Published in final edited form as:

J Sex Med. 2020 October ; 17(10): 1971–1980. doi:10.1016/j.jsxm.2020.07.004.

Association between Body Mass Index and Female Sexual Dysfunction: A Cross-sectional Study from the Data Registry on Experiences of Aging, Menopause and Sexuality

Stephanie S. Faubion, MD, MBA^{1,2}, Flavia Fairbanks, MD³, Carol L. Kuhle, DO, MPH^{1,2}, Richa Sood, MD, MS^{1,2}, Juliana M. Kling, MD, MPH⁴, Jennifer A. Vencill, PhD, LP^{2,5}, Kristin C. Mara, MS⁶, Ekta Kapoor, MBBS^{1,2,7}

¹Center for Women's Health, Mayo Clinic, Rochester, MN

²Division of General Internal Medicine, Mayo Clinic, Rochester, MN

³Department of Obstetrics and Gynecology and PROSEX, University of São Paulo School of Medicine, Brazil

⁴Division of Women's Health Internal Medicine, Mayo Clinic, Scottsdale, AZ

⁵Department of Psychology and Psychiatry, Mayo Clinic, Rochester, MN

⁶Division of Biomedical Statistics and Informatics, Mayo Clinic, Rochester, MN

⁷Division of Endocrinology, Diabetes, Metabolism and Nutrition, Mayo Clinic, Rochester, MN

Keywords

Sexual function; obesity; overweight; female sexual dysfunction; women

Introduction

The prevalence of obesity in U.S. adults continues to increase. More than two in three women were overweight or obese in 2016.¹ This is a concerning statistic given the associations of overweight and obesity with chronic medical conditions such as the metabolic syndrome, diabetes, heart disease, stroke, mood disorders, and cancers, including endometrial, breast, ovarian, and colon cancers.^{1,2} Further, weight gain is common among women as they age with an estimated average weight gain of 0.7 kg per year during the fifth and sixth decades of life.^{3,4}

Corresponding author: Stephanie S. Faubion MD, MBA, Faubion.stephanie@mayo.edu, 200 First St. SW, Rochester, MN 55902, 507-538-0289.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Disclosures:

EK: Consultant for Mithra Pharmaceuticals

Sexual function changes in women are associated with a number of factors, including age, reproductive stage, physical and emotional health status, and psychosocial factors such as the presence of a partner, partner's physical and sexual health, relationship satisfaction, and quality of communication.^{5–10} Sexual health is an important part of an individual's overall health, and it has been shown to associate with quality of life as individuals age.^{8,11,12} Unfortunately, sexual health concerns are highly prevalent in women across all age groups, and are generally more prevalent with advancing age.^{13,14} Female sexual dysfunction (FSD) is an overarching term that includes a range of common and often overlapping disorders and is defined as sexual symptoms associated with distress which persist for at least 3 months and occur with at least 75% of sexual experiences.¹⁵ The criterion of personal distress associated with a sexual health concern is a critical one for diagnosis and treatment, particularly given the demonstrated discrepancy between simply having a sexual problem and experiencing personal distress associated with the problem. The prevalence of sexual problems associated with sexually related personal distress was investigated in the PRESIDE (Prevalence of Female Sexual Problems Associated with Distress and Determinants of Treatment Seeking) study which found that the age-adjusted prevalence of any sexual problem was 43.1%, whereas sexually related personal distress was 22.2%.¹⁴ Any distressing sexual problem (defined as reporting both a sexual problem and sexually related personal distress) was reported by 12.0% of participants and was more common in women aged 45–64 years (14.8%) than in either younger (10.8%) or older women (8.9%).¹⁴ Factors correlating with distressing sexual problems included low education level, poor health, thyroid problems, urinary incontinence, as well as anxiety and depression.¹⁴

Previous studies investigating the association of BMI and sexual dysfunction in women have demonstrated inconsistent findings with some studies showing an association^{16–18} and others not.^{19–21} The significant variability in results of prior studies investigating the association between BMI and FSD is most likely attributable to methodological differences as well as the lack of opportunity for direct comparison due to the use of heterogeneous patient-reported sexual function measures and varying cutoffs for the definition of sexual dysfunction.^{16,18,20,22} In addition, existing studies have not taken into account personal distress associated with sexual problems, which is the defining criterion for FSD. Finally, previous studies have not routinely examined potential confounding variables such as partner status or the presence of mental health concerns. The present study was conducted to evaluate potential associations between overweight/obesity, self-reported sexual problems, and associated distress in women and to identify potential confounding factors.

Methods

This cross-sectional study was performed by analyzing medical records of cis-gender women seen for a specialty consultation at women's health clinics at Mayo Clinic Rochester, MN and Scottsdale, AZ, between May 1, 2015 and September 15, 2019. All women seen for clinical care in these specialty clinics were included in the analysis unless they did not provide permission for the use of their private health information to be used for research purposes [about 6% of eligible women decline participation in the Data Registry on Experiences of Aging, Menopause and Sexuality (DREAMS)].²³ As part of their clinical visit for evaluation of menopause- or sexual health-related concerns, women filled out

questionnaires assessing sexual function (Female Sexual Function Index [FSFI] and Female Sexual Distress Scale Revised [FSDS-R]), mood (Patient Health Questionnaire [PHQ-9]), anxiety (Generalized Anxiety Disorder scale [GAD-7]), and relationship distress (Kansas Marital Satisfaction Scale [KMSS]). Data regarding demographic information (age, marital status, education, employment, race/ethnicity), body mass index (BMI), parity, self-reported reproductive stage, use of systemic menopausal hormone therapy (MHT), use of hormonal contraception, and use of selective serotonin reuptake inhibitors (SSRI) or serotonin-norepinephrine reuptake inhibitors (SNRI) were also obtained from their medical records. Reproductive stage was determined by participant report as follows: premenopause (having regular periods), perimenopause (changes in periods, but have not gone 12 months in a row without a period), postmenopause (after menopause), or unsure. The women were divided into five groups according to BMI (kg/m²): normal (18–24.9), overweight (25–29.9), class I obesity (30–34.9), class II obesity (35–39.9) and class III obesity (≥ 40). The study was approved by the Mayo Clinic Institutional Review Board, and data were included in the Data Registry on Experiences of Aging, Menopause and Sexuality.

Sexual function was measured using the FSFI, a standardized questionnaire comprised of 19 questions divided into 6 domains (desire, arousal, lubrication, orgasm, sexual satisfaction, and pain). The final score is a sum of the domain scores and varies from 1.2 to 36. A total FSFI score ≥ 26.55 indicates significant sexual problems, with lower scores indicating worse sexual function.^{24,25}

Sexual distress was assessed with the FSDS-R. It is composed of 13 questions, graded from 0 = never to 4 = always, depending on the frequency of each symptom. The final score varies from 0 to 52, and scores ≥ 11 imply significant distress associated with sexual problems, with higher scores indicating greater distress.²⁶

Depression was assessed by the PHQ-9 with scores ranging from 0–27, and anxiety was assessed with GAD-7 scale with scores ranging from 0–21. For both the PHQ-9 and GAD-7, scores of 5, 10, and 15 indicate mild, moderate, and severe depression and anxiety, respectively.²⁷

Relationship distress was assessed using the 3-question KMSS which asks about satisfaction with one's partner, with one's relationship, and with one's relationship with their partner (1 = extremely dissatisfied to 7 = extremely satisfied). Total scores range from 3 to 21, and a score of 16 or lower indicates some degree of relationship distress, while a score of greater than or equal to 17 indicates a non-distressed relationship.²⁸

Statistical Analysis

Data were summarized using mean (standard deviation, SD) or median (interquartile range, IQR) for continuous variables and frequencies and percentages for categorical variables. ANOVA was used to compare continuous variables between groups, and either a chi-square or Fisher's exact test were used to compare categorical variables. Multivariable logistic regression was used to assess the association between BMI categories and FSD, defined as FSFI < 26.55 and FSDS-R ≥ 11 after adjusting for other patient characteristics in sexually active women. All two-way interactions were assessed, and no significant interactions were

found. All analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC), and p-values <0.05 were considered statistically significant.

Results

Between May, 2015 and September 2019, 6688 women aged 18 to 94 years (mean age 52.5 years) were seen for consultation in women's health clinics at Mayo Clinic, Rochester, MN and Scottsdale, AZ. While the majority of women (81%) reported being sexually active in the prior 4 weeks, there was a significant association between sexual activity and BMI such that women in higher weight categories were significantly less likely to report being sexually active, both on univariate analysis and after adjustment for multiple potential confounding factors, including age, education, MHT use, SSRI/SNRI use, hormonal contraception use, anxiety and depression (Table 1).

Of the 5441 sexually active women, 2621 (48.2%) were of normal weight; 1605 (29.5%) were overweight; 1215 (22.3%) were obese. When obesity was further divided into classes, 734 (13.5%) were class I; 298 (5.5%) were class II; 183 (3.4%) were class III. Reproductive stage was self-reported in a subset of women (2934/5441), and greater than 30% of women in each BMI group were uncertain of their reproductive status, and between 26.9% and 34.7% reported being postmenopausal with women in higher BMI groups less likely to report being postmenopausal compared to women in lower BMI groups. While the majority of women (> 80%) were not using MHT, there were between BMI group differences in MHT use, with decreasing rates of MHT use with higher BMI category. There were between group differences in the use of SSRI/SNRIs, with increasing rates of use with higher BMI category. There were differences between BMI groups in age, parity, and education, with women in higher BMI categories reporting lower levels of education. There were no differences in employment status or partner status between BMI categories. Sociodemographic and participant characteristics are presented in Table 2.

On univariate analysis of sexually active women, there was a significant association between BMI category and FSFI total scores and sexual function domain scores of arousal, lubrication, orgasm, and satisfaction, such that lower total and domain scores (indicating worse sexual function) associated with higher BMI category. The association between BMI category and pain approached significance ($p=0.05$). Sexual desire was not associated with BMI category ($p=0.11$). There were some differences between BMI groups on pairwise comparison of FSFI domain scores of arousal, orgasm and satisfaction (see supplemental table). There was also an association between higher BMI category and mean FSDS-R scores, signifying greater distress related to sexual problems in overweight and obese women compared to normal weight women. However, FSD by the combined endpoint of FSFI 26.55 and FSDS-R 11 did not significantly differ by BMI category ($p=0.33$). There was a significant trend for anxiety and depressed mood (scores 5 indicating at least mild anxiety and depression, respectively) in overweight and obese women compared with normal weight women. The majority of women (>72% in all weight categories) reported no relationship distress, and there were no differences in rates of relationship distress between BMI categories. (Table 3) On multivariable analyses, after adjusting for age, education, MHT use, SSRI/SNRI use, hormonal contraception use, anxiety, and depression, BMI was

not significantly associated with FSD by the combined endpoint (FSFI = 26.55 and FSDS-R = 11). (Table 4)

Discussion

This cross-sectional study is, to our knowledge, the largest study to examine the association between obesity and sexual function in women. Results demonstrate a significant association between BMI and sexual activity, with women in overweight and all obesity categories being less likely to report being sexually active than normal weight women. Further, a progressive trend by higher weight category was noted such that women with class III obesity were less likely to be sexually active than women with class I or II obesity. This may be explained by the well-documented weight discrimination experienced by obese individuals which can impact dating and relationship prospects.^{29–31} In contrast, a study investigating associations between sexual activity and weight status found no difference in sexual activity across weight groups in middle-aged and older adults, and overweight women reported more frequent sexual activity compared to their normal weight counterparts.³²

Among sexually active women, overweight/obesity was associated with greater sexual distress and worse sexual function overall and in all domains except for sexual pain and desire on univariate analysis. The association BMI and FSD by the combined endpoint FSD by the combined endpoint (FSFI = 26.55 and FSDS-R = 11) was not significant on univariate or multivariable analyses. These results speak to the complexity of FSD and the myriad contributing factors, and does not rule out an indirect or moderating effect of obesity on female sexual function.

Existing studies investigating the association between female sexual function and BMI have shown conflicting results. A French population survey involving 5535 women showed no difference in measures of sexual function (desire, arousal, pain) as assessed by the Contexte de la Sexualite en France questionnaire in overweight or obese women compared with normal weight women, although there was a significant trend toward decreasing desire with increasing BMI.²⁰ Similarly, a population sample from Sweden involving 2810 subjects, 1266 of whom were women, showed no significant differences between normal weight versus overweight and obese individuals in terms of sexual satisfaction, desire and arousal.¹⁹ A small case-control study of 64 women seen in an obesity clinic also demonstrated no significant differences between FSFI total or domain scores in obese women compared to normal weight controls.²¹

In contrast, other studies have shown a link between BMI and sexual function in women. One small case-control study of 120 Iranian women with sexual dysfunction showed that women with a BMI ≥ 25 had significantly lower FSFI total and domain scores than normal weight women.¹⁸ Similarly, a case control study that examined 52 women with sexual dysfunction showed that FSFI scores correlated with BMI.¹⁷ Another case control study of 60 women seen in a weight clinic in Greece demonstrated significantly lower total FSFI scores in obese women than in normal weight controls, as well as lower scores in most sexual function domains, including desire, arousal, lubrication, orgasm and satisfaction. In

addition, BMI in obese women was negatively associated with all sexual function domains except for orgasm and pain.¹⁶

Several studies have found high rates of sexual problems in overweight or obese women seen for management of obesity.^{33–36} In addition, bariatric surgery for weight loss has been associated with improvements in sexual functioning in women,^{37–39} although the benefit seemed to wane over 4 years of follow up in one study.³⁹

Obesity has the potential to impact sexual function in several ways. It may have a direct impact given that adipose tissue is an active endocrine organ that releases inflammatory cytokines such as tumor necrosis factor alpha (TNF- α) and interleukin 6 (IL-6).⁴⁰ It is conceivable that the obesity mediated inflammatory response alters female sexual function, but that has not been established. In addition, while adipose tissue is thought to exert a direct effect on sexual desire and erectile function in men through its impact on steroid hormones - decreasing testosterone and increasing estradiol, a direct effect of adiposity-related steroid hormone changes and its potential impact on sexual function in women has not been clearly defined.⁴¹

In addition to a direct effect, obesity may also have an indirect impact on sexual function given its association with multiple comorbidities including metabolic syndrome, dyslipidemia, cardiovascular disease, pelvic floor disorders, and osteoarthritis, all of which could potentially impact sexual function. Metabolic syndrome has been linked with poorer sexual function in women in some studies,^{42–47} but not in others.^{48–50} Further, components of metabolic syndrome, eg. elevated blood glucose levels,⁴⁵ hypertriglyceridemia,^{42,44} and elevated C-reactive protein levels,⁴³ have been independently associated with sexual dysfunction in some studies, though again, not in all.⁴⁹ Coronary artery disease is also more prevalent in overweight and obese individuals⁵¹ and is linked to sexual dysfunction, conceivably due to vascular endothelial dysfunction, changes in the arterial vascular bed, and impairment in genital blood flow.^{51–54} Similarly, obesity is a risk factor for urinary incontinence and pelvic prolapse,^{55,56} and lower urinary tract symptoms are associated with worse sexual function.^{22,57} Osteoarthritis can adversely impact sexual function due to pain and reduced range of motion.⁵⁸

The menopause transition is associated with hormonal, social, and psychological changes which may promote the development of sexual dysfunction, but the relationship between menopause and sexual function remains complex. The Study of Women's Health Across the Nation (SWAN) demonstrated that all sexual function variables (desire, arousal, orgasm, intercourse frequency) declined across the menopause transition, BMI increased over time, and a higher BMI was associated with less frequent intercourse. However, no direct association between changes in BMI and changes in sexual function was identified in 2,528 women followed longitudinally over 13 years.¹⁰ The results of the current study are consistent with the findings in SWAN in showing an association between sexual activity and BMI and in failing to reveal an association between BMI and sexual problems or distress after accounting for other potential modifying factors.

Obesity also has the potential to adversely impact sexual function by mediating psychosocial factors such as mood, body image issues, and poor self esteem. Anxiety and depression are linked with both obesity^{59,60} and sexual dysfunction,^{61,62} and may therefore be important moderating factors. Existing literature supports a bidirectional association between depression and sexual dysfunction such that depression predicts sexual dysfunction, and conversely, sexual dysfunction predicts depression.⁶¹ The present study is consistent with prior studies and highlights the associations of obesity with depression and anxiety and also corroborates the known associations among obesity, sexual dysfunction, and the use of SSRI/SNRIs.^{63,64} However, no causal link between mood and obesity has been identified to date.

Several studies have demonstrated associations between body image and sexual function.^{65–71} While a normal BMI does not necessarily protect against problems with self image, body dissatisfaction is common among obese individuals, particularly in women.⁷² The Women's Health Initiative Observational Study demonstrated that women transitioning into marriage or partnered relationships experienced an increase in BMI, and divorce or separation was associated with a reduction in BMI and waist circumference.⁷³ In the present study, no association was noted between BMI and partner status or relationship distress.

The wide variation in results of existing studies investigating the association of obesity and FSD is influenced, at least in part, by the heterogeneity in the measures used for assessment of sexual function and the variability in the definition of FSD. As an example, the studies to date have not taken into account personal distress related to sexual dysfunction, a key factor in determining the presence of FSD.¹⁵ Other methodological factors that could contribute to the heterogeneity of findings include lack of a normal weight comparison group in some studies, small sample size, poor study design and lack of adjustment for potential confounders, including mood, reproductive stage, antidepressant and MHT use. Another potential factor influencing the results of studies investigating FSD and contributing factors, including BMI, is that women who report being sexually inactive are often excluded from the analyses. This is mostly because patient reported outcome measures commonly used to assess sexual function are directed only toward women who report recent sexual activity. Sexually inactive women may, in fact, be avoiding sexual activity because of sexual dysfunction, and excluding them from the analyses could introduce biases in the findings.

The present study identified a link between sexual function and obesity in a cohort of women seeking care for menopause- or sexual health-related concerns at a tertiary care center, although this finding was accounted for by multiple factors known to associate with FSD, such as age, anxiety, depression, MHT and antidepressant use. These results highlight the association, albeit indirect, between two prevalent conditions in women and suggest that overweight and obese women should be proactively assessed for sexual dysfunction, and appropriate interventions implemented using a biopsychosocial approach to address the biological, psychological, sociocultural and relationship factors that could contribute to FSD.⁷⁴

The strengths of this study include the large cohort size and the evaluation of sexual health concerns associated with sexually related personal distress, which distinguishes this study

from others investigating associations of obesity and female sexual function. In addition, this study examined potential moderating factors, including level of education, relationship distress, reproductive stage, depressed mood, anxiety and MHT and antidepressant use.

However, there are important limitations to be noted. This cohort consisted of women who presented to subspecialty women's clinics at a tertiary care center, and the majority had sexual dysfunction. Moreover they were mostly white, employed, educated and partnered. Therefore, the generalizability of these findings may be somewhat limited. In addition, the current study did not include potential confounders such as partner factors, e.g., partner's physical, emotional and sexual health or detailed assessment of participant comorbidities which could impact sexual function (e.g., metabolic syndrome, pelvic floor disorders, osteoarthritis). Because of the cross-sectional nature of the study, directionality of associations between sexual activity or sexual function and weight cannot be determined.

Conclusions

This large cross-sectional study found that being overweight or obese was associated with lower rates of sexual activity. Among sexually active women, those who were overweight and obese had worse sexual function in most sexual function domains, including arousal, lubrication, satisfaction, orgasm and pain, as well as greater sexually related personal distress. However, these associations were not directly associated with BMI, but were instead mediated by other factors including age, medication use, and mood disturbances.

Given the high prevalence of obesity, and the significant quality of life impairment associated with FSD, it is important to screen overweight and obese women for FSD and to offer appropriate counseling and treatment using a biopsychosocial approach to identify and address all contributing factors in addition to general weight management recommendations. The present study also underscores the need for consistent and standardized measures for assessment of FSD and for development of measures to assess sexual function in women who are not sexually active.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

References

1. Health, United States, 2017: With Chartbook on Long-term Trends in Health. Centers for Disease Control and Prevention (CDC) National Center for Health Statistics (NCHS) <https://www.cdc.gov/nchs/data/abus/2017/058.pdf>. Published 2018. Accessed July 30, 2019.
2. Bhaskaran K, Douglas I, Forbes H, dos-Santos-Silva I, Leon DA, Smeeth L. Body-mass index and risk of 22 specific cancers: a population-based cohort study of 5.24 million UK adults. *Lancet*. 2014;384(9945):755–765. [PubMed: 25129328]
3. Karvonen-Gutierrez C, Kim C. Association of Mid-Life Changes in Body Size, Body Composition and Obesity Status with the Menopausal Transition. *Healthcare (Basel)*. 2016;4(3).
4. Sternfeld B, Wang H, Quesenberry CP Jr., et al. Physical activity and changes in weight and waist circumference in midlife women: findings from the Study of Women's Health Across the Nation. *Am J Epidemiol*. 2004;160(9):912–922. [PubMed: 15496544]

5. Avis NE, Brockwell S, Randolph JF Jr., et al. Longitudinal changes in sexual functioning as women transition through menopause: results from the Study of Women's Health Across the Nation. *Menopause*. 2009;16(3):442–452. [PubMed: 19212271]
6. Lonnee-Hoffmann RA, Dennerstein L, Leher P, Szoek C. Sexual function in the late postmenopause: a decade of follow-up in a population-based cohort of Australian women. *J Sex Med*. 2014;11(8):2029–2038. [PubMed: 24888566]
7. Palacios S, Tobar AC, Menendez C. Sexuality in the climacteric years. *Maturitas*. 2002;43 Suppl 1:S69–77. [PubMed: 12361890]
8. Thomas HN, Hess R, Thurston RC. Correlates of Sexual Activity and Satisfaction in Midlife and Older Women. *Ann Fam Med*. 2015;13(4):336–342. [PubMed: 26195678]
9. Harder H, Starkings RML, Fallowfield LJ, et al. Sexual functioning in 4,418 postmenopausal women participating in UKTOCS: a qualitative free-text analysis. *Menopause*. 2019.
10. Nackers LM, Appelhans BM, Segawa E, Janssen I, Dugan SA, Kravitz HM. Associations between body mass index and sexual functioning in midlife women: the Study of Women's Health Across the Nation. *Menopause*. 2015;22(11):1175–1181. [PubMed: 25803669]
11. Laumann EO, Nicolosi A, Glasser DB, et al. Sexual problems among women and men aged 40–80 y: prevalence and correlates identified in the Global Study of Sexual Attitudes and Behaviors. *Int J Impot Res*. 2005;17(1):39–57. [PubMed: 15215881]
12. Lindau ST, Schumm LP, Laumann EO, Levinson W, O'Muirheartaigh CA, Waite LJ. A study of sexuality and health among older adults in the United States. *N Engl J Med*. 2007;357(8):762–774. [PubMed: 17715410]
13. Laumann EO, Paik A, Rosen RC. Sexual dysfunction in the United States: prevalence and predictors. *Jama*. 1999;281(6):537–544. [PubMed: 10022110]
14. Shifren JL, Monz BU, Russo PA, Segreti A, Johannes CB. Sexual problems and distress in United States women: prevalence and correlates. *Obstet Gynecol*. 2008;112(5):970–978. [PubMed: 18978095]
15. McCabe MP, Sharlip ID, Atalla E, et al. Definitions of Sexual Dysfunctions in Women and Men: A Consensus Statement From the Fourth International Consultation on Sexual Medicine 2015. *J Sex Med* 2016;13(2):135–143. [PubMed: 26953828]
16. Assimakopoulos K, Panayiotopoulos S, Iconomou G, et al. Assessing sexual function in obese women preparing for bariatric surgery. *Obes Surg*. 2006;16(8):1087–1091. [PubMed: 16901365]
17. Esposito K, Ciotola M, Giugliano F, et al. Association of body weight with sexual function in women. *Int J Impot Res*. 2007;19(4):353–357. [PubMed: 17287832]
18. Mozafari M, Khajavikhan J, Jaafarpour M, Khani A, Direkvand-Moghadam A, Najafi F. Association of body weight and female sexual dysfunction: a case control study. *Iran Red Crescent Med J*. 2015;17(1):e24685. [PubMed: 25763278]
19. Adolfsson B, Elofsson S, Rossner S, Unden AL. Are sexual dissatisfaction and sexual abuse associated with obesity? A population-based study. *Obes Res*. 2004;12(10):1702–1709. [PubMed: 15536235]
20. Bajos N, Wellings K, Laborde C, Moreau C, Group CSF. Sexuality and obesity, a gender perspective: results from French national random probability survey of sexual behaviours. *Bmj*. 2010;340:c2573. [PubMed: 20551118]
21. Kadioglu P, Yetkin DO, Sanli O, Yalin AS, Onem K, Kadioglu A. Obesity might not be a risk factor for female sexual dysfunction. *BJU Int*. 2010;106(9):1357–1361. [PubMed: 20394615]
22. Melin I, Falconer C, Rossner S, Altman D. Sexual function in obese women: impact of lower urinary tract dysfunction. *Int J Obes (Lond)*. 2008;32(8):1312–1318. [PubMed: 18475273]
23. Faubion SS, Kapoor E, Kling JM, et al. Data Registry on Experiences of Aging, Menopause, and Sexuality (DREAMS): A cohort profile. *Maturitas*. 2018;107:44–49. [PubMed: 29169579]
24. Rosen R, Brown C, Heiman J, et al. The Female Sexual Function Index (FSFI): a multidimensional self-report instrument for the assessment of female sexual function. *J Sex Marital Ther*. 2000;26(2):191–208. [PubMed: 10782451]
25. Wiegel M, Meston C, Rosen R. The female sexual function index (FSFI): cross-validation and development of clinical cutoff scores. *J Sex Marital Ther*. 2005;31(1):1–20. [PubMed: 15841702]

26. Derogatis L, Clayton A, Lewis-D'Agostino D, Wunderlich G, Fu Y. Validation of the female sexual distress scale-revised for assessing distress in women with hypoactive sexual desire disorder. *J Sex Med.* 2008;5(2):357–364. [PubMed: 18042215]
27. Spitzer RL, Williams JBW, Kroenke K. Instruction Manual: Instructions for Patient Health Questionnaire (PHQ) and GAD-7 Measures. In. PHQ and GAD-7 Instructions 1990.
28. Crane DR, Middleton KC, Bean RA. Establishing Criterion Scores for the Kansas Marital Satisfaction Scale and the Revised Dyadic Adjustment Scale. *American Journal of Family Therapy* 2000;28(1):53–60.
29. Hunger JM, Blodorn A, Miller CT, Major B. The psychological and physiological effects of interacting with an anti-fat peer. *Body Image.* 2018;27:148–155. [PubMed: 30267954]
30. Pearl RL, Puhl RM. Weight bias internalization and health: a systematic review. *Obes Rev.* 2018;19(8):1141–1163. [PubMed: 29788533]
31. Sutin AR, Terracciano A. Perceived weight discrimination and obesity. *PLoS One.* 2013;8(7):e70048. [PubMed: 23894586]
32. Smith L, Yang L, Forwood S, et al. Associations between sexual activity and weight status: Findings from the English Longitudinal Study of Ageing. *PLoS One.* 2019;14(9):e0221979 [PubMed: 31498846]
33. Bond DS, Vithiananthan S, Leahey TM, et al. Prevalence and degree of sexual dysfunction in a sample of women seeking bariatric surgery. *Surg Obes Relat Dis.* 2009;5(6):698–704. [PubMed: 19733514]
34. Erenel AS, Kılinc FN. Does Obesity Increase Sexual Dysfunction in Women? *Sex Disabil.* 2012.
35. Sarwer DB, Spitzer JC, Wadden TA, et al. Sexual functioning and sex hormones in persons with extreme obesity and seeking surgical and nonsurgical weight loss. *Surg Obes Relat Dis.* 2013;9(6):997–1007. [PubMed: 24120985]
36. Steffen KJ, King WC, White GE, et al. Sexual functioning of men and women with severe obesity before bariatric surgery. *Surg Obes Relat Dis.* 2017;13(2):334–343. [PubMed: 27986585]
37. Bond DS, Wing RR, Vithiananthan S, et al. Significant resolution of female sexual dysfunction after bariatric surgery. *Surg Obes Relat Dis.* 2011;7(1):1–7. [PubMed: 20678969]
38. Oliveira CFA, Dos Santos PO, de Oliveira RA, et al. Changes in Sexual Function and Positions in Women With Severe Obesity After Bariatric Surgery. *Sex Med.* 2019;7(1):80–85. [PubMed: 30509513]
39. Sarwer DB, Wadden TA, Spitzer JC, et al. 4-Year Changes in Sex Hormones, Sexual Functioning, and Psychosocial Status in Women Who Underwent Bariatric Surgery. *Obes Surg.* 2018;28(4):892–899. [PubMed: 29164510]
40. Kershaw EE, Flier JS. Adipose tissue as an endocrine organ. *J Clin Endocrinol Metab.* 2004;89(6):2548–2556. [PubMed: 15181022]
41. Rowland DL, McNabney SM, Mann AR. Sexual Function, Obesity, and Weight Loss in Men and Women. *Sex Med Rev.* 2017;5(3):323–338. [PubMed: 28456610]
42. Alvisi S, Baldassarre M, Lambertini M, et al. Sexuality and psychopathological aspects in premenopausal women with metabolic syndrome. *J Sex Med.* 2014;11(8):2020–2028. [PubMed: 24848980]
43. Esposito K, Ciotola M, Marfella R, Di Tommaso D, Cobellis L, Giugliano D. The metabolic syndrome: a cause of sexual dysfunction in women. *Int J Impot Res.* 2005;17(3):224–226. [PubMed: 15716979]
44. Martelli V, Valisella S, Moscatiello S, et al. Prevalence of sexual dysfunction among postmenopausal women with and without metabolic syndrome. *J Sex Med.* 2012;9(2):434–441. [PubMed: 22023878]
45. Otuncemur A, Dursun M, Ozbek E, et al. Effect of metabolic syndrome on sexual function in pre- and postmenopausal women. *J Sex Marital Ther.* 2015;41(4):440–449. [PubMed: 24824329]
46. Ponholzer A, Temml C, Rauchenwald M, Marszalek M, Madersbacher S. Is the metabolic syndrome a risk factor for female sexual dysfunction in sexually active women? *Int J Impot Res.* 2008;20(1):100–104. [PubMed: 17882275]
47. Trompeter SE, Bettencourt R, Barrett-Connor E. Metabolic Syndrome and Sexual Function in Postmenopausal Women. *Am J Med.* 2016;129(12):1270–1277 e1271. [PubMed: 27132570]

48. Dombek K, Capistrano EJ, Costa AC, Marinheiro LP. Metabolic syndrome and sexual function in postmenopausal women. *Arch Endocrinol Metab.* 2016;60(6):545–553. [PubMed: 27982200]
49. Kim YH, Kim SM, Kim JJ, Cho IS, Jeon MJ. Does metabolic syndrome impair sexual function in middle- to old-aged women? *J Sex Med.* 2011;8(4):1123–1130. [PubMed: 21235723]
50. Politano CA, Valadares AL, Pinto-Neto A, Costa-Paiva L. The metabolic syndrome and sexual function in climacteric women: a cross-sectional study. *J Sex Med.* 2015;12(2):455–462.
51. Buscot MJ, Thomson RJ, Juonala M, et al. Distinct child-to-adult body mass index trajectories are associated with different levels of adult cardiometabolic risk. *Eur Heart J.* 2018;39(24):2263–2270. [PubMed: 29635282]
52. Kaya C, Yilmaz G, Nurkalem Z, Ilktac A, Karaman MI. Sexual function in women with coronary artery disease: a preliminary study. *Int J Impot Res.* 2007;19(3):326–329. [PubMed: 17170712]
53. Megiddo E, Justo D, Arbel Y, Oren A, Heruti R, Banai S. [Sexual dysfunction and coronary artery disease in adult women]. *Harefuah.* 2009;148(9):611–614, 657. [PubMed: 20070051]
54. Miner M, Esposito K, Guay A, Montorsi P, Goldstein I. Cardiometabolic risk and female sexual health: the Princeton III summary. *J Sex Med.* 2012;9(3):641–651; quiz 652. [PubMed: 22372651]
55. Santaniello F, Giannantoni A, Cochetti G, Zucchi A, Costantini E. Body mass index and lower urinary tract symptoms in women. *Arch Ital Urol Androl.* 2007;79(1):17–19. [PubMed: 17484398]
56. Kapoor DS, Davila GW, Rosenthal RJ, Ghoniem GM. Pelvic floor dysfunction in morbidly obese women: pilot study. *Obes Res.* 2004;12(7):1104–1107. [PubMed: 15292474]
57. Bilgic D, Gokyildiz S, Kizilkaya Beji N, Yalcin O, Gungor Ugurlucan F. Quality of life and sexual function in obese women with pelvic floor dysfunction. *Women Health.* 2019;59(1):101–113. [PubMed: 29979949]
58. Currey HL. Osteoarthritis of the hip joint and sexual activity. *Ann Rheum Dis.* 1970;29(5):488–493. [PubMed: 5476676]
59. Jantaratnotai N, Mosikanon K, Lee Y, McIntyre RS. The interface of depression and obesity. *Obes Res Clin Pract.* 2017;11(1):1–10.
60. Garipey G, Nitka D, Schmitz N. The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis. *Int J Obes (Lond).* 2010;34(3):407–419. [PubMed: 19997072]
61. Atlantis E, Sullivan T. Bidirectional association between depression and sexual dysfunction: a systematic review and meta-analysis. *J Sex Med.* 2012;9(6):1497–1507. [PubMed: 22462756]
62. Brotto L, Atallah S, Johnson-Agbakwu C, et al. Psychological and Interpersonal Dimensions of Sexual Function and Dysfunction. *J Sex Med.* 2016;13(4):538–571. [PubMed: 27045257]
63. Grundy A, Cotterchio M, Kirsh VA, Kreiger N. Associations between anxiety, depression, antidepressant medication, obesity and weight gain among Canadian women. *PLoS One.* 2014;9(6):e99780. [PubMed: 24932472]
64. Lorenz T, Rullo J, Faubion S. Antidepressant-Induced Female Sexual Dysfunction. *Mayo Clin Proc.* 2016;91(9):1280–1286. [PubMed: 27594188]
65. Thomas HN, Hamm M, Borrero S, Hess R, Thurston RC. Body Image, Attractiveness, and Sexual Satisfaction Among Midlife Women: A Qualitative Study. *J Womens Health (Larchmt).* 2019;28(1):100–106. [PubMed: 30307808]
66. Graham CA, Sanders SA, Milhausen RR, McBride KR. Turning on and turning off: a focus group study of the factors that affect women's sexual arousal. *Arch Sex Behav.* 2004;33(6):527–538. [PubMed: 15483367]
67. Koch PB, Mansfield PK, Thureau D, Carey M. "Feeling frumpy": the relationships between body image and sexual response changes in midlife women. *J Sex Res.* 2005;42(3):215–223. [PubMed: 19817035]
68. Sanchez DT, Kiefer AK. Body concerns in and out of the bedroom: implications for sexual pleasure and problems. *Arch Sex Behav.* 2007;36(6):808–820. [PubMed: 17657464]
69. Sims KE, Meana M. Why did passion wane? A qualitative study of married women's attributions for declines in sexual desire. *J Sex Marital Ther.* 2010;36(4):360–380. [PubMed: 20574890]

70. Wallwiener S, Strohmaier J, Wallwiener LM, et al. Sexual Function Is Correlated With Body Image and Partnership Quality in Female University Students. *J Sex Med.* 2016;13(10):1530–1538. [PubMed: 27567073]
71. Kingsberg SA. Attitudinal survey of women living with low sexual desire. *J Womens Health (Larchmt).* 2014;23(10):817–823. [PubMed: 25105910]
72. Weinberger NA, Kersting A, Riedel-Heller SG, Luck-Sikorski C. Body Dissatisfaction in Individuals with Obesity Compared to Normal-Weight Individuals: A Systematic Review and Meta-Analysis. *Obes Facts.* 2016;9(6):424–441. [PubMed: 28013298]
73. Kutob RM, Yuan NP, Wertheim BC, et al. Relationship Between Marital Transitions, Health Behaviors, and Health Indicators of Postmenopausal Women: Results from the Women's Health Initiative. *J Womens Health (Larchmt).* 2017;26(4):313–320. [PubMed: 28072926]
74. Parish SJ, Hahn SR, Goldstein SW, et al. The International Society for the Study of Women's Sexual Health Process of Care for the Identification of Sexual Concerns and Problems in Women. *Mayo Clin Proc.* 2019.

Table 1.

Sexual Activity by BMI Category

BMI category	% Sexually Active	Univariate		Multivariable*	
		Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value
Normal weight	84.9%	Reference		Reference	
Overweight	80.3%	0.73 (0.63, 0.84)	<0.001	0.75 (0.65, 0.87)	<0.001
Class I Obesity	78.7%	0.66 (0.55, 0.79)	<0.001	0.70 (0.58, 0.85)	<0.001
Class II Obesity	72.2%	0.46 (0.36, 0.59)	<0.001	0.49 (0.38, 0.62)	<0.001
Class III Obesity	71.5%	0.45 (0.34, 0.60)	<0.001	0.47 (0.35, 0.63)	<0.001

* adjusted for age, education, MHT use, SSRI/SNRI use, hormonal contraception use, anxiety and depression

Table 2.

Characteristics of Sexually Active Women

	Normal (N=2621)	Overweight (N=1605)	Obese Class I (N=734)	Obese Class II (N=298)	Obese Class III (N=183)	p value
Age, Mean (SD)	51.9 (11.6)	53.3 (10.8)	53.0 (11.0)	50.5 (10.6)	47.8 (10.1)	<0.001
BMI, Mean (SD)	22.0 (1.9)	27.2 (1.4)	32.2 (1.5)	37.0 (1.4)	44.2 (4.6)	
Partner Status						0.15
Married/Life Partner	2201 (84.6%)	1333 (83.7%)	616 (84.0%)	242 (81.8%)	142 (78.0%)	
Divorced/Separated/Widowed/Single	400 (15.4%)	259 (16.3%)	117 (16.0%)	54 (18.2%)	40 (22.0%)	
Education						<0.001
Missing	308	195	87	35	17	
High School graduate/GED or lower	156 (6.7%)	121 (8.6%)	69 (10.7%)	33 (12.5%)	23 (13.9%)	
At least some college	2157 (93.3%)	1289 (91.4%)	578 (89.3%)	230 (87.5%)	143 (86.1%)	
Employed						0.36
Missing	495	327	139	56	34	
Yes	1310 (61.6%)	825 (64.6%)	375 (63.0%)	156 (64.5%)	100 (67.1%)	
No	816 (38.4%)	453 (35.4%)	220 (37.0%)	86 (35.5%)	49 (32.9%)	
Race						<0.001
White	2415 (92.1%)	1463 (91.2%)	681 (92.8%)	257 (86.2%)	168 (91.8%)	
American Indian/Alaskan Native	3 (0.1%)	10 (0.6%)	2 (0.3%)	4 (1.3%)	2 (1.1%)	
Asian	57 (2.2%)	22 (1.4%)	8 (1.1%)	3 (1.0%)	1 (0.5%)	
Black or African American	10 (0.4%)	20 (1.2%)	13 (1.8%)	12 (4.0%)	3 (1.6%)	
Native Hawaiian/Pacific Islander	3 (0.1%)	1 (0.1%)	0 (0.0%)	1 (0.3%)	0 (0.0%)	
Parity						0.002
0	86 (3.3%)	35 (2.2%)	18 (2.5%)	12 (4.0%)	6 (3.3%)	
1	192 (7.3%)	116 (7.2%)	67 (9.1%)	23 (7.7%)	14 (7.7%)	
2	542 (20.7%)	367 (22.9%)	160 (21.8%)	36 (12.1%)	44 (24.0%)	
3+	444 (16.9%)	302 (18.8%)	132 (18.0%)	73 (24.5%)	25 (13.7%)	
Unknown	1357 (51.8%)	785 (48.9%)	357 (48.6%)	154 (51.7%)	94 (51.4%)	
Menopause status						0.010
Missing	1180	751	355	142	79	
Pre-menopausal	260 (18.0%)	123 (14.4%)	46 (12.1%)	26 (16.7%)	17 (16.3%)	

	Normal (N=2621)	Overweight (N=1605)	Obese Class I (N=734)	Obese Class II (N=298)	Obese Class III (N=183)	p value
Perimenopausal	227 (15.8%)	154 (18.0%)	57 (15.0%)	24 (15.4%)	25 (24.0%)	
Postmenopausal	500 (34.7%)	282 (33.0%)	124 (32.7%)	44 (28.2%)	28 (26.9%)	
Not Sure	454 (31.5%)	295 (34.5%)	152 (40.1%)	62 (39.7%)	34 (32.7%)	
Medications						
Menopause Hormone Therapy (systemic)	352 (19.8%)	191 (17.4%)	93 (18.1%)	25 (12.5%)	16 (11.3%)	0.015
SSRI/SNRI	224 (12.6%)	184 (16.8%)	107 (20.8%)	39 (19.5%)	35 (24.8%)	<0.001
Hormonal Contraception	134 (7.5%)	67 (6.1%)	22 (4.3%)	11 (5.5%)	11 (7.8%)	0.083

Table 3.

Questionnaire Data Among Sexually Active Women

	Normal (N=2621)	Overweight (N=1605)	Obese Class I (N=734)	Obese Class II (N=298)	Obese Class III (N=183)	p value
GAD 7						<0.001
Missing	264	164	79	27	16	
< 5	1617 (68.6%)	977 (67.8%)	439 (67.0%)	157 (57.9%)	84 (50.3%)	
5	740 (31.4%)	464 (32.2%)	216 (33.0%)	114 (42.1%)	83 (49.7%)	
PHQ 9						<0.001
Missing	199	127	63	22	11	
< 5	1625 (67.1%)	903 (61.1%)	359 (53.5%)	126 (45.7%)	71 (41.3%)	
5	797 (32.9%)	575 (38.9%)	312 (46.5%)	150 (54.3%)	101 (58.7%)	
KMSS-M						0.95
Missing	150	90	51	26	16	
17	1816 (73.5%)	1105 (72.9%)	493 (72.2%)	196 (72.1%)	121 (72.5%)	
< 17	655 (26.5%)	410 (27.1%)	190 (27.8%)	76 (27.9%)	46 (27.5%)	
FSFI - Desire, Mean (SD)	2.7 (1.2)	2.6 (1.2)	2.5 (1.3)	2.6 (1.2)	2.7 (1.3)	0.11
FSFI - Arousal, Mean (SD)	3.4 (1.6)	3.3 (1.7)	3.0 (1.7)	3.1 (1.7)	3.2 (1.7)	<0.001
FSFI - Lubrication, Mean (SD)	3.5 (1.9)	3.4 (2.0)	3.2 (2.0)	3.3 (2.1)	3.5 (2.1)	0.009
FSFI - Orgasm, Mean (SD)	3.5 (2.0)	3.4 (2.0)	3.0 (2.1)	3.1 (2.1)	3.3 (2.1)	<0.001
FSFI - Satisfaction, Mean (SD)	3.8 (1.7)	3.7 (1.7)	3.4 (1.7)	3.4 (1.7)	3.5 (1.7)	<0.001
FSFI - Pain, Mean (SD)	3.6 (2.2)	3.6 (2.3)	3.4 (2.3)	3.3 (2.4)	3.6 (2.3)	0.05
FSFI Total, Mean (SD)	20.2 (8.6)	19.8 (8.9)	18.5 (9.1)	18.4 (9.5)	19.5 (9.4)	<0.001
FSFI Total						0.27
> 26.55	691 (26.4%)	419 (26.1%)	169 (23.0%)	69 (23.2%)	52 (28.4%)	
26.55	1930 (73.6%)	1186 (73.9%)	565 (77.0%)	229 (76.8%)	131 (71.6%)	
FSDS-R Total Score, Mean (SD)	17.2 (13.6)	17.7 (14.1)	18.5 (14.0)	19.4 (14.3)	19.3 (14.4)	0.016
FSDS-R Total Score						0.28
< 11	1001 (38.2%)	602 (37.5%)	263 (35.8%)	101 (33.9%)	59 (32.2%)	
11	1620 (61.8%)	1003 (62.5%)	471 (64.2%)	197 (66.1%)	124 (67.8%)	
FSFI 26.55 and FSDS 11						0.33
No	1140 (43.5%)	684 (42.6%)	300 (40.9%)	113 (37.9%)	75 (41.0%)	

	Normal (N=2621)	Overweight (N=1605)	Obese Class I (N=734)	Obese Class II (N=298)	Obese Class III (N=183)	p value
Yes	1481 (56.5%)	921 (57.4%)	434 (59.1%)	185 (62.1%)	108 (59.0%)	

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 4.

Multivariable Model for FSD Among Sexually Active Women

BMI category	Odds Ratio * (95% CI)	p-value
Normal weight	Reference	
Overweight	0.99 (0.87, 1.13)	0.87
Obese Class I	1.00 (0.85, 1.19)	0.97
Obese Class II	1.03 (0.80, 1.34)	0.80
Obese Class III	0.81 (0.59, 1.11)	0.18

* adjusted for age, education, MHT use, SSRI/SNRI use, hormonal contraception use, anxiety and depression

FSD defined by the combined endpoint of FSFI ≥ 26.55 and FSDS-R ≥ 11