Lower Urinary Tract Symptoms and Fall Incidence in Older U.S. Men

by

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CERTIFICATE OF APPROVAL

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ABSTRACT

Falls are a widespread problem among older people and can have serious implications, including injury and death. Urinary incontinence in women has been associated with an increased risk of falling. Nocturia has also been recognized as a risk factor in both men and women. Previous authors have hypothesized that people rushing to the bathroom, particularly in the middle of the night, were more likely to walk unsafely and fall. But, the previous study on nocturia and falls controlled only for age and gender. To better describe the relationship between urinary symptoms and falls in older men, we prospectively examined the association between lower urinary tract symptoms (LUTS) and one year cumulative incidence of falls in 5906 community-dwelling men aged 65 years and older who are participants in the MrOS cohort. LUTS were measured by the American Urological Association (AUA) Symptom Index and classified into categories according to standard cut points. In the study population, 54.1% of participants reported mild symptoms, 39.4% reported moderate symptoms, and 6.5% reported severe symptoms. The multivariate model for the relation of LUTS on falls controlled for age, history of falls, history of dizziness, arthritis, central nervous system medication use, and use of walking aids. The multivariate relative risk (RR) for incident falls for men with moderate symptoms compared to men with mild symptoms was 1.2 (95% CI = 1.0 - 1.3); the relative risk for men with severe symptoms compared to men with mild symptoms was 1.7 (95% CI = 1.3 - 2.1). Additional adjustment for demographic characteristics, neuromuscular function measurements, body size, lifestyle, and history of neurological disease

did not substantially alter these results. Changing the outcome to encompass multiple falls (0 to 1 falls versus 2 or more falls), also resulted in an elevated relative risk for men with moderate and severe symptoms: RR = 1.3 (95% CI = 1.1 - 1.5) and RR = 2.1 (95% CI = 1.5 - 2.7) respectively. Use of prostate medications, including finasteride, did not significantly affect the participant's risk of falling. When modeled as individual exposures, three of the individual AUA symptoms had a significant effect on falls: urinating again less than two hours after finishing, difficulty postponing urination, and pushing or straining to begin urination. In conclusion, moderate and severe LUTS are associated with an increase in the one year risk of falls.

INTRODUCTION

Falls represent a substantial health burden among older people. It is estimated that 25 to 50 percent of community dwelling adults aged 65 and older fall at least once per year (Kannus 1999). About half of those people fell multiple times. Nationally, men have higher fall rates than women; men have 39.9 falls per 100,000 person-years, compared to 25.9 for women (Oregon Department of Human Services 2002). The rate of falls increases exponentially with age. Men who are 65 to 69 years of age have a fall rate of 7.3 per 100,000 person years; the rate increases to 110.2 per 100,000 for men 85 years and older (Oregon Department of Human Services 2002).

Falls can have serious implications for older people; they are the most common cause of injury deaths and the leading cause of nonfatal injuries and hospital admissions for trauma (National Center for Injury Prevention and Control 2003). Between 20% and 30% of people who fall incur moderate to severe injuries, such as hip fractures or head traumas (National Center for Injury Prevention and Control 2003). Fractures are some of the most serious injuries resulting from falls. Hip fractures are particularly problematic, often leading to long-term health problems. After treatment for hip fracture, 71% of people transfer to a skilled or intermediate care facility (Oregon Department of Human Services 2002). A history of falls also causes fear of future falls for elderly individuals. This fear may progress to decreased activity and changes in gait and balance, further increasing the risk of falling (Oregon Department of Human Services 2002). People who are injured by falling often do not fully recover, and

suffer long-term loss of mobility, decreased independence, and increased anxiety (Kannus 1999).

Falls are also costly to the healthcare system. The cost of treating a person for one injurious fall in a year is estimated at $19,440 for hospital, care center, emergency room, and home health care charges (Rizzo 1998). Injuries to older adults that require hospitalization are five times more likely to be fall-related than to be from another cause (National Center for Injury Prevention and Control 2003). About 71% of the total costs for treating injuries in people over 60 are due to treating injuries from falls (Rizzo 1998).

FALL RISK FACTORS

The pathway to falls is multifactorial and is influenced by the physical, neurological, health and lifestyle changes that come with aging, along with environmental factors. Intrinsic factors that influence fall risk include musculoskeletal changes, neurological changes, history of falls, and general health. These intrinsic factors, which are associated with aging, combine with environmental factors, like stairs, slippery surfaces, and other common obstacles to increase fall risk (van Bemmel et al. 2005, Marshall et al. 2005).

The pathway between the musculoskeletal changes and falls is well documented. The American Geriatric Society ranked muscle weakness as the primary risk factor for falls (mean RR from a review of studies = 4.4), followed by history of falls (mean RR=3.0), gait deficit (mean RR=2.9), and balance deficit (mean RR = 2.9) as the top four risks (American Geriatric Society 2001).

Epidemiologic data demonstrate that leg muscle strength, slow 6-meter walk time, shorter balance time, difficulty standing from a chair, slow foot reaction time, and decreased neuromuscular function in general contributed to risk of falling (Davis et al. 1999, Rekeneire, et al. 2003, Sohng et al. 2004, Tromp, et al. 2001, Wilson 1998). In addition to slow pace, gait (length of stride) has been shown to affect stability and increase risk of falls (Bhatt et al. 2005).

Neurologic conditions, such as a previous stroke (Harris 2005, Henning et al. 2004, Ruchinskas et al. 2003) or Parkinson's disease (Henning et al. 2004, Ruchinskas et al. 2003), have been associated with increased incidence of falls. These conditions may increase fall risk by decreasing a person's sensation, stability, and reaction time. Along the same line of reasoning, peripheral neuropathy (decreased vibration and pressure sensitivity) has also been observed to increase fall risk (Schwartz et al. 2002). This decreased sensation may cause a person to respond less quickly to fall stimuli, like uneven or slippery surfaces. Similarly, diabetes, which can adversely affect sensation due to nerve damage, is associated with increased risk of falling (Schwartz et al. 2002).

Mental alertness also contributes to fall risk. Medications that may affect a person's awareness, like benzodiazapine (Rekeneire, et al. 2003, Tromp, et al. 2001) and other psychotropic medications (Schwartz et al. 1999, Weiner et al. 1998) increase risk of falling. Depression (Tromp, et al., 2001,Whooley et al. 1999) and dizziness (Tromp, et al., 2001) also contribute to fall risk.

Having a history of falls is also consistently sited as independently increasing the risk for future falls (Davis et al. 1999, Rekeneire, et al. 2003,

Ruchinskas et al. 2003, Tromp, et al. 2001). People with a history of falls may fear falling again. This fear may lead to inactivity, which has also been reported as a risk factor for falls (Gregg et al. 2000, Oregon Department of Human Services 2002, Schwartz et al. 1999, Sohng et al. 2004, Tromp, et al. 2001). Fear of falls may also exacerbate the neurological and musculoskeletal changes, like balance and gait, further increasing a person's fall risk (Oregon Department of Human Services 2002). The pathway between a person's first fall and his future falls is complex and multifactorial.

Other medical conditions also increase a person's risk of falling. Arthritis and rheumatism increase fall risk (Arden et al. 1999, Davis et al. 1999, Schwartz et al. 1999, Schwartz et al. 2002); a person with decreased range of motion and painful joints may be slower in responding to fall stimuli. Vision impairment can also contribute to the pathway to increase incident falls (American Geriatrics Society et al. 2001, Wilson 1998). Persons who can not see obstacles or accurately perceive their depth are more likely to stumble upon them.

In addition to these specific conditions, generally poor health also seems to affect fall risk; a person reporting two or more medical conditions has an increased risk for falling (Davis et al. 1999). Lung disease and heart disease also contribute to fall risk (Davis et al. 1999). People who are healthier may also be more involved in their families and communities, lifestyle factors which are inversely associated with falls risks in women (Faulkner et al. 2003).

URINARY SYMPTOMS & FALL RISK

Recent data suggest that urinary symptoms may play a role in fall etiology. Urinary incontinence in elderly, community-dwelling men and women has been well documented as a risk for falling (Brown et al. 2000, Rekeneire, et al. 2003, Tromp, et al. 2001, Tromp, et al. 1998, Wolf et al. 2000). One prospective cohort study of men and women reported that participants with urinary incontinence had between 60% and 80% increased risk of falls (Tromp, et al. 1998, Tromp, et al. 2001). Another cross-sectional analysis of men and women reported that symptoms of urinary incontinence increase fall risk by 50% (Rekeneire, et al. 2003). It has been hypothesized that people with urge incontinence have increased urinary frequency and nocturia, and may increase their fall risk by rushing to the bathroom to avoid incontinent episodes (Brown et al. 2000).

Emerging data suggests that other urinary symptoms may also increase fall risk. In a cross-sectional study of adults with and without nocturia, those who reported nocturia at least twice per night were significantly more likely to report falls (Odds Ratio = 1.84, 95% CI = 1.05-3.22) (Stewart et al. 1992). The risk of falling increased as the number of nocturia events per night increased. The authors hypothesized that risk may be due to several factors. First, people navigating to the bathroom in the middle of the night, likely in low lighting, may be more likely to stumble. Second, people with interrupted sleep patterns may be more tired and sleepy during the day, which might contribute to fall risk. Third, they may be somnolent when ambulating shortly after awakening. Of note, this study controlled for only age and gender in the analysis, without adjusting for

other potential risk factors; it is unknown whether the conclusion may have been affected by confounding. Moreover, the assessment of nocturia did not use a standardized instrument. Therefore, it is important to clarify and expand the association between urinary symptoms and falls.

Urinary incontinence and nocturia are two examples of lower urinary tract symptoms (LUTS). LUTS severity is measured with the American Urological Association (AUA) symptoms index score, an index created and validated by the AUA (Barry 1992). The score is obtained from a self-administered questionnaire with seven questions regarding incomplete emptying, frequency, hesitancy, urgency, weak urinary stream, intermittence, and nocturia [Table 1]. The score ranges from 0 to 35 points. Standard cut points are used to define categories of symptom severity, with a score of 0 indicating no lower urinary tract symptoms, 1 to 7 indicating mild symptoms, 8 to 19 indicating moderate symptoms, and 20 or higher indicating severe symptoms.

LUTS are common in older men. A cross-sectional study of men aged 41 to 81, with 25% below the age of 65, found that 62% of men had either no or mild symptoms, 34% had moderate symptoms, and 5% of men had severe symptoms; symptom severity increased with age (Roberts et al. 1997). It is presently unknown whether urinary symptoms or symptom severity are associated with fall risk. This lack of knowledge could have important implications for the prevention, treatment, and clinical management of urinary symptoms.

There are many causes of LUTS. Normal lower urinary tract functioning occurs in two phases: 1) bladder filling and urine storage and 2) bladder emptying. Interruptions in either of these phases can be caused by neurologic conditions (like stroke or Parkinson's disease), outlet obstructions (like those caused by benign prostatic hyperplasia), or idiopathic origins, resulting in LUTS (Walsh et al., 2002). Age is a known risk factor for LUTS (Lepor 1993). Other risk factors for urinary symptoms are not well documented. In one prospective investigation, physical inactivity, alcohol consumption, and cigarette smoking were observed to increase the risk of benign prostatic hyperplasia, which was partially determined by the AUA symptom index score (Platz 1998).

Treatment options for LUTS include medications, thermal-based therapy, and surgery. Over-the-counter treatments and phytotherapy (plant extracts) are also used (Cerrato 2000). In a study of the effectiveness of treatment for LUTS, the AUA symptom score dropped three to six points (out of 35 points) for patients using medications for 10 to 16 months depending on the medication, versus a drop of two points for patients on placebo (AUA 2003). Scores for patients who opt for surgery drop 14 to 20 points after 10 to 16 months, versus a drop of a half point for those patients who are monitored but not treated. Although treatment is available, urinary symptoms often go untreated because they are not seen as a serious health risk (AUA 2003). The most common first treatment strategy is watchful waiting, which is used in 34% of the cases (Trueman 1999). If LUTS do increase risk of falls, that risk may factor into deciding how aggressively to treat

the symptoms. Furthermore, successful treatment of LUTS may reduce the risk of falls and their accompanying morbidity in the elderly.

There are several plausible reasons to hypothesize that urinary symptoms may influence the likelihood of falling. People with urge-related symptoms may rush to the bathroom. In the rush, they may walk unsafely and be less likely to avoid or navigate common obstacles. The act of voiding itself can induce physiologic changes that result in blood pressure fluctuations that, in turn, can trigger episodes of dizziness and syncope. For example, sitting to void, and then standing up, may trigger orthostatic hypotension. Orthostatic hypotension is a drop in blood pressure caused by standing up quickly and is common in elderly people (Ooi, et al. 2000). Similarly, orthostasis can be induced by standing after a long period of recumbency, particularly in the elderly. A study of elderly nursing home residents found that orthostatic hypotension increases risk for recurrent falls (Ooi, et al. 2000). Another mechanism that may affect fall risk is micturition syncope. Micturition syncope refers to a brief loss of consciousness during or immediately following voiding. It is caused by a combination of vagal stimulation to the bladder, vagal stimulation due to a standing position during voiding, and orthostatic hypotension. Micturition syncope often occurs in men with prostatic hypertrophy, who may have to strain to begin urination (Farrehi, et al. 1995). The pathophysiologic changes that can result from voiding suggest that other urinary symptoms, in addition to incontinence, may be associated with incident falls among men. However, this association has not been studied among older men. The availability of the standardized AUA questionnaire makes

it possible to investigate this association in detail by providing information on the symptom severity as well as the frequency of individual symptoms.

We investigated the association of lower urinary tract symptoms in a large cohort of community-dwelling U.S. men ages 65 and older. Participants in the Osteoporotic Fractures in Men (MrOS) prospective cohort study completed the AUA symptom index questionnaire at enrollment and reported falls prospectively via questionnaires mailed every four months during follow-up. Information collected at baseline included several potentially confounding variables, including demographics, body size, lifestyle, neuromuscular function, medical history, and history of neurologic disease. The MrOS cohort provides an ideal setting in which to quantify the association between urinary symptoms and falls, while controlling for confounders.

METHODS

PARTICIPANTS

MrOS is a prospective cohort study designed to quantify risk factors for falls and osteoporotic fracture among older U.S. men. Participants were 5995 men ages 65 and older from six geographical areas in the United States. About one thousand men were recruited at each of the academic medical centers in Birmingham, Alabama; Minneapolis, Minnesota; Palo Alto, California; Pittsburgh, Pennsylvania; Portland, Oregon; and San Diego, California. The recruitment sites were chosen to enhance the likelihood that the cohort would be diverse in race, ethnicity, socio-economic status, and geography. Potential participants were recruited from April 2000 through April 2002 with mass mailings to male community members aged 65 years and older, by word of mouth, through advertisements in community newspapers, and with other methods appropriate for the geographic areas. Men were not eligible for participation in the MrOS study if they met any of the following exclusion criteria: 1) bilateral hip replacements, 2) unable to walk without the assistance of another person, 3) not competent to give informed consent, 4) not expected to live near a clinical site for the duration of the study, or 5) unlikely to survive the duration of the study due to medical conditions (as judged by the principal investigator).

Each participant enrolled in the study completed a baseline questionnaire and a clinic visit. Follow-up for falls and fractures began at baseline for each participant and occurred every four months with one-page questionnaires mailed in July, November, and March.

BASELINE QUESTIONNAIRE

Lower Urinary Tract Symptoms

Each MrOS participant completed an extensive self-administered questionnaire at enrollment. A portion of the questionnaire contained the American Urological Association (AUA) symptom index. This series of seven questions was created and validated by the AUA multidisciplinary measurement committee to measure severity of lower urinary tract symptoms (Barry et al., 1992). The questions address incomplete bladder emptying, frequency, intermittence, urgency, weak urinary stream, hesitancy, and nocturia. Complete wording of each question in the instrument is shown in Table 1. In addition to the AUA symptom index, the MrOS questionnaire also elicited information about history of diagnosed prostate diseases (including prostate cancer), and medications that men typically use for the treatment of LUTS, including prescription medications, supplements, and herbal remedies. Complete wording for the question regarding medications and the possible responses are shown in Table 2.

Medical History

Medical history was self-reported on the MrOS questionnaire. Participants were asked "if a doctor or other health care provider" had ever told the participant that they have or had a particular condition. The conditions list includes heart attack, angina, congestive heart failure, arthritis, prostatitis, chronic obstructive

lung disease (COPD), cataracts, glaucoma, osteoporosis, hypertension, diabetes, high thyroid, low thyroid, cancer, stroke, and Parkinson's disease. The questionnaire also asked if the participant sometimes had trouble with dizziness (no time period specified) or if he had fallen in the past 12 months.

Demographic Characteristics

On the Self Administered Questionnaire (SAQ), participants reported race and ethnicity as African American, American Indian, Alaska Native, Asian, Pacific Islander, Hispanic or Latino, White, or any combination of the listed races and ethnicities. Men also reported the highest level of education that they completed, ranging from some elementary school to completed graduate school. Participants reported current marital status, including married or living in a marriage-like relationship, widowed, divorced, separated, or single (never married).

Lifestyle

Information on physical activity over the past 7 days was collected using the Physical Activity Scale for the Elderly (PASE) (Washburn et al. 1993). Quality of life was measured using the Short Form 12 Health Survey (SF-12) (Ware et al. 1996). Lifetime cigarette smoking was also collected, including whether the participant had smoked 100 cigarettes or more in his lifetime and whether he currently smokes.

CLINIC VISIT

The baseline assessment included a clinic visit at the academic medical center through which the participant was enrolled. The clinic visit included body size measurements, structured interviews, neuromuscular function measurements, functional vision measurements, and medication inventory. The mode of measurement for each component of the clinic visit in now described.

Body Size

Height was measured using a stadiometer. Weight was measured using a standard scale. Body Mass Index was calculated using the following formula: weight(kg) / height(m)^2.

Lifestyle Interview

A structured interview was conducted by trained study staff using a standardized data collection form to collect information on lifestyle. Current alcohol consumption was categorized by how many drinks the participant consumes per day, month, or year. Walking activity was categorized by whether the participant took walks for exercise, daily or almost everyday. The participant also reported if he used a walking aid, such as a cane.

Neuromuscular function measurement

Neuromuscular function was measured using several different methods: grip strength, timed chair stands, walking speed, narrow walking speed, and leg power.

Grip strength was measured in kilograms using a Jamar Hydraulic Hand-Held Dynamometer (Bolingbrook, IL). Each hand was measured twice while the participant was in a seated position. All trials were averaged to obtain the final grip strength measurement. If a participant reported recent hand or wrist surgery or pain or inflammation in their hands or wrists, grip strength was not measured.

Timed chair stands measured the time it took the participant to stand up five times from a seated position in a chair without using his arms. First, to qualify for the measurement, the participant was asked to stand from a chair without using his arms. If unsuccessful, he was recorded as unable to complete the chair stand measurement. If successful, he was asked to stand five times as quickly as he could and the measurement was recorded in seconds.

Walking speed was measured on a six meter course. The participant was instructed to walk at his usual pace. Two trials were performed and walking speed was calculated in meters per second using both trials. Narrow walking speed was also measured on a six meter walking course. The participant was instructed to walk within two lines that were spaced 20 centimeters apart. If he successfully stayed between the lines (with less than three deviations), his time to walk the six meters was measured in seconds. The participant was given three attempts; the fasted measured pace was used for this analysis.

Leg power was measured in watts using a Nottingham Power Rig (Bassey, et al. 1992). Maximum leg extension power was measured while the participant was in a seated position. Each leg's power was measured nine times; the highest measurement of either leg was used for this analysis.

Functional Vision

Corrected vision acuity was measured using the Bailey-Lovie Distance Visual Acuity measurement (Bailey and Lovie 1976). Study staff also administered the Pelli-Robson test for contrast sensitivity (Pelli et al. 1988) and the Frisby Stereo test for depth perception (Frisby 1980).

Medication Use

Medication use was recorded via an inventory. Before the clinic visit, participants were instructed to write down all of the prescription medications they had been using for at least one month. When they came in for the clinic visit, they were asked to bring the list and the medication bottles, and the list was verified by study staff. Medications were categorized and recorded by the study personnel using a standardized format. In this analysis, we considered central nervous system medications to include selective serotonin reuptake inhibitors (SSRI), benzodiazepines, and nonbenzodiazepine anticonvulsants.

FOLLOW-UP PROCEDURES

Follow-up questionnaire

Follow-up questionnaires were mailed to each participant three times per year beginning after enrollment, on March 1st, July 1st, and November 1st, to collect information on study endpoints, including incident falls. The questionnaire asked whether the participant had fallen in the past four months and the months of recall (e.g. March, April, May, and June) were listed. A second question addressed how many times the participants had fallen: 1, 2, 3, 4, or 5 or more falls. All participants who did not return the questionnaire, did not complete it, or gave inconsistent answers received a phone call from study staff who administered the questions over the telephone. Participants who did not return questionnaires were investigated to ascertain information on address changes or deaths. Participants with complete information on incident falls for the first 12 months of follow-up were included in this analysis. Because recruitment extended over two years, the calendar dates of the participants' follow-up periods are different [Figure 1]. Twelve months is a standard time over which to collect data on incident falls (Masud et al. 2001). To be consistent with most previous reports on fall risk, we estimate the 12-month cumulative incidence of falls.

Data collection and management

The study progress and the data collection are managed by the Coordinating Center located at the University of California at San Francisco and

the Administrative Center at Oregon Health & Science University. The scientific direction of the study is guided by the MrOS Steering Committee. In accord with established procedures, the MrOS Steering Committee reviewed and approved the analysis proposal for this report. Institutional Review Boards at each clinical site approved the MrOS research protocols and all participants provided informed consent.

Data were collected on "teleforms" that were faxed directly to the Coordinating Center. Questionnaires filled out by participants were reviewed for completeness by study staff before submission. The faxed data was transferred directly to the Coordinating Center's computer system, which automatically checks the data for missing data points and data validity (logic, range, etc.). Data edits were posted to a secure website to which each clinic had access. Study staff corrected the errors on the website, and also corrected the hard copies of the questionnaire which were stored at each clinic site.

Study Population

A total of 5906 participants, 98.5% of the total cohort, were included in the analysis. Four participants were excluded because they did not answer all of the AUA symptom index questions. Ten participants were excluded because they died or terminated before the first follow-up. Seventy-five men were excluded because they did not respond to one or more tri-annual questionnaires during the first 12 month follow-up.

Variable Classification

We considered the AUA symptom severity categories as the primary exposure variable. Symptom scores were divided according to published cutpoints of 0 to 7 (none or mild symptoms), 8 to 19 (moderately severe symptoms), and 20 to 35 (severe symptoms) (Barry et al. 1992).

Because numerous measures have been reported to be associated with falls, we considered a number of variables as potential confounders in this analysis. We divided these characteristics into meaningful subgroups to contain demographic, body size, lifestyle, neuromuscular function, medical history, and history of neurologic disease variables. The demographic variables included clinic site, race, self-reported health status, education level, and marital status. The body size subgroup contained height, weight, and body mass index (BMI). The lifestyle subgroup contained PASE score, alcoholic drinks per week, lifetime cigarette smoking, and walking for exercise daily. The neuromuscular function subgroup contained chair stand time, grip strength, leg power, walking pace, and narrow walking pace. The medical history subgroup contained use of walking aids, CNS medication use, use of medication to treat bone disease, testosterone injections, falls within past year, history of dizziness, congestive heart failure, angina, myocardial infarction, heart problems (congestive heart failure, angina, or myocardial infarction), arthritis, prostatitis, chronic obstructive pulmonary disease (COPD), cataracts, glaucoma, osteoporosis, high blood pressure, diabetes, high thyroid, low thyroid, prostate cancer, vision acuity, and visual contrast sensitivity.

The neurologic disease subgroup included history of stroke and history of Parkinson's disease.

In the descriptive analysis, distributions of each variable were examined and continuous variables were examined for normality. Numbers in each level for categorical variables were examined and categories were collapsed as necessary. Age was categorized into 5-year increments: 65 to 69, 70 to 74, 75 to 79, and 80 or older. All other continuous variables were classified into quintile subdivisions. Categorical variables were examined for distribution, and similar classifications were combined to create more even distributions, ensure that no classification had fewer than 30 participants, and maintain logical divisions. Race and ethnicity included white, African-American, Asian, Hispanic, or other. Self-reported health status was classified as very poor/poor/fair, good, and excellent. Education level was classified into four levels: no high school, some high school, some college, and college. Marital status responses were collapsed into two groups: currently married and not currently married. Alcohol use was classified into three divisions which denote the number of drinks per week: zero, one to five, or six or more. Smoking status was divided into three classifications: never, former, and current smokers. Contrast sensitivity vision measurements were divided into pass/fail classifications, with a score of greater than or equal to 35 denoting a passing score. Depth perception was also divided into a pass/fail classification; participants who were able to pass the most subtle level of depth perception were included in the pass category. Additional detail on the source

and classification of all variables considered in this analysis in contained in Appendix 1.

Statistical Analysis

Overview

The statistical analysis was performed in four steps. First, in descriptive analyses, we identified potential confounding variables by examining the distributions of all variables in each subgroup according to the AUA symptom categories and then according to fall status during follow-up. Second, we began the multivariate analysis with models containing the main exposure variable and age, then added one at a time each variable that had been observed in the descriptive analysis to be associated with urinary symptom severity or fall risk. Third, we built models for each of the six variable subgroups, including all covariates that made a significant contribution to the model fit (determined by delta G values). Finally, the six subgroup models were combined into one model, and relative risk (RR) estimates and delta G values were compared to find the most complete and parsimonious model. We have illustrated our multivariate modeling approach in Figure 2. We chose this approach in order to systematically examine candidate variables in a way that 1) minimized the potential for type one error, 2) permitted us to choose the most important variable from among those that are correlated (such as leg power and grip strength), and 3) permitted us to identify potential confounding variables during the model building process as recommended by Greenland (Greenland, 1989).

Descriptive Analysis

The first step of the statistical analysis was to identify potentially confounding variables. We examined distributions of potentially confounding variables by incident falls over one year and by AUA symptom score category and estimated chi-square tests for contingency tables. We determined which variables were associated with falls and LUTS and should be included in the next step of model building. A variable was included for further assessment in the multivariate analysis if it met any of the following criteria: 1) the p-value from the chi-square test for its association to incident falls or AUA symptom score was 0.05 or less, 2) the variable was of interest due to previous studies on falls or LUTS, or 3) the variable had clinical importance (such as history of stroke).

Multivariate analysis

To understand the relation of potential covariates with LUTS and risk of falls, we next built logistic models containing the symptoms categories, age, and one predictor variable. Relative risks (RR) (estimated with odds ratios), 95% confidence intervals, and delta G values (calculated from -2 log likelihood scores) were used to assess the association of each candidate variable with incident falls. Each logistic model was ranked by the delta G value, which was calculated as the difference of the -2 log likelihood value for the model containing symptom category, age, and a potentially confounding variable to the value for the model containing only symptom category and age. Delta G values denote whether the

coefficient of the covariate is statistically significant (Hosmer & Lemshow 2000); a higher delta G value signifies a more substantial contribution to model variance. Each candidate variable was ranked among all variables in the same subgroup. To identify the "best model" for each subgroup, we fit the second highest ranked variable into the model already containing symptom categories, age, and the previously added variable. We sequentially added the third, then fourth, then fifth, and so on highest ranking variables until all candidate variables had been examined. The "best model" included only those variables that confounded the symptom and fall association or that contributed to model fit, using the delta G criteria. Changes in RR greater than 10% were used to identify a confounding variable (Greenland, 1989). At this point in the analysis, each of the previously excluded variables was added back in, one at a time, to confirm they did not contribute significantly to the subgroup model.

Once each subgroup model was created, a similar method was used to combine the six multivariate models. Consistent with the variable selection process, the subgroup models were ranked by the -2 log likelihood values. The model with the smallest -2 log likelihood value was used for the base model, then variables from the second, third, and so on ranked models were incorporated into the base model one subgroup at a time. Then, delta G values for each new model were computed and ranked again. The subgroup model that contributed most to the base model was included, until all remaining models' delta G values did not pass the critical value. This complete model was examined to determine whether the addition of each group of variables changed the relative risk value

for falls. To simplify the analysis, only the groups that changed the odds ratio by 10% or more when they were added to the complete model or that are considered clinically important were used in the subsequent analyses. Goodness of fit was determined using the Hosmer & Lemshow test for lack of fit; p-values greater than 0.05 are considered to indicate good fit. Areas under the receiver-operating characteristic (ROC) curve were used to compare the models' ability to predict falls before determining the final model (Hosmer & Lemshow 2000).

Because previous studies have found men with neurologic disease to have increased fall risk and increased urinary symptoms (Ashburn et al. 2001, Campos-Sousa et al. 2003, Henning et al. 2004, Nyberg et al. 1997, Tutuarima et al. 1997), we re-examined the association of LUTS severity and fall risk after excluding participants with a history of stroke or Parkinson's disease from our study population. Further restriction to men without a history of prostate cancer, whose LUTS may be due to the cancer or the cancer therapies (Kollmeier et al. 2003), permitted us to examine whether existing underlying disease conditions explained any observed association. Finally, to address the possibility that asymptomatic deficits in neurologic function might be a common precursor to both falls and onset of urinary symptoms, we restricted the analysis to men who reported no history of falls in the 12 months before baseline.

The present analysis excluded 85 participants who did not have complete follow-up information during the 12 month study period. To examine whether bias from loss-to-follow-up could have affected the results of the main analysis,

we estimated the RR and 95% CI after reclassifying all men with missing fall data as 1) having fallen during the study period and 2) as not having fallen during the study period.

Next, to determine if medications to treat urinary symptoms may affect the relation of LUTS severity and fall risk, we stratified the model by current prostate medication use. The first stratification separated men who reported using any medication, supplement, or herbal remedy to treat prostate symptoms and men who did not. The severe and moderate AUA categories were collapsed for these analyses to avoid small sample sizes in each stratum. The RRs in each stratum were estimated. The second stratified analysis used the same method to stratify men who reported using finasteride (Proscar), a prescription medication, and those who did not.

Some authors have hypothesized that recurrent, or frequent, falls are better indicators of intrinsic risk factors, rather than single falls which may be due to environmental factors (King et al. 1995). Because some associations become stronger in relation to recurrent falls, we repeated the analysis using two or more falls during the 12 month follow-up period as the outcome variable.

Finally, to evaluate whether specific symptoms were associated with fall risk, we modeled each of the seven response variables that comprise the AUA symptom score separately as exposure variables.

RESULTS

LOWER URNIARY TRACT SYMPTOM PREVALENCE

Distributions of AUA symptom categories demonstrate that the majority of participants (54.1%) reported no or mild symptoms [Table 3]. Moderate symptoms were reported by 39.4% of the cohort, and severe symptoms by 6.5%. Distributions of individual symptoms demonstrated that pushing or straining to begin urination more than half of the time was reported by less than 2% of participants, while over 75% of men reported that they have no problem with this symptom. About 3% to 4% of the cohort reported "Almost always" finding it difficult to postpone urination (4.0%), having to urinate again less than two hours after finishing (4.1%), having a sensation of not emptying bladder completely (3.0%), and stopping and starting several times when urinating (3.1%). Nocturia was the most commonly reported symptom for men in this cohort; 4.6% of men reported getting up at least five times per night to use the bathroom, and 24.9% reported getting up 3 or more times each night to urinate.

BASELINE CHARACTERISTICS

The distributions of potential fall risk factors by AUA symptom severity are presented in Table 4. Men with moderate or severe symptoms tend to be older, with 46% being over 75 years old, compared to 38% of men with mild symptoms. However, we observed little variation in other demographic variables, including race, site of enrollment, and marital status. Men with moderate or severe symptoms reported less physical activity [mean (sd) PASE score = 140.5 (66.2)]

compared to men with mild symptoms [mean (sd) PASE score = 152.2 (69.0)]. The proportion that reported walking daily for exercise, however, was similar in each LUTS category. Smoking status and current number of alcoholic drinks per week also vary little by symptom category.

Physical performance measures have been observed to be associated with fall risk (Davis et al. 1999, Rekeneire, et al. 2003, Sohng et al. 2004, Tromp, et al. 2001). In the MrOS cohort, we observed that participants with moderate or severe symptoms tended on average to have lower leg power, weaker grip strength, and slower usual walking speed, narrow walk speed, and timed chair stands when compared to men with no or mild symptoms. Reported use of walking aids, such as canes or walkers, was also greater among men in the moderate or severe symptom categories. In contrast, body size measurements, including height, body mass index, and weight, varied little by symptom category.

The prevalence of LUTS was consistently associated with reported medical conditions. Men with severe symptoms were more likely to report a history of falls, dizziness, cardiac heart failure, myocardial infarction, high blood pressure, angina, arthritis, prostatitis, chronic obstructive pulmonary disorder (COPD), osteoporosis, previous stroke, diabetes, and low thyroid. These men were also tended to have poorer vision, including distance vision, contrast sensitivity, and depth perception. They were also more likely to report cataracts and glaucoma. The only conditions that showed little variation by urinary symptoms were high thyroid and prostate cancer.

Similar to the results observed for medical history, medication use also consistently varied by LUTS. Use of CNS medications (benzodiazepine, selective serotonin reuptake inhibitor [SSRI], or nonbenzodiazepine anticonvulsant) and medications for osteoporosis were more frequent in men with severe symptoms. About 37% of men with moderate or severe symptoms reported taking a medication, herbal remedy, or supplement to treat prostate symptoms almost every day, compared to 17% of men with mild symptoms.

Incident falls also varied by LUTS severity. One quarter of the cohort reported an incident fall during the follow-up period, and 12% reported two or more incident falls. Men with severe symptoms were more likely to report an incident fall than men with moderate or mild symptoms, and also tended to report two or more incident falls more frequently. About 22% of men with severe symptoms reported two or more incident falls, while 9% and 1% of men with mild and moderate symptoms, respectively, reported two or more falls.

ASSOCIATION OF URINARY SYMPTOMS WITH FALL RISK

Age adjusted models of fall risk in relation to AUA symptom category demonstrate that both moderate and severe urinary symptoms are associated with increased risk of falls [Table 5]. The relative risk (RR) for falls among men reporting moderate symptoms compared to men with mild symptoms is 1.34 (95% CI = 1.18 - 1.51). The RR for men with severe symptoms compared to men with mild symptoms is 2.03 (95% CI = 1.62 - 2.54).

Medical history at baseline, including history of falls in the 12 months before enrollment, history of dizziness, history of arthritis, use of CNS medications, and use of walking aids, were the most notable confounders of the association. Adjusting for history of falls in the 12 months before baseline modestly attenuated the RR for moderate symptoms to 1.2 (95% CI = 1.1 - 1.4) and for severe symptoms to 1.9 (95% CI = 1.5 - 2.3). Additional adjustment for history of dizziness did not affect the RR for moderate symptoms, but did further attenuate the RR for severe symptoms to 1.8 (95% CI = 1.4 - 2.2). Further adjustment for the remaining variables in the medical history subgroup (arthritis, CNS medication use, and use of walking aids) did not further substantially alter the RR (shown in Table 5, labeled "+ Medical History"). Further control for variables in the neuromuscular function, demographic factors, lifestyle, and body size subgroups did not materially alter these RR estimates [Table 5]. Since we observed no confounding of the association of urinary symptom severity and fall risk by any variables in these five subgroups, in subsequent analyses we controlled for age and the five medical history variables.

Because previous studies have found that men with neurologic disease have increased fall risk (Ashburn et al. 2001, Henning et al. 2004, Nyberg et al. 1997, Tutuarima et al. 1997) and increased prevalence of urinary symptoms (Campos-Sousa et al. 2003), we repeated the analyses after excluding participants who reported history of stroke or Parkinson's disease, reanalyzing the remaining 5529 men [Table 6]. The association of falls with moderate (RR = 1.1, 95% CI = 1.0 - 1.3) and severe urinary symptoms (RR = 1.6, 95% CI = 1.2 -

2.0) were slightly attenuated. Further restriction of the study population to men without a history of prostate cancer, leaving 4874 men in the analysis, also resulted in modest attenuation of the moderate symptom (RR = 1.2, 95% CI = 1.0 - 1.3) and severe symptom (RR = 1.5, 95% CI = 1.1 - 1.9) risk.

In addition to existing disease conditions, it is also possible that asymptomatic, clinically undetectable deficits in neurologic function could result in falls as well as onset of urinary symptoms. To address this possibility, we restricted the analysis to men who reported no previous history of falls at baseline. In this restricted study population of 4665, the association of urinary symptoms severity remained significantly associated with fall risk. In multivariate analyses adjusted for age and the medical history variables, the RR of falls among those with moderate symptoms compared with mild symptoms was 1.2 (95% CI: 0.8-1.4) and was 1.5 (95% CI: 1.1-2.0) among those with severe symptoms.

Although losses to follow-up were minimal in this cohort, we did exclude 85 participants who did not have complete follow-up information. The proportion with missing fall follow up data varied significantly by symptom severity and was 1.1% among those classified with mild symptoms, 1.2% among those with moderate symptoms, and 2.8% among those with severe symptoms (chi-square p-value=0.02). To examine whether loss-to-follow-up could have affected our results, we performed two additional analyses. We classified participants with missing fall data first as having fallen during the 12 month study period and second as not having fallen during the study period. Then we estimated RR and

95% CI in multivariate analyses. The results were not materially different from those shown in Table 5. When those with missing fall data were reclassified as having fallen, the multivariate RR was 1.2 (95% CI=1.0-1.3) for moderate compared with mild symptoms and 1.7 (95% CI=1.4-2.2) for severe compared with mild symptoms. Similarly, when those with missing fall data were reclassified as having never fallen, the multivariate RR was 1.2 (95% CI=1.0-1.3) for moderate compared with mild symptoms and 1.6 (95% CI=1.3-2.0) for severe compared with mild symptoms. The results of these additional analyses indicate that bias from loss-to-follow-up is unlikely to be an alternative explanation for the association of urinary symptom severity with fall risk.

It has been hypothesized that recurrent, or "frequent," falls are better indicators of intrinsic risk factors than single falls (King et al. 1995). We repeated the analysis using cumulative incidence of two or more falls during the 12 month follow-up period as the outcome measure; 700 of the participants, 12% of the cohort, reported two or more incident falls [Table 6]. The RR for two or more falls for men with moderate symptoms was 1.3 (95% CI = 1.1 - 1.5) and the RR for men with severe symptoms was 2.1 (95% CI = 1.5 - 2.7).

We examined whether reported use of a medication or supplement to treat urinary symptoms influences the relation of fall risk to LUTS severity [Table 7]. Among those men who reported using medications or supplements for prostate symptoms, the number who reported any fall during follow-up were 101 among those classified with mild symptoms, 190 among those classified with moderate symptoms, and 66 among those classified with severe symptoms. We collapsed

the moderate and severe symptom categories in these analyses to allow for adequate samples sizes in each stratum. In age and medical history adjusted analyses, we observed that the associations of LUTS severity to fall risk were similar among men who did and did not report using any medications or supplements for urinary symptoms. The RR for men with moderate or severe symptoms who reported using medications or supplements was 1.3 (95% CI = 1.0 - 1.8) and the RR for men with moderate or severe symptoms not using medications or supplements was 1.2 (95% CI = 1.1 - 1.4). We repeated these analyses after stratifying for reported use of the prescription medication finasteride (Proscar). The reported use of finasteride also did not appear to influence the association of LUTS and fall risk.

RELATION OF INDIVIDUAL SYMPTOMS TO FALL RISK

To determine which, if any, symptoms might explain the association of fall risk with LUTS severity, we examined each symptom separately in a model controlling for age, history of falls, history of dizziness, arthritis, CNS medication use, and use of walking aids [Table 8]. We observed that fall risk was associated with three individual symptoms. Compared to men who reported not having the symptom, men who reported almost always having to push or strain to begin voiding have a RR of 1.9 (95% CI = 0.9 - 3.9); men who reported almost always finding it difficult to postpone urination and men who reported having to urinate again less than two hours after finishing are also at increased risk for falls had RR's of 1.6 (95% CI = 1.2-2.1) and 1.4 (95% CI = 1.0-1.9), respectively. Other

urinary symptoms, including nocturia episodes, were not significantly associated with fall risk over one year.

Goodness of Fit

We examined goodness of fit for the two variations of models that adjusted for medical history variables: one adjusting for age, history of falls, and history of dizziness, the other additionally adjusting for arthritis, CNS medication use, and use of walking aids. P-values derived from the Hosmer & Lemeshow test for lack of fit were 0.8143 and 0.9006, respectively, indicating that both models fit well (Hosmer & Lemeshow 2000). Assessment of leverage observations found outlying data points in neither model. The model controlling for only age, history of falls, and history of dizziness had an area under the ROC curve of 0.663. The model that further adjusted for arthritis, CNS medication use, and use of walking aids had a slightly larger area under the curve, 0.675. The more parsimonious model fits almost as well as the larger model. However, the high power or our analysis, due to the large MrOS cohort, allows us to control for more variables without sacrificing power. To be conservative, we used the larger model, including age, history of falls, history of dizziness, arthritis, CNS medication, and use of walking aids, for all analyses.

DISCUSSION

In this prospective study among U.S. men ages 65 years and older, we observed a direct association between LUTS severity and risk of incident falls over one year. Men with severe LUTS, as classified by the AUA symptom index (Barry, et al. 1992), were 60% more likely to fall compared to men with no symptoms or mild symptoms. The association was independent of several potential risk factors for falls, including demographic factors, body size, lifestyle factors, neuromuscular function, and certain aspects of medical history. The association remained significant when we repeated the analysis after excluding men with history of stroke, Parkinson's disease, or prostate cancer. Moreover, we continued to observe a significantly elevated fall risk among those with severe urinary symptoms after restricting the analysis to men who did not report a previous history of falls. These observations suggest our results are not due to either existing disease conditions or to asymptomatic deficits in neurologic function that may be common to both fall risk and urinary symptoms.

Notably, reported use of prescription medications, herbal remedies, or supplements to treat prostate symptoms did not alter the relation of LUTS severity and fall risk. We observed that the association between LUTS severity and falls became stronger when we used two or more falls as the outcome variable. When each of the seven symptoms from the AUA questionnaire was evaluated separately in relation to incident falls, we observed that three symptoms were associated with fall risk: difficulty postponing urination, urinating again less than two hours after finishing, and pushing or straining to begin

urination. Men who report almost always having one of these symptoms were between 40% and 90% more likely to report an incident fall.

Our results differ from a previous study which suggested that men's risk of falling is associated with nocturia (Stewart 1992). The previous study found that persons who got up two or more times per night to urinate were at increased fall risk, after controlling for age and gender. However, our data did not provide evidence for an association of nocturia with fall risk. Instead, we observed that fall risk is affected by urinary urge and urinary frequency. There are several possible reasons for this discrepancy. First, the questions used to determine nocturia are not comparable; the studies used different wording, classifications, and time periods to collect information on nocturia. Second, the authors of the report did not provide a sex-specific risk ratio, likely due to small numbers of male subjects reporting no nocturia (zero episodes) or "severe" nocturia (>3 episodes) and falls (n=4 and n=5, respectively). Because of small sample sizes, the association in men would have been difficult to estimate. Finally, the paper from Stewart et al. is a cross-sectional analysis, so the temporal sequence of urinary symptoms and falls cannot be determined.

Several hypotheses may explain the association of LUTS and fall risk. There may be a common pathologic or neurologic condition that contributes to both risk of LUTS and risk of falls. However, our data are not entirely consistent with this hypothesis since the association of urinary symptom severity and fall risk was observed among men who did not report falling in the 12 months before enrollment and among those who did not report a history of stroke, Parkinson's

disease, or prostate cancer. Environmental factors may also influence the association. For example, urgency and frequency may contribute to fall risk via a similar pathway: men rushing to the bathroom may be more likely to walk unsafely and less able to navigate environmental risk factors, like slippery surfaces. We could not address this possibility with our data, because we had no information on the circumstances of the fall. Pushing or straining to begin urination could follow a different pathway in increasing fall risk. Pushing or straining initiates Valsalva's maneuver, which increases intra-abdominal pressure, triggering a vasovagal reflex (Guyton & Hall 1996). Valsalva's maneuver first causes a sharp increase in blood pressure due to increased pressure in the trunk, followed by a sharp decrease in blood pressure due to the vasovagal reflex. These changes in blood pressure have been shown to cause dizziness and fainting (O'Mahony et al. 1998), and are also a cause of micturition syncope (Farrehi, et al. 1995). Our data are consistent with the hypothesis that a man who reports almost always pushing or straining to begin urination may be employing Valsalva's maneuver to void. If this is true, micturition syncope may explain the elevated risk of falls we observed in relation to this symptom.

While frequency, urge, and pushing or straining to begin urination increase fall risk, the remaining four symptoms were not associated with falls in this prospective study. Three of the remaining symptoms occur during voiding: sensation of not emptying bladder, weak urinary stream, and stopping and starting several times when urinating. Because these symptoms occur during

voiding, as opposed to prior, they may not cause a person to rush to the bathroom.

It is important to note the limitations of this analysis. First, the tri-annual questionnaire did not collect information on the events surrounding reported falls. More details may have helped us elucidate the pathway for LUTS increasing fall risk. For example, in this study it is unknown whether any of the falls reported during follow-up occurred in or near the bathroom, during or after voiding, or if a fall occurred on the way to the bathroom because of environmental obstacles. Second, AUA symptom index addresses only symptoms within the past 30 days. It is unknown how well symptoms over the last 30 days correlate with symptoms over the coming year. Likewise, we were unable to determine the duration of urinary symptoms. Participants may have been misclassified if their symptoms recently had changed from a previous state. However, because the design of this study is prospective, such misclassification in our cohort should have been unrelated to fall reports. Therefore, any misclassification of urinary symptoms would likely have underestimated the association with fall risk.

MrOS is a volunteer cohort. These volunteers are likely to be healthier than the general U.S. male population of this age. Falls were reported by 25% of the cohort over the 12 month follow-up period. This is consistent with previous studies that have estimated fall incidence to be between 25% and 50% (Kannus et al. 1999). Therefore, these data should be generalizable to other US men in relatively good health and the age range of the MrOS cohort participants. However, these results may not be less applicable to less healthy older US men.

The large number of statistical analyses performed in this study increases the potential for type I error. We recognized this limitation and tried to minimize its effects by paying attention to biological plausibility and previous study results when examining our variables. When building the final multivariate model, we selected variables that both had significant chi-square values and affected the relative risk when added to the model.

This study also has important strengths. MrOS is a large cohort study comprised of older U.S. men and has comprehensive information on fall risk factors. Such data allows for a thorough examination of possible confounding variables. The risk factors for falls that were found in this study are consistent with previous studies. Having a history of falls is consistently sited as independently increasing the risk for future falls (Davis et al. 1999, Rekeneire, et al. 2003, Ruchinskas et al. 2003, Tromp, et al. 2001). Trouble with dizziness has also been found to contribute to fall risk (Tromp, et al., 2001). Previous studies agree that arthritis increases fall risk (Arden et al. 1999, Davis et al. 1999, Schwartz et al. 1999, Schwartz et al. 2002), as does use of benzodiazapine (Rekeneire, et al. 2003, Tromp, et al. 2001) and other psychotropic medications (Schwartz et al. 1999). The use of walking aids has also been found to increase likelihood of falls by increasing attentional and neuromotor demands and interfering with limb movement during balance recovery (Bateni et al. 2005).

The MrOS study collected thorough information on prostate health, including LUTS. By using the standardized AUA symptom index questionnaire, we are able to use clinically relevant symptom categories. We also had very

complete data on factors that may affect urinary symptoms, such as diagnosed prostate diseases, medication use, and use of herbal remedies or supplements to treat prostate symptoms. Minimal loss to follow-up is another important strength of this study. Of the 5,995 men enrolled in the study, 5,920 (98.7%) had complete data on incident falls. We observed that missing follow-up information was associated with symptom severity. However, the association of urinary symptom severity and fall risk was virtually identical to the results reported in Table 5 when additional analyses were performed, first reclassifying participants with missing fall data as fallers and then as non-fallers. Thus, possible bias from loss-to-follow-up is unlikely to provide an alternative explanation for the observed association.

The association of LUTS with falls deserves further study. There may be physiologic or neurologic factors that lead to both falls and urinary symptoms, and could not be elucidated in this analysis. Nonetheless, the observed association should be taken into account when treating men with LUTS. Because men who use medication to treat LUTS may still have an increased risk for falls, healthcare providers might need to use an alternate avenue to help these men prevent falls. Education on environmental risk factors for falls may help counter the intrinsic factors that cannot be effectively treated. Controlling environmental risk factors, like ensuring a clear path to the bathroom, sitting to urinate, and waiting to stand after urination, may help counter the increased risk due to lower urinary tract symptoms. The results of this analysis will aid

healthcare providers in identifying patients at high risk for falls and instructing them in controlling for appropriate environmental fall risk factors.

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Table 1. Questions included in the American Urological Association symptom index.

AUA Symptom Question*	
1	Over the past month, how often have you had a sensation of not emptying your bladder completely after you finish urinating?
2	Over the past month, how often have you had to urinate again less than two hours after you finished urinating?
3	Over the past month, how often have you found you stopped and started again several times when you urinated?
4	Over the past month, how often have you found it difficult to postpone urination?
5	Over the past month, how often have you had a weak urinary stream?
6	Over the past month, how often have you had to push or strain to begin urination?
7	Over the past month, how many times did you most typically get up to urinate from the time you went to bed at night until the time you got up in the morning?

*Answers for questions one through six included Not at all, Less than 1 time in 5, Less than half the time, About half the time, More than half the time, and Almost always. Answers for the seventh question, regarding nocturia, included None, 1 time, 2 times, 3 times, 4 times, and 5 time or more.

Table 2. Medications, herbal remedies, and supplements used every day or almost every day to treat prostate symptoms, as reported in the MrOS Self Administered Questionnaire. Alternate names for the medications are listed in parentheses.

Please indicate which medication or herbal remedies/supplements you take: (Mark all that apply.)
Finasteride (Proscar)
Saw palmetto (Sernoa repens)
South African star grass (Hypoxis rooper, B-sitosterol)
Stinging nettle (Urtica dioica)
Rye grass pollen (Secale cereala)
Pumpkin seed (Curcubita pep)
African plum (Pygeum africanum)
Other

Table 3. Prevalence of lower urinary tract symptoms at baseline among US men ages 65 years and older: the MrOS cohort

	Frequency of symptom in the past month					
	Not at all	Less than 1 time in 5	Less than half the time	About half the time	More than half the time	Almost always
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Had to push or strain to begin urination	4463 (75.6)	935 (15.8)	256 (4.3)	142 (2.4)	77 (1.3)	33 (0.6)
Found it difficult to postpone urination	2440 (41.3)	1778 (30.1)	632 (10.7)	501 (8.5)	317 (5.4)	238 (4.0)
Had to urinate again < 2hrs after finishing	1425 (24.1)	2050 (34.7)	950 (16.1)	859 (14.5)	379 (6.4)	243 (4.1)
Sensation of not emptying bladder	3131 (53.0)	1435 (24.3)	493 (8.4)	452 (7.7)	219 (3.7)	176 (3.0)
Stopped and started several times when urinating	2868 (48.6)	1507 (25.5)	581 (9.8)	470 (8.0)	295 (5.0)	185 (3.1)
Had a weak urinary stream	2607 (44.1)	1408 (23.8)	639 (10.8)	540 (9.1)	379 (6.4)	333 (5.6)
	None	1 time	2 times	3 times	4 times	≥5 times
Times typically get up at night	409 (6.9)	2173 (36.8)	1854 (31.4)	927 (15.7)	270 (4.6)	273 (4.6)
Severity Score*	Mild		Moderate		Severe	
Number (%) of men in category	3197 (54.1)		2324 (39.4)		385 (6.5)	

* The severity scores were obtained by assigning values of 0 to the lowest category and 5 to the highest category, and summing the values for each of the seven AUA symptom index questions. Cutpoints are 0-7 for none/mild, 8-19 for moderate, 20-35 for severe.

Table 4. Variation in potential fall risk factors according to lower urinary tract symptom severity among US men ages 65 years and older at baseline: MrOS Cohort

		Frequency of LUTS symptom severity			
Characteristic		Mild	Moderate	Severe	p-value*
AGE	65 - 69	1052 (60%)	608 (35%)	95 (5%)	<0.01
	70 - 74	927 (55%)	647 (38%)	113 (7%)	
	75 - 79	727 (51%)	616 (43%)	85 (6%)	
	80+	491 (47%)	453 (44%)	92 (9%)	
SITE	Birmingham	463 (49%)	401 (42%)	86 (9%)	<0.01
	Minneapolis	559 (56%)	384 (39%)	54 (5%)	
	Palo Alto	526 (54%)	383 (39%)	63 (6%)	
	Pittsburgh	562 (56%)	378 (38%)	62 (6%)	
	Portland	553 (55%)	395 (40%)	52 (5%)	
	San Diego	534 (54%)	383 (39%)	68 (7%)	
Race	White	2848 (54%)	2103 (40%)	340 (6%)	0.07
	African American	125 (53%)	86 (36%)	25 (11%)	
	Asian	117 (63%)	61 (33%)	8 (4%)	
	Hispanic	71 (57%)	47 (38%)	6 (5%)	
	Other	36 (52%)	27 (39%)	6 (9%)	
Self-reported health status	Very poor/fair	318 (38%)	416 (50%)	102 (12%)	<0.01
	Good	1671 (54%)	1197 (39%)	202 (7%)	
	Excellent	1208 (60%)	709 (35%)	81 (4%)	
Education level	No/some high school	198 (52%)	144 (38%)	42 (11%)	<0.01
	High school	581 (57%)	381 (37%)	62 (6%)	
	Some college	728 (53%)	541 (40%)	92 (7%)	
	College	1691 (54%)	1258 (40%)	189 (6%)	
Marital Status	Not married	564 (55%)	391 (38%)	77 (7%)	0.29
	Married	2633 (54%)	1933 (40%)	308 (6%)	
Height	<168.55 cm	623 (53%)	780 (66%)	76 (6%)	0.12
	168.55 cm - 172.34 cm	607 (52%)	496 (42%)	68 (6%)	
	172.35 cm - 175.74 cm	633 (53%)	466 (39%)	89 (7%)	
	175.75 cm - 179.69 cm	660 (56%)	437(37%)	79 (7%)	
	>=179.70 cm	674 (57%)	445 (37%)	73 (6%)	
Weight	<72 kg	608 (53%)	471 (41%)	76 (7%)	0.25
	72.0 - 78.5 kg	670 (56%)	474 (39%)	61 (5%)	
	78.6 - 85.1 kg	626 (53%)	478 (41%)	74 (6%)	
	85.2 - 93.4 kg	642 (55%)	439 (38%)	88 (8%)	
	>=93.5 kg	651 (54%)	462 (39%)	86 (7%)	

*P-values were obtained using a Chi-square test of independence

Body mass index (BMI)	>24.306 kg/m^2	653 (55%)	457 (39%)	70 (6%)	0.25
	24.306 - 26.097 kg/m^2	647 (55%)	469 (40%)	64 (5%)	
	26.097 - 27.897 kg/m^2	610 (52%)	489 (41%)	83 (7%)	
	27.897 - 30.203 kg/m^2	657 (56%)	445 (38%)	78 (7%)	
	>= 30.203 kg/m^2	629 (53%)	463 (39%)	90 (8%)	
PASE	<90.00	563 (48%)	514 (44%)	101 (9%)	<0.01
	90.00-126.36	611 (52%)	497 (42%)	75 (6%)	
	126.37-159.15	639 (54%)	467 (40%)	73 (6%)	
	159.16-197.50	667 (56%)	440 (37%)	74 (6%)	
	>=197.50	715 (60%)	405 (34%)	62 (5%)	
Alcohol intake	0	1096 (52%)	845 (40%)	151 (7%)	0.26
	1 to 5 per wk	1124 (55%)	797 (39%)	128 (6%)	
	6 or more per wk	973 (55%)	378 (22%)	106 (6%)	
Cigarette smoking status	Never	1229 (56%)	851 (38%)	132 (6%)	<0.01
	Former	1837 (53%)	1413 (40%)	241 (7%)	
	Current	130 (64%)	60 (30%)	12 (6%)	
Walk for exercise daily	No	1575 (53%)	1180 (40%)	206 (7%)	0.21
	Yes	1622 (55%)	1144 (39%)	179 (6%)	
Chair stands	>13.15 sec (slowest)	557 (48%)	505 (44%)	88 (8%)	<0.01
	11.26 - 13.15 sec	619 (54%)	448 (39%)	78 (7%)	
	9.90 - 11.25 sec	628 (55%)	446 (39%)	78 (7%)	
	8.57 - 9.89 sec	635 (56%)	437 (38%)	68 (6%)	
	>=8.56 sec (fastest)	677 (59%)	412 (36%)	53 (5%)	
	Unable	72 (46%)	68 (43%)	17 (11%)	
Average grip strength	<32.00 kg	576 (50%)	483 (42%)	99 (9%)	<0.01
	32.00 - 36.25 kg	580 (52%)	471 (42%)	67 (6%)	
	36.50 - 40.25 kg	613 (54%)	440 (39%)	80 (7%)	
	40.50 - 45.25 kg	692 (58%)	437 (37%)	65 (5%)	
	45.50 - 65.50 kg	695 (58%)	434 (36%)	64 (5%)	
	Excluded with reason	38 (38%)	53 (54%)	8 (8%)	
Maximum leg power	>154.1 watts	530 (50%)	456 (43%)	84 (8%)	<0.01
	154.1 - 189.1 watts	555 (52%)	441 (41%)	81 (8%)	
	189.2 - 223.2 watts	571 (53%)	436 (41%)	64 (6%)	
	223.3 - 258.8 watts	637 (59%)	385 (36%)	50 (5%)	
	>=258.9 watts	635 (59%)	368 (34%)	76 (7%)	
	Missing with reason	227 (51%)	194 (44%)	21 (5%)	
	Missing without reason	42 (44%)	44 (46%)	9 (9%)	
Average walk speed	<1.0237 m/s	554 (47%)	526 (45%)	101 (9%)	<0.01
	1.0238 - 1.1530 m/s	632 (54%)	462 (39%)	87 (7%)	
	1.1531 - 1.2620 m/s	658 (56%)	457 (39%)	67 (6%)	
	1.2630 - 1.3870 m/s	653 (56%)	446 (38%)	68 (6%)	
	>=1.3888 m/s	692 (58%)	430 (36%)	62 (5%)	

Narrow walk speed	>1.37 m/s	592 (58%)	371 (36%)	63 (6%)	<0.01
	1.24 - 1.37 m/s	590 (58%)	394 (39%)	37 (4%)	
	1.11 - 1.23 m/s	623 (58%)	396 (37%)	61 (6%)	
	0.95 - 1.10 m/s	591 (55%)	400 (37%)	83 (8%)	
	0.11 - 0.94 m/s	558 (48%)	519 (44%)	93 (8%)	
	No successful trials	243 (45%)	244 (46%)	48 (9%)	
Walking aids	No aids	3129 (55%)	2233 (39%)	361 (6%)	<0.01
	Aids	67 (37%)	90 (50%)	24 (13%)	
CNS medication use	No	3005 (55%)	2138 (39%)	342 (6%)	<0.01
	Yes	192 (46%)	186 (44%)	43 (10%)	
Bone disease medication	No	3140 (54%)	2256 (39%)	370 (6%)	<0.01
	Yes	57 (41%)	68 (49%)	15 (11%)	
Prostate symptoms medication	None	2667 (61%)	1516 (35%)	193 (4%)	<0.01
	Alpha blocker	236 (31%)	376 (52%)	108 (15%)	
	Proscar	42 (44%)	42 (44%)	11 (12%)	
	Herbs	204 (39%)	270 (52%)	48 (9%)	
	Alpha blocker & Proscar	16 (25%)	39 (62%)	8 (13%)	
	Alpha blocker & Herbs	27 (25%)	67 (61%)	15 (14%)	
	Proscar & Herbs	2 (29%)	5 (71%)	0 (0%)	
	All	3 (21%)	9 (64%)	2 (14%)	
Testosterone injections	No	3171 (54%)	2300 (39%)	378 (6%)	0.15
	Yes	26 (46%)	24 (42%)	7 (12%)	
Falls within past year	No	2634 (56%)	1755 (38%)	276 (6%)	<0.01
	Yes	563 (45%)	569 (46%)	109 (9%)	
Trouble with dizziness	No	2558 (58%)	1625 (37%)	239 (5%)	<0.01
	Yes	639 (43%)	699 (47%)	146 (10%)	
History of heart problems (CHF, angina, MI)	No	2541 (56%)	1708 (38%)	260 (6%)	<0.01
	Yes	656 (47%)	616 (44%)	125 (9%)	
Congestive heart failure	No	3060 (55%)	2181 (39%)	357 (6%)	<0.01
	Yes	137 (44%)	143 (46%)	28 (9%)	
Angina	No	2810 (55%)	1949 (38%)	308 (6%)	<0.01
	Yes	387 (36%)	375 (45%)	77 (9%)	
Myocardial infarction	No	2815 (55%)	1961 (39%)	315 (6%)	<0.01
	Yes	382 (47%)	363 (45%)	70 (9%)	
Arthritis	No	1795 (58%)	1135 (37%)	172 (6%)	<0.01
	Yes	1402 (50%)	1189 (42%)	213 (8%)	
Prostatitis	No	2557 (58%)	1654 (37%)	220 (5%)	<0.01
	Yes	640 (43%)	670 (45%)	165 (11%)	
COPD	No	2924 (55%)	2036 (39%)	318 (6%)	<0.01
	Yes	273 (43%)	288 (46%)	67 (11%)	
Cataracts	No	2192 (57%)	1446 (37%)	235 (6%)	<0.01
	Yes	1005 (49%)	878 (43%)	150 (7%)	

Glaucoma	No	2949 (55%)	2072 (39%)	345 (6%)	<0.01
	Yes	248 (46%)	252 (47%)	40 (7%)	
Osteoporosis	No	3116 (55%)	2224 (39%)	357 (6%)	<0.01
	Yes	81 (39%)	100 (48%)	28 (13%)	
High blood pressure	No	1897 (56%)	1272 (38%)	194 (6%)	<0.01
	Yes	1300 (51%)	1052 (41%)	191 (8%)	
Diabetes	No	2860 (54%)	2077 (39%)	329 (6%)	0.05
	Yes	337 (53%)	247 (39%)	56 (9%)	
High thyroid	No	3145 (54%)	2289 (39%)	377 (6%)	0.71
	Yes	52 (55%)	35 (37%)	8 (8%)	
Low thyroid	No	3000 (55%)	2142 (39%)	355 (6%)	0.04
	Yes	197 (48%)	182 (44%)	30 (7%)	
Prostate cancer	No	2811 (54%)	2064 (40%)	334 (6%)	0.40
	Yes	386 (55%)	260 (37%)	51 (7%)	
Contrast sensitvity	<35 (High)	840 (51%)	674 (41%)	126 (8%)	<0.01
	>=35 (Low)	2357 (55%)	1650 (39%)	259 (6%)	
Vision	<53	589 (53%)	434 (39%)	80 (7%)	0.08
	53 - 56	583 (53%)	444 (40%)	81 (7%)	
	57 - 59	668 (52%)	538 (42%)	84 (7%)	
	60 - 62	614 (55%)	442 (39%)	68 (6%)	
	>=63	743 (58%)	466 (36%)	72 (6%)	
Depth perception	Pass	2585 (54%)	1856 (39%)	317 (7%)	0.46
	Fail	225 (55%)	165 (40%)	21 (5%)	
Stroke	No	3041 (55%)	2184 (39%)	347 (6%)	<0.01
	Yes	156 (47%)	140 (42%)	38 (11%)	
Parkinson's disease	No	3180 (54%)	2297 (39%)	379 (6%)	<0.01
	Yes	17 (34%)	27 (54%)	6 (12%)	

Table 5. Relation of lower urinary tract symptom severity to risk of any incident fall in the next 12 months: MrOS cohort

	None/Mild symptoms	Moderate symptoms	Severe symptoms
Entire cohort (n=5906)			
Number of falls by LUTS severity	702	650	144
Cumulative Incidence [95% CI] of falls	22.0% [20.5%-23.4%]	27.0% [26.1%-29.8%]	37.4% [32.6%-42.2%]
Model adjusted for following variables:*	*RR [95% CI]*	*RR [95% CI]*	*RR [95% CI]*
Age	1.0 (ref)	1.3 [1.2, 1.5]	2.0 [1.6, 2.5]
+ History of falls	1.0	1.2 [1.1, 1.4]	1.9 [1.5, 2.3]
+ History of dizziness	1.0	1.2 [1.1, 1.4]	1.8 [1.4, 2.2]
Model adjusted for following variable groups:*			
+ Medical History**	1.0	1.2 [1.0, 1.3]	1.7 [1.3, 2.1]
+ Neuromuscular Function**	1.0	1.2 [1.0, 1.3]	1.6 [1.3, 2.1]
+ Demographic variables**	1.0	1.2 [1.0, 1.3]	1.6 [1.3, 2.1]
+ Lifestyle variables**	1.0	1.2 [1.0, 1.3]	1.6 [1.3, 2.1]
+ Neurological Disease variables**	1.0	1.1 [1.0, 1.3]	1.6 [1.3, 2.1]
+ Body Size variables**	1.0	1.1 [1.0, 1.3]	1.6 [1.3, 2.0]
Cohort restricted to participants without previous stroke or Parkinson disease (n=5529)			
Model adjusted for* Age + Medical History**	1.0	1.1 [1.0, 1.3]	1.6 [1.2, 2.0]
Cohort restricted to participants without previous stroke, Parkinson disease, or history of prostate cancer (n=4874)			
Model adjusted for* Age + Medical History**	1.0	1.2 [1.0, 1.3]	1.5 [1.1,1.9]

* Multivariate logistic regression analysis was used to model fall risk

** Medical History variables include arthritis, CNS medication use, and use of walking aids. Neuromuscular Function variables include narrow walk pace quintile, grip strength quintile, and chair stand time quintile. Demographic variables include self-reported quality of life, education level, and study site. Lifestyle variables include walking for exercise daily or almost daily and number of drinks per week. Neurological Disease variables include history of stroke and Parkinson's disease. Body Size variables includes body mass index quintile.

Table 6. Relation of lower urinary tract symptom severity to risk of 2 or more incident falls in the next 12 months: MrOS cohort

	None/Mild symptoms	Moderate symptoms	Severe symptoms
Number of 2 or more falls by LUTS severity	292	322	86
Cumulative Incidence [95% CI] of falls	9.1% [8.6%-9.6%]	1.4% [1.2%-1.6%]	22.3% [18.1%-26.5%]
	RR [95% CI]	*RR [95% CI]*	*RR [95% CI]*
Model* adjusted for Age	1.0 (ref)	1.6 [1.3, 1.8]	2.7 [2.1, 3.6]
Model* adjusted for Age + Medical History**	1.0 (ref)	1.3 [1.1, 1.5]	2.1 [1.5, 2.7]

* Multivariate logistic regression analysis was used to model fall risk

** Medical History variables include arthritis, CNS medication use, and use of walking aids.

Table 7. Relation of lower urinary tract symptom severity to risk of any reported fall in the next 12 months according to reported use of medications to treat prostate symptoms: MrOS cohort

	Any Use of Medication for Symptoms		Use of Finasteride (Proscar) for Symptoms	
	No	Yes	No	Yes
	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Symptom Severity*				
Mild	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Moderate/Severe	1.2 [1.1-1.4]	1.3 [1.0-1.8]	1.2 [1.1-1.4]	1.6 [0.7-3.6]

* The severity scores were obtained by assigning values of 0 to the lowest category and 5 to the highest category, and summing the values for each of the seven AUA symptom index questions. Cutpoints are 0-7 for none/mild, 8-35 for moderate/severe.

Table 8. Relation of individual lower urinary tract symptoms to risk of any fall in the next 12 months: MrOS cohort

	Frequency of symptom in the past month					
	Not at all	Less than 1 time in 5	Less than half the time	About half the time	More than half the time	Almost always
		OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]	OR [95% CI]
Had to push or strain to begin	1.0 (ref)	1.1 [0.9-1.3]	0.8 [0.6-1.0]	1.4 [1.0-2.1]	1.3 [0.8-2.2]	1.9 [0.9-3.9]
Found it difficult to postpone urination	1.0 (ref)	1.2 [1.0-1.4]	1.4 [1.1-1.7]	1.4 [1.1-1.8]	1.8 [1.3-2.3]	1.6 [1.2-2.1]
Had to urinate again < 2hrs after finishing	1.0 (ref)	1.1 [1.0-1.3]	1.2 [1.0-1.5]	1.2 [1.0-1.5]	1.3 [1.0-1.7]	1.4 [1.0-1.9]
Sensation not emptying bladder	1.0 (ref)	1.1 [0.9-1.2]	1.2 [1.0-1.5]	1.4 [1.1-1.8]	1.3 [0.9-1.8]	1.2 [0.8-1.7]
Stopped and started several times when urinating	1.0 (ref)	1.1 [1.0-1.3]	1.0 [0.8-1.3]	1.1 [0.9-1.4]	1.1 [0.8-1.7]	1.2 [0.8-1.7]
Had a weak urinary stream	1.0 (ref)	1.1 [0.9-1.3]	1.0 [0.8-1.2]	1.1 [0.9-1.4]	1.1 [0.9-1.4]	1.1 [0.9-1.5]
	None	1 time	2 times	3 times	4 times	≥5 times
Times typically get up at night	1.0 (ref)	0.8 [0.6-1.0]	0.9 [0.7-1.1]	1.0 [0.7-1.3]	1.1 [0.8-1.6]	1.2 [0.8-1.7]

Figure 1. Schedule of follow-up for participants in the MrOS cohort.

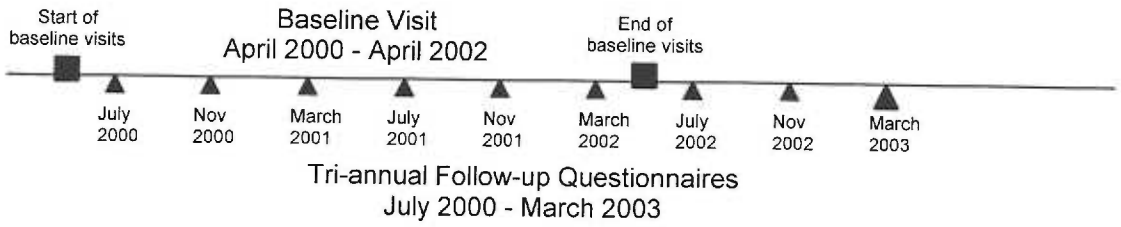

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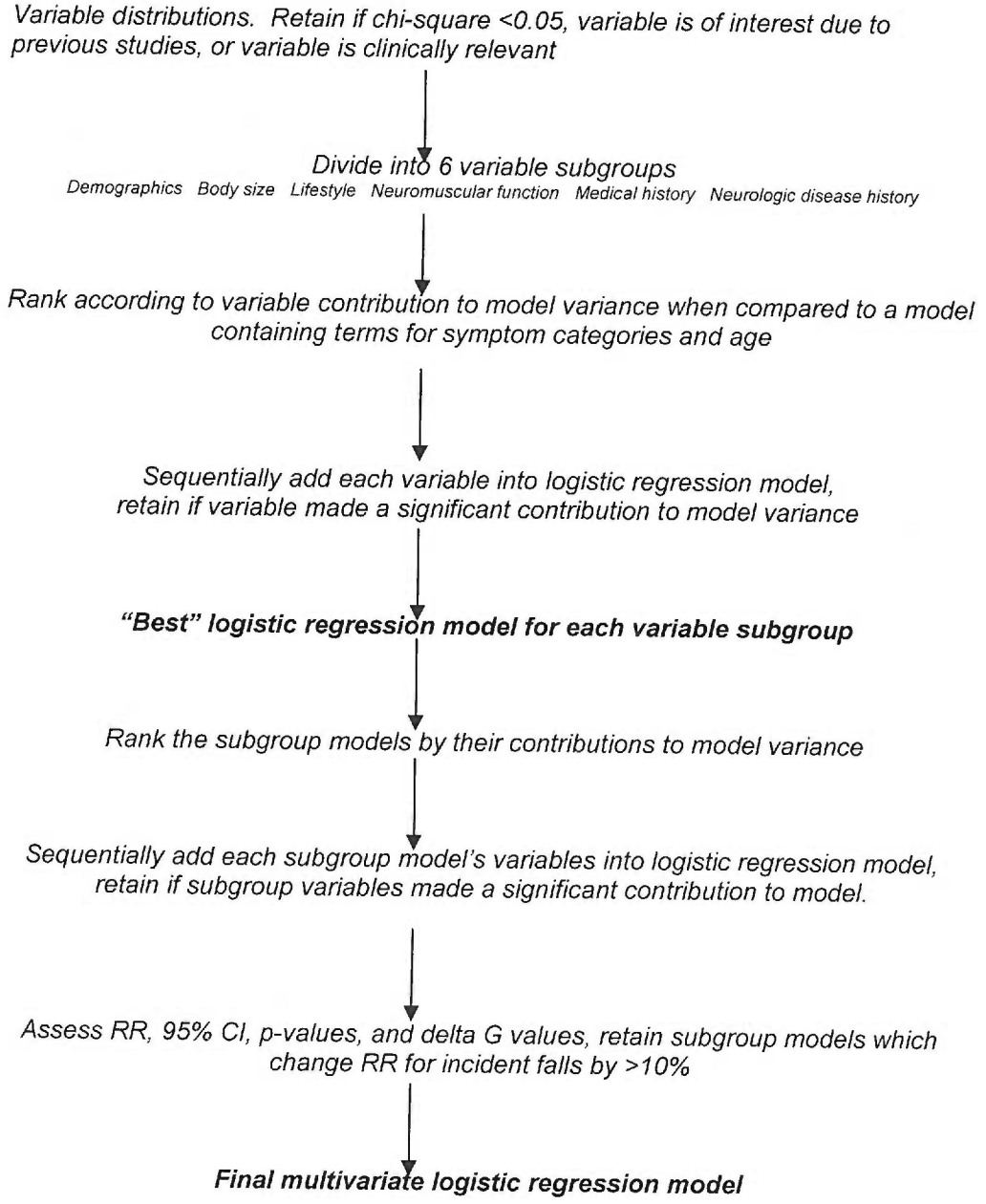
Figure 2. Flow chart to depict the steps in building the multivariate logistic regression model to estimate fall risk in relation to lower urinary tract symptom severity.



APPENDIX A. Classification of variables examined for the association of lower urinary tract symptom severity and incident falls over 12 months, by analysis subgroup.

Characteristic	Assessment Method	Classification groups
Exposure Variable		
AUA symptom category	Self-report on AUA symptom questionnaire	No/mild symptoms (AUA score of 0 to 7) (reference)
		Moderate symtpoms (AUA score of 8 to 19)
		Severe symptoms (AUA score of 20 or more)
Demographic Variables		
Age (years)	Self-report date of birth	65 - 69 (reference)
		70 - 74
		75 - 79
		≥ 80
Study site	Determined by clinic enrolled	Birmingham (reference)
		Minneapolis
		Palo Alto
		Pittsburgh
		Portland
		San Diego
Race/Ethnicity	Self-report	White (reference)
		African-American
		Asian
		Hispanic
		Other
Health Status	Self-report	Very poor/fair
		Good
		Excellent
Highest level of education	Self-report	No high school (ref)
		High school
		Some college
		College
Marital Status	Self-report	Not married/separated (ref)
		Married
Body Size Variables		
Height (cm)	Measured with a stadiometer	Quintiles: <168.55 cm (ref)
		168.55 cm - 172.34 cm
		172.35 cm - 175.74 cm
		175.75 cm - 179.69 cm
		≥179.70 cm

Weight (kg)	Measured with a standard scale	Quintiles: <72 kg (ref)
		72.0 - 78.5 kg
		78.6 - 85.1 kg
		85.2 - 93.4 kg
		≥93.5 kg
Body Mass Index (kg/m^2)	Calculated from weight and height measurements	Quintiles: >24.306 kg/m^2 (ref)
		24.306 - 26.097 kg/m^2
		26.097 - 27.897 kg/m^2
		27.897 - 30.203 kg/m^2
		≥ 30.203 kg/m^2
Lifestyle Variables		
Physical Activity Score for the Elderly (PASE)	Self-report	Quintiles: <90.00 (ref)
		90.00-126.36
		126.37-159.15
		159.16-197.50
		>=197.50
Alcohol intake	Self-report	Less than 1 per week (ref)
		1 to 6 per week
		More than 6 per week
Cigarette smoking status	Self-report	Never smoker (ref)
		Former smoker
		Current smoker
Walk for exercise daily	Self-report	No (ref)
		Yes
Neuromuscular Function Variables		
Chair stands (seconds)	Seconds to complete 5 stands without using arms	Quintiles: >13.15 sec (ref, slowest)
		11.26 - 13.15 sec
		9.90 - 11.25 sec
		8.57 - 9.89 sec
		≥8.56 sec (fastest)
Average grip strength, both hands (kg)	Measured with a dynamometer	Quintiles: <32.00 kg (ref, weakest)
		32.00 - 36.25 kg
		36.50 - 40.25 kg
		40.50 - 45.25 kg
		≥45.50 kg
		Excluded for hand pain/surgery
Maximum power of either leg (watts)	Measured with a Nottingham power rig	Quintiles: >154.1 watts (ref, weakest)
		154.1 - 189.1 watts
		189.2 - 223.2 watts
		223.3 - 258.8 watts
		≥258.9 watts
		Unable to complete
		Missing (reason unknown)

Average 6-meter walk speed (m/s)	Calculated value from the time to complete 6-meter walk	Quintiles: <1.0237 m/s (ref, slowest)
		1.0238 - 1.1530 m/s
		1.1531 - 1.2620 m/s
		1.2630 - 1.3870 m/s
		≥ 1.3888 m/s
Narrow walk speed using best time (m/s)	Calculated value from the time to complete the Narrow walk measurement	Quintiles: >1.37 m/s (ref, slowest)
		1.24 - 1.37 m/s
		1.11 - 1.23 m/s
		0.95 - 1.10 m/s
		0.11 - 0.94 m/s
		No successful trials
Medical History Variables		
Walking aids	Self-report	Does not use a walking aid (ref)
		Uses a walking aid
CNS medication use (serotonin reuptake inhibitor, benzodiazepine, or nonbenzodiazepine anticonvulsant)	Recorded via inventory	None (ref)
		Uses CNS medication
Bone disease medication	Self-report	None (ref)
		Uses bone disease medication
Prostate symptoms medication	Self-report	Does not use medication (ref)
		Uses medication
Testosterone injections	Self-report	None (ref)
		Receives injections
Falls within past year	Self-report	None (ref)
		One or more falls in past year
Trouble with dizziness (no time period specified)	Self-report	None (ref)
		Trouble with dizziness
History of heart problems (CHF, angina, or MI)	Self-report	None (ref)
		History of heart problems
History of Arthritis	Self-report	None (ref)
		History of arthritis
History of Prostatitis	Self-report	None (ref)
		History of prostatitis
History of Angina	Self-report	None (ref)
		History of angina
History of Chronic obstructive pulmonary disease (COPD)	Self-report	None (ref)
		History of COPD

History of Congestive heart failure	Self-report	None (ref) History of congestive heart failure
History of Cataracts	Self-report	None (ref) History of cataracts
History of Glaucoma	Self-report	None (ref) History of glaucoma
History of Osteoporosis	Self-report	None (ref) History of osteoporosis
History of Stroke	Self-report	None (ref) History of stroke
History of Myocardial Infarction (MI)	Self-report	None (ref) History of MI
History of High blood pressure	Self-report	None (ref) History of high blood pressure
History of Diabetes	Self-report	None (ref) History of diabetes
History of High thyroid	Self-report	None (ref) History of high thyroid
History of Low thyroid	Self-report	None (ref) History of low thyroid
History of Prostate Cancer	Self-report	None (ref) History of prostate cancer
Contrast sensitivity	Score from Pelli-Robson measurement	> 35 (ref, greater sensitivity) ≤ 35
Vision Acuity	Score from Bailey-Lovie test	<53 (ref, poorer vision acuity) 53 - 56 57 - 59 60 - 62 ≥ 63
Depth Perception	Frisby Stereo test	Pass (ref) Fail
Neurologic Disease Variables		
History of Stroke	Self-report	None (ref) History of stroke
History of Parkinson's disease	Self-report	None (ref) History of Parkinson's disease