Quality of Life Research (2019) 28:2419–2428
https://doi.org/10.1007/s11136-019-02205-w

Health-related quality of life in adult males with lower urinary tract symptoms

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Accepted: 6 May 2019 / Published online: 13 May 2019

Abstract

Purpose To assess the status and impact of lower urinary tract symptoms (LUTS) on health-related quality of life (HRQoL) in a community-based sample of Korean adult males.

Methods We analyzed the data of 101,606 adult males aged ≥ 19 years of age obtained during the 2011 Korean Community Health Survey. Subject data were assessed for LUTS and HRQoL using international prostate symptom scores, and EuroQol-five-dimensions three-level version (EQ-5D-3L) and EuroQol-visual analogue scale (EQ-VAS) scores.

Results Of the 101,606 subjects, 53,323 (52.5%) reported having at least one LUTS and 3116 (3.1%) had an IPSS of ≥ 20, indicating severe LUTS. In those aged 19–39 years, 28.7% (8343/29,072) reported they had mild to severe LUTS. The prevalence of LUTS was high among those aged 40–59 years (47.7%), 60–79 years (80.5%), and ≥ 80 years (91.2%). In addition, EQ-5D-3L and EQ-VAS scores decreased as LUTS severity and frequency increased.

Conclusions Adult men of all ages with mild to severe LUTS have poorer health statuses and quality of life. Even among young males, LUTS severity and was found to negatively affect HRQoL.

Keywords EQ-5D-3L · Health-related quality of life · Lower urinary tract symptoms · International prostate symptom score · The Korean Community Health Survey

Abbreviations

HRQoL	Health-related quality of life
LUTS	Lower urinary tract symptom
EQ-5D-3L	EuroQol-five-dimensions three-level version
EQ-VAS	EuroQol-visual analogue scale

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11136-019-02205-w) contains supplementary material, which is available to authorized users.

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Introduction

Lower urinary tract symptoms (LUTS), which are often secondary to BPH, can be categorized into three major groups including the following symptoms: (1) storage, urinary frequency, nocturia, urgency, incontinence; (2) voiding, weak stream, hesitancy, and terminal dribble; and (3) postmicturition, incomplete emptying, postmicturition dribble. These symptoms of LUTS have a negative effect on health-related quality of life (HRQoL), including psychological and physical health, and can lead to major depressive symptoms [1], cardiovascular disease, and cerebral stroke [2, 3]. Individuals with obesity are more likely to develop or experience progressive LUTS [4] and socio-demographic factors (i.e., lower household income, marital status) are associated with poorer HRQoL and more severe LUTS. Increased LUTS severity leads to a higher risk of incidental falls [5].

LUTS is also highly prevalent in adult men, notably those aged 40 years or older. About 35% to 77% of men in their 40s and 60s have experienced at least one symptom of LUTS, and the prevalence of LUTS continues to increase [6, 7]. Young people have also experienced LUTS, with 27% of men in their 20s having experienced all symptoms of LUTS

[8]. Additionally, about 15% of these men experience nocturia at least once [8]. However, because the prevalence of LUTS is age related, many studies on LUTS have focused on men ≥ 40 years [1, 2, 9]. Although recently reported population-based epidemiological studies included young adults, these studies focused on specific symptoms [10, 11]. Moreover, there is a lack of epidemiological studies related to HRQoL in young adult men experiencing LUTS. Therefore, the primary purpose of this study was to explore the relationship between LUTS severity and HRQoL in adult men of all ages, including young adults.

The EQ-5D-3L, developed by the EuroQOL, is a well-validated, comprehensive tool for measuring HRQoL [12]. Because of its simplicity, EQ-5D-3L is widely used to assess patients with diseases [2, 13] and to assess members of general populations [14]. Moreover, EQ-5D-3L is commonly used to assess urologic problems, especially LUTS, and its association with quality of life in elderly men [1, 2, 9], whereas Short Form-36 [15] or Short Form-20 [16] is usually used in research studies on young adults. The lack of a younger subject population using EQ-5D-3L measuring HRQoL in young men with LUTS is a major limitation. The second purpose of this study is therefore to evaluate the validity of EQ-5D-3L for assessing LUTS in young men.

Materials and methods

This study used the data from the Korean Community Health Survey conducted in 2011. The survey conducted by the Korean Center for Disease Control and Prevention is a large-scale sample survey performed annually to evaluate the health status of adults aged 19 years or older who are local residents living in urban and rural regions of Korea [17]. It is performed through face-to-face interviews by trained individuals, who visit the subjects' homes using electronic questionnaire in a laptop. The Korean Community Health Survey had two stratified sampling procedures. In the first stage, based on the number of households by housing type in the resident area (street/village/district), the primary sample unit was extracted proportionally using the extraction probability method considering the size of the households. In the second stage of sampling, the number of households was identified in the selected sample of the first stage and then extracted through systematic sampling methods [18]. This process was applied to ensure that the sample units were representative of the entire Korean population. To enable statistical representation of the population, the data collected from the survey were weighted. Weighted values were calculated using household weight and personal and adjusted weights [17, 19, 20]. The detailed analytic method of weighting is shown in Supplementary File 1. In 2011, the data were collected from 16 metropolitan cities and provinces with 253 regional sites around the country. The questionnaire of the survey consisted of 18 categories and 257 questions on demographic and socioeconomic characteristics, as well as health-related problems that included topics such as LUTS and HRQoL, which were assessed by the Korean version of the International Prostate Symptom Score [21], EQ-5D-3L, and EQ-VAS [22]. The LUTS survey was performed in 2011. Detailed descriptions, including sampling household, participants, variables, and weight, were reported on the Korean Community Health Survey website [23].

Of the 229,226 individuals who completed the Korean Community Health Survey in 2011, 126,209 women and 1411 men who did not complete the LUTS survey ($n = 1191$) and EQ-VAS ($n = 220$) were excluded. As a result, 101,606 male subjects were included (Fig. 1).

The Korean Community Health Survey was approved by the Institutional Review Board of Korean Centers for Disease Control and Prevention (IRB No. 2011-05CON-04-C). This study was exempt from the ethical approval by the Daegu Catholic University Medical Center institutional review board (IRB number: CR-18-075-L).

Variables

The Korean version of the International Prostate Symptom Score [21], which had reliability and validity after translation and back translation of the English version [24], was used to assess LUTS severity. The scale is a validated instrument that contains seven urinary symptoms: incomplete emptying, frequency, intermittency, urgency, nocturia, and weak stream. Nocturia was rated using a six-point scale from 0 to 5 (representing 0 and 5 times/night). The other six symptoms were rated using a six-point scale from zero to five ("never" and "almost always"). The score ranged from 0 (no symptoms) to 35, indicating more severe symptoms. Total scores were divided as follows: 0–7, mild LUTS; 8–19, moderate LUTS, 20–35, severe LUTS [25]. However, in the present study, mild LUTS (0–7 points) was subdivided into a normal (no LUTS) subgroup and a mild LUTS subgroup (1 to 7 points). In the normal subgroup, the subjects with benign prostatic hyperplasia were classified into a mild LUTS subgroup ($n = 716$). Nocturia rates were categorized on the basis of number of visits per night as follows: 0, 1–2, or > 3. In addition, subjects were also divided according to symptom frequencies during or after urination: not at all, 0 points; less than half of the time, 1–2 points; half of the time or more, 3–5 points. Cronbach's alpha of the English version of IPSS was 0.86 [24] and that of the Korean version was 0.91 [21].

HRQoL was measured by the Korean version of the EQ-5D-3L, which was administered through the process of translation, back translation, and cognitive debriefing of the English version according to the EuroQol group's

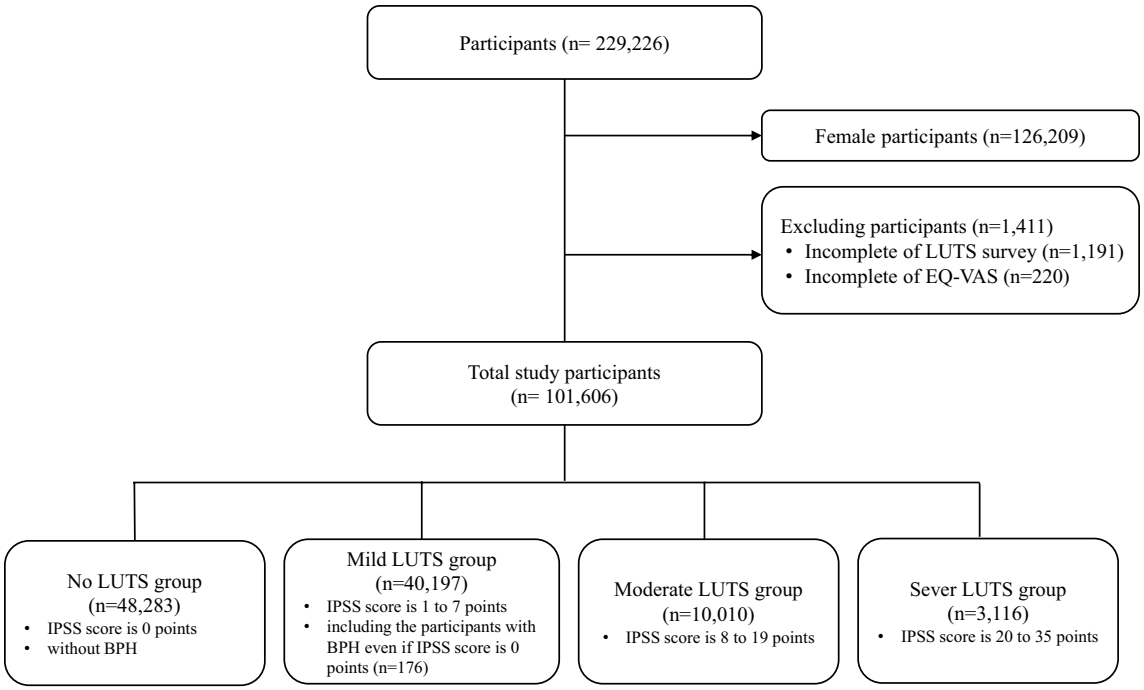

Fig. 1 Participant selection process for the present study

guidelines [26]. The Korean version of the EQ-5D-3L is used as a tool for measuring HRQoL in the Korean adult population and has been shown to have good validity and reliability [26–28]. The EQ-5D-3L is composed of five dimensions: mobility, self-care, usual activities, pain or discomfort, and anxiety or depression, with three different levels, as follows: 1, no problem; 2, some problem; or 3, severe problem [26]. In this study, analysis was conducted based on the presence of a problem in each of the five dimensions: "no problem (no problem)" and "any problem (some or severe problem)." The index of EQ-5D-3L was calculated using the Korean value set of the Korean version of EQ-5D-3L, where higher scores indicate better overall health status [29]. In addition, EQ-VAS scores were used to assess the perceived health status based on responses to the question, "How good is your health today?," which were scored on a 0 to 100 scale (0 = worst imaginable health state to 100 = best imaginable health state). Cronbach's alpha of the Korean version of EQ-5D-3L and EQ-VAS was 0.751 and 0.767 [26].

On the basis of the literature review, variables were divided into three categories: psychological, physical, and socio-demographic status. Variables considered for psychological and physical status included benign prostatic hyperplasia, which was defined by a diagnosis from a physician with or without treatment. Other comorbidities (cerebral stroke, depression, and myocardial infarction) were also defined by a diagnosis from a medical doctor. Experiences of falling during the last 1 year were assessed.

Socio-demographic variables such as marital status, including common-law marriage, were assessed. Obesity was assessed on the basis of the body mass index (BMI, kg/m^2) using the criteria for the Asia–Pacific region [30] and divided into following two groups: no obesity, BMI $\leq$ 24.9 kg/m^2; and obesity, BMI $\geq$ 25 kg/m^2. Economic status was assessed as annual average household income and divided into following four groups: lowest, 15 million Korean won or less; low-middle, 30 million Korean won or less; middle-high, 48 million Korean won or less; and highest quartiles 48 million Korean won or more.

Statistical analysis

Pearson's Chi-squared test and ANOVA were used to identify the distribution of EQ-5D-3L and EQ-VAS scores by LUTS severity. To identify age-related differences, subjects were categorized by age as follows: 19–39, 40–59, 60–79, and $\geq$ 80 years. Pearson's Chi-squared test and ANOVA were also used to analyze the difference between EQ-5D-3L index and VAS score by age groups and LUTS severity. Multiple

linear regressions analysis was performed to identify the impact of LUTS on HRQoL adjusted for psychological, physical, and social-demographic status. *P* values of < 0.05 were considered statistically significant, and the analysis was performed using IBM SPSS version 22.0 (IBM Corp., Armonk, NY, USA) for Windows.

Results

Regarding LUTS severity, about 52.5% of all study subjects had mild to severe LUTS, and 28.9% of young subjects (19- to 39-year-olds, $n = 29{,}122$) had mild to severe LUTS. The proportion of the subjects experiencing all LUTS symptoms significantly increased with age. Nocturia was the most common symptom in all age groups. Other symptoms were slightly different in the four age groups. In the 19 to 39 age group, frequency (40.4%) was followed by nocturia, and in the 60–79- and ≥ 80-year-old groups, a weak stream (53.8% and 70.2%, respectively) and intermittency (45.8%, and 63.6%, respectively) were most common with nocturia. The demographic and clinical characteristics of the study population are presented in Table 1.

The proportions of reported problems in each dimension of the EQ-5D-3L and EQ-VAS by LUTS severity are summarized in Table 2. The 4th dimension, "pain/discomfort," was the most commonly reported problem in those with or without LUTS. As LUTS severity increased, the proportions of reported problems significantly increased in all dimensions of the EQ-5D-3L. The average of EQ-5D-3L index for groups with LUTS was 0.951, 0.870, and 0.748 in the mild, moderate, and severe symptom groups, respectively. EQ-VAS scores diminished significantly as the LUTS severity increased.

As age increased, LUTS severity increased and the EQ-5D-3L index and EQ-VAS scores significantly decreased (Table 3). In 19–39 age group, the EQ-5D-3L index of the severe LUTS was 0.840 and that of the mild LUTS was 0.976. In comparison, the EQ-5D-3L index of the severe LUTS was 0.781 and that of the mild LUTS was 0.837 in the 80s or older group.

The EQ-5D-3L index and EQ-VAS were found to be significantly associated with LUTS frequency, that is, EQ-5D-3L index and EQ-VAS scores decreased significantly as the frequency of LUTS increased (Table 4).

The relationship of the EQ-5D-3L index and EQ-VAS with LUTS severity was maintained after controlling for age and other variables (Table 5).

Discussion

The results of the current study showed that quality of life significantly decreased as LUTS severity increased in all age groups. Our findings are consistent with those of other LUTS studies, which showed that all dimensions of HRQoL, as measured using the EQ-5D-3L, significantly decreased with an increase in LUTS severity and frequency [1, 2, 31]. Furthermore, the general health status (as measured by the EQ-VAS) decreased in a similar manner. In addition, we found that even at young ages, a relationship between HRQoL and LUTS severity appears a similar change with middle or older ages. To our knowledge, no empirical research exists that clarifies the relationship between all LUTS severities and HRQoL, measured by EQ-5D-3L, in young adult populations. A study using other scales and dealing only with one symptom of LUTS showed that in men from Finland aged ≥ 19 years, HRQoL measured by a generic 15D instrument decreased as nocturia frequency increased [32]. Additionally, in French adults aged > 50 years, EQ-5D-3L indices have been estimated as 0.90 ± 0.12, 0.81 ± 0.21, and 0.73 ± 0.25 for mild, moderate, and severe LUTS [2], similar to the findings reported in studies performed in UK [31] and Korea [1].

Consistent with the results of other studies [8, 33], the prevalence of LUTS in 19–39-year-olds was lower than that among those aged ≥ 40 years. However, it is important to note that LUTS in young age is not as rare as many physicians believe. Among Korean adult young men in this study, 28.7% reported having a mild LUTS or more. This figure is somewhat higher than other former studies [8, 34]. As mentioned in the literature review, factors (i.e., married status, economic status, comorbidities) affecting LUTS, which are covered in this study, are differ by age increasing, so it is needed to reflect specific variables that showed only in young population. Considering that LUTS is related with lifestyle and health behavior (i.e., caffeine consumption, obesity) [35–37], further studies on the risk factors of LUTS considering the lifestyle of young population will be helpful for understanding the trend presently identified in young men. Furthermore, LUTS in young adults is also associated with urinary conditions, such as primary bladder neck obstruction, detrusor over-activity, or impaired detrusor contractility [37, 38]; our findings emphasize the need to screen young men experiencing voiding difficulty for urologic diseases.

The results of this large community-based study suggest EQ-5D-3L is a valid tool for assessing quality of life

Table 1 The demographic and clinical characteristics of the study population

LUTS	*N* (weighted %)[a]	Age (years)				*P* value[b]
		19–39	40–59	60–79	80 or more	
Total	101,606 (100)	29,072 (28.6)	41,756 (41.1)	27,952 (27.5)	2826 (2.8)	
Severity[c]						
Normal	48,283 (47.5)	20,730 (71.3)	21,852 (52.3)	5455 (19.5)	246 (8.1)	< 0.001
Mild	40,197 (39.6)	7860 (27.0)	17,391 (41.6)	13,974 (50.0)	972 (35.0)	
Moderate	10,010 (9.8)	448 (1.5)	2150 (5.1)	6390 (22.9)	1022 (36.1)	
Severe	3116 (3.1)	34 (0.1)	363 (0.9)	2133 (7.6)	586 (20.8)	
Subtotal	53,323 (52.5)	8342 (28.7)	19,904 (47.7)	22,497 (80.5)	2580 (91.2)	
Symptoms[d]						
Incomplete emptying	18,719[e] (12.3)	1649 (19.8)	5808 29.2)	9762 (43.4)	1500 (58.1)	< 0.001
Frequency	21,570 (14.2)	3373 (40.4)	6393 (32.1)	10,194 (45.3)	1610 (62.4)	
Intermittency	19,010 (12.5)	1677 (20.1)	5386 (27.1)	10,305 (45.8)	1642 (63.6)	
Urgency	14,736 (9.7)	1197 (14.3)	3801 (19.1)	8277 (36.8)	1461 (56.6)	
Weak stream	21,061 (13.9)	1079 (12.9)	6051 (30.4)	12,116 (53.9)	1815 (70.3)	
Hesitancy	14,111 (9.3)	870 (10.4)	3468 (17.4)	8325 (37.0)	1448 (56.1)	
Nocturia	42,760 (28.1)	5295 (63.5)	14,888 (74.8)	20,132 (89.5)	2445 (94.8)	
Marriage						
Yes	83,410 (82.1)	13,473 (16.2)	39,321 (47.1)	27,796 (33.3)	2820 (3.4)	< 0.001
No	18,176 (17.9)	15,593 (85.8)	2424 (13.3)	153 (0.8)	6 (0.0)	
Annual income						
Lowest	24,117 (25.6)	2728 (10.0)	5241 (21.7)	14,190 (58.8)	1958 (8.1)	< 0.001
Low to middle	27,231 (28.9)	8695 (36.1)	11,075 (45.9)	7095 (29.4)	366 (1.5)	
Middle to high	16,874 (17.9)	6518 (38.6)	8103 (48.0)	2139 (12.7)	114 (0.7)	
Highest	26,049 (27.6)	9104 (34.9)	14,287 (54.8)	2484 (9.5)	174 (0.7)	
Obesity (BMI ≥ 25)						
Yes	28,356 (28.5)	9044 (31.9)	13,146 (46.4)	5916 (20.9)	250 (0.9)	< 0.001
No	71,270 (71.5)	19,888 (27.9)	28,331 (39.8)	20,956 (29.4)	2095 (2.9)	
Falling experience						
Yes	14,717 (14.5)	4732 (32.2)	5007 (34.0)	4435 (30.1)	543 (3.7)	0.155
No	86,811 (85.5)	24,305 (28.0)	36,727 (42.3)	23,499 (27.1)	2280 (2.6)	
BPH diagnosis						
Yes	8202 (8.1)	153 (1.9)	1699 (20.7)	5536 (67.5)	814 (10.0)	< 0.001
No	93,261 (91.9)	28,903 (31.0)	40,025 (42.9)	22,342 (24.0)	1991 (2.1)	
BPH with treatment						
Yes	4656 (56.8)	22 (0.5)	618 (13.2)	3424 (73.5)	592 (12.8)	< 0.001
No	3545 (43.2)	131 (3.7)	1081 (30.4)	2112 (59.6)	221 (6.3)	
Stroke						
Yes	2236 (2.2)	28 (1.3)	392 (17.5)	1582 (70.8)	234 (10.5)	< 0.001
No	99,359 (97.8)	29,043 (29.2)	41,360 (41.6)	26,368 (26.5)	2588 (2.6)	
Myocardial infarction						
Yes	1725 (1.7)	26 (1.5)	459 (26.6)	1126 (65.3)	114 (6.6)	< 0.001
No	99,831 (98.3)	29,041 (29.1)	41,286 (41.4)	26,801 (26.8)	2703 (2.7)	
Depression						
Yes	1194 (1.2)	244 (20.4)	442 (37.0)	464 (38.9)	44 (3.7)	< 0.001
No	100,397 (98.8)	28,825 (28.7)	41,312 (41.1)	27,481 (27.4)	2779 (2.8)	

LUTS Lower urinary tract symptoms, *BPH* Benign prostatic hyperplasia

[a]LUTS severity and symptoms are the percentage by ages and other variables are the percentage by total number of each variables

[b]Chi square for trend analysis

[c]Measured using total IPSS scores (0 = normal, 1–7 point = mild, 8–19 points = moderate, 20–35 = severe)

[d]Seven symptoms of IPSS scale

[e]Value for each symptom present in the total number of the subjects with the symptom at least once during previous month in the mild or greater LUTS groups in each range

Table 2 Comparison of EQ-5D-3L and EQ-VAS scores by LUTS severity

EQ-5D-3L	LUTS severity								*P* value*
	None (*n* = 48,283)	Mild (*n* = 40,197)	Moderate (*n* = 10,010)	Severe (*n* = 3116)	None (*n* = 48,283)	Mild (*n* = 40,197)	Moderate (*n* = 10,010)	Severe (*n* = 3116)	
	n	(%)	*n*	(%)	*n*	(%)	*n*	(%)	
Mobility									
No problems	46,541	(96.4)	35,854	(89.2)	6751	(67.4)	1362	(43.7)	< .001
Any problems	1742	(3.6)	4343	(10.8)	3259	(32.6)	1754	(56.3)	
Self-care									
No problems	47,718	(98.8)	38,838	(96.6)	8755	(87.5)	2171	(69.7)	< .001
Any problems	565	(1.2)	1359	(3.4)	1255	(12.5)	945	(30.3)	
Usual activities									
No problems	46,858	(97.0)	36,765	(91.5)	7298	(72.9)	1512	(48.5)	< .001
Any problems	1425	(3.0)	3432	(8.5)	2712	(27.1)	1604	(51.5)	
Pain or discomfort									
No problems	43,310	(89.7)	31,163	(77.5)	5306	(53.0)	1023	(32.8)	< .001
Any problems	4973	(10.3)	9034	(22.5)	4704	(47.0)	2093	(67.2)	
Anxiety or depression									
No problems	46,058	(95.4)	36,219	(90.1)	7633	(76.3)	1901	(61.0)	< .001
Any problems	2225	(4.6)	3978	(9.9)	2377	(23.7)	1215	(39.0)	
EQ-5D-3L index, mean(SD)[a]	0.979 (0.069)		0.951 (0.105)		0.870 (0.171)		0.748 (0.261)		< .001
VAS, mean (SD)[a]	76.0 (15.7)		72.6 (16.9)		63.8 (19.4)		53.9 (22.4)		< .001

*P values were determined using the Chi-square test or ANOVA

[a]All groups were significantly different by post hoc Tukey testing

in LUTS populations regardless of age. The features and most common symptoms of LUTS, including nocturia, weak stream, frequency, and incomplete emptying, are more related with physical condition, activities, and emotion (e.g., anxiety or depression) than with social functioning. Some studies reported that a HRQoL scale that included social aspects (e.g., Sort Form-36) is likely to be insensitive to the specific social situations that men with severe LUTS face [15]; rather, it is more proper tools to incontinent individuals with overactive bladder symptoms affecting social functioning [16]. In other words, an appropriate tool that includes social functions should be used to measure quality of life in individuals with LUTS with accompanying chronic diseases or incontinence. On the basis of the results of the present study, we recommend a scale like the EQ-5D-3L be used when focus is placed on

Table 3 Differences in EQ-5D-3L index and EQ-VAS scores by age and LUTS severity

LUTS severity by ages	EQ-5D-3L index			EQ-VAS		
	Mean	SD	*P* value	Mean	SD	*P* value
19–39 years						
Normal	0.988	0.047	< 0.001	76.6	15.6	< 0.001
Mild	0.976	0.064		73.9	16.2	
Moderate	0.927	0.126		64.7	20.2	
Severe	0.840	0.276		58.9	25.3	
Total	0.984	0.055		75.6	16.0	
40–59 years						
Normal	0.980	0.065	< 0.001	76.2	15.3	< 0.001
Mild	0.966	0.082		73.6	16.3	
Moderate	0.913	0.137		65.4	19.1	
Severe	0.793	0.245		54.0	24.3	
Total	0.969	0.083		74.3	16.3	
60–79 years						
Normal	0.951	0.116	< 0.001	73.3	17.3	< 0.001
Mild	0.926	0.129		71.1	17.7	
Moderate	0.866	0.172		63.9	19.2	
Severe	0.762	0.251		54.8	22.0	
Total	0.904	0.158		68.6	19.0	
≥ 80 years						
Normal	0.850	0.201	< 0.001	66.6	19.1	< 0.001
Mild	0.837	0.183		64.7	19.8	
Moderate	0.781	0.208		59.0	20.3	
Severe	0.661	0.288		50.2	22.1	
Total	0.781	0.229		59.8	21.1	

physical and emotional aspects when measuring HRQoL in individuals with LUTS alone.

A number of limitations of the present study warrant consideration. First, the study provides information on the association between LUTS and several dimensions of HRQoL based on the results of a cross-sectional survey, and thus did not enable the cause–effect relationships to be assessed. In view of the association between sleep disturbance and LUTS [39], we suggest a survey that also addresses sleep adequacy be conducted to more precisely assess the impact of LUTS severity.

On the other hand, this study also has several strengths. The current study represents a comprehensive evaluation of adults of all ages with LUTS and shows the relationship between LUTS severity and HRQoL using the EQ-5D-3L. Furthermore, this study shows the EQ-5D-3L is reliable and valid for assessing the impact of quality of life in adults with LUTS.

Conclusions

The results of this large community-based study of men aged ≥ 19 years suggest LUTS is a significant contributor to poor HRQoL in men of all ages. Furthermore, it shows that the prevalence of LUTS increases with age. Interestingly, the prevalence of LUTS in men aged 19–30 years was found to be higher than that in previous reports. Owing to changes in lifestyle and eating habits in Korean men in this age range, the authors urge that public awareness of LUTS be increased and that appropriate physical and laboratory examinations be devised for the early screening and treatment of urologic diseases. In addition, EQ-5D-3L was a valid tool not only for the elderly with LUTS but also for the young population, and it is expected to be used widely to measure the HRQoL in young populations. Further studies will be needed continuously to examine the validity of EQ-5D-3L in young populations.

Table 4 EQ-5D-3L and EQ-VAS differences with respect to frequency of lower urinary tract symptoms (LUTS)

Lower urinary tract symptoms	EQ-5D-3L index		*P* value	EQ-VAS		*P* value
	Mean	SD		Mean	SD	
Incomplete emptying						
Not at all	0.965	0.092	< 0.001	74.5	16.5	< 0.001
< 1/2 the time	0.913	0.144		67.5	18.2	
≥ 1/2 the time	0.806	0.233		58.4	21.6	
Frequency						
Not at all	0.966	0.092	< 0.001	74.5	16.5	< 0.001
< 1/2 the time	0.920	0.138		68.7	18.2	
≥ 1/2 the time	0.812	0.230		59.4	21.9	
Intermittency						
Not at all	0.966	0.091	< 0.001	74.5	16.5	< 0.001
< 1/2 the time	0.910	0.147		67.6	18.3	
≥ 1/2 the time	0.800	0.236		58.4	21.9	
Urgency						
Not at all	0.964	0.092	< 0.001	74.3	16.5	< 0.001
< 1/2 the time	0.901	0.154		66.3	18.7	
≥ 1/2 the time	0.778	0.249		56.8	22.4	
Weak stream						
Not at all	0.969	0.086	< 0.001	74.7	16.4	< 0.001
< 1/2 the time	0.912	0.143		67.8	18.1	
≥ 1/2 the time	0.814	0.225		59.8	21.5	
Hesitancy						
Not at all	0.964	0.093	< 0.001	74.2	16.6	< 0.001
< 1/2 the time	0.896	0.159		66.1	18.7	
≥ 1/2 the time	0.780	0.249		56.9	21.9	
Nocturia						
Not at all	0.974	0.077	< 0.001	75.2	16.1	< 0.001
< 1/2 the time	0.936	0.126		71.1	17.7	
≥ 1/2 the time	0.841	0.209		62.4	21.1	

< 1/2 the time = less than half of the time (1–2 points for individual LUTS symptoms)

≥ 1/2 the time = half of the time or more (3–5 points for individual LUTS symptoms)

Table 5 Changes of EQ-5D-3L and EQ-VAS according to LUTS severity by Multiple regression analysis

Variables	EQ-5D-3L			EQ-VAS		
	β	*t*	*P*	*β*	*t*	*P*
Constant		712.255	< 0.001		317.269	< 0.001
LUTS severity	− .212	− 63.124	< 0.001	− .182	− 49.433	< 0.001
Ages	− .193	− 44.612	< 0.001	− .045	− 9.608	< 0.001
Marriage	.070	19.357	< 0.001	0.16	4.152	< 0.001
Annual income	.096	29.994	< 0.001	.112	31.932	< 0.001
Falling experience	− .112	− 38.815	< 0.001	− .059	− 18.804	< 0.001
Obesity (BMI ≥ 25)	.007	2.432	.015	0.006	1.861	.063
Cerebral stroke	− .186	− 63.703	< 0.001	− .075	− 23.371	< 0.001
Myocardial infarction	− .025	− 8.472	< 0.001	− .028	− 8.778	< 0.001
Depression	− .111	− 38.869	< 0.001	− .060	− 19.183	< 0.001
$F = 3370.192 (P < .001)$, $R^2 = .247$, $_{adj}R^2 = .247$, D–W = 1.621				$F = 1116.405 (P < .001)$, $R^2 = .098$, $_{adj}R^2 = .098$, D–W = 0.064		

Author contributions All authors contributed to the conception and design of the study. SK Kim and KH Kim contributed to the acquisition of data. SH Kim analyzed the data and YW Jeong was involved in drafting the manuscript. SK Kim, KH Kim, YW Jeong, and SJ Yoo were involved in the draft revision. All authors read and approved the final manuscript.

Compliance with ethical standards

Funding None.

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

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