ORIGINAL RESEARCH—CLINICAL PSYCHOLOGY

Psychophysiological Assessment in Premenopausal Sexual Arousal Disorder

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ABSTRACT

Introduction. Female sexual arousal disorder (FSAD) is a complex diagnostic category whose definition continues to evolve.

Aim. The purpose of this study was to explore the physiological patterns of genital arousal in 31 women with and 30 women without sexual arousal difficulties using a vaginal photoplethysmograph. In addition, subtypes of FSAD, based on a recently proposed redefinition, were explored on measures of sexual arousal.

Results. Whereas there were no psychophysiological or subjective sexual arousal differences when the entire group of women with arousal complaints was compared to a control group, significant differences emerged when subtypes of arousal disorder were compared. Only women fitting the description of "Genital Arousal Disorder" showed evidence of impaired psychophysiological arousal, whereas those characterized with "Subjective Sexual Arousal Disorder" and "Combined Genital and Subjective Sexual Arousal Disorder" did not differ from the control group. These subgroups also differed in the correlation between psychophysiological and subjective arousal.

Conclusion. Overall, there is evidence for diagnostic heterogeneity in FSAD which supports the recent redefinition of this disorder into subtypes.

Key Words. DSM-IV Sexual Dysfunctions; Female Sexual Arousal Disorder; Premenopausal; Psychophysiological Assessment

Introduction

Our understanding of the precise mechanisms that control female sexual arousal is at present incomplete. It has been conceptualized as a complex interaction between physiological and psychological components [1,2]. Impairment of these various dimensions—in particular subjective excitement—is frequently the focus of sexual difficulties encountered in the clinical setting; however, epidemiological data for loss of subjective arousal are absent. According to both the Diagnostic and Statistical Manual of Mental Disorders, 4th edition, text revision (DSM-IV-TR) [3], and the World Health Organization International Classification of Diseases-10 [4], female sexual arousal disorder (FSAD) is diagnosed when there is insufficiency of genital lubrication or swelling that results in distress. Population-based estimates suggest that the symptom of lubrication difficulty affects 11 to 19% of women younger than 30, up to 24–27% of women older than 50 [5,6], and may

be as high as 75% for those women seeking routine gynecological care [7]. However, lack of subjective sexual arousal, especially when intercourse frequency is more tuned to the higher needs of the partner, is a more common complaint among women presenting clinically. The DSM-IV-TR acknowledges that individuals with FSAD may have little or no subjective sense of sexual arousal in the Associated Features subsection (p. 501) [3], but no defining criteria for subjective sexual arousal impairment are offered. Moreover, the major focus on genital responding has limited attention of assessment and management of impaired subjective arousal.

There has been a notable effort to improve the accuracy and clarity of the existing nosology for female sexual dysfunctions over the past two decades [8]. In 1999, the American Foundation of Urologic Disease sponsored the meeting of an international consensus panel in hopes of refining the current diagnostic criteria of the female sexual disorders [9]. The criteria for FSAD were revised to provide a more explicit recognition that it could be expressed as either a lack of subjective excitement or as a lack of genital lubrication/vasocongestion [9]. Significant criticisms about the revisions have been raised, however [10,11], including probable important etiological differences, and therefore management options, between loss of genital arousal and long-term lack of subjective arousal to any stimuli. A second international panel was convened in 2002–2003, with the goal of substantiating diagnostic redefinitions in evidence-based science. The FSAD category underwent significant revision with the recognition that it might be expressed in one of three ways. *Subjective sexual arousal disorder* was characterized as absence of or markedly diminished feelings of sexual arousal, excitement, or pleasure (with some awareness of reflex genital response present); *Genital sexual arousal disorder* was described as self-reported complaints of absent or impaired genital sexual arousal; and *Combined genital and subjective arousal disorder* was characterized as the absence or reduction of both sexual feelings/excitement and awareness of genital sexual arousal [12]. Although these revised subtypes of FSAD are predicted to better capture the complaints seen in the clinical setting, the empirical evidence supporting them is only partial. Differentiation of FSAD subtypes is important as it may lead to improved management [13]. There has been much recent pharmaceutical interest in women's sexual dysfunction especially in agents to augment genital congestion (see [14] for review). However, such drugs can only potentially help women with impairment of genital vasocongestion in response to stimuli that subjectively excite them given that increased engorgement of their own genitalia per se, infrequently sexually excites women [15].

Sexual psychophysiological techniques are increasingly used in such clinical trials [16–19], with the most widely employed instrument being the vaginal photoplethysmograph. It is a tampon-shaped probe inserted vaginally which provides an index of vaginal vasocongestion [20], an indirect measure of genital arousal. In part due to the conflicting literature on physiological patterns in women with sexual dysfunction, vaginal photoplethysmography is not currently a component of routine assessment in the clinical setting. For example, genital vasocongestion to visual sexual stimuli was shown to be significantly lower in women seeking treatment for heterogeneous sexual complaints compared to sexually healthy women [21,22] and in women with dyspareunia [23], but was also found not to distinguish women with and without sexual arousal concerns [24], or women with mixed sexual dysfunction that included arousal complaints [25]. Ineffective film stimuli, uncertainty about which signal to examine, and testing in a laboratory setting may account for the inconsistencies [26]. It is also likely that diagnostic criteria used to categorize women were not standardized. Another feasible explanation is that, within any one diagnostic group, significant individual variability in genital vasocongestion exists, thus masking significant effects when mean values are observed. Certainly, the observation that sildenafil citrate is completely ineffective in heterogeneous groups of women with sexual dysfunction [27], but effective when specific subgroups of women are tested [28] supports this latter conclusion.

The proposed subtypes of FSAD [12] are clinically based. Specifically, the speculation about impaired genital arousal is made on the basis of self-report only. The primary aim of this study, therefore, was to assess the physiological aspects of arousal complaints using a vaginal photoplethysmograph. The secondary aim of this study was to characterize this potentially heterogeneous group of women with FSAD according to the recently proposed expanded definitions [12]. Whereas the primary aim is expected to replicate the findings of Morokoff and Heiman (1980) [24] and Meston and Gorzalka (1996) [25], in which there were no significant psychophysiological dif-

ferences between a sexually healthy control group and women reporting general sexual arousal concerns, we predict that a comparison among FSAD subtypes would reveal differences in genital and subjective sexual arousal, thus corroborating the proposed subtypes.

A third aim is to compare the correlation between genital vasocongestion and subjective sexual arousal between a control group and women meeting the criteria for different types of sexual arousal difficulties. In general, psychophysiological studies show associations between genital and subjective sexual arousal that are significantly positive, negative, or not related at all in sexually healthy women [1,2]. Genital–subjective correlations in women with sexual dysfunction have been positive [24], absent [21], or not measured [22,25]. It has been suggested that women in general might not attend to genital vasocongestion during the early stages of sexual arousal [1,29] and that there are other nongenital factors important for determining the subjective sexual experience. However, given the widely disparate methodologies employed in psychophysiological studies of female sexual dysfunction, it is difficult to know if these same conclusions can be drawn for women experiencing sexual arousal difficulties. A better understanding of the relationship between genital and subjective sexual arousal across women with subtypes of FSAD might better inform cognitive and behavioural treatments [30].

Method

Participants

Sixty-one women between the ages of 18–45 participated in this experiment and responded to separate newspaper advertisements or notices (one recruiting women with and the other recruiting women without sexual difficulties) placed in community centers and fitness clubs. We aimed to recruit equal numbers of women reporting some type of sexual arousal difficulty and controls. A detailed telephone screen by a trained research assistant allowed for assessment of inclusion and exclusion criteria. Women were assessed on the following domains: (i) experience of difficulties with persistent inability to attain/maintain an adequate swelling or lubrication response in the genitals; (ii) experience of difficulties with persistent inability to attain/maintain until completion of sexual activity an adequate level of mental sexual excitement; and (iii) significant personal or interpersonal distress as a result of these symptoms. The first domain was taken from criterion A for FSAD [3], and the second was adapted from the second consensus panel's revision to FSAD [12]. Thirty-one women endorsed either 1 and 3, 2 and 3, or 1, 2, and 3, thus making up the total FSAD group. Thirty women responded negatively to all three of these questions, and made up the control group. Women were also assessed for hypoactive sexual desire disorder (e.g., lack of feeling desire for sexual activity, not experiencing fantasies or thoughts, either alone or with a partner, or not being receptive to sexual activity). Although the comorbidity between FSAD and hypoactive sexual desire disorder is considered to be very high [31], any woman who met diagnostic criteria for hypoactive desire disorder was excluded from the study given our focus on arousal complaints. Women who complained of problematic sexual desire (e.g., some impairment of receptivity because of arousal difficulties), but did not meet diagnostic criteria for dysfunction were included in the FSAD group—if they met the criteria. Arousal complaints were later validated in person by a brief clinical interview. Thus, there were four groups of women participating in the current study: (i) control group (N = 30); (ii) women complaining of absent or impaired genital sexual arousal (Genital sexual arousal disorder; N = 7); (iii) women reporting absence of or markedly diminished feelings of sexual arousal, sexual excitement, or sexual pleasure (Subjective sexual arousal disorder; N = 8); and (iv) women reporting absence of, or markedly diminished feelings of sexual arousal/excitement/pleasure and diminished or absent genital arousal (Combined genital and subjective sexual arousal disorder; N = 16). Only women who reported that their arousal complaint was acquired (i.e., had new onset) and generalized (i.e., present regardless of contextual setting or menstrual phase) were included. All women were currently involved in a relationship, and had a self-reported heterosexual orientation. Exclusion criteria included: current diagnosis of dyspareunia, current use of medications known to affect vascular or sexual functioning, diabetes, hypertension, lack of sexual experience, current untreated psychopathology, and surgical or natural menopause. Most of the women had orgasmic difficulties because they were very rarely sufficiently aroused to trigger an orgasm. Women who agreed to participate and who met inclusion criteria were asked to schedule a date for their session. All procedures were approved and in accordance with the Institu-

tional Review Board of the university where this research took place.

Procedure

The session was conducted by one of two female researchers and began by orienting the subject to the laboratory equipment, obtaining written consent, and answering any questions about the study protocol. Women then completed a battery of questionnaires in a private, internally locked, testing room adjacent to the investigator's room. Questionnaires included: the Derogatis Sexual Function Inventory [32] (DSFI; a standardized self-report multidimensional test designed to measure the current level of sexual functioning), and the Golombok–Rust Inventory of Sexual Satisfaction [33] (GRISS; to assess relationship and sexual satisfaction), in addition to demographic questions established by the investigators. Following completion of the questionnaires, an in-person interview, recently employed for postmenopausal women with arousal complaints [28], assessed criteria for each of the FSAD subtypes according to the recent redefinitions, with the goal of validating or correcting information provided during the screen. Women were also asked: (i) their estimated level of sexual arousal from viewing erotica; (ii) their highest ever level of sexual arousal; (iii) if they experienced vaginal dryness during sexual activity; and if so, (iv) did this cause a problem during sexual intercourse. Psychophysiological testing was identical for all women, and took place after the completion of the questionnaires. Following a 5-minute baseline period, women were exposed to one of two film sequences, each consisting of a 3-minute neutral and 4-minute erotic clip in the private testing room. The film stimuli employed had previously been shown to elicit genital and subjective sexual arousal in women without sexual dysfunction [34]. The two neutral-erotic films were presented in a counterbalanced fashion across groups. Immediately before and after the film, the subjects completed a self-report questionnaire assessing autonomic arousal, perception of genital sexual arousal, mental sexual arousal, anxiety, positive affect, and negative affect [35]. These items were rated on a seven-point Likert scale from (1) not at all, to (7) intensely. Assessment of affect is considered important because of emotional reactions to erotica which may obscure self-reports of sexual arousal.

At study completion, women were debriefed and provided with information on resources for treatment of FSAD in the city, as well as mailed a copy of the results.

Psychophysiological Recording

Vaginal pulse amplitude (VPA) was chosen instead of vaginal blood volume (VBV) as it is found consistently to be the more sensitive and specific measure of genital arousal [36]. VPA was monitored throughout exposure to each film segment and recorded on an HP Vectra Celeron personal computer using the software program, AcqKnowledge III, Version 3.5 (BIOPAC Systems, Inc., Santa Barbara, CA) and a Model MP100WSW data acquisition unit (BIOPAC Systems, Inc.) for analogue/digital conversion. A sampling rate of 200 samples/second was used for VPA throughout the 180 seconds of neutral and 180 seconds of erotic film exposure. The signal was band-pass filtered (0.5–30 Hz). One of two vaginal probes (Behavioural Technology Inc., Salt Lake City, UT) was used, and the incoming signal was calibrated before each session using the zero adjustment knob on the MP100WSW unit. Data were analysed in 30-second segments, then averaged over the neutral and erotic segments separately, resulting in two data points per subject. Artifact detection after visual inspection of the data permitted the omission of artifacts.

Data Analyses

Analyses were initially conducted by comparing women in the control group to the total FSAD group using Independent samples *t*-tests or the Welch's *t*-test in cases of violation of homogeneity of variance. Next, the three subtypes of FSAD were compared to each other and to the control group using analyses of variance (ANOVA) followed by Tukey's multiple comparisons tests. ANOVA for repeated measures with group as the between subjects factor (control and FSAD) and film as the within subjects factor (neutral and erotic) were used to investigate the effects of FSAD on VPA and subjective ratings of sexual arousal. In cases of a significant interaction, simple effects analyses, using a corrected error term, were utilized to determine which groups or testing intervals significantly differed. Simple effects analyses [37] were conducted within groups for analysis of psychophysiological data given the lack of an absolute metric in this instrument, and were conducted between groups for analyses of self-report data. Eta-square (η^2) was calculated as a measure of effect size for all analyses involving FSAD subtype comparisons on genital and subjective arousal

measures. Pearson product moment correlations were used to investigate the degree of association between genital and subjective measures of arousal. Correlations were assessed using the difference between average VPA during erotic stimulus and average VPA during neutral stimulus, correlated with difference scores on subjective sexual arousal and perception of genital arousal. A Bonferroni correction was applied to the analysis of subjective reactions to the film given that the six domains of this scale are not necessarily independent. A P level of $0.05/6 = 0.008$ was thus set for these comparisons. For analysis of all other variables, a P level of 0.05 was deemed significant.

Results

Demographic Information

The mean age for sexually healthy women was significantly lower than that for women reporting arousal difficulties, $t(59) = 1.62$, $P < 0.001$ (23.4 and 30.6 years old, respectively). There were no significant age differences between diagnostic groups, however, $P > 0.05$. Ethnic breakdown indicated that most participants were Caucasian. Women with sexual arousal difficulties had a significantly higher level of education achieved, $t'(38.2) = 2.38$, $P = 0.022$, than sexually healthy women (15.6 and 14.6 years of education, respectively), although this may be an artifact of women with FSAD being slightly older. The total FSAD group reported significantly more medical conditions than the control group, $t'(44.1) = 2.26$, $P = 0.029$, despite no subtype differences on this variable. There were also significantly more days of work missed by women with heterogeneous FSAD compared to controls, $t'(37.8) = 2.65$, $P = 0.012$. All women were currently involved in a heterosexual relationship, although the duration for women with FSAD was significantly longer, $t'(42.4) = 2.37$, $P = 0.023$—again, possibly due to the women with FSAD being significantly older. Psychopathology, derived from the DSFI Brief Symptom Inventory subscale, was low and did not differ between groups, $P > 0.05$. There were no significant group differences on information about or attitudes toward sexuality, nor on diversity of sexual experiences, both $P > 0.05$, as measured by the DSFI subscales. Negative affect, $t(53) = 3.30$, $P = 0.002$ and negative body image, $t(59) = 2.28$, $P = 0.026$ were significantly higher in women with FSAD, although it was only the latter that was in the significant range of abnormality (i.e., two standard deviations from the mean). Women in the FSAD group reported difficulties with vaginal dryness during sexual activity significantly more than healthy control women, $\chi^2(3) = 25.23$, $P < 0.001$, specifically with those in the Genital sexual arousal disorder group as well as those in the Combined genital and subjective arousal disorder groups endorsing vaginal dryness significantly more than women complaining solely of difficulties in subjective sexual arousal. The two former groups also reported that vaginal dryness was problematic during sexual intercourse, unlike sexually healthy women or those with subjective sexual arousal difficulties, $\chi^2(3) = 33.89$, $P < 0.001$. Data for the GRISS are presented in Table 1. Each of the GRISS subscales were significantly higher in women with FSAD, including sexual infrequency, $t(54.4) = 4.51$, $P < 0.001$, sexual noncommunication, $t(59) = 2.90$, $P = 0.005$, sexual dissatisfaction, $t(59) = 3.87$, $P < 0.001$, avoidance of sexual activity, $t'(48.6) = 6.05$, $P < 0.001$, nonsensuality, $t(59) = 2.26$, $P = 0.028$, vaginismus symptoms,

Table 1 Scores from the Golombok–Rust Inventory of Sexual Satisfaction (GRISS) for women in the control group (N = 30), the total Female Sexual Arousal Disorder group (Total FSAD; N = 31), and across subtypes of FSAD: Genital sexual arousal disorder (Genital FSAD; N = 7), Subjective sexual arousal disorder (Subjective FSAD; N = 8), and Combined genital and subjective sexual arousal disorder (Combined FSAD; N = 16). Data represent means ± SEM

Measure	Control group	Total FSAD	Genital FSAD	Subjective FSAD	Combined FSAD
Infrequency[c,d]	3.24 (0.31)	5.58 (0.42)	3.86 (0.70)	5.75 (0.92)	6.25 (0.52)
Non-communication[b]	3.07 (0.34)	4.45 (0.34)	4.57 (0.84)	3.50 (0.71)	4.88 (0.40)
Dissatisfaction[c]	2.30 (0.23)	3.48 (0.20)	4.00 (0.49)	3.00 (0.27)	3.50 (0.29)
Avoidance[c,e,f]	2.13 (0.27)	5.27 (0.44)	2.33 (0.80)	5.00 (0.68)	6.50 (0.44)
Non-sensuality[a]	3.07 (0.35)	4.19 (0.35)	3.71 (0.89)	4.13 (0.74)	4.44 (0.46)
Vaginismus[b]	2.63 (0.34)	4.13 (0.41)	4.42 (0.84)	2.63 (0.60)	4.75 (0.59)
Anorgasmia[c]	3.60 (0.34)	5.90 (0.45)	5.86 (0.86)	5.38 (0.91)	6.19 (0.67)

Values for the GRISS subscales are presented in standard score units with a score greater than 5 indicating significant impairment.
Significant difference between control group and total FSAD group: [a] $P < 0.05$, [b] $P < 0.01$, [c] $P < 0.001$.
Significant difference between Genital FSAD and Combined FSAD group: [d] $P < 0.05$, [e] $P < 0.001$.
Significant difference between Genital FSAD and Subjective FSAD group: [f] $P < 0.05$.

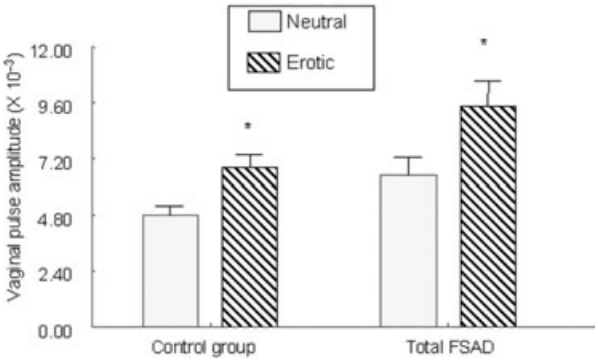

Figure 1 Effects of neutral and erotic stimuli on vaginal pulse amplitude (VPA) in the control group and the total group of women with female sexual arousal disorder (FSAD). Data represent means (in millivolts) ± standard error of the mean. The main effects of each group are not analyzed because of the absence of zero scale with the vaginal photoplethysmograph. *$P < 0.001$, significant difference between neutral and erotic stimuli.

t(59) = 2.79, $P = 0.007$, and anorgasmia complaints, t′(55.8) = 4.08, $P < 0.001$. Despite these significant differences, only the avoidance and anorgasmia subscales of the GRISS achieved levels indicative of sexual dysfunction (i.e., scaled score higher than 5). Sexual infrequency was significantly higher in women with combined genital and subjective arousal disorder compared to those with genital arousal disorder, $P = 0.042$. GRISS avoidance was significantly higher in those with subjective sexual arousal disorder as well as those with the combined condition, compared to those with genital arousal disorder only, $P = 0.023$ and $P < 0.001$, respectively. Satisfaction with the sexual relationship was significantly lower in the total group of women with FSAD, t(59) = 6.63, $P < 0.001$. There were also significant subtype differences on this measure, with women in the Combined genital and subjective sexual arousal disorder group having significantly lower sexual satisfaction than either women with impaired genital ($P = 0.048$) or impaired subjective ($P = 0.010$) sexual arousal alone. Although anticipated sexual arousal to erotica was significantly lower in the total group of women with FSAD, t(51.1) = 2.62, $P = 0.012$, the groups did not differ on self-report of actual level of sexual arousal ever experienced, $P > 0.05$, confirming that the diagnosis of FSAD was acquired, and not lifelong.

Effects of Erotic Stimuli and FSAD on Psychophysiological Sexual Arousal

Because of technical reasons during data collection, VPA data are not available for one woman in the control and two women in the FSAD groups. As suggested by Figure 1, the main effect of erotic film was significant, $F_{1,55} = 34.50$, $P < 0.001$, indicating that women responded with increased VPA after erotic film exposure. The interaction between film and FSAD was not significant for VPA, $F_{1,55} = 1.22$, $P > 0.05$. Group main effects were not analysed because of the methodological feature of photoplethysmography in that it is void of absolute metric, thus necessitating within–subject and interaction analyses only [38]. Analyses were then repeated by comparing the FSAD subgroups to sexually healthy women. There was a significant film by FSAD subtype interaction, $F_{3,53} = 6.73$, $P < 0.001$, $\eta^2 = 0.276$, which is presented in Figure 2 as percent increase in VPA from neutral to erotic stimuli conditions. Follow-up simple effects analyses revealed that sexually healthy women, $F_{1,53} = 15.06$, $P < 0.001$, women with Subjective sexual arousal complaints, $F_{1,53} = 41.85$, $P < 0.001$, and women with Combined genital and subjective sexual arousal disorder, $F_{1,53} = 6.946$, $P < 0.01$, experienced a

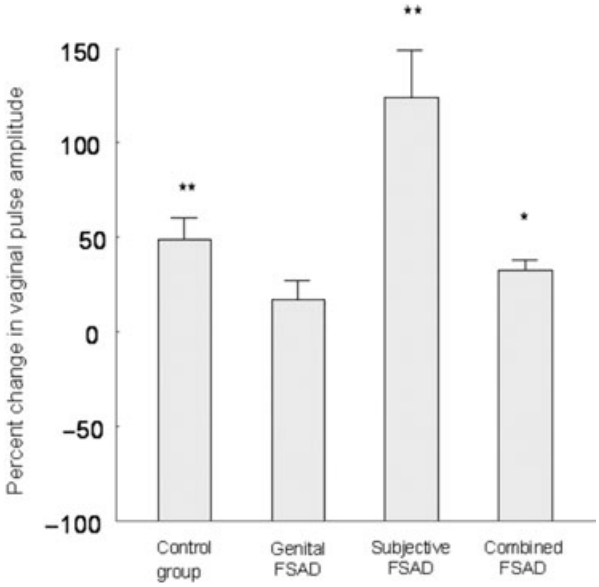

Figure 2 Effects of erotic stimulus on vaginal pulse amplitude (VPA) in the control group, in women with Genital sexual arousal disorder (Genital FSAD), Subjective sexual arousal disorder (Subjective FSAD), and women with Combined genital and subjective sexual arousal disorder (Combined FSAD). Data represent the mean percent increase in VPA in response to erotic vs. neutral stimuli ± standard error of the mean. The y-axis represents increase from neutral to erotic films so that a 100% would indicate a doubling in average VPA from neutral to erotic stimuli conditions. *$P < 0.01$, **$P < 0.001$, significant increase from neutral to erotic stimuli.

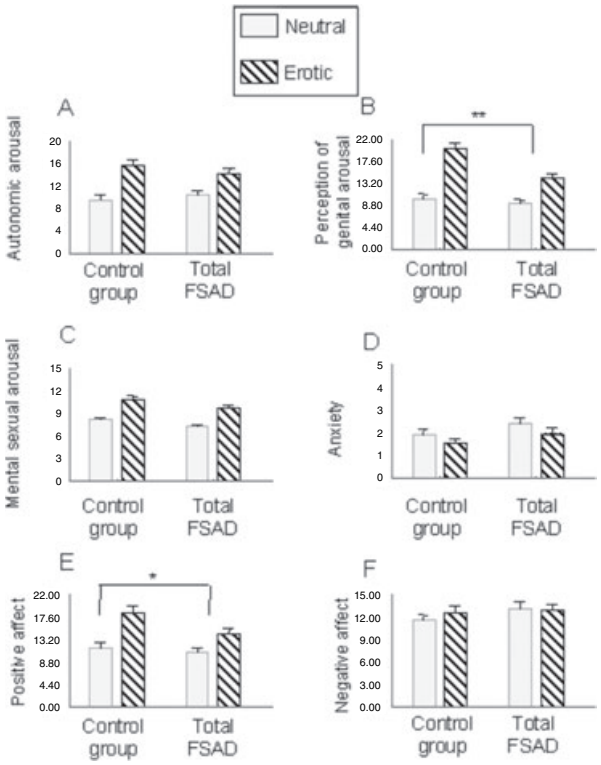

Figure 3 Effects of neutral and erotic stimuli on (A) self-reported autonomic arousal, (B) perception of genital arousal, (C) mental sexual arousal, (D) anxiety, (E) positive affect, and (F) negative affect in the control group, and in all women reporting arousal complaints (total FSAD). Data represent means ± standard error of the mean. $^{*}P < 0.05$, $^{**}P < 0.01$, significant interaction between group and film.

significant increase in VPA after exposure to the erotic film whereas women characterized by Genital sexual arousal disorder did not experience such an increase in VPA, $F_{1,53} = 0.931$, $P > 0.05$.

Effects of Erotic Stimuli and FSAD on Self-Report Measures

There was a main effect of erotic film such that self-reported autonomic arousal, $F_{1,58} = 54.65$, $P < 0.001$, perception of genital arousal, $F_{1,59} = 96.90$, $P < 0.001$, mental sexual arousal, $F_{1,59} = 73.30$, $P < 0.001$, and positive affect, $F_{1,58} = 53.64$, $P < 0.001$, were all significantly increased (Figure 3). The erotic film showed a trend towards reducing anxiety in all women, $F_{1,59} = 6.36$, $P = 0.014$, and had no effect on negative affect, $F_{1,56} = 0.77$, $P > 0.05$.

The control and total FSAD groups significantly differed on perception of genital arousal, $F_{1,59} = 8.751$, $P = 0.004$, and on mental sexual arousal, $F_{1,59} = 8.473$, $P = 0.005$, with lower scores being endorsed by the FSAD group (Figure 3). There were no significant group differences for self-reported autonomic arousal, $F_{1,58} = 0.035$, $P > 0.05$; anxiety, $F_{1,59} = 1.592$, $P > 0.05$; and negative affect, $F_{1,56} = 0.421$, $P > 0.05$. Positive affect showed a trend towards being lower in the total group of women with FSAD, $F_{1,58} = 2.949$, $P = 0.091$, although this did not reach statistical significance.

The interaction between FSAD and erotic film was significant for perception of genital arousal, $F_{1,59} = 9.96$, $P = 0.003$, and showed a trend for positive affect, $F_{1,58} = 5.88$, $P = 0.018$, but was not significant for self-reported autonomic arousal, $F_{1,58} = 2.94$, $P > 0.05$; mental sexual arousal, $F_{1,59} = 0.09$, $P > 0.05$; anxiety, $F_{1,59} = 0.07$, $P > 0.05$; or negative affect, $F_{1,56} = 2.05$, $P > 0.05$ (Figure 3). Simple effects analyses by subtype revealed that for both perception of genital arousal and positive affect, the increase after the film was markedly higher in sexually healthy women than women with FSAD.

There was a trend towards a main effect of group on perception of genital arousal, $F_{3,57} = 3.748$, $P = 0.016$, $\eta^2 = 0.165$ and significance for mental sexual arousal, $F_{3,57} = 5.269$, $P = 0.003$, $\eta^2 = 0.217$. FSAD subtype and film interacted, although not statistically significantly, for perception of genital arousal, $F_{3,57} = 3.43$, $P = 0.023$, $\eta^2 = 0.153$. A follow-up simple effects analysis revealed that with exposure to the erotic film, women with Genital sexual arousal disorder ($P < 0.05$) and women with Combined genital and subjective arousal disorder ($P < 0.001$) had a significantly lower perception of genital arousal than sexually healthy women (Figure 4). Women with FSAD characterized as Subjective sexual arousal disorder did not differ from the control group, $P > 0.05$. Self-reported autonomic arousal, $F_{3,56} = 1.264$, $P > 0.05$, $\eta^2 = 0.063$; mental sexual arousal, $F_{3,57} = 0.171$, $P > 0.05$, $\eta^2 = 0.009$; anxiety, $F_{3,57} = 0.881$, $P > 0.05$, $\eta^2 = 0.044$; negative affect, $F_{3,54} = 1.542$, $P > 0.05$, $\eta^2 = 0.079$, and positive affect, $F_{3,56} = 1.935$, $P > 0.05$, $\eta^2 = 0.094$, did not significantly differ between these groups.

Genital–Subjective Sexual Arousal Correlations

Results from Pearson product moment correlation analyses are presented in Table 2. Mental sexual arousal showed a significant negative correlation with VPA in the control group, $P = 0.045$, and a near-significant positive correlation with VPA in the Genital arousal disorder group, $P = 0.09$. The mental arousal–VPA correlation was not significant in other groups, and the perception of genital

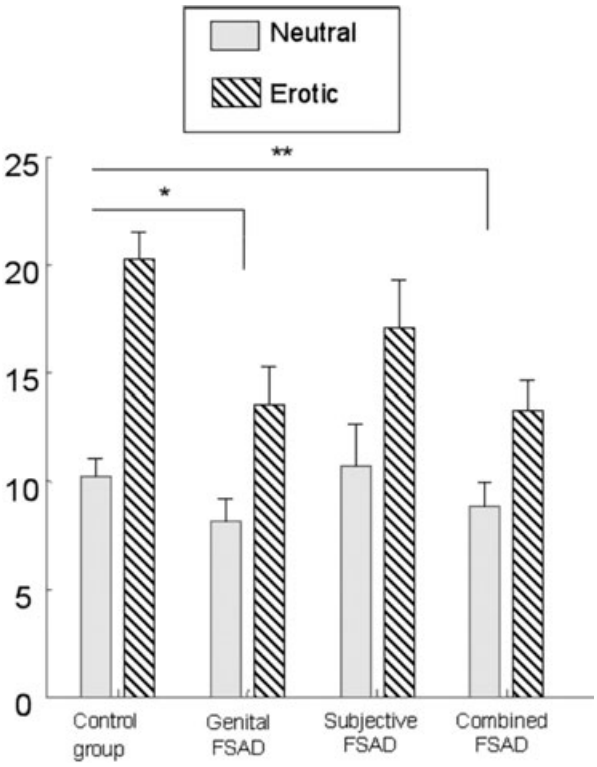

Figure 4 Effects of neutral and erotic stimuli on perception of genital arousal in the control group, in women with Genital sexual arousal disorder (Genital FSAD), Subjective sexual arousal disorder (Subjective FSAD), and women with Combined genital and subjective sexual arousal disorder (Combined FSAD). Data represent means ± standard error of the mean. Maximum possible score is 35. $^{*}P < 0.05$, $^{**}P < .001$, significantly different from control group.

arousal–VPA correlation was not significant in any group, $P > 0.05$. It is important to keep in mind that interpretation of the lack of significant effects in these analyses is related to the low number of subjects per group, hence, the low probability of significance.

Discussion

Overall, the data demonstrate that the erotic film was effective at increasing VPA, reducing self-reported anxiety and increasing self-reported autonomic arousal, perception of genital arousal, mental sexual arousal, and positive affect across all women. Moreover, there was no significant difference in VPA response to the erotic film between the control group and the total group of women with FSAD. However, when the subtypes of FSAD were subsequently compared based on the recent redefinitions, differential VPA patterns emerged. Women in the Genital arousal disorder subgroup did not display an increase in VPA with exposure to the erotic film whereas all other subgroups did. Perception of genital arousal to the erotic film was significantly lower in the total group of women with FSAD compared to sexually healthy women, and when this was analysed further according to arousal subtype, both women with Genital sexual arousal disorder as well as Combined genital and subjective arousal disorder had lower scores than the women in the Subjective subgroup. This study represents novel findings on psychophysiological assessment in FSAD, and suggests, perhaps, that there may indeed be lower levels of vaginal vasocongestion in a subgroup of women, which accounts for their lower self-reports of genital arousal.

Although the current findings indicate that as a group, women reporting sexual arousal difficulties do not differ from sexually healthy women on psychophysiological arousal assessment, women complaining solely of difficulties with genital arousal show psychophysiological patterns that are different from women with other types of sexual arousal complaints. Prior studies of psychophysiological responding in women with arousal dysfunction [21,24] did not attempt to carefully delineate the type of arousal impairment in participants. Our finding that the total group of women with FSAD did not significantly differ on photoplethysmographic patterns from the control group is consistent with such a conclusion [24,25]. There have recently been descriptions of the Genital sexual arousal disorder subgroup [13,39,40], but empirical data on the group characteristics are lacking.

Table 2 Correlations between (i) average VPA and perception of genital arousal, and (ii) average VPA and mental sexual arousal among women in the control group, women with unspecified FSAD, women with impaired genital arousal, women with impaired subjective arousal, and women with combined genital and subjective sexual arousal impairment

	Perception of genital arousal and VPA	Mental sexual arousal and VPA
Control group	$r = -0.221$	$r = -0.375^{*}$
Total FSAD group	$r = 0.077$	$r = 0.166$
Genital sexual arousal disorder	$r = 0.225$	$r = 0.684^{**}$
Subjective sexual arousal disorder	$r = -0.059$	$r = -0.030$
Combined genital + subjective sexual arousal disorder	$r = 0.119$	$r = 0.185$

Values represent Pearson Product Moment Correlation Coefficients
* $P < 0.05$, ** $P < 0.09$.

The extent to which the psychophysiological features of this group are attributable to underlying genital organic factors is unknown, although the current data certainly provide support for this conclusion. Emerging research is beginning to delineate the precise peripheral and central pathways involved in the genital arousal response [41], and there has been speculation that the photoplethysmograph may be useful in detecting arousal impairment because of organic genital etiology [42]. These findings contrast with a similar study of premenopausal women carefully clinically assessed for genital arousal disorder, who were psychophysiologically identical to control women [42]. However, it is not clear that those women had acquired dysfunction. Interestingly, a further study suggested genital arousal disorder acquired at menopause is actually heterogeneous as only a proportion of women with dysfunction had congestive deficiency demonstrable by vaginal photoplethysmography [28]. These same women were shown to benefit from a phosphodiesterase inhibitor under laboratory conditions [28].

Using vaginal photoplethysmography, women complaining of difficulties in subjective arousal or both genital and subjective arousal difficulties displayed a VPA response to erotica that was no different from a control group. This is despite the Combined arousal disorder group reporting lower levels of perceived genital arousal during an interview. Women with the Combined disorder then are characterized as finding nothing subjectively exciting in their sexual lives (by history) and not attending to their healthy genital response. Women with subjective arousal disorder also fail to find their sexual lives exciting, but are aware of genital reflex events, which also fail to excite them. It is very interesting that under laboratory conditions mental sexual arousal in both the Subjective arousal disorder and Combined arousal disorder groups was similar to control women. It is possible that the sexual stimulus employed may have been insufficient to allow differences between these groups to be reached. Alternatively, the sexual stimuli or contexts in their lives may have been problematic, and therefore in a laboratory setting, devoid of interpersonal context, their sexual excitement was tapped. Clearly further research, employing more naturalistic sexual stimuli, is necessary in order to explore differences in mental sexual arousal between these groups.

The lack of a difference in psychophysiological patterns between the control group and women in the Combined sexual arousal disorder subgroup was not unexpected. These women were classified based on their self-reported difficulties across both domains, but the literature to date confirms healthy psychophysiological responding in the majority of such women [1]. This group has been described in the clinical literature as possibly "missing" their genital vasocongestion which is indeed occurring [13,39,40]. It is equally possible that vasocongestion is insufficient in ways that are not detected by this laboratory test. Of note, exercise-induced facilitation of sympathetic nervous system activity was necessary in order for VPA differences between anorgasmic and sexually healthy women to be observed [25]. Levin [43] warns against making inferences about the underlying vaginal vasculature based on VPA and VBV given that these two signals can change in opposite directions. Perhaps the use of VBV in this subgroup of women might have revealed different patterns. Clearly, the clinical delineation of a subgroup, by means of noting nothing sexually excites their minds nor triggers awareness of a genital response, points to therapeutic interventions rather different from pharmacological enhancement of congestion. It could be argued that helping these women become aware of their genital response might be of benefit. However, because they describe a global lack of subjective arousal, such a technique might simply move them to the Subjective arousal subtype. Further studies on larger numbers of women, as well as replication in a condition of heightened sympathetic activity, might clarify the findings.

Some models of sexual arousal presume that during sexual excitement genital and subjective sexual arousal increase and decrease to the same degree [44]. However, desynchrony between genital and subjective sexual arousal is a frequent finding in this research with women [2]. In the current study, definitive conclusions on the genital-subjective relationship across subgroups of FSAD cannot be drawn because of insufficient sample sizes. However, significant and near-significant findings deserve some comment. Specifically, mental sexual arousal and VPA were negatively correlated in sexually healthy women, but showed a trend towards being positively correlated in women with Genital sexual arousal disorder. An interpretation of the current findings is dependent on an understanding of how correlational analyses were conducted. Given that difference scores between neutral and erotic stimulus conditions were used in correlational analyses, this would suggest that large neutral-erotic differences in subjective assessment

and large neutral-erotic differences in psychophysiological assessment would result in a positive correlation. The trend for such a pattern in the Genital arousal disorder group suggests, perhaps, that this group may be relying on changes in actual genital arousal for their subjective sexual arousal reports. Another interpretation would be that this group appears to be valid reporters of genital arousal. Both speculations suggest that women with genital arousal disorder are attuned to genital arousal and the lack thereof, a common finding in this group in clinical practice. However, these are the first empirical data to test arousal disorder subtype correlations.

Moreover, the negative correlation found in sexually healthy women indicates that with small increases in VPA, there is a concomitantly larger increase in mental sexual arousal, and that with large VPA increases, mental sexual arousal does not increase to a similar degree. Perhaps sexually healthy women are able to shift focus to the source of more noticeable increases in arousal, be they genital or subjective. Clearly, the subjective sexual arousal response is complex and is affected by these cognitive sources [45] and contextual factors [46]. The lack of statistically significant correlations in the Subjective and Combined sexual arousal disorder subgroups may be attributed to *true* desynchrony in these aspects of arousal, or simply to a lack of statistical power from insufficient sample size. Morokoff and Heiman (1980) [24] discovered negative correlations between genital and subjective sexual arousal when women were presented with an audiotape, a significant positive correlation when allowed to fantasize, and no correlation when women with FSAD were shown an audiovisual film. It remains speculative that different methods of erotic stimulus exposure may evoke different patterns of genital–subjective correlations across subtypes. Clearly larger-scaled studies with sufficient sample sizes as well as repeated subjective–physiological correlations across trials, rather than averages, are necessary to resolve these inconsistencies.

Although the use of female-friendly erotica found to increase positive affect was employed in hopes of alleviating reluctance to participate, the generalizability of the findings must be considered. The conclusions are limited by the fact that not all women feel comfortable taking part in sexuality research. Women who participate in sexual psychophysiological studies tend to be less likely to object to viewing sexually explicit films, are exposed to commercially available erotica more often than nonvolunteers [47], and report significantly more sexual experience, have more sexual partners and have higher levels of sex guilt than nonvolunteers [48]. Other issues to consider are individual differences in the subject's familiarity or experience with erotica, individual differences in sexual arousability to erotica, individual differences in preference for different types of erotica, the level of comfort with invasive genital instruments, and the subject's willingness to share information about personal material honestly. Rowland raises the issue of the considerable amount of time necessary to participate in laboratory studies of sexual arousal [49]. All of these factors may also be contributing to the selection of a unique, highly motivated sample of individuals willing to undergo laboratory testing, often for several hours. Additionally, the extent to which the current sample of women with FSAD are representative of women in the community is unknown. Given that the clinical group responded to an advertisement that stated "Do you experience significant difficulties with sexual arousal?" and later self-reported significant distress and interference in their interpersonal relationship during the telephone screen with a desire for information on treatment resources, it is likely that the current sample resembles women presenting to sex therapy clinics with complaints of FSAD. In addition, although the FSAD group was slightly though significantly older than the sexually healthy group, we do not believe that this significantly impacted the findings given that age or menopausal status, per se, are not found to affect psychophysiological sexual arousal [34,50].

It remains uncertain the extent to which psychophysiological assessment of female sexual arousal might be useful in the clinical setting, despite this possibility being considered for nearly three decades [29,51]. Whereas penile plethysmography has been suggested to provide useful information for discriminating psychogenic from organic erectile dysfunction [52], definitive conclusions and analogous studies have yet to be presented for vaginal photoplethysmography. Moreover, it has been argued that as a laboratory procedure, psychophysiological assessment may not accurately reflect sexual arousal patterns in a person's natural environment [29]. However, the current findings do provide some empirical support for the hypothesis that FSAD is a heterogeneous diagnostic category composed of subgroups. Until now, subtype differentiation was solely based on self-report data. The current findings provide at least modest support that there

may be psychophysiological differences between groups as well. These findings are, however, limited by our incomplete understanding of the nature of the photoplethysmographic signal and what this implies about underlying sexual physiology. We cannot make inferences with respect to anatomical or biochemical events that differ between the groups. However, these data do carry implications for the treatment of arousal problems, which has proven difficult to date. There is at least preliminary evidence that such subtype differentiation in FSAD may allow for the positive effects of pharmaceutical agents to emerge [28,53], and remains to be explored with other modalities of treatment. Future investigations might examine the effects of treatment matching based on physiological and subjective sexual arousal impairments. For women with subjective arousal disorder, we would predict physiological agents with strictly peripheral effects to be of very limited use, whereas for women in the Combined arousal disorder group, we would speculate that a multimodal intervention targeting the psychological as well as perceived physiological difficulties would be optimal.

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