Published in final edited form as:

J Am Geriatr Soc. 2013 January ; 61(1): 46–54. doi:10.1111/jgs.12073.

The Association of Body Size and Composition with Erectile Dysfunction in Older Men: Osteoporotic Fractures in Men (MrOS) Study

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Abstract

Objectives—To examine the association of body size and composition with erectile dysfunction (ED) in older men.

Design—Cross-sectional analysis of the Osteoporotic Fractures in Men study.

Setting—Six U.S. clinical sites.

Participants—Community-dwelling men aged 65 years and older.

Measurements—Body composition measures using anthropometry (body weight, body mass index [BMI]) and dual x-ray absorptiometry (total body fat percent, trunk fat percent, ratio of trunk and total body fat). Erectile dysfunction was assessed using the single item Massachusetts Male Aging Study (MMAS) scale and the International Index of Erectile Function questionnaire (IIEF-5).

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Conflict of Interest: The editor in chief has reviewed the conflict of interest checklist provided by the authors and has determined that the authors have no financial or any other kind of personal conflicts with this paper.

Results—Among men completing the MMAS scale (n=4108), prevalence of complete ED was 42%. Among sexually active men completing the IIEF-5 questionnaire (n=1659), prevalence of moderate to severe ED was 56%. In multivariate-adjusted analyses reporting prevalence ratios (PR) and 95% confidence intervals (CI), the prevalence of MMAS-defined complete ED was significantly increased in men in the highest quartile of increased body weight PR = 1.24, 95% CI = 1.16-1.34), total body fat percentage (PR = 1.25, 95% CI = 1.13-1.40), and trunk fat percentage (PR = 1.24, 95% CI = 1.15-1.38), and in men with BMI >30.0 kg/m² compared to those with BMI 22.0-24.9 kg/m² (PR = 1.17, 95% CI = 1.05-1.31). Associations appeared similar for IIEF-5 defined moderate to severe ED in analyses adjusted for age and study site.

Conclusion—In a cohort of older men, increased body weight, BMI, and total body fat percent were independently associated with increased prevalence of moderate to severe and complete ED. Future studies should investigate whether interventions to promote weight loss and fat loss will improve erectile function in older men.

Keywords

obesity; erectile dysfunction; men; aged

INTRODUCTION

Erectile dysfunction (ED) is defined by the National Institute of Health (NIH) consensus statement on impotence as ‘the persistent inability to attain or maintain a penile erection adequate for satisfactory sexual intercourse’.¹ The prevalence of ED increases with age² and ED is an important cause of poorer health-related quality of life in men.^{3, 4} Data from the 2001-2002 National Health and Nutrition Examination Survey (NHANES) show that ED is prevalent in 18.2% of men over the age of 20, with the prevalence increasing significantly to 43% in those between 60 to 69 years and going as high as 70% in men older than 70 years.⁵

Cross-sectional studies in middle aged and older populations have reported that ED is strongly associated with cardiovascular risk factors like diabetes, hypertension, hyperlipidemia and smoking.^{2, 6, 7} A higher body weight and greater body mass index (BMI) have also shown to be associated with prevalent ED.^{6, 8-10} However, because body fat increases and is redistributed with advancing age, measures of body composition such as percent body fat or central adiposity may better predict obesity-associated health risks in older individuals than weight and BMI.¹¹ It is hypothesized that obesity increases the risk of vascular disease through endothelial dysfunction. Endothelial dysfunction causes impaired arteriolar smooth muscle relaxation, thereby preventing vasodilatation and leading to the development of ED.¹² One small study in Asian men showed that body fat percent measured by bioelectrical impedance (BIA) had a U-shaped association with ED, with the highest prevalence of ED in men in the lowest and highest quintiles of body fat percent.¹³

To our knowledge, the association between body composition and ED prevalence has not been evaluated among older U.S. men. We performed a cross-sectional analysis to investigate the association of body composition as measured with dual x-ray absorptiometry

(DXA) with prevalent ED among older U.S. men participating in the Osteoporotic Fractures in Men (MrOS) study cohort.

METHODS

Participants

The MrOS study enrolled 5,994 men aged 65 years and older between March 2000 and April 2002. Recruitment took place in 6 U.S. academic medical centers: Birmingham, Alabama; Minneapolis, Minnesota; Palo Alto, California; the Monongahela Valley near Pittsburgh, Pennsylvania; Portland, Oregon; and San Diego, California. Men were ineligible if they could not walk without the assistance of another person or had bilateral hip replacements. Details of the recruitment process have been published elsewhere.^{14, 15} Institutional review boards at each center approved the protocol. All men provided written informed consent. Of the 5,994 original MrOS enrollees, 5,229 (87%) completed a second study visit (V2) a mean of 4.6 years after the baseline clinic visit. Among the 5,994 original enrollees, 571 men died, 85 dropped out and 109 refused to participate before V2 (Figure 1). Of the 5,994 original MrOS enrollees, 4,371 (73%) had complete measures of body composition at a second study visit (V2) a mean of 4.6 years after the baseline visit (Figure 1). Of these men, 4,108 completed a single question regarding ED derived from the MMAS¹⁶ and, among 1,792 who reported at least some sexual activity in the prior six months, 1,659 (93%) completed the International Index of Erectile Function (IIEF-5) questionnaire.¹⁷

Measures of body weight, BMI and body composition

During V2, participants underwent measurement of height (cm) (by stadiometer) and weight (kg) (by balance beam or digital scale). BMI was calculated (kg/m^2) and categorized as low normal (17.5–21.9 kg/m^2), normal (22.0–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), or obese ($\geq 30 \text{ kg}/\text{m}^2$).¹⁸ Body composition was measured using DXA scanners at each study site (Hologic QDR 4500W scanners, Hologic, Inc., MA).¹⁹ A central quality control lab, certification of DXA operators, and standardized procedures for scanning were used to ensure reproducibility of DXA measurements. A Hologic whole body phantom was circulated and measured at the six clinical sites. The variability across clinics was within acceptable limits, and cross-calibration correction factors were not required. The primary DXA-derived body composition measures used in the present study were total body weight (kg), body mass index (total body weight [kg]/height [m^2]), total body fat percent ([total body fat mass/total body weight]*100), trunk fat percent ([total trunk fat/total body fat mass]*100), and ratio of trunk fat to total body fat.

Measures of erectile function

ED was assessed using the self-reported single-item MMAS question and the self-reported IIEF-5 questionnaire. On the MMAS questionnaire, participants were asked to report the frequency with which they were able to get and keep an erection sufficient for sexual intercourse during the preceding 6 months, categorized on four levels from not impotent to completely impotent (Figure 2).¹⁶ On the IIEF-5 questionnaire, which requires participants to have been sexually active in the preceding 6 months, participants were asked to rate their

confidence in and difficulty attaining and maintaining erections sufficient for intercourse, and satisfaction with sexual intercourse (Figure 2). Each IIEF-5 item is scored from 1-5 (total range 5-25), with higher scores indicating better erectile function. Based on the total IIEF-5 score, ED is classified into severity categories (severe 5-7; moderate 8-11; mild-moderate 12-16; mild 17-21; and No ED > 22).¹⁷

Other variables—Information on date of birth, race, and highest level of education attained were assessed at study baseline (visit 1). At V2, participants self-reported information on medical history (diabetes, hypertension and coronary artery disease), physical activity (Physical Activity Scale for the Elderly [PASE]²⁰), depression symptoms (Geriatric Depression Score [GDS]²¹), lower urinary tract symptoms (American Urological Association [AUA] Symptom Index²²), and self reported health status (excellent or good vs. fair or poor). Self reported current medications (including beta blockers and ED treatments [e.g. phosphodiesterase type 5 inhibitors]), were verified by in-clinic review of prescriptions and non-prescription medication bottles. All study visit procedures including the collection of medication information were performed by study staff who had undergone centralized training and used study-wide standard operating procedures.

Statistical analysis

To examine the representativeness of the analytical cohorts to the larger MrOS study population, characteristics (frequencies, means) were compared between participants who completed versus those who did not complete the sexual function questionnaires (MMAS and IIEF-5) and the entire cohort of men who participated in V2. The categories of participants were compared using chi-square tests for categorical variables, *t*-tests for normally distributed continuous variables and Kruskal-Wallis tests for continuous variables with skewed distributions. Dichotomous ED outcomes were defined by the MMAS questionnaire (complete ED vs. no or minimal ED) and by the IIEF-5 questionnaire (moderate-severe ED vs. none, mild, or mild-moderate ED). These cut points were selected (Table 2) because they both defined clinically relevant levels of ED and included a similar prevalence of men among those completing both questionnaires (23% on MMAS vs. 25.6% on IIEF-5). We used multivariable log-binomial regression models to quantify the association of obesity and body composition measures with ED prevalence. Prevalence ratios (PR) relating the obesity or body composition variable to ED first were adjusted for age and clinic site, and then further adjusted for additional factors that we hypothesized a priori to be important clinical confounders of the predictor outcome relationship that were assessed in the majority of study participants. Additionally we included covariates that were potentially thought to be confounders and those which had a statistically significant association with the predictor and outcome. Final multivariate models were adjusted for V2 age, clinic site, sexual orientation, self-reported health status (excellent or good vs. fair or poor), smoking status (never vs. former vs. current) physical activity (continuous PASE score)^{10, 23}, prostate symptom score (continuous AUA symptom index)²⁴, depressive symptoms (continuous GDS score)^{25, 26}, current medications (beta blockers, ED treatments)^{8, 27}, and history of diabetes^{28, 29}, coronary artery disease (CAD)⁵, dyslipidemia, peripheral artery disease and hypertension.^{5, 7} All statistical analyses were performed using Statistical Analysis Software version 9.2 (SAS Institute, Cary, NC).

RESULTS

Participant characteristics

Demographics of all men with body composition measures and subsets who also completed the MMAS and IIEF-5 questionnaires are presented in Table 1. The average age of participants was approximately 77 years, with those completing the MMAS and IIEF-5 questionnaires being younger. Caucasian men formed 90% of the study cohort. Most participants were well educated (>55% college graduates), and >80% were married. Compared to men who did not complete the sexual function questionnaires, men who completed the MMAS (81%) and IIEF-5 (88%) questionnaires were significantly more likely to be married ($p < 0.05$ for both comparisons). Response rates to sexual function questionnaires at different clinical sites ranged from 14-20%.

Body composition

Mean BMI was approximately 27 kg/m²; nearly 50% of men were overweight (BMI 25.0-29.9 kg/m²) and 21% were obese (BMI >30 kg/m²). Mean total body fat percent was 26.6 (Table 1).

Prevalence of ED

Among the 4108 men who completed the MMAS question, prevalence of complete ED was 42%, and another 27% of men had moderately severe ED (Table 1). In the subset of men reporting sexual activity in the past six months and completing the IIEF-5 questionnaire ($n=1659$), prevalence of moderate to severe ED was 56%. The percentage of men with MMAS defined complete ED was significantly lower in those who completed the IIEF-5 questionnaire compared to that in those who did not complete the IIEF-5 questionnaire (23% vs. 42%; $p < 0.01$).

Association between obesity, body composition and ED

In multivariate analyses, higher body weight was significantly associated with increased prevalence of MMAS-defined complete ED (Table 2). Compared to the reference group (weight 46.9-73.0 kg), in those with weight in the highest quartile (89.5-135.9 kg) the PR for complete ED was 1.24 (95% CI 1.16-1.34). Similarly, higher BMI was significantly associated with increased prevalence of MMAS-defined complete ED. Compared to the reference group (BMI 22.0-24.9 kg/m²), in overweight (BMI 25.0-29.9 kg/m²) and obese participants (BMI > 30.0 kg/m²), the multivariate-adjusted PR for complete ED was 1.18 (95% CI 1.08-1.30) and 1.17 (95% CI 1.05-1.31), respectively. In participants with a lower BMI (< 22.0 kg/m²), the PR of complete ED was not significantly different from the reference group. Compared to men in the lowest respective quartiles, those in the highest quartiles of total body fat percent (PR = 1.25, 95% CI = 1.13-1.40) and trunk fat percent (PR = 1.24, 95% CI = 1.15-1.38) had a significantly increased multivariate-adjusted prevalence of complete ED. The ratio of trunk fat to total body fat (a measure of central obesity) was significantly associated with complete ED in age and clinic site adjusted models (PR = 1.12, 95% CI = 1.02-1.23), but failed to achieve statistical significance in the multivariable model.

In comparison, within the subset of men who completed the IIEF-5 questionnaire, body weight and BMI were not statistically significantly associated with prevalence of IIEF-5 defined moderate to severe ED (i.e. IIEF-5 score <11) (Table 3). Although increased total body fat percent was associated with an increased prevalence of IIEF-5 defined moderate to severe ED (PR = 1.39, 95% CI = 1.10-1.76) when adjusting for age and clinic site alone, results were no longer statistically significant in the multivariate model. Trunk fat percent and the ratio of trunk fat to body fat were not statistically significantly associated with IIEF-5 defined moderate to severe ED.

DISCUSSION

In this cohort of older men, we found that several measures of obesity and central adiposity were significantly associated with increased ED prevalence. Increased body weight, BMI, and total body fat percent all were independently associated with increased prevalence of complete ED. While one measure of central obesity, trunk fat percent, also was independently associated with increased prevalence of complete ED, the association between another, the ratio of trunk fat to total body fat, and complete ED was only small in magnitude and not statistically significant.

Our results are generally consistent with those reported in prior studies. In a cross-sectional analysis conducted in the large Health Professionals Follow-up Study (HPFS) cohort of U.S. men aged 50 years or older, those in the highest versus lowest BMI quintile had a multivariate-adjusted 1.2-fold increased risk of ED, defined as self-reported poor or very poor ability to achieve and maintain an erection sufficient for intercourse without treatment.⁸ In a small cross-sectional study in Brazilian men aged 40 years or older without vascular disease, diabetes, hypertension, or psychotropic drug use, the subgroup older than 60 years had statistically significant increases in risk of ED defined as IIEF-5 score <25 associated with five of eight reported anthropometric measures of central obesity, including waist circumference and ratio of waist to hip circumference.³⁰ Another small cross-sectional study, conducted in Korean men aged 45 years or older without heart disease, stroke, cancer, depression or treated thyroid disease, reported a 'U' shaped association between quintiles of body fat percentage as measured by BIA and odds of any ED, defined as IIEF-5 score <18.¹³

There were several important differences between the MrOS study cohort and prior studies that may contribute to the differences reported in their associations between obesity and ED. Compared to the MrOS analysis cohort, prior studies enrolled much younger populations,^{13, 30, 8} and excluded participants with vascular disease and other ED risk factors.³⁰ Consequently, their results may be less applicable to older men with comorbid conditions. Whereas earlier studies used anthropometry^{8, 30} and BIA¹³ to measure obesity and body morphometry, the MrOS study utilized DXA. Compared to DXA, anthropometric measures such as BMI may overestimate adiposity in the elderly who have experienced height loss, underestimate adiposity in the elderly with aging-associated selective loss of lean mass,³¹ and are less well able to measure regional fat deposits. Compared to DXA, BIA appears to overestimate body fat percentage, and this discordance increases with increasing age.³² Last, all the studies defined ED differently, including two that included some

participants with no ED³⁰ or only mild ED,¹³ a subgroup in which we found a relatively weaker association with measures of obesity and adiposity.

Though the current results suggest a modest association between higher body size and fat and the prevalence of ED, limited data are available regarding whether prevention of obesity or reduction of obesity would improve ED clinical outcomes. Ten year follow up data from the MMAS suggested that among men aged 40 to 70 years, those who were obese at baseline were at increased risk of developing ED, whether or not they subsequently lost weight.⁹ By comparison, in a small, randomized trial, among obese 35-55 year old men with ED, those assigned to diet and exercise counseling targeting at least a 10% loss in total body weight reported a mean improvement of three IIEF-5 points ($p < 0.01$) as compared to no change in those given general information about healthy food choices and exercise.³³

Possible explanations for the differences between these studies include reduced responsiveness of erectile function to weight loss at older ages, and that weight loss is not the most important marker of improvements in body composition to affect erectile function. While there is emerging data from randomized and observational studies demonstrating that lifestyle change, weight loss and increase in physical activity are associated with better erectile function even among diabetics and older men,^{34, 35} it is unknown whether weight loss and specifically fat loss alone would lead to a similar improvement in erectile dysfunction in an older population. While the MrOS study has collected data on change in body composition measures and incident ED at subsequent study visits, an analysis of the effect of change in body composition on prevalent and incident ED is beyond the scope of this manuscript.

Our study reports the association of body composition measures with erectile dysfunction using the MMAS and the IIEF-5 scale, both of which are validated tools to assess for ED. In a study of men aged 55-85 years, ED diagnosed by the MMAS single item questionnaire was found to strongly correlate (Spearman $r=0.80$) with ED diagnosed by a urologic clinical exam.³⁶ In addition, the prevalence of ED by the MMAS scale, correlated closely with that on the IIEF-5 scale in this older population.¹⁶ However, recent data validating the IIEF scale in older men suggest that norms for the older population may be different from younger persons.³⁷ In this study of a random sample of men over the age of 65 living with their spouses, the IIEF-15 and IIEF-5 showed reliability of measurement and correlation between subscales (IIEF-15) similar to the original study by Rosen et al.³⁸ In this study, 75% of sexually active persons over the age of 65 reported an IIEF-5 score < 25 suggesting erectile dysfunction (median score 21) compared to 0% erectile dysfunction in adults between the ages of 18-39.³⁹ While an advancing age related decrease in sexual activity has been reported in men⁴⁰, further studies are needed to determine if current measures of sexual function need to be normalized for this decrease in order to accurately estimate the incidence and prevalence of sexual dysfunction. Our results show that measures of obesity are more strongly associated with ED measured by the MMAS scale. Since the IIEF-5 was answered only by men who reported some sexual activity in the preceding 6 months, perhaps their overall sexual function is also better than those not reporting activity. The smaller size of the IIEF-5 cohort compared to the MMAS cohort may also have precluded smaller differences from being detected.

Our study has several limitations. The cross sectional nature of the analysis precludes evaluation of a temporal association between body composition and ED. Although we included variables with clinical and statistical significance in our final multivariate models, we did not assess for collinearity between them, and it is possible that doing so may undermine our point estimates. Because participants in the present study were older, mostly white, community-dwelling men, and tended to be highly educated, the generalizability of findings to other populations is uncertain. Further, because only men with sexual activity in the past six months completed the IIEF-5 scale, associations we reported between body composition and IIEF-5 defined ED likely reflect those from a subgroup with less severe ED than the men included in the MMAS analyses overall. However, this study has several strengths; the MrOS study is a large and well characterized cohort of older US men. Body composition using DXA has been precisely collected with good quality control. While DXA might underestimate abdominal fat in those with low abdominal fat content⁴¹, it may in fact better estimate abdominal fat in older adults who commonly have a relative increase in this measure with aging. In addition, our analyses accounted for a large number of potential confounders that could have impacted observed associations. Last, MrOS study eligibility criteria were not based on sexual function, limiting the potential that selection bias influenced study results.

It is predicted that the worldwide prevalence of ED will increase from 150 million in 1995 to nearly 322 million in 2025.⁴² Considering that rates of ED increase with age and the worldwide percentage of persons over the age of 65 is estimated to double from 4.2% in 1995 to 9.7% in 2025⁴³, the above predicted estimate of ED may be a conservative one. A public health problem of this magnitude will need to be addressed both from and healthcare policy and economic standpoint.

In a cohort of older, community-dwelling men, we found that increased body weight, BMI, and total body fat percent all were independently associated with increased prevalence of moderate to severe and complete ED. Future studies should investigate whether interventions to promote weight loss and fat loss will improve erectile function in older men. Pending the findings of such research, clinicians may consider offering diet and exercise advice to lose weight in their older patients with ED.

Acknowledgments

We thank Kyle Moen for his technical editing assistance.

Source of Funding:

The Osteoporotic Fractures in Men (MrOS) Study is supported by National Institutes of Health funding. The following institutes provide support: the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS), the National Institute on Aging (NIA), the National Center for Research Resources (NCRR), and NIH Roadmap for Medical Research under the following grant numbers: U01 AR45580, U01 AR45614, U01 AR45632, U01 AR45647, U01 AR45654, U01 AR45583, U01 AG18197, U01-AG027810, and UL1 RR024140.

Sponsor's Role: The sponsor played no role in the study design, analysis, and interpretation of data or preparation of this manuscript.

Appendix

Appendix 1

Sexual function questionnaires

IIEF-5 Questionnaire					
How do you rate your confidence that you could get and keep an erection?	Very low 1	Low 2	Moderate 3	High 4	Very high 5
When you had erections with sexual stimulation, how often were your erections hard enough for penetration?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5
During sexual intercourse, how often were you able to maintain your erection after you had penetrated (entered) your partner?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5
During sexual intercourse, how difficult was it to maintain your erection to completion of intercourse?	Extremely difficult 1	Very difficult 2	Difficult 3	Slightly difficult 4	Not difficult 5
When you attempted sexual intercourse, how often was it satisfactory for you?	Almost never/never 1	A few times (much less than half the time) 2	Sometimes (about half the time) 3	Most times (much more than half the time) 4	Almost always/always 5

MMAS single item questionnaire				
Erectile dysfunction (sometimes called impotence) means not being able to get and keep an erection that is rigid enough for satisfactory sexual activity. How would you describe yourself?	1. Not impotent- Always able to get and keep an erection good enough for sexual intercourse	2. Minimally impotent- Usually able to get and keep an erection good enough for sexual intercourse	3. Moderately impotent- Sometimes able to get and keep an erection good enough for sexual intercourse	4. Completely impotent- Never able to get and keep an erection good enough for sexual intercourse

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Figure 1. Flow diagram of participants and visits in the MrOS study

V1 = MrOS baseline study visit; V2 = MrOS study visit 2; SAQ = self-administered questionnaire; SF = sexual function; MMAS = Massachusetts Male Aging Study Questionnaire; IIEF-5 = International Index of Erectile Function.

Table 1
Comparison of demographic and other factors among men with and without complete data on erectile dysfunction

Characteristics	MMAS questionnaire				IIEF-5 questionnaire		
	All participants (n=4,371)	Completers (n=4,108)	Non-completers (n=273)	p-value*	Completers (n=1,659)	Non-completers (n=2,712)	p-value*
Mean age (SD), years	77.4 (5.4)	77.3 (5.4)	79.4 (5.8)	<0.01	75.6 (4.6)	78.6 (5.6)	<0.01
Caucasian, %	90.4	90.6	9.4	0.294	89.3	10.7	0.052
Education, %				<0.01			<0.01
<College Graduate	44	43	56		38	48	
College Graduate	56	57	44		62	52	
Marital status, %				<0.01			<0.01
Married	80	81	65		88	76	
Widower	11	10	22		5	14	
Separated	1	1	0		0	1	
Divorced	5	5	7		5	5	
Never married	3	3	5		1	4	
MMAS categories, (N=4108), %				---			<0.01
No ED	-	15			21		
Mild ED	-	15			22		
Moderate ED	-	27			33		
Complete ED	-	42			23		
Mean BMI (SD), kg/m ²	27.2 (3.9)	27.2 (3.8)		0.527	27.3 (3.6)		0.211
BMI Category, %				0.089			<.001
17.5-21.9 (Low Normal)	6	6	8		4	7	
22.0-24.9 (Normal)	24	24	27		22	25	
25.0-29.9 (Overweight)	49	50	42		53	47	
30 (Obese)	21	20	24		21	21	
Total Body fat %,	26.6 (5.5)	26.6 (5.5)	26.4 (5.8)	0.670	26.1 (5.3)	26.8 (5.6)	<.001
Total Trunk fat %	28.8 (6.4)	28.8 (6.3)	28.2 (6.9)	0.137	28.5 (6.1)	29.0 (6.6)	0.010

MMAS=Massachusetts Male Aging Study Questionnaire; SD= Standard Deviation; IIEF-5 = International Index of Erectile Function

* p-value for differences in each category between those who completed vs. those who did not complete questionnaire

Table 2

Association of weight, adiposity and body composition with complete erectile dysfunction (MMAS)*

Adiposity measures	Prevalence of complete erectile dysfunction, %	Age and site adjusted [†] PR (95% CI)	Multivariate adjusted [‡] PR (95% CI)
Total Body Weight, kg			
46.9-73.0	42.1	1.0 (ref)	1.0 (ref)
73.1-80.7	42.1	1.04 (0.96-1.13)	1.15 (1.04-1.28)
80.8-89.4	41.0	1.14 (1.04-1.24)	1.07 (0.97-1.18)
89.5-135.9	44.0	1.23 (1.14-1.32)	1.24 (1.16-1.34)
P value		<.001	<.001
BMI Categories			
17.5-21.9 (Low Normal)	39.1	0.99 (0.83-1.12)	1.01 (0.81-1.20)
22.0-24.9 (Normal)	38.7	1.0 (ref)	1.0 (ref)
25.0-29.9 (Overweight)	43.6	1.17 (1.08-1.26)	1.18 (1.08-1.30)
30.0 (Obese)	45.0	1.24 (1.14-1.36)	1.17 (1.05-1.31)
P value		<.001	<.001
Total Body fat %			
8.9-22.6	35.5	1.0 (ref)	1.0 (ref)
22.7-26.5	39.3	1.06 (0.96-1.18)	1.12 (1.00-1.27)
26.6-30.2	43.1	1.21 (1.10-1.34)	1.21 (1.10-1.37)
30.3-46.9	51.7	1.31 (1.20-1.44)	1.25 (1.13-1.40)
P value		<.001	<.001
Trunk Fat %			
7.8-24.6	36.7	1.0 (ref)	1.0 (ref)
24.7-29.1	39.7	1.09 (1.00-1.20)	1.16 (1.06-1.31)
29.2-33.3	43.1	1.20 (1.10-1.32)	1.19 (1.08-1.33)
33.4-48.1	50.1	1.28 (1.20-1.40)	1.24 (1.15-1.38)
P value		<.001	<.001
Ratio of trunk fat to total body fat			
0.34-0.51	42.0	1.0 (ref)	1.0 (ref)
0.52-0.55	42.5	1.06 (0.97-1.14)	0.99 (0.90-1.10)
0.56-0.59	43.0	1.10 (1.01-1.18)	1.09 (0.99-1.20)

Adiposity measures	Prevalence of complete erectile dysfunction, %	Age and site adjusted [†] PR (95% CI)	Multivariate adjusted [‡] PR (95% CI)
0.60-0.72	43.0	1.12 (1.02-1.23)	1.05 (0.95-1.16)
P value		0.05	0.08

MMAS=Massachusetts Male Aging Study Questionnaire; PR=Prevalence Ratio; CI= Confidence Interval; BMI=Body Mass Index

* self reported complete erectile dysfunction to MMAS single item questionnaire

[†] Adjusted for age and study site

[‡] Adjusted for age, study site, sexual orientation, self-rated health status, lower urinary tract symptoms, physical activity, depression, current medications (beta blockers, ED treatments), smoking status, self reported diabetes, dyslipidemia, coronary artery disease, peripheral artery disease, and hypertension.

Table 3

Association of weight, adiposity and body composition with moderate to severe erectile dysfunction (IIEF-5)*

Body composition quartiles	Prevalence of moderate/severe erectile dysfunction, %	Age and site adjusted [†] PR (95% CI)	Multivariate adjusted [‡] PR (95% CI)
Total Body Weight, kg			
46.9-73.0	22.7	1.0 (ref)	1.0 (ref)
73.1-80.7	26.3	1.07 (0.96-1.51)	1.07 (0.87-1.33)
80.8-89.4	22.4	0.91 (0.71-1.16)	0.92 (0.73-1.16)
89.5-135.9	28.7	1.20 (0.96-1.51)	1.11 (0.89-1.39)
P value		0.109	0.291
BMI Categories			
17.5-21.9 (Low Normal)	32.9	1.34 (0.93-1.77)	1.32 (0.92-1.80)
22.0-24.9 (Normal)	23.3	1.0 (ref)	1.0 (ref)
25.0-29.9 (Overweight)	24.9	1.08 (0.89-1.34)	1.08 (0.88-1.34)
30.0 (Obese)	27.7	1.13 (0.89-1.46)	1.16 (0.90-1.49)
P value		0.399	0.364
Total Body fat %			
8.9-22.6	21.3	1.0 (ref)	1.0 (ref)
22.7-26.5	24.7	1.15 (0.90-1.46)	1.14 (0.90-1.45)
26.6-30.2	26.0	1.21 (0.95-1.53)	1.09 (0.87-1.39)
30.3-46.9	31.0	1.39 (1.10-1.76)	1.09 (0.86-1.40)
P value		0.046	0.740
Trunk Fat %			
7.8-24.6	22.8	1.0 (ref)	1.0 (ref)
24.7-29.1	24.0	1.02 (0.81-1.30)	1.10 (0.88-1.40)
29.2-33.3	26.2	1.15 (0.92-1.45)	1.00 (0.80-1.27)
33.4-48.1	29.5	1.22 (0.97-1.54)	1.05 (0.84-1.35)
P value		0.263	0.804
Ratio of trunk fat to total body fat			
0.34-0.51	24.3	1.0 (ref)	1.0 (ref)
0.52-0.55	24.1	0.96 (0.75-1.22)	1.00 (0.79-1.26)
0.56-0.59	25.5	1.04 (0.82-1.32)	1.02 (0.82-1.28)

Body composition quartiles	Prevalence of moderate/severe erectile dysfunction, %	Age and site adjusted [†] PR (95% CI)	Multivariate adjusted [‡] PR (95% CI)
0.60-0.72	27.8	1.06 (0.84-1.34)	1.06 (0.84-1.35)
P value		0.835	0.944

IIEF-5=International Index of Erectile Function; PR=Prevalence Ratio; CI= Confidence Interval; BMI=Body Mass Index

* Moderate/severe erectile dysfunction was defined as IIEF-5 score <11

[†] Adjusted for age and study site

[‡] Adjusted for age, study site, sexual orientation, health status, prostate symptom score, physical activity, depression, current medications (beta blockers, ED treatments), smoking status, self reported diabetes, dyslipidemia, coronary artery disease, peripheral artery disease, and hypertension.