Associations Between Modest Weight Changes and Onset and Progression of Lower Urinary Tract Symptoms in Two Population-based Cohorts

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OBJECTIVES To conduct a study to determine whether weight changes were associated with the risk of developing lower urinary tract symptoms (LUTS). Obesity has been associated with LUTS in aging men.

METHODS The study population consisted of men participating in the Olmsted County Study of Urinary Symptoms and Health Status among Men and the Flint Men's Health Study. Weight loss and weight gain were defined as a change of ≥5% of the baseline weight. LUTS progression was measured by calculating the American Urological Association Symptom Index (AUASI) score slopes for 4 years of follow-up in both cohorts. Additional Cox proportional hazard models were constructed to determine whether the weight changes were associated with the later development of moderate-to-severe symptoms or with a ≥4-point increase in the AUASI score (Olmsted County Study of Urinary Symptoms and Health Status among Men cohort only).

RESULTS Weight changes were not associated with LUTS progression (all $P > .05$). Additionally, the rate at which the AUASI scores changed did not vary by the weight change. Finally, in the Olmsted County Study of Urinary Symptoms and Health Status among Men cohort, the weight changes were not associated with risk of having a moderate-to-severe AUASI score or a ≥4-point increase in the AUASI score.

CONCLUSIONS Modest weight loss might not prevent the onset or progression of LUTS. However, modest weight gain also might not contribute to changes in LUTS. UROLOGY 78: 437–441, 2011.

Lower urinary tract symptoms (LUTS) affect a substantial proportion of aging men, ranging from 10% among men in their 40s to >70% among men aged ≥80 years.[1-4] Moderate-to-severe LUTS are associated with a substantially decreased quality of life.[5-7] Moreover, the annual healthcare costs associated with the treatment of LUTS (and associated benign prostatic hyperplasia [BPH]) are substantial, with estimates ranging from 2 to 4 billion dollars annually.[8,9] Therefore, behavioral interventions that safely and reliably reduce a man's need for medical therapy and/or surgery are likely to promote health, improve quality of care, and have significant economic implications.

With some studies suggesting that heavier men, or those with larger waist circumferences, are more likely to have LUTS,[10-13] weight loss could be 1 such intervention. However, previous studies reported cross-sectional associations, and it remains unknown how a man's weight might affect the development of LUTS over time. More importantly, it remains unclear whether changes in weight, either weight loss or weight gain, might be asso-

Funding Support: *The original Olmsted County Study cohort was established through funding from Merck Research Laboratories. Data collection was additionally supported by the National Institutes of Health (grants DK058859, AG034676, and RR24150). The analyses were supported by the Urologic Diseases in America Project (N01-DK-7-0003).*

S. J. Jacobsen performs research studies for Beckman Coulter and Merck and is an unpaid consultant for Merck.

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Submitted: December 16, 2010, accepted (with revisions): March 29, 2011

0090-4295/11/$36.00
doi:10.1016/j.urology.2011.03.054

ciated with the likelihood of developing LUTS or the likelihood of LUTS progression. For example, if weight loss is associated with a decreased risk of later developing LUTS, or if weight loss slows the progression of LUTS, high-risk groups could be targeted with weight loss treatment plans to reduce the incidence of this common condition.

To address these questions, we took advantage of the longitudinal data available from 2 cohort studies of community-dwelling men: The Olmsted County Study of Urinary Symptoms and Health Status among Men (OCS) and the Flint Men's Health Study (FMHS). The OCS and FMHS have very similar designs, but the OCS included only white men and the FMHS included only black men. Combining data from these 2 population-based cohorts provided the ideal opportunity to determine whether changes in weight were associated with the onset and progression of LUTS in 2 racially diverse populations.

MATERIAL AND METHODS

Study Populations

Olmsted County Study. The initial study cohort was constructed through the creation of an age-stratified sampling frame that identified approximately 95% of the men aged 40-79 years predicted to be residing in Olmsted County, Minnesota, by the 1990 U.S. Census.[3,14] The community medical records of a random sample of potential participants were screened for indications of prostate surgery, denervated or surgically treated bladder, urethral stricture, or debilitating central nervous system disease. After exclusion of the men with these characteristics, 3874 were invited to participate, and 2115 (55%) were enrolled in the cohort. All study participants were visited in their homes by the study coordinators. At that time, the participants completed questionnaires that included questions similar to the American Urological Association Symptom Index (AUASI).

All the men in the cohort have been followed up biennially since 1990. At each round of follow-up, all men completed similar questionnaires, including the AUASI. The men who died or were lost to follow-up during the study course were replaced during rounds 2 and 3, resulting in a total of 2447 study participants. The ninth round of follow-up (16 years) was completed in August 2007, and the median length of follow-up for the men in this cohort was 13.8 years (25th and 75th percentile 9.2 and 15.7 years). The analyses in the present study included men who participated in rounds 1 and 3 and had weight measures available at both points (n = 1674).

Flint Men's Health Study. The FMHS cohort was designed to be a parallel cohort for the OCS. In the FMHS, a probability sample of black men was selected from households located in Genesee County, Michigan, in 1996.[15] The eligible men were stratified into 10-year age groups: 40-49, 50-59, 60-69, and 70-79. Men in the older age groups, 60-79 years, were oversampled. A subject was ineligible if he reported a history of prostate cancer or previous surgery on the prostate gland. A trained interviewer from the University of Michigan Institute for Social Research contacted each sample household, identified 732 eligible subjects, and performed a detailed in-home interview. This interview included completion of the AUASI and demographic and other lifestyle information.

At 4 years after baseline (2000), 432 of the men who participated in the baseline clinical examination were eligible and invited to complete the same study protocol. Of the 432 men, 186 (43%) were available and agreed to participate. Men with positive biopsy results, missing round 1 data, or missing weight data were removed from the analyses (n = 18), leaving 168 men who participated in both baseline and follow-up rounds.

Measurement of Weight Change

Weight was measured for all study participants by a study assistant at baseline and at approximately 4 years of follow-up for all men in both the OCS and the FMHS using a standard protocol and a beam balance scale.[16] For the present study, weight loss and weight gain were defined as weight lost or gained between the baseline measurement and 4 years after initial enrollment. Given data suggesting that even modest weight loss might have clinical benefit, weight loss was classified as any weight loss and as a loss of ≥5% of the baseline body weight.[17] Weight gain was also defined as any weight gain and a gain of ≥5% of the baseline body weight. All analyses were performed using both definitions; however, the results were similar, regardless of the definition. Therefore, only the results for changes of ≥5% of the baseline body weight are presented.

Measuring Changes in LUTS

At least 4 years of follow-up were available for both the OCS and the FMHS cohorts. For the initial analyses, changes in LUTS were measured by calculating the annual change in the AUASI score from baseline to 4 years of follow-up. The development of moderate-to-severe LUTS (AUASI score >7) and having at least a 4-point increase in the AUASI score were also examined as secondary endpoints in the OCS cohort.

Statistical Analysis

The characteristics of the combined study populations at baseline and 4 years of follow-up are presented. The measurements across weight change categories were assessed and tested for trends. Analyses were adjusted for age and race. The empirical distribution of the annual change (points/year) in the AUASI score was calculated by dividing the difference between the baseline and 4-year follow-up AUASI score measures by the number of years between the measurements. Additionally in the OCS men, Cox proportional hazards models were used to estimate the associations between the changes in weight and the future development of adverse urologic outcomes. Follow-up was from the definition of weight change (4-year follow-up) until the first occurrence of the outcome analyzed or the date of the last follow-up point. Separate analyses were conducted for each outcome, and the men with the outcome before the 4-year follow-up point (prevalent cases) were removed. Multivariate models were used to adjust for potential confounders, including baseline age, weight, diabetes, hypertension, and regular physical activity.

RESULTS

The study population consisted of 168 black men and 1674 white men. The characteristics of the combined study population are listed in Table 1. At 4 years of follow-up, 8% of the population had lost ≥5% of their baseline

Table 1. Study population characteristics (n = 1842)

Characteristic	Value
Baseline	
Age (y)	54.0 (47.2, 63.1)
Weight (kg)	84.8 (77.1, 94.4)
BMI (kg/m^2)	26.9 (24.5, 29.4)
AUASI score	5 (2, 9)
At 4-y follow-up point	
Weight (kg)	87.9 (79.0, 98.0)
Change in weight (kg)	3.1 (−0.2, 6.2)
BMI (kg/m^2)	28.3 (25.8, 31.1)
Change in BMI (kg/m^2)	1.4 (0.3, 2.5)
AUASI score	6 (2, 10)
From baseline to 4-y follow-up	
No weight loss	1367 (74.2)
Lost <5% of baseline weight	328 (17.8)
Lost ≥5% of baseline weight	147 (8.0)
From baseline to 4-y follow-up	
No weight gain	483 (26.2)
Gained <5% of baseline weight	621 (33.7)
Gained ≥5% of baseline weight	738 (40.1)

BMI = body mass index; AUASI = American Urological Association Symptom Index.

Data presented as median, with interquartile range in parentheses (quartile 1, quartile 3) or numbers, with percentages in parentheses.

weight, and 40% of the population had gained ≥5% of their baseline weight.

Age was strongly associated with changes in urinary symptoms during the 4-year period, with older men more likely to experience an increase in the AUASI score during that period (Table 2). However, weight loss and weight gain were not significantly associated with changes in the AUASI score (Table 2). Additionally, the rate at which the AUASI scores changed did not vary with the occurrence of a weight change (Table 3). The men who lost ≥5% of their baseline weight had a median annual increase of 0.3 points in their AUASI score annually compared with a median change of 0 points annually among those who did not lose any weight. Similarly, men who gained ≥5% of their baseline weight had a median change in their AUASI score the same as those who did not gain any weight (0 points annually in both groups; Table 3).

Finally, we examined the risk of developing moderate-to-severe symptoms (AUASI score >7) or having a 4-point increase in AUASI score after 4 years of follow-up in the OCS cohort. Neither weight loss nor weight gain were associated with the risk of having a moderate-to-severe AUASI score or at least a 4-point increase in the AUASI score (Table 4).

COMMENT

In the present study, we found that modest weight changes during a 4-year period were not associated with the risk of developing moderate-to-severe LUTS. Additionally, weight changes were not associated with the rate at which LUTS progressed. Although modest weight loss might have other health benefits, these data suggest that neither weight loss nor weight gain play a substantial role in LUTS progression.

Several studies have linked being overweight, or having a larger waist circumference, to an increased prevalence of LUTS.[10,12,13] These previous studies were cross-sectional; therefore, it was not possible to determine whether changes in weight might influence the development of the onset of LUTS. Kristal et al[11] conducted a longitudinal study among men participating in the Prostate Cancer Prevention Trial and found that men with a greater body mass index (BMI) or a larger waist/hip ratio were more likely to develop severe LUTS than men with a lower BMI or smaller waist/hip ratio. In that study, LUTS were defined as an International Prostate Symptom Score of ≥15, corresponding to "severe" LUTS as measured by the AUASI. It could be that a greater BMI or waist/hip ratio is a risk factor for later developing severe LUTS, but not more moderate LUTS. In our study, modest weight loss was not associated with the risk of developing either moderate or severe LUTS, suggesting that although greater BMI might be a risk factor for developing severe LUTS, modest weight loss might not influence the development of either moderate or severe LUTS (data not shown). It is not clear, however, why modest weight gain was not associated with LUTS development or progression in our study. A relatively small proportion of our population were in the obese BMI range, and a small proportion had severe LUTS, compared with those in the study by Kristal et al.[11] If obese men are the most likely to develop severe LUTS, we might not have had the power to detect such an association in our study. However, our results suggest that men in the normal to overweight BMI categories might not be at high risk of moderate-to-severe LUTS if their weight increases by ≥5%.

Because our study was not a clinical trial, it is possible that uncontrolled confounders could have been responsible for the lack of association we observed between modest weight changes and the development of LUTS. For example, it was not possible for us to determine the reasons for the weight changes in our study population. Men who lost ≥5% of their baseline weight were older than those who had lost less weight, and it is possible that these men developed age-related conditions that resulted in weight loss but also increased their risk of LUTS. We conducted a secondary analysis stratifying our results by baseline age; however, we still did not observe a protective effect of weight loss in the younger age group (data not shown).

It is also possible that our lack of association between weight loss and LUTS is because more significant weight changes are necessary to see positive associations. A weight change of ≥5% corresponded to a loss or gain of approximately 9 lb in the OCS cohort and 9.7 lb in the FMHS cohort. A more significant change in weight (such as ≥10% of baseline weight) could potentially have been significantly associated with these outcomes. Very few

Table 2. Associations between changes in weight and changes in urologic outcomes during 4 years of follow-up*

Characteristic	Decrease in AUASI Score (n = 702)	No Change in AUASI Score (n = 232)	Increase in AUASI Score (n = 904)	*P* Value†
Baseline age (y)	52.4 (46.5, 62.2)	51.6 (45.5, 59.0)	55.3 (48.6, 64.2)	<.0001
Baseline weight (kg)	86.2 (77.1, 95.3)	85.5 (78.4, 94.3)	83.9 (75.8, 93.8)	.51
Baseline BMI (kg/m^2)	27.0 (24.5, 29.5)	27.2 (25.0, 29.4)	26.6 (24.4, 29.3)	.49
Weight loss				.68
No weight loss	515 (73.4)	179 (77.1)	672 (74.3)	
Lost <5% of baseline weight	135 (19.2)	41 (17.7)	149 (16.5)	
Lost ≥5% of baseline weight	52 (7.4)	12 (5.2)	83 (9.2)	
Weight gain				.47
No weight gain	191 (27.2)	53 (22.8)	236 (26.1)	
Gained <5% of baseline weight	226 (32.2)	91 (39.2)	303 (33.5)	
Gained ≥5% of baseline weight	285 (40.6)	88 (37.9)	365 (40.4)	

Abbreviations as in Table 1.
Data presented as median, with interquartile range (quartile 1, quartile 3) in parentheses or numbers, with percentages in parentheses.
* Four men did not have AUASI score assessment at baseline; thus, change in AUASI score could not be calculated and their data were excluded.
† Test for trend *P* value adjusted for age and race.

Table 3. Rate of change in AUASI score (points/year) by weight change categories*

Variable	Patients (n)	Median (Q1, Q3)	*P* Value†
Weight loss			.32
No weight loss	1366	0.0 (−0.5, 0.9)	
Lost <5% of baseline weight	325	0.0 (−0.6, 0.9)	
Lost ≥5% of baseline weight	147	0.3 (−0.4, 1.1)	
Weight gain			
No weight gain	480	0.0 (−0.6, 0.9)	.79
Gained <5% of baseline weight	620	0.0 (−0.5, 0.9)	
Gained ≥5% of baseline weight	738	0.0 (−0.5, 0.9)	

AUASI = American Urological Association Symptom Index; Q = quartile.
* Four men did not have AUASI score assessment at baseline; thus, change in AUASI score could not be calculated and their data were excluded.
† Adjusted for baseline age and race.

Table 4. Risk of developing elevated AUASI score by weight change category (OCS cohort only)

	AUASI Score >7		4-Point Increase in AUASI Score	
	Unadjusted* HR (95% CI)	Adjusted† HR (95% CI)	Unadjusted* HR (95% CI)	Adjusted† HR (95% CI)
No weight loss	Reference	Reference	Reference	Reference
Lost <5% of baseline weight	1.03 (0.77, 1.37)	0.95 (0.71, 1.28)	1.05 (0.85, 1.29)	1.00 (0.81, 1.25)
Lost ≥5% of baseline weight	1.21 (0.81. 1.80)	1.06 (0.71, 1.59)	1.04 (0.77, 1.42)	0.96 (0.70, 1.32)
No weight gain	Reference	Reference	Reference	Reference
Gained <5% of baseline weight	0.93 (0.70, 1.23)	0.99 (0.75, 1.31)	0.96 (0.78, 1.17)	0.99 (0.80, 1.22)
Gained ≥5% of baseline weight	0.95 (0.73, 1.24)	1.05 (0.80, 1.38)	0.95 (0.77, 1.15)	1.01 (0.83, 1.24)

AUASI = American Urological Association Symptom Score; OCS = Olmsted County Study of Urinary Symptoms and Health Status among Men; HR = hazard ratio; CI = confidence interval.
* Prevalent cases (859 of 1674 men for AUASI score >7 and 483 of 1674 men for 4-point increase in AUASI index) of each outcome removed.
† Analyses adjusted for baseline age, weight, diabetes, hypertension, and regular physical activity.

men in our study had a weight loss of this magnitude (35 men [2.1%] in the OCS and 10 men [6.0%] in the FMHS). However, 211 men (12.6%) in the OCS and 15 men (8.9%) in the FMHS had a weight gain of ≥10%. We conducted secondary analyses examining the associations between these larger changes and the outcomes of interest and still did not observe significant associations between these levels of weight change and LUTS onset or progression (data not shown). Finally, a significant proportion of both study populations were lost to follow-up during the study period. However, the characteristics of those lost to follow-up did not differ substantially from those who remained in the study, suggesting that participation bias was unlikely to account for our findings.[18,19]

CONCLUSIONS

We found that a weight loss or weight gain of ≥5% of the baseline body weight was not associated with the onset or progression of LUTS in 2 populations of aging men. These results suggest that modest weight loss might have limited utility in preventing LUTS onset or progression. However, modest weight gain also might not promote the onset or progression of LUTS.

Acknowledgment. To the men who participated in the Olmsted County Study (OCS) and the Flint Men's Health Study (FMHS), the study personnel, and Kristie Shorter for her assistance in preparation of this report.

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