SEXUAL MEDICINE REVIEWS REVIEW

Diet and Female Sexual Health

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ABSTRACT

Introduction: Female sexual dysfunction is common, and there is growing interest in the relationship between everyday dietary habits and female sexuality. Most of the research at this point is focused on pathological states such as metabolic syndrome, obesity, and eating disorders, which seem to exacerbate sexual dysfunction.

Aim: To characterize sexual dysfunction in the presence of comorbidities including metabolic syndrome, obesity, and disordered eating states and to examine the effect of dietary patterns on female sexuality.

Methods: A comprehensive review of peer-reviewed publications on the topic was performed through a PubMed search. Key search terms and phrases included female sexual dysfunction, diet, dietary patterns, metabolic syndrome, obesity, Mediterranean diet, and eating disorders.

Main Outcome Measure: The main outcome measures were female sexual function scores as measured on the Female Sexual Function Index and domain-specific dysfunctions.

Results: Metabolic syndrome negatively affects sexual function in women, and this effect is most pronounced in younger, premenopausal women. Obesity may also detract from female sexuality, but the data on this comorbidity are more mixed. Endothelial dysfunction, which can result from excess inflammation seen in metabolic syndrome and obesity, can lead to poor blood flow to genitourinary organs, thus providing a pathophysiological link between these diseases and sexual dysfunction. Patients with disordered eating also suffer from sexual morbidity, which may be due to comorbid psychiatric illness and emaciation-induced hypogonadism. Promising data show that the Mediterranean diet helps alleviate sexual dysfunction in women, but other dietary patterns require more formal investigation.

Conclusion: Incorporation of healthy dietary patterns into everyday life may positively influence female sexuality, but more substantial data are needed to confirm this idea. **Towe M, La J, El-Khatib F, et al. Diet and Female Sexual Health. Sex Med Rev 2020;8:256–264.**

Key Words: Female Sexual Dysfunction; Mediterranean Diet; Obesity; Metabolic Syndrome; Eating Disorders

INTRODUCTION

The prevalence of female sexual dysfunction is high, with up to 43% of women experiencing a sexual complaint at some point in life.[1] This estimate may be higher than what is reported, as oftentimes women are uncomfortable bringing up sexual concerns with their physician, and their physician may also be reluctant to ask out of fear of providing inadequate treatment. The multifactorial nature of female sexual dysfunction, along with a lack of accepted measurement methods to assess it, may also contribute to its underdiagnosis and undertreatment.

Sexual health is closely related to overall wellbeing. Disturbances in one area of health generally have an adverse effect on the other. Chronic conditions such as neurological impairment, renal disease, inflammatory disorders, and cancer can all negatively impact sexual health.[2,3] Because general health is largely influenced by what is eaten, everyday dietary patterns have the potential to either positively or negatively affect sexual life. This may be especially relevant for patients with metabolic disorders, as diet and metabolism are closely related.

The role of diet in female sexual health is an area of study that is gaining attention from the scientific community. Previous research at this point has focused on male sexual dysfunction, with less emphasis on the correlation between diet and female sexuality. Furthermore, the studies in females that are available specifically investigate the role of dietary intervention in women

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with comorbid disorders of metabolism, which is a topic that requires attention and synthesis in this review. Preliminary data are sparse, but it seems that diet can influence sexuality mainly through correction of underlying metabolic pathophysiology that can result from such comorbidities. The role of this review is to describe the current literature regarding female sexual function in relation to metabolic syndrome (MetS), obesity, and eating disorders and to assess the effect of certain dietary patterns on sexual function, as well.

METABOLIC SYNDROME AND FEMALE SEXUAL DYSFUNCTION

Metabolic syndrome occurs due to aberrancies in metabolic pathways and manifests as dyslipidemia, insulin resistance, atherogenesis, and central obesity. The presence of MetS raises the risk of cardiovascular events and all-cause mortality.[4,5] Additionally, MetS has been cited as an associated factor for both male and female sexual dysfunction. In males, MetS is commonly linked to erectile dysfunction, for which the proposed pathophysiology involves endothelial dysfunction and excessive inflammation.[6]

There is less of an established link between MetS and female sexual dysfunction. A few studies have found a higher prevalence of sexual complaints in women with MetS than in those without, and this relationship seems to be most pronounced in younger, premenopausal women.[7–9] Furthermore, some series have linked specific components of MetS to certain domains of sexual dysfunction in women. A study by Otunctemur et al[10] utilized the Female Sexual Function Index (FSFI) to assess female dysfunction in this manner with lower scores indicating a greater degree of dysfunction. In their cohort of 400 women, a higher fasting blood glucose level significantly predicted lower total FSFI scores ($P < .001$).[10] In 2 separate studies, a higher level of triglycerides was independently associated with the presence of female sexual dysfunction.[11,12] A summary of the findings between sexual dysfunction and MetS is presented in Table 1.[7–15]

Although the link between MetS and female sexual dysfunction is less established than for male sexual dysfunction, presumably similar pathophysiologic mechanisms are at play. MetS is characterized as an over-inflammatory state with production of proinflammatory cytokines such as interleukin-6, tumor necrosis factor-alpha, and C-reactive protein (CRP).[16] These chemical mediators can negatively affect the synthesis of nitric oxide (NO), which is important for proper blood flow in the genitourinary area. Some studies have shown that increasing NO activity through the administration of a phosphodiesterase-5 inhibitor allows women to experience significant improvement in arousal, orgasm, and enjoyment compared to placebo-treated women.[17,18] Therefore, higher concentrations of inflammatory mediators associated with MetS may have a detrimental effect on sexual health, as seen in the series by Esposito et al[9] of 200 women which found that FSFI score was negatively correlated with CRP levels. These findings support the notion that MetS contributes to higher sexual morbidity in females and that improvements in metabolic state, possibly through dietary intervention, may ameliorate such deficits.

OBESITY AND FEMALE SEXUAL DYSFUNCTION

Obesity can be a component of MetS but has also been studied separately with regard to its effect on sexual health. Obesity in isolation is cited as a risk factor for female sexual dysfunction in some studies,[19–21] but others have not found a strong link between excess body weight and female sexual health.[22,23] Two randomized clinical trials that assessed weight loss as an intervention for improving function for women with sexual dysfunction have found contradictory results, as well. A multidisciplinary approach that incorporated a hypocaloric diet with physical exercise found significant improvements in FSFI scores to parallel reductions in body weight and body mass index (BMI).[24] The subjects in this study also saw improvements in insulin resistance and endothelial dysfunction, which may have been the mediating variables between sexual function recovery and weight loss. However, another trial examining the effect of intensive lifestyle intervention with educational, dietary, and fitness components found no statistically significant changes in female sexual function scores despite significant weight loss in the intervention group.[25] The authors acknowledged that psychosocial variables such as depressive and menopausal symptoms may have presented as possible confounders and contributed to these results. Similar findings are observed in studies of obese women undergoing bariatric surgery. Most of these series report moderate improvement in sexual functioning for the first few years after surgery, especially for women with the highest levels of baseline dysfunction.[26–28] These initial improvements, however, seem to erode over time with most women returning to their baseline FSFI scores regardless of what level they began with.

Interestingly, drugs that are used to treat female sexual dysfunction also tend to result in weight loss. Flibanserin, recently approved by the Food and Drug Administration for the treatment of women with hypoactive sexual desire disorder, has been found to lead to weight loss in both pre- and postmenopausal women, possibly through enhancement of norepinephrine release in the cortex.[29] The antidepressant buproprion is also occasionally used off-label for the treatment of hypoactive sexual desire disorder in women. Whereas many antidepressants lead to weight gain, bupropion has the opposite effect, presumably due to its stimulatory properties.[30] It is possible that the dysfunction-ameliorating effects of these drugs may be enhanced somewhat by the concurrent weight loss that many females experience while taking them.

Similar to MetS, obesity can lead to excess inflammation in the body and subsequent endothelial dysfunction. Adipose tissue

Table 1. Studies examining the association between metabolic syndrome and female sexual function

Study	Design	Sample size, N	Subjects	Sexual function measure	Results
Esposito et al[9]	Prospective cohort	200	Premenopausal women	FSFI	Women with metabolic syndrome had significantly lower FSFI scores (23.2 ± 5.4 vs 30.1 ± 4.7; $P = .001$) and higher levels of CRP ($P = .01$). FSFI scores decreased as the number of components of metabolic syndrome increased ($P < .01$).
Ponholzer et al[8]	Retrospective cohort	538	Pre- and postmenopausal women	Self-designed questionnaire	Metabolic syndrome was an independent risk factor for decreased sexual desire in premenopausal women ($P = .03$) but not postmenopausal women ($P = .50$), after correcting for age.
Kim et al[14]	Cross-sectional	773	Menopausal women (40–65 y)	FSFI	The frequency of FSD was similar between women with metabolic syndrome and women without (52.1% vs 55.1%, respectively; $P = .66$). The pain domain score on the FSFI was significantly different between groups ($P = .03$). Components of the metabolic syndrome were not associated with FSD.
Martelli et al[11]	Cross-sectional	208	Postmenopausal women	FSFI FSDS	The prevalence of sexual dysfunction was significantly higher in women with metabolic syndrome (38%) vs those without (19%) ($P = .003$). Multivariate analysis showed that higher levels of triglycerides were linked to a higher risk of presenting FSD (OR = 2.007; 95% CI, 1.033–3.901).
Politano et al[13]	Cross-sectional	256	Menopausal women (40–60 y)	SPEQ	There was no association between the presence of metabolic syndrome and sexual dysfunction ($P = .93$).
Otunctemur et al[10]	Cross-sectional	400	Pre- and postmenopausal women	FSFI	Female sexual dysfunction was found more often in both pre- and postmenopausal women with metabolic syndrome ($P = .001$ and $P < .001$, respectively), and this was consistent across all FSFI domains. A higher fasting blood glucose was significantly associated with lower FSFI scores ($P < .001$).
Alvisi et al[12]	Prospective cohort	204	Premenopausal women	FSFI FSDS	The prevalence of pathologic FSFI scores was significantly higher in women with metabolic syndrome (44.9%) compared to those without (29.2%) ($P = .049$). In logistic regression, high triglycerides were independently associated with FSD (OR = 3.097; 95% CI, 1.272–7.542; $P = .026$).
Dombek et al[15]	Cross-sectional	111	Menopausal women (45–65 y)	FSFI	In univariate or multivariate analysis, no associations were seen between the presence of metabolic syndrome and FSD.
Trompeter et al[7]	Retrospective cohort	376	Postmenopausal women	FSFI	Women with metabolic syndrome had significantly lower sexual desire ($P = .04$) and lower arousal ($P = .01$) scores on the FSFI compared to women without metabolic syndrome.

CRP = C-reactive protein; FSD = female sexual dysfunction; FSDS = Female Sexual Distress Scale; FSFI = Female Sexual Function Index; OR = odds ratio; SPEQ = Short Personal Experience Questionnaire.

can upregulate cytokines and prooxidant mediators leading to decreased NO bioavailability.[16] The compromise in blood distribution to the genitourinary system may be responsible for decrements in sexual function. Maseroli et al[31] utilized Doppler ultrasound to measure clitoral blood flow in 72 women with sexual dysfunction and found an inverse correlation between BMI and flow. After adjusting for multiple confounders, women who were obese or had MetS had significantly higher vascular resistance indices ($P = .019$), indicating that the presence of these comorbidities adversely affected arterial blood flow to the clitoris. The cardiovascular consequences of obesity and other comorbidities have been quoted by other reviews, as well.[32,33] These results provide a plausible pathophysiological explanation for the maladaptive effects on sexual health seen with obesity.

SPECIFIC DIETS

Food is becoming increasingly more accessible than it has ever been, which has sprouted a multitude of diets. The most discussed diet in the literature with regard to sexual health is the Mediterranean diet; however, a recent trial utilizing the ketogenic diet examined its effect on quality-of-life outcomes. Although not discussed below, the Western diet and its components are indirectly associated with sexual morbidity. The Western diet is characterized by processed foods, refined carbohydrates, and high sodium and monounsaturated fat contents and has been extensively linked to the development of MetS, obesity, diabetes mellitus, and cardiovascular morbidity.[34–36] As stated previously, these comorbidities have been implicated as risk factors for female sexual dysfunction.

Mediterranean Diet

The Mediterranean diet consists of fruits, vegetables, whole grains, nuts, and fish and has been explored as a possible intervention for improving sexual health in females. Giugliano et al[37] assessed dietary patterns and sexual function scores in 595 women with type 2 diabetes and found that those with a diet that closely matched that of the Mediterranean had better sexual functioning per FSFI scores. In addition, those who least adhered to a Mediterranean diet had the highest prevalence of female sexual dysfunction. In another study by Esposito et al,[38] women with MetS were systematically randomized to either a Mediterranean diet or a control diet. Women in the Mediterranean diet arm achieved greater improvement in FSFI scores than the control arm over 2 years, and these results were paralleled by improvements in metabolic parameters. Additionally, the women on a Mediterranean diet had decreased serum CRP levels, suggesting a reduction in inflammatory status as well. A more recent trial by the same group investigated the use of the Mediterranean diet to reduce sexual function deterioration in patients with type 2 diabetes. In this study, both groups had significant decreases in FSFI scores after the 8-year follow-up compared to baseline, but the women who adhered to the Mediterranean diet had significantly less deterioration.[39] This trend occurred at each level of dietary adherence, with more substantial benefits seen in women with the highest level of adherence.

Ketogenic Diet

The ketogenic diet is a relatively new concept that is characterized by low carbohydrate but high fat and protein intake, which drives the body into a ketotic state and allows for faster burning of body fat. Much of the current research on this diet investigates its effects on general wellbeing and its use for treating chronic diseases. A recent study by Castro et al[40] found that implementation of a ketogenic diet in obese women had favorable effects from a sexual function standpoint. Women placed on a very low calorie ketogenic diet saw a statistically significant improvement in mean total score and the excitation and lubrication subdomains of the FSFI.[40] Interestingly, the orgasmic domain also increased significantly but only during the maximal ketosis phase of the diet, and it returned to baseline at the conclusion of the study. More research needs to be initiated to explore the possible sexual benefits that can occur from following the ketogenic diet.

Vegetarianism/Veganism

To date, no studies have specifically looked at female sexual function in relation to vegetarian/vegan diets; however, it might be expected that a diet high in fruits and vegetables and low in animal products would provide similar beneficial effects seen with the Mediterranean diet. On the other hand, this dietary pattern poses a risk to vegetarians and vegans, as they are prone to developing certain nutrient deficiencies. Iron-deficiency anemia was found to be a risk factor for poor sexual function in a cohort of Iranian women.[41] Another study found a significant improvement in FSFI scores in women being treated for iron deficiency.[42] Vegans may be at further risk for vitamin D deficiency, which has also been linked to female sexual dysfunction.[43,44] In a double-blind randomized clinical trial, females deficient in vitamin D who were experiencing baseline sexual dysfunction saw significant improvement in FSFI scores after intramuscular injections of vitamin D compared to placebo-treated women.[45] Formal studies need to be conducted to determine if the dysfunction resulting from these deficiencies is a valid concern for people on vegetarian or vegan diets.

SPECIFIC FEMALE SEXUAL DYSFUNCTIONS

Female sexual dysfunction can be broadly classified into 4 distinct groups: disorders of desire, arousal, orgasm, or pain.[46] Most studies examing dietary influence on female sexual health use a quantitative score to assess sexual health; they correlate diet with a linear measure of sexual function such as the FSFI, and very few isolate specific dysfunctions for this discussion. Two that have been previously reported on are vulvodynia and persistent sexual arousal syndrome, but others such as hypoactive sexual desire disorder, dyspareunia, and vaginismus have not

Table 2. Studies investigating role between eating disorders and female sexual function

Study	Design	Sample size, N	Subjects	Sexual function measure	Results
Wiederman et al[54]	Cross-sectional	450	Adult women with anorexia nervosa or bulimia nervosa	DSED-R	Bulimic women compared to anorexics were more sexually active (85.6% vs 53.4%) and masturbated more (51.0% vs 24.2%). The severity of caloric restriction was inversely related to having masturbated, a finding that is more pronounced in anorexics.
Wiederman and Pryor[63]	Cross-sectional	117	Adolescent women with anorexia nervosa or bulimia nervosa	DSED-R	Bulimic impulse symptoms appear to relate to sexual experience. Bulimic females engaged in sexual intercourse significantly more than anorexic females (63.8% vs 11.9%).
Abraham[62]	Longitudinal study	86	Women with bulimia nervosa and age/parity-matched female controls	Interview-style questioning	Thirty percent of bulimic women reported lack of libido at lower BMI (BMI < 19), and 86% of bulimic women lacked sexual interest when at heavier weights.
Castellini et al[64]	Cross-sectional	309	Adult obese women with BED, obese women without BED, and normal-weight female controls	FSFI	Obese women with BED had lower total FSFI scores than those without BED ($P < .01$). Both obese women with and without BED had lower total FSFI scores than normal weight controls ($P < .01$). Women with BED had worse scores in all 6 FSFI domains, but those without BED had only 4 out of 6 worse FSFI domain scores compared with normal-weight controls.
Pinheiro et al[58]	Cross-sectional	686	Adult women with anorexia nervosa or bulimia nervosa with or without binge eating or purging behaviors and adult female controls	SIAB-P	Women with eating disorders had higher loss of libido (66.9% vs 35%) and sexual anxiety (59.2% vs 15%) compared to normal controls. Women with eating disorders reported higher avoidance (23.0% vs 5%) or absence of sexual intercourse (21.7% vs 5%) in relationships than did normal controls. Loss of libido and sexual anxiety were associated with lower minimal lifetime BMI.
Castellini et al[59]	Cross-sectional	160	Women with anorexia nervosa, women with bulimia nervosa, and control subjects	FSFI	Anorexic women had significantly lower FSFI total scores than controls ($P < .01$). Restricting subtype anorexics had significantly lower scores compared to the binging/purging subtype. Multivariate linear regression showed emotional and binge eating behavior in bulimic and binge/purge anorexic women to be negatively correlated with FSFI scores ($P < .01$).

BED = binge eating disorder; BMI = body mass index; DSED-R = Diagnostic Survey for Eating Disorders-Revised; FSFI = Female Sexual Function Index; SIAB-P = Structured Interview for Anorexic and Bulimic Disorders-Psychopathology Scale.

been addressed. In general, the data relating individual dietary components to specific sexual dysfunctions are poor, and it may be safe to assume that validated surveys assessing overall female sexuality are more prudent for this purpose.

A single case report exists in which a patient consuming excessive amounts of soy products complained of persistent genital arousal requiring sexual stimulation 15 times a day.[47] In this case, the patient was also experiencing dysmenorrhea and menorrhagia. Elimination of her soy diet completely resolved her symptoms, and it can be hypothesized that activation of estrogen receptors by the isoflavones from soy products were causing her symptoms.

Vulvodynia (pain in the vulva) has previously been linked to oxalate consumption. A case report in the early 1990s linking oxalate consumption to vulvar pain led to a more systematic investigation of a possible link between oxalate consumption and the onset of vulvodynia,[48] although later studies did not demonstrate a reduction in dietary oxalate to be an effective therapy for treating vulvodynia.[49] Further, a population-based, case-control study did not even identify the consumption of oxalate-rich foods as a risk factor for the development of this pain disorder.[50]

EATING DISORDERS AND FEMALE SEXUAL DYSFUNCTION

In the realm of diet and sexual function, a few groups have looked at sexuality in patients with disordered eating. Females with eating disorders such as anorexia nervosa and bulimia nervosa suffer from higher rates of sexual dysfunction than the general population.[51] The sexual difficulties seen in patients with disordered eating is most likely multifactorial in etiology. From a physiologic point of view, these patients experience disruptions in metabolism and body homeostasis from restricting food intake, subsequent starvation, and purging behaviors. Additionally, these patients commonly suffer from comorbid anxiety and depression; thus, it is likely that there is also a psychological component to their sexual dysfunction. Oftentimes, perceptions in body image are disturbed, resulting in low self-esteem and possibly negative feelings of sexual inadequacy and unattractiveness.

Interestingly, studies have shown that the psychologic component may be more relevant for bulimic patients suffering from sexual dysfunction. Bulimic patients tend to be more promiscuous and impulsive when it comes to sexual interactions.[52–54] Certain studies have correlated the pathological eating behaviors in bulimics, namely binging and purging, with higher risk sexual behaviors.[52,55,56] These patients tend to be normal or even overweight compared to anorexic patients, which may also explain why psychiatric disturbance has more etiologic relevance when discussing sexual dysfunction. In contrast, anorexic patients are underweight by definition and can suffer from emaciation leading to central hypogonadism.[57] This downregulation of the hypothalamic-pituitary-gonadal axis reduces fertility and likely also leads to poor sexual health.[58] Castellini et al[59] found anorectics to have worse desire, pain, lubrication, and orgasm scores on the FSFI than bulimic patients. In a study by Pinheiro et al,[58] a higher proportion of anorexic patients reported loss of libido than bulimic patients, which was also associated with lower lifetime BMI. This finding was also seen in the purging subtype of anorexics. In other series, the restoration of weight in these patients seems to ameliorate sexual dysfunction, particularly by increasing sexual drive.[60,61] Presumably, this would put the body back in homeostasis and restore the natural influence of the hypothalamic-pituitary-gonadal axis over sexual behavior. Table 2 summarizes studies investigating sexual dysfunction in eating-disordered patients.[54,58,59,62–64]

CONCLUSION

There is still a wide gap in our knowledge regarding diet and its influence over female sexual health. Much more of the contemporary literature has focused on comorbidities such as metabolic syndrome and obesity and their subsequent impact on sexual functioning. Specifically, these diseases seem to negatively affect sexuality by putting the body in a state of excess inflammation, resulting in endothelial dysfunction and compromised blood flow through the genitourinary system. More recently, a few studies have utilized the Mediterranean diet as an intervention for alleviating sexual dysfunction in women with comorbid obesity, diabetes, and metabolic syndrome. In these trials, improvements in female sexual function have been paralleled by improvements in metabolic markers and reductions in inflammatory cytokines. One trial investigating lifestyle outcomes with the ketogenic diet found overall positive effects on sexual health, but additional research regarding this and other common dietary patterns is lacking. Patients with disordered eating also tend to have a high rate of sexual morbidity, and the type of dysfunction differs among eating disorders. Bulimic patients tend to be more impulsive and engage in higher risk sexual behaviors, which may be more reflective of psychiatric disturbance. Anorexics, on the other hand, suffer from decreased arousal, lubrication, and worse orgasmic function, quite possibly due to starvation-induced perturbations in hormonal regulation.

From these findings, we can conclude that severe fluctuations in metabolic state put an unnatural strain on the body, with sexual dysfunction being one of the downstream effects of metabolic syndrome, obesity, and disordered eating. It appears that healthy dietary patterns such as those seen with the Mediterranean diet can potentially serve a protective function to prevent development of these deficits; however, additional study is needed to both confirm and identify a possible mechanism behind such effects.

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