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The prevalence of lower urinary tract symptoms in a Chinese population, and the correlation with uroflowmetry and disease perception

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Abstract
Objectives To evaluate the prevalence of lower urinary tract symptoms (LUTS) in a population of Chinese men, and its correlation with uroflowmetry and disease perception.
Materials and methods Male volunteers above 40-year old were recruited in the community. Assessment with International Prostatic Symptom Score (IPSS), uroflowmetry, and a quiz on prostatic disease knowledge with 12 true–false-type questions were performed. Correlation of IPSS with uroflowmetry results and prostatic disease knowledge was analyzed.
Results A total of 319 men were recruited for the study, with a mean age of 62 ± 8 years. About 69.3 % of them had moderate-to-severe symptoms on IPSS. A statistically significant correlation was found between IPSS and Q_{max} ($r = -0.260$, $p < 0.001$), IPSS and quality of life ($r = -0.172$, $p = 0.002$), and IPSS and post-void residuals ($r = 0.223$, $p < 0.001$). About 53.0 % of subjects had less than 4 correct answers for the 12 true–false questions. Negative correlation was noted between the number of correct answers and IPSS ($r = -0.185$, $p = 0001$). In other words, for the better knowledge on prostatic diseases, the lower IPSS was found.
Conclusions In a cohort of community-dwelling Chinese men, a significant portion of the population had moderate-to-severe LUTS. While uroflowmetry parameters were found to correlate with IPSS, the degree of knowledge on prostatic diseases also shared a statistically significant correlation with IPSS. This has an implication on the role of urological health education in the future.

Keywords Lower urinary tract symptoms · Uroflowmetry · Disease perception

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Introduction

Lower urinary tract symptoms (LUTS) are regarded by the most cultures as an inevitable consequence of aging. Although there was a relatively little geographical or racial variation in the prevalence of histologically defined benign prostatic hyperplasia (BPH) [1], bother from lower urinary tract symptoms varied among populations [2]. Previously, studies of LUTS and health status had mostly been conducted in Western countries [3–5]. However, as BPH has become a common disease in Asian countries in recent decades, with prevalence comparable to that found in the West [6], studies on LUTS of the Asian population is getting more robust. While many of these reports employed

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questionnaires as a tool for subjective assessment of LUTS, objective assessment of such disease entity has been lacking [7–9].

In the past, uroflowmetry had a controversial role in the evaluation of LUTS. Much of this controversy stems from the considerable within-person variability of its most representative parameter, peak urinary flow rate (Q_{max}) [10]. This is in part due to variations in the voided volume, and a learning curve of measurement [11]. In spite of these limitations, uroflowmetry has in recent years gained a relevant role in the assessment of LUTS, owing to its nature of being noninvasive, rapid, and simple to execute [12]. With this perspective, uroflowmetry was used as a part of the assessment in our study population.

Whereas objective assessment provides useful information on the physiological and anatomic aspects of LUTS, the evaluation of LUTS has a highly subjective component compared to other common age-related chronic conditions. This may be more susceptible to various forms of reporting bias possibly rooted in sociocultural differences in symptom perception or differences in knowledge of the disease as a result of a variation in education [13]. While LUTS has been a prevalent condition, studies on the correlation between symptom and disease perception were limited in the literature. In other areas of medicine, health education was found to improve the outcome of a number of medical conditions [14–16]. But similar studies were lacking in the urological community, particularly on LUTS. We report the results of a cohort study conducted in Hong Kong Chinese men, assessing the prevalence of LUTS subjectively and objectively with the International Prostate Symptom Score (IPSS) and uroflowmetry. With reference to these, we also report the association between symptom scores and the study cohort knowledge on prostatic disease.

Patients and methods

Study participants were recruited between July 2011 and October 2011 by local open advertisement in the media. All male above 40-year old were welcomed. Upon interview, informed consent and basic demographic information of the volunteers were obtained, including their education level.

Subjects were asked to fill in the IPSS questionnaire. At the same time, uroflowmetry was performed. Uroflowmetry result was considered valid if the voided volume was more than 100 ml. However, if the subject repeatedly had his voided volume less than 100 ml, and if it was representable according to the subject, we would consider it a valid result. The subject was also enquired about his current status of medical care. If he was seeking medical attention for his LUTS, it would be noted down during data collection. Furthermore, 12 true–false-type questions on the knowledge of prostatic diseases were asked to the subject (See Appendix). This served to assess the participant's understanding of prostatic symptoms and conditions.

Descriptive statistics were used to characterize the demographic data, IPSS, and uroflowmetry results. Correlation between age and parameters of LUTS, including IPSS and uroflowmetry variables, was presented with Pearson's correlation coefficient. Relationship between IPSS and uroflowmetry results was studied with regression analysis. Multivariable linear regression was used to compare IPSS among participants with different levels of knowledge on prostatic diseases, while controlling for age and medical follow-up status. $P < 0.05$ was considered statistically significant. SPSS software package version 20.0 (SPSS Inc, Chicago, IL, USA) was used for all calculations.

Table 1 Subjects demographics and characteristics

Subjects (*n*)	319
Mean age, years ± SD	62 ± 8.0
Education level	
Primary or below (*n*)	61 (19.1 %)
Secondary (*n*)	182 (57.1 %)
Tertiary or above (*n*)	76 (23.8 %)
Medical attention on LUTS (*n*)	
Yes (*n*)	26 (8.2 %)
No (*n*)	293 (91.8 %)
IPSS	
0–7 (*n*)	98 (30.7 %)
8–19 (*n*)	140 (43.9 %)
20–35 (*n*)	81 (25.4 %)
QoL score ± SD	2.94 ± 1.18
Uroflowmetry Q_{max}	
<10 ml/s (*n*)	54 (16.9 %)
10–15 ml/s (*n*)	85 (26.6 %)
>15 ml/s (*n*)	180 (56.5 %)
Uroflowmetry PVR	
≤150 ml (*n*)	245 (76.8 %)
>150 ml (*n*)	74 (23.2 %)
Prostatic disease knowledge questionnaire	
<4 answers correct (*n*)	169 (53.0 %)
4–6 answers correct (*n*)	117 (36.7 %)
>6 answers correct (*n*)	33 (10.3 %)

SD standard deviation, *LUTS* lower urinary tract symptoms, *IPSS* International Prostate Symptom Score, *QoL* quality of life, Q_{max} peak flow rate, *PVR* post-void residue

Table 2 IPSS and uroflowmetry results according to age

Age (years)	*n*	Mean IPSS ± SD	Mean Q_{max} ± SD	Mean PVR ± SD
60 or below	137	11.89 ± 8.02	19.41 ± 7.51	84.9 ± 101.6
61–70	133	13.84 ± 8.22	16.86 ± 8.01	116.1 ± 110.1
70 or above	49	14.45 ± 7.36	12.58 ± 6.52	104.2 ± 78.0

SD standard deviation, *IPSS* International Prostate Symptom Score, Q_{max} peak flow rate, *PVR* post-void residue

Table 3 Correlation between uroflowmetry and IPSS

		Q_{max}	PVR	IPSS	QoL
Q_{max}	Pearson's correlation	1	−0.125	−0.260	−0.172
	p value	–	0.026	<0.001	0.002
PVR	Pearson's correlation	−0.125	1	0.223	0.106
	p value	0.026	–	<0.001	0.058

IPSS International Prostate Symptom Score, Q_{max} peak flow rate, *PVR* post-void residue, *QoL* quality of life

Results

Between July 2011 and October 2011, 319 male subjects answered to the advertisement and were recruited into the study. Their demographic data are outlined in Table 1. The mean age of the subjects was 62 ± 8 years, ranging from 43 to 87 years. Majority of them had their education at the secondary school level (57.1 %). About 91.8 % of the participants had never received any medical attention concerning LUTS. In this study population, 43.9 % scored moderate symptoms on IPSS. As for severe symptoms, 25.4 % belonged to this category. Overall, 56.5 % of the subjects had their $Q_{max} > 15$ ml/s. Most of the participants had post-void residue (PVR) less than 150 ml (76.8 %).

A statistically significant positive correlation was found between age and other variables (Table 2). Among older patients, a higher IPSS was found, particularly concerning the items on urgency and nocturia. Pearson's correlation coefficient, *r*, for IPSS, urgency, and nocturia correlating with age is $r = 0.243$ ($p < 0.0005$), $r = 0.333$ ($p < 0.0005$), and $r = 0.151$ ($p = 0.007$), respectively. As for uroflowmetry parameters, the older the patient, the slower the Q_{max} ($r = -0.293$, $p < 0.0005$). Using linear regression, it was revealed that there was a 0.80-point increase in IPSS for every 5 years increase in age (95 % CI 0.264–1.342; $p = 0.004$). In the same time interval, Q_{max} would decrease by 1.43 ml/s for every 5-year difference (95 % CI −1.947 to −0.922; $p < 0.0005$).

When analyzing the relationship between uroflowmetry parameters and IPSS, we found a statistically significant but weak correlation (Table 3). A higher Q_{max} would give a lower IPSS ($r = -0.260$, $p < 0.001$) and a lower quality of life (QoL) score ($r = -0.172$, $p = 0.002$), while a larger PVR would give a higher IPSS ($r = 0.223$, $p < 0.001$). When correlating individual IPSS questions with Q_{max} and PVR, similar results were again generated. In particular, Q_{max} correlated with the IPSS item on weak stream ($r = -0.203$, $p < 0.001$), and PVR correlated with the IPSS item on incomplete emptying ($r = 0.126$, $p = 0.025$).

The 12 true–false questions on prostatic diseases yielded a 100 % response rate. About 53.0 % of the subjects had less than 4 correct answers, 36.7 % had 4–6 correct answers, and 10.3 % of the participants had more than 6 correct answers. There was a statistically significant negative correlation between the number of correct answers and IPSS ($r = -0.185$, $p = 0.001$). In other words, the better knowledge on prostatic diseases, the lower the IPSS was found. However, for Q_{max} and PVR, such relationship was not found with the number of questions answered correctly (Q_{max}: $r = 0.050$, $p = 0.377$; PVR: $r = 0.12$, $p = 0.824$). For analysis of factors affecting IPSS, namely age, prostatic diseases knowledge, and medical follow-up status, all 3 factors were shown to be statistically significant independent predictors of IPSS total score upon multiple linear regression (Table 4). An increase in one correctly answered question led to a mean of 0.7-point decrease in IPSS for subjects with the same standardized age and medical follow-up status (95 % CI −1.1 to −.03).

In the study population, 69.3 % experienced moderate-to-severe LUTS (Table 1). Among this group of participants, only 10.4 % of them sought medical advice for their urinary tract problems. On chi-square analysis, there was no association found between the level of education and their behavior on seeking medical advice.

Discussion

In the current era of an increased life expectancy and the aging of baby boomer generation, male LUTS would become an issue of increasing socioeconomic and medical importance [17]. While studies on LUTS prevalence have been conducted in Europe [18], the United States [19], Japan [20], and Korea [21], data on the Chinese population are relatively scarce. Moreover, many of these studies focused on aged populations only, investigating male subjects of more than 60-year old. Often, participants with history of urological disease were excluded from analysis. Our cohort of community-dwelling men including subjects

Table 4 Regression analysis for correlation between prostatic disease knowledge, medical follow-up status, age, and IPSS

Factors	Univariable analysis		Multivariable analysis			
	β	*p* value	coefficients	SE	95 % CI	*p* value
No. of correct answers	−0.185	0.001	−0.7	0.2	−1.1 to −0.3	0.001
With medical follow-up	0.174	0.002	5.3	1.6	2.1–8.4	0.001
Age	0.163	0.004	0.6	0.3	0.03–1.1	0.039

SE standard error, *CI* confidence interval

below the age of 60 years supplemented valuable information to the current literature. The less stringent exclusion criteria provided insight into the situation in real-life practice.

From our data, 69.3 % of our participants reported moderate-to-severe LUTS on IPSS questionnaire. When the results were stratified according to different age group, 60.6 % of participants below the age of 60 years reported moderate-to-severe symptoms. As for the age group of 61–70 years, and the group above 70 years, percentage of participants reporting moderate-to-severe symptoms was 74.4 and 79.6 %, respectively. These figures were generally higher than those quoted in the literature, which ranged from 16 to 56 % [20, 22–25]. This could be as a result of not having excluded patients with history of urological disease from our current study. Such randomly selected subjects from the community represented the entire spectrum of lower urinary tract symptoms. Furthermore, a change of prevalence of LUTS over time was observed. Haidinger et al. [25] reported a decrease in the prevalence of LUTS in the Austrian male population over a period of 14 years, while Malmsten et al. [26] found an increase in the prevalence of LUTS in a Swedish community over a period of 11 years. The reason behind this discrepancy observed in the temporal trend of LUTS prevalence in different regions was unknown. However, as many of the studies on the prevalence of LUTS were carried out more than 5–10 years ago, such findings called for an update of the current epidemiological status.

As in prior studies, LUTS severity was associated with age. Although a few studies reported a negative correlation between age and symptom index [27, 28], most community-based studies showed that age and symptom scores correlated positively [3, 4, 9, 21]. This finding was echoed in our study. There was a trend suggesting an increase in the severity of LUTS in old subjects, in particular for the irritative domain in IPSS. Our results found a 0.80-point increase in IPSS for every 5 years increase in age. This figure was comparable with other longitudinal studies in the literature [9, 29]. On the other hand, we reported a decrease in Q_{max} by 1.43 ml/s per 5 years. This value fell between the estimates reported by a cross-sectional study (about 2 ml/s per 10 years) [30] and a longitudinal study (about 4 ml/s per 10 years) [31] of the cohort in Olmsted County, Minnesota. With most population-based LUTS studies focusing on symptom assessment, such Q_{max} deterioration description was among the first few reports available in the literature concerning the Asian community.

Uroflowmetry is one of the most frequently used tests in urology today for assessment of LUTS [32]. There has been a considerable interest in the past decade to correlate the findings in uroflowmetry with IPSS. Ezz el Din et al. [32] and Waide et al. [33] described a statistically significant but weak correlation between uroflowmetry parameters and IPSS. Among parameters obtained by uroflowmetry, maximum flow rate is the most representative variable. Current study also concluded the definite relationship between Q_{max} with both IPSS and QoL.

While objective voiding characteristics play a role in symptom manifestation as reflected by IPSS, such a weak correlation would suggest that the symptom complex as perceived by patients could be more than the result of histologic or anatomic BPH [32]. In fact, the impact of several factors on IPSS had been investigated in the literature. However, inconclusive data were observed. A cohort study by Wong et al. suggested that a high level of physical activity was associated with a decreased odds of moderate-to-severe LUTS [34]. Yet, other studies had reservation on such conclusion [35], [36]. Low income and marital status were proposed by Fowke et al. [37]. In their cohort, both factors were found to be of statistically significant correlation. Furthermore, the factor of education level was also marginally associated with IPSS.

It had been known that while LUTS per se would increase the level of anxiety on patients [38], anxiety itself would in turn be a risk factor for developing LUTS [39]. As anxiety is closely related to the status of uncertainty, relief of uncertainty is often a measure to alleviate anxiety. Such phenomenon could be observed in the high rates of prostate-specific antigen screening since its introduction, despite concerns about the efficacy of early intervention [40]. From the current study, we observed that a better

understanding of prostatic disease and symptoms would yield a lower IPSS. In fact, one more correctly answered question in the prostatic disease knowledge questionnaire resulted in a mean of 0.7-point reduction in IPSS. Such finding was independent of age and medical follow-up status. Although the relationship was a statistically significant but weak correlation, it would be a reasonable postulation that the knowledge of disease itself might contribute to the symptom complex of LUTS, as it is likely of multifactorial etiology [41].

For patients already diagnosed of BPH, the role of "self-management interventions (SMI)" had been discussed in the literature. "Self-management" was initially defined by Barlow et al. [42] as "the individual's ability to manage the symptoms, treatment, physical and psychosocial consequences, and lifestyle changes inherent in living with a chronic condition." SMI was subsequently investigated by Brown et al. [43] and Chen et al. [44] as a potential treatment module for patients with uncomplicated LUTS. It involved provision of information on disease together with techniques that could help to promote behavioral change. The aforementioned studies demonstrated success with SMI in their cohort of LUTS patients, showing a significant reduction in the rate of treatment failure and an improvement in urinary symptoms. However, there was a concern over the use and safety of SMI in the management of LUTS secondary to BPH. The risk expressed in the literature was that it might result in reduced prescribing of disease-altering agents such as 5-alpha-reductase inhibitors, which were known to reduce the risk of progression and the need for transurethral resection of the prostate [45].

While uncertainty still lies upon the use of SMI on patients with clinical diagnosis of BPH, it is worthwhile to investigate the role of health education on community-dwelling subjects. Health education would promote the public knowledge on prostatic diseases. On one hand, as one has a better cognitive sense of being more in control, knowledge on the disease would help address the uncertainties surrounding LUTS, possibly relieving the anxiety of men on aging, prostatic symptoms, and disease progression. On the other hand, while health education alone might not constitute the full package of SMI, its benefit on LUTS in the public could not be completely ruled out. After all, Chen et al. noticed a significant mean reduction in IPSS of 8.5-point with SMI in their study [44]. These theories could be the reasons underlying our observation that subjects with better knowledge on prostatic diseases had a lower IPSS on investigation.

As with any investigation, our study had some limitations. While the selection of community-based subjects in our study was an endeavor to reflect the real-life situation in our population, recruitment with open advertisement might create a selection bias of presumably healthy subjects. However, such bias would have been unlikely to alter our results in identifying correlates of LUTS parameters with respect to IPSS. In addition, LUTS is a complex condition. While its manifestation and degree are quantified by IPSS questionnaire, LUTS per se could be attributed to multiple factors. The subjects in our study have not undergone comprehensive stringent assessment to standardize parameters such as prostate volume, neurological status, and detrusor function. In this aspect, it is a limitation of our study. We hope that our future study with a different approach in assessment could address this issue. Furthermore, our administration of IPSS questionnaire and prostatic diseases questionnaire was done by face-to-face interviews. It served to remove the bias from subjects' illiteracy and their misunderstanding of questions in the questionnaires. Nevertheless, some subjects might feel embarrassed to disclose their condition under the condition of a face-to-face interview. But considering the interviews were performed by professionally trained medical personnel and in a setting with adequate privacy, we believed that such bias was reduced to the minimum.

Conclusions

The results of the present study indicated that in a cohort of community-dwelling men, a significant portion of the population had moderate-to-severe LUTS. While age was found to be positively correlated with IPSS, there were other factors which had contributed to the ultimate symptom complex. Like the objective parameters of uroflowmetry, degree of knowledge on prostatic diseases also shared a weak but statistically significant correlation with IPSS. As LUTS has become an important public health problem, every effort should be made to alleviate the situation. In the light that the knowledge on prostatic diseases would reduce symptom index, a new dimension for public health education in urology might have just been opened. Future research could enable resources to be targeted more efficiently to the most optimal health education program for the public.

Conflict of interest None.

Appendix

Prostatic Disease Knowledge Questionnaire

1. After the age of 70 years old, urinary frequency and nocturia are normal phenomena. It does not mean there is something wrong with the prostate, and no medical attention is needed.	True☐	False☐
2. If there is a benign prostatic enlargement, it will eventually lead to urinary retention. Earlier the surgery, better the outcome.	True☐	False☐
3. Benign prostatic enlargement and prostatic caner are two different conditions. Benign prostatic enlargement would not evolve into prostatic cancer.	True☐	False☐
4. Prostatic cancer is rare among Chinese. Therefore, there is no need to be aware of the condition.	True☐	False☐
5. Prostatic cancer only happens to people above 65 years old.	True☐	False☐
6. Once PSA level in the blood is higher than the normal range, prostatic cancer is confirmed.	True☐	False☐
7. Prostatic cancer is a slow growing disease. Less than 5% of the patients will die of the disease.	True☐	False☐
8. Early prostatic cancer can be asymptomatic.	True☐	False☐
9. For advanced prostatic cancer, usually hormonal treatment would be employed as first-line treatment instead of chemotherapy.	True☐	False☐
10. Advanced prostatic cancer always give severe bone pain.	True☐	False☐
11. There are a number of causes for prostatitis, but majority of them are not due to sexual intercourse.	True☐	False☐
12. Bacteria is the main cause for prostatitis. Antibiotics is necessary for treatment. Long-term antibiotics is needed if there is no improvement.	True☐	False☐

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