International Urogynecology Journal (2019) 30:377–383
https://doi.org/10.1007/s00192-018-3739-7

ORIGINAL ARTICLE

Association between comorbidities and female sexual dysfunction: findings from the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3)

Allison R. Polland[1,2] · Meghan Davis[2] · Alexander Zeymo[3] · Cheryl B. Iglesia[1,2]

Received: 21 March 2018 / Accepted: 31 July 2018 / Published online: 3 September 2018

Abstract

Introduction and hypothesis Although medical comorbidities are widely recognized to be associated with erectile dysfunction, less research has been done on their association with female sexual dysfunction (FSD). The purpose of this study was to assess whether FSD is associated with comorbidities; we hypothesized that there is an association.

Methods This is a secondary analysis of the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3), a prospective stratified probability sample of individuals aged 16–74. We assessed for association between sexual function scores and heart attack, heart disease, hypertension, stroke, diabetes, chronic lung disease, depression, other mental health condition, other neurologic conditions, and incontinence, as well as menopause and smoking status. Correlation between comorbidities and specific domains of sexual function was also assessed.

Results A total of 6777 women, with an average age of 35.4 (14.1), responded to the survey and reported sexual activity in the past year. There was an association between sexual function score and age, menopause, hysterectomy, heart disease, hypertension, diabetes, obesity, smoking, depression, other mental health condition, stroke, other neurological condition, and homosexual attraction ($p < 0.05$). On multivariate analysis, age, sexual attraction, smoking status, depression, and other mental health conditions remained significantly correlated with sexual function ($p < 0.05$). Comorbidities were found to be correlated with specific domains.

Conclusions Comorbidities were associated with FSD and specific comorbidities associated with dysfunction in specific domains. Urogynecologists and urologists must assess for comorbidities, as women presenting with sexual dysfunction may provide an opportunity for early diagnosis of life-threatening conditions.

Keywords Female sexual dysfunction · Desire · Lubrication · Comorbidities · Depression · Smoking

Introduction

Female sexual dysfunction (FSD) is a highly prevalent but poorly understood condition. Sexual dysfunction can be described as difficulty experienced by an individual during any stage of a normal sexual activity, including desire, arousal, lubrication, orgasm, or pain. The National Health and Social Life Survey found sexual dysfunction to be more prevalent in women than in men: 43% vs. 31% [1]. Despite the high prevalence, the risk factors for FSD are less well understood than those for male sexual dysfunction. A systematic review in 2004 by West et al. looked at >40 studies and noted an association between FSD and physical health (both observed and perceived), race/ethnicity, emotional condition, number of premarital partners, religion, sexual orientation, and the rigidity of gender roles in a relationship [2].

The sexual response in women includes desire, arousal, orgasm, and resolution. Arousal is an active process that balances both excitatory and inhibitory factors. Excitatory factors include estrogen, testosterone, melanocortin, and oxytocin and neurotransmitters dopamine and norepinephrine. Inhibitory factors include serotonin, prolactin, and endogenous opioids. The exact central neuroendocrine mechanisms involved in arousal are not fully understood. Several areas of the brain appear to be involved in arousal, such as the brain stem, hypothalamus, and

✉ Allison R. Polland
Allison.r.polland@medstar.net

[1] Georgetown University, Washington, DC, USA

[2] MedStar Washington Hospital Center, 106 Irving St NW, POB 405 S, Washington, DC 20010, USA

[3] MedStar Health Research Institute, Washington, DC, USA

forebrain including the amygdala [3]. Central stimulation of the pelvic nerves induces smooth-muscle relaxation and decreases resistance within the arteries, leading to increased blood flow to the genitals. Lubrication then occurs, followed by vaginal lengthening and dilation due to smooth-muscle relaxation. There is increased blood flow to the clitoris, which increases intracavernous pressure causing tumescence and protrusion of the glans clitoris. This is associated with eversion and congestion of the labia minora [4].

Similar to male sexual function, in women, endothelial function and arterial flow within the hypogastric and pudendal arteries are needed for normal vasculogenic response to stimulation. Current data has shown evidence of an association between female sexual health and vascular risk factors, including hypertension, metabolic syndrome/obesity, diabetes, and coronary heart disease [5]. There is limited evidence studying the relationship between lung disease and FSD; however, COPD has been associated with sexual dysfunction in men, perhaps related to dyspnea on exertion or because COPD is often comorbid with other neurovascular conditions [6, 7].

In addition to general medical conditions, pelvic floor disorders and pelvic surgery can alter sexual function. Urinary incontinence (UI) is associated with a high prevalence of sexual dysfunction, ranging from 19 to 68% among incontinent women [8]. Radical hysterectomy can affect female sexual function by causing anatomic disruption with neurovascular injury. Nerve-sparing laparoscopic radical hysterectomy as compared with a traditional laparoscopic radical hysterectomy has been found to result in less sexual dysfunction [9]. Menopause, a condition characterized by a series of neuroendocrine changes, has also been associated with FSD. Even ovarian-sparing hysterectomy for benign indications has been associated with earlier menopause and can still impact sexual function [10, 11].

Female sexual function is complex and affected by multiple psychosocial factors in addition to neuroendocrine, metabolic, and vascular risk factors. Depression is significantly correlated with sexual dysfunction. In a population-based study of >31,000 women in the United States, ~40% with sexual arousal disorders also reported having concurrent depression [12]. This relationship remained significant after controlling for antidepressant medication use [13].

While multiple factors related to medical comorbidities have been shown to affect sexual function, the interplay between these factors has not been examined in a large population-based study. Furthermore, it is unclear whether medical comorbidities affect the different domains of female sexual function, including desire, arousal, lubrication, orgasm, and pain. The purpose of this study was to assess whether sexual function in women is correlated with medical comorbidities in a large population sample.

Methods

This study is a secondary analysis of the third National Survey of Sexual Attitudes and Lifestyles (Natsal-3), a prospective stratified probability sample of British individuals aged 16-74 interviewed between 2010 and 2012. Natsal-3 is the third in a series of population-based surveys exploring the associations between health and sexual lifestyle in Britain; informed consent was obtained from all participants in the initial study. All female participants who participated in the Natsal-3 survey were eligible for inclusion in this secondary analysis. Participants who reported not being sexually active within the past year were excluded. Individuals who were sexually active within the past year but not in a relationship were included but were unable to answer sexual function questions regarding partnership. Their missing answers were estimated in the original Natsal-3 data set using modeling techniques. Those estimated values were used in this secondary analysis. Sexual function was assessed using the validated Natsal-SF [14], a 17-item measure that provides an indication of an individual's level of sexual function, taking into account reported function problems, the relational context, as well as levels of satisfaction and distress. The Natsal-SF includes questions regarding interest, arousal, orgasm, pain, and lack of lubrication reported as "uncomfortable dry vagina." Low sexual function was defined as the lowest quintile of distribution of Natsal-SF scores, as this was the cutoff point used in the original study. Comorbidities and treatment were assessed by participant self-report in the form of a binary yes/no answer. Funding for the survey was provided by grants from the UK Medical Research Council and the Wellcome Trust, with support from the Economic and Social Research Council and the Department of Health. Secondary data analysis was approved by the MedStar Health Research Institute Institutional Review Board. All analyses were performed using R programming with additional statistical packages [15–19].

We assessed for correlations between sexual function and age and BMI using Pearson's correlation. We also assessed for association between sexual function and sexual attraction. Additionally, we assessed for associations between sexual function scores and the following medical conditions: heart attack, heart disease, hypertension, stroke, diabetes, chronic lung disease, depression, other mental health conditions, other neurologic conditions, incontinence, menopause, and smoking status using *t* tests, analysis of variance (ANOVA), Cuzick's test for trend, and chi-square tests where appropriate. Factors found to be correlated with sexual function score were analyzed in a multivariate analysis. Additionally, participant-reported data regarding the effect of medical conditions and medications on their sexual function was assessed.

Association between comorbidities and specific domains of sexual function (desire, arousal, orgasm, lubrication, and pain) were assessed. Participants were asked whether or not

they had experienced the following symptoms for >3 months in the past year: lacked interest in having sex, no excitement/arousal during sex, no orgasm or took a long time to reach orgasm despite arousal, uncomfortable dry vagina, and physical pain as a result of sex. We assessed the length of time and frequency with which they experienced dysfunction, the degree of distress caused by the dysfunction, and the prevalence of dysfunction causing avoidance of sexual behavior in each domain. We also assessed the relationship between this and seeking medical care for dysfunction. An additional analysis assessed the effects of specific factors that may cause hormonal changes, such as menopause and hysterectomy, on sexual function. In the Natsal-3 survey, women were asked specifically whether they had experienced menopause but not the age at which they experienced it. A recursive partitioning and regression tree model was used to determine the age threshold where there was a significant partitioning between participants who were and were not menopausal.

Results

A total of 6711 women were included in the analysis, with a mean age of 35.4 years [standard deviation (SD) 14.1]. The average BMI was 30.1 (SD 18.8), and 15.8% of participants was obese. Depression was the most common comorbidity, reported in 897 (13.4%) participants; 560 were on medication. Hypertension was the second most common comorbidity, reported in 506 (7.5%), with 323 on medication. Diabetes was present in 164 (2.4%); 129 were taking medication, 43 of whom were taking insulin. Incontinence was the least common comorbidity and reported in only 19 (0.3%) participants (Fig. 1). Half (50.7%) of participants reported no smoking history, while 20.6% were former and 28.7% were current smokers.

Most of the sample reported heterosexual attraction; however 804 (12%) reported having homosexual attraction at least once and 24 (0.4%) reported strictly homosexual attraction. Low sexual function was seen in a greater percentage of homosexual women as compared with heterosexual women (Table 1). There were 24 women who reported homosexual attraction only, 63 mostly homosexual attraction, and 96 equal attraction to men and women. Among homosexual women, 33.3% had low sexual function as compared with 26% of women who reported equal attraction to men and women and 17.7% of women who reported strictly heterosexual attraction.

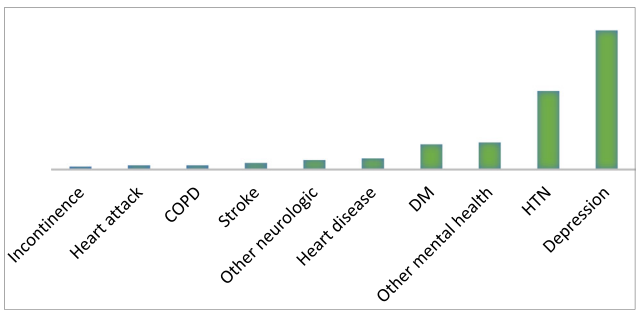

Fig. 1 Prevalence of comorbidities in the study population

The average age of participants reporting low sexual function was older than those with normal sexual function scores: 38.8 vs 34.7 years, respectively ($p < 0.001$), and age was significantly correlated with low sexual function (Table 2). The age threshold at which a significant partitioning occurred between participants who were and were not menopausal was determined to be 50.5 years, and menopause was associated with low sexual function ($p < 0.001$). Use of hormone replacement therapy was associated with better sexual function ($p = 0.002$). Within this sample, 329 women (4.9%) had undergone hysterectomy, and history of hysterectomy was associated with low sexual function ($p < 0.001$). Age at hysterectomy was not significantly associated.

When asked whether their health affected their sexual activity, 17.2% of women reported it did. Low sexual function was seen in a greater percentage of women (38%) who felt health affected their sexual activity vs. those who did not (14.3%). Only 7.5% of participants felt that medication affected their sexual activity, and low sexual function was seen in a greater percentage of those who felt this way compared with those who did not.

Sexual function is complex, and we found that comorbidities and other factors considered explain only 4.7% of variability in sexual function. On univariate analysis, low sexual function was associated with heart disease, hypertension, stroke, diabetes mellitus, lung disease, depression, and other mental health and neurologic conditions, as well as age, smoking, BMI, and sexual attraction. It was also associated with use of medications for heart disease, hypertension, diabetes, depression, and other mental health conditions. It was not associated with heart attack, chronic lung disease, or incontinence (Table 3). On multivariate analysis, age, sexual attraction, smoking status, depression, and other mental health conditions remained statistically significant predictors of low sexual function.

With regard to domains, lack of interest or desire was most common (2128 participants), followed by delayed or absent orgasm (1139), difficulty with lubrication (749), lack of arousal (539), and pain (506). Duration of dysfunction in each domain was significantly associated with low sexual function ($p < 0.001$ for all domains). Within each domain, degree of distress was significantly associated with avoidance of sex due to a domain-specific problem ($p < 0.05$ for all domains). Duration of symptoms was associated with seeking care from a general practitioner in all domains ($p < 0.05$ for all domains). With respect to comorbidities and domain-specific dysfunctions, heart disease was associated with difficulty with

Table 1 Prevalence of low sexual function by sexual attraction; *n*, (%)

Sexual attraction	Total	Low sexual function score $n = 2176$	Normal sexual function score $n = 9407$	*P* value
				<0.001
Heterosexual only	5710 (85.1)	1009 (17.7)	4701 (82.3)	
Mostly heterosexual	804 (12)	176 (21.9)	628 (78.1)	
About equal	96 (1.4)	25 (26)	71 (74)	
Mostly homosexual	63 (0.9)	14 (22.2)	49 (77.8)	
Homosexual only	24 (0.4)	8 (33.3)	16 (66.7)	
Never felt sexually attracted to anyone	13 (0.2)	3 (23.1)	10 (76.9)	
Refused to answer	1 (0)	0 (0)	1 (100)	

lubrication ($p = 0.031$), while depression was associated with dysfunction in desire, arousal, orgasm, and pain ($p < 0.001$ for all). Other factors associated with domain-specific dysfunctions included age, which was associated with dysfunction in desire and lubrication ($p < 0.001$) and orgasm ($p = 0.036$. BMI was associated with pain ($p < 0.001$), and difficulty with lubrication ($p = 0.009$) and orgasm ($p = 0.017$) (Fig. 2).

Discussion

The relationship between comorbidities and female sexual function is complex, and prior studies examining the relationship often failed to provide a complete picture. Few studies have considered more than a single comorbidity, and those that did are limited to two or three comorbidities, resulting in a less robust analysis. Prior studies have also been limited by small sample sizes or convenience samples, such as women attending a hypertension clinic [20]. This study supports the findings of others regarding the relationship between FSD and individual vascular comorbidities evaluated on univariate analysis. Doumas et al. found a greater percentage of hypertensive women had FSD (42.1%) as compared with normotensive women (19.4%) [20]. Esposito et al. found the Female Sexual Function Index (FSFI) to be strongly correlated with BMI in women with FSD (FSFI <23) [21]. In addition to obesity, diabetes is associated with FSD. Esposito et al. found the overall prevalence of FSD to be 53.4% among 595 type 2 diabetic women, with an even higher prevalence among women who were postmenopausal (63.9%) [22]. In that cohort, women who had signs of depression were 1.86 times more likely to have FSD than women who were not depressed. Sexual function problems have been reported in up to 65% of women with coronary heart disease [23], and acute myocardial infarction has been associated with decreased and less satisfaction with sexual activity [24]. Smoking is an independent risk factor for FSD, with cumulative smoking exposure associated with higher risk [25]. Stroke, which may cause motor and sensory deficits as well as alterations in the hypothalamic–pituitary axis, was found in one study to be associated with sexual function problems in women [26]. Our findings from a large population database also support those of prior studies, which found psychosocial factors such as depression to be significantly correlated with sexual function [12].

In our study, incontinence was not associated with low sexual function on either univariate or multivariate analysis, whereas prior studies found a high prevalence of FSD among women with incontinence [8]. The lack of association may have been related to the small number of women with incontinence in the Natsal-3 cohort. This low prevalence may be explained by the young age of participants and the use of a binary variable to describe incontinence. Women who had rare

Table 2 Prevalence of low sexual function score by age; *n* (%)

Age group	Total	Low sexual function score $n = 2176$	Normal sexual function score $n = 9407$	*P* value
				<0.001
16-24	1677 (25)	214 (12.8)	1463 (87.2)	
25-34	2243 (33.4)	369 (16.5)	1874 (83.5)	
35-44	1054 (15.7)	223 (21.2)	831 (78.8)	
45-54	877 (13.1)	207 (23.6)	670 (76.4)	
55-64	574 (8.6)	158 (27.5)	416 (72.5)	
65-74	286 (4.3)	64 (22.4)	222 (77.6)	

Table 3 Univariate analysis of comorbidities and low sexual function defined as lowest quintile of Natsal-SF among women; *n* (%)

Variable	Low sexual function	Normal sexual function	*P* value
Heart attack	7 (25)	21 (75)	0.511
Heart disease	24 (32.9)	49 (67.1)	0.002
Hypertension	124 (24.5)	382 (75.5)	<0.001
Stroke	16 (38.1)	26 (61.9)	0.002
Diabetes	55 (33.5)	109 (66.5)	<0.001
Chronic lung disease	6 (20.7)	23 (79.3)	0.938
Depression	292 (32.6)	605 (67.4)	<0.001
Other mental health	71 (40.3)	105 (59.7)	<0.001
Other neurological	22 (35.5)	40 (64.5)	0.001
Incontinence	6 (31.6)	13 (68.4)	0.235

episodic stress or urge incontinence but did not experience more frequent bladder leakage may not have reported themselves to be incontinent. On multivariate analysis, only age, sexual attraction, smoking status, depression, and other mental health conditions remained statistically significant. Not surprisingly, this finding suggests that many variables in the multivariate analysis, such as heart attack, heart disease, hypertension, stroke, diabetes, smoking, and BMI, were strongly correlated. Thus, the effect of any one variable on sexual function is smaller and may not be significant, which is an inherent limitation of creating a model that includes a large number of intercorrelated comorbidities. Prior studies demonstrate that we cannot discount these comorbidities simply as confounders [1, 2, 5, 12, 20–27].

Within this sample, prior hysterectomy was associated with low sexual function; however, age at hysterectomy was not significantly associated with low sexual function. Prior studies have shown radical hysterectomy to be associated with sexual dysfunction and nerve-sparing laparoscopic radical hysterectomy to result in less sexual dysfunction [9]. Indications for and route of hysterectomy were not collected from participants, nor was oophorectomy data. Therefore, we must consider that this association may be affected by menopause in participants who underwent oophorectomy; however, even

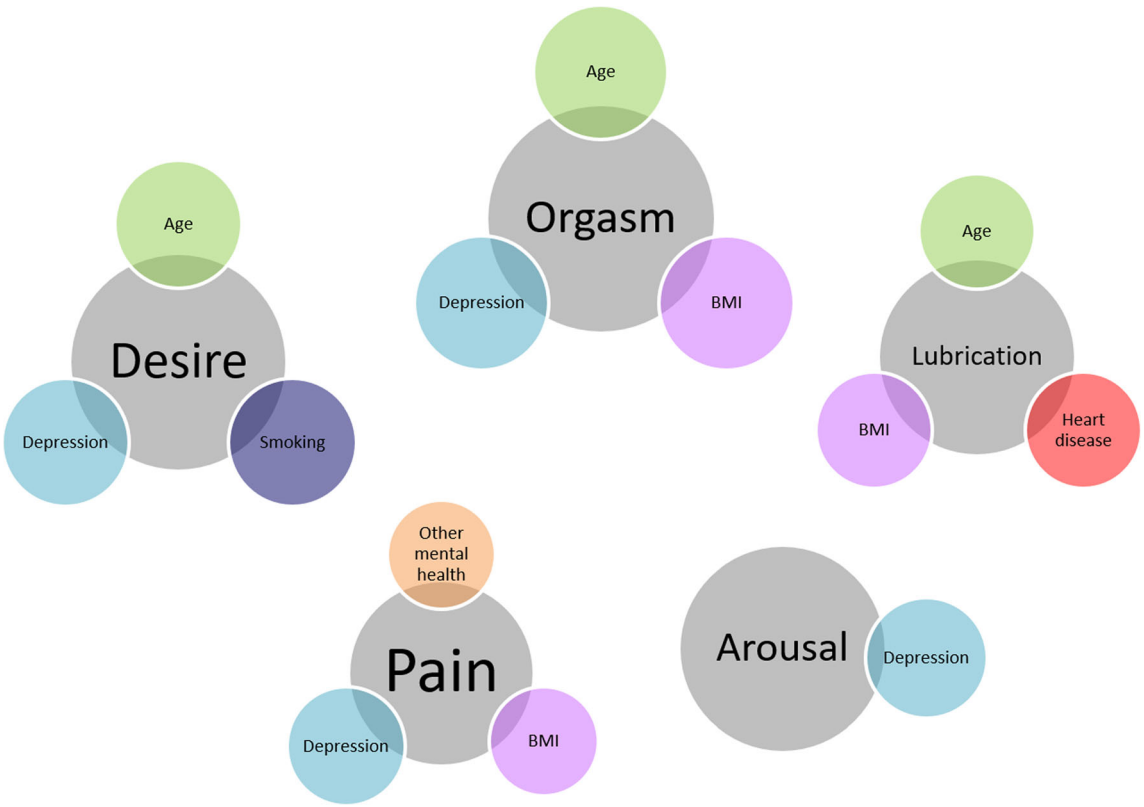

Fig. 2 Factors associated with dysfunction in different domains

ovarian-sparing hysterectomy for benign indications has been associated with earlier menopause [10]. Age was associated with sexual dysfunction ($p < 0.001$). As most respondents were premenopausal, it is important to note that 41% of premenopausal women may suffer from FSD, as was noted in a recent meta-analysis [28]. Menopause, as seen in this and prior studies, is associated with sexual dysfunction. With regard to the domains of sexual dysfunction, we found age was associated with dysfunction in desire, lubrication, and orgasm. BMI was associated with dysfunctions in lubrication, pain, and orgasm but not arousal or desire. Esposito et al. found that desire and pain did not correlate with BMI, while arousal ($r = -0.75$), lubrication ($r = -0.66$), orgasm ($r = -0.56$), and satisfaction ($r = -0.56$, all $P < 0.001$) did. These differences may be explained by the use of different surveys instruments, e.g., the FSFI vs. the Natsal-SF. Monga et al. found stroke to be associated with decreased libido and difficulties with lubrication and orgasm; in contrast, our study did not find stroke to be associated with dysfunction in specific domains [26].

Homosexual attraction was associated with low sexual function. Although this is an interesting finding, we recognize that we captured a low number of homosexual participants in this stratified probability sample. While a convenience sample of homosexuals would yield a larger number of participants, it might not be reflective of the overall population, as a convenience sample might overrepresent individuals who identify as lesbian and may not capture individuals with homosexual attractions or experiences who do not identify as such [29].

Perception of the effects of health and medication on sexual function may be incongruous with the effects as measured by sexual function scores. Although 17.2% of women reported health affected their sexual activity, almost 60% of these women did not have low sexual function. Given that low sexual function was defined as the lowest quintile of Natsal-SF scores, it is possible that many participants who had excellent sexual function scores may have experienced a decline in sexual function with the use of medication; however, this did not drop below the threshold of low sexual function.

Limitations of the Natsal-3 database relating to response rate, desirability bias, and recall bias have been discussed elsewhere [14]. We used participant self-report of comorbidities without confirmation from a medical record, which may affect findings. We cannot infer causality in the associations demonstrated in this study; in fact, it is likely that bidirectional causality exists between many comorbidities and low sexual function [14]. While this study only shows an association, further research could determine whether sexual dysfunction in women might be a predictor for later diagnosis of comorbidities, as it is in men. Consistent with previous studies, we excluded participants who were not sexually active in the last year, which may have served to exclude a population with sexual dysfunction so severe that it prohibits sexual activity [14]. Additionally, the list of comorbidities for which data was collected is not exhaustive. We recognize that many other conditions may impact sexual function, including but not limited to cancers, vulvar disorders, urologic and gynecologic conditions, skin conditions, hyperprolactinemia, thyroid disorders, and hypoestrogenic, states such as may occur with breast feeding.

Conclusion

Sexual function is complex, and we found that comorbidities explain <5% of the variability in sexual function scores in women. While multiple comorbidities were associated with FSD on univariate analysis, this association was lost on multivariate analysis, likely due to the correlation between many comorbidities. Still, depression and other mental health conditions remained significant on multivariate analysis, which highlights the importance of mental health in sexual function. Specific comorbidities, such as depression and heart disease, were associated with dysfunction in specific domains, such as difficulty with lubrication. Urogynecologists and urologists should be aware of the association between medical comorbidities and sexual dysfunction. Sexual-dysfunction complaints may provide an opportunity for early diagnosis of comorbidities.

Compliance with ethical standards

Conflicts of interest None.

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