


BMJ Open Lower urinary tract symptoms and functional ability in older adults: a community-based cross-sectional study

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ABSTRACT

Objectives Functional ability, or the ability to live actively in older age, is essential for healthy ageing. This study assessed the association between the five types of lower urinary tract symptoms (LUTS) and functional ability among community-dwelling older adults (≥65 years old).

Design A cross-sectional study.

Setting Community-dwelling older adults (≥65 years old) randomly selected from the basic resident register of Kashiwa city as part of the Kashiwa study.

Participants The study included 916 community-dwelling older adults (481 male participants) in Japan.

Outcome measures A self-administered questionnaire was used to collect data regarding LUTS, which included frequency, nocturia, urgency, urinary incontinence and overactive bladder (OAB). Functional ability was measured using the Japan Science and Technology Agency Index of Competence. Sex-stratified logistic regression analyses were conducted, adjusting age, obesity, alcohol consumption, polypharmacy and comorbidities.

Results Male participants experienced symptoms of frequency, nocturia, urgency, urinary incontinence and OAB at rates of 68.0%, 89.0%, 16.0%, 3.7% and 4.3%, respectively. Female participants experienced these symptoms at rates of 68.3%, 80.0%, 11.0%, 7.4% and 8.5%, respectively. Among male participants, lower functional ability was only associated with nocturia (≥3 times/night) (adjusted OR (AOR): 1.71, 95% CI 1.05 to 2.79). Contrarily, lower functional ability among female participants was significantly associated with frequency (AOR: 1.61, 95% CI 1.04 to 2.49), urgency (AOR: 2.06, 95% CI 1.08 to 3.95) and OAB (AOR: 2.43, 95% CI 1.15 to 5.11).

Conclusion The different associations between LUTS and functional ability by sex might be related to differences in the effect of comorbidities and physical fatigue. Our results help clarify the multifaceted effects of LUTS in old age, the need for early detection and treatment of LUTS, and the importance of maintaining functional ability.

INTRODUCTION

The concept of ‘healthy ageing’ provides a different perspective regarding the quality of life (QOL) of older adults¹ and was defined by the WHO as ‘the process of developing and maintaining the functional ability that enables well-being in older age’.² Functional ability includes a person’s ability to fulfil their

Strengths and limitations of this study

- The study participants were selected from randomly recruited older adults in a city.
- Functional ability, an essential concept for healthy ageing, was measured using a comprehensive scale.
- Recall bias is undeniable because a self-administered questionnaire was used to measure lower urinary tract symptoms.
- A cross-sectional design precludes a conclusion regarding the causality of the relationship.

basic needs, learn, grow, make decisions, be mobile, build and maintain relationships and contribute to society. This perspective reframes older adults as individuals who can facilitate their healthy ageing rather than being passive receivers of support. Moreover, the maintenance of functional ability to achieve healthy ageing is becoming an important theme in countries with ageing populations.³

Lower urinary tract symptoms (LUTS) include problems with storage, voiding or post-micturition functions and are not limited to specific sexes, ages or regions.⁴ A study using the International Continence Society’s definitions estimated that 45.2% of the global population of individuals who are >20 years old have at least one LUTS.⁵ Furthermore, LUTS are more prevalent among older adults, with one international population-based study estimating that 80.7% of older men and 79.3% of older women (>60 years old) have at least one type of LUTS, such as nocturia.⁶ However, despite the high prevalence of LUTS, the consultation rate remains low.⁷ As global population ageing continues, the proportion of individuals suffering from LUTS might increase, especially among older adults.^{8,9}

The presence of LUTS can negatively affect individuals’ QOL,^{10,11} and storage-related symptoms (eg, nocturia, urgency or urinary

incontinence) have negative and significant detrimental effects on people's QOL.^{12 13} For example, nocturia (≥ 2 times/night) can lead to decreased QOL due to interrupted sleep,¹⁴ falls on the way to the toilet¹⁵ and fall-related fractures.¹⁶ Urinary incontinence also affects QOL, which is related to the severity, type and number of incontinent episodes.¹⁷ Moreover, QOL tends to decrease with age, suggesting that older adults face a double burden of increased LUTS and decreased QOL.

In recent years, studies have been conducted to clarify the association between LUTS and more complex abilities than activities of daily living (ADL). An American study analysed data from the National Health and Nutrition Examination Surveys and found a significant association between urinary incontinence and functional limitations, such as difficulty stooping, crouching or kneeling, in women in the community.¹⁸ In a longitudinal study of community-dwelling older men, the risk of onset of functional limitations (mobility, ADL and cognitive dysfunctions) 2 years later was examined in relation to the severity of LUTS. The results showed that the more severe the LUTS, the worse the mobility and ADL, but not cognitive dysfunction.¹⁹ In order to promote healthy ageing, it will be important to add the research considering the association between various types of LUTS and more complex abilities. Therefore, this study aimed to compare five types of LUTS with a comprehensively assessed functional ability in community-dwelling older adults.

MATERIAL AND METHODS

We used the Strengthening the Reporting of Observational Studies in Epidemiology cross-sectional reporting guidelines.²⁰

Participants

The study participants were selected from a community-based study in Kashiwa city, Japan (the Kashiwa study). The Kashiwa study evaluated 2044 community-dwelling older adults (≥ 65 years old) who were randomly selected from the basic resident register of Kashiwa city in 2012. Surveys were performed every 1–2 years, and the present study evaluated information on participants of the 2016 survey when questions regarding LUTS were introduced. A total of 1339 individuals who were not in long-term care participated in the 2016 survey. Among them, we excluded 423 individuals with cognitive dysfunction (Mini-Mental State Examination score of ≤ 23) to ensure the reliability of the data collected by the self-administered questionnaire, gait problems (whether they reported that they could walk without any help) to eliminate the effects of physical movement restrictions on functional ability and LUTS, or missing data regarding the main variables. Finally, the present study evaluated data from 916 participants (481 male participants and 435 female participants).

Functional ability

In this study, we evaluated functional ability using the Japan Science and Technology Agency Index of Competence

1. Can you use a mobile phone?
2. Can you use the ATM?
3. Can you operate a video recorder such as a Blu-ray recorder or DVD player?
4. Can you send an e-mail using a mobile phone or computer?
5. Are you interested in news and events from overseas?
6. Can you determine the credibility of health-related information?
7. Do you enjoy art, films, or music?
8. Do you watch educational/cultural programs?
9. Do you follow any measures to prevent yourself from becoming a victim of crimes.
10. Do you try to be creative while doing daily tasks (i.e., cleaning, cooking)?
11. Can you take care of an ill person?
12. Do you take care of your grandchildren, family members, or acquaintances?
13. Do you participate in regional festivals or events?
14. Do you participate in a neighborhood association or a residents' association?
15. Would you be able to assume a managerial position such as an organizer in a residents' association or group activities?
16. Do you engage in charity or volunteer activities?

Figure 1 The English version of the JST-IC. Scale developers translated the items from Japanese to English. The English version has not been validated. JST-IC, Japan Science and Technology Agency Index of Competence.

(JST-IC).^{21 22} The JST-IC is a validated scale to measure the level of overall competence to live actively in older age with 16 items regarding new device use, information collection, life management and social participation (figure 1). The original Japanese version of the JST-IC was used in the research. The scores range from 0 to 16, with higher scores indicating greater functional ability.

Lower urinary tract symptoms

To collect data on the five types of LUTS (frequency, nocturia, urgency, urinary incontinence and overactive bladder (OAB)), we used a self-administered questionnaire regarding the frequency of urination during the day and night, urgency and urinary incontinence. Frequency was defined as ≥ 8 urinations during the day, while nocturia was defined as ≥ 1 urination during the night. Urgency was defined as 'a compelling need to urinate, due to pain or an unpleasant sensation, that is difficult to defer',²³ and the number of urinary incontinent episodes was recorded. We also considered the presence of OAB, which is clinically important and prevalent among older adults, which we defined as the occurrence of urgency with frequency or nocturia.

Other variables

Based on previous studies regarding LUTS,^{24 25} the following variables were selected as possible confounding factors: age, obesity (body mass index (BMI) of ≥ 25 kg/m²), alcohol consumption (≥ 5 times/week),²⁶ polypharmacy (≥ 6 drugs/day)²⁷ and comorbidities (hypertension, heart disease, diabetes and dyslipidaemia).^{28–31}

Data analysis

Considering that the characteristics of LUTS differ depending on sex, the participants were stratified according to sex. The distribution of all variables, sex differences and the crude associations between the five types of LUTS and JST-IC were examined by univariate analysis. Since no clear cut-off value has been set for JST-IC, we initially planned to treat it as a continuous variable. However, we changed to treat it as a categorical

Table 1 Characteristics of participants

Characteristics		Total	Male participants	Female participants	P value
		n=916	n=481	n=435	
		n (%)	n (%)	n (%)	
Age (years)	Mean, SD	76.3, 5.1	76.5, 5.2	76.1, 5.0	
JST-IC	≥12	488 (53.3)	258 (53.6)	230 (52.9)	0.82
	<12	428 (46.7)	223 (46.4)	205 (47.1)	
Obesity*†	BMI≥25	199 (22.0)	121 (25.6)	78 (18.1)	0.01
	BMI<25	704 (78.0)	351 (74.4)	353 (81.9)	
Alcohol consumption†	≥5 times/week	250 (27.3)	213 (44.3)	37 (8.5)	<0.01
	<5 times/week	665 (72.7)	268 (55.7)	397 (91.5)	
Polypharmacy†	≥6 drugs/day	151 (16.6)	92 (19.2)	59 (13.7)	0.03
	<6 drugs/day	758 (83.4)	386 (80.8)	372 (86.3)	
Comorbidities					
Hypertension	Yes	407 (44.4)	238 (49.5)	169 (38.9)	<0.01
	No	509 (55.6)	243 (50.5)	266 (61.1)	
Heart disease	Yes	123 (13.4)	85 (17.7)	38 (8.7)	<0.01
	No	793 (86.6)	396 (82.3)	397 (91.3)	
Diabetes	Yes	101 (11.0)	68 (14.1)	33 (7.6)	<0.01
	No	815 (89.0)	413 (85.9)	402 (92.4)	
Dyslipidaemia	Yes	307 (33.5)	123 (25.6)	184 (42.3)	<0.01
	No	609 (66.5)	358 (74.4)	251 (57.7)	
LUTS					
Frequency	≥8 times/daytime	624 (68.1)	327 (68.0)	297 (68.3)	0.92
Nocturia	≥1 time/night	776 (84.7)	428 (89.0)	348 (80.0)	<0.01
	≥2 times/night	419 (45.7)	267 (55.5)	152 (34.9)	<0.01
	≥3 times/night	136 (14.8)	99 (20.6)	37 (8.5)	<0.01
Urgency	≥1 time/day	125 (13.6)	77 (16.0)	48 (11.0)	0.03
Urinary incontinence	≥1 time/day	50 (5.5)	18 (3.7)	32 (7.4)	0.02
OAB		106 (11.6)	69 (14.3)	37 (8.5)	<0.01

*Obesity was defined according to the Japanese guideline.³⁸

†Missing cases: 13 in obesity, 1 in alcohol consumption and 7 in polypharmacy.

BMI, body mass index; JST-IC, Japan Science and Technology Agency Index of Competence; LUTS, lower urinary tract symptom; OAB, overactive bladder (frequency and nocturia (≥1) and urgency).

variable using the median (=12) for the multivariate analyses due to the collected data that was not normally distributed (Shapiro-Wilk test, $p < 0.05$). To determine the association of each LUTS with functional ability by sex, logistic regression analyses predicting lower JST-IC were run with the following independent variables: each LUTS (frequency, nocturia (1 time/night, 2 times/night or ≥3 times per night), urgency, urinary incontinence or OAB), age, obesity, alcohol intake, polypharmacy and comorbidities (hypertension, heart disease, diabetes and dyslipidaemia). As the dependent variable of the logistic regression analyses, the binary variable of JST-IC in which the high and low scores were reversed was used. All statistical analyses were performed using SPSS Statistics for

Windows, V.27.0, and differences were considered statistically significant at p values of < 0.05 .

Patients and public involvement

The participants were not involved in the design, conduct, reporting or dissemination plans of our research. However, the study results will be available to the participants and the public through the open-access journal article.

RESULTS

Table 1 lists the participants' characteristics stratified by sex. Male participants had significantly higher proportions

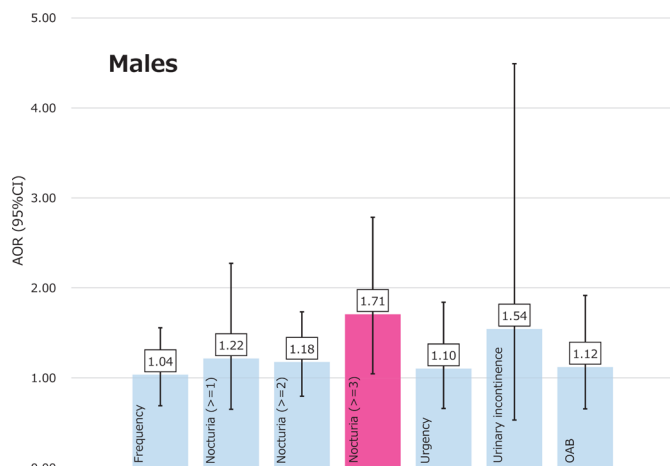


Figure 2 Results of the logistic regression analyses predicted lower functional ability with various types of LUTS in older male participants (n=468). The JST-IC was used as a binary dependent variable in which the high and low scores were reversed. In each analysis, age, obesity, alcohol consumption, polypharmacy and comorbidities were adjusted. AOR, adjusted OR; JST-IC, Japan Science and Technology Agency Index of Competence; LUTS, lower urinary tract symptoms; OAB, overactive bladder.

of obesity, alcohol consumption, polypharmacy, comorbidities (hypertension, heart disease and diabetes) and three types of LUTS (nocturia, urgency and OAB). On the other hand, female participants had significantly higher proportions of dyslipidaemia and urinary incontinence. Crude associations between each LUTS and the total score of JST-IC or its four components (new device use, information collection, life management and social participation) are listed in online supplemental tables.

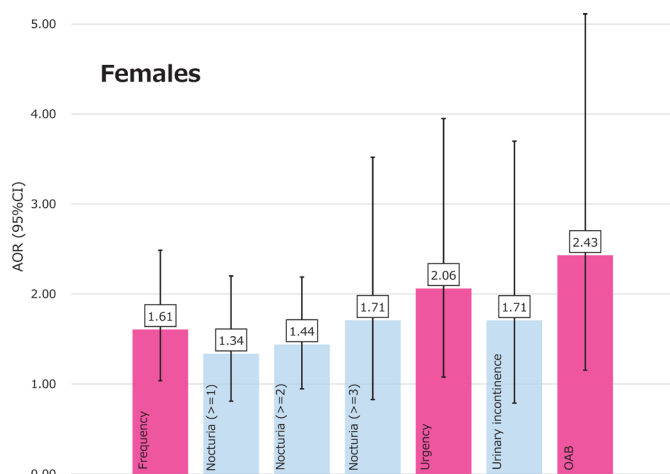


Figure 3 Results of the logistic regression analyses predicted lower functional ability with various types of LUTS in older female participants (n=424). The JST-IC was used as a binary dependent variable in which the high and low scores were reversed. In each analysis, age, obesity, alcohol consumption, polypharmacy and comorbidities were adjusted. AOR, adjusted OR; JST-IC, Japan Science and Technology Agency Index of Competence; LUTS, lower urinary tract symptoms; OAB, overactive bladder.

Figures 2 and 3 show the results of the logistic regression analyses to determine the association of each LUTS type with lower functional ability after adjustment for age, obesity, alcohol consumption, polypharmacy and comorbidities. Among male participants, lower functional ability was significantly associated with nocturia (≥ 3 times/night) only (adjusted OR (AOR): 1.71, 95% CI 1.05 to 2.79). Contrarily, lower functional ability among female participants was significantly associated with frequency (AOR: 1.61, 95% CI 1.04 to 2.49), urgency (AOR: 2.06, 95% CI 1.08 to 3.95) and OAB (AOR: 2.43, 95% CI 1.15 to 5.11).

DISCUSSION

The results indicated that nocturia (≥ 3 times/night) was significantly associated with lower functional ability among male participants; it was significantly associated with frequency, urgency and OAB among female participants. Thus, the association of LUTS with functional ability may vary according to sex.

Nocturia was more prevalent and influential in male participants than in female participants. One of the reasons for this may be the influence of comorbidities. Male participants were more likely to have hypertension, heart disease and diabetes, which are known as risk factors for nocturia.^{28–30} It is possible that these comorbidities increase nighttime urination and, at the same time, have a negative impact on various daytime activities. In addition, it is necessary to consider the effects of polypharmacy.³² As shown in table 1, male participants were taking more drugs than female participants. In recent years, it is known that an increase in the number of medications taken by older adults leads to adverse events.³³ Taking high doses of drugs for the treatment of comorbidities may lead to polypharmacy and reduce functional ability. Another possibility is that alcohol intake has an effect. It is known that even a small amount of alcohol has an adverse effect on health.³⁴ In this study, male participants consumed more alcohol, which may have a negative impact on the health that underpins functional ability. Thus, the effect of nocturia may be judged to be more serious among male participants.

Lower functional ability was significantly associated with frequency, urgency and OAB only among female participants. This could be explained by the physical differences between male participants and female participants. As shown in table 1, female participants had a lower BMI. Weight loss and fatigue in old age are strongly associated with each other and even cause frailty.³⁵ Toileting is a complex physical activity,³⁶ and frequent toileting requires more physical strength and endurance. Older female participants with lower weight could be more likely to have physical fatigue due to frequent toileting, and it could lead to lower functional ability.³⁷

The present study had several limitations. First, recall bias is undeniable because a self-administered questionnaire was used to measure the frequency of urination,

urgency and urinary incontinence. However, we aimed to minimise the possibility of underestimation or overestimation by double-checking the responses with the participants when the questionnaires were collected. Second, the relatively small sample size could have affected the results, and the cross-sectional design precludes a conclusion regarding the causality of the relationship between LUTS and competence. A well-designed prospective study with a larger sample size is needed to deeply evaluate the causality of this relationship and the related mechanism(s).

This study examined the association between five types of LUTS and functional ability for healthy ageing. Among male participants, lower functional ability was associated with nocturia (≥ 3 times/night) only, while it was associated with frequency, urgency and OAB among female participants. These sex-based differences may be due to the sex-related difference in the effect of comorbidities and physical fatigue. Our results help clarify the multifaceted effects of LUTS in old age, the need for early detection and treatment of LUTS, and the importance of maintaining functional ability.

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Contributors KT conceptualised the study, analysed and interpreted the data and wrote the first draft of the manuscript. KT, TT, YY, MF-S-S and KI collected the data. TT, YY, MF-S-S, B-KS and KI have given critical feedback. All authors contributed to reviewing and editing the manuscript. KT accepts full responsibility for the finished article as guarantor, had access to any data, and controlled the decision to publish.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. The study protocol was approved by the ethics committee of the University of Tokyo (approval numbers: 12-8 and 18-166). Participants gave informed consent to participate in the Kashiwa study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request.

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REFERENCES

- 1 Michel J-P, Sadana R. "Healthy Aging" Concepts and Measures. *J Am Med Dir Assoc* 2017;18:460–4.
- 2 World Health Organization. Ageing and life-course, 2020. Available: <https://www.who.int/ageing/healthy-ageing/en/> [Accessed 06 Aug 2020].
- 3 Friedman SM, Mulhausen P, Cleveland ML, et al. Healthy aging: American geriatrics Society white paper executive summary. *J Am Geriatr Soc* 2019;67:17–20.
- 4 Abrams P, Cardozo L, Wagg A. *Incontinence*. 6th ed. International Continence Society, 2017.
- 5 Irwin DE, Kopp ZS, Agatep B, et al. Worldwide prevalence estimates of lower urinary tract symptoms, overactive bladder, urinary incontinence and bladder outlet obstruction. *BJU Int* 2011;108:1132–8.
- 6 Irwin DE, Milsom I, Hunskaar S, et al. Population-based survey of urinary incontinence, overactive bladder, and other lower urinary tract symptoms in five countries: results of the EPIC study. *Eur Urol* 2006;50:1306–15.
- 7 Mourad S, Shokeir A, Ayoub N, et al. Prevalence and impact of lower urinary tract symptoms: results of the EPIC survey in Egypt. *NeuroUrol Urodyn* 2019;38:637–43.
- 8 Vahabi B, Wagg AS, Rosier PFWM, et al. Can we define and characterize the aging lower urinary tract?—ICI-RS 2015. *NeuroUrol Urodyn* 2017;36:854–8.
- 9 Camões J, Coelho A, Castro-Diaz D, et al. Lower urinary tract symptoms and aging: the impact of chronic bladder ischemia on overactive bladder syndrome. *Urol Int* 2015;95:373–9.
- 10 Coyne KS, Sexton CC, Irwin DE, et al. The impact of overactive bladder, incontinence and other lower urinary tract symptoms on quality of life, work productivity, sexuality and emotional well-being in men and women: results from the EPIC study. *BJU Int* 2008;101:1388–95.
- 11 Soler R, Averbek MA, Koyama MAH, et al. Impact of LUTS on treatment-related behaviors and quality of life: a population-based study in Brazil. *NeuroUrol Urodyn* 2019;38:1579–87.
- 12 Kupelian V, Wei JT, O'Leary MP, et al. Nocturia and quality of life: results from the Boston area community health survey. *Eur Urol* 2012;61:78–84.
- 13 Minassian VA, Sun H, Yan XS, et al. The interaction of stress and urgency urinary incontinence and its effect on quality of life. *Int Urogynecol J* 2015;26:269–76.
- 14 Van Kerrebroeck PEV, Dmochowski R, FitzGerald MP, et al. Nocturia research: current status and future perspectives. *NeuroUrol Urodyn* 2010;29:623–8.
- 15 Decalf V, Bower W, Rose G, et al. Prevalence and characteristics of incident falls related to nocturnal toileting in hospitalized patients. *Acta Clin Belg* 2021;76:1–6.
- 16 Nakagawa H, Niu K, Hozawa A, et al. Impact of nocturia on bone fracture and mortality in older individuals: a Japanese longitudinal cohort study. *J Urol* 2010;184:1413–8.
- 17 Kwon BE, Kim GY, Son YJ, et al. Quality of life of women with urinary incontinence: a systematic literature review. *Int NeuroUrol J* 2010;14:133–8.
- 18 Greer JA, Xu R, Propert KJ, et al. Urinary incontinence and disability in community-dwelling women: a cross-sectional study. *NeuroUrol Urodyn* 2015;34:539–43.
- 19 Bauer SR, Cawthon PM, Ensrud KE, et al. Lower urinary tract symptoms and incident functional limitations among older community-dwelling men. *J Am Geriatr Soc* 2022;70:1082–94.
- 20 von Elm E, Altman DG, Egger M, et al. The strengthening of reporting of observational studies in epidemiology (STROBE) statement. *Epidemiology* 2007;18:800–4.
- 21 Iwasa H, Masui Y, Inagaki H, et al. Development of the Japan science and technology agency index of competence to assess functional capacity in older adults: conceptual definitions and preliminary items. *Gerontol Geriatr Med* 2015;1:2333721415609490.
- 22 Iwasa H, Masui Y, Inagaki H, et al. Assessing competence at a higher level among older adults: development of the Japan science and technology agency index of competence (JST-IC). *Aging Clin Exp Res* 2018;30:383–93.
- 23 International Continence Society. Ics glossary, 2021. Available: <https://www.ics.org/glossary> [Accessed 08 Mar 2020].
- 24 Coyne KS, Kaplan SA, Chapple CR, et al. Risk factors and comorbid conditions associated with lower urinary tract symptoms: EpiLUTS. *BJU Int* 2009;103 Suppl 3:24–32.
- 25 Madhu C, Coyne K, Hashim H, et al. Nocturia: risk factors and associated comorbidities; findings from the EpiLUTS study. *Int J Clin Pract* 2015;69:1508–16.



- 26 Oh M-J, Eom C-S, Lee H-J, *et al.* Alcohol consumption shows a J-shaped association with lower urinary tract symptoms in the general screening population. *J Urol* 2012;187:1312–7.
- 27 Talasz H, Lechleitner M. Polypharmacy and incontinence. *Z Gerontol Geriatr* 2012;45:464–7.
- 28 Hwang EC, Kim S-O, Nam D-H, *et al.* Men with hypertension are more likely to have severe lower urinary tract symptoms and large prostate volume. *Low Urin Tract Symptoms* 2015;7:32–6.
- 29 Gacci M, Corona G, Sebastianelli A, *et al.* Male lower urinary tract symptoms and cardiovascular events: a systematic review and meta-analysis. *Eur Urol* 2016;70:788–96.
- 30 Smith DB. Urinary incontinence and diabetes: a review. *J Wound Ostomy Continence Nurs* 2006;33:619–23.
- 31 Barbosa JABA, Muracca E, Nakano E, *et al.* Risk factors for male lower urinary tract symptoms: the role of metabolic syndrome and androgenetic alopecia in a Latin American population. *Urology* 2013;82:182–8.
- 32 Suvada K, Plantinga L, Vaughan CP, *et al.* Comorbidities, age, and polypharmacy limit the use by US older adults with nocturia of the only FDA-approved drugs for the symptom. *Clin Ther* 2020;42:e259–74.
- 33 Davies LE, Spiers G, Kingston A, *et al.* Adverse outcomes of polypharmacy in older people: systematic review of reviews. *J Am Med Dir Assoc* 2020;21:181–7.
- 34 Zaitsu M, Takeuchi T, Kobayashi Y, *et al.* Light to moderate amount of lifetime alcohol consumption and risk of cancer in Japan. *Cancer* 2020;126:1031–40.
- 35 Fried LP, Tangen CM, Walston J, *et al.* Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001;56:M146–57.
- 36 World Health Organization. *International classification of functioning, disability and health*. World Health Organization, 2001.
- 37 Deffieux X, Hubeaux K, Dick J, *et al.* Urine leakage related to physical fatigue in women with urinary stress incontinence. *J Obstet Gynaecol Res* 2009;35:738–45.
- 38 Japanese Society for the Study of Obesity. *Guidelines for the management of obesity disease (in Japanese)*, 2016.