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Associations of Obesity with Lower Urinary Tract Symptoms and Noncancer Prostate Surgery in the Third National Health and Nutrition Examination Survey

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The authors examined the association between obesity and lower urinary tract symptoms (LUTS) in the Third National Health and Nutrition Examination Survey. This 1988–1994 US cross-sectional study included 2,797 men aged ≥60 years whose current weight, weight at age 25 years, highest weight ever, height, waist circumference, and body mass index (BMI) were assessed. LUTS cases had at least three of these symptoms: nocturia, incomplete emptying, weak stream, and hesitancy. Controls were men without symptoms or noncancer prostate surgery. Odds ratios adjusted for age and race and weighted for selection probability were estimated by logistic regression. The odds of LUTS were lower for men who were obese at age 25 years compared with men whose BMI was normal (odds ratio = 0.49, 95% confidence interval: 0.27, 0.91). An increase in BMI between age 25 years and the highest BMI ever was positively associated with LUTS (odds ratio = 1.90, 95% confidence interval: 0.89, 4.05). Men with a larger waist circumference (≥102 cm) were more likely to have LUTS compared with men with a smaller waist circumference (odds ratio = 1.48, 95% confidence interval: 0.87, 2.54). Results suggest that being overweight in young adulthood may be associated with a lower prevalence of LUTS later in life, whereas weight gain and central adiposity in adulthood are possibly associated with a higher prevalence of LUTS.

nutrition surveys; obesity; prostate; surgery; urinary tract

Abbreviations: BMI, body mass index; LUTS, lower urinary tract symptoms; NHANES III, Third National Health and Nutrition Examination Survey.

Lower urinary tract symptoms (LUTS), often the result of benign prostatic hyperplasia, are common among older men and have a negative impact on quality of life. A prior analysis of data from the Third National Health and Nutrition Examination Survey (NHANES III) reported that 22 percent of US men aged 70–79 years had had noncancer prostate surgery presumably for LUTS and that the prevalence of specific LUTS increased with age (1). No modifiable risk factors for LUTS or underlying pathology have been conclusively identified.

Prostate size or prostate growth rate has been found to be positively associated with anthropometric measures such as body mass index (BMI) or waist-to-hip ratio (2), but the associations are less clear for LUTS and noncancer prostate surgery, including transurethral resection of the prostate. Positive associations between anthropometric measures of obesity and LUTS as well as noncancer prostate surgery were observed in one cohort study (3) but not in another (4).

By using data from NHANES III, a nationally representative sample of noninstitutionalized US men (5), we examined cross-sectionally the association between obesity, especially central adiposity, and the frequency of LUTS in men aged 60 years or older. We explored body weight and BMI in early adulthood as well as changes in BMI as risk factors for LUTS and noncancer prostate surgery (as an indicator of more severe symptomatic LUTS).

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MATERIALS AND METHODS

Participants

Included in the analysis were men 60 years of age or older who participated in NHANES III. This cross-sectional study consists of a multistage, stratified, clustered probability sample of the US civilian, noninstitutionalized population at least 2 months of age and was conducted by the National Center for Health Statistics, Centers for Disease Control and Prevention between 1988 and 1994 (5). Subjects participated in an interview conducted at home and an extensive physical examination, which included a blood sample, performed at a mobile examination center. Mexican Americans, African Americans, and the elderly were oversampled to ensure minimum sample sizes of these population groups. Of 3,117 men aged 60 years or older, we excluded those who had a mobility impairment (n = 103) or were not self-respondents (n = 133). We further excluded 84 men who reported during the interview having had a prostate cancer diagnosis at some point prior to the interview. The remaining 2,797 men were included in the analysis.

Outcome assessment

Men aged 60 years or older were asked about the following symptoms: 1) How many times per night do you usually get up to urinate (pass water)? ("nocturia"); 2) when you urinate (pass water), do you usually feel like you have not completely emptied your bladder? ("incomplete emptying"); 3) do you usually have trouble starting to urinate (pass water)? ("hesitancy"); and 4) has the force of your urinary stream of water decreased over the years? ("weak stream"). Additionally, men were asked whether they had ever had surgery for their prostate not related to cancer ("noncancer prostate surgery").

The four above-mentioned symptoms are components of the American Urological Association symptom index (6), which further includes questions on frequency, intermittence, and urgency. This index discriminates between men with benign prostatic hyperplasia and controls in the clinical setting (6). Because the frequency, intermittence, and urgency symptoms were not assessed in NHANES III, we could not compute the standardized symptom index. Thus, in the present analysis, men were considered LUTS cases if they reported three or four of the symptoms (excluding those men who reported noncancer prostate surgery). Nocturia was included as a symptom when men had to get up at least twice per night. Men who reported ever having had noncancer prostate surgery were considered a separate group of cases. These men are likely those with the most severe or bothersome LUTS. The comparison group consisted of men who did not report any of the four symptoms and who never had noncancer prostate surgery. Because individually these symptoms are not specific for benign prostatic hyperplasia, men who had only one or two symptoms were not considered cases, nor were they included in the comparison group.

Exposure assessment

Self-reported current body weight, body weight at age 25 years, highest body weight ever, and current height were used to calculate BMI (body weight in kilograms divided by the square of height in meters) for each assessed point in life. Current body weight and height were also assessed during a physical examination that was part of NHANES III. However, since only self-reported weight was available for former ages and self-reported and measured current BMI were highly correlated (r = 0.93), we used self-reported current height and body weight to be consistent over time. Results for BMI in which measured height and weight were used gave similar inferences, however. BMI was categorized as <25.0 kg/m^2 (normal), 25.0–29.9 kg/m^2 (overweight), and ≥30.0 kg/m^2 (obese). Additionally, we computed change in BMI from age 25 years to the age at interview as well as change in BMI between age 25 years and the highest BMI ever. For BMI increase, we considered men with a small BMI gain, from 0 to 0.99 kg/m^2, as the comparison group and created tertiles for men whose BMI gain was ≥1.00 kg/m^2. Current waist and hip circumferences were measured during the physical examination. We divided waist circumferences into three categories: low (<94.0 cm), medium (94.0–101.9 cm), and high (≥102 cm). The cutpoints have been suggested as indicators for weight management (7).

Statistical analysis

Statistical analyses were performed by using SAS version 8.1 (SAS Institute, Inc., Cary, North Carolina) and SUDAAN software (8). We used sample weights that took into account several features of the NHANES III survey: the specific probabilities of selection for the individual domains that were oversampled as well as nonresponse and differences between the sample and the total US population (5).

For several indicators of body habitus, logistic regression was used to calculate odds ratios and 95 percent confidence intervals for having three or four LUTS or of having had noncancer prostate surgery compared with having no symptoms or surgery. We adjusted for age (in 5-year categories) and race (non-Hispanic Black, non-Hispanic White, Mexican American, other). Including other possible risk factors for LUTS and benign prostatic hyperplasia in the models, such as cigarette smoking (never, former, current), alcohol intake (at least one alcoholic drink per month or less; assessed by using a food frequency questionnaire), frequency of leisure-time moderate and vigorous physical activity (assessed by interview), and energy intake (assessed by using a 24-hour dietary recall), did not substantially alter the results. Trend tests were performed by assigning to each subject the median value for the category of the risk factor in which the subject belonged and modeling this term as a continuous variable, the coefficient for which was evaluated by using the Wald test.

We determined the joint association of waist circumference (<102, ≥102 cm) and current BMI (<30 or ≥30 kg/m^2) with LUTS or noncancer prostate surgery by entering into the model terms for the combination of the two anthropometric variables; the reference category was normal-to-

TABLE 1. Age-adjusted baseline characteristics* of male study participants aged 60 years or older, Third National Health and Nutrition Examination Survey, 1988–1994

	No symptoms and no surgery	One or two symptoms, no surgery	Three or four symptoms, no surgery	Noncancer prostate surgery
Unweighted sample size (no.)	715	1,304	326	452
% of total sample	28.8	46.7	10.3	14.1
Age (years) (mean (SE†))	67.6 (0.3)	69.5 (0.2)	71.0 (0.6)	73.9 (0.6)
Energy intake (kcal/day) (mean (SE))	2,021 (40)	2,087 (31)	1,854 (64)	2,063 (64)
Current height‡ (inches§) (mean (SE))	69.0 (0.13)	69.3 (0.10)	69.2 (0.15)	69.0 (0.29)
Current weight‡ (pounds§) (mean (SE))	176.9 (1.41)	181.2 (1.24)	179.5 (1.63)	171.3 (2.33)
Current BMI†,¶ (mean (SE))	27.0 (0.19)	27.4 (0.17)	27.2 (0.26)	26.2 (0.32)
Current waist circumference# (cm) (mean (SE))	100.4 (0.66)	101.1 (0.50)	101.2 (0.65)	99.1 (0.87)
Current hip circumference# (cm) (mean (SE))	99.9 (0.47)	100.5 (0.37)	100.3 (0.50)	98.4 (0.64)
Former smoker (%)	47.8	58.5	57.3	57.9
Current smoker (%)	23.8	14.9	19.3	12.0
At least one alcoholic drink per month (%)	52.5	51.3	41.6	46.3
Non-Hispanic White (%)	85.8	84.7	86.2	84.7
Non-Hispanic Black (%)	6.9	8.9	7.5	6.6
Mexican American (%)	1.9	2.2	3.7	2.9
Other race (%)	5.5	4.1	2.6	5.8
Years of education (no.) (mean (SE))	11.3 (0.2)	11.4 (0.2)	10.4 (0.4)	11.2 (0.3)

* All percentages and means were calculated by using sampling weights and were adjusted for age.
† SE, standard error of the mean; BMI, body mass index (weight (kg)/height (m)^2).
‡ Self-reported during the interview.
§ 1 inch = 2.54 cm; 1 pound = 0.45 kg.
¶ Calculated from self-reported height and weight.
# Measured during the physical examination.

overweight current BMI and a low-to-medium current waist circumference. We tested for multiplicative interaction by including a cross-product term for waist circumference (<102, ≥102 cm) and current BMI (<30 or ≥30 kg/m^2) along with the main effect terms for each in the logistic regression model. The statistical significance of the cross-product term was evaluated by using the Wald test. Similar analyses were conducted to examine the joint effects of BMI at age 25 years (using a cutoff point of ≥25 kg/m^2 to ensure a sufficient sample size in each group since men were leaner at age 25 years than they were at the time of the interview) and increase in BMI between age 25 years and the highest BMI ever, and joint effects between BMI at age 25 years and current waist circumference.

RESULTS

After weighting was applied to account for selection probability, nonresponse, and representativeness, 28.8 percent of the men did not have any of the four LUTS and never had noncancer prostate surgery. A total of 46.7 percent had one or two symptoms (but no surgery), and 10.3 percent had three or four symptoms (but no surgery) (table 1). "Weak stream" was the symptom reported most often (42.8 percent). About 14 percent of the men had ever had noncancer prostate surgery. Men who had neither symptoms nor surgery were younger than men who reported LUTS or surgery. After we took age into account, mean energy intake was lower among men with LUTS than among men who had had noncancer prostate surgery as well as among men without symptoms or surgery. Additionally, men who reported neither symptoms nor surgery more often reported drinking at least one alcoholic beverage per month compared with men who had three or four symptoms or had had surgery, and they were more often current smokers. Men who had had surgery had a lower current body weight and lower waist and hip circumferences than men in the other three groups.

The prevalence of a current BMI of ≥25 kg/m^2 was 71.2 percent among men without LUTS, 74.3 percent among LUTS cases, and 63.1 percent among noncancer prostate surgery cases. We did not observe a significantly higher odds of LUTS for men who were currently overweight or obese compared with men whose current BMI was normal (table 2). Current weight and height were not significantly associated with LUTS or noncancer prostate surgery (data not shown). Men whose highest BMI ever was ≥30 kg/m^2 did not report LUTS more often than did men whose highest

TABLE 2. Odds ratios* for LUTS† or noncancer prostate surgery by current BMI,† BMI at age 25 years, and highest BMI ever for men aged 60 years or older, Third National Health and Nutrition Examination Survey, 1988–1994

	BMI			p for trend
	<25	25–29.9	≥30	
Current BMI				
LUTS				
OR†,‡ (95% CI†)	1.00	1.15 (0.70, 1.89)	1.25 (0.73, 2.16)	0.38
OR§ (95% CI)	1.00	0.83 (0.47, 1.49)	0.76 (0.31, 1.86)	0.61
Surgery				
OR‡ (95% CI)	1.00	0.73 (0.44, 1.11)	0.68 (0.41, 1.20)	0.13
OR§ (95% CI)	1.00	0.65 (0.30, 1.40)	0.52 (0.18, 1.45)	0.22
BMI at age 25 years				
LUTS				
OR‡ (95% CI)	1.00	0.64 (0.41, 0.98)	0.49 (0.27, 0.91)	0.009
OR§ (95% CI)	1.00	0.54 (0.32, 0.91)	0.44 (0.23, 0.82)	0.006
Surgery				
OR‡ (95% CI)	1.00	0.77 (0.49, 1.19)	0.34 (0.12, 0.95)	0.04
OR§ (95% CI)	1.00	0.76 (0.48, 1.21)	0.35 (0.11, 1.11)	0.06
Highest BMI ever				
LUTS				
OR‡ (95% CI)	1.00	1.11 (0.49, 2.54)	1.39 (0.66, 2.93)	0.19
OR§ (95% CI)	1.00	0.82 (0.32, 2.12)	0.83 (0.31, 2.22)	0.91
Surgery				
OR‡ (95% CI)	1.00	0.72 (0.38, 1.35)	0.67 (0.36, 1.24)	0.30
OR§ (95% CI)	1.00	0.91 (0.43, 1.93)	0.82 (0.36, 1.87)	0.66

* All results were calculated by using sampling weights.

† LUTS, lower urinary tract symptoms; BMI, body mass index (weight (kg)/height (m)^2); OR, odds ratio; CI, confidence interval.

‡ Adjusted for age and race.

§ Adjusted for age, race, and waist circumference.

BMI ever was <25 kg/m^2 (table 2). However, men who were overweight or obese in young adulthood tended to have a lower prevalence of LUTS and noncancer prostate surgery.

After we adjusted for BMI at age 25 years, men's odds of LUTS (p = 0.05) but not surgery (p = 0.35) increased with increasing BMI between age 25 years and highest BMI ever compared with those for men whose increase in BMI ranged from 0 to 0.99 kg/m^2 (table 3). Similar, but weaker and not statistically significant associations were observed for changes in BMI between age 25 years and age at interview (not shown). We considered the joint effects of BMI at age 25 years and BMI gain in adulthood (table 4). Compared with men who had a normal BMI at age 25 years and a modest BMI gain, men who had a normal BMI at age 25 years and a substantial BMI gain during adulthood had an elevated odds of LUTS, whereas those men who had a high BMI at age 25 years and a substantial gain in BMI during adulthood did not have an elevated odds. When the same comparison group was used, men who had a high BMI at age 25 years and a modest BMI increase had a reduced odds of LUTS. When we used an alternative comparison group of men who had a higher BMI at age 25 years but whose gain in BMI was only modest, we found that men whose BMI at age 25 years was normal but who had a large gain in BMI in adulthood had a significantly higher odds of LUTS (odds ratio = 2.24, 95 percent confidence interval: 1.21, 4.12).

Currently having a larger waist circumference (≥102 cm) was positively associated with LUTS (table 5) but was slightly inversely associated with noncancer prostate surgery. To explore whether overall obesity in adulthood or central adiposity in particular is more likely to contribute to LUTS symptomatology, we mutually adjusted BMI and waist circumference. Waist circumference reflects overall obesity and the variation in abdominal fat mass, whereas BMI represents overall obesity and lean body mass. Therefore, BMI adjusted for waist circumference basically represents lean body mass. The association between current BMI and LUTS was attenuated, while the inverse association of BMI at age 25 years with LUTS and surgery became stronger after we adjusted for current waist circumference

TABLE 3. Odds ratios* for LUTS† or noncancer prostate surgery by increase in BMI† between age 25 years and highest BMI ever for men aged 60 years or older, Third National Health and Nutrition Examination Survey, 1988–1994

	Increase in BMI				*p* for trend
	0–0.99	1.00–4.44	4.45–7.49	>7.49	
LUTS					
OR†,‡ (95% CI†)	1.00	1.22 (0.56, 2.65)	1.63 (0.77, 3.46)	1.90 (0.89, 4.05)	0.05
OR§ (95% CI)	1.00	1.33 (0.65, 2.73)	1.58 (0.75, 3.33)	1.56 (0.64, 3.79)	0.53
Surgery					
OR‡ (95% CI)	1.00	1.14 (0.59, 2.22)	1.31 (0.64, 2.69)	0.83 (0.43, 1.58)	0.35
OR§ (95% CI)	1.00	1.04 (0.51, 2.15)	1.35 (0.51, 3.57)	0.81 (0.33, 1.94)	0.52

* All results were calculated by using sampling weights.
† LUTS, lower urinary tract symptoms; BMI, body mass index (weight (kg)/height (m)^2); OR, odds ratio; CI, confidence interval.
‡ Adjusted for age, race, and BMI at age 25 years.
§ Adjusted for age, race, BMI at age 25 years, and waist circumference.

(table 2). The association of increase in BMI between age 25 years and highest BMI ever with LUTS was attenuated after adjustment for current waist circumference (table 3). However, the association of current waist circumference with LUTS was slightly stronger after mutual adjustment for current BMI (table 5).

To examine whether the odds of LUTS and noncancer prostate surgery associated with waist circumference varied by current BMI, we considered the joint effects of current BMI and waist circumference (table 4). Compared with men with a current BMI of <30 kg/m^2 and a smaller waist circumference, both men who had a BMI of <30 kg/m^2 and a larger waist circumference and men with a BMI of ≥30 kg/m^2 and a large waist had elevated odds of LUTS. However, when the same comparison group was used, men who had a high current BMI but a smaller waist circumference had a lower odds of LUTS.

We also examined whether the inverse association between BMI at age 25 years and LUTS later in adulthood was modified by current waist circumference (table 4).

TABLE 4. Odds ratios* of LUTS† for joint effects between BMI† at age 25 years, current BMI, and waist circumference in men aged 60 years or older, Third National Health and Nutrition Examination Survey, 1988–1994

	BMI at age 25 years			
	<25		≥25	
	OR†	95% CI†	OR	95% CI
Waist circumference <94 cm	1.00		0.63	0.21, 1.84
Waist circumference ≥94 cm	1.41	0.84, 2.39	0.77	0.39, 1.53
p for interaction	0.79			
BMI increase of <0.44	1.00		0.66	0.32, 1.35
BMI increase of ≥0.44	1.49	0.80, 2.76	0.96	0.48, 1.92
p for interaction	0.95			
	Current BMI			
	<30		≥30	
	OR	95% CI	OR	95% CI
Waist circumference <102 cm	1.00		0.39	0.10, 1.58
Waist circumference ≥102 cm	1.43	0.82, 2.50	1.35	0.79, 2.31
p for interaction	0.32			

* All results were calculated by using sampling weights and were adjusted for age and race.
† LUTS, lower urinary tract symptoms; BMI, body mass index (weight (kg)/height (m)^2); OR, odds ratio; CI, confidence interval.

TABLE 5. Odds ratios* of LUTS† and noncancer prostate surgery by waist circumference in men aged 60 years or older, Third National Health and Nutrition Examination Survey, 1988–1994

	Waist circumference (cm)			
	<94.0	94.0–101.9	≥102.0	*p* for trend
LUTS				
OR†,‡ (95% CI†)	1.00	0.98 (0.51, 1.87)	1.48 (0.87, 2.54)	0.08
OR§ (95% CI)	1.00	1.12 (0.52, 2.39)	1.75 (0.81, 3.81)	0.12
Surgery				
OR‡ (95% CI)	1.00	0.82 (0.42, 1.65)	0.70 (0.45, 1.10)	0.19
OR§ (95% CI)	1.00	0.96 (0.48, 1.94)	0.88 (0.44, 2.02)	0.92

* All results were calculated by using sampling weights.
† LUTS, lower urinary tract symptoms; OR, odds ratio; CI, confidence interval.
‡ Adjusted for age and race.
§ Adjusted for age, race, and body mass index.

Compared with men with a normal BMI at age 25 years and a current smaller waist circumferences (<94 cm), men with a low BMI at age 25 years and a larger current waist circumference had an elevated odds of LUTS, whereas men with a higher BMI at age 25 years and a larger waist did not have a higher odds of LUTS. Men with a higher BMI at age 25 years and a smaller waist circumference had a nonsignificantly lower odds of LUTS compared with men with a normal BMI at age 25 years and a lower current waist circumference.

DISCUSSION

In this cross-sectional analysis of obesity, LUTS, and noncancer prostate surgery, we observed that men with a larger waist circumference, indicating central adiposity, were more likely to have LUTS compared with men with a smaller waist circumference. A higher BMI in early adulthood was associated with a lower odds of LUTS later in life, whereas a large increase in BMI over adulthood was associated with a greater odds of LUTS.

We observed a higher prevalence of LUTS among men with a larger waist circumference, which is consistent with results from the Health Professionals Follow-up Study (3), but we did not observe a statistically significant association with current BMI. Haidinger et al. (9) found a positive association between LUTS and waist circumference but no association between LUTS and current BMI or body weight. BMI and waist circumference capture different aspects of adiposity. BMI is the most commonly used indicator of obesity, but it is not a good indicator of body fat distribution and of the amount of body fat itself since it correlates with body fat as well as with lean body mass. The proportion of lean body mass represented by BMI in older men is smaller than in younger men, thus possibly producing differential effects of BMI on hormones by age. In contrast, waist circumference reflects mainly the variation in subcutaneous and visceral abdominal fat (10).

Waist circumference is positively correlated with plasma insulin levels (10), and the association between waist circumference and LUTS could reflect an effect of insulin on the development of LUTS. This explanation is supported by the attenuation of the association between current BMI and LUTS after we mutually adjusted for waist circumference as well as the observation that currently overweight or obese men with a larger waist circumference had an elevated odds of LUTS whereas men with a high BMI but a smaller waist circumference did not. Hammarsten and Högstedt (2), who found a positive association of insulin level with prostate volume and growth, hypothesized that the trophic effect of a high insulin level might induce an enlarged prostate. An increased insulin concentration is also associated with increased sympathetic nervous system activity, which may additionally contribute to LUTS symptoms.

A larger waist circumference is associated with lower testosterone and sex hormone-binding globulin concentrations independently of BMI (11), whereas estradiol seems to increase with increasing adiposity in men (12). A higher ratio of estrogen to testosterone in overweight or obese men may be postulated to increase the risk of LUTS by enhanced induction of the estrogen receptor and decreased net dihydrotestosterone formation in the prostate. Indeed, higher circulating estradiol concentration has been found to be associated with a higher risk of surgery for benign prostatic hyperplasia (4) and larger prostate volume (13). However, in contrast to this hypothesis, Platz et al. (14) observed an inverse association between serum estradiol levels and benign prostatic hyperplasia in a large sample.

The association of weight gain with LUTS may have reflected that the increase in BMI during adulthood is due largely to an increase in central adiposity and supports the hypothesis of an insulin-mediated effect on LUTS development. Alternatively, Gapstur et al. (11) showed in a prospective study that an increase in BMI during adulthood was associated with declining circulating levels of total and free testosterone as well as sex hormone-binding globulin. This change in the estradiol/testosterone ratio might be associated with maintenance of benign prostatic hyperplasia.

Men who were obese at age 25 years were less likely to have LUTS or noncancer prostate surgery later in life, even after we controlled for current waist circumference. Similarly, in the Health Professionals Follow-up Study (15), men whose BMI at age 21 years was high had a lower risk of prostate cancer later in life. It is likely that these men were also obese during puberty and adolescence, which may have influenced steroid hormone balance during prostate maturation. Obese boys have a delayed onset of puberty (16), likely because of lower testosterone and higher estrogen levels. Berry et al. (17) observed pathologic signs of benign prostatic hyperplasia at ages 31–40 years and concluded that the initiation of benign prostatic hyperplasia growth is likely to start before age 30 years. The early phase of development of benign prostatic hyperplasia nodules is thought to be induced by dihydrotestosterone-mediated production of growth-stimulatory factors by the stroma that induce signal transduction within epithelial cells (18). Young obese men with higher estrogen and lower testosterone levels compared with leaner men possibly have lower intraprostatic dihydrotestosterone production. Lower dihydrotestosterone levels might protect against initial development of benign prostatic hyperplasia nodules earlier in adulthood.

No positive associations of current BMI, highest BMI ever, and waist circumference with noncancer prostate surgery were observed. A higher risk of benign prostatic hyperplasia surgery for men with a larger waist circumference was observed in the Health Professionals Follow-up Study (3) but not in another cohort study (4). Daniell et al. (19), who found that obesity was a risk factor for prostate enlargement but not for prostate surgery due to obstructive uropathy in men aged 60–74 years, concluded that the risk factors for prostate enlargement and for obstructive uropathy that requires surgical treatment might be different. However, not all men who have an enlarged prostate develop symptoms, and, among those who are symptomatic, not all will choose to have surgery. It might be possible that obese men choose surgery less often than lean men do.

In NHANES III, body weight was assessed retrospectively and cross-sectionally for multiple time points throughout a subject's lifetime, enabling us to consider differences in the influence of adiposity at different stages of life on LUTS and noncancer prostate surgery. We used self-reported current weight and height to be consistent with self-reported weight at age 25 years and highest weight ever. Self-reported current weight and height correlated very highly with current weight and height measured during the physical examination, indicating no serious under- or overreporting of weight or height in this group of men. We found no association between BMI and LUTS after adjustment for age and race. Further adjustment for current waist circumference revealed a stronger inverse association between measured current BMI and LUTS compared with use of self-reported BMI. We cannot completely rule out the possibility that obese people might have underestimated their previous weight, but misreport of past weight is unlikely to be differential with respect to LUTS. We assessed BMI and waist circumference concurrently with LUTS and after noncancer prostate surgery. Therefore, results reflect associations and do not necessarily reflect causal effects. We evaluated the body habitus hypothesis in a sample representative of the US population of older men, aiding in the broad generalizability of these results. In addition, the elderly were oversampled, allowing for stable estimates in our analysis. During the NHANES III interview, participants reported on four of the seven symptoms of the American Urological Association symptom index (6). To preclude a high false-positive rate, we included in our analysis only those men with at least three of the four symptoms, who are more likely to have LUTS than are men with only one or two symptoms. Finally, these results pertain to a selected array of urinary symptoms in men who do not have such symptoms because of factors such as paralysis or being bedridden.

In conclusion, our results suggest that being overweight in young adulthood may be associated with a lower prevalence of LUTS later in life. Weight gain and central adiposity in adulthood are possibly associated with a higher prevalence of LUTS. To directly investigate the findings from our study, we are currently examining the association of glucose and insulin metabolism with LUTS, which might mediate the effect of central adiposity on LUTS. Obesity is an increasing health problem in the United States and other Western countries. If an association between weight gain associated with central adiposity and LUTS exists, it would have an impact on the health of millions of men, affecting their daily life. The advice to avoid weight gain during adulthood could possibly be part of preventive strategies for this common set of urinary symptoms in the general population of noninstitutionalized older men.

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