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Gait speed and overactive bladder in the healthy community-dwelling super elderly—The Sukagawa Study

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ABSTRACT

Aim

To assess the association of muscle mass, grip strength, and gait speed with overactive bladder (OAB) in community-dwelling elderly adults.

Methods

This cross-sectional study was based on data collected from 350 Japanese healthy community-dwelling elderly individuals aged ≥75 years from the Sukagawa Study. Muscle mass (kg) was measured by bioelectrical impedance, whereas grip strength (kg) and gait speed (m/s) were measured by performance testing. Muscle mass and grip strength were corrected for body mass index (BMI). The primary outcome was the presence of OAB, evaluated using the OAB symptom score.

Results

Of 314 participants analyzed, 146 (47%) were men, and 88 (28%) presented OAB. The mean (standard deviation [SD]) BMI, muscle mass, grip strength, and gait speed were 23.2 (3.2) kg/m^2, 38.4 (7.5) kg, 26.6 (8.1) kg, and 1.2 (0.2) m/s, respectively. Multivariable logistic regression analysis revealed that slower gait speed was associated with a greater likelihood of OAB (adjusted odds ratio [aOR] per -1 SD, 1.47; 95% confidence interval [CI], 1.11–1.95). No significant associations between muscle mass or grip strength and OAB were noted (aOR per -1 SD, 0.75, 1.03; 95% CI, 0.41–1.37, 0.62–1.72, respectively). Slower gait speed was also associated with higher likelihood of urgency and urgency incontinence (aOR per -1 SD, 1.35, 1.40; 95% CI, 1.04–1.74, 1.06–1.84, respectively).

Conclusions

In the healthy community-dwelling elderly, gait speed was associated with OAB, including urgency and urgency incontinence. Our findings may provide a new framework for OAB management with respect to functional mobility.

Keywords

body mass index, frailty, grip strength, muscle mass, urgency, urinary incontinence

1 INTRODUCTION

The chronic syndrome of overactive bladder (OAB) is characterized by urgency, with or without urgency incontinence, usually with increased frequency and nocturia.[1] OAB is an age-related, but complex and multifactorial condition suggesting abnormal vesical muscular contractions and/or an afferent sensory disorder. The symptoms are associated with a patient's decreased sexual, physical, psychological, and social activities; poorer quality of life; and significant economic burdens of over $80 bn/year in the USA alone.[2,3]

Frailty is also a major global health burden, especially in a super-aging society. It is defined as a clinical state of high vulnerability in physical, psychological, and/or social function toward the development of negative health outcomes, such as disability, hospitalization, institutionalization, and death.[4] In recent years, associations of frailty indicators with urinary incontinence (UI) have been studied intensively in older individuals,[5] and it has been suggested that physical frailty might be a predictor of incidence of UI.[6,7] OAB is known as the most common cause of UI, specifically urgency or mixed UI. A previous population-based study showed progression from OAB alone to OAB with UI in 28% of women analyzed during the study follow-up.[8] Given these results, we hypothesized that physical frailty is also associated with OAB.

Thus far, only one observational study, which used the Timed Up and Go Test (TUGT) as a frailty indicator, evaluated the association between physical frailty and OAB in patients.[9,10] Nevertheless, in that study, OAB was defined not by either a questionnaire or bladder diary but by ICD codes. Furthermore, body weight, muscle mass, and strength were not investigated despite being major components for determining the state of physical frailty. Both overweight/obesity and underweight were reported to be associated with OAB.[11,12] Additionally, body muscle mass and strength might be associated with pelvic floor muscle strength and, therefore, with bladder function. Hence, we conducted a cross-sectional study to evaluate the association of physical frailty with OAB in older individuals by using a validated questionnaire for OAB and measuring body mass index (BMI), muscle mass, grip strength, and gait speed.

2 MATERIALS AND METHODS

2.1 Study setting and participants

The Sukagawa Study is a prospective community-dwelling cohort study conducted in Sukagawa City, which is located in the central part of Fukushima Prefecture in Japan. The cohort study evaluated the factors influencing health-related quality of life, physical and psychological disability, nursing care requirements, and costs of medical and nursing care among very elderly people. Detailed information regarding the study setting has been described previously.[13] Briefly, we recruited residents who were independent in terms of activities of daily living. Individuals were invited to participate in the health check-up and survey used in this study by the local government of Sukagawa City. For the present cross-sectional study, we used data from 350 participants collected in 2017. We obtained written informed consent from all participants. The Internal Ethics Review Board approved this study and its protocols, which were performed in accordance with the tenets of the Declaration of Helsinki.

2.2 Participants

Eligible participants were aged ≥75 years and those who participated in the health check-up and survey conducted by Sukagawa City. Participants with dementia (defined by scores ≤23 points on the Mini-Mental State Examination [MMSE]) were excluded from the analysis because of potential underreporting of self-reported outcomes.

2.3 Measurement of body mass index, muscle mass, grip strength, and gait speed

Weight in kilograms (kg) and standing height to the nearest millimeter were measured to calculate BMI in kg/m^2. BMI was stratified into three categories as follows: underweight (<18.5), normal weight (range 18.5 to <25), and overweight (≥25). Whole body muscle mass was measured in kg with a bioelectrical impedance analyzer Tanita MC780A (Tanita Corporation, Tokyo, Japan). Maximum grip strength was measured in kg using handheld dynamometers. Two attempts were performed for each hand and the strongest data of the attempt performed on the strongest hand was used for the analyses. Muscle mass and grip strength were corrected for BMI (namely, divided by BMI).[14] Gait speed was measured in meters/second (m/s) over a distance of 10 m using a stopwatch, for which each individual was asked to walk at his or her usual speed.

2.4 Outcomes

The primary outcome was the presence of OAB evaluated using the overactive bladder symptom score (OABSS) validated by Homma et al (see Supporting Table S1).[15] The OABSS is a four-item questionnaire used to evaluate daytime frequency, nocturia, urgency, and urgency incontinence, and the secondary outcome was the presence of each of these four symptoms. The total score was the simple sum of the four symptom scores (range, 0–15). Individuals with an urgency score of ≥2 and sum score of ≥3, which is equivalent to the lower limit for OAB symptoms that are regarded as pathological (i.e., "the daily urination frequency of eight times or more, and urgency of once a week or more"), were considered to have OAB.[15,16] A higher score indicated increased severity of OAB, and the severity was further divided into mild (total score of 3–5 points), moderate (6–11 points), and severe (12 or more points).[16] In this study, individuals with a score of ≥1 for each item were considered to have each symptom.

2.5 Statistical analysis

Participants were divided into the following three categories based on the presence/absence and severity of OAB: non-OAB, mild OAB, and moderate-to-severe OAB. Baseline characteristics are presented using standard descriptive statistics: means (standard deviation [SD]) for continuous variables and number and percentages for categorical variables. The Kruskal-Wallis test was performed for continuous variables, whereas the Fisher's exact test was used for categorical variables. Odds ratios (ORs) and 95% confidence intervals (CIs) for the likelihood of having OAB, and the four symptoms were estimated using logistic regression models. In multivariable logistic regression models including BMI categories (underweight, normal weight, and overweight), muscle mass (corrected for BMI), grip strength (corrected for BMI), and gait speed as covariates, were adjusted for the following clinically important confounding factors related to both exposure (BMI, muscle mass, grip strength, and gait speed) and outcome (OAB and individual symptoms): age; sex; history of diabetes mellitus, hypertension, stroke, depression, and smoking; and drinking habits (identified using a self-administered questionnaire). We further used uni- and multivariable ordered logistic regression models to evaluate the associations of BMI, muscle mass, grip strength, and gait speed with OAB severity as an ordinal variable.

Participants with complete data on exposure and outcome variables and other above-mentioned covariates were included in the primary analyses. A *P*-value of < 0.05 was considered statistically significant. Statistical analyses were conducted using STATA version 14

(Stata Corp LP, College Station, TX, USA).

3 RESULTS

3.1 Baseline characteristics

A total of 350 residents participated in the health check-up. After excluding 17 participants with missing data and 19 with dementia, 314 participants were included in the primary analyses (Figure 1).

Baseline characteristics of participants are summarized in Table 1. The mean (SD) age of participants was 80.1 (3.4) years. Of the 314 participants analyzed, 146 (47%) were men and 88 (28%) had OAB. Of the participants with OAB, 57 (18%) were categorized as having moderate-to-severe OAB. Overall, the mean (SD) muscle mass corrected for BMI, grip strength corrected for BMI, and gait speed were 1.7 (0.3), 1.2 (0.4), and 1.2 (0.2), respectively. The mean (SD) BMI was 23.2 (3.2), and 25 (8%) and 81 (16%) participants were classified as underweight and overweight, respectively. Among the four OAB symptoms, nocturia was the most prevalent (86%).

3.2 Primary outcome

In the crude analyses of BMI, muscle mass, grip strength, and gait speed, only gait speed was associated with a likelihood of having OAB (OR per -1 SD, 1.47; 95% CI, 1.15–1.89) (Table 2).

After adjustment for age; sex; history of diabetes mellitus, hypertension, stroke, depression, and smoking; and drinking habits, slower gait speed was associated with a greater likelihood of OAB (adjusted OR [aOR] per -1 SD, 1.47; 95% CI, 1.11–1.95) as well as overweight status (aOR, 2.15; 95% CI, 1.13–4.11), whereas there were no significant associations between either muscle mass or grip strength and OAB (aOR per -1 SD, 0.75 and 1.03; 95% CI, 0.41–1.37 and 0.62–1.72, respectively).

3.3 Secondary outcomes

In both crude and multivariable analyses, no significant associations of BMI, muscle mass, grip strength, and gait speed with daytime frequency were observed (Table 3). Muscle mass and grip strength were associated with a likelihood of having nocturia in the crude analyses (OR per -1 SD, 0.58 and 0.67; 95% CI, 0.41–0.82 and 0.47–0.94, respectively); however, such associations did not remain statistically significant after adjustment for all covariates (aOR per -1 SD, 0.64 and 1.46; 95% CI, 0.27–1.52 and 0.68–3.11, respectively). In the crude analyses, slower gait speed was associated with a greater likelihood of having urgency and urgency incontinence (OR per -1 SD, 1.27 and 1.38; 95% CI, 1.01–1.59 and 1.08–1.77, respectively), and these associations remained significant even after adjustment for all covariates (aOR per -1 SD, 1.35 and 1.40; 95% CI, 1.04–1.74 and 1.06–1.84, respectively).

3.4 Overactive bladder severity

In the multivariable ordered logistic regression analysis, we confirmed that slower gait speed was associated with a greater likelihood of more severe OAB (aOR per -1 SD, 1.50; 95% CI, 1.14–1.96) as well as overweight status (aOR, 1.89; 95% CI, 1.01–3.53) (Table 4).

4 DISCUSSION

This cross-sectional study was conducted to evaluate the associations of BMI, muscle mass, grip strength, and gait speed with the prevalence of OAB in community-dwelling elderly adults aged ≥75 years. Overweight status and slower gait speed, but not muscle mass or grip strength, were significantly associated with a greater likelihood of exhibiting OAB following adjustment for potential confounders including age; sex; history of diabetes mellitus, hypertension, stroke, depression, and smoking; and drinking habits. Only slower gait speed was also associated with a greater likelihood of having urgency and urgency incontinence. Moreover, for OAB severity, we confirmed significant associations of overweight and slower gate speed with an increased likelihood of having more severe OAB.

Data on body composition and physical performance retrieved in this study (Table 1) were very similar to those reported in a previous Japanese study involving a large number of community-dwelling older adults (>10,000 participants) whose mean age was 73.6 years.[17] According to the same study, both grip strength and gait speed declined with age. Given the fact that our participants were much older than those included in the previous study, it may be considered that our study participants were healthier than the majority of community-dwelling elderly adults in Japan. Moreover, the mean gait speed of our participants was comparable or superior to those reported previously in studies conducted among community-dwellers in other countries, although the walking distance analyzed in our study differed from those studies.[7,18]

As mentioned above, only one previous observational study has evaluated the association between a physical frailty indicator and OAB. In this previous study, frailty was measured by TUGT, and a slow TUGT exhibited a significant association with a diagnosis of OAB in patients who presented to an academic urology practice, although the authors did not investigate BMI, muscle mass, or strength.[10] Specifically for BMI, many previous studies have demonstrated the importance of overweight and obesity as risk factors of OAB,[11] and our results also support these findings. Several studies have further assessed the effectiveness of bariatric surgery on OAB and have shown postoperative improvement in symptoms among obese patients.[19,20] Based on these findings, overweight and obesity are important factors that could affect associations between TUGT and OAB. In another previous study assessing the relationships between physical limitations connected to mobility and the different types of UI—but not OAB—among community-dwelling older women, gait speed was associated with both urgency and mixed UI, but not with stress UI after adjusting for age, BMI, and the institution.[21] Our findings were in agreement with the latter study. The authors further hypothesized that impaired mobility may increase the risk of urine leakage because individuals with impaired mobility take longer to reach the lavatory when the urge to urinate is strong or that urgency UI is associated with higher risks of falling and hip fracture, which can lead to fewer opportunities for physical activity and therefore, reduced physical strength.

The above explanations are conceivable, but our findings provide a new framework for a better understanding of the etiology of the complex symptoms of OAB. First, in our study, gait speed was associated not only with urgency UI but also with urgency itself and OAB, which suggest that requiring longer times to reach the lavatory due to impaired mobility could cause a "fear of leakage" with or without any actual leakage. There is a consensus that the fear of leakage is an important and non-negligible factor of urgency among OAB patients, which may be overlooked under the current OAB definition of "a sudden compelling desire to void, which is difficult to defer."[22] Urgency is a symptom that is subjective and therefore, easily affected by an individual's beliefs and sensations. Second, it is rather difficult to believe that slower gait speed is related to urgency or OAB because of reduced physical activity and strength, at least in the present study, since our study participants were relatively healthy and independent. In fact, significant associations of gait speed with both urgency and OAB were observed independently of muscle mass and strength.

Taken together, another possible explanation for the observed associations is that bladder and gait control are regulated through a common physiological pathway. Both bladder function and gait are controlled by complex cognitive and sensory processes involving various components and levels of the nervous system. An interesting previous study revealed that gait speed and rhythmicity differed even in the same individual with or without a strong desire to void among healthy continent women.[23] This finding suggests a possible interaction between the complex nervous systems controlling bladder and gait, and supports our hypothesis. Furthermore, OAB is a well-known risk factor of falls in older age.[21,22] Nevertheless, the underlying pathophysiology of OAB is not fully understood and might be quite different in individuals among the super elderly, because different forms of functional deterioration, age-related changes, diseases, and injuries involving this complex nervous system could influence bladder and gait dysfunction simultaneously, even in the healthier population.[24]

In terms of BMI, evidence regarding an association between underweight and OAB is scarce, unlike those between overweight or obesity and OAB. A Korean population-based study involving a notable number of adult men (>90,000 participants) revealed that underweight, but not overweight status, was associated with a greater likelihood of having OAB following adjustment for potential confounders.[12] In our study, the point estimate in aOR of underweight status (vs. normal weight) for the likelihood of having OAB was also >1, although it was not statistically significant possibly due to the small number of underweight participants in the study.

Our findings are very important because they offer new perspectives for the assessment and management of OAB, which are particularly prevalent and relevant in older people. Our results suggest that functional mobility and OAB should not be considered separate entities not only in frail elderly individuals, but also in healthy elderly adults. Further longitudinal studies are warranted to examine the significance of slow gait speed as a predictor of new incidence of OAB; thus, we will investigate this possible association longitudinally in a future Sukagawa Study. In the clinical setting, clinicians should also pay greater attention to functional mobility in the treatment of OAB patients. Our findings also underline the importance of the potential development of new and effective lifestyle interventions for OAB, as both overweight and slower gait speed are modifiable factors through lifestyle changes; however causal relationships remain undefined by the current cross-sectional study design. Neurophysiological investigations focusing on the nervous system related to bladder and gait function could be helpful to confirm our findings and elucidate the underlying mechanisms.

This study has several limitations. First, we analyzed healthy community-dwelling elderly adults, which might have resulted in underestimation of the associations of poor physical performance measure with OAB; hence, the generalizability of our results is limited. Second, given that the definition of OAB used in this study was based on the criteria defined by the Japanese Urological Association,[16] the presence of other urological disorders such as urinary tract infections or cancer could not be ruled out. Moreover, OAB symptoms could be affected by lifestyle, medication, and benign prostatic hyperplasia in men, which were not measured in this study. Third, we may have missed nonlinear associations between gait speed and OAB, because we used gait speed as a continuous variable. There is, however, no clinically meaningful cutoff value of gait speed for healthy subjects.

Our study also has several strengths. First, the proportion of participants with missing data on relevant variables was quite small (<5%), given the thorough data collection by well-trained staff. Second, we adjusted for the relevant confounding factors that could affect associations between BMI, muscle mass and strength, gait speed, and OAB. Third, we excluded people with an MMSE score of ≤23. Although the OABSS has been psychometrically validated and has demonstrated reliability, discriminant validity, and responsiveness among patients with OAB including the elderly, the score is calculated based on self-reports and therefore, could be strongly affected by cognitive function. Finally, our study participants were not patients but community-dwellers. It is well demonstrated that most individuals with OAB symptoms are likely to hesitate to seek medical treatment[25]; thus, targeting only those who are treated for OAB in the hospital is insufficient when evaluating the association between clinical factors and OAB. The prevalence of OAB in this study was similar to that reported in other population-based studies.[2,10,12]

5 CONCLUSION

Among healthy community-dwelling elderly individuals aged ≥75 years, slower gait speed and overweight status, but not muscle mass or grip strength, were associated with a greater likelihood of exhibiting OAB. Gait speed was also associated not only with urgency incontinence but also with urgency. Furthermore, slower gait speed and overweight status were associated with a greater likelihood of having more severe OAB. Our findings could provide a novel framework for preventing and managing OAB.

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest.

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Figure Legends

Figure 1. Flowchart of the study participants.

Figure 1.

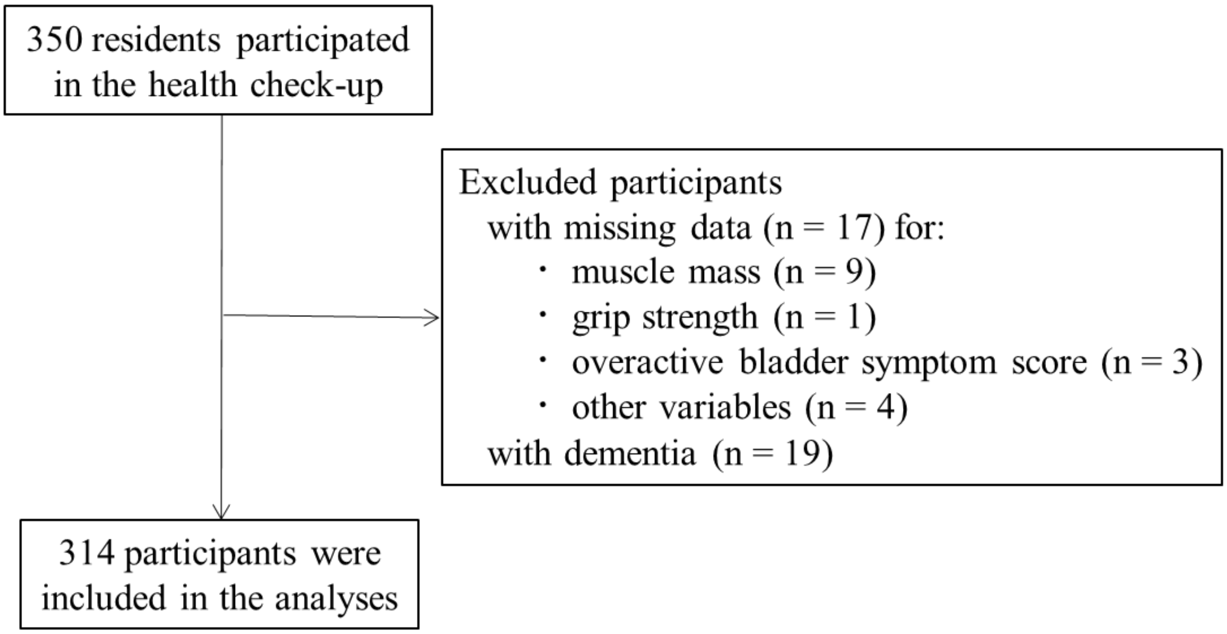
350 residents participated in the health check-up
Excluded participants
with missing data (n = 17) for:
・ muscle mass (n = 9)
・ grip strength (n = 1)
・ overactive bladder symptom score (n = 3)
・ other variables (n = 4)
with dementia (n = 19)
314 participants were included in the analyses

Table 1. Baseline characteristics of the participants

	Total (n=314)	Non-OAB (n=226)	OAB (n=88)		P-value
			Mild OAB (n=31)	Moderate-to-severe OAB (n=57)	
Age, years	80.1 (3.4)	79.8 (3.2)	81.4 (3.7)	80.6 (3.6)	0.016
Male sex, n (%)	146 (46.5)	100 (44.3)	15 (48.4)	31 (54.4)	0.36
BMI, kg/m2	23.2 (3.2)	23.1 (3.0)	23.5 (3.3)	23.4 (4.1)	0.78
Underweight, n (%)	25 (8.0)	17 (7.5)	3 (9.7)	5 (8.8)	
Normal weight, n (%)	208 (66.2)	157 (69.5)	18 (58.1)	33 (57.9)	
Overweight, n (%)	81 (25.8)	52 (23.0)	10 (32.3)	19 (33.3)	
Muscle mass, kg	38.4 (7.5)	38.1 (7.4)	39.8 (8.5)	38.8 (7.5)	0.48
Muscle mass corrected for BMI	1.7 (0.3)	1.7 (0.3)	1.7 (0.3)	1.7 (0.3)	0.68
Grip strength, kg	26.6 (8.1)	26.4 (8.2)	26.7 (8.1)	27.3 (7.8)	0.68
Grip strength corrected for BMI	1.2 (0.4)	1.2 (0.4)	1.1 (0.3)	1.2 (0.4)	0.81
Gait speed, m/s	1.2 (0.2)	1.2 (0.2)	1.2 (0.2)	1.1 (0.3)	0.005
Diabetes, n (%)	46 (14.6)	35 (15.5)	2 (6.5)	9 (15.8)	
Hypertension, n (%)	170 (54.1)	126 (55.8)	14 (45.2)	30 (52.6)	
Stroke, n (%)	11 (3.5)	8 (3.5)	0	3 (5.3)	
Depression, n (%)	6 (1.9)	5 (2.2)	1 (3.2)	0	
Smoking, n (%)	118 (37.6)	81 (35.8)	12 (38.7)	25 (43.9)	
Drinking, n (%)	107 (34.1)	76 (33.6)	10 (32.3)	21 (36.8)	
Mini-Mental State Examination	28.7 (1.7)	28.9 (1.6)	28.2 (2.2)	28.4 (1.9)	0.22
OABSS total score	3.6 (2.8)	2.2 (1.3)	4.5 (0.7)	8.6 (1.9)	0.0001
Daytime frequency, n (%)	174 (55.4)	116 (51.3)	12 (38.7)	46 (80.7)	

Nocturia, n (%)	270 (86.0)	187 (82.7)	28 (90.3)	55 (96.5)
Urgency, n (%)	141 (44.9)	53 (23.5)	31 (100)	57 (100)
Urgency incontinence, n (%)	91 (29.0)	30 (13.3)	11 (35.5)	50 (87.7)

Continuous variables are presented as mean (standard deviation), whereas categorical variables are presented as number (percentage).
Individuals with a score of ≥1 for each item of the OABSS were considered to have each symptom of daytime frequency, nocturia, urgency, and urgency incontinence.
BMI, body mass index; OAB, overactive bladder; OABSS, overactive bladder symptom score.

Table 2. Association between body mass index, muscle mass, grip strength, and gait speed and overactive bladder

	Overactive bladder			
	OR (95%CI)	P-value	aOR (95%CI)†	P-value
BMI				
Underweight	1.45 (0.59–3.56)	0.42	1.24 (0.45–3.46)	0.68
Normal weight	1		1	
Overweight	1.72 (0.99–2.99)	0.06	**2.15 (1.13–4.11)**	**0.021**
Muscle mass corrected for BMI				
Per -0.1	0.97 (0.90–1.05)	0.45	0.92 (0.76–1.10)	0.36
Per -1SD	0.91 (0.71–1.16)		0.75 (0.41–1.37)	
Grip strength corrected for BMI				
Per -0.1	0.98 (0.92–1.05)	0.59	1.01 (0.87–1.17)	0.91
Per -1SD	0.93 (0.73–1.20)		1.03 (0.62–1.72)	
Gait speed				
Per -0.1m/s	**1.17 (1.06–1.30)**	**0.002**	**1.17 (1.04–1.32)**	**0.008**
Per -1SD	**1.47 (1.15–1.89)**		**1.47 (1.11–1.95)**	

P-values <0.05 are highlighted using boldface.

† adjusted for age, sex, diabetes, hypertension, stroke, depression, drinking, smoking and all variables in the table.

aOR, adjusted odds ratio; BMI, body mass index; CI, confidence interval; OR, odds ratio; SD, standard deviation.

Table 3. Association of body mass index, muscle mass, grip strength, and gait speed with daytime frequency, nocturia, urgency, and urgency incontinence items of the overactive bladder symptom score

	Daytime frequency				Nocturia				Urgency				Urgency incontinence			
	OR (95%CI)	P-value	aOR (95%CI)†	P-value	OR (95%CI)	P-value	aOR (95%CI)†	P-value	OR (95%CI)	P-value	aOR (95%CI)†	P-value	OR (95%CI)	P-value	aOR (95%CI)†	P-value
BMI																
Underweight	0.81 (0.35–1.86)	0.62	0.98 (0.39–2.51)	0.97	3.73 (0.49–28.7)	0.21	3.59 (0.42–30.4)	0.24	1.42 (0.62–3.26)	0.41	1.12 (0.44–2.84)	0.81	1.77 (0.75–4.16)	0.19	1.57 (0.60–4.16)	0.36
Normal weight	1		1		1		1		1		1		1		1	
Overweight	0.81 (0.48–1.35)	0.41	0.64 (0.36–1.16)	0.14	0.68 (0.34–1.36)	0.28	0.88 (0.39–2.01)	0.76	1.16 (0.69–1.94)	0.58	1.46 (0.81–2.63)	0.21	1.12 (0.63–1.96)	0.82	1.21 (0.63–2.31)	0.57
Muscle mass corrected for BMI																
Per -0.1	0.99 (0.92–1.06)	0.70	0.98 (0.83–1.16)	0.80	**0.85 (0.76–0.94)**	**0.002**	0.87 (0.67–1.14)	0.31	0.99 (0.92–1.06)	0.74	0.99 (0.84–1.17)	0.89	1.02 (0.95–1.10)	0.59	0.98 (0.82–1.18)	0.84
Per -1SD	0.96 (0.77–1.20)		0.93 (0.54–1.61)		**0.58 (0.41–0.82)**		0.64 (0.27–1.52)		0.96 (0.77–1.20)		0.96 (0.56–1.65)		1.07 (0.84–1.37)		0.94 (0.52–1.70)	
Grip strength corrected for BMI																
Per -0.1	1.01 (0.95–1.08)	0.76	1.12 (0.98–1.28)	0.10	**0.89 (0.81–0.98)**	**0.022**	1.11 (0.90–1.38)	0.33	0.97 (0.91–1.03)	0.37	0.89 (0.78–1.02)	0.09	1.02 (0.95–1.09)	0.54	0.97 (0.84–1.12)	0.66
Per -1SD	1.04 (0.83–1.29)		1.49 (0.93–2.40)		**0.67 (0.47–0.94)**		1.46 (0.68–3.11)		0.90 (0.72–1.13)		0.66 (0.41–1.06)		1.08 (0.84–1.38)		0.89 (0.53–1.49)	

Gait speed																
Per -0.1m/s	1.00 (0.92–1.10)	0.94	1.00 (0.90–1.11)	0.96	1.01 (0.88–1.15)	0.91	1.03 (0.89–1.20)	0.70	**1.10 (1.00–1.21)**	**0.042**	**1.13 (1.02–1.26)**	**0.023**	**1.14 (1.03–1.27)**	**0.009**	**1.15 (1.03–1.29)**	**0.017**
Per -1SD	1.01 (0.81–1.26)		1.01 (0.78–1.30)		1.02 (0.74–1.40)		1.08 (0.75–1.55)		**1.27 (1.01–1.59)**		**1.35 (1.04–1.74)**		**1.38 (1.08–1.77)**		**1.40 (1.06–1.84)**	

P-values <0.05 are highlighted using boldface.

† adjusted for age, sex, diabetes, hypertension, stroke, depression, drinking, smoking and all variables in the table.

aOR, adjusted odds ratio; BMI, body mass index; CI, confidence interval; OR, odds ratio; SD, standard deviation.

Table 4. Association between body mass index, muscle mass, grip strength, and gait speed and overactive bladder severity

	Severe overactive bladder			
	OR (95%CI)	P-value	aOR (95%CI)†	P-value
BMI				
Underweight	1.42 (0.59–3.43)	0.44	1.29 (0.48–3.48)	0.62
Normal weight	1		1	
Overweight	1.70 (0.98–2.92)	0.06	**1.89 (1.01–3.53)**	**0.046**
Muscle mass corrected for BMI				
Per -0.1	0.97 (0.90–1.05)	0.48	0.95 (0.79–1.14)	0.57
Per -1SD	0.92 (0.72–1.17)		0.84 (0.47–1.53)	
Grip strength corrected for BMI				
Per -0.1	0.98 (0.91–1.05)	0.53	0.99 (0.86–1.15)	0.93
Per -1SD	0.92 (0.72–1.18)		0.98 (0.58–1.63)	
Gait speed				
Per -0.1m/s	**1.18 (1.07–1.31)**	**0.001**	**1.18 (1.06–1.32)**	**0.003**
Per -1SD	**1.50 (1.18–1.91)**		**1.50 (1.14–1.96)**	

P-values <0.05 are highlighted using boldface.

† adjusted for age, sex, diabetes, hypertension, stroke, depression, drinking, smoking and all variables in the table

aOR, adjusted odds ratio; BMI, body mass index; CI, confidence interval; OR, odds ratio; SD, standard deviation.