



## Original Article

Int Neurourol J 2022;26(1):37-44  
<https://doi.org/10.5213/inj.2142146.073>  
pISSN 2093-4777 · eISSN 2093-6931



# The Relationship Between Lower Urinary Tract Symptoms and Osteoarthritis Symptoms Among Vendors in a Conventional Market

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**Purpose:** This study aimed to investigate lower urinary tract symptoms (LUTS) and the correlation between LUTS and osteoarthritis (OA) symptoms in the vendors working in a conventional market.

**Methods:** This cross-sectional study was conducted on 153 vendors aged 40 and over from August 10th to September 8th, 2020, in a conventional market. Data were collected via the self-reported questionnaires. We assessed LUTS by International Prostate Symptom Score (IPSS) and OA symptoms by Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC).

**Results:** The mean age of 153 subjects was  $61.31 \pm 9.92$  years old. The mean score of IPSS and WOMAC was  $5.37 \pm 5.68$  (range, 0–35) and  $16.89 \pm 19.61$  (range, 0–96). Fifty-one percent of subjects had urinary incontinence at least monthly. Twenty-four point two percent of subjects had moderate-to-severe LUTS which were defined as a score of IPSS  $\geq 8$ . LUTS were positively correlated with OA symptoms ( $r = 0.41$ ,  $P < 0.001$ ).

**Conclusions:** The results showed that LUTS were associated with OA symptoms, and it also emphasized the need for vendors to be provided with a health education program to manage and prevent their LUTS and OA symptoms.

**Keywords:** Lower urinary tract symptoms; Osteoarthritis; Occupation

• **Fund/Grant Support:** This work was supported by a research grant from Jeju National University in 2020.

• **Research Ethics:** The study was performed in accordance with the ethical standards of the Declaration of Helsinki. This study was approved by the institutional review board (approval number: JJNU-IRB-2020-031) of Jeju National University. All subjects provided written informed consent before participating in this study.

• **Conflict of Interest:** No potential conflict of interest relevant to this article was reported.

## INTRODUCTION

The impact of lower urinary tract symptoms (LUTS) on individuals' everyday life can be significant, triggering distress and reduced confidence that may adversely affect work-related pro-

ductivity and social interactions [1]. Reduced quality of life has been reported among individuals with LUTS, and many individuals experience bothersome symptoms that impair the quality of their daily life [2].

LUTS encompasses a wide range of symptoms, categorized

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**Submitted:** April 25, 2021 / **Accepted after revision:** June 3, 2021



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by the International Continence Society (ICS) as bladder storage, voiding, and postmicturition symptoms. Storage symptoms include urinary frequency, nocturia, urinary urgency, and urinary incontinence (UI). Voiding symptoms include slow stream, intermittent stream, hesitancy, and straining [3].

Yoo et al. [4] reported a total prevalence of LUTS of 68.2%, including 70.6% among men and 66.0% among women, according to the ICS definition in their study of 2,080 subjects aged 40 years or older. Przydacz et al. [5] assessed a population aged 40 years or older in a Western country and reported a prevalence of LUTS of 69.8% (66.2% among men and 72.6% among women). Importantly, the definition of LUTS can vary among studies, influencing the results. Liu et al. [6] reported in their study of participants aged older than 40 years that the prevalence of LUTS, defined as the presence of at least moderate symptoms according to the International Prostate Symptom Score (IPSS), among the total study population was approximately 30%; while, in a Korean study, the prevalence of LUTS characterized by moderate or greater symptoms per IPSS was higher in men (44.7%) than in women (35.8%) [4].

Osteoarthritis (OA) is also highly prevalent around the globe as a leading cause of disability that can negatively impact people's physical and mental well-being [7]. The knees and hips are the parts most affected by OA in general, leading to pain, stiffness, swelling, and loss of normal joint function [8]. The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a widely used measure for assessing pain, stiffness, and physical function among people with OA of the knee and hip joints [9]. Moreover, mobility problems, including those symptoms caused by OA, might lead to a delay in urination at an appropriate time or trouble with using the toilet [10]. Previous research has shown that OA and OA pain are associated with UI [11], and Ahmadi et al. [12] also reported that OA increased the risk of UI.

On the other hand, occupation type and workplace environment may be closely related to the presence of voiding problems. Limited restroom use among workers may occur in the work environment due to an increased work burden, i.e., greater inconvenience when using the restroom at work [13]. Workers in service and retail occupations may not have adequate time for toileting due to high-paced job demands [14]. Moreover, occupations that demand characteristics such as awkward positioning, physically hard activities, and more manual labor are risk factors of LUTS and UI [15]. Several studies have assessed the prevalence of LUTS, including UI among women

working in production facilities, teachers, and female air force members [16-18].

In Korea, community-based epidemiologic studies on LUTS have concluded that LUTS is associated with sociodemographic characteristics [19], lifestyle [20], and falls and/or a fear of falling [21]. Kim and Kwak [22] examined the association between UI in working women and their occupational status by using data from the fourth Korea National Health and Nutrition Examination Survey.

Vendors at the conventional market need to work on strenuous physical lifting and activities, knee-bending or squatting position, and prolonged standing posture all day long, which may lead to a higher risk of developing muscle joint problems and knee OA in particular [23]. However, there is little research on LUTS in specific occupational groups, such as conventional market vendors with limited restroom use and a significant daily musculoskeletal burden. Therefore, we aimed to investigate LUTS and the relationship between LUTS and OA symptoms among vendors working in a conventional market as one of the specific occupational groups that remains to be investigated. We also intended to provide basic data to support the development of an education program for the management of voiding and musculoskeletal health among vendors in a conventional market.

## MATERIALS AND METHODS

### Design and Ethics Statement

This study employed a cross-sectional design. The present study was conducted following the ethical standards of the Declaration Helsinki and was approved by the Institutional Review Board at Jeju National University (approval number: JJNU-IRB-2020-031).

### Samples and Data Collection

Data were collected via a self-reported questionnaire. A total of 153 individuals, who were all vendors aged 40 years and older working at a conventional market located in Jeju City, agreed to participate in the study with a full understanding of the purpose and the content of the study. Individuals who had a medical history of stroke and/or Parkinson disease were excluded. The first author provided details on the purposes, contents, and methods of the study to the chairman and directors of the Vendors Association and they agreed with data collection. Then, from August 10 through September 8, 2020, the author and/or

research assistants visited each vendor's store. After explaining the study's purpose to each vendor, data were collected by their completion of the questionnaire, which took about 15 minutes per vendor. Vendors' participation in the study was voluntary and they were given a full explanation regarding discontinuing completion of the questionnaire at any time together with an assurance of confidentiality of their responses and personal information.

### Sample Size

The sample size was computed using the G\*power 3.1 software [24]. With a statistical significance of 0.05, a power of 0.95, and an effect size of 0.3, in the correlation, the sample size was found to be 134. Considering the potential for loss to follow-up, we distributed 160 questionnaires; 7 with incomplete data were eventually excluded, so 153 vendors were enrolled in this study.

### Questionnaire and Measures

#### General characteristics

Using the questionnaire, the study participants were asked about general characteristics, such as sex, age, educational level, marital status, alcohol consumption, smoking, regular exercise habits, and chronic diseases.

#### Lower urinary tract symptoms

LUTS were evaluated by the Korean version of the IPSS [25]. The IPSS includes 4 voiding LUTS (hesitancy, intermittency, weak stream, and incomplete emptying of the bladder) and 3 storage LUTS (frequency, urgency, and nocturia). Subjects were asked to indicate the frequency with which they experienced each of the 7 symptoms during the past 3 months on a scale of 0–5. IPSS scores range from 0 to 35; scores ranging from 0 to 7 indicate mild LUTS, scores from 8 to 19 indicate moderate LUTS, and scores from 20 to 35 indicate severe LUTS. Positive LUTS was operationally defined as a score of IPSS  $\geq 8$  of moderate-to-severe LUTS.

#### Urinary incontinence

UI was assessed on the basis of the definition of the ICS [5] as a "complaint of any involuntary leakage of urine," and UI was operationally defined as incontinence by the reporting of involuntary urine loss at least once per month during the 3 months prior to data collection. Stress UI symptoms were identified when the participant responded positively to the question, "have you had leakage of urine when you coughed, laughed, exercised,

lifted, or climbed stairs during the past 3 months?" Urge UI was identified when the participant responded positively to the question, "during the past 3 months, when leakage of urine has occurred, were you aware of the need to urinate before the leakage occurred?" Mixed UI was confirmed when the participant responded positively to these 2 questions [26].

#### OA symptoms

The WOMAC, a self-reported questionnaire that includes 24 questions classified into 3 subscales of pain, stiffness, and physical function, was used to assess OA symptoms [27]. The WOMAC includes 5 questions on pain, 2 questions on stiffness, and 17 questions on physical function. Each question was scored on a 5-point Likert scale format as none (0), mild (1), moderate (2), severe (3), or extreme (4). The score for each subscale is calculated by summing the component item scores for each subscale. Thus, the total score ranges are 0–96; 0–20 for pain, 0–8 for stiffness, and 0–68 for physical function.

#### Statistical Analysis

Statistical procedures were performed with the SAS ver. 9.2 (SAS Institute, Cary, NC, USA). Descriptive data were reported by using the mean, standard deviation, or frequency as indicated. To test the mean differences in the scores of LUTS by general characteristics and the mean differences in the scores of WOMAC by UI and LUTS severity, a Student t-test, or 1-way analysis of variance with post hoc test (Duncan test) was adopted. Pearson correlation coefficient was calculated to identify the relationship between LUTS and OA symptoms, and age was corrected as a covariate.

## RESULTS

### General Characteristics

A total of 153 participants were enrolled in this study, 77.8% of whom were female, with a mean age of  $61.31 \pm 9.92$  years (range, 40–80 years); 39.9% of participants were aged 60 to 69 years and 18.3% were aged 70 years or older. Additionally, 23.5% had completed elementary school, and 70.6% were married. 9.8% of the participants drank alcohol regularly, and 7.2% were current smokers. No regular exercise was reported by 50.3% of the participants, and 42.1% had chronic diseases (Table 1).

**Table 1.** General characteristics of study participants (n = 153)

Characteristic	Value
Sex	
Male	34 (22.2)
Female	119 (77.8)
Age (yr), mean ± SD (range)	61.31 ± 9.92 (40–80)
40–49	25 (16.3)
50–59	39 (25.5)
60–69	61 (39.9)
≥ 70	28 (18.3)
Education level	
Elementary school	36 (23.5)
Middle school	35 (22.9)
High school	61 (39.9)
College and over	21 (13.7)
Marital status	
Single	9 (5.9)
Married	108 (70.6)
Divorce/widow	36 (23.5)
Alcohol drinking	
None	84 (54.9)
Infrequently	54 (35.3)
Regularly	15 (9.8)
Smoking habit	
None	125 (81.7)
Previous	17 (11.1)
Current	11 (7.2)
Regular exercise habit	
None	77 (50.3)
1–2 times a week	49 (32.0)
3–7 times a week	27 (17.7)
Chronic diseases (n = 152)	
No	88 (57.9)
Yes	64 (42.1)

Values are presented as number (%) unless otherwise indicated. SD, standard deviation.

**LUTS and Severity, UI, and OA Symptoms**

The mean IPSS was 5.37 ± 5.68. Concerning the reported severity of LUTS, 20.9% of participants were included in the moderate group and 3.3% were included in the severe group according to their IPSS scores; thus, 24.2% of respondents with LUTS had moderate-to-severe symptoms (IPSS ≥ 8). Among all symptoms of LUTS, nocturia garnered the highest score (1.51 ± 1.04).

**Table 2.** Severity and each symptom of LUTS, UI, and OA symptoms (n = 153)

Variable	Value
Severity of the LUTS	
Mild (IPSS range, 0–7)	116 (75.8)
Moderate (IPSS range, 8–19)	32 (20.9)
Severe (IPSS range, ≥ 20)	5 (3.3)
Each symptom score of the LUTS	
Incomplete emptying of bladder	0.60 ± 1.02 (0–5)
Frequency	0.70 ± 1.08 (0–5)
Urgency	0.73 ± 1.03 (0–5)
Intermittency	0.67 ± 1.06 (0–5)
Weak stream	0.73 ± 1.17 (0–5)
Hesitancy	0.43 ± 0.92 (0–5)
Nocturia	1.51 ± 1.04 (0–5)
Total LUTS score	5.37 ± 5.68 (0–35)
UI/patterns	
No UI	75 (49.0)
Stress UI	47 (30.7)
Urge UI	2 (1.3)
Mixed UI	29 (19.0)
UI/sex	
Male	
No	25 (73.5)
Yes	9 (26.5)
Female	
No	50 (42.0)
Yes	69 (58.0)
Osteoarthritis symptoms (WOMAC score)	16.89 ± 19.46 (0–96)
Pain	3.41 ± 4.16 (0–20)
Stiffness	2.11 ± 2.01 (0–8)
Physical function	11.37 ± 14.40 (0–68)

Values are presented as number (%) or mean ± standard deviation (range). LUTS, lower urinary tract symptoms; UI, urinary incontinence; OA, osteoarthritis; IPSS, International Prostate Symptom Score; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index.

Fifty-one percent of all study participants had experienced UI more than once a month during the prior 3 months; more specifically, 49% had experienced no UI, 30.7% had experienced stress UI, 1.3% had experienced urge UI, and 19.0% had experienced mixed UI. 26.5% of the male and 58.0% of the female subjects had UI.

The total WOMAC score of OA symptoms was 16.89 ± 19.61, and the following subscale scores were also recorded: pain, 3.41 ± 4.16; stiffness, 2.11 ± 2.01; and physical function, 11.37 ±

14.40 (Table 2).

**Differences in the Scores of LUTS by General Characteristics**

LUTS was significantly different according to age ( $F=4.67, P=0.003$ ) and marital status ( $F=4.03, P=0.019$ ). LUTS scores of those aged 70 years or older were significantly higher than those aged 40 to 49 years, 50 to 59 years, or 60 to 69 years. LUTS scores of participants who were divorced or widowed

**Table 3.** Differences in LUTS scores by general characteristics

Characteristic	Mean ± SD	t or F	P-value
Sex		-0.09	0.931
Male	5.24 ± 4.99		
Female	5.33 ± 5.88		
Age (yr)		4.67	0.003* (a < b)
40–49	4.60 ± 6.07 <sup>a</sup>		
50–59	4.90 ± 4.32 <sup>a</sup>		
60–69	4.30 ± 4.50 <sup>a</sup>		
≥70	8.85 ± 7.94 <sup>b</sup>		
Education level		1.14	0.334
Elementary school	6.46 ± 6.70		
Middle school	5.94 ± 6.92		
High school	4.44 ± 4.03		
College and over	4.86 ± 5.62		
Marital status		4.03	0.019* (a < b)
Single	4.67 ± 2.18 <sup>a</sup>		
Married	4.59 ± 4.34 <sup>a</sup>		
Divorce/widow	7.61 ± 8.59 <sup>b</sup>		
Alcohol drinking		2.28	0.106
None	5.30 ± 5.11		
Infrequently	4.56 ± 5.21		
Regularly	8.07 ± 9.06		
Smoking habit		0.02	0.981
None	5.32 ± 5.78		
Previous	5.41 ± 5.03		
Current	5.0 ± 5.92		
Regular exercise habit		0.59	0.554
None	5.80 ± 6.72		
1–2 times a week	4.71 ± 4.55		
3–7 times a week	5.00 ± 4.15		
Chronic diseases		1.05	0.295
No	5.73 ± 5.77		
Yes	4.75 ± 5.59		

LUTS, lower urinary tract symptoms; SD, standard deviation. \* $P < 0.05$ , Duncan test.

were significantly higher than those of single or married participants (Table 3).

**Differences in OA Symptom Scores by UI and LUTS Severity**

OA symptoms were significantly different according to UI ( $t = -3.96, P < 0.001$ ), being statistically significantly higher among those with UI than among those without UI.

OA symptoms were also significantly different by LUTS severity ( $F = 2.87, P < 0.001$ ). According to LUTS severity, OA symptoms scores were the highest in the severe LUTS group ( $52.60 \pm 28.61$ ), then lower in the moderate LUTS group ( $27.91 \pm 23.68$ ) and in the mild LUTS group ( $12.12 \pm 14.48$ ) (Table 4).

**Correlation Between LUTS and OA Symptoms**

Pearson correlation coefficient showed that there was a significant, positive correlation between LUTS and OA symptoms ( $r = 0.41, P < 0.001$ ). In other words, the more severe the OA symptoms, the more severe the LUTS (Table 5).

**DISCUSSION**

The IPSS, which has been mostly used for evaluation purposes in previous epidemiological studies of LUTS in both men and

**Table 4.** Differences in the scores of OA symptoms (WOMAC score) by UI and LUTS severity

Characteristic	Mean ± SD	t or F	P-value
UI		-3.98	< 0.001
No	10.49 ± 13.94		
Yes	22.36 ± 22.10		
LUTS		21.21	< 0.001* (a < b < c)
Mild (IPSS range, 0–7)	12.12 ± 14.48 <sup>a</sup>		
Moderate (IPSS range, 8–19)	27.91 ± 23.68 <sup>b</sup>		
Severe (IPSS range, 20–35)	52.60 ± 28.61 <sup>c</sup>		

OA, osteoarthritis; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; UI, urinary incontinence; LUTS, lower urinary tract symptoms; SD, standard deviation; IPSS, International Prostate Symptom Score.

\* $P < 0.05$ , Duncan test.

**Table 5.** The relationship between LUTS and OA symptoms

Variable	r-value (P-value)
OA symptoms	0.41 (< 0.001*)

LUTS, lower urinary tract symptoms; OA, osteoarthritis. \* $P < 0.05$ , age as a covariate.



women, is a valid, reliable, and sensitive measure to assess individuals of both sexes with LUTS and is a simple means for assessing the severity of LUTS [28,29]. In this study, IPSS was also used to evaluate LUTS and 24.2% of participants had LUTS defined as an IPSS score of at least 8 points (moderate and severe LUTS group). This result was lower than the prevalence of 30.1% reported by Liu et al. [6] among 2,068 subjects aged 40 years or older in Taiwan but was similar to the finding of 22.7% in the recent study of Przydacz et al. [5] of 6,005 subjects aged 40 years or older in a Western country. However, in a study of 2,080 subjects aged 40 years or older in Korea, a prevalence rate of 40.1% for LUTS defined by an IPSS of at least 8 points (moderate and severe group) was reported [4], which is much higher than the result of this investigation.

When considering each symptom of LUTS, nocturia garnered the highest score in this study. Similarly, in the study of Lee et al. [30] of subjects aged 19 years or older in Korea and that of Pinnock and Marshall [31] involving female and male residents in the community, nocturia was the most frequent and common symptom. Also, in a study of Taiwanese females, the most bothersome symptom was nocturia [6]. Nocturia is a symptom classified as one major component of common urologic conditions harbored by community-dwelling individuals. However, despite the higher prevalence, diverse etiology, and clinical importance of nocturia, management strategies for nocturia have not been designed successfully. Nakagawa et al. [32] reported from a 5-year observation period that community-dwelling elderly individuals with nocturia were at greater risk for fracture and death than those without nocturia. As such, we need further research on the assessment and management of nocturia, in particular among vendors at conventional markets. This study also showed that the LUTS score was significantly different by age and marital status. With participants aged 70 years or older having significantly higher scores than the other age groups (40–49, 50–59, and 60–69 years). In epidemiological studies by Lieberman et al. [33] and Terai et al. [28], LUTS based on IPSS score tended to increase with age. However, in this study, LUTS scores were similar across the fourth, fifth, and sixth decades of life, while the LUTS scores of those aged 70 years or older were significantly higher. Such a tendency might be because of the limitations of the study's sample representatives. Considering marital status, divorced or widowed participants had significantly higher LUTS scores than those who were single or married. This result suggests that environmental factors such as family structure and marital status have an impact on

LUTS score and severity. Divorced or widowed people may demonstrate a greater likelihood of neglecting their LUTS [19].

In this study, the subjects with UI showed a significantly higher LUTS score than the subjects without UI. Fifty-one percent of subjects had UI at least monthly, with 30.7% experiencing stress UI, 19.0% experiencing mixed UI, and 1.3% experiencing urge UI, respectively. As compared to the results in previous studies, which had defined UI definition in the same manner as done in this study, the prevalence of UI was 29% among production workers [16], 21% among female air force members [18], and 38% among nurses [34], our subject had UI at a relatively higher level. Stress UI was predominant; this finding is also similar to that of a previous study of UI types among nurses aged 21 to 59 years [17]. It can be assumed that stress UI may be precipitated by the physical demands of work (e.g., lifting, bending, and strenuous activity) of market vendors or nurses [14]. UI seriously degrades individuals' quality of life due to adversely affecting work efficiency and social life. Therefore, it is important for vendors to recognize that UI must be properly managed and prevented.

In our study, we did not investigate the severity of UI. Therefore, it should be needed to investigate the severity of UI, including the detailed UI frequency and the impact of UI on quality of life among vendors in further study.

The OA symptom scores of the group with UI were significantly higher than those of the group without UI. These results of this study support those of previous studies in which UI was reportedly related to OA and OA pain [11]. There are the specific characteristics of the conventional market that influence this result: toilets are often far away and there is a possibility that they may refrain from urinating because of customers who come by constantly. OA symptoms like pain, stiffness, and limited physical mobility could lead to UI in vendors who might have difficulty with getting to the toilet within a reasonable amount of time or with removing clothes quickly. Among the people with OA, the inability to change one's posture to prevent stress UI is considered to cause stress UI [35].

In this study, a significant relationship was observed between LUTS and OA symptoms. It seems to be that the difficulty of going to the toilet in time to void due to OA symptoms and mobility problems may be attributed to LUTS, and vendors who have OA pain and other OA symptoms may be negligent in pursuing LUTS management and treatment. From our study results, we can assume that the alleviation of OA symptoms would bring about improvements in LUTS among vendors. In

addition, there is a need for health education to manage and prevent these 2 health problems at the same time.

As prolonged sitting and standing postures may produce changes in the musculoskeletal and vascular milieu of the pelvis and lower extremity vasculature, which may cause LUTS [35], deeper investigations in the future focusing on the specific association between vendors' postures and OA and/or OA symptoms and of the impact on pelvic floor muscle and function should be considered.

Our study had several limitations. First, vendors were sampled from a single conventional market in one city and data collection was cross-sectional in its design. Determining the presence of LUTS and OA symptoms relied largely on answers to self-reported questionnaires, these conditions were not measured by objective methods, such as physical examination, diagnostic testing, or a physician's diagnosis; thus, symptoms might be underreported.

In conclusion, significantly higher LUTS scores among vendors in a conventional market were reported by those aged 70 years or older, those who were divorced or widowed, and those with UI. Also, the OA symptom score was significantly higher in the group with UI. This study showed that LUTS are significantly correlated with OA symptoms. The conventional market setting may allow for easy dissemination of health education to the vendors. To establish an intervention program for proper management and prevention of LUTS and OA symptoms, group education and individualized education may be required through vendors' meetings and/or education by using smartphones.

## ACKNOWLEDGMENTS

We, the authors, give thanks to the Chairman, Mr. Won-Il Kim, and to Mrs. Hae-Rye Park of the Association of Jeju Dongmun Conventional Market for data collection. Especially, we appreciate Mr. In-Kyu Ha, Ms. Shi-Ja Choi, and Ms. Suzie Kim, who helped collect the article's data. This work was supported by a research grant from Jeju National University in 2020.

## AUTHOR CONTRIBUTION STATEMENT

- Conceptualization: *HJS, HSM*
- Data curation: *HJS*
- Formal analysis: *HJS*
- Funding acquisition: *HJS*
- Methodology: *HJS, MDB, ML, HJK, HSM*

- Project administration: *HJS*
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