ( $p = .014$ ). There were no significant differences between ergonomics, psychological hazards, and LUTS. In addition, there were no significant differences in mental health between women with and without SUI.

The results of the multiple logistic regression analysis for the factors

associated with UU in men are presented in Table 4. We used independent variables whose significance was confirmed by univariate analysis (Table 2). Men who had hypertension (OR, 5.19; 95 % CI, 1.09–24.75) or nocturia (OR, 7.15; 95 % CI, 1.31–38.86) were more likely to have UU compared with men who did not. Additionally, higher anxiety scores significantly increased the odds of UU in men (OR, 1.46; 95 % CI, 1.06–2.03). The Hosmer and Lemeshow Goodness-of-Fit tests indicated an adequate fit to the data in the models ( $\chi^2 = 3.817$ ,  $p = .873$ ).

The results of the multiple logistic regression analysis for the factors associated with SUI in women are presented in Table 5. We used independent variables whose significance was confirmed by univariate analysis (Table 3). However, marital status was excluded as an independent variable because all women with SUI in our study lived with their spouses. Advanced age significantly increased the odds of SUI in women (OR, 1.10; 95 % CI, 1.01–1.19), and blue-collar female workers were more likely to have SUI than their white-collar counterparts (OR, 7.20; 95 % CI, 1.18–43.98). The Hosmer and Lemeshow Goodness-of-Fit tests indicated an adequate fit to the data in the models ( $\chi^2 = 14.588$ ,  $p = .068$ ).

### 4. Discussion

This study was performed to assess the prevalence of LUTS, sex-related differences in LUTS, and mental health of workers with LUTS and to analyze factors associated with LUTS among Korean workers. In this study, we discovered that the overall prevalence of LUTS with at least one of three symptoms including nocturia, UU, or SUI was 23.4 %. Although the extent of variability in prevalence of LUTS exist due to methodological differences, it is known that it increases with age (Chow et al., 2018; Irwin et al., 2006a; Yee et al., 2019; Yoo et al., 2018). However, the possibility of underreporting cannot be ruled out, which is one of the characteristics of self-reporting. In the current study, the prevalence of UU was 15.7 % in men, which was similar to the findings of previous population-based studies (Irwin et al., 2006a; Yoo et al., 2018), where the prevalence of UU in men ranged from 10.8 % to 19.5 %.

In the current study, factors such as hypertension, nocturia, and anxiety were found to be associated with UU in men. Hypertension is often managed with diuretics and calcium channel blockers, and beta blockers that can exacerbate symptoms of urinary urgency (Akbar et al., 2022; Rohmann et al., 2005). Moreover, a possible explanation linking hypertension to urgency is higher sympathetic activity relative to parasympathetic activity, which subsequently leads to increased sensitivity to bladder filling and urgency (Akbar et al., 2022). This multi-ethnic study on atherosclerosis by Akbar et al. (2022) found that overactive bladder (OAB) was significantly associated with higher systolic blood pressure among men with OAB on antihypertensive medication.

Nocturia can be driven not only by a LUTS dysfunction involving the bladder, prostate, or urethra but nighttime urine overproduction or nocturnal polyuria resulting from renal, cardiovascular, or pulmonary factors (Weiss, 2012). In middle-aged adults, the male maximum flow rate (Q<sub>max</sub>) decreases to approximately 60 % of female Q<sub>max</sub>; correspondingly, the detrusor pressure and residual urine in men rise to significantly higher levels than in women (Bauer & Huebner, 2013). Increased residual urine can cause nocturia at night.

Higher anxiety levels significantly increased the odds of UU in men in our study. This finding is consistent with that of a previous study (Coyne et al., 2009), which found that the significant predictors of anxiety in men are UU, nocturia, incomplete emptying, and bladder pain. This may be attributed to the fact that UU could increase anxiety in daily life. A meta-analysis also revealed that compared to women with UU, men with UU were more likely to have anxiety (Melotti et al., 2017). Furthermore, anxiety was found to be more severe in patients with UU with incontinence than in those with UU without incontinence in Brazilian (Teloken et al., 2006) and Korean populations (Lim et al., 2007). To date, the causal relationship between anxiety and UU is unclear;

**Table 1**  
Sample characteristics and LUTS of Korean workers in 2019, stratified by sex.

Variables		Total (N = 192) M ± SD (Range) or N (%)	Men (N = 102) M ± SD (Range) or N (%)	Women (N = 90) M ± SD (Range) or N (%)	χ <sup>2</sup> /t (p)		
Demographic factors	Age (years)	44.6 ± 11.3 (18–68)	46.1 ± 12.0 (19–67)	42.9 ± 10.4 (18–68)	1.95 (0.053)		
		<40	65 (33.9)	33 (32.4)	32 (35.6)	3.37 (0.185)	
		40–49	57 (29.7)	26 (25.5)	31 (34.4)		
		≥50	70 (36.4)	43 (42.1)	27 (30.0)		
	Education (N = 191)	≤High School	78 (40.8)	43 (42.6)	35 (38.9)	0.27 (0.605)	
		≥College	113 (59.2)	58 (57.4)	55 (61.1)		
	Marital status	No spouse	55 (28.6)	26 (25.5)	29 (32.2)	1.06 (0.303)	
		Living with spouse	137 (71.4)	76 (74.5)	61 (67.8)		
	Income (million KRW) (N = 191)	<2	68 (35.6)	25 (24.8)	43 (47.8)	11.01 (0.001)	
		≥2	123 (64.4)	76 (75.2)	47 (52.2)		
Health-related behaviours	BMI (kg/m <sup>2</sup> ) (N = 185)	Undeweight (<18.5)	9 (4.9)	5 (5.0)	4 (4.7)	14.50 (0.001)	
		Normal (18.5–22.9)	90 (48.6)	36 (36.0)	54 (63.5)		
		Overweight/Obese (≥23.0)	86 (46.5)	59 (59.0)	27 (31.8)		
		Current smoking	56 (29.2)	54 (52.9)	2 (2.2)	59.53 (<0.001)	
	Heavy drinking	70 (36.5)	44 (43.1)	26 (28.9)	4.19 (0.041)		
	Self-reported health problems	Hypertension	36 (18.8)	29 (28.4)	7 (7.8)	13.39 (<0.001)	
		DM	11 (5.7)	9 (8.8)	2 (2.2)	3.86 (0.050)	
	Total Fluid Intake (ml/day) (N = 191)	Water	1184.3 ± 556.4 (150–3000)	1218.4 ± 571.6 (300–3000)	1145.2 ± 539.0 (150–3000)	4.58 (<0.001)	
		Caffeinated drinks <sup>a</sup>	346.3 ± 243.6 (0–1500)	406.6 ± 274.9 (0–1500)	277.1 ± 179.8 (0–750)	3.90 (<0.001)	
		Alcohol	270.3 ± 512.9 (0–2700)	422.8 ± 637.7 (0–2700)	95.6 ± 208.6 (0–900)	4.89 (<0.001)	
		Others <sup>b</sup>	225.3 ± 318.1 (0–2220)	237.5 ± 323.9 (0–1500)	210.7 ± 312.5 (0–2200)	0.58 (0.562)	
		Caffeinated drinks consumption <sup>c</sup> (mg/day)	113.0 ± 80.5 (0–520)	131.9 ± 92.4 (0–520)	91.3 ± 57.5 (0–260)	3.69 (<0.001)	
	LUTS	Frequency (times/day) (N = 191)	≤5	65 (34.0)	40 (39.6)	25 (27.8)	4.08 (0.130)
			6–8	96 (50.3)	49 (48.5)	47 (52.2)	
			≥9	30 (15.7)	12 (11.9)	18 (20.0)	
Nocturia (≥2 times/night)		19 (9.9)	11 (10.8)	8 (8.9)	0.19 (0.661)		
UU		21 (10.9)	16 (15.7)	5 (5.6)	5.04 (0.025)		
SUI		15 (7.8)	2 (2.0)	13 (14.4)	10.35 (0.002)		
Organizational factors	Company size (number of employees)	<50	84 (43.8)	50 (49.0)	34 (37.8)	2.47 (0.291)	
		50–249	68 (35.4)	33 (32.4)	35 (38.9)		
		≥250	40 (20.8)	19 (18.6)	21 (23.3)		
	Industry classifications	Manufacturing	136 (70.8)	84 (82.4)	52 (57.8)	14.10 (0.003)	
		Wholesale & retail	17 (8.9)	5 (4.9)	12 (13.3)		
Hotels & restaurants		14 (7.3)	5 (4.9)	9 (10.0)			
Others		25 (13.0)	8 (7.8)	17 (18.9)			
Work-related environments	Job classifications	White collar	111 (57.8)	65 (63.7)	46 (51.1)	15.59 (<0.001)	
		Pink collar	37 (19.3)	9 (8.8)	28 (31.1)		
		Blue collar	44 (22.9)	28 (27.5)	16 (17.8)		
	Ergonomics hazards	Heavy lifting, pulling or moving	84 (43.8)	42 (41.2)	42 (46.7)	0.59 (0.444)	
		Prolonged standing	111 (57.8)	60 (58.8)	51 (56.7)	0.09 (0.763)	
		Repetitive hand movements	121 (63.0)	58 (56.9)	63 (70.0)	3.54 (0.060)	
	Psychological hazards	Customer service	57 (29.7)	24 (23.5)	33 (36.7)	3.95 (0.047)	

(continued on next page)

**Table 1** (continued)

Variables	Total (N = 192) M ± SD (Range) or N (%)	Men (N = 102) M ± SD (Range) or N (%)	Women (N = 90) M ± SD (Range) or N (%)	χ <sup>2</sup> /t (p)
Working time (hr/week)				4.05 (0.044)
<48	129 (67.2)	62 (60.8)	67 (74.4)	
≥48	63 (32.8)	40 (39.2)	23 (25.6)	
Shift work	53 (27.7)	27 (26.5)	26 (29.2)	0.18 (0.673)

Note. M = Mean; SD = Standard Deviation; KRW = South Korean Won; BMI = Body mass index; DM = Diabetes mellitus; LUTS = Lower urinary tract symptoms; UU = Urinary urgency; SUI = Stress urinary incontinence; <sup>a</sup> Coffee and caffeine contained drinks; <sup>b</sup> Carbonated drinks, milk, and fruit juice; <sup>c</sup> Caffeinated drinks consumers' consumption.

**Table 2**

Differences in the general characteristics and mental health between men with UU and men without UU among Korean workers in 2019.

Variables	No UU (N = 86) M ± SD or N (%)	Yes UU (N = 16) M ± SD or N (%)	χ <sup>2</sup> /t (p)
<b>Demographic factors</b>			
Age (years)	45.0 ± 12.4	52.1 ± 7.1	-3.16 (0.003)
<40	32 (37.3)	1 (6.3)	9.19 (0.010)
40-49	23 (26.7)	3 (18.7)	
≥50	31 (36.0)	12 (75.0)	
Education			0.01 (0.917)
≤High School	36 (42.4)	7 (43.8)	
≥College	49 (57.6)	9 (56.3)	
Marital status			0.00 (0.961)
No spouse	22 (25.6)	4 (25.0)	
Living with spouse	64 (74.4)	12 (75.0)	
Income (million KRW)			0.43 (0.512)
<2	20 (23.5)	5 (31.3)	
≥2	65 (76.5)	11 (68.8)	
<b>Health-related behaviors</b>			
BMI (kg/m <sup>2</sup> )			0.23 (0.628)
Undeweight/Normal (<23.0)	34 (40.0)	7 (46.7)	
Overweight/Obese (≥23.0)	51 (60.0)	8 (53.3)	
Current smoking	42 (48.8)	12 (75.0)	3.71 (0.054)
Heavy drinking	34 (39.5)	10 (62.5)	2.90 (0.089)
Self-reported health problems			
Hypertension	18 (20.9)	11 (68.8)	15.16 (<0.001)
DM	7 (8.1)	2 (12.5)	0.32 (0.572)
Total fluid intake (ml/day)	2298.8 ± 942.6	2212.5 ± 1240.6	0.32 (0.750)
Water	1249.7 ± 562.3	1050.0 ± 610.5	1.29 (0.201)
Caffeinated drinks <sup>a</sup>	399.4 ± 285.9	445.3 ± 209.4	-0.61 (0.542)
Alcohol	391.6 ± 616.7	590.6 ± 739.9	-1.15 (0.254)
Others <sup>b</sup>	258.1 ± 339.3	126.6 ± 196.9	1.50 (0.136)
Caffeinated drinks consumption <sup>c</sup> (mg/day)	130.9 ± 96.9	137.2 ± 65.8	-0.25 (0.805)
<b>LUTS</b>			
Frequency (times/day)			1.17 (0.559)
≤5	35 (40.7)	5 (33.3)	
6-8	42 (48.8)	7 (46.7)	
≥9	9 (10.5)	3 (20.0)	
Nocturia (≥2 times/night)	5 (5.8)	6 (37.5)	14.08 (<0.001)
<b>Organizational factors</b>			
Company size (number of employees)			0.21 (0.646)
<50	43 (50.0)	7 (43.8)	
≥50	43 (50.0)	9 (56.2)	
Industry classifications			0.71 (0.401)
Manufacturing	72 (83.7)	12 (75.0)	
Non-manufacturing	14 (16.3)	4 (25.0)	
<b>Work-related environments</b>			
Job classifications			0.26 (0.878)
White collar	54 (62.8)	11 (68.8)	
Pink collar	8 (9.3)	1 (6.3)	
Blue collar	24 (27.9)	4 (25.0)	
Ergonomics hazards			
Heavy lifting, pulling or moving	33 (38.4)	9 (56.3)	1.78 (0.182)
Prolonged standing	49 (57.0)	11 (68.8)	0.77 (0.380)
Repetitive hand movements	48 (55.8)	10 (62.5)	0.25 (0.620)
Psychological hazards			
Customer service	20 (23.3)	4 (25.0)	0.02 (0.880)
Working time (hr/week)			3.33 (0.068)
<48	49 (57.0)	13 (81.3)	
≥48	37 (43.0)	3 (18.7)	
Shift work	22 (25.6)	5 (31.3)	0.22 (0.637)
<b>Mental health</b>			
Anxiety (scores)	4.4 ± 2.9	7.1 ± 2.7	-3.43 (0.001)
Depression (scores)	6.2 ± 3.7	8.0 ± 3.1	-1.80 (0.075)
Perceived stress (scores)	15.8 ± 5.1	18.8 ± 4.2	-2.22 (0.029)

Note. UU = Urinary urgency; M = Mean; SD = Standard Deviation; BMI = Body mass index; KRW = South Korean Won; DM = Diabetes mellitus; LUTS = Lower urinary tract symptoms; <sup>a</sup> Coffee and caffeine contained drinks; <sup>b</sup> Carbonated drinks, milk, and fruit juice; <sup>c</sup> Caffeinated drinks consumers' consumption.

**Table 3**  
Differences in the general characteristics and mental health between women with SUI and women without SUI among Korean workers in 2019.

Variables		No SUI (N = 77) M ± SD or N (%)	Yes SUI (N = 13) M ± SD or N (%)	$\chi^2$ / t (p)	
Demographic factors	Age (years)	41.6 ± 10.6	50.8 ± 3.2	-6.14 (<0.001)	
		<40	0 (0.0)	22.12 (<0.001)	
		40–49	2 (15.4)		
		≥50	11 (84.6)		
	Education	≤High School	28 (36.4)	7 (53.6)	1.43 (0.232)
		≥College	49 (63.6)	6 (46.2)	
	Marital status	No spouse	29 (37.7)	0 (0.0)	7.22 (0.008)
		Living with spouse	48 (62.3)	13 (100.0)	
	Income (million KRW)	<2	35 (45.5)	8 (61.5)	1.15 (0.283)
		≥2	42 (54.5)	5 (38.5)	
Health-related behaviours	BMI (kg/m <sup>2</sup> )	Undeweight/Normal (<23.0)	6 (46.2)	3.45 (0.063)	
		Overweight/Obese (≥23.0)	20 (27.8)	7 (53.8)	
	Current smoking	1 (1.3)	1 (7.7)	2.09 (0.269)	
		23 (29.9)	3 (23.1)	0.25 (0.749)	
	Heavy drinking	Hypertension	4 (5.2)	3 (23.1)	4.96 (0.059)
		DM	0 (0.0)	2 (15.4)	12.12 (0.019)
	Total fluid intake (ml/day)	1706.8 ± 656.3	1855.4 ± 811.7	-0.73 (0.469)	
		Water	1150.7 ± 569.2	1113.5 ± 323.8	0.23 (0.820)
		Caffeinated drinks <sup>a</sup>	283.0 ± 177.1	242.3 ± 198.8	0.75 (0.454)
		Alcohol	88.2 ± 206.4	138.5 ± 224.7	-0.80 (0.425)
Others <sup>b</sup>		184.9 ± 224.3	316.2 ± 610.7	-1.03 (0.323)	
Caffeinated drinks consumption <sup>c</sup> (mg/day)	93.7 ± 56.8	77.2 ± 61.7	0.95 (0.342)		
	Frequency (times/day)	≤5	4 (30.8)	0.23 (0.892)	
6–8		6 (46.2)			
≥9		3 (23.1)			
LUTS	Nocturia (≥2 times/night)	6 (7.8)	2 (15.4)	0.79 (0.374)	
	Company size (number of employees)	<50	2 (15.4)	3.24 (0.072)	
Industry classifications		≥50	11 (84.6)		
	Work-related environments	Manufacturing	6 (46.2)	0.84 (0.359)	
Job classifications		Non-manufacturing	7 (53.8)		
	Ergonomics hazards	White collar	44 (57.1)	2 (15.4)	8.56 (0.014)
Pink collar		22 (28.6)	6 (46.2)		
Blue collar		11 (14.3)	5 (38.5)		
Psychological hazards		Heavy lifting, pulling or moving	34 (44.2)	8 (61.5)	1.35 (0.245)
	Prolonged standing	41 (53.2)	10 (76.9)	2.54 (0.111)	
	Repetitive hand movements	54 (70.1)	9 (69.2)	0.01 (0.948)	
Mental health	Working time (hr/week)	Customer service	7 (53.8)	1.93 (0.165)	
		<48	9 (69.2)	0.22 (0.641)	
	≥48	4 (30.8)			
Mental health	Shift work	3 (23.1)	0.28 (0.599)		
	Anxiety (scores)	5.5 ± 3.9	6.0 ± 3.5	-0.44 (0.664)	
	Depression (scores)	6.0 ± 3.9	8.0 ± 4.6	-1.66 (0.100)	
	Perceived stress (scores)	17.2 ± 5.9	17.4 ± 6.4	-0.08 (0.939)	

Note. SUI = Stress urinary incontinence; M = Mean; SD = Standard Deviation; BMI = Body mass index; KRW = South Korean Won; DM = Diabetes mellitus; LUTS = Lower urinary tract symptoms; <sup>a</sup> Coffee and caffeine contained drinks; <sup>b</sup> Carbonated drinks, milk, and fruit juice; <sup>c</sup> Caffeinated drinks consumers' consumption.

**Table 4**  
Factors associated with UU among Korean male workers in 2019.

Variable	OR (95 % CI)	p
Age (years)	1.04 (0.96–1.11)	0.329
Hypertension <sup>a</sup>	5.19 (1.09–24.75)	0.039
Nocturia <sup>a</sup>	7.15 (1.31–38.86)	0.023
Anxiety (scores)	1.46 (1.06–2.03)	0.022
Perceived stress (scores)	0.94 (0.78–1.12)	0.458

Note. UU = Urinary urgency; OR = Odds ratio; 95 % CI = 95 % Confidence Interval; <sup>a</sup> reference = no.

**Table 5**  
Factors associated with SUI among Korean female workers in 2019.

Variable	OR (95 % CI)	p
Age (years)	1.10 (1.01–1.19)	0.026
Job_pink-collar <sup>a</sup>	3.60 (0.61–21.27)	0.157
Job_blue-collar <sup>a</sup>	7.20 (1.18–43.98)	0.033

Note. SUI = Stress urinary incontinence; OR = Odds ratio; 95 % CI = 95 % Confidence Interval; <sup>a</sup> reference = white-collar.

however, anxiety and UU are highly correlated to each other. Thus, anxiety and UU among male workers must be detected early and managed properly. Occupational health providers should educate

workers on the possibility of UU if they have hypertension, nocturia, or anxiety. We did not investigate the type of antihypertensive drugs taken and the time of administration, nor did we measure residual urine volume. Therefore, further studies are needed for evaluation after this information has been collected.

According to Irwin et al. (2006b), approximately 7 % of men with OAB-related incontinence changed jobs or were terminated because of their bladder control problems. One of the factors in men's employment decisions may be bladder control problems. In a study, 23.5 % of men did not discuss their LUTS with either personal or professional relations, and 59.1 % did not discuss their LUTS with any professional relation (Knudsen et al., 2020). Concerns and the influence of LUTS on daily activities are important determinants of general practitioner consultation, yet only one in three bothersome LUTS are discussed with a general practitioner (Rubach et al., 2019). LUTS were associated with poor employment and life satisfaction; however, sufferers did not discuss their conditions. Thus, periodic check-ups and counseling are necessary to assess and manage bladder conditions and maintain male workers' employment.

In this study, we identified SUI as the most common LUTS in female workers. The 14.4 % prevalence of SUI in female workers in this study is lower compared with that in the population-based study in South Korea (22.9 %) (Yoo et al., 2018). The possible explanation of this difference is the difference in the participants' ages (42.9 vs. 54.3 years), as it is well known that the prevalence of SUI in women is higher in their 50's than in their 40's (Ge et al., 2015).

We identified that the factors associated with SUI in women were advanced age and blue-collar jobs, which is consistent with the results of previous studies. Advanced age is a significant risk factor for SUI in women (Nagai et al., 2021; Wang et al., 2011). Pelvic floor dysfunction in nurses is associated with occupational roles such as lifting heavy weights and poor bladder habits (Lopes et al., 2019). Women working in services or sales are more likely to have increased odds of UI compared to those in unemployed women, and UI was significantly associated with occupational environments such as dangerous jobs with a high probability of accidents, awkward positions for long time, and lifting heavy weight (Kim & Kwak, 2017). Female workers should manage physical activity that can increase abdominal pressure, weaken pelvic floor support, and cause SUI. Therefore, bladder health management is critical for occupational health. Occupational health providers must routinely assess workers' bladder habits and emptying problems to prevent and manage LUTS.

Moreover, although not verified in this study, according to previous studies, alcohol consumption (Kim et al., 2019; Wang et al., 2011), education, body mass index (Wang et al., 2011), smoking, stress (Kim et al., 2019), depression (Coyne et al., 2009; Xiong et al., 2020; Xiong et al., 2021), fluid intake, including caffeine (Robinson et al., 2017), and shift work (Sigalos et al., 2019) have been associated with LUTS. Further research is needed to assess the bad habits of workers or harmful working environments and verify their relationship with work-related diseases.

This study has several limitations. First, we used self-reported questionnaires to assess LUTS symptoms. We did not measure objective data, such as residual urine check using diagnostic tests; thus, symptoms might be underreported. Second, we could not measure the work environment related to unhealthy toileting behaviors such as delayed voiding and straining to void. Finally, we recruited a small number of participants from several workplaces.

## 5. Conclusions

LUTS are more common in middle-aged adults and are bothersome in everyday life. Workers who spend most of their days at work can be affected by their occupational role or work environment. Our findings reveal that UU is more prevalent in men and that the associated factors are hypertension, nocturia, or anxiety. In addition, SUI is more prevalent

in women, and the associated factors are advanced age or blue-collar workers. This means that men need to control and manage chronic diseases, urinary symptoms, and mental health to prevent LUTS; women need to achieve successful aging and maintain healthy work environments. LUTS can reduce the quality of life, employment, and work productivity. Occupational health practitioners need to gain insight into sex-specific urinary conditions, assess workers regularly for bladder storage problems, and offer patient-centered interventions for UU and SUI in male and female workers, respectively.

## Ethics statement

This study was approved by the D University Institutional Review Board (CUIRB-2019-0002).

## CRediT authorship contribution statement

**Young Joo Lee:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Visualization, Funding acquisition. **Jeongok Park:** Conceptualization, Methodology, Validation, Writing – review & editing, Visualization, Funding acquisition.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

Data will be made available on request.

## Acknowledgements

Not applicable.

## Funding information

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) [grant number NRF-2018R1C1B5042936] and by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education [grant number NRF-2022R1A2C1092084].

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