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Lower urinary tract symptoms in male patients with stroke: A nationwide population-based study

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ABSTRACT

Background and objectives: There is a scarcity of large population-based studies investigating lower urinary tract symptoms (LUTS) using the International Prostate Symptom Score (IPSS) in stroke survivors. We investigated the prevalence and severity of LUTS in male stroke survivors and determined the independent effect of stroke on LUTS using data from a nationwide population-based survey.

Methods: Cross-sectional data obtained from the 2011 Korean Community Health Survey were analyzed. The prevalence and severity of LUTS were compared between 1936 male stroke patients and 90,506 male non-stroke participants. Multivariable logistic regression was used to identify the independent effect of stroke on LUTS.

Results: Male stroke patients more frequently reported both storage symptoms (frequency, urgency, and nocturia) and voiding symptoms (straining, weak stream, intermittency, and incomplete emptying) compared to male non-stroke population. The storage and voiding subscores of IPSS and quality of life score were higher in male stroke patients than in male non-stroke population. Multivariable logistic regression adjusted for age, socioeconomic factors, physical and mental health measures, and comorbidities, found stroke to be an independent risk factor for all 7 symptoms of LUTS.

Conclusion: The present study confirmed a high prevalence of LUTS in male stroke survivors that cannot be attributed only to potential confounders, implying that stroke may independently contribute to the development of LUTS. Our findings warrant the need for timely detection by physicians and proper management of LUTS to promote functional outcomes and quality of life in stroke population.

1. Introduction

Urinary incontinence (UI), defined as the complaint of any involuntary leakage of urine (Abrams et al., 2003), is a frequent complication of acute ischemic or hemorrhagic stroke, affecting 32–79% of stroke patients admitted to hospitals with up to 25% of them remaining incontinent at 1 year (Brittain, Peet, & Castleden, 1998; Mehdi, Birns, & Bhalla, 2013; Williams, Srikanth, Bird, & Thrift, 2012). The prevalence of UI is higher in stroke survivors than in the general population (11.6% in the elderly aged ≥ 65 years) (Campbell, Reinken, & McCosh, 1985). Patients with acute stroke suffering from UI showed greater disability and higher rates of mortality and institutionalization at 2 years than those without initial UI (Patel, Coshall, Rudd, & Wolfe, 2001). Other lower urinary tract symptoms (LUTS) such as nocturia, urgency, and daytime frequency are also commonly reported in stroke patients (2017, Brittain et al., 2000; Tibaek et al., 2008). Considering the high prevalence of LUTS and their negative influence on stroke outcomes (Brittain et al., 2000; Patel et al., 2001), a thorough assessment and a structured treatment strategy of LUTS may be important to improve functional outcomes (Mehdi et al., 2013).

The International Prostate Symptom Score (IPSS), adapted from the American Urological Association symptom score (Barry et al., 1992), is widely used for quantification of subjective LUTS and quality of life (QoL) in benign prostatic hyperplasia and other conditions causing urinary symptoms. The IPSS was translated and validated linguistically in multiple languages including Korean (Badia, Garcia-Losa, & Dal-Re, 1997; Choi et al., 1996). The IPSS consists of seven questions that are divided into storage and voiding symptoms; therefore, it may be useful for detecting LUTS and evaluating the severity of each symptom in stroke patients.

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It has been known that LUTS are associated with lifestyle factors such as smoking, alcohol, physical activity (Rohrmann et al., 2005), and body mass index (BMI) (Rohrmann, Smit, Giovannucci, & Platz, 2004), and comorbidities such as metabolic syndrome (Kaplan, 2007), diabetes mellitus (Sarma et al., 2008), and hypertension (Haidinger et al., 2000). However, there are very few nationwide population-based studies evaluating LUTS in stroke population using comprehensive adjustments for the potential confounding factors (Nakayama, Jørgensen, Pedersen, Raaschou, & Olsen, 1997). To the best of our knowledge, there is no currently available large population-based study investigating LUTS using the IPSS in stroke survivors. Herein, we assessed the independent effect of stroke on LUTS. We compared the prevalence and severity of LUTS using the IPSS between male stroke survivors and male non-stroke population adjusting for factors associated with LUTS using data from a nationwide population-based survey.

2. Methods

2.1. Study population

Data from the 2011 Korean Community Health Survey (https://chs.cdc.go.kr/chs/index.do) were used in our study. The Korean Community Health Survey, a nationwide cross-sectional health interview survey conducted annually by the Korea Centers for Disease Control and Prevention, explores patterns of disease prevalence and morbidity, health-related behaviors, and personal lifestyle in adults aged ≥19 years. The sample size is 900 subjects in each of the 253 community units, including 16 metropolitan cities and provinces. The actual number of respondents in this annual survey is approximately 230,000. The KCHS has a two-stage sampling process. The first stage of sampling process involves selection of a sample area (tong/ban/ri) as a primary sample unit according to the number of households using a probability proportional to size sampling technique. The second stage of sampling process includes selection of sample households in each sample area using systematic sampling methods. To ensure the samples to be statistically representative of the general population, this survey data are weighted by reference to the sampling design (Rim et al., 2011). Data were collected by technicians trained in computer-assisted personal interviewing. Exclusion criteria were the following: (1) uninhabitable areas owing to redevelopment or reconstruction; (2) households in the nonresidential areas (e.g., business district, industrial complex); (3) residences for specific groups (e.g., lepers colony, dormitory, religious communities); and (4) households where the interviewer could not contact the family members after visiting the household more than three times. This study was approved by the Institutional Review Board of the Korea Centers for Disease Control and Prevention (IRB No. 2011-05CON-04-C), and written informed consent was obtained from each participant.

Of the 102,679 male participants aged 19–103 years, a total of 10,237 participants were excluded from the statistical analysis since they did not complete the LUTS questionnaires (817 participants) or provided incomplete data regarding demographics, socioeconomic status, physical and mental health measures, or comorbid diseases (9,420 participants).

2.2. Demographic data, socioeconomic status, and physical health measures

Demographic data (age, BMI), socioeconomic status (highest level of education, employment status, marital status, household income, smoking status, alcohol drinking status), and medical history were investigated and included in the statistical analysis (Table 1 for details). The presence of ischemic or hemorrhagic stroke was relied on the physician's diagnosis. Comorbidities including hypertension, diabetes mellitus, angina pectoris/myocardial infarction, hyperlipidemia, asthma, depression, benign prostatic hyperplasia, and UI (Abrams et al., 2003) were investigated as well.

Table 1
Demographic data, socioeconomic status, and physical health measures.

	Male stroke patients (n = 1,936)	Male non-stroke population (n = 90,506)	p-Value
Age (years)	67.6 ± 10.0	49.4 ± 15.9	< 0.001
Highest level of education			< 0.001
Elementary school or lower	803 (41.5)	14116 (15.6)	
Middle school	378 (19.5)	11037 (12.2)	
High school	505 (26.1)	29819 (32.9)	
College or higher	250 (12.9)	35524 (39.3)	
Employment status (employed)	713 (36.9)	71704 (79.5)	< 0.001
Marital status			< 0.001
Married	1643 (84.9)	67167 (74.2)	
Others (single, separated, divorced, widowed)	293 (15.1)	22339 (25.8)	
Household income			< 0.001
Lowest	1117 (57.7)	22013 (24.3)	
Low middle	317 (16.4)	25353 (28.0)	
Upper middle	195 (10.1)	20040 (22.1)	
Highest	307 (15.9)	23100 (25.5)	
Body mass index (kg/m^2)		< 0.001	
< 18.5	466 (24.1)	25783 (28.5)	
18.5–25	1337 (69.1)	60707 (67.1)	
≥ 25	133 (6.9)	4016 (4.4)	
Smoking status			< 0.001
Non-smoker	356 (18.4)	21510 (23.8)	
Past smoker	1104 (57.0)	29130 (32.2)	
Current smoker	475 (24.5)	39866 (44.0)	
Alcohol drinking status (risky drinker)[a]	318 (16.4)	44409 (49.1)	< 0.001
Physical activity (regular exercise)[b]	964 (49.8)	51275 (56.7)	< 0.001
Sleep time (hours)			< 0.001
≤ 5	352 (18.2)	12855 (14.2)	
6–8	1355 (70.0)	74529 (82.4)	
≥ 9	229 (11.8)	3108 (3.4)	
Level of stress			< 0.001
No	592 (30.6)	18881 (20.9)	
Some	804 (41.6)	48302 (53.4)	
Moderate	443 (22.9)	20490 (22.6)	
Severe	93 (4.8)	2802 (3.1)	
Diabetes mellitus	502 (25.9)	7638 (8.4)	< 0.001
Hypertension	1265 (65.4)	18493 (20.4)	< 0.001
Angina pectoris or Myocardial infarction	291 (15.1)	2517 (2.8)	< 0.001
Depression	82 (4.2)	992 (1.1)	< 0.001
Asthma	139 (7.2)	1501 (1.7)	< 0.001
Hyperlipidemia	436 (22.6)	8406 (9.3)	< 0.001
Benign prostatic hyperplasia	493 (25.5)	6912 (7.6)	< 0.001
Urinary incontinency	44 (2.3)	243 (0.3)	< 0.001

Values are presented as number (%) or mean ± SD.

[a] Risky drinker indicates participants who had 12 or more binge drinking episodes that consumed 5 or more alcoholic beverages during the past year.

[b] Regular exercise includes routine walking at least five times per week for at least 30 min at a time or running at least three times per week for at least 20 min at a time.

2.3. Lower urinary tract symptoms

LUTS were evaluated by using the Korean version of IPSS (Choi et al., 1996). Each symptom was defined according to the International Continence Society definitions (Abrams et al., 2003). Subjects were asked to score each of the following 7 urinary symptoms which are according to;

(1) Incomplete emptying: How often have you had a sensation of not emptying your bladder?
(2) Frequency: How often have you had to urinate less than two hours?
(3) Intermittency: How often have you found you stopped and started again several times when you urinated?

(4) Urgency: How often have you found it difficult to postpone urination?
(5) Weak stream: How often have you had a weak urinary stream?
(6) Straining: How often have you had to strain to start urination?
(7) Nocturia: How many times did you typically get up at night to urinate?

Each symptom is graded from 0 (not at all) to 5 (almost always), according to the frequency of occurrence. Total IPSS score ranges from 0 to 35, and the severity of LUTS was divided into mild (0–7), moderate (8–19), and severe (20–35 points) (Noguchi et al., 2016). The storage subscore of the IPSS was calculated as the sum of questions about frequency, urgency, and nocturia, and categorized as low (0–3), intermediate (4–8), and high (9–15 points) (Avery et al., 2004). The voiding subscore of IPSS was calculated as the sum of questions about incomplete emptying, intermittency, weak stream, and straining, and categorized as low (0–4), intermediate (5–11), and high (12–20 points) (Liao, Chung, & Kuo, 2011). Nocturia was categorized into zero to 1 time, 2 to 3 times, and ≥ 4 times per night. Urinary symptoms other than nocturia were categorized as not at all, less than half the time, and at least half the time (Noguchi et al., 2016). Effects of LUTS on QoL were explored by the question (if you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about that?), and the score ranges from 0 (delighted) to 6 (terrible).

2.4. Statistical analysis

Demographics, socioeconomic characteristics, and clinical variables were compared between male stroke patients and male non-stroke population using the Chi square test, Fisher's exact test, Student's t-test, or Wilcoxon's rank-sum test, where appropriate. Multivariable logistic regression was carried out to investigate the effects of stroke on LUTS: Model 1 adjusted for age; Model 2 adjusted for age, education level, employment status, marital status, household income, BMI, smoking status, alcohol drinking status, physical activity, sleep time, the level of stress, and the presence of comorbid diseases. Results were expressed with adjusted odds ratio (OR) and 95% confidence interval (CI). Subgroup analyses of between-group comparisons and multivariable logistic regression were additionally performed in the elderly male population of > 65 years. A $p < 0.05$ indicates statistical significance in all tests. Statistical analyses were conducted using the Statistical Package for Social Sciences (Version 21.0; IBM, Armonk, New York).

3. Results

Overall, 92,442 participants completed survey, and 1,936 (2.1%) reported that they had been diagnosed with stroke. The baseline characteristics and clinical variables of the participants are detailed in Table 1. Compared to male non-stroke population, male stroke patients were more likely to be older, unemployed, married, obese, and have lower household income and level of education (all $p < 0.001$). The proportions of regular exercise and risky drinker were lower, whereas the proportion of smokers was higher in male stroke patients than in male non-stroke population (all $p < 0.001$). The level of stress and sleep time were also different between the groups (both $p < 0.001$). As expected, stroke patients had more comorbid diseases including hypertension, diabetes mellitus, angina pectoris/myocardial infarction, hyperlipidemia, asthma, depression, benign prostatic hyperplasia, and UI (all $p < 0.001$).

Differences in LUTS between male stroke patients and male non-stroke population are detailed in Table 2 and Fig. 1. Total IPSS score was higher in male stroke patients than in male non-stroke population ($p < 0.001$). Moderate to severe LUTS (IPSS score, 8–35) was more common in male stroke patients compared to male non-stroke population ($p < 0.001$). Male stroke patients more frequently reported both storage symptoms (i.e., frequency, urgency, and nocturia) and voiding symptoms (i.e., straining, weak stream, intermittency, and incomplete emptying) compared to male non-stroke population (all $p < 0.001$). The storage and voiding subscores of IPSS were higher in male stroke patients relative to male non-stroke population (both $p < 0.001$). The QoL score was also higher in male stroke patients than in male non-stroke population ($p < 0.001$).

Table 2
Comparison of lower urinary tract symptoms between male stroke and male non-stroke population.

	Male stroke patients (n = 1,936)	Male non-stroke population (n = 90,506)	p-Value
Incomplete emptying			< 0.001
Not at all	1059 (54.7)	74606 (82.4)	
Less than half the time	480 (24.8)	11671 (12.9)	
Half the time or more	397 (20.5)	4229 (4.7)	
Frequency			< 0.001
Not at all	1025 (52.9)	72024 (79.6)	
Less than half the time	512 (26.4)	14064 (15.5)	
Half the time or more	399 (20.6)	4418 (4.9)	
Intermittency			< 0.001
Not at all	1030 (53.2)	74419 (82.2)	
Less than half the time	504 (26.0)	12095 (13.4)	
Half the time or more	402 (20.8)	3992 (4.4)	
Urgency			< 0.001
Not at all	1142 (59.0)	78213 (86.4)	
Less than half the time	425 (22.0)	9112 (10.1)	
Half the time or more	369 (19.1)	3181 (3.5)	
Weak stream			< 0.001
Not at all	918 (47.4)	72654 (80.3)	
Less than half the time	508 (26.2)	12270 (13.6)	
Half the time or more	510 (26.3)	5582 (6.2)	
Straining			< 0.001
Not at all	1155 (59.7)	78795 (87.1)	
Less than half the time	432 (22.3)	8686 (9.6)	
Half the time or more	349 (18.0)	3025 (3.3)	
Nocturia (number)			< 0.001
0–1	936 (48.3)	75256 (83.2)	
2–3	718 (37.1)	11736 (13.0)	
4 or more	282 (14.6)	3514 (3.9)	
Storage IPSS subscore	4.2 ± 4.1	1.4 ± 2.4	< 0.001
Low (0–3)	1101 (56.9)	79044 (87.3)	
Intermediate (4–8)	510 (26.3)	8969 (9.9)	
High (9–15)	325 (16.8)	2493 (2.8)	
Voiding IPSS subscore	5.1 ± 5.9	1.4 ± 3.3	< 0.001
Low (0–4)	1143 (59.0)	80434 (88.9)	
Intermediate (5–11)	464 (24.0)	7469 (8.3)	
High (12–20)	329 (17.0)	2604 (2.9)	
Total IPSS score	9.2 ± 9.4	2.8 ± 5.3	< 0.001
Mild (0–7)	1087 (56.1)	79775 (88.1)	< 0.001
Moderate (8–19)	531 (27.4)	8371 (9.2)	< 0.001
Severe (20–35)	318 (16.4)	2360 (2.6)	< 0.001
Quality of life score	2.9 ± 1.5	1.6 ± 1.4	< 0.001

Values are presented as number (%) or mean ± SD.
IPSS, International Prostate Symptom Score.

Table 3 shows the independent effect of stroke on each component of LUTS after adjusting for age (model 1) and for age, socioeconomic factors, physical and mental health measures, and comorbidities (model 2). In both models, compared with male non-stroke population, male stroke patients more frequently experienced symptoms of incomplete emptying, frequency, intermittency, urgency, weak stream, straining, and nocturia. As expected, compared to male non-stroke population, male stroke patients had worse overall LUTS severity and storage symptoms severity as well as voiding symptoms severity.

Table 4 shows the independent effect of stroke on each component of LUTS in the elderly male population of > 65 years after adjusting for

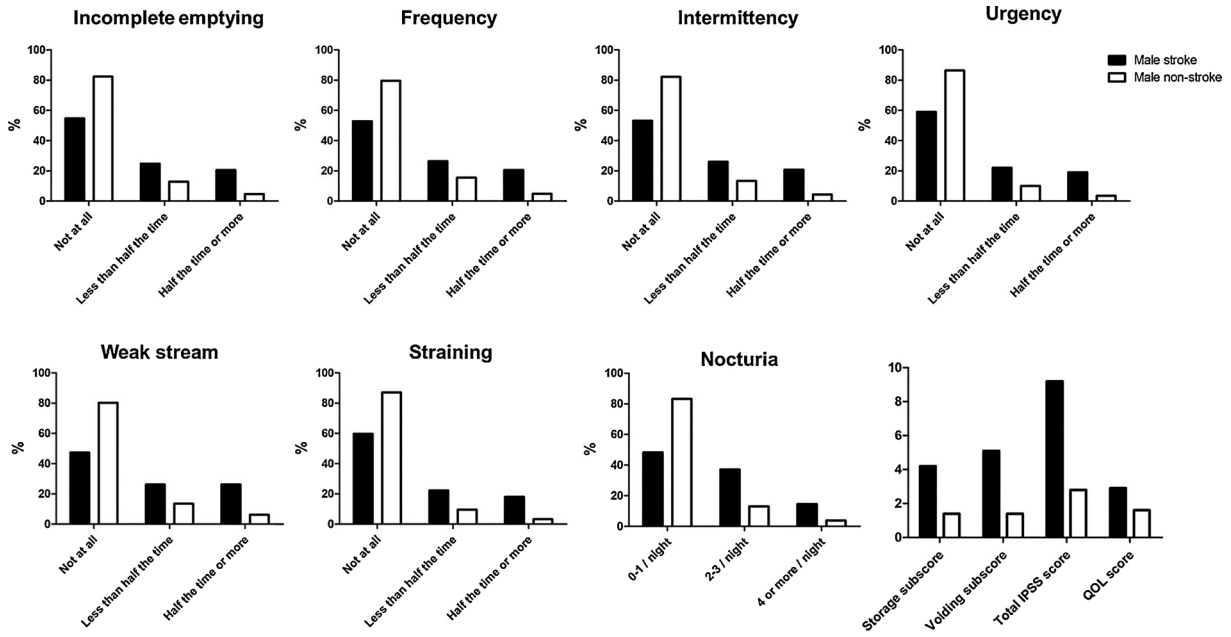

Fig. 1. Comparison of lower urinary tract symptoms between male stroke and male non-stroke population. IPSS, International Prostate Symptom Score; QOL, quality of life.

age, socioeconomic factors, physical and mental health measures, and comorbidities. Compared to male non-stroke population (n = 17,219), male stroke patients (n = 1,239) more frequently reported symptoms of incomplete emptying, frequency, intermittency, urgency, weak stream, straining, and nocturia. Male stroke patients had worse overall LUTS severity and storage symptoms severity as well as voiding symptoms severity in comparison with male non-stroke population. The results of subgroup analyses using the elderly male population were substantially identical to those of whole male population.

4. Discussion

We found that male stroke patients experienced more LUTS including both voiding and storage symptoms than male non-stroke population. Importantly, stroke was found to be an independent risk factor for LUTS, even after adjusting for the confounding factors that potentially affect LUTS. In particular, stroke increased the risk of severe LUTS by 2-fold and moderate LUTS by 1.4-fold.

Our finding of a higher prevalence of LUTS in male stroke patients than in male non-stroke population is consistent with previous observations (Brittain et al., 2000; Tian et al., 2016; Tibaek et al., 2017; Williams et al., 2012). LUTS were highly prevalent in not only male but also female patients with stroke (Tibaek et al., 2008). The prevalence of at least one urinary symptom (e.g., nocturia, urgency, increased daytime frequency, incomplete emptying, and UI) was 94% in 482 Danish stroke patients, of which 78% perceived LUTS as a bothersome symptom that adversely affected their daily life (Tibaek et al., 2008). In addition, British and Chinese community-based studies showed that 64% and 62.6% of stroke patients reported at least one urinary symptom, respectively (Brittain et al., 2000; Tian et al., 2016). In line with the previous finding of nocturia being the most common among LUTS in stroke patients (Brittain et al., 2000; Tian et al., 2016; Tibaek et al., 2017; 2008; Williams et al., 2012), the most frequent LUTS in our stroke population were nocturia (51.7%) and weak stream (52.5%), followed by frequency (47%), intermittency (46.8%), incomplete emptying (45.3%), urgency (41.1%), and straining (40.3%). The prevalence of individual LUTS in stroke patients was much higher than non-stroke population, which accords well with previous findings (Tian et al., 2016; Tibaek et al., 2017).

Development of LUTS following stroke has been robustly related to poor stroke outcomes (Mehdi et al., 2013). Unrecovered UI after stroke was found to increase mortality (Patel et al., 2001; Rotar et al., 2011) and lead to poor functional outcomes (Barer, 1989). This condition also adversely affected the ability of patients to undergo physical therapy, resulting in unfavorable response to rehabilitation (Ween, Alexander, D'Esposito, & Roberts, 1996). LUTS can have a detrimental psychological influence on both the stroke patients and their caregivers (Brittain et al., 2000; Tibaek et al., 2011). Moreover, LUTS could interfere with sleep, QoL, daily activities, social activities, and interpersonal relationships (Brittain et al., 2000; Mehdi et al., 2013). As expected, the QoL score in the IPSS was higher in stroke patients in our study, indicating that stroke survivors had poorer overall QoL compared with non-stroke population. Depression after stroke was more commonly reported in those patients with LUTS compared with those without (Brittain et al., 2000; Jorgensen, Engstad, & Jacobsen, 2005). Considering the high prevalence and detrimental effects of LUTS on stroke patients, early recognition and individually tailored management of LUTS should promote favorable outcomes in stroke population (Mehdi et al., 2013; Thomas et al., 2008; Wikander, Ekelund, & Milsom, 1998).

The mechanism underlying increased LUTS in stroke remains largely unknown; however, neuroanatomical correlates of the micturition pathway could account for the diverse urinary dysfunctions found in stroke patients. Bladder storage and emptying dysfunctions were frequently observed in patients with acute pontine and medullary infarctions, respectively (Yum et al., 2013). Furthermore, a close association of chronic pontine stroke with detrusor underactivity (emptying dysfunction) has been reported (Lee, Choi, & Shin, 2017), suggesting that the LUTS pattern might be differently expressed depending on not only the lesion location but also the timing after stroke onset (Mehdi et al., 2013). Moreover, given the inhibitory input for voluntary control of micturition from the frontal cortex to the pontine micturition center (Fowler, Griffiths, & de Groat, 2008), stroke lesions above the pons may result in an uninhibited bladder and storage dysfunctions. It is unfortunate that detailed characteristics with regard to stroke, such as lesion size and location, severity of disability, and cognitive dysfunction, were not provided in this survey; thus, biological effects of damaged brain from stroke on LUTS could not be explored. Moreover, this survey did not investigate prescribed drugs (e.g., diuretics), which

Table 3
Independent effect of stroke on lower urinary tract symptoms.

	Model 1		Model 2	
	OR	95% CI	OR	95% CI
Incomplete emptying				
Not at all	1	Reference	1	Reference
Less than half the time	1.44	1.28-1.61	1.34	1.19-1.51
Half the time or more	2.18	1.92-2.48	1.74	1.52-1.98
Frequency				
Not at all	1	Reference	1	Reference
Less than half the time	1.42	1.27-1.60	1.28	1.14-1.43
Half the time or more	2.14	1.89-2.46	1.69	1.48-1.93
Intermittency				
Not at all	1	Reference	1	Reference
Less than half the time	1.39	1.24-1.56	1.25	1.11-1.40
Half the time or more	2.22	1.95-2.52	1.74	1.53-1.99
Urgency				
Not at all	1	Reference	1	Reference
Less than half the time	1.45	1.29-1.63	1.32	1.17-1.49
Half the time or more	2.40	2.10-2.74	1.90	1.66-2.18
Weak stream				
Not at all	1	Reference	1	Reference
Less than half the time	1.40	1.25-1.58	1.27	1.13-1.43
Half the time or more	2.08	1.84-2.35	1.64	1.44-1.85
Straining				
Not at all	1	Reference	1	Reference
Less than half the time	1.45	1.29-1.63	1.29	1.15-1.46
Half the time or more	2.32	2.03-2.65	1.83	1.59-2.11
Nocturia				
0–1	1	Reference	1	Reference
2–3	1.73	1.55-1.93	1.44	1.29-1.61
4 or more	2.01	1.73-2.33	1.55	1.34-1.81
Overall LUTS severity				
Mild (0–7)	1	Reference	1	Reference
Moderate (8–19)	1.70	1.51-1.90	1.42	1.26-1.59
Severe (20–35)	2.76	2.39-3.18	2.05	1.77-2.38
Voiding IPSS subscore				
Low (0–4)	1	Reference	1	Reference
Intermediate (5–11)	1.64	1.46-1.85	1.40	1.24-1.57
High (12–20)	2.64	2.29-3.03	1.98	1.71-2.28
Storage IPSS subscore				
Low (0–3)	1	Reference	1	Reference
Intermediate (4–8)	1.59	1.42-1.79	1.36	1.21-1.52
High (9–15)	2.61	1.26-3.00	1.98	1.71-2.29

Model 1 adjusted for age. Model 2 adjusted for age, education level, employment status, marital status, household income, BMI, smoking status, alcohol drinking status, physical activity, sleep time, the level of stress, and the presence of comorbid diseases.
LUTS, lower urinary tract symptoms; OR, odds ratio; CI, confidence interval; IPSS, International Prostate Symptom Score.

could also influence the presence of urinary symptoms.

The strengths of our study include the large sample size, nationwide population-based design, the sampling methods representative of the general population, and the use of standardized symptom questionnaires (i.e., IPSS). In addition, this survey provided detailed information regarding the potential factors that could be associated with LUTS, allowing us to assess the independent effect of stroke on LUTS using comprehensive statistical adjustments. The potential limitations of our study should also be stated. First, because this survey employs a cross-sectional design, temporal and causal relationships between LUTS and stroke cannot be determined. Second, all data in this survey were based on self-reported questionnaires; thus, the recall bias leading to overestimation or underestimation could not be entirely ruled out. Third, the IPSS has not been yet validated in stroke patients, and thus, further studies are required for reliability and validation of the IPSS in patients with stroke. Fourth, since this sample may be biased toward mild or moderate stroke patients who could fill out the survey, the true prevalence of LUTS may be underestimated. Lastly, the generalizability of our findings to the entire stroke population is limited because of data exclusively collected from the male participants.

Table 4
Independent effect of stroke on lower urinary tract symptoms in male population of > 65 years.

	Adjusted OR	95% CI
Incomplete emptying		
Not at all	1	Reference
Less than half the time	1.13	0.96-1.35
Half the time or more	1.34	1.11-1.61
Frequency		
Not at all	1	Reference
Less than half the time	1.22	1.06-1.41
Half the time or more	1.57	1.34-1.83
Intermittency		
Not at all	1	Reference
Less than half the time	1.17	1.01-1.34
Half the time or more	1.59	1.38-1.86
Urgency		
Not at all	1	Reference
Less than half the time	1.22	1.06-1.42
Half the time or more	1.88	1.61-2.19
Weak stream		
Not at all	1	Reference
Less than half the time	1.19	1.03-1.38
Half the time or more	1.46	1.26-1.69
Straining		
Not at all	1	Reference
Less than half the time	1.21	1.05-1.40
Half the time or more	1.67	1.43-1.96
Nocturia		
0–1	1	Reference
2–3	1.35	1.18-1.55
4 or more	1.68	1.41-2.00
Overall LUTS severity		
Mild (0–7)	1	Reference
Moderate (8–19)	1.30	1.13-1.49
Severe (20–35)	1.97	1.69-2.33
Voiding IPSS subscore		
Low (0–4)	1	Reference
Intermediate (5–11)	1.31	1.14-1.51
High (12–20)	1.82	1.54-2.14
Storage IPSS subscore		
Low (0–3)	1	Reference
Intermediate (4–8)	1.17	1.01-1.36
High (9–15)	1.72	1.42-2.09

Model adjusted for age, education level, employment status, marital status, household income, body mass index, smoking status, alcohol drinking status, physical activity, sleep time, the level of stress, and the presence of comorbid diseases.
LUTS, lower urinary tract symptoms; OR, odds ratio; CI, confidence interval; IPSS, International Prostate Symptom Score.

5. Conclusion

The present study confirmed a high prevalence of LUTS in male stroke survivors, which cannot be attributed only to potential confounders, implicating stroke as an independent risk factor for the development of LUTS. Given the physical and psychological as well as social impacts of LUTS on stroke patients, our findings warrant the need for timely detection and proper management of LUTS in stroke patients. Future studies should determine whether a comprehensive assessment and a vigorous treatment of LUTS may lead to improvement of functional stroke outcomes and QoL.

Conflict of interest

The authors declare no conflict of interest.

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