THE RELATIONSHIP BETWEEN PAIN SENSITIVITY AND VASOCONGESTION DUE TO SEXUAL AROUSAL IN WOMEN WITH PROVOKED VESTIBULODYNIA

by

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Abstract

Women with chronic vulvar pain report reduced sexual function in comparison to non-affected women, including decreased sexual arousal. Experimentally induced sexual arousal has been examined in women with and without chronic vulvar pain, with contradictory results: some studies have found that only subjective arousal is affected in women with versus without vulvar pain, while other research has suggested that only genital responsiveness is affected in women with pain. As a result of these inconsistent findings, the role of arousal mechanisms in the causation and maintenance of provoked vestibulodynia (PVD) remains unclear. Thirty women with (n = 15) and without PVD (n = 15) were recruited to examine the relationship among physiological and subjective arousal, pain sensitivity and psychological/sexual function. Laser Doppler imaging (LDI) directly measured blood flow to the external genitals in response to an erotic film, and pain sensitivity was assessed before and after imaging. The PVD group had significantly lower blood flow than the control group during the erotic film when baseline blood flow levels were controlled; there were, however, no group differences in ratings of subjective arousal during the erotic film. Vestibular pain thresholds were significantly lower in the PVD group before and after the erotic film compared to the control group. In contrast, pain intensity ratings were significantly higher pre-erotic film in the PVD group, but there was no group difference post-erotic film. Pain thresholds did not significantly change in either group following exposure to the erotic film. Lastly, the PVD group had significantly lower sexual and psychological function in comparison to the control group, and intercourse frequency and pain catastrophizing significantly predicted genital function.
responsiveness in the PVD group. The results suggest that women with PVD show an attenuated physiological response to erotic stimuli in an experimental setting, in the absence of differences in subjective arousal. The findings thus support the role of arousal in the maintenance of PVD, potentially in interaction with other physical and psychological factors. The study also has implications for the assessment and treatment of PVD, whereby arousal processes should be explicitly and separately managed in women with this condition.
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Chapter 1

Introduction

Provoked vestibulodynia (PVD) is a highly prevalent vulvar pain condition among pre-menopausal women (Harlow, Wise, & Stewart, 2001). Women with PVD have significantly lower pain thresholds than non-affected women at the vulvar vestibule (e.g., Pukall, Binik, Khalifé, Amsel, & Abbott, 2002) (a thin ring of skin surrounding the vaginal opening), which results in a sharp burning pain during vaginal penetration activities, including sexual intercourse (Bergeron, Binik, Khalifé, Pagidas, & Glazer, 2001). It is thus not surprising that reduced sexual function is commonly reported by women with this condition, including decreased arousal and lubrication (Masheb, Lozano-Blanco, Kohorn, Minkin, & Kerns, 2004). It has been theorized that decreased arousal may play a role in the etiology of PVD (e.g., Bancroft, 1989; Hawton, 1980); reduced sexual arousal may interact with physical (e.g., pelvic floor muscle dysfunction) and psychological factors (e.g., pain catastrophizing) to exacerbate the pain over time.

The experimental study of the physiological (i.e., physical) and subjective (i.e., mental) components of sexual arousal in women with PVD, however, has produced inconclusive results. Some studies have found that women with PVD are capable of becoming as physiologically aroused as non-affected women in response to a visual erotic stimulus depicting intercourse but report lower levels of subjective arousal, while others have found decreased physiological arousal in the absence of group differences in subjective arousal ratings (Brauer, Laan, & ter Kuile, 2006; Payne et al., 2007; Wouda et
A variety of internal and external instruments have been used to measure blood flow to the genitals, a key physiological correlate of female sexual arousal, each with its own set of drawbacks. Laser Doppler imaging (LDI) is a non-invasive direct measure of blood flow to the external genitals and has recently been validated as a measure of physiological sexual arousal in healthy women (Styles, Maclean, Reid, & Sultana, 2006; Waxman & Pukall, 2009). Specifically, increased blood flow to the vulva as measured by LDI during the presentation of an erotic film was strongly and positively correlated with subjective ratings of sexual arousal (Waxman & Pukall, 2009). In addition, this technology avoids problems associated with other measures of physiological arousal, such as invasiveness (e.g., Meston, 2000; Payne & Binik, 2006).

To clarify the relationship among sexual arousal, vulvar blood flow, and pain sensitivity in PVD, the current study sought to directly measure genital blood flow via LDI in response to an erotic film, as well as assess pain sensitivity before and after the film presentation. Psychological and sexual function were also assessed to examine the interaction of these factors with genital and subjective sexual arousal. Examining these factors is important, as women with PVD report significantly lower psychological function as well as sexual function in comparison to non-affected women (see Pukall, Smith, & Chamberlain, 2007); thus, this condition has negative psychological correlates beyond those related to sexuality. Given that PVD is associated with reduced emotional well-being and quality of life (e.g., Arnold, Bachmann, Rosen, Kelly, & Rhoads, 2006), it
is imperative that causal and maintaining factors involved in PVD be investigated in order to increase our understanding of the pain experience of this clinical population.

The results of the current study will enable us to better understand the role of different components of sexual arousal in PVD, as well as the relationship between physiological and subjective arousal in this condition. Furthermore, the current study will increase our knowledge as to what processes (i.e., increased vulvar blood flow) may contribute to the pain experienced by women with PVD. The latter point is especially relevant given that certain therapy techniques aim to increase arousal as a component of treatment for PVD (Payne et al., 2007; Phillips, 2000). Thus, furthering our knowledge of the interplay between arousal and pain sensitivity, in conjunction with sexual and psychosocial functioning in this condition, will contribute to greater understanding of their roles in the causation and maintenance of PVD, which in turn, may impact chosen interventions and targets for assessment and treatment.
Chapter 2
Literature Review

Vulvodynia: Definitions, Terminology and Prevalence

Chronic vulvar pain affects approximately 16% of women in the general population (Harlow et al., 2001). This common condition is generally referred to as vulvodynia, and is defined by the International Society for the Study of Vulvovaginal Disease (ISSVD) as medically unexplained vulvar discomfort and pain (Moyal-Barracco & Lynch, 2004). The ISSVD further classifies vulvodynia into two main subtypes based on pain location: (a) generalized vulvodynia (GVD), in which the pain affects the entire vulvar area, and (b) localized vulvodynia, in which the pain affects a particular vulvar region, such as the clitoris (termed clitorodynia) or the vulvar vestibule (termed vestibulodynia). The pain associated with vulvodynia can be provoked (i.e., elicited by pressure to the affected area), unprovoked (i.e., occurring in the absence of external stimulation), or have a mixture of both characteristics. The most common form of vulvodynia involving provoked pain is called provoked vestibulodynia (PVD; formerly known as vulvar vestibulitis syndrome).

Women with PVD report experiencing a severe, sharp and burning pain localized to the vulvar vestibule (i.e., vaginal entrance) in response to pressure (Aikens, Reed, Gorenflo, & Haefner, 2003; Arnold et al., 2006; Bergeron, Binik, Khalifé, Pagidas, & Glazer, 2001). The vulvar vestibule (see Figure 1) is a thin ring of skin attaching the labia minora to the hymeneal remnants (Cervero, 1994). Although both sexual (e.g., sexual
Figure 1. Picture depicting the different areas of the female genital region, including the vulvar vestibule. From CROOKS/BAUR. Our Sexuality (with CD-ROM, InfoTrac® Workbook, and InfoTrac®), 9E. © 2005 Wadsworth, a part of Cengage Learning, Inc. Reproduced by permission.

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intercourse) and non-sexual (e.g., gynecological examinations) situations can provoke the pain experienced by women with PVD (Bergeron, Binik, Khalifé, Pagidas, & Glazer, 2001), the main complaint of affected women is dyspareunia, which is defined as “recurrent genital pain associated with sexual intercourse” in the Diagnostic and Statistical Manual of Mental Disorders (American Psychological Association [APA], 2000, p. 556). Some women experience pain beginning with their first attempt at vaginal penetration (e.g., first tampon insertion, first intercourse; termed primary PVD), while others have a period of pain-free penetration before developing PVD (referred to as secondary PVD).

Dyspareunia prevalence rates vary across the literature, however, a cross-sectional national survey found that 21% of women aged 18 to 29 years reported experiencing painful intercourse during the past 12 months (Laumann, Paik, & Rosen, 1999). PVD is the most common form of dyspareunia in pre-menopausal women, with an estimated lifetime prevalence of 12% in the general population (Harlow et al., 2001). The diagnostic criteria for PVD consist of the following: (a) severe pain on vestibular touch or attempted vaginal entry, (b) tenderness to pressure localized within the vulvar vestibule, and (c) physical findings confined to vestibular erythema of various degrees (Friedrich, 1987). PVD is diagnosed in the absence of relevant physical findings (e.g., vaginal infection) (Moyal-Barracco & Lynch, 2004) in combination with self-reported pain during attempted vaginal penetration (e.g., pain during intercourse, tampon insertion). The diagnosis is then confirmed with the cotton-swab test (Friedrich, 1987), which consists of the palpation of different areas of the vulvar vestibule with a cotton-swab.
Although there is no general consensus regarding the minimum amount of pain required during the cotton-swab test to receive a diagnosis of PVD, the reliability of this procedure in the assessment of PVD has been empirically demonstrated (Bergeron, Binik, Khalifé, Pagidas, & Glazer, 2001; Masheb, Lozano, Richman, Minkin, & Kerns, 2004).

*Physical and Psychological Correlates of PVD*

Beyond the pain triggered by vestibular pressure, PVD can have a negative impact on a woman’s physical and emotional well-being, affecting her overall quality of life (Arnold et al., 2006; Laumann et al., 1999; Sackett, Gates, Heckman-Stone, Kobus, & Galask, 2001). PVD has been associated with a number of other chronic pain conditions, such as irritable bowel syndrome, interstitial cystitis, and fibromyalgia (Arnold et al., 2006; Pukall & Binik, 2009; Rabin, O’Leary, Neighbors, & Whitmore, 2000). PVD has also been linked with a significantly higher incidence of lifetime urinary tract infections and yeast infections (Arnold et al., 2006; Arnold, Bachmann, Rosen, & Rhoads, 2007; Sarma, Foxman, Bayirli, Haefner, & Sobel, 1999).

In terms of psychological correlates, women with PVD have a higher incidence of depressive symptoms (Aikens et al., 2003; Sackett et al., 2001; Wylie, Hallam-Jones, & Harrington, 2004), lower body image (Granot & Lavee, 2005; Sackett et al., 2001), and heightened anxiety (Granot, Friedman, Yarnitsky, & Zimmer, 2002; Granot & Lavee, 2005; Nunns & Mandal, 1997; Payne, Binik, Amsel, & Khalifé, 2005; Wylie et al., 2004) as compared with non-affected women. Not all studies, however, have found reduced
psychological functioning in women with PVD (Meana, Binik, Khalifé, & Cohen, 1997; van Lankveld, Weijenborg, & ter Kuile, 1996).

**PVD and Sexual Arousal**

Despite its potentially debilitating physical and psychological correlates, little is known concerning the causal and maintaining factors involved in PVD (see Pukall, Smith, et al., 2007 for a review), and the role of sexual arousal has not been extensively explored. In the past, certain theoretical models have postulated that a lack of sexual arousal is a primary cause of dyspareunia (Bancroft, 1989; Hawton, 1985; Spano & Lamont, 1975). In fact, both Hawton (1985) and Bancroft (1989) have suggested that pain experienced at the vaginal entrance (where the pain is localized in women with PVD) may be directly related to a lack of arousal. Bancroft’s (1989) model focuses on genital vasocongestion (i.e., the swelling of genital tissues with blood). This process marks the beginning of physiological sexual arousal; the resulting increase in blood flow throughout the genital region in turn leads to fluid seeping through the vaginal walls, thus creating vaginal lubrication (Allgeier & Allgeier, 1995). Vaginal lubrication is believed to allow for comfortable and pleasurable vaginal penetration (Masters & Johnson, 1966). Bancroft (1989) hypothesized that women with dyspareunia have insufficient vasocongestion, leading to pain during sexual intercourse, and that the pain experienced during intercourse leads to decreased sexual arousal and lubrication over time.

Some models specifically implicate psychological factors, whereby pain or its anticipation may lead to inhibited arousal; this response is potentially mediated by the
fear of experiencing pain (Bancroft, 1989; Spano & Lamont, 1975). Brauer, ter Kuile, Janssen, and Laan (2007) examined the effects of pain-related fear on sexual arousal in women with and without dyspareunia. Women viewed two erotic film clips; however, before viewing one of the clips, they were told there was a 60% chance they would receive a painful stimulus to a non-genital area. The induction of pain-related fear decreased both groups’ levels of sexual arousal in comparison to the no-threat condition. Thus, pain-related fear has the potential to reduce sexual arousal. This finding is particularly relevant to the pain experience of women with PVD, as they have been shown to have higher levels of pain catastrophizing and hypervigilance to pain in comparison to non-affected women (e.g., Payne et al., 2005; Payne et al., 2007; Pukall et al., 2002); women with PVD closely attend to, ruminate about, and feel helpless in managing the pain they experience during intercourse.

In addition, pelvic floor muscle dysfunction, such as increased pelvic floor hypertonicity (i.e., muscle tension) (Reissing, Binik, Khalife, Cohen, & Amsel, 2004; Reissing, Brown, Lord, Binik, & Khalife, 2005), has been found in women with PVD in comparison to non-affected women. It has been suggested that a protective guarding response may result from, and help maintain, the pain experienced by women with PVD, whereby tightening of the pelvic floor muscles in reaction to painful vestibular pressure increases the intensity of the pain (e.g., Reissing et al., 2005). These physical and psychological responses may strengthen over time and exacerbate the pain, as well as result in decreased arousal. This hypothesis is partially corroborated by the fact that women with PVD consistently report significantly lower sexual function in areas such as
arousal and lubrication in comparison to non-affected women (e.g., Masheb, Lozano-Blanco, et al., 2004). Women with PVD also report lower perceived arousability when engaging in different sexual activities and situations (Brauer et al., 2006).

Experimental Measurement of Female Sexual Arousal

Several studies have directly investigated sexual arousal in women suffering from dyspareunia, with varying results. Typically, films or readings with erotic content are used to induce sexual arousal during its measurement (Rowland, 1999). Sexual arousal is believed to have two major components: the physiological aspect, usually measured in terms of physical changes (e.g., increases in blood flow) in the vagina or to the vulva, and the subjective aspect, comprised of the individual’s self-reported ratings of their degree of sexual arousal. Physiological sexual arousal has typically been measured via the vaginal photoplethysmograph in women. This instrument is a tampon-like device that is inserted into the vagina to determine the level of genital vasocongestion through its photocell detector. The vaginal photoplethysmograph emits light and then measures the amount of light back-scattered to the photocell from the vaginal walls, which provides a measure of vaginal blood flow. The photoplethysmograph yields two main assessments of genital arousal: vaginal blood volume (VBV), which represents general pooling of blood into the genital region, and vaginal pulse amplitude (VPA), which is believed to represent moment-to-moment changes in vaginal vasocongestion with each heartbeat (Meston, 2000). As VBV has proven to be relatively unreliable (e.g., Heiman, 1977; see Meston, 2000), VPA is the most often used measure of sexual arousal when
photoplethysmography is employed (Meston, 2000). However, problems related to movement artifacts and the invasiveness of the instrumentation, as well as questions surrounding the analysis and interpretation of the resulting data have been raised (e.g. Meston, 2000; Payne & Binik, 2006; Rellini, McCall, Randall, & Meston, 2005).

Fortunately, other methodologies exist for the measurement of physiological sexual arousal in women, such as instruments measuring genital temperature, including the labial thermistor clip (see Payne & Binik, 2006; Payne et al., 2007) and thermal imaging (Kukkonen, Binik, Amsel, & Carrier, 2007; Kukkonen, Binik, Amsel, & Carrier, 2009). Such temperature-measuring devices purport to indirectly measure blood flow; genital temperature is hypothesized to be related to blood flow, such that the higher the temperature, the higher the amount of blood flow to the genital region (e.g., Kukkonen et al., 2007; Payne & Binik, 2006). A proven, direct measure of blood flow itself would also greatly contribute to the existing literature, providing further insight into the pathophysiological mechanisms underlying PVD.

Laser Doppler imaging (LDI) operates on the Doppler Effect. When light interacts with a moving object (i.e., a blood cell), there is a change in the frequency of the backscattered light. Therefore, LDI processes information concerning the number of moving blood cells by measuring the quantity of backscattered light from the laser beam emitted by the imager, allowing one to determine the amount of tissue perfusion in a specific area, which is then expressed in arbitrary units (Aspres, Egerton, Lim, & Shumack, 2003; Fullerton et al., 2002). LDI therefore directly measures the amount of cutaneous blood flow to a depth of 2 to 3 mm. This technology has been utilized to
visualize blood flow in a variety of clinical populations, including women with vulvar pathology (Saravanamuthu, Seifalian, Reid, & MacLean, 2003). Furthermore, LDI has previously been used to measure sexual arousal in two samples of sexually healthy women (Styles et al., 2006; Waxman & Pukall, 2009). Styles et al. (2006) observed a significant increase in participant vulvar blood flow during the reading of an erotic passage, indicating that LDI can detect changes in blood flow due to physiological sexual arousal. Subjective arousal data was also collected based on one item presented to participants following the imaging; however, the association between physiological and subjective arousal was not explored in this sample. In addition, a recent LDI study randomized sexually healthy women to one of four film conditions; each participant watched an erotic, neutral, anxiety-provoking or humor film after baseline vulvar blood flow was measured (Waxman & Pukall, 2009). Blood flow to the genitals significantly increased in participants who viewed the erotic film, but not within participants in the non-erotic conditions. Furthermore, levels of physiological arousal were positively and significantly related to reported levels of subjective arousal. Thus, LDI is capable of detecting increases in genital blood flow due to sexual arousal, as well as differentiating it from non-erotic mood-induced states (Waxman & Pukall, 2009).

Despite the fact that physiological sexual arousal can be measured in a number of ways, the subjective component of sexual arousal has traditionally been evaluated through self-report on various scales. For example, some studies use a 0 to 10 numerical rating scale to retrospectively evaluate how sexually aroused the participant becomes during exposure to erotic stimuli, where 0 corresponds to ‘not at all’ and 10 corresponds
to ‘the most ever’ (Kukkonen et al., 2007; Waxman & Pukall, 2009), or other similar variations. A handful of studies have examined one or both components of sexual arousal in women with dyspareunia and/or PVD in a laboratory setting.

Investigation of Sexual Arousal in PVD

Wouda et al. (1998) measured physiological sexual arousal via the vaginal photoplethysmograph in women with dyspareunia and controls while they viewed a film segment depicting oral sex (fellatio and cunnilingus), followed by a segment featuring cunnilingus and sexual intercourse (with a brief distraction task between segments). Although there were no significant group differences in physiological arousal during the oral sex segment, physiological arousal in the dyspareunia group decreased and arousal increased in the control group during the intercourse segment. Interestingly, despite this physiological difference, there were no differences in subjective sexual arousal ratings following the intercourse segment. The authors concluded that the decrease in vasocongestion observed in the dyspareunia group was an unconscious negative reaction towards penetrative activities, which prevented their genital response from further increasing during the intercourse segment.

Brauer et al. (2006) also utilized vaginal photoplethysmography to measure sexual arousal in women with dyspareunia (over 60% of the sample met diagnostic criteria for PVD) and non-affected women during a film segment depicting oral sex and a segment depicting intercourse. All participants completed subjective arousal questionnaires following each film segment. In contrast to Wouda et al.’s (1998)
findings, there were no significant differences in the level of physiological arousal between the dyspareunia and control groups. In fact, there was a trend indicating that the dyspareunia group exhibited higher physiological arousal during the intercourse segment than the control group. Results were in the opposite direction for the oral sex segment, with the control group exhibiting higher levels of physiological arousal than the dyspareunia group. Women with dyspareunia, however, reported significantly less positive sexual affect than the control group when watching both segments. Importantly, both of the above studies found desynchrony between physiological and subjective arousal within women with dyspareunia. Desynchrony is a term used in the sexual arousal literature to describe no or low correlations between physiological and subjective measures of arousal (Hall, Binik, & Di Tomasso, 1985).

Payne et al. (2007) also found no significant differences in physiological sexual arousal when specifically comparing women with PVD to non-affected women. In this study, genital temperature change was measured via the labial thermistor clip, which was gently attached to the left labia minora of each participant for the duration of the testing. Participants viewed an erotic film and a neutral film, with film order randomized over two testing sessions. Both groups’ level of physiological arousal significantly increased during exposure to the erotic film as compared to baseline measures. Subjective sexual arousal was measured through several questions administered after the presentation of each film. Although there were no significant differences between the groups’ responses, there was a trend towards lower subjective sexual arousal in the PVD group. Additionally, the more anxious women in the PVD group felt before viewing the erotic
film, the less physiologically aroused they became. Women in the PVD group also reported less desire to engage in intercourse after watching the film segment. These results suggest that although women with PVD become as physiologically aroused as controls during exposure to an erotic film, they report being less willing to act on this desire than pain-free women, and anxiety may modulate their level of physiological arousal.

*The Relationship Between Pain Sensitivity and Sexual Arousal*

Overall, past research seems to indicate that an inherent lack of arousal does not play a significant role in PVD, as women with this condition are able to become as physiologically aroused as pain-free women when exposed to visual sexual stimuli in an experimental setting. Therefore, models of PVD that implicate decreased physiological arousal in the etiology of this condition (Bancroft, 1989; Hawton, 1985; Spano & Lamont, 1975) have not been supported to date. Despite the results of these studies, however, questions regarding sexual arousal and its effects on pain sensitivity in women with PVD remain. It has been hypothesized that sexual arousal may actually *decrease* the perception of pain in the genital region (Gruenwald, Lowenstein, Gartman, & Vardi, 2007), and vaginal stimulation has been proposed to have an analgesic effect (Whipple & Komisaruk, 1985). Decreased pain perception during intercourse has been suggested to be evolutionarily advantageous, as pain may hinder successful reproduction (Gruenwald et al., 2007). Indeed, lower lifetime pregnancy rates have been found in women with PVD in comparison to non-affected women (Arnold et al., 2006).
Laboratory studies have been inconclusive regarding the relationship between sexual arousal and peripheral pain sensitivity in sexually healthy women. Whipple and Komisaruk (1985) examined the effect of vaginal self-stimulation (applied with a pressure transducer) on touch thresholds (i.e., the point at which a sensation is first perceived), pain thresholds (i.e., the point at which a pain sensation is first detected), and pain tolerance (i.e., the point at which a pain sensation is no longer tolerable) during finger compression. Pain thresholds and tolerance both significantly increased during vaginal stimulation as compared to baseline. This finding is unlikely to have resulted from distraction during the pain-inducing procedure, as touch thresholds did not increase as one would expect if distraction was responsible for the pain attenuation phenomenon (Whipple & Komisaruk, 1985). In contrast, King and Alexander (2000) found that pain thresholds (but not pain tolerance), as measured by a cold pressor task (i.e., immersion of one’s hand in a container of ice cold water), significantly decreased after exposure to an auditory erotic stimulus. Thus, the role of sexual arousal in pain sensitivity remains unclear, as sexual arousal has been found to both decrease (King & Alexander, 2000) and to increase (Whipple & Komisaruk, 1985) pain thresholds. King and Alexander (2000) endeavored to explain these contradictory results, hypothesizing that mild sexual arousal, as induced by auditory or visual stimuli, may decrease pain thresholds in women, while more intense, direct, stimulation may increase pain thresholds.

Although there is considerable debate surrounding the pathway(s) through which PVD develops, one of the most consistent findings in women with this condition is an increase in vestibular pain sensitivity. Women with PVD have been shown to exhibit
lower pain thresholds (i.e., higher sensitivity to pain) in the vulvar vestibule as compared to controls in a number of studies (see Pukall, Bergeron, & Goldfinger, 2008). Only one study has, however, examined vestibular pain sensitivity in women with PVD during experimentally induced sexual arousal to assess whether pain thresholds increase or decrease after exposure to an erotic film. Consistent with the previous literature, Payne et al. (2007) demonstrated that women with PVD had significantly lower pain thresholds over the vestibule as compared with control women at baseline and during both film conditions (i.e., neutral, erotic). In addition, they found that women with PVD had significantly lower pain thresholds during the erotic condition as compared to the neutral condition (but not compared to baseline), with the control group displaying lower vestibular pain thresholds during the erotic condition in comparison to baseline. Therefore, exposure to erotic material decreased pain thresholds in both groups of women. The decrease in pain thresholds in the PVD group was not due to a lack of arousal, as women with PVD were found to be as physiologically aroused in the erotic condition (as measured by the labial thermistor) as pain-free women. As a result, other factors may be responsible for this increased sensitivity in the vestibular region.

As labial temperature was higher in both the PVD and control groups during the erotic condition, and women with PVD had significantly lower vestibular pain thresholds than the control group, increased blood flow may be a possible explanation for the decrease in pain thresholds within this sample of women. In support of a possible association between pain sensitivity and genital blood flow, Bohm-Starke, Hilliges, Blomgren, Falconer, and Rylander (2001) investigated baseline blood flow in the
vestibular area of women with PVD via LDI. They found that women with PVD had significantly higher perfusion values in the posterior vestibule – typically the area of highest pain in women with PVD – as compared to controls, indicating higher blood flow to this area. These results support a possible relationship between decreased pain thresholds and increased vestibular blood flow in women with PVD.

The findings of the Payne et al. (2007) and Bohm-Starke, Hilliges, et al. (2001) studies suggest that increased blood flow may play a role in the pain of PVD, whereby increased vasocongestion may be related to decreased vestibular pain thresholds in affected women. As well, despite the findings of comparable levels of physiological sexual arousal in women with dyspareunia/PVD in response to erotic films, methodological issues with the previously described studies (e.g., Brauer et al., 2006; Wouda et al., 1998) hamper our ability to derive conclusions about sexual arousal in women with PVD. This point is especially relevant given that findings relating to subjective arousal have varied across studies; self-reported levels of arousal have tended to be desynchronous with physiological arousal in this population (e.g., Brauer et al., 2006; Wouda et al., 1998). In addition, despite previous research suggesting that genital responsiveness is not impaired in women with PVD, affected women consistently report lower arousal and lubrication during sexual activity than non-affected women (e.g., Masheb, Lozano-Blanco, et al., 2004).
Purpose and Rationale of Present Study

To clarify the role of sexual arousal, blood flow, and pain sensitivity in PVD, the purpose of this study is to directly measure genital blood flow via LDI in response to an erotic film, as well as measure pain sensitivity before and after the presentation of an erotic film. LDI will be used to assess physiological sexual arousal through the measurement of external genital blood flow, as it avoids problems associated with other measures of physiological arousal. The use of the vaginal photoplethysmograph in women with PVD is worrisome due to the invasiveness of this instrument; it requires the participant to insert the tampon-like device into the vagina, which is likely to be painful and emotionally difficult for women suffering from PVD. In addition, the use of photoplethysmography has traditionally led to consistent desynchrony between physiological and subjective measures of sexual arousal (see Meston, 2000 for a review), which has led some to assume that women do not utilize physiological signs of arousal (e.g., vasocongestion) in evaluating their level of subjective arousal (Laan, Everaerd, van der Velde, & Geer, 1995; Nappi et al., 2005). There are, however, other possible interpretations for the lack of concordance between female physiological and subjective arousal in laboratory studies of sexual arousal. Findings of desynchrony between these two aspects of arousal have been postulated to result from measurement error in the assessment of vaginal vasocongestion by the vaginal photoplethysmograph (Laan & Janssen, 2007), as well as statistical issues in the measurement of the relationship between VPA and subjective arousal (Rellini et al., 2005). Another possible reason for this lack of concordance may be because women are not aware of internal processes
associated with sexual arousal. Thus, women may perhaps be more aware of what is happening on the external part of their genitals. Supporting this idea is the finding that the newer instruments measuring physical changes in the external genitals (e.g., thermal imaging, labial thermistor, LDI) demonstrate strong correlations between these two aspects of arousal in women (Kukkonen et al., 2007; Kukkonen et al., 2009; Payne et al. 2007; Waxman & Pukall, 2009). As a result, LDI may allow us to capture what may be most obvious to female participants in terms of external genital feelings associated with sexual arousal. The sensitivity of LDI in the measurement of physiological sexual arousal has been demonstrated in previous studies examining pain-free women (Styles et al., 2006; Waxman & Pukall, 2009).

This study will substantially add to the literature by attempting to replicate a portion of Payne et al.’s (2007) finding of decreased pain thresholds due to sexual arousal, through a direct measure of blood flow covering the entire vulvar region. Furthermore, subjective arousal will be continuously measured throughout the film, allowing for a more reliable measure of arousal throughout the stimulus presentation, rather than relying on retrospective accounts (Meston, 2000). Lastly, Payne et al. (2007) collected post-film pain threshold data while participants were still watching the films, which may have interfered with arousal (and was reported to have decreased arousal in over half of participants). This interference is supported by research demonstrating that cognitive distraction significantly affects sexual arousal in women (Elliot & O’Donohue, 1997), whereby levels of physiological and subjective arousal varied in relation to the level of experimental distraction (higher levels of distraction led to decreased arousal).
when listening to an auditory erotic stimulus. The negative effect of distraction on sexual arousal has been extended to women with sexual dysfunction (Salemink & van Lankveld, 2006).

In addition, the relationship among sexual arousal and psychological (e.g., pain-related anxiety, pain catastrophizing) and sexual (e.g., intercourse frequency, perceived arousability) factors will be examined. Psychological and sexual function has been found to be reduced in a number of areas in women with PVD compared to non-affected women. Affected women exhibit higher levels of pain catastrophizing, more anxiety, higher levels of depressive symptoms, as well as lower arousability, sexual frequency, and decreased sexual function in all domains in comparison to non-affected women (e.g., Smith, Pukall, & Boyer, 2009). Thus, beyond potentially replicating past research regarding differences in psychological and sexual function between women with and without PVD, this study presents an opportunity to explore how such factors are associated with physiological arousal in women with PVD.

**Objectives**

1. To determine whether women with PVD have increased baseline genital blood flow as compared to controls.

2. To determine whether there are differences in physiological and subjective sexual arousal between women with PVD and controls in response to an erotic film.

3. To determine the effect of sexual arousal on vestibular pain sensitivity in women with PVD and controls.
4. To examine group differences in self-reported psychological and sexual functioning, as well as to investigate the relationship between sexual arousal and psychological and sexual function in women with PVD.

Hypotheses

1. Women with PVD will have significantly higher baseline genital blood flow when compared to controls.

2. In response to the erotic film, women with PVD will become as physiologically aroused as controls (as demonstrated by LDI blood flow measurements), replicating the findings of past studies examining sexual arousal in women with dyspareunia/PVD. Second, women with PVD will report significantly less subjective arousal than controls.

3. Vestibular pain thresholds will decrease after exposure to an erotic film stimulus in women with PVD as well as in controls (with significantly lower pain thresholds in the PVD group as compared to the control group, both before and after the film).

4. Women with PVD will report poorer psychological and sexual function than controls, replicating past research findings. Analyses examining the relationship between psychological/sexual function and sexual arousal will be exploratory in nature, as there has been little investigation concerning the association between these variables and direct measures of physiological arousal in women with PVD.
Chapter 3
Method

Participants

Thirty women between the ages of 18 and 40 years were recruited for the study, with 15 women in each group (PVD, control). Cohen (1992) suggests a sample of 20 to 30 women in each group for large effect sizes, a power of .80, and an alpha level of .05; recruitment for the present study proceeded with this number in mind. Participants in each group were matched on age (+/- 3 years), as pressure pain sensitivity is affected by age (Lautenbacher, Kunz, Strate, Nielsen, & Arendt-Nielsen, 2005). Participants were recruited through advertisements (see Appendix A and Appendix B) posted in a variety of areas throughout Queen’s University and the city of Kingston (e.g., campus buildings, coffee shops). Advertisements were also placed on the social networking site Facebook. Individuals who clicked on a Facebook ad were directed to the Sexual Health Research Laboratory (SHRL) webpage, which includes descriptions of ongoing studies and an online form to submit contact information. Participants were able to specify which specific studies were of interest, and an automated email was sent to the SHRL email account. Monetary compensation in the amount of $60 was provided for participating in the present study.

Women interested in participating first underwent a telephone screening interview to determine their eligibility (see Appendix C). The screening interview included questions concerning socio-demographic information, medical, gynecological and sexual
history, as well as past exposure to sexually explicit material. To be eligible for the PVD group, women had to report pain that was: (a) present on at least 60% of intercourse occasions, (b) localized to the vaginal opening, and (c) at least six months in duration. To be eligible for the control group, women could not have ever suffered from recurrent and/or persistent pain with intercourse.

In addition, the following inclusion criteria applied to women in either group: (a) over 18 years of age; (b) fluent in English; (c) non-smokers, with no history of drug or alcohol abuse; (d) not currently suffering from a psychiatric/psychological condition reported to interfere with sexual functioning (e.g., depression); (e) not currently taking medication(s) reported to interfere with sexual functioning, pain sensitivity and/or blood flow (e.g., antidepressants); (f) nulliparous, as parity status has been associated with experiencing pain during intercourse (e.g., Barrett et al., 2000; Glazener, 1997; Paterson, Davis, Khalifé, Amsel, & Binik, 2009); (g) heterosexual or bisexual sexual orientation, as the chosen erotic film featured a male and female engaged in sexual activity, and certain questionnaires utilized in the study have not yet been validated with lesbian women; (h) have had at least one previous gynecological examination; and (i) have previously watched sexually explicit films, as well as be comfortable with and not object to watching such a film for the purpose of the present study.

Materials & Apparatus

Structured Interview
The experimenter conducted a structured interview (see Appendix D) covering areas such as demographics, gynecological history, relationship/sexual history, bodily pain, as well as vulvar pain history (if applicable). The latter section also included questions concerning the pain’s characteristics (e.g., pain frequency and intensity; specific situations eliciting the pain). Participants in both groups were also asked if they experienced difficulty becoming sexually aroused during intercourse; if endorsed, the participant was asked to rate her difficulty on a 0 (no difficulty) to 10 (most difficulty imaginable) scale and describe her beliefs as to why she experiences arousal difficulties.

**Questionnaires**

The following questionnaires were administered, in order, during or following the structured interview. All questionnaires had an acceptable reliability level in the current sample (see Table 1 for internal consistency values).

1. The McGill Pain Questionnaire (MPQ) (Melzack, 1975) is a 21-category measure examining sensory, affective and evaluative components of the pain experience (Pain Rating Index, PRI; total scores range from 0 to 78), including a 5-point scale evaluating pain intensity (Present Pain Intensity, PPI; scores ranging from 1 [mild] to 5 [excruciating]). For the PRI, respondents are instructed to pick the word in each subclass which best describes their pain, or indicate by leaving the subclass blank that no word in the subclass describes their pain. The PRI can be interpreted with regards to the total number of words chosen, the rank values associated with this subset of words, and the pain quality denoted by the words chosen (Burckhardt & Jones, 2003).
Table 1

*Internal Consistency of Questionnaires in the Current Sample*

<table>
<thead>
<tr>
<th>Measure</th>
<th>No. of items</th>
<th>N</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain Catastrophizing Scale (PCS) for worst regularly experienced (non-vulvar) pain</td>
<td>13</td>
<td>28</td>
<td>.92</td>
</tr>
<tr>
<td>Pain Catastrophizing Scale (PCS) for vulvar pain</td>
<td>13</td>
<td>15</td>
<td>.92</td>
</tr>
<tr>
<td>Pain Anxiety Symptom Scale (PASS-20)</td>
<td>20</td>
<td>15</td>
<td>.80</td>
</tr>
<tr>
<td>Female Sexual Function Index (FSFI)</td>
<td>19</td>
<td>29</td>
<td>.94</td>
</tr>
<tr>
<td>Desire subscale</td>
<td>2</td>
<td>30</td>
<td>.82</td>
</tr>
<tr>
<td>Arousal subscale</td>
<td>4</td>
<td>30</td>
<td>.95</td>
</tr>
<tr>
<td>Lubrication subscale</td>
<td>4</td>
<td>30</td>
<td>.94</td>
</tr>
<tr>
<td>Orgasm subscale</td>
<td>3</td>
<td>30</td>
<td>.91</td>
</tr>
<tr>
<td>Satisfaction subscale</td>
<td>3</td>
<td>29</td>
<td>.88</td>
</tr>
<tr>
<td>Pain subscale</td>
<td>3</td>
<td>30</td>
<td>.93</td>
</tr>
<tr>
<td>Sexual Arousability Index (SAI)</td>
<td>28</td>
<td>27</td>
<td>.93</td>
</tr>
<tr>
<td>Beck Depression Inventory-II (BDI-II)</td>
<td>20a</td>
<td>29</td>
<td>.91</td>
</tr>
<tr>
<td>State-Trait Anxiety Inventory (STAI, Trait form)</td>
<td>20</td>
<td>30</td>
<td>.92</td>
</tr>
</tbody>
</table>

*Note. Cronbach’s alpha was not calculated for the McGill Pain Questionnaire (MPQ), as a number of the word categories were not highly endorsed by women in the PVD group. The BDI-II reliability analysis was based on 20 items, as there was zero variance for the item assessing suicidal ideation, which was dropped from the analysis.*
The MPQ has been used to quantify pain in a variety of chronic pain populations, as well as for labour pain and other acute pain states (see Katz & Melzack, 1999). Strong evidence for the reliability and validity of the MPQ has been demonstrated across a variety of studies (see Melzack & Katz, 2001 for a review). The MPQ was administered to women in the PVD group during the structured interview to describe their vulvar pain.

2. The Pain Catastrophizing Scale (PCS) (Sullivan, Bishop, & Pivik, 1995) is a 13-item measure of catastrophizing, which includes subscales relating to pain rumination, helplessness and magnification. Catastrophizing is defined by Sullivan et al. (1995) as “an exaggerated negative orientation towards noxious stimuli” (pg. 524). Each item is rated on a 5-point scale ranging from 0 (not at all) to 4 (all the time), with regards to how much the respondent experiences the thought/feeling denoted by the item when in pain. Total scores range from 0 to 52, with higher scores indicating higher pain catastrophizing. Scores of 30 and above on the PCS indicate a clinically relevant level of catastrophizing (Sullivan, 2004), with cutoff scores of 11, 13 and 5 for the respective subscales. The test-retest reliability ($r = .75$ after six weeks) and internal consistency of the PCS (Cronbach’s alpha = .87) and its subscales (Cronbach’s alpha values = .87, .79, .60, respectively) has been demonstrated (Sullivan et al., 1995). In addition, there is strong evidence for the factor structure of the PCS, as well as its concurrent and discriminant validity (Osman et al., 2000; Osman et al., 1997). In the present study, women in the PVD group completed the PCS twice: once during the structured interview for their worst, regularly experienced non-vulvar pain (e.g.,
headache pain, menstrual pain), and once more following the interview in relation to their vulvar pain. Women in the control group completed the PCS once during the structured interview in relation to their worst, regularly experienced pain.

3. The Pain Anxiety Symptom Scale - 20 items (PASS-20) (McCracken & Dhingra, 2002) assesses pain-related fear/anxiety across four subscales: cognitive anxiety, escape/avoidance, fearful appraisal, and physiological anxiety. The respondent rates how frequently they engage in each thought/activity in response to pain on a 6-point scale, ranging from 0 (never) to 5 (always); total scores range from 0 to 100. Abrams, Carleton and Asmundson (2007) suggested preliminary criteria (i.e., scores above 30) to identify individuals who may have maladaptive levels of pain-related anxiety and are thus at increased risk for chronic pain and disability. The test-retest reliability ($r = .68$ after three months) and internal consistency (Cronbach’s alpha = .83) of the PASS-20 and its subscales (Cronbach’s alpha values = .70 to .85) has been established (e.g., Coons, Hadjistavropoulos, & Asmundson, 2004). The convergent and predictive validity, as well as the validity of the PASS-20 structure has also been demonstrated in both clinical and non-clinical samples (Abrams et al., 2007; Coons et al., 2004; McCracken & Dhingra, 2002; Roelofs et al., 2004). Participants in the PVD group completed the PASS-20 with regards to their vulvar pain following the structured interview.

4. The Female Sexual Function Index (FSFI) (Rosen et al., 2000) is a 19-item questionnaire, which measures sexual functioning during the previous four weeks. It contains six subscales: Desire, Arousal, Lubrication, Orgasm, Satisfaction and Pain.
Questions are answered on a 5-point Likert scale, with the response choices and anchors depending upon the particular question. Total scores range from 2 to 36, with higher scores indicating greater sexual functioning. Scores below 26.55 on this measure have been suggested to denote risk of sexual dysfunction (Wiegel, Meston, & Rosen, 2005). The measure and its subscales possess high internal consistency (Cronbach’s alpha values = .82 and above), with test-retest coefficients for the subscales ranging from .79 to .86 when re-administered after two to four weeks (Rosen et al., 2000). It has been administered to sexually healthy women, as well as women with a variety of sexual dysfunctions (including dyspareunia) with results illustrating the scale’s construct (including discriminant) validity (Masheb, Lozano-Blanco et al., 2004; Rosen et al., 2000). The FSFI was administered to all participants following the structured interview.

5. The Sexual Arousability Inventory (SAI) (Hoon, Hoon, & Wincze, 1976) is a 28-item scale, which assesses sexual arousability through ratings of how sexually aroused the respondent has been, or believes they would be, for a range of sexual experiences/situations. Each item is rated on a 7-point Likert scale from -1 (adversely affects arousal; unthinkable, repulsive, distracting) to 5 (always causes sexual arousal; extremely arousing). Total scores range from -28 to 140, with higher scores indicating higher perceived arousability. The SAI possesses test-retest reliability ($r = .69$ after an eight-week period), as well as high internal consistency (Cronbach’s alpha values of .91 and above) (Hoon et al., 1976). The construct validity of the measure has also been established: SAI scores are highly correlated with awareness of
physiological changes during sexually arousing situations, intercourse frequency, satisfaction with intercourse frequency, and sexual responsiveness (Burgess & Krop, 1978; Hoon et al., 1976). The SAI possesses discriminant validity, as it has been shown to differentiate between sexually healthy women and those with sexual dysfunction (Hoon et al., 1976). The SAI was administered to all participants following the structured interview.

6. The Beck Depression Inventory (BDI-II) (Beck, Steer, & Brown, 1996) is a 21-item scale assessing the presence of cognitive, affective, and somatic symptoms of depression over the past two-week period. All questions, except for two, contain groups of four statements relating to a common theme. Each statement corresponds to a weight on a 4-point Likert scale (0 to 3); questions relating to sleep and appetite contain groups of seven statements, however, they are still rated on this 4-point scale. Total scores range from 0 to 63, with higher scores indicating higher levels of depressive symptoms. Clinical cutoff scores of 14 to 19, 20 to 28, and 29 to 63 have been denoted for mild, moderate and severe depression, respectively. The BDI-II possesses test-retest reliability ($r = .93$ after one week), as well as high internal consistency (Cronbach’s alpha = .92) (Beck et al., 1996). The construct validity of the measure has also been established (Beck et al., 1996). The BDI-II was administered to all participants following the structured interview.

7. The Trait portion of the State-Trait Anxiety Inventory (STAI) (Speilberger, 1983) was administered to evaluate each respondent’s general level of anxiety. Respondents are to indicate how well they believe each of the 20 statements describes how they
generally feel, on a 4-point Likert scale, ranging from 1 (almost never) to 4 (almost always). Scores range from 20 to 80, with higher scores indicating higher levels of anxiety. The internal consistency of the Trait portion of the STAI has been demonstrated across different samples (Cronbach’s alpha values = .89 and above), and the scale has also been shown to possess construct and concurrent validity (Spielberger, 1983). The Trait portion of the STAI was administered to all participants following the structured interview.

Measures of Sexual Arousal

LDI. Superficial (2 to 3 mm of depth) blood flow was measured with a laser Doppler perfusion imager (moorLDI2-IR laser Doppler imager, Moor Inc., Axminster, England) positioned 30 to 40 cm from the participant’s vulva, as recommended by Moor Inc. A low power laser beam combined with a visible red aiming beam scanned the vulvar region, which then generated a colour image on a laptop computer (Dell Inspiron), where the continuum of colours represents differing amounts of perfusion in the scanning region; the higher the perfusion rate, the more blood flow to the area. Five 2 minute and 43 second scans were performed during each 15-minute film in order to visualize blood flow in the vulvar region over time. Each scan was 256 X 128 pixels in size. Before the imaging began, the digital camera of the LDI took a colour photograph of the area to be scanned in order to aid in identifying different structures of the external genitals within each scan. A region of interest (ROI) was constructed from the photograph for data analysis; this circular region included areas of the labia majora, labia minora and clitoral hood. Blood flow levels were calculated within the constructed ROI.
for each participant in all of the scans. A difference score was also generated for each participant to evaluate the change in physiological arousal from the baseline to the erotic condition. This score was calculated by subtracting the average blood flow level during the baseline film from that during the erotic film.

Subjective sexual arousal. During the LDI testing, a measure of continuous arousal (Kukkonen, et al., 2009) was utilized to assess each participant’s level of arousal during the erotic film. Through a wireless remote (Hiro 2.4 GHz 3 in 1 Wifi Presenter, Hiro Inc., California), the participant documented her level of arousal from 0 (not at all aroused) to 10 (the most aroused I’ve ever been), which was recorded in a text file on a Dell desktop computer controlled by the remote. The computer program cued the participant every 30 seconds as to her last recorded level of arousal if she had not changed her rating in the previous 30 seconds.

In addition, an 8-item questionnaire (see Appendix E) was presented to the participant through i-goggles before the erotic film, with questions related to current levels of mental and physical arousal (e.g., ‘Do you feel like having sex with a partner?’). The participant verbally answered each question on an 11-point Likert scale (0 to 10) and her responses were recorded by the experimenter. Immediately following the second sensory testing session, each participant filled out an 18-item questionnaire (see Appendix F) related to her mental and physical arousal during the erotic film (e.g., ‘How would you rate your peak sexual arousal during the film?’). Both questionnaires have been used in previous research examining female sexual arousal (Kukkonen et al., 2007; Kukkonen et al., 2009; Waxman & Pukall, 2009).
Films. Three 15-minute films were shown throughout the LDI testing, with five 2-minute and 43 second scans of the vulva recorded for each film. These films have also been used in previous studies investigating female sexual arousal (Kukkonen et al., 2007; Kukkonen et al., 2009; Waxman & Pukall, 2009).

1. Acclimatization film: A neutral film depicting still nature images complemented with calming music (LaBarge, 2002) was presented to each participant while her genital blood flow stabilized in her position on the gynecological table.

2. Baseline film: A second neutral film depicting a travelogue of the Yukon and Alaska (Glusic, 1994) was presented to each participant to measure her baseline blood flow level. An average of each participant’s blood flow levels over the five scans was calculated to evaluate the change in blood flow levels following the presentation of the erotic film.

3. Erotic film: Lastly, each participant watched a female-oriented erotic film (i.e., a film centered on the female character’s responses and enjoyment) (Janssen, Carpenter, & Graham, 2003) to elicit sexual arousal. The film depicted a variety of sexual activities, including kissing, manual stimulation of the breasts and female genitals, male and female oral stimulation, and penile-vaginal penetration. This film has been previously found to induce female sexual arousal in experimental settings (Janssen et al., 2003; Kukkonen et al., 2007; Kukkonen et al., 2009; Waxman & Pukall, 2009).
The films were viewed with Olympus eyetrek FMD-250W i-goggles (Center Valley, PA, USA) plugged into a laptop computer (Toshiba, Tecra) on which the films were played. The experimenter was behind a curtain with a wireless remote throughout the LDI testing, which enabled her to start and stop each film, as well as control the presentation of the pre-film questionnaire. Participants were, therefore, able to view the films in a relatively private manner, so as to minimize the impact of the experimenter’s presence on the participant’s level of sexual arousal.

Procedure

This research protocol was approved by the Health Sciences Research Ethics Board (HSREB) at Queen’s University. Based on the telephone screening interview, eligible participants underwent two testing sessions.

Session I

Eligible participants presented themselves to the Department of Obstetrics and Gynecology at the Kingston General Hospital for a gynecological examination. A female graduate student explained the study’s objectives and procedures before obtaining informed consent from the participant (see Appendix G for the Letter of Information and Consent Form produced for the current study). The participant then underwent a standardized gynecological examination to localize any pain she may be experiencing. The gynecologist visually and manually examined the internal and external genitalia and reproductive organs, and performed a cotton-swab palpation of five randomly ordered vestibular sites (cotton-swab test). These five vestibular sites are described in terms of
clock positions (i.e., 1, 4-5, 6, 7-8, and 11 o’clock), with the 12 o’clock position directly below the urethral meatus (see Figure 2). The cotton-swab test is the primary diagnostic tool for PVD (Friedrich, 1987), and is a reliable measure of the pain associated with PVD (Bergeron, Binik, Khalifé, Pagidas, & Glazer, 2001). In addition, the gynecologist performed a cotton-swab palpation of the labia majora, labia minora, perineum, midline area of the vulva, and the vagina, to determine whether the pain was restricted to the vestibular region.

After each palpation, the participant was asked to indicate the intensity of the pain on a scale from 0 (no pain at all) to 10 (worst pain ever felt). The graduate student remained in the room during the examination to record these ratings, as well as to provide the participant with any assistance she required. The participant was in total control of the examination and was able to stop at any time. This gynecological examination was based on a standardized protocol developed in the SHRL. In combination with self-reported pain history, the examination formed the basis of the diagnosis (PVD or control) for inclusion in the remaining study procedures. Women deemed ineligible to participate were provided with information concerning various forms of genital pain, as well as information regarding physical/mental health resources in the community.

Session II

The second session took place at the SHRL, which is located in the Department of Psychology at Queen’s University. Participants were scheduled during the luteal phase (between days 7 and 12) of their menstrual cycle, as the morphology and sensitivity of
Figure 2. Diagram of vestibular sites palpated during the cotton-swab test. From CROOKS/BAUR. *Our Sexuality (with CD-ROM, InfoTrac® Workbook, and InfoTrac®)*, 9E. © 2005 Wadsworth, a part of Cengage Learning, Inc. Reproduced by permission. www.cengage.com/permissions
the vulvar vestibule has been shown to fluctuate throughout the menstrual cycle (Johannesson, Blomgren, Hilliges, Rylander, & Bohm-Starke, 2007), which could therefore affect the measurement of pain sensitivity. In addition, female physiological arousal (as measured by genital temperature) has also been shown to fluctuate in relation to the menstrual cycle (Slob, Bax, Hop, Rowland, & van der Werff ten Bosch, 1996). To ensure that genital blood flow was at normal, non-aroused levels during LDI testing, participants were asked to abstain from caffeine and alcohol for at least 4 hours before testing, as well as to abstain from sexual intercourse for at least 24 hours before testing. The second session was comprised of three main components: (a) a structured interview and completion of questionnaires, (b) sensory testing, and (c) LDI testing. Participants were familiarized with the testing environment and procedures before any testing began.

The structured interview took approximately 30 to 45 minutes to complete. Following the interview, the participant filled out a variety of questionnaires, including the PASS-20 (McCracken & Dhingra, 2002), FSFI (Rosen et al., 2000), SAI (Hoon et al., 1976), BDI-II (Beck et al., 1996), and the Trait form of the STAI (Spielberger, 1983). This portion of the session took approximately 30 minutes to complete.

Following the interview and questionnaires, the participant was asked to undress from the waist down and lie down comfortably on the gynecological table after covering herself with a drape. The experimenter stood behind a curtain partitioning the room while the participant undressed and positioned herself on the gynecological table. The participant then underwent approximately 10 minutes of sensory testing to determine her vestibular pain threshold, which is defined as the point at which the participant first
detects a pain sensation. Pain thresholds were measured through the use of vulvalgesiometers (see Figure 3) (Pukall, Young, Roberts, Sutton, & Smith, 2007), which are a series of five calibrated mechanical instruments that allow for the application of 26 standardized pressures between 3 and 950 grams, via the use of springs with different compression rates. A cotton-swab attached at one end of the vulvalgesiometer is the only part of the instrument that comes into direct contact with the tested area. The vulvalgesiometer has been used in previous studies examining pain sensation in women with PVD (e.g., Payne et al., 2007; Pukall, Binik, & Khalifé, 2004). Furthermore, pain threshold testing with vulvalgesiometers has been shown to replicate the burning pain that women with PVD often describe experiencing during intercourse (Pukall, Smith, et al., 2007).

The trained experimenter applied each pressure at the 6 o’clock position on the vulvar vestibule, with increasing increments and an inter-stimulus interval of 5 seconds until the participant’s pain threshold was reached. After the application of each pressure, the participant was asked whether the pressure was painful or not (e.g., “Was that touch or pain?”). Once her pain threshold was reached (i.e., once pain was reported), the participant was asked to rate the intensity of the pain, using a scale of 0 (no pain at all) to 10 (worst pain ever felt) to evaluate the sensory component of the pain. A modified version of this procedure was repeated following LDI testing. A trained female research assistant was present during both sensory testing sessions to record participant ratings.

After the LDI was appropriately positioned, the participant was instructed to put on the i-goggles and the acclimatization film was presented while the LDI scanned the
Figure 3. A set of vulvalgesiometers.
vulvar area five times. All scans taken throughout the session were 6.7 cm height and width, resulting in a high-resolution image of 32,768 pixels. Room temperature was kept between 22 and 26 degrees Celsius throughout, with the experimenter recording the temperature at the end of each LDI scan (Bohm-Starke, Hilliges, et al., 2001; Kukkonen et al., 2007); there was less than 1 degree of within-subject variation. The baseline nature film was then presented, during which the LDI completed another five scans of the participant’s vulvar region. The pre-erotic-film questionnaire items were then presented one at a time through the i-goggles, with the participant verbally answering each question while the experimenter recorded her answers behind the curtain. The erotic film was then shown through the i-goggles while the LDI took the last set of five scans of the participant’s vulvar region. Throughout the erotic film, the participant reported her current level of arousal with a wireless remote that she was given before the third film began. The participant was instructed to rate her level of sexual arousal during the film on a scale from 0 (not at all aroused) to 10 (the most aroused I’ve ever been).

A shortened sensory testing session took place immediately after the erotic film. The participant was instructed to remove the i-goggles, while the experimenter turned on the lights and retrieved the vulvalgesiometers. Utilizing participant data from the earlier sensory testing, a pain threshold testing interval was constructed, beginning five pressure levels below the participant’s previously recorded pain threshold. Beginning at the lowest pressure in this interval, each pressure was applied in an increasing fashion until the participant reported a pain sensation. Shortening sensory testing in this manner minimized the time period between the end of the erotic film and the determination of the
participant’s post-film pain threshold, providing a closer approximation of the relationship between the participant’s level of genital vasocongestion (e.g., blood flow levels) and pain sensitivity following the erotic film (i.e. before blood flow returned to baseline). The participant then dressed and completed the post-film questionnaire concerning the erotic film. She received a verbal and written debriefing (see Appendix H), as well as a general resource sheet regarding gynecological, pain and mental health web-links and resources in the Kingston area (see Appendix I).
Chapter 4
Results

Data Considerations

All data were analyzed with the Statistical Package for the Social Sciences (SPSS), version 17 (SPSS Inc., Chicago). Data assumptions underlying the parametric statistics conducted were assessed prior to analysis, with necessary data transformations and corrections applied. Skewness and kurtosis values were examined individually for each group (PVD, control) for all dependent variables. Variable distributions with significant skewness or kurtosis (e.g., $z > 3.29, p < .001$), where $z$ represents the ratio between the statistic and its standard error (Tabachnick & Fidell, 2007), were transformed. Dependent variables were also screened for univariate outliers, defined as extreme $z$ scores (e.g., $z > 3.29, p < .001$).

There were no missing data on measures of physiological or subjective sexual arousal. There were six missing questionnaire responses for the entire sample: (a) three missing responses on the SAI, (b) two missing responses on the BDI-II, and (c) one missing response on the FSFI. Missing data were replaced with the overall sample mean for the item if the participant was missing less than 10% of the scale’s items (Tabachnick & Fidell, 1996); if missing more, their data were dropped from the analysis. Data were excluded twice: two control participants did not experience any regular pain and could not complete the PCS.
The alpha level was set at .05 for all analyses. Trends towards significance are reported for alpha values between .05 and .10. Chi-square analyses were conducted to examine group differences on categorical variables, while t tests were used to examine group differences on continuous variables. Effect size values are reported in the form of Cohen’s $d$ for all t test analyses. Cohen (1992) indicates that $d = 0.20, 0.50, 0.80$ correspond to small, medium and large effect sizes, respectively. For paired samples t tests, Cohen’s $d$ was calculated using the following formula: $d = t_c [2(1 - r)/n]^{1/2}$, where $t_c$ is the paired t test value and $r$ is the correlation between the measures (Dunlap, Cortina, Vaslow, & Burke, 1996).

Effects sizes for the analysis of covariance (ANCOVA) examining group differences in physiological arousal when baseline blood flow levels were covaried out, and for the multivariate analysis of variance (MANOVA) examining group differences in sexual function, are reported as $\eta^2$. Cohen (1988) has suggested that $\eta^2 = .01, .09, .25$ correspond to small, medium and large effect sizes, respectively (as cited in Tabachnick & Fidell, 2007). With respect to the ANCOVA, however, it is possible that a larger effect size value could be expected due to the physiological nature of the data (Tabachnick & Fidell, 2007).

Prior to running the MANOVA, dependent variables were screened for multicollinearity, according to the criteria proposed by Belsely, Kuh, and Welsch (1980) (as cited in Tabachnick & Fidell, 2007), where multicollinearity is defined as a dimension with a condition index greater than 30, and at least two variables with variance proportions greater than .50 on that particular dimension. Data were also screened for
normality, multivariate outliers, and homogeneity of variance. Multivariate outliers were screened for with Mahalanobis Distance through SPSS regression, and homogeneity of variance was assessed with Box’s M test (alpha level of $p < .001$).

To examine the change in blood flow levels (e.g., physiological arousal) from the baseline to the erotic condition, a difference score was generated for each participant. This score was calculated by subtracting the average blood flow level during the baseline film from that during the erotic film. Physiological arousal was also examined with raw data for the ANCOVA analysis, with average blood flow levels during the erotic film as a measure of physiological arousal and baseline blood flow levels covaried out of the analysis. All participants showed an increase in blood flow in response to the erotic film with the exception of one PVD participant, who had a negligible change in blood flow levels (i.e., an increase of less than 10 flux units); her data were included in all analyses in accordance with previous research examining female sexual arousal (see Kukkonen et al., 2009).

Sample Characteristics

Demographics

The current sample had a mean age of 20.83 years ($SD = 2.02$) and 15.17 years of education ($SD = 1.53$). Over half of the participants (56.7%) were completing a college/undergraduate degree, and 33.3% held a college/undergraduate diploma. The majority were born in Canada (86.7%) and identified as Canadian (80%). See Table 2 for further demographic information. There were no significant differences in age,
Table 2

Demographic Characteristics of the Sample

<table>
<thead>
<tr>
<th>Measure</th>
<th>$M (SD)$ or $n$ (%)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>20.83 (2.02)</td>
<td>18 – 27</td>
</tr>
<tr>
<td>Birthplace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>26 (86.7)</td>
<td></td>
</tr>
<tr>
<td>Asia</td>
<td>2 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Middle East</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Western Europe</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Culture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canadian</td>
<td>24 (80)</td>
<td></td>
</tr>
<tr>
<td>Western European</td>
<td>2 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Eastern European</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>American</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Québécoise</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Number of years of education</td>
<td>15.17 (1.53)</td>
<td>13 – 20</td>
</tr>
<tr>
<td>Highest level of education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some of a college/undergraduate degree</td>
<td>17 (56.7)</td>
<td></td>
</tr>
<tr>
<td>College/undergraduate degree</td>
<td>10 (33.3)</td>
<td></td>
</tr>
<tr>
<td>Some graduate school/professional training</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Measure</td>
<td>$M (SD)$ or $n$ (%)</td>
<td>Range</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Graduate/professional school degree</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Trade school graduate</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Current religious affiliation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>20 (66.7)</td>
<td></td>
</tr>
<tr>
<td>Catholic</td>
<td>3 (10)</td>
<td></td>
</tr>
<tr>
<td>Christian (unspecified)</td>
<td>3 (10)</td>
<td></td>
</tr>
<tr>
<td>Protestant</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Judaism</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Buddhism</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Atheism</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Relationship status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dating one partner regularly</td>
<td>10 (33.3)</td>
<td></td>
</tr>
<tr>
<td>Dating one partner regularly (long distance)</td>
<td>6 (20)</td>
<td></td>
</tr>
<tr>
<td>Living with partner</td>
<td>5 (16.7)</td>
<td></td>
</tr>
<tr>
<td>Casual sex with one partner</td>
<td>4 (13.3)</td>
<td></td>
</tr>
<tr>
<td>Casual sex with multiple partners</td>
<td>2 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Single, not dating</td>
<td>2 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Common-law</td>
<td>1 (3.3)</td>
<td></td>
</tr>
<tr>
<td>Sexual orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterosexual</td>
<td>27 (90)</td>
<td></td>
</tr>
<tr>
<td>Measure</td>
<td>$M$ ($SD$) or $n$ (%)</td>
<td>Range</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Bisexual</td>
<td>2 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Heteroflexible</td>
<td>1 (3.3)</td>
<td></td>
</tr>
</tbody>
</table>
$t(28) = -0.81, p > .05$, or number of years of education, $t(28) = -0.12, p > .05$, between the groups. Age was positively skewed and an inverse transformation was applied to normalize the data prior to analysis. The results, however, did not differ following transformation; thus, the untransformed results are reported for ease of interpretation. There were also no group differences for birthplace, $\chi^2 = 1.15, (1, N = 30), p > .05$, or culture, $\chi^2 = 0.83, (1, N = 30), p > .05$, when comparing Canada to ‘other’ nationalities.

Over half the sample (56.7%) was raised within a religious home environment, with 33% of participants currently identifying with a religious community. Those with a current religious affiliation rated the importance of religion in their daily life as an average of 5.44 ($SD = 2.74$) on a scale from 0 (*not important at all*) to 10 (*extremely important*). There were no significant differences in religious upbringing (yes/no) or current religious affiliation (yes/no) between the groups, $\chi^2 = 1.22, (1, N = 30), p > .05$, and $\chi^2 = 0.00, (1, N = 30), p > .05$, respectively.

Ninety percent of the sample identified as heterosexual ($n = 27$). Two PVD participants identified as bisexual and were in heterosexual relationships. One control participant identified as heteroflexible (i.e., did not identify as bisexual but had some interest/curiosity in sexual activity with a same-sex partner). Seventy-four percent of participants were in a relationship at the time of testing ($n = 22$); the average relationship duration was 23.55 months or 1.96 years ($SD = 18.14$ months or 1.51 years, range = 5 to 67 months). There were no group differences in relationship status (yes/no), $\chi^2 = 0.68, (1, N = 30), p > .05$, or relationship duration, $t(17.85) = -1.13, p > .05$. A correction was
applied to the latter $t$ test to account for unequal variances between the groups as indicated by Levene’s test for homogeneity of variance, $F(1, 20) = 5.51, p < .05$.

**Gynecological History**

The majority of participants (76.7%) were using hormonal contraceptives (see Table 3), for an average of 49.83 months or 4.15 years ($SD = 24.50$ months or 2.04 years, range = 6 to 120 months). Given that use of synthetic hormones affects pain sensitivity (Johannesson et al., 2007) and may also impact sexual arousal (Seal, Broto, & Gorzalka, 2005), a chi-square analysis was conducted to ensure there were no group differences in hormonal contraceptive use, $\chi^2 = 0.19, (1, N = 30), p > .05$, or duration of synthetic hormone use, $t(21) = -0.16, p > .05$.

The most common gynecological conditions were bladder/urinary tract and yeast infections. Forty-three percent of the sample had experienced at least one bladder/urinary tract infection, and 53.3% reported one or more lifetime yeast infections (see Table 4 for average number of infections by group). Independent samples $t$ tests were conducted to determine whether there were significant differences in number of infections (bladder/urinary, yeast), between the groups. Data were transformed prior to analysis, as both variables were positively skewed. A correction was also applied to the $t$ test examining bladder/urinary tract infections to account for unequal variances between the groups, as indicated by Levene’s test for homogeneity of variance, $F(28) = 8.70, p < .01$. Women in the PVD group ($M = 3.33, SD = 5.43$) had experienced a larger number of bladder/urinary tract infections than women in the control group ($M = 0.60, SD = 1.12$),
Table 3

Types of Hormonal Contraceptives Utilized by the Sample

<table>
<thead>
<tr>
<th>Hormonal contraceptive</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral contraceptives</td>
<td>20 (87)</td>
</tr>
<tr>
<td>Alesse</td>
<td>5 (21.7)</td>
</tr>
<tr>
<td>Ortho Tricyclen</td>
<td>5 (21.7)</td>
</tr>
<tr>
<td>Yasmine</td>
<td>4 (17.4)</td>
</tr>
<tr>
<td>Ortho Tricyclen Lo</td>
<td>3 (13)</td>
</tr>
<tr>
<td>Aviane</td>
<td>2 (8.6)</td>
</tr>
<tr>
<td>Micronor</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>Marvelon</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>Evra (birth control patch)</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>Mirena intrauterine device</td>
<td>1 (4.3)</td>
</tr>
<tr>
<td>Depo Provera injections</td>
<td>1 (4.3)</td>
</tr>
</tbody>
</table>

Note. One participant was taking both Alesse and Yasmine, and is included under both categories.
### Table 4

**Lifetime Number of Bladder/Urinary Tract and Yeast Infections, By Group**

<table>
<thead>
<tr>
<th>Infection Type</th>
<th>No infection(s)</th>
<th>Number of infections</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (%)</td>
<td>M (SD)</td>
</tr>
<tr>
<td><strong>PVD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bladder/urinary tract</td>
<td>7 (46.7)</td>
<td>6.25 (6.18)</td>
</tr>
<tr>
<td>Yeast</td>
<td>5 (33.3)</td>
<td>2.40 (1.90)</td>
</tr>
<tr>
<td><strong>Control</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bladder/urinary tract</td>
<td>10 (66.7)</td>
<td>1.80 (1.30)</td>
</tr>
<tr>
<td>Yeast</td>
<td>9 (60)</td>
<td>1.17 (0.41)</td>
</tr>
</tbody>
</table>

*Note.* Descriptive statistics for number of infections only take into account individuals in each group who had experienced at least one infection.

*a*The PVD group had experienced significantly more yeast infections than the control group, when the overall sample was taken into account (*p* < .05); women in the PVD group had also experienced a larger number of bladder/urinary tract infections compared to the control group, which showed a trend toward significance (*p* = .07).
which showed a trend towards significance, $t (19.9) = -1.91, p = .07, d = 0.72$. There was a significant difference in the number of yeast infections experienced by each group, $t (28) = -2.12, p = .043, d = 0.80$. Women in the PVD group had experienced significantly more yeast infections ($M = 1.60, SD = 1.92$) than women in the control group ($M = 0.47, SD = 0.64$).

In addition, one PVD participant was diagnosed with interstitial cystitis (a chronic bladder condition), another had suffered from an unspecified vaginal infection, and one control participant reported several abnormal cervical Papanicolaou tests (e.g., Pap smear). Two participants had undergone gynecological interventions in their lifetime: an abortion (PVD group) and abscess removal (control group).

**Medical/Psychiatric History**

The following chronic conditions were reported by the current sample: (a) migraine headaches (PVD = 8, control = 2); (b) chronic neck/back pain (PVD = 2); (c) irritable bowel syndrome (control = 1); (d) interstitial cystitis (PVD = 1); and (e) osteoarthritis (PVD = 1).

Two participants in the PVD group had been diagnosed with a mood disorder (depression and bipolar disorder) and were taking medication (Selective Serotonin Reuptake Inhibitor [SSRI], and an SSRI and anticonvulsant combination, respectively). A third PVD participant was taking a low-dose antidepressant (SSRI class) for anxiety. Given that neither the condition nor the medication(s) was reported to interfere with sexual function or changed the intensity/quality of their vulvar pain, these women met
inclusion criteria for the study. None of the control participants were currently suffering from a psychiatric condition.

**PVD Vulvar Pain History and Characteristics**

PVD participants had been experiencing vulvar pain for a mean of 43.50 months or 3.62 years ($SD = 25.10$ months or 2.09 years, range = 10 – 96 months). Half of the women ($n = 8, 53.3\%$) reported that the pain had begun with their first sexual experience and/or first penetrative intercourse occasion (i.e., primary PVD).

The majority of intercourse occasions over the past six months were reported to have been painful ($M = 81.9\%$, $SD = 13.90$, range = 60 to 100\%). The average pain intensity was rated as 5.53 ($SD = 1.46$, range = 3 - 8) on a scale from 0 (*no pain at all*) to 10 (*worst pain ever felt*). Unpleasantness due to the pain was rated as 5.67 ($SD = 1.99$, range = 2 - 9), on a scale from 0 (*not unpleasant at all*) to 10 (*most unpleasant experience*). There was a significant correlation between reported intercourse pain intensity and unpleasantness ratings, $r = .71$, $p = .003$. All participants reported experiencing pain at the vaginal opening during intercourse. In addition, five women reported pain inside the vagina, one experienced pain everywhere on the vulva, and another had pain in the pelvic/abdominal region during intercourse. Situations (other than intercourse) eliciting vulvar pain are reported in Table 5.

Sixty percent of the PVD group ($n = 9$) had not consulted a health professional about their vulvar pain. Four (26.7\%) had consulted one health professional, and two women had contacted three (13.3\%). Two of the women who had sought help were referred to a specialist, and only one woman had received a diagnosis (provisional
Table 5

*Situations Eliciting Vulvar Pain in the PVD Group*

<table>
<thead>
<tr>
<th>Situation/activity</th>
<th>n (%)</th>
<th>M (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gynecological examination</td>
<td>14 (93.3)</td>
<td>5.57 (2.21)</td>
<td>3 – 10</td>
</tr>
<tr>
<td>Manual stimulation by a partner</td>
<td>10 (66.7)</td>
<td>3.70 (1.83)</td>
<td>1 – 7</td>
</tr>
<tr>
<td>Urination following intercourse</td>
<td>9 (60)</td>
<td>3.67 (1.41)</td>
<td>2 – 5</td>
</tr>
<tr>
<td>Finger insertion</td>
<td>9 (60)</td>
<td>3.33 (1.41)</td>
<td>2 – 6</td>
</tr>
<tr>
<td>Tampon insertion</td>
<td>8 (53.3)</td>
<td>3.50 (2.00)</td>
<td>1 – 7</td>
</tr>
<tr>
<td>Tampon removal</td>
<td>5 (33.3)</td>
<td>3.60 (2.07)</td>
<td>2 – 7</td>
</tr>
<tr>
<td>Friction/pressure with clothing</td>
<td>4 (26.7)</td>
<td>2.50 (1.29)</td>
<td>1 – 4</td>
</tr>
<tr>
<td>Oral stimulation by a partner</td>
<td>3 (20)</td>
<td>5.00 (2.00)</td>
<td>3 – 7</td>
</tr>
<tr>
<td>During sporting activity</td>
<td>2 (13.3)</td>
<td>3.00 (1.41)</td>
<td>2 – 4</td>
</tr>
<tr>
<td>Masturbation</td>
<td>1 (6.7)</td>
<td>6.00</td>
<td></td>
</tr>
<tr>
<td>After sitting for long periods of time</td>
<td>1 (6.7)</td>
<td>3.00</td>
<td></td>
</tr>
</tbody>
</table>

Note. Average pain intensity was rated on a scale from 0 (*no pain at all*) to 10 (*worst pain ever felt*).
diagnosis of PVD by a psychologist).

**Menstrual Cycle**

The majority of participants were tested during the luteal phase of their menstrual cycle (i.e., between days 7 to 12). Due to scheduling difficulties, one participant was tested on day 6, five on days 13 and 14, and one participant was tested on day 24. All participants tested outside of days 7 to 12, with one exception, were taking hormonal contraceptives, which suppress ovulation and thus, deviation from testing during the luteal phase is unlikely to have impacted the results. Three participants were taking a continuous form of hormonal contraceptives and could be tested at any point, as ovulation is suppressed without monthly menstrual bleeding to mimic the menstrual cycle.

**Questionnaire Measures of Psychological and Sexual Function**

Group differences on measures of psychological and sexual function were examined through MANOVA and t test analyses. Conceptually-related measures of sexual function were grouped together (six FSFI subscales, SAI total score) and analyzed with a MANOVA (the total FSFI score was not included in the MANOVA to avoid singularity). Significant results were followed up with independent samples t tests. Scores on the BDI-II and STAI Trait form were highly correlated ($r = .77, p < .001$); thus, an independent samples t test was conducted with a composite score created from these variables in order to examine group differences, rather than a MANOVA (Tabachnick &
Fidell, 2007). The composite score was created by converting BDI-II and STAI scores to standardized $z$ scores and then computing the average value for each participant.

Group differences on the PCS and overall FSFI scores were examined through $t$ test analyses. See Table 6 for a summary of descriptive statistics and significant group differences for the following measures.

**PVD Vulvar Pain Measures**

The average Pain Rating Index (PRI) on the MPQ was 29.53 ($SD = 11.93$), corresponding to the pain severity level typically seen in patients with chronic back, non-terminal cancer, and phantom limb pain (Katz & Melzack, 1999). This pain severity level is also consistent with MPQ scores in other samples of PVD women (e.g., Payne et al., 2005). The mean reported pain intensity (PPI) rating was 2.80 ($SD = 0.67$) on a scale from 1 (*mild*) to 5 (*excruciating*); this value lies between the descriptors *discomforting* and *distressing* on the scale.

The mean score on the PASS-20 was 32.93 ($SD = 12.38$), with mean subscale scores of 8.60 ($SD = 5.30$), 4.80 ($SD = 3.55$), 14.07 ($SD = 4.59$) and 5.47 ($SD = 3.66$) for escape/avoidance, fearful appraisal, cognitive anxiety and physiological anxiety, respectively. Over half of the PVD group ($n = 8$, 53.3%) had scores indicative of maladaptive pain-related anxiety regarding their vulvar pain (i.e., scores of 30 or above) (Abrams et al., 2007).

**Pain Catastrophizing Scale (PCS)**

Two control women did not report any regular pain, thus, analyses for group differences were conducted with 13 matched participants ($N = 26$). The control group
## Table 6

*Descriptive Statistics for Questionnaire Measures*

<table>
<thead>
<tr>
<th>Measure</th>
<th>n (per group)</th>
<th>Possible range</th>
<th>PVD Mean (SD)</th>
<th>PVD Range</th>
<th>Control Mean (SD)</th>
<th>Control Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>McGill Pain Questionnaire (MPQ)</td>
<td>15</td>
<td>0 – 78</td>
<td>29.53 (11.93)</td>
<td>11 – 60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain Rating Index (PRI)</td>
<td></td>
<td>0 – 100</td>
<td>32.93 (12.38)</td>
<td>12 – 56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain Intensity Rating (PPI)</td>
<td></td>
<td>0 – 5</td>
<td>2.80 (0.68)</td>
<td>1 – 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain Anxiety Symptom Scale – 20 (PASS-20)</td>
<td>15</td>
<td>0 – 20</td>
<td>8.60 (5.30)</td>
<td>0 – 18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escape/avoidance</td>
<td></td>
<td>0 – 20</td>
<td>4.80 (3.55)</td>
<td>0 – 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fearful thinking</td>
<td></td>
<td>0 – 20</td>
<td>14.07 (4.59)</td>
<td>5 – 20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive anxiety</td>
<td></td>
<td>0 – 20</td>
<td>5.47 (3.66)</td>
<td>0 – 11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiological anxiety</td>
<td></td>
<td>0 – 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measure</td>
<td>PVD</td>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>----------------------</td>
<td>----------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$n$</td>
<td>Possible range</td>
<td>M (SD)</td>
<td>Range</td>
<td>M (SD)</td>
<td>Range</td>
</tr>
<tr>
<td>Pain Catastrophizing Scale (PCS)</td>
<td>13</td>
<td>(per group)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vulvar pain vs. worst non-vulvar pain</td>
<td>0 – 52</td>
<td>16.23 (9.43)*</td>
<td>3 – 35</td>
<td>9.31 (7.13)</td>
<td>1 – 29</td>
<td></td>
</tr>
<tr>
<td>Worst non-vulvar pain vs. worst non-vulvar pain</td>
<td>0 – 52</td>
<td>19.23 (8.80)**</td>
<td>0 – 33</td>
<td>9.31 (7.13)</td>
<td>1 – 29</td>
<td></td>
</tr>
<tr>
<td>Female Sexual Function Index (FSFI)</td>
<td>14</td>
<td>2 – 36</td>
<td>24.68 (3.25)**</td>
<td>18.9 – 31</td>
<td>30.45 (4.14)</td>
<td>23 – 35.7</td>
</tr>
<tr>
<td>Desire</td>
<td>1.2 – 6</td>
<td>4.20 (0.91)</td>
<td>3 – 5.4</td>
<td>4.50 (0.87)</td>
<td>3 – 6</td>
<td></td>
</tr>
<tr>
<td>Arousal</td>
<td>0 – 6</td>
<td>4.69 (0.81)*</td>
<td>3.3 – 5.7</td>
<td>5.38 (0.67)</td>
<td>3.9 – 6</td>
<td></td>
</tr>
<tr>
<td>Lubrication</td>
<td>0 – 6</td>
<td>4.41 (1.15)*</td>
<td>2.1 – 6</td>
<td>5.40 (0.69)</td>
<td>3.9 – 6</td>
<td></td>
</tr>
<tr>
<td>Orgasm</td>
<td>0 – 6</td>
<td>3.89 (1.63)</td>
<td>1.6 – 6</td>
<td>4.43 (1.62)</td>
<td>1.6 – 6</td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>0.8 – 6</td>
<td>4.80 (0.83)</td>
<td>3.6 – 6</td>
<td>5.14 (1.13)</td>
<td>2.8 – 6</td>
<td></td>
</tr>
<tr>
<td>Measure</td>
<td>n</td>
<td>Possible range</td>
<td>PVD</td>
<td>Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------</td>
<td>----------------</td>
<td>------------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(per group)</td>
<td>M (SD)</td>
<td>Range</td>
<td>M (SD)</td>
<td>Range</td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>0 – 6</td>
<td>2.69 (1.02)**</td>
<td>1.2 – 4.4</td>
<td>5.60 (0.59)</td>
<td>4.4 – 6</td>
<td></td>
</tr>
<tr>
<td>Sexual Arousability Inventory (SAI)</td>
<td>14</td>
<td>-28 – 140</td>
<td>83.07 (19.11)</td>
<td>37 – 121</td>
<td>94.57 (23.86)</td>
<td>63 – 131</td>
</tr>
<tr>
<td>Standardized composite score</td>
<td>15</td>
<td>0.45 (1.04)**</td>
<td>-1.04 – 0.45 (0.58)</td>
<td>-1.18 – 2.67</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td>Beck Depression Inventory - II (BDI-II)</td>
<td>15</td>
<td>0 – 63</td>
<td>12.20 (8.49)</td>
<td>0 – 32</td>
<td>5.87 (4.41)</td>
<td>1 – 17</td>
</tr>
<tr>
<td>State-Trait Anxiety Inventory</td>
<td>15</td>
<td>20 – 80</td>
<td>41.67 (11.17)</td>
<td>26 – 67</td>
<td>32.13 (6.90)</td>
<td>21 – 43</td>
</tr>
</tbody>
</table>

(StAI; Trait form)

*Note. The control group did not complete the MPQ and PASS-20.*

*p < .05 **p < .01 ***p < .001
distribution was leptokurtic (i.e., significant positive kurtosis) and a square root transformation was applied. This transformation normalized the control score distribution, but resulted in significant negative skewness for the PVD distribution; as a result, the untransformed data were analyzed.

PCS total scores were examined in three ways: (a) control scores for worst regular pain versus PVD scores for worst regular (non-vulvar) pain, (b) control scores for worst regular pain versus PVD scores for vulvar pain, and (c) PVD scores for worst regular pain versus PVD scores for vulvar pain. Both t tests comparing PVD and control group PCS scores were significant: \( t(24) = -3.16, p = .004, d = 1.29 \), and \( t(24) = -2.11, p = .045, d = 0.86 \), respectively. Therefore, the PVD group had significantly higher catastrophizing scores when rating their worst regularly experienced non-vulvar pain (\( M = 19.23, SD = 8.80 \)), and vulvar pain (\( M = 16.23, SD = 9.43 \)), in comparison to control women’s ratings of their worst regularly experienced pain (\( M = 9.31, SD = 7.13 \)). There was no significant difference in PVD ratings of their vulvar pain (\( M = 18.00, SD = 9.91 \), range: 0 – 33) in comparison to their worst regularly experienced pain (\( M = 20.07, SD = 8.45 \), range: 3 – 35), \( t(14) = 0.64, p = .531, d = 0.16 \).

The total scores for two PVD participants were above the clinical cutoff of 30 when rating their worst regular pain, and another two PVD participants had significantly relevant levels of catastrophizing when rating their vulvar pain. No control scores were above the clinical guidelines provided by Sullivan et al. (2004).

Sexual Function
One control participant had not engaged in sexual activity during the past month, thus, MANOVA and $t$ test analyses were based on 14 matched participants ($N = 28$). Total FSFI scores were significantly lower in the PVD group ($M = 24.68, SD = 3.25$) compared to the control group ($M = 30.45, SD = 4.14$), $t(26) = 4.11, p < .001, d = 1.61$. Thus, women with PVD reported significantly lower overall sexual function than the control group. Twenty percent of the control group ($n = 3$) and 73.3% of the PVD group ($n = 11$) had scores indicative of sexual dysfunction (i.e., below the cutoff of 26.55).

A one-way between-subjects MANOVA was performed on seven dependent variables related to sexual function (FSFI subscale scores for Desire, Arousal, Lubrication, Orgasm, Satisfaction, Pain, and total SAI scores) to examine group differences; correlations between dependent variables are depicted in Table 7. The combined dependent variables were significantly affected by group, according to Wilks’ criterion, $F(7, 20) = 13.23, p < .001, \eta^2 = .822$.

Follow-up $t$ tests analyses revealed that there were significant group differences on the Arousal, $t(26) = 2.44, p = .022, d = 0.96$, Lubrication, $t(26) = 2.74, p = .011, d = 1.08$, and Pain, $t(20.74) = 9.25, p < .001, d = 3.63$, subscales of the FSFI. A correction was applied to the Pain subscale $t$ test to account for unequal variances between the groups, as indicated by Levene’s test for homogeneity of variance, $F(1, 26) = 6.01, p < .05$. Therefore, the PVD group reported significantly less arousal and lubrication, and significantly more pain than the control group. There were no significant differences on the following subscales: Desire, $t(26) = 0.89, p = .382, d = 0.35$, Orgasm, $t(26) = 0.89, p = .384, d = 0.35$, or Sexual Satisfaction, $t(26) = .518, p = .609, d = 0.20$. There were
Table 7

*Correlations Between Dependent Variables for MANOVA Examining Group Differences in Sexual Function

<table>
<thead>
<tr>
<th>Measure</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. FSFI Desire</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. FSFI Arousal</td>
<td>.35</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. FSFI Lubrication</td>
<td>.22</td>
<td>.68***</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. FSFI Orgasm</td>
<td>.45*</td>
<td>.55**</td>
<td>.25</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. FSFI Satisfaction</td>
<td>.28</td>
<td>.26</td>
<td>.32</td>
<td>.63***</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. FSFI Pain</td>
<td>.32</td>
<td>.54**</td>
<td>.62***</td>
<td>.37*</td>
<td>.13</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>7. SAI Total</td>
<td>.63***</td>
<td>.32</td>
<td>.19</td>
<td>.17</td>
<td>.25</td>
<td>.23</td>
<td>-</td>
</tr>
</tbody>
</table>

*Note.* All values are reported as Pearson product-moment correlations, \( r \).

FSFI = Female Sexual Function Index.

*\( p < .05 \) ** \( p < .01 \) *** \( p < .001 \)
also no significant differences in total SAI scores, \( t(26) = 1.41, p = .171, d = 0.55 \), between the groups. Thus, self-reported arousability in a variety of sexual situations did not significantly differ between women with PVD and controls.

**Psychological Function**

Given the high correlation between BDI-II and STAI Trait scores, a standardized composite score was created for each participant, as described above. There was a significant difference between the groups on the composite variable, \( t(28) = -2.91, p = .007, d = 1.10 \). Thus, women with PVD showed significantly greater internalizing symptoms (anxiety, depression) than the control group. See Table 6 for composite mean scores, and BDI-II and STAI descriptive statistics for the current sample. Based on BDI-II clinical cut-off scores (Beck et al., 1996), (a) one control and four PVD participants met criteria for mild depression, (b) one PVD participant met criteria for moderate depression, and (c) one PVD participant met criteria for severe depression.

**Self-Reported Difficulty With Arousal.**

Difficulty with arousal during intercourse was also examined. There was a significant difference in the number of participants reporting arousal difficulties (yes/no), \( \chi^2 = 3.97, (1, N = 30), p = .046 \). Thus, a significantly larger number of women in the PVD group \( (n = 7) \) experienced difficulty with arousal as compared to the control group \( (n = 2) \). The reported magnitude of difficulty was an average of 2 out of 10 \( (SD = 1.41, \text{range} = 1 – 3) \) for the control group, and 5 out of 10 \( (SD = 2.31, \text{range} = 2 – 9) \) for the PVD group. Group differences in arousal difficulty, with those stating they had no arousal problems rated as a 0 on the scale from 0 (**no difficulty**) to 10 (**most difficulty**
imaginable), were investigated. The distribution was positively skewed and no transformation could normalize the control group distribution. Analyses were conducted on the transformed data closest to normality, following an inverse transformation; however, means and standard deviations are reported from the original distribution as the results did not differ. A correction was also applied to account for unequal variances between the groups as indicated by Levene’s test for homogeneity of variance, $F(1, 28) = 31.60, p < .001$. There was a significant difference between the groups, $t(21.39) = 2.39$, $p = .026$, $d = 0.90$, whereby the PVD group ($M = 2.33, SD = 2.99$) reported significantly more difficulty with arousal during intercourse than the control group ($M = 0.27, SD = 0.80$).

Six out of the 7 women in the PVD group (85.7%) implicated vulvar pain (i.e., experiencing pain or its anticipation) in their response to an open-ended question about why they believe they have arousal difficulties. The two controls and remaining pain participant associated their difficulty with subjective arousal, anorgasmia (i.e., difficulty achieving orgasm), and relationship difficulties, respectively.

**Physiological Arousal**

*Group Differences in Baseline Blood Flow*

To determine whether there was a significant difference between the groups’ mean baseline blood flow levels, an independent samples $t$ test was conducted. The result was non-significant, $t(28) = -0.73, p = .470, d = 0.28$, indicating that the PVD ($M =
197.36, SD = 36.93) and control groups (M = 185.29, SD = 52.07) did not differ in the amount of vulvar blood flow at resting state.

**Group Differences in Physiological Arousal**

A between-subjects analysis of covariance (ANCOVA) was performed on mean blood flow during the erotic film to examine potential differences in physiological arousal between the PVD and control groups. Mean baseline blood flow served as a covariate in this analysis. After covariate adjustment, there was a significant effect of group, $F (1, 27) = 7.71, p = .01, \eta^2 = .22$. The adjusted means indicated that women with PVD (M = 292.71, SE = 20.80) had significantly lower blood flow levels during the erotic film in comparison to the control group (M = 374.81, SE = 20.80) when controlling for baseline blood flow levels.

A trend toward significance was found when the analysis was conducted with difference scores, corresponding to the change in blood flow from baseline to the erotic condition, as the dependent variable. Levene’s test for homogeneity of variances was significant, $F (1, 28) = 4.52, p < .05$; thus, a correction was applied to account for unequal variances between the groups. The $t$ test result showed a trend toward significance, $t (21.61) = 1.792, p = .087, d = 0.68$, whereby women in the PVD group (M = 109.66, SD = 67.68) showed less of an increase in blood flow during exposure to an erotic film in comparison to the control group (M = 175.22, SD = 124.45).
Subjective Arousal

Group differences in subjective arousal were examined with: (a) participant ratings on the post-film questionnaire, and (b) the average rating of arousal throughout the film. Following LDI testing, participants rated how sexually aroused they became during the film on an 11-point Likert scale ranging from 0 (not at all aroused) to 10 (most aroused I’ve ever been). There was no significant difference between the groups, $t(28) = -0.58, p = .563, d = 0.22$. Therefore, retrospective, discrete ratings of subjective arousal in response to the erotic film did not significantly differ between women in the PVD group ($M = 4.33, SD = 2.02$) and women in the control group ($M = 3.93, SD = 1.71$). There was also no significant difference between the groups when average ratings of arousal collected during the film were compared, $t(28) = -1.62, p = .115, d = 0.61$. Thus, the PVD ($M = 3.27, SD = 1.74$) and control ($M = 2.41, SD = 1.09$) groups reported comparable overall levels of subjective arousal while watching the film. The correlation between the two measures of subjective arousal was $r = .66, p = .008$, for the control group, and $r = .93, p < .001$, for the PVD group.

Relationship Between Physiological and Subjective Arousal

Pearson product-moment correlation analyses were utilized to determine the strength of the association between physiological and subjective arousal for each group (see Table 8). Participant difference scores, representing the change in blood flow from the baseline to the erotic condition, were used as the measure of physiological arousal, while subjective arousal was assessed in two ways: a) participant ratings on the post-film
Table 8

Correlations Between Physiological and Subjective Arousal

<table>
<thead>
<tr>
<th>Group</th>
<th>Correlations with difference scores</th>
<th>Correlations with average blood flow levels during erotic film</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post-film arousal</td>
<td>Post-film arousal</td>
</tr>
<tr>
<td></td>
<td>Average arousal during the film</td>
<td>Average arousal during the film</td>
</tr>
<tr>
<td>Entire Sample (N = 30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVD (n = 15)</td>
<td>.20</td>
<td>.22</td>
</tr>
<tr>
<td>Control (n = 15)</td>
<td>.25</td>
<td>.26</td>
</tr>
<tr>
<td>Overall</td>
<td>.17</td>
<td>.20</td>
</tr>
</tbody>
</table>

With Exclusion (N = 24)

<table>
<thead>
<tr>
<th>Group</th>
<th>Correlations with difference scores</th>
<th>Correlations with average blood flow levels during erotic film</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Post-film arousal</td>
<td>Post-film arousal</td>
</tr>
<tr>
<td></td>
<td>Average arousal during the film</td>
<td>Average arousal during the film</td>
</tr>
<tr>
<td>PVD (n = 11)</td>
<td>.12</td>
<td>.28</td>
</tr>
<tr>
<td>Control (n = 13)</td>
<td>.40</td>
<td>.43</td>
</tr>
<tr>
<td>Overall</td>
<td>.27</td>
<td>.34</td>
</tr>
</tbody>
</table>

Note. All values are reported as Pearson product-moment correlations, \( r \).

Difference scores represent the change in blood flow levels from the baseline to the erotic film.
questionnaire regarding how sexually aroused they became during the film, from 0 (*not at all aroused*) to 10 (*the most aroused I’ve ever been*), and b) the average rating of arousal reported during the film, assessed on the same 11-point Likert scale. None of the correlations were significant when all participants were taken into account. The analyses were repeated using average blood flow levels during the erotic film as the measure of physiological arousal, and the results were similar to the correlations with the difference scores (see Table 8). Figures 4 and 5 depict the average change in physiological arousal (i.e., difference scores) in comparison to subjective arousal, as measured by post-film ratings (Figure 4) and the continuous measure of arousal during the film (Figure 5).

In addition, within-subject correlations were calculated between the average blood flow levels for each of the five scans during the erotic film and the average rating of arousal reported during each scan. Therefore, a correlation depicting the strength of the relationship between physiological and subjective arousal was produced for each participant. As illustrated in Table 9, there was a great deal of variability in the concordance between physiological and subjective arousal ratings across participants. Correlations ranged from -.90 to .98 for the PVD group, and .12 to .99 for the control group. Nevertheless, the majority of participants had correlations of .3 and above across groups. Between-subject correlation analyses were thus repeated with six participants excluded based on the within-subject concordance between physiological and subjective arousal: participants with negative correlations or positive correlations below .3 were not included in the analyses. As illustrated in Table 8, the strength of the relationship between physiological and subjective arousal increased in the majority of cases.
Figure 4. Mean change in blood flow levels during the erotic film compared to average ratings of subjective arousal post-film.
Figure 5. Mean change in blood flow levels during the erotic film compared to the average rating of subjective arousal during the film.
Table 9

Within-Subject Correlations Between Blood Flow During the Erotic Film and Continuous Ratings of Arousal

<table>
<thead>
<tr>
<th>Group</th>
<th>r</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVD</td>
<td>-.90 -.69 -.05 -.05 .35 .39 .63 .70 .79 .87 .94 .96 .98 .98</td>
</tr>
<tr>
<td>CTL</td>
<td>.12 .27 .48 .51 .55 .79 .79 .85 .87 .92 .92 .94 .94 .94 .99</td>
</tr>
</tbody>
</table>

Note. A correlation could not be produced for one PVD participant, as her rating of subjective arousal was zero for the entire film. CTL = Control

Relationship Between Physiological Arousal and Pain Sensitivity

Group differences in pain thresholds and pain intensity ratings before and after the erotic film were examined (see Table 10 for descriptive statistics). Pain threshold data were transformed prior to analysis to normalize the distributions; both results were significant, thus, the untransformed data have been reported for ease of interpretation. A correction was also applied to account for unequal variances between the groups, as indicated by Levene’s test for homogeneity of variance for pain thresholds before, \( F(1, 28) = 29.98, p < .001 \), and after, \( F(1, 28) = 16.11, p < .01 \), the erotic film. Both results were significant, indicating that women with PVD had lower pain thresholds (i.e., they were more sensitive to pain) before, \( t(14.21) = 3.79, p = .002, d = 1.49 \), and after the erotic film, \( t(14.57) = 3.72, p = .002, d = 1.41 \), as compared to women in the control group.
Group variances were also unequal for pain intensity ratings, as indicated by Levene’s test for homogeneity of variance for pain intensity before, $F(1, 28) = 13.78, p = .001$, and after, $F(1, 28) = 4.30, p < .05$, the erotic film; a correction was therefore applied to each $t$ test. Women with PVD had significantly higher pain intensity ratings at pain threshold than the control group before the erotic film, $t(22.56) = -2.47, p = .021, d = 0.93$; however, there was no difference between the groups’ pain intensity ratings following the erotic film, $t(22.58) = -1.33, p = .197, d = 0.50$.

Table 10

Pain Sensitivity Before and After Presentation of the Erotic Film

<table>
<thead>
<tr>
<th>Group</th>
<th>Pain Threshold (g)</th>
<th>Pain Intensity</th>
<th>Pain Threshold (g)</th>
<th>Pain Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$ (SD)</td>
<td>$M$ (SD)</td>
<td>$M$ (SD)</td>
<td>$M$ (SD)</td>
</tr>
<tr>
<td>PVD</td>
<td>18.33*** (10.46)</td>
<td>2.20* (1.08)</td>
<td>21.67*** (15.77)</td>
<td>2.43 (1.43)</td>
</tr>
<tr>
<td>Control</td>
<td>135.67 (119.49)</td>
<td>1.40 (0.63)</td>
<td>128.67 (110.38)</td>
<td>1.87 (0.83)</td>
</tr>
</tbody>
</table>

* $p < .05$ **$p < .001$**

Note. Pain intensity was rated on a 0 (no pain at all) to 10 (worst pain ever felt) scale.

The impact of physiological arousal on pain thresholds was examined in two ways. A paired samples $t$ test was conducted for each group to determine whether pain thresholds significantly differed following exposure to the erotic film. The results were
non-significant for the PVD, $t(14) = -1.01, p = .290, d = 0.21$, and control groups, $t(14) = .349, p = .733, d = 0.06$. Therefore, pain thresholds did not significantly change from pre- to post- erotic film for either group, as depicted in Figure 6.

These analyses, however, do not take into account variations in physiological arousal across the sample; differential levels of arousal may impact pain thresholds in different ways. Therefore, Pearson product-moment correlations were computed to examine the relationship between change in physiological arousal (as measured by the difference score from baseline to the erotic condition) and the change in pain thresholds from pre- to post-erotic film (representing the subtraction of each participant’s post-film pain threshold from her pre-film pain threshold). For the PVD group, $r(13) = -.11, p = .68$, and for the control group, $r(13) = .39, p = .15$. The results were similar when average blood flow levels during the erotic film were used as the measure of physiological arousal; for the PVD group, $r(13) = -.20, p = .48$, and for the control group, $r(13) = .38, p = .18$.

*Psychological/Sexual Function as Predictors of Physiological Arousal in Women with PVD*

Several linear regression analyses were conducted to examine psychological and sexual predictors of physiological arousal in the PVD group. Physiological arousal was
Figure 6. Change in pain thresholds, before and after exposure to an erotic film, in grams.
assessed through participant difference scores, representing the change in blood flow from baseline to the erotic film. Analyses were also conducted using the average blood flow levels during the erotic film as the dependent variable, however, all $r$ squared values were comparable or smaller in size when compared to analyses using the difference scores.

**Sexual Function**

Self-reported intercourse frequency within the past month, sexual arousability (SAI total score) and overall sexual function (FSFI total score) were each examined as predictors of physiological arousal, as measured by the change in blood flow from the baseline to the erotic film (difference score). Linear regression with intercourse frequency as the independent variable showed a trend toward significance, $b = -3.88$, $\beta = -.49$, $p = .064$, $R^2 = .24$. Therefore, women with lower monthly intercourse frequency had a higher increase in blood flow during the erotic film. Linear regression models with SAI and FSFI total scores as predictors of change in blood flow were both non-significant: $b = -1.21$, $\beta = -.37$, $p = .170$, $R^2 = .14$, and $b = -2.86$, $\beta = -.14$, $p = .614$, $R^2 = .02$, respectively.

**Pain Measures**

Total scores on the PASS-20, MPQ and PCS for vulvar pain were individually examined as predictors of physiological arousal. Neither the PASS-20, $b = 2.10$, $\beta = .385$, $p = .157$, $R^2 = .15$, nor the MPQ total score, $b = 1.96$, $\beta = .346$, $p = .206$, $R^2 = .12$, significantly predicted arousal in the PVD group. Total scores on the PCS for vulvar pain, however, significantly predicted the change in physiological arousal from baseline to the
erotic film, $b = 4.39$, $\beta = .642$, $p = .01$, $R^2 = .41$. Therefore, women with higher scores on the PCS showed a higher increase in blood flow during the erotic film.
Chapter 5
Discussion

The main findings of the present study were as follows: (a) Women with PVD and controls had similar blood flow levels in the external genitals at resting state; (b) The PVD group had significantly lower levels of physiological arousal than controls (as measured by average blood flow during the erotic film, controlling for baseline blood flow levels), however, subjective arousal levels (retrospective and continuous ratings) did not significantly differ between the groups; (c) Pain thresholds did not significantly change in either group following exposure to the erotic film; and (d) Women with PVD had significantly lower sexual and psychological function in comparison to the control group.

Vulvar Blood Flow at Resting State

There was no difference in baseline blood flow levels between women with and without PVD. This finding is contrary to what was hypothesized; it was predicted that women with PVD would have higher vulvar blood flow levels than the control group at baseline, paralleling the findings of Bohm-Starke, Hilliges, et al. (2001), who found increased baseline blood flow in the posterior vestibules of women with PVD versus non-affected women. The present study, however, imaged the vulvar region (e.g., labia majora and minora), not the vestibular area. Imaging the vestibular area of participants in the current study would have required manual separation of the labia majora and minora, which could have affected blood flow due to pressure and stretching of the surrounding tissues.
anatomy. Thus, women with PVD may have had higher blood flow levels in the posterior vestibule as compared to control women, but this hypothesis could not be directly addressed in the current study without confounding the blood flow data.

Bohm-Starke, Hilliges, et al. (2001) posited that PVD may develop following a triggering event (e.g., recurrent yeast infections) which produces inflammation to the vestibular area, resulting in neurophysiological changes that produce ongoing sensitization, even after the initial inflammation response has subsided. Higher lifetime frequency of yeast infections, for instance, has been associated with PVD in the research literature (e.g., Sarma et al., 1999), as well as in the present study. Continued irritation of the vestibular mucosa could result in vestibular hypersensitivity and increased blood flow to the area, which would serve to maintain the symptoms of PVD (see Bohm-Starke, 2001 for a review). This theory has been supported by research indicating that there is little inflammatory activity at the vestibules of women with PVD (e.g., inflammation markers such as cyclooxygenase 2 and inducible nitric oxide synthase) (Bohm-Starke, Falconer, Rylander, & Hilliges, 2001), despite the presence of increased innervation and sensitivity at the vestibule as compared to controls (Bohm-Starke, 2001; Bohm-Starke, Hilliges, Falconer, & Rylander, 1998). This framework may help explain the current findings: if increased blood flow to an area is related to hypersensitivity to pain in that same area, one would not expect a general increase in blood flow to the entire vulvar region in women with PVD (as measured in the current study), as this condition is defined by pain limited to the vestibule (Friedrich, 1987).
Physiological and Subjective Arousal

In response to an erotic film, women with PVD exhibited significantly lower blood flow levels than controls; subjective reports of arousal, however, did not differ between the groups. These results are contrary to the expected pattern: it was hypothesized that there would be no differences in physiological arousal between the groups and that the PVD group would report significantly lower subjective arousal ratings than the control group. These hypotheses were based on the findings of Brauer et al. (2006) and Payne et al. (2007). Past research suggested that women with PVD are capable of becoming as physiologically aroused as controls in response to an erotic film; however, in the current study, the physiological arousal response of the PVD group was not as large as that of the control group. Given the groups’ similar ratings of subjective arousal both during and following the film, these findings suggest that physiological arousal processes may be impaired in women with PVD.

The anatomical region in which physiological arousal is assessed may aid in explaining the discrepant findings between the current study and previous research. Brauer et al. (2006) measured internal vaginal blood flow using the photoplethysmograph, while Payne et al. (2007) and the current LDI study assessed blood flow as a measure of arousal in the external genitals. Given the superficial nature of the pain in dyspareunia, one could argue that differences in blood flow near the vaginal opening would be most informative in investigating physiological arousal in PVD; examining blood flow several inches inside the vaginal canal may not be accurate enough. On the other hand, the measurement of physiological arousal with the labial
thermistor clip may be too specific to uncover group differences in arousal within the external genitals. Payne et al. (2007) assessed temperature over the left labia minora with a small-diameter (4.8 mm) thermistor; thus, temperature could only be assessed in a limited area. In addition, temperature is an indirect measure physiological arousal, which is assumed to be associated with increased blood flow to the genitals. In contrast, the current study measured blood flow directly over the entire vulvar region. A recent study using contrast enhanced magnetic resonance imaging (MRI) found significant enhancement of the external genitals (i.e., labia minora, clitoris and vestibular bulbs) during female sexual arousal (Suh, et al., 2004); the authors concluded that the external genitals are predominantly where enhancement takes place during sexual arousal, due to the increase in blood flow to the external genitals. Thus, LDI measurement may provide a more complete picture of physiological arousal in the external genitals compared to other instruments, which may account for why a difference in physiological arousal was found between women with and without PVD in this study.

The group differences in blood flow found in the current study are, however, not unique in the literature. Wouda et al. (1998) discovered an interaction between group membership and the depicted sexual act between women experiencing dyspareunia and controls. Following a scene depicting oral sexual stimulation, physiological arousal levels (as measured by the vaginal photoplethysmograph) decreased in the dyspareunia group but increased in the control group during exposure to a scene depicting intercourse; there were no group differences in subjective arousal following the intercourse segment. In addition, there were no group differences in physiological arousal levels before exposure
to the intercourse segment. These findings were interpreted by the authors as indicating that the dyspareunia group had an unconscious aversive reaction to the intercourse segment, which prevented any further physiological response to the film (Wouda et al., 1998). This interaction may shed light on the group differences in physiological arousal found in the current study. Although physiological arousal levels in response to the erotic film were not as high in the PVD group in comparison to the control group, there was nevertheless an increase in blood flow from the baseline to the erotic condition in women with PVD. The blood flow data and a visual examination of the LDI scans (see Figure 7 for examples) clearly illustrate that almost all participants showed an observable response to the erotic film, regardless of group membership; these findings further validate the sensitivity of the LDI as a measure of female physiological arousal. Only one PVD participant showed negligible changes in blood flow from the baseline to the erotic film, and could be characterized as a non-responder (Kukkonen et al., 2009).

Therefore, it is possible that group differences in physiological arousal are not driven by a lack of response in the PVD group but may instead be indicative of an attenuated response, similar to what was suggested by Wouda et al. (1998). Physiological arousal in response to a visual sexual stimulus in women with PVD may have a ceiling effect; the maximal potential level of blood flow to the external genitals in affected women may be below the potential level of physiological arousal in non-affected women. Palace and Gorzalka (1990) similarly accounted for group differences in physiological arousal between women with and without sexual dysfunction (attributed to psychological causes) who had similar levels of subjective arousal in response to an erotic stimulus.
Figure 7. LDI baseline and erotic scans for: (a) a control participant, (b) a PVD participant, and (c) the ‘non-responder’ in the PVD group.
They hypothesized that individual differences in the physiological capacity for arousal may have been responsible for lower genital responsiveness in the sexually dysfunctional group; women with sexual problems may have lower response lability (Palace & Gorzalka, 1990). That differing levels of physiological arousal between the groups were perceived as equally subjectively arousing in the current study supports the idea that affected women were not consciously inhibiting their level of arousal. However, whether differences in physiological arousal were due to a conditioned aversion response to sexual intercourse as a result of the repeated vulvar pain, or were present before the condition developed, cannot be inferred.

Brauer, ter Kuile, and Laan (2008) recently examined the impact of cognitive appraisal on sexual arousal in women with and without dyspareunia. The results demonstrated that physiological arousal (as measured by vaginal photoplethysmography) and level of negative affect were modulated by whether participants were instructed that the female character in an erotic film was in pain or enjoyment during a sexual encounter. Participants who received the pain instruction had lower levels of physiological arousal (marginally significant difference) and reported a significantly higher level of negative affect following the film in comparison to those who received the sexual enjoyment instruction. There were no differences in physiological arousal between women with and without dyspareunia. Brauer et al. (2008) interpreted these findings in the context of an information-processing model of sexual arousal (e.g., Janssen, Everaerd, Spiering, & Janssen, 2000), whereby a non-sexual or emotionally negative appraisal of sexual stimuli (e.g., perceiving the female character as being in pain during sexual activity) inhibited
both physiological and subjective arousal in women who received the pain instruction before viewing the film. These findings may partially explain the results of the current study: automatic cognitive processes (e.g., activation of both sexual and threat/worry-related meanings) (Janssen et al., 2000) may have resulted in a negative appraisal of the erotic film, which attenuated the resultant physiological response in the PVD group. Appraisal of a sexual stimulus is theorized to occur simultaneously with automatic genital vasocongestion, causing a physiological response to the stimulus within seconds (Everaerd, Laan, Both, & van der Velde, 2000, as cited in Basson, 2002).

In support of this explanation, Payne et al. (2005) demonstrated that women with PVD display a selective attentional bias towards pain information on an emotional Stroop task compared to non-affected women. In addition, Thaler, Meana, and Lanti (2009) found that pain stimuli were more salient (e.g., elicited more false memories) than sexual stimuli in women with dyspareunia as compared to women without pain during intercourse. They hypothesized that the stronger semantic networks for pain in women with PVD may be due to the repeated activation of these networks in their previous experiences. These networks may produce hypervigilance for pain cues (i.e., pain networks are more easily triggered) and higher levels of catastrophizing. This hypervigilance towards pain stimuli may impact sexual function, specifically arousal. Payne et al. (2005) suggest that pain hypervigilance may lead to increased attention directed toward pain processing during activities eliciting vulvar pain (i.e., sexual intercourse), which may result in decreased attention directed towards the processing of sexually arousing stimuli.
Distraction from sexually arousing stimuli has been shown to decrease sexual arousal in both women with and without sexual dysfunction (Elliot & O’Donohue, 1997; Salemink & van Lankveld, 2006). This distraction coupled with increased awareness of the pain may decrease physiological arousal as well as further exacerbate the pain of PVD (Payne et al. 2005; Thaler et al., 2009). This attentional bias may work in conjunction with psychological factors such as pain catastrophizing and pain-related anxiety – shown to be elevated in women with PVD (e.g., Payne et al., 2007; Pukall et al., 2002) – during sexual intercourse to decrease physiological arousal. This explanation is supported by the findings of Brauer et al. (2007), which demonstrated that the induction of pain-related fear negatively affects physiological arousal in women with and without vulvar pain. The authors also found that across groups, women reported more negative affect, less positive affect, and tended to report less genital sensations; thus, subjective arousal was additionally affected.

According to Janssen et al.’s (2000) information processing model of sexual arousal, however, subjective arousal levels would also be expected to be significantly lower in the PVD group in comparison to the control group if the erotic stimulus was negatively appraised, such as in Brauer et al.’s (2007) experimental manipulation. This corollary was not met in the present study. There are several possible explanations as to why there were only group differences in physiological arousal. Laan et al. (1995) have suggested that women may use cues other than peripheral feedback from the genitals to assess their level of subjective arousal (e.g., affective state, personal characteristics, the setting in which arousal is taking place). If women with PVD utilized external cues in
evaluating their level of subjective arousal, the laboratory setting may have reduced feelings of threat and worry as actual genital pain during sexual stimulation was not part of the protocol. The situation may therefore have been judged as more subjectively arousing than a sexual experience with a partner (which would likely entail pain), resulting in a similar level of physiological arousal. Thus, the testing environment may have produced ratings of subjective arousal that were comparable to those of the control group despite group differences in blood flow levels during the erotic film.

Based on the framework of Laan et al. (1995), ter Kuile, Vigeveno, and Laan (2007) similarly suggested that emotional and situational cues may take precedence over genital sensations in evaluating subjective arousal. They found that women with high levels of chronic daily stress exhibited lower physiological arousal in comparison to women with lower levels of stress; however, subjective arousal levels were comparable between the groups (ter Kuile et al., 2007). It can be argued that women with a chronic pain condition endure higher, long-term stress levels than women who do not have such a condition. Indeed, PVD has been linked to decreased quality of life (Arnold et al., 2006), which may be associated with feelings of helplessness over controlling the pain (Smith et al., 2009). In support of the association between stress and reduced sexual function, Bodenmann, Ledermann, Blattner, and Galluzzo (2006) found a significant relationship between sexual problems and stress after controlling for relationship quality and psychological symptoms. Ter Kuile et al. (2007) also found a trend associating higher chronic daily stress with more sexual complaints; they hypothesized that this trend was an underestimation of the relationship between stress and sexual difficulties, as only
women without sexual problems participated in the study. Thus, psychological factors such as stress may account for the desynchrony between physiological and subjective arousal in the current study’s PVD group.

In contrast to the conclusions drawn by Laan et al. (1995), recent research suggests that women use cues from the external genitals in evaluating their level of sexual arousal. This assertion is based on studies involving the use of instruments measuring physiological arousal in the external genitals. Results demonstrate a strong relationship between physiological and subjective arousal (Kukkonen et al., 2007; Kukkonen et al., 2009; Payne et al., 2007; Waxman & Pukall, 2009). Therefore, although women with PVD may use feedback from their external genitals to evaluate their level of subjective arousal, a ceiling effect in genital responsiveness to sexual stimuli (i.e., their maximal response is lower than that of non-affected women) may have shifted how subjective arousal levels correspond to different levels of physiological arousal. The evaluation of subjective arousal in women with this condition may be based on different anchors than in women without PVD, whereby a lower genital response is judged as more subjectively arousing, as this level of genital responsiveness corresponds to a subjective arousal level associated with more genital responsiveness in non-affected women. To clarify, if physiological and subjective arousal are assessed on 11-point Likert scales, from 0 (no physiological/subjective arousal) to 10 (most physiological/subjective arousal), and subjective arousal is evaluated based on external genital sensations, maximal physiological response in women with PVD (e.g., a rating of 10) would correspond to a lower genital response in non-affected women (e.g., a rating of 7);
however, if both groups reach their maximum response level (e.g., ratings of 10) and rate their subjective arousal level as maximal (e.g., ratings of 10), there would be no difference in subjective arousal between the groups despite a lower genital response level in the PVD group. This theory is based on speculation at this point, as the current study was the first to measure sexual arousal in women with PVD using the LDI. Future studies will clarify the pattern of results.

Lastly, it is possible that women with PVD were also less subjectively aroused in response to the film; however, due to demand characteristics, they may have compensated for a lower level of subjective arousal in their ratings. Hamilton, Rellini, and Meston (2008) found that sexually healthy women with lower scores on the arousal subscale of the FSFI had increased cortisol (i.e., a physiological stress response marker) in response to an erotic film. The authors postulated that participating in a sexual arousal study may be more anxiety-provoking for women who have experienced problems with arousal in the past, as women with increased cortisol reported being less relaxed before the film than women whose cortisol levels decreased during the film. Cortisol change, however, did not predict genital responsiveness to the film; thus, increased cortisol was not associated with a lower genital response. In the current study, there was no significant difference in how relaxed or anxious participants reported being before the film. These findings do not necessarily indicate that participants in the PVD group did not feel more anxiety or pressure to physiologically respond to the erotic film, however, as participants were not specifically asked about anxiety regarding performance demands in the testing situation.
Wincze, Albert, and Bansal (1993) found a pattern of results similar to those in the present study, whereby women with diabetes showed decreased physiological arousal compared to non-affected women. However, subjective arousal reports did not differ between the groups. The authors posited that concerns about diabetes impacting their sexual function may have led women in the diabetes group to report more subjective arousal than they actually felt. Taken in combination, the findings of Hamilton et al. (2008) and Wincze et al. (1993) may account for the pattern of results in the current study. Women in the PVD group may have experienced anxiety about becoming aroused in the laboratory setting given their self-report of decreased arousal compared to the control group. As a result of this concern, women in the PVD group may have overestimated their ratings of subjective arousal during the film.

**Relationship Between Physiological and Subjective Arousal**

In contrast to recent research that has measured physiological arousal in the external genitals (Kukkonen et al., 2007; Kukkonen et al., 2009; Payne et al., 2007), including a recent LDI study (Waxman & Pukall, 2009), correlations between physiological and subjective arousal in the present study were relatively small in size for both women with and without PVD. Strong correlations have been found between measures of physiological and subjective arousal in studies assessing physical changes in the external genitals (Kukkonen et al., 2007; Kukkonen et al., 2009; Payne et al., 2007; Waxman & Pukall, 2009). The robust association between the two aspects of sexual arousal suggests that women may be more aware of external versus internal genital
changes, as past research using vaginal photoplethysmography has tended to find discordance between measures of physiological and subjective arousal in women (see Rellini et al., 2005 for a review). Furthermore, Kukkonen et al. (2009) found higher concordance levels between temperature and subjective arousal in younger (18 to 28 year olds) versus older (30 to 45 year olds) participants. This discrepancy was postulated to be due to differences in temperature change across the lifespan, as the increase in temperature during sexual arousal was lower for the latter group. The finding of low correlations between physiological and subjective arousal in the current sample, which had a mean age of 21 years, is thus even more puzzling. Given past results with similar methodologies, the likely explanation for the present results is that there was insufficient power to detect a significant relationship between physiological and subjective arousal with the current sample. High variability in physiological arousal coupled with a relatively restricted range for measures of subjective arousal (i.e., no post-film ratings of arousal were above 7, on a scale from 0 [not at all aroused] to 10 [most sexually aroused I’ve ever been], with average group ratings of 3.93 for the control group and 4.33 for the PVD group) may thus be responsible for the lack of concordance between these measures in the current study. In addition, the majority of correlations increased when the individuals with the lowest within-subject correlations were excluded; this finding suggests that the low concordance rate when the entire sample was taken into account may be driven by this handful of participants who did not demonstrate a strong relationship between physiological and subjective measures throughout the erotic film.
One of the criticisms of analyses examining between-group concordance of physiological and subjective arousal is that continuous measures of physiological and subjective arousal are reduced to an average value (Rellini et al., 2005). Using averages does not allow one to capture changes in arousal over time, which may provide valuable information about the relationship between physiological and subjective arousal (Rellini et al., 2005). Therefore, condensing data in this manner may underestimate the relationship between these two facets of sexual arousal. Although no group inferences can be made, within-subject correlations between measures of sexual arousal are one manner in which this issue can be addressed. In the current study, within-subject correlations were produced based on the average continuous rating of arousal and blood flow levels during each scan. Interestingly, all control participants had positive correlations between measures of physiological and subjective arousal; however, four PVD participants had negative correlations (i.e., higher blood flow levels were related to lower ratings of subjective arousal). Although these analyses were based on a small number of data points and a relatively small sample, these findings may suggest that some women with PVD are less aware or attentive to physiological cues when assessing their subjective level of sexual arousal.

Intercourse orgasm consistency has been demonstrated to account for variability in within-subject correlations between physiological and subjective arousal when watching an erotic film in both premenopausal and postmenopausal women (Brody, 2007; Brody, Laan, & van Lunsen, 2003). Brody et al. (2003) found that women who had greater orgasm consistency during intercourse had higher positive correlations between
measures of physiological and subjective arousal. This finding coincides with research by Hoon and Hoon (1978) which demonstrated that women with the highest versus the lowest orgasm consistency during sexual activity are more aware of the physiological changes associated with sexual arousal. These findings may explain potential differences in variability between women with and without PVD, as some research has found that women with PVD report more difficulties with orgasm than non-affected women (e.g., Masheb, Lozano-Blanco, et al., 2004). Given the pain experienced during intercourse, among other sexual difficulties reported by the current sample (e.g., decreased arousal), orgasm consistency could potentially explain the negative relationship between blood flow levels and subjective arousal in several of the PVD participants, as well as the lower positive correlations in some participants across groups.

Response bias may also be responsible for the low concordance seen in certain participants; some women may have felt uncomfortable reporting that they were experiencing physiological arousal to the erotic film. Brody et al. (2003) did not find that socially desirable responding was related to the correlation between physiological and subjective arousal; however, this study did not specifically examine impression management, which is a distinct form of socially desirable responding, defined as faking or lying (Paulhus, 1998). Future studies should examine the role of response bias in women with and without sexual dysfunction, specifically, its impact on ratings of subjective arousal, and thus, its contribution to the relationship between physiological and subjective arousal in a laboratory setting.
Relationship Between Physiological Arousal and Pain Sensitivity

In support of the third hypothesis, women with PVD had significantly lower pain thresholds than the control group, both before and following exposure to the erotic film. These findings are consistent with the growing number of studies that have demonstrated hypersensitivity to pain at the vestibule in women with PVD (see Pukall et al., 2008 for a review). In addition, ratings of pain intensity at pain threshold were significantly higher for the PVD versus control group before the onset of the erotic film, but not afterwards. This difference in reported pain intensity before the erotic film is in contrast to Pukall et al.’s (2002) finding that reported pain intensity at pain threshold did not differ between women with and without PVD, despite significant differences in the groups’ pain thresholds. It is possible that the separation in pain intensity ratings before the film in the current study was due to group differences in anxiety surrounding the sensory testing procedure. Women with PVD may have felt more anticipatory anxiety about the impending pain stimulus (e.g., not knowing how much pain to expect, worrying that they would feel a great deal of pain) than the control group, who do not share the PVD group’s history of painful experiences at the tested area. This difference in previous experiences may have resulted in a higher perceived pain intensity at pain threshold for the PVD group during the first sensory testing session but not the second, because anxiety surrounding the testing would likely have dissipated after undergoing such testing once (e.g., knowledge that the pain experienced during sensory testing will be minor). This theory is supported by the findings of Passchier et al. (1992), who demonstrated that pain intensity ratings were significantly and positively related to subjective ratings of anxiety.
before a blood extraction procedure in both a high anxiety group (individuals diagnosed with Panic Disorder) and a sample from the general population. Thus, anxiety about experiencing pain during the first sensory testing session may have caused women in the PVD group to report higher pain intensity ratings than the control group at pain threshold.

Contrary to expected findings, there was no significant change in pain thresholds following the erotic film in either group. This result opposes the findings of Payne et al. (2007), who found that both women with and without PVD showed a decrease in pain thresholds following exposure to an erotic film. Contradictory findings have also been reported in research examining peripheral pain sensitivity in sexually healthy women. Whipple and Komisaruk (1985) found that pain thresholds during finger compression increased during vaginal stimulation, while King and Alexander (2000) found that pain thresholds during a cold pressor task decreased after listening to an erotic auditory stimulus. King and Alexander (2000) hypothesized that mild sexual arousal may increase pain sensitivity, while direct, more intense stimulation may decrease pain sensitivity. This theory could explain why no differences in pain thresholds emerged in the current study after participant exposure to visual sexual stimuli. There was great variability in physiological response to the erotic stimulus, as measured by the change in blood flow levels from the baseline to the erotic film; however, statistical analyses examining the relationship between physiological arousal and pain thresholds did not account for the strength of the physiological response along with group membership due to sample size restrictions. Therefore, it is possible that low and high responders in each group had a
differential pattern of pain sensitivity pre- to post-erotic film, which was canceled out when the pain thresholds of each group were examined as a whole.

Another possible explanation is that there is no significant relationship between vestibular sensitivity and physiological arousal; there may be individual differences in pain perception at the vestibule following increased blood flow to the genitals (e.g., whether pressure to the vestibule is perceived as more or less sensitive when sexually aroused). Previous research efforts demonstrating a change in pain thresholds in response to sexual stimuli (King & Alexander, 2000; Whipple & Komisaruk, 1985) assessed pain thresholds in non-genital areas. Thus, pain thresholds in the genital region, specifically the vestibule, may be affected by different factors. Although Payne et al. (2007) measured pain thresholds at the vestibule, their findings could be due to the procedure employed during sensory testing. Participant touch and pain thresholds were assessed while participants were still watching the film, which was reported to have affected arousal by the majority of participants. Undergoing sensory testing while still watching an erotic stimulus may have resulted in increased perceived sensitivity due to situational factors, such as anxiety. In support of this explanation, Rhudy and Meagher (2000) demonstrated that experimentally-induced anxiety decreased pain thresholds in a radiant heat pain task. In contrast, pain thresholds were measured immediately following the erotic film in the present study.

The pattern of pain threshold differences found in Payne et al.’s (2007) study also suggests that external factors other than arousal may have affected pain thresholds. Although pain thresholds were significantly lower following the erotic film in both
groups (in comparison to baseline for the control group, and in comparison to the neutral film for the PVD group), pain thresholds were not significantly lower compared to both baseline and the neutral condition in either group. If only sexual arousal was responsible for increasing pain perception at the vestibule, one would expect pain thresholds to be significantly lower than both control conditions following the erotic film. Other factors, such as cognitive distraction due to the film, may have impacted the results; Payne et al. (2007) posited that women in the PVD group may have reported higher pain thresholds during the neutral versus the erotic film because they reported paying more attention to the neutral film than the control group. Therefore, Payne et al. (2007) may have found within-subject differences in pain sensitivity due to the procedure employed in measuring post-film pain thresholds.

*Psychological and Sexual Function*

Scores on pain-related measures were consistent with previous research. The current sample had a pain severity level (as measured by the MPQ) similar to that reported in other PVD studies (e.g., Payne et al., 2005). Over half the PVD group reported maladaptive levels of pain-related anxiety. In addition, levels of pain catastrophizing were significantly greater in the PVD group with regards to both their worst regularly experienced pain and their vulvar pain as compared to the control group. Contrary to past research (e.g., Pukall et al., 2002), however, pain catastrophizing scores were not higher for intercourse versus non-intercourse pain in the PVD group. There was no difference in how much women with PVD catastrophized about their vulvar pain.
compared to their worst regular pain. Vulvar pain PCS scores in the current study, however, tended to be lower than in other studies, while PCS scores for non-intercourse pain were comparable (Payne et al., 2007; Pukall et al., 2002). Therefore, vulvar pain catastrophizing may have been less debilitating in the current PVD sample. Given the relatively young age of our sample, this finding could have been the result of having experienced the pain for a shorter amount of time.

Group differences on questionnaire measures supported the hypothesis that women with PVD would exhibit significantly poorer sexual and psychological function in comparison to the control group. These findings replicate previous findings of decreased psychosexual functioning in women with PVD as compared to non-affected women (see Smith et al., 2009). Past research documenting increased internalizing psychological symptoms (e.g., anxiety, depression) was also replicated in the current sample; women with PVD reported significantly higher overall levels of anxiety and depression in comparison to the control group. Furthermore, a number of women in the PVD group met BDI-II clinical criteria for varying levels of depression; this finding is consistent with the reported association between Major Depressive Disorder and vulvodynia (e.g., Masheb, Wang, Lozano, & Kerns, 2005). Thus, women with PVD in the current study reported lower psychological function than controls with regards to both general psychological distress (i.e., higher levels of anxiety and depression) as well as pain-specific distress (i.e., higher levels of pain catastrophizing and maladaptive levels of pain-related anxiety).
Women with PVD in the current sample also reported significantly poorer overall sexual function compared to the control group. Furthermore, the majority of PVD participants had total FSFI scores indicative of sexual dysfunction according to the clinical cutoff score (Wiegel et al., 2005). These findings replicate past research and support the consensus that women with PVD suffer from decreased sexual function. Interestingly, however, the current sample did not have reduced sexual function in all areas as past research has suggested (Masheb, Lozano-Blanco, et al., 2004). The PVD group reported significantly less arousal, lubrication, and more pain than the control group, while subscales relating to desire, orgasm and sexual satisfaction did not differ between women with and without PVD. In addition, the majority of women in the PVD group reported experiencing arousal difficulties during sexual intercourse, and, in almost all cases, these difficulties were attributed to the anticipation and/or the experience of pain during intercourse. These findings support an association among arousal, lubrication and pain in women with PVD.

_Psychological and Sexual Function as Predictors of Physiological Arousal in Women with PVD_

Pain-related psychological constructs and sexuality measures were examined as predictors of physiological arousal in women with PVD. Intercourse frequency within the last month, as well as vulvar pain PCS scores, were each found to linearly predict the change in blood flow levels from the baseline to the erotic film. Self-reported sexual arousability (SAI total score), overall sexual function (FSFI total score), pain-related
anxiety (PASS-20 total score), and pain severity (MPQ PRI score) were all non-significant predictors.

**Intercourse Frequency**

Women with PVD who had engaged in fewer intercourse occasions with the past month had a higher change in blood flow levels from the baseline to the erotic film (trend, $p = .064$); thus, engaging in less frequent sexual intercourse predicted higher physiological arousal during the erotic film. This finding can be interpreted with regards to desire, attention and novelty/habituation. Lower intercourse frequency does not imply lower sexual desire; in the current study, women with and without PVD had comparable levels of desire on the FSFI. Some women with PVD may be engaging in less intercourse to avoid the resultant pain; in fact, avoidance of intercourse can be used as a coping strategy (Pukall, Smith, et al., 2007). The desire to engage in intercourse may have interacted with the novelty of a visual sexual stimulus depicting intercourse. Novelty has long been studied in the context of visual attention; our attentional system has a bias towards processing information that is perceived as more novel. Beginning as infants, we closely attend to new information and stop responding to repeated stimuli (i.e., habituation); we learn to become disinterested in such information (e.g., Shaffer, Wood, & Willoughby, 2005). Therefore, women with PVD who had engaged in less intercourse may have perceived the film as novel information, and thus, paid closer attention to it. As a result of this increased attention towards the sexual stimuli, they may have become more physiologically aroused by the film than women who had engaged in more frequent intercourse. This supposition is strongly supported by research and theory linking...
attention and arousal, whereby increased focus on erotic stimuli and cues leads to increased sexual arousal, while focus on non-sexual cues leads to decreased sexual arousal (see Barlow, 1986).

In contrast, women engaging in more frequent intercourse may not have shown as large an increase in blood flow levels because of habituation. Habituation to sexual stimuli has been demonstrated in men; O’Donohue and Geer (1985) found that physiological and subjective arousal decreased in magnitude after repeated exposure to the same sexual stimuli. On the other hand, this phenomenon has not been conclusively demonstrated in women. Laan and Everaerd (1995) found a marginally significant effect, whereby genital responses were lower in women repeatedly shown the same visual sexual stimulus versus a group exposed to sexual stimuli that varied in content. Physiological arousal, however, did not deplete over time for women in the constant condition; they continued to show a response to the film. Although these results do not confirm or disconfirm that women can habituate to sexual stimuli, a novelty effect was seen, whereby women in the study responded with higher levels of physiological arousal when exposed to novel sexual stimuli (Laan & Everaerd, 1995). Therefore, women who had engaged in less frequent intercourse in the past month may have been more attentive to the film, which was viewed as more novel than to women who had engaged in intercourse more frequently. This increased attention could then have resulted in a greater change in blood flow levels.

_Catastrophizing_
Higher levels of pain catastrophizing about vulvar pain predicted a greater increase in blood flow levels from the baseline to the erotic film; thus, women who catastrophized more about their vulvar pain were more physiological aroused during the erotic film. Although seemingly counter-intuitive, this finding can be interpreted with regards to the relationship among the sympathetic nervous system (SNS), anxiety/stress and sexual arousal. The activation of the SNS has been shown to facilitate physiological sexual arousal in women; women who engage in an intense, acute period of exercise (thereby increasing SNS activation) show higher levels of physiological response to an erotic film (Meston & Gorzolka, 1995). In a follow-up study, Meston and Gorzolka (1996) found that physiological arousal was facilitated by moderate levels of SNS activation, while lower levels resulted in lower facilitation and higher levels inhibited arousal. Feelings of anxiety can also activate the SNS (Hoehn-Saric & McLeod, 1988, as cited in Bradford & Meston, 2006), and this mood state has been shown to facilitate physiological arousal in women with and without sexual dysfunction in response to an erotic stimulus (e.g., Palace & Gorzalka, 1990).

Given that the affective and cognitive components of pain catastrophizing can be interpreted as a state of anxiety, one may posit that the autonomic arousal produced by pain catastrophizing may activate the SNS and facilitate physiological sexual arousal under certain circumstances. Consistent with the findings of Meston and Gorzolka (1996), Bradford and Meston (2006) demonstrated a curvilinear relationship between state anxiety and physiological arousal: women with moderate anxiety scores showed greater VPA increases in response to an erotic film compared to women with low or high
levels of state anxiety. In contrast to previous research (e.g., Pukall et al., 2002; Reissing et al., 2004), vulvar pain scores on the PCS in the current sample tended to be within normal limits, with only two women reporting levels of pain catastrophizing above the clinical cutoff score. Therefore, pain catastrophizing levels may not have been elevated enough to have an inhibitory effect on physiological arousal; the resulting SNS activation may in fact have facilitated genital responsiveness, resulting in increased physiological arousal.

*Theoretical and Clinical Implications*

The present study supports a possible association between vulvar pain and decreased arousal and lubrication. Women with PVD had significantly lower blood flow levels in response to an erotic film, and reported lower sexual functioning in areas related to arousal, lubrication and pain in comparison to controls. The PVD group also reported more frequent and greater difficulty with arousal during intercourse during the structured interview than the control group; in addition, women with PVD who endorsed experiencing arousal difficulties believed that pain and/or its anticipation was the cause of the problem. These findings implicate decreased arousal in the pain experience of women with PVD through both physiological and self-report measures.

Causation, however, cannot be inferred; arousal difficulties may be primary or secondary to the pain. Nevertheless, women in the current sample tended to report that the pain was responsible for decreased arousal, rather than the reverse. These anecdotal reports seem to oppose Hawton (1985) and Bancroft’s (1989) supposition that
insufficient vasocongestion leads to superficial pain during intercourse. On the other hand, these reports seem to corroborate the latter portion of the cyclic theory proposed by Bancroft (1989), whereby vulvar pain (or its anticipation) may lead to decreased arousal and lubrication over time. Psychological factors have also been implicated in this cycle, whereby pain-related fear catastrophizing and hypervigilance, among other components, may play a role in the link between pain and reduced arousal (e.g., Bancroft, 1989; Payne et al., 2005; Spano & Lamont, 1975). In support of this hypothesis, the PVD group reported significantly higher levels of catastrophizing than the control group, and the majority of affected women met criteria for maladaptive levels of pain-related anxiety.

The results of the present study have implications for the assessment and treatment of PVD. Sexual difficulties in women with PVD have long been known to go beyond simply experiencing pain during intercourse; other aspects of sexual function are consistently found to be negatively affected in women with this condition. This study, however, specifically associates decreased arousal and lubrication with greater reported pain. Decreased arousal and lubrication may actually exacerbate pain beyond vestibular hypersensitivity (Payne et al., 2005); thus, interventions targeting arousal difficulties may be of use. This framework supports the use of sex therapy techniques in the treatment of PVD to address sexual difficulties, such as decreased arousal, in addition to the pain.

Paying attention to sexual issues in therapy is supported by research demonstrating that significant pain reduction following treatment does not necessarily result in increased sexual function or frequency of intercourse (Bergeron, Binik, Khalifé, Pagidas, & Glazer,
Meana, et al., 2001). Sexual function may require attention over and above that provided by treatments with the goal of pain reduction.

Overall, the results support an individualized, multimodal approach to treatment (Damsted Petersen, Boyer, & Pukall, 2009; Haefner et al., 2005). Each woman with PVD presents with her own set of pain experiences and sexual difficulties; thus, a thorough assessment of physical, psychological and sexual factors may provide the best understanding of the areas in which a patient will most benefit from treatment. In the current study, some women responded with high physiological arousal while others exhibited lower levels in response to the erotic film. In addition, subjective arousal ratings may or may not have corresponded to individual blood flow levels (as shown in the variability in within-subject correlations between the two facets of arousal). Thus, there are individual variations in responsiveness to an erotic stimulus within a laboratory setting, which may be due to a variety of physical, psychological, sexual and/or situational factors. The complexity of sexual arousal is illustrated by the finding that moderate levels of pain catastrophizing may have facilitated physiological arousal in the current study. This statement supports the finding that enhancement or inhibition of sexual arousal by factors such as anxiety vary across and within women, depending on the situation (e.g., Graham, Sanders, Milhausen, & McBride, 2004).

Limitations

The current study has several limitations. The results are based on a relatively small sample size, which limited the statistical analyses and associations that could be
tested with the current data set. Nevertheless, the large effect sizes associated with significant group differences lend support to the clinical relevance of the differences found. The generalizability of the above findings may also be limited due to the demographics of the current sample. Participants in the current study had a mean age of 21 years and no participant was over 30 years of age; in addition, the majority of participants identified with the Canadian culture and they were primarily university-educated. The restricted age range, along with other demographic variables, limits the generalizability of the results to older women from different educational and cultural backgrounds. Kukkonen et al. (2009) have shown that genital temperature change in response to an erotic film may vary across the lifespan, with individuals 18 to 29 years of age showing a greater average temperature change than 30 to 45 year olds. Therefore, blood flow levels and group differences in physiological arousal may have differed with a more representative sample. Group differences on self-report measures, however, were consistent with previous PVD research with regards to the pain severity and levels of psychological and sexual function.

Despite a psychological and sexual profile that is consistent with the PVD literature, the reliability of the diagnosis of PVD in the current study should be addressed. Previous studies that have demonstrated the reliability and validity of Friedrich’s diagnostic criteria for PVD (Bergeron, Binik, Khalifé, Pagidas, & Glazer, 2001; Masheb, Lozano, et al., 2004) included laboratory tests to confirm that another diagnosis did not better account for the vulvar pain experienced by participants (e.g., vaginal infection, sexually transmitted infection). This exclusion is consistent with the ISSVD definition for
vulvodynia (Moyal-Barracco & Lynch, 2004), whereby provoked localized pain at the vaginal opening should not be labeled as PVD if another present condition can directly, better explain the pain. Due to the available resources for the present study, however, laboratory tests could not be conducted to exclude such diagnoses. The gynecological examination confirmed that pain was confined to the vestibule and that there were no internal or external signs to indicate that another condition was present that could account for the pain (e.g., vulvar dermatological condition, such as lichen sclerosus). Therefore, it is possible that some women in the sample may have been experiencing vulvar pain due to another condition.

The ecological validity of the findings is further impacted by the laboratory testing environment. Research has shown that females who volunteer for psychophysiological arousal research differ from non-volunteers on a number of sexuality-related variables (e.g., Morokoff, 1986; Plaud, Gaither, Hegstad, Rowan, & Devitt, 1999; Strassberg & Lowe, 1995). Given that there are differences in women who volunteer for such studies versus those who do not, the findings of the current study may not be generalizable to women in the general population. Past research, however, has focused on individuals who volunteer for more invasive sexual arousal research utilizing instruments such as the vaginal photoplethysmograph; thus, the non-invasive instrumentation used in the present study may have decreased the likelihood of a sampling bias.

Another caveat of any research investigating sexual arousal is the generalization of findings in the laboratory to sexual experiences in a natural environment; research
investigating the pain experience of women with PVD assumes that arousal processes in the laboratory are similar to those in a real-life situation. The testing environment was thus constructed to maximize privacy in order to approximate a naturalistic situation as closely as possible. Some methodological aspects of the study could not, however, be altered to increase ecological validity. For example, the participant had to have her legs spread apart for the length of the blood flow imaging with minimal movement, as the LDI is sensitive to movement. Some women found this position uncomfortable, which may have interfered with the arousal process. On the other hand, the great majority of participants showed a significant physiological response to the erotic film, which suggests that the testing situation did not necessarily inhibit arousal.

One could also argue that viewing an erotic film is unlikely to tap into the psychological processes (e.g., pain catastrophizing, pain-related hypervigilance and anxiety) that occur when a woman with PVD is confronted with a sexual situation eliciting vulvar pain. The fact that the PVD group showed lower physiological arousal to the erotic film than the control group despite no threat of pain in the situation, however, supports the supposition that self-reported arousal difficulties (i.e., decreased arousal and lubrication) may result from altered processing of sexual stimuli as postulated by Payne et al. (2005).

Lastly, response styles, such as socially desirable responding, were not controlled for in the current analyses. Based on their findings of a response bias in self-report of sexuality-related variables under anonymous conditions, Meston, Heiman, Trapnell, and Paulhus (1998) suggested that the desire to present a favourable sexual image for females
may involve presenting conservative attitudes and behaving in a restrained asexual manner. Therefore, self-report measures in the current study, including subjective arousal ratings and intercourse frequency, may have been affected by some participants’ desire to present themselves in a favourable manner (i.e., impression management) (Meston et al., 1998).

**Future Directions**

Replication of the study’s findings regarding physiological and subjective arousal is needed with a larger, more representative sample. Women with PVD may have different arousal patterns, depending on their age. In addition, blood flow levels in response to differing sexual stimuli (e.g., film segments depicting intercourse, oral stimulation, manual stimulation) should be examined to determine whether decreased physiological arousal in women with PVD compared to controls is associated with specific content types. If results similar to those of Wouda et al. (1998) are found, whereby scenes depicting intercourse are associated with decreased arousal, these findings may suggest that the mechanisms modulating physiological arousal in women with PVD are specifically related to sexual stimuli involving vaginal penetration. In addition, direct examination of cognitive distraction markers in women with PVD may provide insight into how physiological arousal is affected during sexual activity in this clinical population. Visual attention during exposure to sexual stimuli is currently being researched in women with dyspareunia with this purpose in mind.
The relationship between pain sensitivity and sexual arousal has been largely unexplored. In addition, research to date has not incorporated individual variations in physiological arousal when examining the relationship between sexual arousal and pain thresholds in both women with PVD and non-affected women. A relationship between pain thresholds and physiological arousal may emerge when blood flow levels are accounted for. For instance, King and Alexander (2000) suggested that pain thresholds may decrease with lower levels of physiological arousal, while higher levels may produce an increase in pain thresholds, which could be interpreted as evolutionarily advantageous (Gruenwald et al., 2007). This area is thus a promising next avenue of investigation in determining the impact of physiological arousal on pain sensitivity in women with and without sexual dysfunction.

The comparison of sexual arousal in women with PVD compared to other women who experience arousal difficulties is also of importance. These groups include: (a) women with other forms of vulvar pain, such as generalized vulvodynia (GVD), and (b) women diagnosed with Female Sexual Arousal Disorder (FSAD). Little is known about the etiology of GVD and no research has directly examined sexual arousal in this population. Comparison of arousal mechanisms in women with different subtypes of vulvodynia will further our understanding of their commonalities, as well as the differences between them. GVD is typically characterized by more diffuse vulvar pain, which may or may not be unprovoked in nature. Unprovoked, generalized pain may be the most debilitating; in fact, women with more complex pain presentation than pain that is localized and provoked (e.g., in women with PVD) have been shown to have lower
sexual function, including decreased arousal and lubrication (Smith, Boyer, Pukall, & Chamberlain, 2009). Thus, women with GVD may exhibit lower genital responsiveness to an erotic film than women with PVD.

Women with FSAD, on the other hand, are thought to be capable of physiological arousal levels comparable to women without sexual difficulties, based on studies using vaginal photoplethysmography; however, subjective arousal ratings seem to be significantly impaired (e.g., Laan, van Driel, & van Lunsen, 2008). This pattern of results has led to hypotheses that some women with FSAD are disconnected from genital responsiveness; they do not register cues of physiological arousal (Basson, 2002). In addition, Laan et al. (2008) postulated that women with FSAD may not have adequate sexual stimulation in a naturalistic environment. Current research is examining whether these results will be replicated when measuring physiological arousal in the external, rather than the internal, genitals, with LDI technology. Pathways to decreased arousal in FSAD and PVD may or may not be similar, which would have implications for assessment (e.g., discriminating between diagnoses) and treatment. Previous research has shown that self-report of arousal levels on the FSFI are comparable between women with FSAD and PVD (Masheb, Lozano-Blanco, et al., 2004); the only differences in sexual function were found in areas relating to pain and lubrication, whereby women with PVD reported more difficulty with both. Comparison of objective and subjective sexual arousal measures in women with FSAD to women with PVD may thus improve our understanding of how arousal is affected in each condition.
Chapter 6
Conclusions

The present study demonstrated that sexual arousal is significantly affected in women with PVD in comparison to controls through self-report and direct blood flow measurement. Women with this condition may develop decreased physiological responsiveness to sexual stimuli over time, although the present study did not find any differences in subjective arousal in comparison to women without this condition. The relationship between physiological arousal and the pain experience of PVD may be related to psychological factors, such as pain hypervigilance, catastrophizing and anxiety, although this theory has not yet been explicitly examined. The results suggest that arousal-related difficulties should be explicitly addressed in the assessment and treatment of PVD.
References


Morokoff, P. J. (1986). Volunteer bias in the psychophysiological study of female


Appendix A

Pain Advertisement

Do you experience pain during intercourse?

Queen’s University Departments of Psychology and Obstetrics & Gynecology are in need of women aged 18-40 with genital pain to participate in a research study.

Study Procedures:

• Gynecological examination
• Interview and questionnaires pertaining to health and sexual functioning;
• Laboratory session involving blood flow imaging and sensory testing of the genital region.

Participation takes approximately 3 hours in total over two separate sessions. All information is strictly confidential, and compensation is provided.

Interested?

For more information, please contact the Sexual Health Research Lab (613) 533-3276
SHRL@queensu.ca

Investigators:
Caroline Pukall Ph.D., Susan Chamberlain M.D., Stéphanie Boyer B.Sc.
Appendix B

Control Advertisement

Are you a physically healthy woman?

Queen’s University Departments of Psychology and Obstetrics & Gynecology are in need of healthy and pain-free women aged 18-40 to participate in a research study.

Study Procedures:

- Gynecological examination
- Interview and questionnaires pertaining to health and sexual functioning;
- Laboratory session involving blood flow imaging and sensory testing of the genital region.

Participation takes approximately 3 hours in total over two separate sessions. All information is strictly confidential, and compensation is provided.

Interested?

For more information, please contact the Sexual Health Research Lab
(613) 533-3276
SHRL@queensu.ca

Investigators:

Caroline Pukall Ph.D., Susan Chamberlain M.D., Stéphanie Boyer B.Sc.
Appendix C
Telephone Screening Interview

Telephone screening interview: LDI Pain Sensitivity Study

Date of call: ________________ Called participant: _____ Participant called: _____

1. How did you hear about this study?

1) Newspaper ad: Which one? __________________________
2) Poster: Where? __________________________________
3) Word of mouth
4) Physician’s office
5) Other: How? ____________________________________

Study information

I am just going to tell you a bit about why this research is being done and then explain in detail exactly what your participation entails. Please interrupt if you have any questions. Also, please be advised that this telephone screening is long and contains some questions of a sensitive nature. Would you like to continue at this time with the screening? YES NO^ (^ if prefer a different time, record date and time for next call: ________________)

The main goal of this study is to learn about how genital blood flow affects genital pain sensitivity in women who experience chronic vulvar pain. Chronic vulvar pain is a condition that affects approximately 16% of women in the general population, and is called vulvodynia. For this study we are looking for both women with vulvodynia and women without such pain.

Your participation in this study involves one appointment at the Kingston General Hospital for a gynecological examination and a separate appointment at the Sexual Health Research Laboratory in the Department of Psychology at Queen's University. The appointment at the hospital takes about 30 minutes, and during this appointment you will be seen by a female gynecologist and a female graduate student. As Kingston General Hospital is a teaching hospital, it is also possible that an observer, such as a medical student or resident, will attend the gynecological examination. The second appointment consists of an interview, completion of questionnaires, sensory testing and genital imaging; this appointment takes approximately 2.5 to 3 hours to complete. The interview will be done by a trained female graduate student and will cover information about demographics, medical and gynecological history, and pain information. You will also be asked to complete some questionnaires about pain, mood and sexual functioning. You are in no way obligated to answer any questions that you feel uncomfortable answering.

The female graduate student will also perform the sensory testing and blood flow measurement, with another female research assistant present to record information. You will be asked to remove your clothing from the waist down and be seated on a gynecological examination table in the gynecological examination position with your legs in stirrups. The researcher will apply a series of pressures to the vestibule – which is the area surrounding the vaginal entrance – with a
calibrated instrument attached to a q-tip, which allows us to know exactly how much pressure is being applied to the area. The purpose of the sensory testing is to determine your pain threshold, which is when the sensation becomes a minor pain rather than simply a pressure sensation, which will signal the end of the testing. We will not be applying any pressure internally. The graduate student will ask you each time she applies a pressure if you feel the stimulus. She will also ask you to rate the strength and unpleasantness of the stimuli once your pain threshold has been determined. Following the sensory testing, the researcher will use a laser Doppler imager to measure your genital blood flow through a series of scans done by the machine. The researcher will place the LDI machine close to, but without touching, your genitals. You will be given a pair of DVD goggles that will be used to watch three films while the machine scans your vulva. Two films will involve nature scenes and the third film will be an erotic film. Each film is approximately 15 minutes in length. Both before and after each film, you will be asked to verbally answer several questions, and during the film, you will be asked to rate your level of sexual arousal throughout. Following the third film, sensory testing will be repeated to determine if there has been any change in your pain threshold.

Although some pain may be experienced during this examination, no other health risks are posed, and the painful sensations do not last for long periods of time. You are in complete control of the procedure and are able to stop at any time. To compensate you for your time and participation, you will be reimbursed $60.00.

**Do you have any questions?**

*Are you interested in seeing if you are eligible for participating in the study?*

**YES** → Thank them and ask for their full name: ________________________________

**NO** → Thank them for their time, and ask them to feel free to call back if they change their mind. End the screening interview.

1. **Do you mind answering some questions about your medical and sexual history to determine if you are eligible for the study?**  NO → Go to #2

   If **YES** → Explain that we need to ask these questions to determine their eligibility for the study. If they are still hesitant, ask them to think about it and call back.

2. **How old are you?** ________________________________

   If under **18** years → Cannot participate: “I am sorry, but in order to participate in this study, you must be 18 years of age or older in order for us to obtain legal consent. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/evening.” **End call.**

   If over **40** years → Cannot participate: “I am sorry, but in order to participate in this study, you must be under 40 years of age. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/evening.” **End call.**
DOES NOT WANT TO SAY – “Unfortunately, to determine whether you are eligible to participate in the study, we must obtain this information. Please take some time to think about this, and if you decide you would like to give me this information, feel free to call me back and we will continue with the questions. Thank you for your time. Have a nice day/ evening.” End call.

3. Are you fluent in English? NO* YES

If not fluent in English → “I am sorry, but in order to participate in this study, you must be fluent in English. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/ evening.” End call.

4. Are you currently experiencing menopause? YES* NO

* If participant is currently experiencing menopause → “I am sorry, but in order to participate in this study, you must not be experiencing menopause. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/ evening.” End call.

5. Do you smoke regularly (e.g., cigarettes, cigars, pipes)? YES* NO

Note: Social smokers (i.e. 1-2 cigarettes/week) are eligible

* If participant smokes → “I am sorry, but in order to participate in this study, you must be a non-smoker. Because this study is examining blood flow and smoking can alter an individual’s blood flow, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/ evening.” End call.

6. Do you have a history of drug and/or alcohol abuse? YES* NO

Note: Abuse will be defined as drug/alcohol use that interferes with one’s daily functioning.

* If participant has history of drug and/or alcohol abuse → “I am sorry, but in order to participate in this study, you must not have a history of drug/alcohol abuse. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/ evening.” End call.

7. Do you have any genital piercings? YES* NO

* If participant has genital piercings → “I am sorry, but in order to participate in this study, you must not have genital piercings. Because the study uses laser Doppler imaging, genital piercings interfere with the imaging. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/ evening.” End call.
8. Do you consider yourself to be heterosexual?  

   YES          NO*  

* If she does not consider herself to be heterosexual → “I am sorry but in order to participate in this study, you must be heterosexual. The questionnaires that we will be using have only been validated for heterosexual relationships, and the erotic film we present depicts heterosexual sexual activities. As this is a new area of research for our lab, we will be expanding to include same-sex oriented women in future genital imaging studies. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/evening.” End call.

9. Have you ever given birth?  

   YES*          NO  

* If she has given birth say “I am sorry, but in order to participate in this study, you cannot have given birth. Unfortunately, you are not eligible to participate in this study. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/evening.” End call.

10. Is there any possibility that you might currently be pregnant?  

   YES*          NO  

* If she believes she may be pregnant, say “I am sorry, but in order to participate in this study, you cannot currently be pregnant. Therefore, at this time, you are not eligible to participate in this study. However, if you are not pregnant and would still like to participate in the study, we would be happy to continue screening you for participation. Do you have any questions for me about this? Thank you again for your interest in our study. Have a nice day/evening.” End call.

11. Are you currently suffering from any medical or psychiatric condition?  

   YES          NO → go to #12  

→ If YES, what condition(s) have you been diagnosed with?

→ Are you taking any medications for this/these conditions?  

   YES*          NO  

   → If yes, which one(s)?  

→ Are you receiving any other treatment for this/these conditions?  

   YES          NO  

   → If yes, which one(s)?  

→ Have you previously taken any medication or received any other treatment for this/these conditions?  

   YES          NO  

   → If yes, which one(s)?
→ If YES, does this condition interfere significantly with your daily and sexual functioning?  
   YES*  NO → go to #12

12. Have you ever had penetrative vaginal intercourse?  YES  NO

13. When was your last gynecological examination?  ____________________________  
   Note: Please make sure that if the women responds in terms of a ‘physical exam’, ensure that the 
   physical included a gynecological/pelvic exam.
   → Was it painful?  YES  NO

14. Do you use tampons or any other kind of internal feminine hygiene product (e.g., Diva 
   Cup)?  YES  NO → go to #15
   → If yes, do you experience pain when you insert/remove (←circle one or both) 
   tampons/product?  YES  NO

15. Are you currently taking hormonal contraceptives?  YES  NO → go to #16
   → If yes, what kind?  ____________________________

16. Do you currently experience pain in your vulvar/genital region?  YES  NO
   YES: For how long have you had this pain?  ____________________________ (min. 6 months)  
   Was this when the pain first began or when you began to regularly experience it?  
   (If caller experienced pain intermittently in the past, ask when pain first began _____)  
   → Go to #17 and use present tense

   NO: Have you ever had recurrent and persistent vulvar/genital pain?  
   → YES: Why do you no longer have the pain?  ____________________________
          Go to #17 and use past tense  
          (Note: If caller has suffered from pain in the past but does not report current 
          pain in her responses to the following questions, she is not eligible.)

   → NO: Go to #25

17. In what situations do/did you feel the pain? (Circle one response)  
   A) It is always or almost always present  
   B) During sexual intercourse or activities involving vaginal penetration: Which 
      activities?  ____________________________

   C) It is always or almost always there and worsens during sexual intercourse/activities 
      involving vaginal penetration:  
      Which activities?  ____________________________

   D) Other:  ____________________________
If B or C is endorsed: When does/did the pain START (or worsen) during sexual intercourse or activities involving vaginal penetration? (Circle one response)
   A) When the penis/finger/object starts to enter the vagina
   B) When the penis/finger/object has fully entered and is thrusting
   C) Only after penetration: How long does it last? __________________________

18. Where do/did you feel the pain? (Circle one response)
   A) At the vaginal opening
   B) Everywhere on the vulva
   C) Inside the vagina
   D) In the pelvic or abdominal region*
   E) Other: ____________________________________________________________

19. What adjective/s would you use to describe the pain you feel in your vulvar/genital region?
   ________________________________________________________________

20. Was the pain present the first time you had sexual intercourse (or tampon insertion; gynecological examination for women who have not had intercourse)?

   YES: Was the pain present with first tampon insertion/gynecological examinations as well?  YES  NO → Go to #22

   NO: → Go to #21

21. Under what circumstances would you say your pain first start? (e.g., after surgery; upon changing partners)?
   ________________________________________________________________

22. Have you received any diagnosis for this pain?  YES  NO → go to #23

   → If yes, what diagnosis/diagnoses did you receive? __________________________

   → By whom? ___________________________________________________________

   → When? __________________________________________________________________

23. Have you ever undergone any treatment for the pain?  YES  NO → go to #24

   → If yes, which one(s)? _________________________________________________

   → Are you currently undergoing treatment for this pain?  YES  NO

   → If yes, which one/s? _________________________________________________
24. Do you have any difficulty at all with vaginal penetration or insertion?   YES  NO

→ If yes, please describe: ____________________________________________________
____________________________________

25. Have you ever suffered, or are you currently suffering, from any chronic pain condition (other than genital pain)? YES  NO → go to #26

→ If yes, what condition(s) have you been diagnosed with?
____________________________________

→ When did this episode/these episodes occur? ________________________________

→ How long did this episode/these episodes last? ______________________________

→ Are you taking any medications for this/these conditions? YES*  NO

→ If yes, which one(s)? _________________________________________________

→ Are you receiving any other treatment for this/these conditions? YES  NO

→ If yes, which one(s)? _________________________________________________

→ Have you previously taken any medication or received any other treatment for this/these conditions? YES  NO

→ If yes, which one(s)? _________________________________________________

→ If yes, does this condition interfere significantly with your daily and sexual functioning? YES*  NO

26. What was the date that your last menstrual period started?
Note: Please explain that we ask this question for the sensory testing session- women’s pain sensitivities can vary as a function of where they are in their cycle.

27. I am now going to ask you about your relationship status. Is that okay?
If NO → Explain that we need to ask these questions to determine which questionnaires they will be filling out during the session.

Are you currently in a relationship? YES  NO

If yes, how long have you been in this relationship? ____________

“The erotic video you will be viewing in this study consist of scenes depicting consenting adults engaged in a variety of sexual activities including kissing, masturbation, mutual oral sex, and penetration. There is no talking or storyline in the video and the scenes are quite explicit.”
28. Have you ever watched sexually explicit movies or videos?  
   YES  NO*  

29. Do you feel uncomfortable about or object to the idea of watching a sexually explicit movie or video?  
   YES*  NO  

* If the caller has never watched a sexually explicit movie or feels uncomfortable watching them, say → “I am sorry, but in order to participate in this study, you must have experience watching sexually explicit movies and feel comfortable doing so as this is part of the study’s procedure. Therefore, you are not eligible to participate in the current study. However, if you change your mind, please feel free to call the lab back and we can continue with screening. Thank you again for your interest in the study. Have a nice day/evening.” End call.  

30. Do you have any difficulty getting aroused at sexually explicit videos or movies?  
   YES*  NO  

   * Please describe the difficulties you have: ___________________________________________  
   ___________________________________________  

Thank you for answering all of those questions!  

END OF SCREENING  

Initial Decision:  

NOT ELIGIBLE__ * (If they are not eligible, explain to them why and thank them for their time.)  

NOT SURE __ (If not sure, tell them that you will call them back after discussing it with your supervisor.)  

CONTROL GROUP __† (Tell them that they are eligible for the study; see below.)  

PVD__ † (Tell them that they are eligible for the study; see below.)  

†Are you interested in participating in the study?  YES  NO  NOT SURE  

→ If no/not sure, thank them for their time and ask them to call back if they change their minds. Answer any questions they might have, especially if they are not sure.  

→ If yes, ask: When are you typically free during the week? Book the gynecological exam according to Sue’s schedule.  

Gynecological Exam Date/time booked: ___________________________________________  

Interview & LDI Testing Date/time booked: ___________________________________________  

Graduate Student booked: ___________________________________________
Research Assistant booked: ________________________________________________

⇒ What is the best way to contact you in order to confirm the appointment?  
*Note: Inform them that if we leave a message, we would leave only our name and number and that we are calling from Queen's University.*

A) Home:______________________________________________________________

B) Work:_____________________________________________________________

C) Cell:______________________________________________________________

D) Email:_____________________________________________________________

Provide the participant with directions to the university and KGH if needed.

**Do you have any questions for me?**

**Would you be interested in participating in future studies that we run in the Sexual Health Research Lab?**  YES ⇒  NO ⇒

⇒ If **yes**: ask for name and phone/email

Name:______________________________________________________________

Phone:_____________________________________________________________

Email:_____________________________________________________________

⇒ If **no**: thank person for her time and interest in the study. Let them know that they can feel free to contact the lab if they have any questions at all.
Structured Interview

LDI Pain Sensitivity Study

MA Study for Stéphanie C. Boyer

Subject Number ________________

Interviewer ________________

Date of Interview ________________
PART A: SOCIO-DEMOGRAPHIC INFORMATION

1) Date of birth _______/_______/_______  
   Age: __________  
   mo  day  year

2) Place of birth  
   1) Canada  2) United States  3) Eastern Europe  
   4) Western Europe  5) Africa  6) Asia  
   7) Australia  8) Middle East  9) Latin/South America  
   10) Caribbean

3) What culture do you consider yourself most associated with?  
   1) Canadian  2) Québécoise  3) American  
   4) Irish/Scottish/Welsh  5) Native American  6) Greek/Italian Canadian  
   7) Eastern European  8) Western European  9) African  
   10) Asian  11) Australian  12) Middle Eastern  
   13) Latin/South American  14) Caribbean  15) Other: ____________

4) What is your mother tongue?  
   1) English  2) French  3) Other: ____________

5) In what religion were you brought up?  
   1) Catholic  2) Protestant  3) Jewish  
   4) None  5) Other: ____________

6) Do you currently identify with any religious community?  
   1) Yes: Which one? ____________  2) No: go to #8

7) How important is religion currently in your daily life on a scale from 0 to 10?  
   (0 = not at all, 10 = extremely important): ____________

8) What is the highest level of formal education you have received?  
   1) Some high school  2) High school graduate  
   3) Some trade school  4) Trade school graduate  
   5) Some college/undergraduate degree  6) College/undergraduate degree  
   7) Some graduate school/professional training  8) Graduate/professional school degree

9) How many years of education has that included? ____________

10) What is your occupational status?  
    1) Employed full-time  2) Employed part-time  3) Unemployed  
    4) Retired  5) Student  6) On disability  
    7) Other: ____________

10) What is the approximate total annual income of your household?  
    1) $0 - $ 9,999  2) $10,000 - $19,999  3) $20,000 - $29,999  
    4) $30,000 - $39,999  5) $40,000 - $49,999  6) $50,000 - $59,999  
    7) $60,000 and over  8) Decline Response
PART B: GYNECOLOGICAL AND SEXUAL HISTORY

1) Do you menstruate regularly (approximately once a month)? 1) YES 2) NO
If no, why not? __________________________________________________________

2) At what age did you first start to menstruate? __________

3) What was the start date of your last menstrual period? _______/_____/_____
   mo  day  year
Participant is currently:
   a) Follicular (few days after menstruation)
   b) Ovulatory (about 2 weeks after start of last menstruation)
   c) Luteal (after ovulation, few days before menstrual onset)
   d) Menstrual

4) Do you take oral contraceptives? 1) YES 2) NO
   If YES, what brand? ______________and for how long? __________

5) What gynecological conditions have you had?
   1) Chlamydia
   2) Gardnerella vaginalis (i.e., bacterial vaginosis)
   3) Genital herpes
   4) Genital warts or H.P.V.
   5) Gonorrhea
   6) H.I.V.
   7) Syphilis
   8) Trichomoniasis
   9) Bladder/urinary tract infections (# of infections: _____)
   10) Interstitial cystitis
   11) Pelvic inflammatory disease (P.I.D.)
   12) Endometriosis
   13) Other: _____________________________
   14) None

6) Have you ever had a yeast infection? 1) YES 2) NO go to # 10
   If yes, how many have you had? __________

7) At what age did you have your first yeast infection? ______

8) How was it/were they diagnosed?
   1) Clinical plus positive culture => # of times: __________
   2) Clinical only => # of times: __________
   3) Self-diagnosed => # of times: __________
9) How was it/were they treated?
   1) Over the counter suppository/cream =&gt; # of times: ________
   2) Oral medication =&gt; # of times: ________
   3) Other: ____________________________ # of times: ________

10) What gynecological interventions have you had (and how many times have you had each one)?
   1) Hysterectomy ______
   2) Láparoscopy ______
   3) Ovariectomy ______
   4) Tubal ligation ______
   5) Curettage ______
   6) Abortion ______
   7) Other: ____________________________
   8) None

11) Note: If participant answers oral contraceptives, do not ask for length of time used.

   If has current partner: What is the main form of contraception you currently use? ______
   For how long have you been using this form of contraception? ______

   If no current partner: What was the main form of contraception you used in the past? ______
   For how long have you used this form of contraception? ______

12) What was the date of your last gynecological exam? ______ / ______

   Was it painful? 1) YES 2) NO

   If yes, please rate the intensity of the pain on a scale from 0 to 10 (0=no pain at all, 10=worst pain ever felt): ______

   If yes, please rate how distressing the pain was on a scale from 0 to 10 (0=not at all distressing, 10=most distressing experience): ______

13) How much bodily pain have you had during the past 4 weeks?
   1) None 2) Very mild
   3) Mild 4) Moderate
   5) Severe 6) Very severe

14) During the past 4 weeks, how much did bodily pain interfere with your work, including work outside the home and housework?
   1) Not at all 2) A little bit
   3) Moderately 4) Quite a bit
   5) Extremely
15) Do you regularly experience pain (i.e. once a month or more) in the following areas? For each YES response, ask:

- **On average, how long does this pain last?**
  - [a] less than 1 hour  
  - [b] 1 to 6 hours  
  - [c] 6 to 24 hours  
  - [d] 1 to 3 days  
  - [e] more than 3 days

- **How would you rate the average intensity of this pain?**  
  - [0 = no pain at all, 10 = the worst pain ever felt]

- **How would you rate your most intense pain of this type?**  
  - [0 = no pain at all, 10 = the worst pain ever felt]

- **For how long have you been experiencing this pain?**  
  - [a] 1-3 months  
  - [b] 3-6 months  
  - [c] 6-12 months  
  - [d] 1-3 years  
  - [e] more than 3 years

- **How much does this pain interfere with your daily activities?**  
  - [0 = not at all, 5 = moderately, 10 = totally]

<table>
<thead>
<tr>
<th>Pain Type</th>
<th>Duration</th>
<th>Avg Int.</th>
<th>Most Int.</th>
<th>Length</th>
<th>Interference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
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<tr>
<td>Face^ (jaw, eyes, ears)</td>
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<td>Mouth^ (teeth, gums, tongue)</td>
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<td>Neck</td>
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<td>Throat</td>
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<td>Back</td>
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<tr>
<td>Arms^ (elbow, forearm)</td>
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<td>Shoulder</td>
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<td>Hands^ (fingers, wrists)</td>
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<td>Chest</td>
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<td>Breast</td>
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<td>Stomach/abdomen</td>
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<td>Pelvic area*:</td>
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<tr>
<td>Rectum</td>
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<tr>
<td>Menstrual</td>
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<tr>
<td>Legs^ (knee, shin, thigh)</td>
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<tr>
<td>Feet^ (ankle, toes)</td>
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<tr>
<td>Joints*:</td>
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<td>Skin*:</td>
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<td>Muscles*:</td>
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<td>Other**:</td>
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</table>

^Circle appropriate areas; *Ask location of pain; **Note pain location of “other” pain mentioned.

16) Have you ever experienced or been diagnosed with any of the following conditions?

- **For each YES response, ask:**
→ **How serious of a problem is this for you?**
[0 = not at all serious, 5 = moderately serious, 10 = extremely serious]

→ **How much does this condition interfere with your daily activities?**
[0 = not at all, 5 = moderately, 10 = totally]

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Seriousness (0 – 10)</th>
<th>Interference (0 – 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headaches/migraines (circle)</td>
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<tr>
<td>Menstrual cramps/Pre-menstrual syndrome(^)</td>
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<tr>
<td>Ovulatory pain</td>
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<td>Endometriosis</td>
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<td>Interstitial cystitis</td>
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<td>Yeast infections</td>
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<td>Vaginal infections</td>
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<tr>
<td>Urinary tract/bladder infections(^)</td>
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<tr>
<td>Other viral/bacterial infections(^)</td>
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<td>Sexually transmitted diseases</td>
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<td>Fibromyalgia</td>
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<td>Chronic fatigue syndrome</td>
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<td>Arthritis</td>
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<td>Angina</td>
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<tr>
<td>Osteoporosis</td>
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<td>Muscle spasms/pain</td>
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<tr>
<td>Neuralgia</td>
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<td>Colitis/Crohn’s disease/IBS(^)</td>
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<tr>
<td>Hemorrhoids</td>
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<td>Constipation</td>
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<tr>
<td>Indigestion</td>
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<tr>
<td>Other*:</td>
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</tbody>
</table>

\(^\)Circle appropriate diagnoses; *Note diagnosis/diagnoses of “other” problem/s mentioned

17) What is your worst regularly experienced (i.e., once a month or more) non-vulvar/genital pain? __________

On a scale of 0 to 10 (0 = no pain at all, 10 = worst pain ever felt), please rate the intensity of this pain _____

On a scale of 0 to 10 (0 = not unpleasant at all, 10 = most unpleasant experience), please rate the degree of unpleasantness you experience during this pain. _____

**Administer PCS for worst non-vulvar pain**
PART C: RELATIONSHIP AND SEXUAL HISTORY

Now I am going to ask you some questions about your sexuality and about your relationship history. If you are currently involved in a relationship or are dating, you will be asked questions about your partner. If you are in an open or non-monogamous relationship, the questions referring to 'your partner' refer to your main partner.

1) What is your current relationship status?
   1) Single, not dating
   2) Casual sex with one partner
   3) Casual sex with multiple partners
   4) Dating one partner regularly
   5) Dating one partner regularly (long distance)
   6) Living with a partner
   7) Married
   8) Common-law
   9) Separated
   10) Divorced
   11) Widowed
   12) Other: ____________

2) How long have you been in this situation? _____ years _____ months

3) Which of the following best describes your sexual orientation?
   1) Heterosexual
   2) Homosexual
   3) Bisexual
   4) Not sure
   5) Other: ____________

4) Have you had penetrative intercourse? (In terms of a heterosexual experience, this refers to penis-in-vagina intercourse. In terms of a same-sex experience, this refers to the first time a partner penetrated you with fingers or a sex toy)
   1) YES
   2) NO – skip to # 8

5) At what age did you first have penetrative intercourse? ______

6) Some women report experiencing pain during their first experience of penetrative intercourse. On a scale from 0 to 10, please rate the intensity of the pain you might have felt (0 = no pain at all, 10 = worst pain ever felt): _____

   On a scale from 0 to 10, please rate the unpleasantness experienced because of the pain (0 = not unpleasant at all, 10 = most unpleasant experience): _____

7) What is the total number of partners you have had penetrative intercourse with? ________

8) Many people engage in masturbation and sexual activities with partners. How often have you engaged in the following sexual activities in the last month?

   Masturbation _____ times
   Manual stimulation of partner’s genitals _____ times
   Partner’s manual stimulation of your genitals _____ times
   Oral stimulation of partner’s genitals _____ times
   Partner’s oral stimulation of your genitals _____ times
   Penetrative vaginal intercourse on you _____ times
   Penetrative vaginal intercourse on partner _____ times
   Manual stimulation of partner’s anus _____ times
Partner’s manual stimulation of your anus  ____ times
Oral stimulation of partner’s anus  ____ times
Partner’s oral stimulation of your anus  ____ times
Penetrative anal intercourse on you  ____ times
Penetrative anal intercourse on partner  ____ times
Penetrative sex-toy play on you  ____ times
Penetrative sex-toy play on partner  ____ times

9) **Do you experience pain in your vulvar region?**
   ➔ If NO, proceed to PART D
   ➔ If YES, proceed to PART E
PART D: PARTICIPANTS WITH NO VULVAR PAIN

1) Over the past 6 months, approximately how many times have you had penetrative intercourse? _____ per month  → If 0, proceed to #4

2) Typically, what percentage of penetrative intercourse occasions has been painful? _____

3) Do you have any difficulty becoming sexually aroused during penetrative intercourse?
   1) YES  2) NO

   If YES, on a scale from 0 to 10, how much difficulty do you have? (0=no difficulty, 10=most difficulty imaginable): ____

   If YES, why do you think you experience difficulty with arousal during penetrative intercourse?

   → Proceed to SECTION G

4) How long has it been since you last had penetrative intercourse? _____ years _____ months

5) I am going to list a number of reasons why you may not have engaged in intercourse for the past 6 months; please let me know what is/are the reason(s) that apply to you.
   1) I have no partner at the moment
   2) I’m afraid of getting pregnant
   3) I have no desire
   4) I’m in a lesbian relationship that does not involve vaginal penetration
   5) I am too anxious
   6) I don’t want penetration
   7) My partner has erection problems
   8) My partner has no desire
   9) Other: __________________________________________

6) In the past, approximately how many times per month were you having penetrative intercourse? _____ per month

7) Typically, what percentage of intercourse occasions were painful? __________

8) Did you have any difficulty becoming sexually aroused during penetrative intercourse?

   If YES, on a scale from 0 to 10, how much difficulty did you have? (0=no difficulty, 10=most difficulty imaginable): ____

   If YES, why do you think you experienced difficulty with arousal during penetrative intercourse?

   → Proceed to SECTION G

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PART E: VULVAR PAIN HISTORY

1) When did you first start experiencing vulvar pain? _____ months ago OR _____ years ago

2) How would you say it started? (circle as many as needed)
   1) With first sexual experience (i.e., primary)
   2) After repeated yeast/bladder/urinary tract infections (circle which one/s)
   3) After childbirth
   4) For no apparent reason
   5) After a change of partner
   6) It has always been there (i.e., primary)
   7) With the onset of menopause
   8) After a gynecological surgery: __________________________
   9) After a gynecological treatment: _________________________
   10) After an abortion
   11) After a significant life stress (e.g., marital conflict, financial problems): ________
   12) Other: ______________________________________________

3) How many health professionals have you consulted for the pain? _______
   ➔ If 0, proceed to # 5

4) What diagnoses were you given by these health professionals?
   None given _____
   Diagnosis/diagnoses: ______________________________________

5) Have you ever attempted to treat or alleviate the pain? 1) YES 2) NO ➔ go to #8
   ➔ If YES, how?
   1) Changing aspects of sex life (e.g., position, speed, enhancing arousal)
   2) Creams (e.g., K-Y, Crisco, moisturizers, corticosteroids, hormonal, anesthetics)
   3) Alternative medicine (e.g., vitamins, diets, homeopathic remedies, physiotherapy)
   4) Psychological treatments (e.g., psychotherapy, hypnosis, Kegels, biofeedback)
   5) Surgery (e.g., vestibullectomy, laser)
   6) Other medical treatments (e.g., hormones, interferon, antibiotics, medications)
   7) Small changes (e.g., cotton underwear, mild soaps, changing mattresses, cold application, donut pillow)
   8) Other: ______________________________________________

6) Which treatments were recommended by a physician? __________________________

7) What treatment has helped the most? _________________________________

8) Were you in a relationship at the time that your vulvar/genital pain started? 1) YES 2) NO
   ➔ If YES, how long had you been in the relationship before the pain first started? __________
→ If YES, and if you are no longer in this relationship, for how long were you in the relationship after the pain started? ________________

9) How has your relationship status changed since the onset of your vulvar/genital pain?
   a) My relationship status has not changed. I am currently in the same relationship I was in at the
time the vulvar pain started.
   b) I am currently in a different relationship than the one I was in when the vulvar pain started.
   c) I was in a relationship at the time the vulvar pain started and I am now dating casually.
   d) I was in a relationship at the time the vulvar pain started and I am now single.
   e) I was dating casually at the time the vulvar pain started and I am now in a relationship.
   f) I was dating casually at the time the vulvar pain started and I am still dating casually.
   g) I was dating casually at the time the vulvar pain started and I am now single.
   h) I was single at the time the vulvar pain started and I am now in a relationship.
   i) I was single at the time the vulvar pain started and I am now dating casually.
   j) I was single at the time the vulvar pain started and I am currently single.
   k) Other: ________________________________
PART F: VULVAR PAIN CHARACTERISTICS

1) **Show MPQ vulva diagram.** Where do you typically feel the pain? Is there a specific spot you can show me? If yes, where? **Circle appropriate area below.**

   1) At the vaginal opening
   2) Everywhere on the vulva
   3) Inside the vagina
   4) In the pelvic or abdominal region

→ **If only one location is chosen,** proceed to the appropriate number.

→ **If more than one pain,** can you differentiate among these different pains?
   
   A) YES → go to appropriate numbers  
   B) NO → go to #6  
   C) Don’t know → go to #2

2) Average pain intensity/unpleasantness at the *vaginal opening* (past 6 months). ______ ______

3) Average pain intensity/unpleasantness *on the vulva* (past 6 months). ______ ______

4) Average pain intensity/unpleasantness *inside the vagina* (past 6 months). ______ ______

5) Average pain intensity/unpleasantness in the *pelvic abdominal* region (past 6 months).

**Administer MPQ for vulvar pain**

6) When does the pain typically *start?*

   1) It is always there
   2) When the penis starts to enter the vagina
   3) When the penis has fully entered and is thrusting
   4) After intercourse: How long does it last? ________________________________
   5) Other: ________________________________

7) How long does the pain typically *last?*

   1) It is always or almost always present: For how many hours per day, on average? ______
   2) It comes and goes: There is no typical pattern
   3) During penile entry only
   4) During penile thrusting only
   5) Only for a period after penile exit
   6) During penile entry and after penile exit
   7) During penile entry and during penile thrusting
   8) During penile thrusting and for some time after penile exit
   9) During penile entry, during penile thrusting, and after penile exit

If it lasts *after penile exit,* please state for how long after the pain is felt.

   Time: ______ minutes  ______ hours  _______ days

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8) Do you regularly experience pain in your genital region during any of the following situations? (Including the intensity of the pain on a scale from 0 to 10, where 0=no pain at all, 10=worst pain ever felt)
   1) Friction/pressure with clothing _____
   2) Urinating in general/after intercourse _____ (circle one or both)
   3) Inserting/removing a tampon _____ (circle one or both)
   4) Masturbating alone _____
   5) Your partner stimulating you manually/orally _____ (circle one or both)
   6) Partner and/or self finger insertion _____ (circle one or both)
   7) During sexual intercourse _____
   8) Gynecological examination _____
   9) Sporting activity: ______________________________________
   10) Sitting for long periods of time _____
   11) My pain is not related to any specific activity _____
   12) Other: ______________________________________________

9) Over the past 6 months, approximately how many times have you had sexual intercourse?
   _____ per month  → If 0, go to #13

10) What percentage of intercourse occasions was painful? ______

11) Average pain intensity/unpleasantness during sexual intercourse. _____ _____

12) Do you have any difficulty becoming sexually aroused during penetrative intercourse?
   1) YES  2) NO → Go to #19

   If YES, on a scale from 0 to 10, how much difficulty do you have? (0=no difficulty, 10=most difficulty imaginable): _____

   If YES, why do you think you experience difficulty with arousal during penetrative intercourse? → Go to #19

   ____________________________________________________________

13) How long has it been since you last had intercourse? ______ months ______ years

14) What is/are the reason(s) that you have not had intercourse in the past 6 months?
   1) I have no partner at the moment
   2) It hurts too much
   3) I fear pain
   4) I’m afraid of getting pregnant
   5) I have no desire
   6) I’m in a lesbian relationship that does not involve vaginal penetration
   7) I am too anxious
   8) I don’t want penetration
   9) My partner has erection problems
   10) My partner has no desire
   11) My partner is concerned about hurting me
12) Other: ________________________________

15) In the past, approximately how many times per month were you having sexual intercourse? _____ per month

16) What percentage of intercourse occasions was painful? _____

17) Average pain intensity/unpleasantness during sexual intercourse. _____ _____

18) Did you have any difficulty becoming sexually aroused during penetrative intercourse?
   
   If YES, on a scale from 0 to 10, how much difficulty did you have? (0=no difficulty, 10=most difficulty imaginable): _____
   
   If YES, why do you think you experienced difficulty with arousal during penetrative intercourse?
   ________________________________

19) What are the top three reasons that you believe you have vulvar/genital pain:

   1) ________________________________

   2) ________________________________

   3) ________________________________

If no current partner ⇒ Proceed to #22.

20) If has current partner: Do you feel that your vulvar/genital pain has negatively affected your relationship? 1) YES  2) NO

   If YES ⇒ How much has the pain negatively impacted your relationship (0 = no impact, 10 = greatest impact imaginable)? _____

21) Do you feel that your vulvar/genital pain has positively impacted your relationship?

   1) YES  2) NO

   If YES ⇒ How much has the pain has positively impacted your relationship (0 = no impact, 10 = greatest impact imaginable)? _____

22) To what extent would you say your vulvar/genital pain impacted your ability to initiate dating relationships (0 = no impact, 10 = greatest impact imaginable)?

   Note: If in same relationship since the start of the pain, ask participant to imagine how much it would impact their ability to do so.

⇒ Proceed to SECTION G
PART G: QUALITATIVE QUESTIONS

1) How much do you agree with the following statement: *On the whole, I am satisfied with myself.* (0 = strongly disagree, 10 = strongly agree) _______

2) How much do you agree with the following statement: *I feel that I am a person of worth.* (0 = strongly disagree, 10 = strongly agree) _______

3) How much do you agree with the following statement: *I feel in control of my body.* (0 = strongly disagree, 10 = strongly agree) _______

4) How important is sex to you (0 = not important at all, 10 = extremely important)? _______

→ Discontinue Interview
Appendix E
Pre-Film Arousal Questionnaire

Please indicate the number which best describes how you feel right now, that is, at this moment:

1. How relaxed do you feel?
   0  1  2  3  4  5  6  7  8  9  10
   not at all relaxed
   the most relaxed I’ve ever been

2. How funny do you find this situation?
   0  1  2  3  4  5  6  7  8  9  10
   not at all
   funniest situation ever

3. Overall, how anxious do you feel?
   0  1  2  3  4  5  6  7  8  9  10
   not at all
   the most I’ve ever felt

4. Overall, how sexually aroused do you feel (both mentally and physically)?
   0  1  2  3  4  5  6  7  8  9  10
   not at all
   the most sexually aroused I’ve ever been

   a) How sexually aroused are you mentally?
      0  1  2  3  4  5  6  7  8  9  10
      not at all
      the most mentally aroused I’ve ever been

   b) How sexually aroused are you physically?
      0  1  2  3  4  5  6  7  8  9  10
      not at all
      the most physically aroused I’ve ever been
5. Do you feel like having sex with a partner?

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6. Do you feel like masturbating?

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Appendix F

Post-Film Arousal Questionnaire

Please indicate the number which best describes your experience:

1. Overall, how relaxed did you feel during this film?

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<tr>
<td>not at all</td>
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<td>the most relaxed I’ve ever been</td>
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2. Overall, how much did you enjoy the film?

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<td>the most enjoyable film I’ve ever seen</td>
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3. Overall, how funny did you find the film?

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<td>not at all funny</td>
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<td>funniest film I’ve ever seen</td>
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4. Overall, how anxious did you become during this film?

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<td>not at all anxious</td>
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<td>the most anxious film I’ve ever been</td>
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5. Overall, how upsetting was this film?

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<td>not at all upsetting</td>
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<td>most upsetting film I’ve ever seen</td>
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6. Overall, how sexually aroused did you become during this film?

0 1 2 3 4 5 6 7 8 9 10
not sexually aroused at all
the most sexually aroused I’ve ever been

7. At what point during the film would you say that you were most sexually aroused?

- Was not at all sexually aroused
- Within the first 5 minutes
- Between 5-10 minutes (middle of film)
- During the last 5 minutes
- Varied throughout (up and down during the film)
- Other; explain

8. How would you rate your peak sexual arousal during the film?

0 1 2 3 4 5 6 7 8 9 10
not at all sexually aroused
the most sexually aroused I’ve ever been

Now I am going to ask you to consider your sexual arousal specifically in terms of mental and physical parts:

9. Overall, how sexually aroused were you *mentally* during the film?

0 1 2 3 4 5 6 7 8 9 10
not at all mentally aroused
the most mentally aroused I’ve ever been

10. Did watching the video make you feel like having sex with a partner?

0 1 2 3 4 5 6 7 8 9 10
not at all
the most I’ve ever felt
11. Did watching the video make you feel like masturbating?

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12. Overall, how sexually aroused were you **physically** during the film?

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13. How much genital change did you feel during the film?

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14. How much lubrication (wetness) did you feel during the film?

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<td>lubrication at all</td>
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15. How much genital tingling or fullness did you feel during the film?

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<td>genital tingling/fullness</td>
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16. How sexually aroused did you feel during the film as compared to how sexually aroused you typically are with a partner?

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<td>much less sexually aroused</td>
<td>no difference</td>
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<td>much more sexually aroused</td>
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17. Did the process of having your genitals filmed affect you in any way?

YES  NO

If Yes, describe how: ________________________________________________________________

A) To what extent did it □ increase or □ decrease your sexual arousal?

0 not at all 1 2 3 4 5 6 7 8 9 10 the most possible

B) To what extent did it □ increase or □ decrease how funny you thought the video was?

0 not at all 1 2 3 4 5 6 7 8 9 10 the most possible

C) To what extent did it □ increase or □ decrease how relaxed you were during the video?

0 not at all 1 2 3 4 5 6 7 8 9 10 the most possible

19. Is there anything else you would like to say about this film?

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

________________________________________________________________________________

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Appendix G
Letter of Information/Consent Form

Letter of Information

The relationship between pain sensitivity and sexual arousal in women with provoked vestibulodynia

Investigators:
Caroline F. Pukall, PhD, Department of Psychology, Queen's University; Susan M. Chamberlain, MD, Department of Obstetrics & Gynecology, Kingston General Hospital; Stéphanie C. Boyer, BSc, Department of Psychology, Queen's University.

Introduction
This is a research project being carried out by a multidisciplinary group of psychologists and gynecologists. The principal psychologist is Dr. Caroline Pukall, Department of Psychology, Queen's University (613-533-3200), and the principal gynecologist is Dr. Susan Chamberlain, Department of Obstetrics and Gynecology, Kingston General Hospital (613-548-1327). The principal student investigator is Stéphanie Boyer, a graduate student under the supervision of Dr. Pukall in the Department of Psychology, Queen’s University (613-533-3276).

Purpose of the study
The purpose of this study is to investigate whether genital pain sensitivity is affected by sexual arousal (i.e. increased genital blood flow). The current study will examine subjective (self-report ratings) and objective measures (genital imaging via Laser Doppler imaging) of sexual arousal in women with provoked vestibulodynia (PVD) and women without PVD, and their relationship to genital pain sensitivity, as measured through pressure-pain stimulation.

Study procedures
Your participation in this study involves undergoing the following procedures over two separate appointments: 1) a gynecological examination; 2) a semi-structured interview and the completion of questionnaires; 3) a sensory testing session; 4) genital blood flow imaging. The gynecological examination will take place at the Department of Obstetrics and Gynecology, Kingston General Hospital. The interview, questionnaires, and sensory testing and genital imaging sessions will take place at the Sexual Health Research Laboratory, Department of Psychology, Queen's University, for approximately 2.5 to 3 hours.

Gynecological examination: During the gynecological examination (10-15 minutes), the doctor will visually and manually examine your internal and external
genitalia and reproductive organs and will touch different areas of your vulva (i.e., external genitals) with a cotton-swab. The doctor will ask you to rate any pain you experience during this examination on a scale of 0 to 10. You will be in complete control of the procedure and may ask to stop at any time and/or control the speed of the examination. A research assistant will be, and an observer (i.e. a medical student, resident) may be, present during the examination.

**Interview and questionnaires:** The semi-structured interview and questionnaires will take a maximum of 45 minutes to complete and will cover sociodemographic information, gynecological, sexual, and medical history, and pain information.

**Sensory testing:** During this session, you will experience pressure-pain stimulation at the vestibule (i.e., the vaginal opening) while your subjective pain ratings are recorded. Pressure-pain stimulation will be applied to the entrance of your vagina in a gradual manner, beginning with a very small amount of pressure. The pressure will then slowly increase until it results in a low level of pain. When this level is reached the pressure application will cease. At various points of the testing, you will be asked to rate the intensity and unpleasantness of the pain sensations on separate numerical rating scales, and describe the painful sensations. This session should take 10-15 minutes to complete. Sensory testing will be repeated following genital imaging.

**Genital imaging:** Laser Doppler imaging (LDI) will be used to evaluate your level of genital blood flow. The LDI machine will be placed close to, but will not touch your genitals. The machine will repeatedly scan your genitals while you watch three 15-minute film segments (2 nature films, 1 erotic film) through DVD goggles. You will be asked to rate your level of sexual arousal during the films, as well as answer a variety of questions before and after the erotic film. The imaging should take 45-60 minutes to complete.

**Compensation**
Upon completion of the gynecological examination, the interview/questionnaire session, and the sensory testing and genital imaging, you will receive $60.00 as compensation for your time and inconvenience. If the study has to be terminated for scientific reasons or if you decide to terminate the study, compensation will be adjusted according to the fraction of the study completed.

**Advantages of participating in this study**
You will have the opportunity to gain information about your genitals and PVD, and you will have access to resources related to keeping your genital region healthy. The information obtained from this study will potentially help our understanding of the relationship between sexual arousal (i.e. genital blood flow) and pain sensitivity.
Disadvantages of participating in this study
The major disadvantage involved in participating in this study is that some of the above procedures (i.e., gynecological examination and sensory testing) may be uncomfortable or painful. The stimuli used during the sensory testing session (i.e., cotton-swab applicators) may cause pain, discomfort, and/or temporary reddening of the skin, but they will not damage your skin. If you do experience pain, it will only last a few seconds. In addition, as some of the questions asked as part of the interview/questionnaire part of the study may cover sensitive topics, such as depression and sexual functioning, you may experience some discomfort answering them.

Confidential nature of this study
Your participation in this study is strictly confidential. The investigators will take all reasonable measures to protect the confidentiality of your records. This includes replacing your name and any identifying information with coded numbers. There will be one password-protected file linking your name and contact information with your participant ID number; the password for this file will be available only to the members of the research team working directly on this study. All written records and data will be identifiable only by your participant ID number, and all of this information will be kept in a locked filing cabinet, which is accessible only to students and staff working at the SHRL. You will not be identified in any publication or reports of this research; data will be aggregated in all reports of this study.

Discontinuation of this study
You are under no obligation to participate in this study, and your acceptance or refusal will not affect access to services. Furthermore, you are free to withdraw from the study at any time, and you are free to refuse to answer any question posed without need of any explanation on your part. In addition, the investigators may end your participation in this study for purely scientific reasons at any time.
Consent form

I, _____________________________, have volunteered to participate in the study entitled *The relationship between pain sensitivity and sexual arousal in women with provoked vestibulodynia*, conducted by Drs. Caroline Pukall and Susan Chamberlain, and by Stéphanie Boyer.

I consent to the information contained in the Letter of Information and understand what is required for participation in the study. I understand that my participation in the study is completely voluntary and that I am free to withdraw at any time. I understand that I will undergo a gynecological examination that will take place at the Kingston General Hospital to determine what genital pain problem I have, or to ensure that I am pain-free and can participate in the study as a control participant. In addition, once a diagnosis is established, I understand that I will complete an interview and questionnaire session. I understand that some of the questions in this session may be quite personal in nature as some of them are related to pain and sexual functioning. Further, I understand that I will undergo sensory testing that involves the application of non-painful and painful stimuli to my genitals, and genital imaging during which my genitals will be scanned. I also understand that my confidentiality will be protected throughout the study, that only investigators directly involved in this study will have access to the data resulting from the study, and that the information I provide will be available to researchers with scholarly interests in vulvodynia (i.e., chronic genital pain in women). I will keep a copy of the letter of information and consent forms for my records.

Should I have further questions, I understand that I can contact any of the following individuals:

- Dr. Caroline Pukall (613-533-3200; caroline.pukall@queensu.ca), Assistant Professor at the Department of Psychology at Queen's University and primary investigator of this study
- Dr. Vern Quinsey (613-533-2492; psychead@post.queensu.ca), Head of the Department of Psychology at Queen's University
- Dr. Albert Clark (613-533-6081), Chair of the Queen's University Health Sciences and Affiliated Teaching Hospitals Research Ethics Board

Signature: __________________________________________

Date: ______________________________________________
The Sexual Health Research Lab conducts a number of studies relating to women’s sexual health and functioning. Should you wish, we can keep your contact information in a password-protected participant recruitment file so that you can be contacted by a member of our research team for participation in other relevant studies.

Yes, Please contact me with information about future studies

Contact Information:

Name (please print):__________________________________________________________

Participant ID #:______________________________________________________________

Email:______________________________________________________________________

Phone Number:________________________________________________________________

No, Please do not contact me regarding future research
Appendix H
Debriefing Form

The relationship between pain sensitivity and sexual arousal in women with provoked vestibulodynia

The purpose of this study was to examine whether genital pain sensitivity is affected by sexual arousal in women with and without provoked vestibulodynia (PVD). We were also interested in examining how genital blood flow and pain sensitivity relate to psychological and sexual adjustment. You have been invited to participate in this study because you speak, read, and write English fluently, and you report having PVD or being free from such pain.

This study was conducted for educational purposes. We recruited two main groups of participants: women with and without PVD. Participants were recruited via advertisements. All participation was voluntary.

Research has shown women with PVD are more sensitive to pain in the genital region than women without PVD. This heightened sensitivity may be related to blood flow to the genital region, as women with PVD have been shown to have significantly higher levels of genital blood flow than pain-free women (Bohm-Starke et al., 2001). Increased genital blood flow is related to sexual arousal, and has been found to further increase pain sensitivity in women with PVD (Payne et al., 2007). As women with PVD tend to experience pain during sexual intercourse and since sexual intercourse is usually associated with sexual arousal, examining the relationship between genital pain sensitivity and genital blood flow in response to a sexually arousing film will contribute to our understanding of the pain experienced by women with PVD.

As stated previously, all information that you provided throughout the study is confidential. The research team members working directly on this project are the only individuals who have access to your responses. As compensation for your participation, a cheque for $60.00 will be sent to your home address.

Thank you for your participation in this study – it is greatly appreciated. Should you have any further questions, comments, or concerns, please do not hesitate to contact the Sexual Health Research Laboratory at (613) 533-3276, or SHRL@queensu.ca, or Dr. Caroline Pukall at (613) 533-3200 or caroline.pukall@queensu.ca

If you would like further information regarding this research topic or related topics, please consult the following articles. Please note that in the past PVD was often referred to as vulvar vestibulitis syndrome.


Appendix I
Participant Resource Sheet

Resources:

Who can I contact in the Kingston area?

Gynecology
Contact your family doctor for a referral to a local gynecologist.

Neurology
Contact your family doctor for a referral to a local neurologist.

Pelvic floor physiotherapy
Liz Tata, MCISc(PT)
Progress Physiotherapy Clinic, 817 Blackburn Mews, Kingston, K7P 2N6
Phone: (613) 533-6595
Please note that you need a referral from your family doctor to see Ms. Tata.

Psychology (focusing on couples therapy)
Dr. Debra Kowalik
797 Princess Street, Kingston
Phone: (613) 544-1065

Dr. Gisele Pharand
55 Sunny Acres Road, Kingston
Phone: (613) 384-1014

Francoise Mathieu, MEd, CCC
847 Princess Street, Kingston
Phone: (613) 547-3247

Dr. Vince Caccamo
221 King Street East, Kingston
Phone: (613) 547-9814

Sexual Health Research Laboratory
Phone: (613) 533-3276
Email: shrl@queensu.ca
General Mental Health Resources:

24 Hour Emergency & Crisis Resources:
The following are 24 hour emergency and crisis services available to the public. If you experience distress and require immediate assistance, you may call these numbers at any time to receive guidance and help:

**Belleville General Hospital** Emergency Dept (24 hours)
(613) 969-7400

This telephone number accesses the main switchboard of the hospital. The switchboard can then direct your call to the Emergency Department.

**Brockville General Hospital** Emergency Dept (24 hours)
(613) 345-5645

This telephone number accesses the main switchboard of the hospital. The switchboard can then direct your call to the Emergency Department.

**Hotel Dieu Hospital** Emergency Dept (24 Hours)
(613) 544-3310

This telephone number accesses the main switchboard of the hospital. The switchboard can then direct your call to the Emergency Department.

**Frontenac Community Mental Health Services (24 hour crisis line):**
(613) 544-4229

**Lanark Leeds and Grenville Mental Health Crisis Line:**
1-866-281-2911

**Lennox & Addington Community Crisis Centre:**
(613) 354-7388

**Telephone Aid Line Kingston (TALK):**
(613) 544-1771

In addition to a distress and crisis line, provides workshops on active listening skills and crisis response techniques. Available from 7 pm to 3 am every night.

Community Resources for Information on Mental Health and Counseling Services:
The following are professional services and information resources available to the public. If you experience distress and do not require immediate assistance, you may call these numbers to receive guidance and information on counseling and mental health services within your community:
Lanark County Mental Health
(613) 283-2170

Frontenac Community Mental Health Services (Information):
(613) 544-1356

Leeds and Grenville Rehabilitation and Counseling Services:
Brockville (Toll Free) (800) 267-4406
Delta (613) 928-3460
Gananoque (613) 382-4016
Kemptville (613) 258-7204
Prescott (613) 925-5940

Kids Help Phone: Parents Help Phone 1-888- 603-9100

*Provides 24-hour confidential support, information and referrals to parents and caregivers of children aged 0-19 years.*

Mental Health Services for Hastings and Prince Edward Counties:
Belleville Main Office (613) 968-2619 or (613) 967-4734
Prince Edward County (613) 476-2990
Centre Hastings (613) 478-9983
North Hastings (613) 332-3826
Trenton (613) 394-1655

Community Resources for Sexual Health

Sexual Assault Crisis Centre Kingston (SACCK)
(613) 544-6424 or (877) 544-6424

*Provides 24-hour confidential crisis support and information.*

Kingston Crisis Pregnancy Centre
(613) 545-0425 or 1-800-917-KCPC

*Provides confidential counseling and resources. Also offers free pregnancy tests, adoption options, maternity and baby clothes, and other baby needs. Does not provide abortions.*
**Sexual Health Resource Centre**
(613) 533-2959

Provides confidential, non-judgmental information and referrals for sexual health, sexually transmitted infections, birth control, and pregnancy alternatives.

**Web Links:**

Sex Information and Education Council of Canada (SIECCAN) website:  
[http://www.sieccan.org](http://www.sieccan.org)

Go Ask Alice! is a health question and answer internet service produced by Alice!, Columbia University’s Health Education Program. Its mission is to increase access to, and use of, health information by providing factual, in-depth, straight-forward, and nonjudgmental information to assist readers’ decision-making about their physical, sexual, emotional, and spiritual health:  

Canadian website devoted to sexuality education and information and administered by the Society of Obstetricians and Gynecologists of Canada:  
[http://www.sexualityandu.com/index_e.aspx](http://www.sexualityandu.com/index_e.aspx)

A site that contains general information on vulvar pain:  

A website dedicated to vulvodynia:  

The International Society for the Study of Vulvovaginal Disease (ISSVD) website:  

National Vulvodynia Association website:  

A discussion group for general vulvar problems:  
[http://groups.yahoo.com/group/VulvarDisorders/](http://groups.yahoo.com/group/VulvarDisorders/)
Un groupe de discussion sur internet dédié spécifiquement au syndrome de vestibulite vulvaire (site en français):
http://groups.msn.com/Vestibulite

Groupe Elva: l’Association officielle pour les femmes atteintes de maladies vulvo-vaginales (site en français):
http://www.groupeelva.org/

International Academy of Sex Research (IASR) website:
http://www.iasr.org/

International Society for the Study of Women’s Sexual Health (ISSWSH) website:
http://www.isswsh.org/

Society for the Scientific Study of Sexuality (SSSS):
http://www.sexscience.org/

Society for Sex Therapy and Research (SSTAR) website:
http://www.sstarnet.org/

National Headache Foundation website:
http://www.headaches.org/consumer/index.html

Mayo Clinic website:
http://www.mayoclinic.com
Specifically, this website provides information on migraine that can be accessed at:
http://www.mayoclinic.com/health/migraine-headache/DS00120

International Association for the Study of Pain (IASP) website:
www.iasp-pain.org/
Specifically, this website provides a list for the general public of organizations that focus on conditions that involve pain. This list can be accessed by
clicking the resources link at the top of the IASP homepage.

National Institutes of Health (NIH). Specifically, this website provides information on migraine:

The College of Psychologists of Ontario (CPO) website:
http://www.cpo.on.ca/
This website provides information on psychological services in Ontario, and allows you to search for psychologists and specific providers of such services.

The Canadian Psychological Association (CPA) website:
http://www.cpa.ca/
This website provides general information on psychology in Canada. It also provides specific information for the general public on various mental and physical health conditions.

American Psychological Association (APA) website:
http://www.apa.org/
This website provides general information on psychology in North America.