

THE RELATIONSHIP BETWEEN PSYCHOSOCIAL FUNCTIONING AND DIFFUSE
NOXIOUS INHIBITORY CONTROL FUNCTION IN WOMEN WITH PROVOKED
VESTIBULODYNIA AND PAIN FREE CONTROLS

by

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Abstract

Provoked Vestibulodynia (PVD) is the most common form of chronic vulvar pain, affecting 12% of women in the general population. PVD is characterized by a severe burning pain in response to pressure localized to the vaginal entrance. Research examining the pain component of PVD indicates that it has much in common with other chronic pain conditions. Increased pain sensitivity has been demonstrated in other chronic pain conditions to be due in part to impairment in centrally acting endogenous pain modulation systems, such as Diffuse Noxious Inhibitory Control (DNIC). DNIC is triggered by the simultaneous application of two painful stimuli, with pain at one body site inhibiting pain at another body site. Because DNIC consists of a feedback loop that involves the spinal cord and the brain, it is thought to be dependent upon both sensory and affective pain components. In the current study, 20 women with PVD and 24 controls underwent sensory testing to determine the integrity of DNIC function. Unexpectedly, women with PVD displayed a DNIC response of greater magnitude than controls. Participants also completed measures to assess the interplay between group, DNIC, and psychosocial functioning. Women with PVD experienced decreases in psychosocial functioning; however, this reduction was not found to mediate the relationship between group and DNIC function. Findings of intact DNIC function in women with PVD do not imply that PVD is not a chronic pain condition. DNIC is a complex and dynamic process and warrants further study using different stimuli and paradigms. This study supports previous literature, while adding to the development of a greater understanding of the interaction between psychophysical and psychosocial components of chronic pain, which will allow for the creation of better assessment and treatment strategies.

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Chapter 1

Introduction

Provoked Vestibulodynia (PVD) is defined as an idiopathic chronic pain condition in which a woman experiences a provoked, burning pain localized to the vulvar vestibule (i.e., vaginal opening). PVD is considered to be a neuropathic chronic pain syndrome (Tympanidis, Terenghi, & Dowd, 2003), which is perpetuated by an alteration in the ratio of excitatory and inhibitory neurons at the dorsal horn of the spinal cord (Melzack & Wall, 1996). A change in the ratio of these neurons can result in structural changes in the dorsal horn, thus altering the processing of pain information (Woolf & Doubell, 1994). There are numerous mechanisms by which these alterations in excitation and structure can occur; it is still not entirely understood how an identical injury leads to different effects for different individuals or even within the same individual at different times (Melzack & Wall, 1996). One hypothesis suggests that the ratio of neurons can be altered by a decrease in Diffuse Noxious Inhibitory Control (DNIC). When functioning properly, DNIC sends inhibitory signals from the brain to the synapses within the spinal cord, resulting in an inhibition of or decrease in pain. In many chronic pain conditions, DNIC does not function properly, resulting in disinhibition and thus leading to the perception of pain in the absence of painful stimuli. Because DNIC signals originate in the brain, they could potentially account for some of the interplay between physiological and psychological factors in the experience of pain. To support this hypothesis, a study of DNIC effects in healthy participants found that DNIC was a consistent predictor of clinical pain and physical health, with greater DNIC responses correlating with less pain, better physical functioning, and better self-rated health (Edwards et al. 2003a). The

current study will expand on these findings in order to examine the interplay between DNIC functioning and catastrophization, somatization, self-efficacy, and sexual functioning in women with PVD.

The role of DNIC in women with PVD will be examined in order to test the integrity of modulatory control of pain in affected women versus non-affected women. The major aim of this research is to increase the current knowledge of the mechanisms involved in the onset and/or maintenance of PVD by examining DNIC function. Findings of diminished DNIC function in women with PVD, in combination with the replication of previous quantitative sensory testing (QST) data demonstrating both peripheral and central nervous system changes, will provide further support for conceptualizing PVD as a chronic pain condition.

Given that PVD has been found to have similar characteristics to other chronic pain conditions, such as rheumatoid arthritis, it is possible that therapeutic interventions found successful in the treatment of similar pain conditions would be applicable to the treatment of PVD. In addition, this research will allow for the elucidation of one potential mechanism underlying the increase in sensitivity in affected women. Psychosocial measures of catastrophization, somatization, self-efficacy, and sexual function will also be examined to assess whether or not they mediate the relationship between group (control, PVD) and psychophysical pain. Examining these complex relationships will allow for the investigation of the interplay between psychophysical and affective components of pain, thus increasing our understanding of the mechanisms by which chronic pain might be initiated or perpetuated. This research has clinical relevance in

terms of understanding what role, if any, centrally acting medications may assist in the treatment of PVD.

Chapter 2

Literature Review

Vulvodynia

The vulva is defined as the external female genitalia, and it includes the clitoris, labia majora and minora, and the vaginal opening, also termed the vulvar vestibule. While for many women the vulva represents an area of immense pleasure, for some women it can be associated with pain; the most common cause of this pain is a disorder termed vulvodynia. The International Society for the Study of Vulvovaginal Disease (ISSVD) defines vulvodynia as “vulvar discomfort, most often described as burning pain, occurring in the absence of relevant visible findings or a specific, clinically identifiable, neurologic disorder” (Haefner, p. 49, 2007). Although chronic vulvar pain has a reported lifetime prevalence of approximately 16% for women in the general population (Harlow, Wise, & Stewart, 2001), it remains one of the most understudied areas of medical and psychological research (Stewart, 2002). The current lack of awareness regarding vulvar disorders, the tendency to view the problem purely as a sexual dysfunction, and the reluctance of women to discuss this very private and meaningful part of their bodies, are all important contributing factors to the under-reporting and under-diagnosis of PVD (Edwards, 2003; Harlow & Stewart, 2003). In fact, a study conducted by Harlow et al. (2001) found that only 50% of women with vulvar pain sought treatment. Of those who did seek treatment, 40% did not receive a diagnosis despite multiple consultations. These statistics reflect the severe lack of medically-related knowledge related to this common and chronic condition.

Provoked Vestibulodynia

Much of the research on vulvodynia to date has focused on Provoked Vestibulodynia (PVD; formerly Vulvar Vestibulitis Syndrome), the most common subtype of vulvodynia. A recent epidemiological study estimated that PVD affects 12% of women in the general population (Harlow et al., 2001). PVD is characterized by a provoked pain localized to the vulvar vestibule (i.e., the vaginal entrance; Friedrich, 1987). Until recently, PVD was considered to be a sexual dysfunction because the most common complaint of women presenting with PVD is that of dyspareunia (i.e., painful intercourse). The major problem with this conceptualization is that the pain can also be elicited by non-sexual activities, such as tampon insertion and gynecological examinations (Meana, Binik, Khalifé, & Cohen, 1997). Although it is important to acknowledge the role of psychosocial factors in the maintenance of PVD, focusing solely on psychosexual conflict may invalidate the pain aspect of the patients' syndrome, resulting in iatrogenic harm (Meana et al., 1997). Therefore, it is important to move away from the idea that PVD is a "sexual pain," and instead begin to view it as a chronic pain syndrome that interferes with sexual functioning (e.g., Pukall, Payne, Binik, & Khalifé, 2003; Pukall, Payne, Kao, Khalifé, & Binik, 2005a). Due to recent research supporting similarities between PVD and other chronic pain syndromes, PVD is now being regarded by many researchers and clinicians as a chronic pain syndrome (e.g., Binik, Reissing, Pukall, Flory, Payne, & Khalifé, 2002).

PVD is an example of an idiopathic chronic pain syndrome, indicating that persistent pain is present in the absence of any identifiable tissue damage (Melzack & Wall, 1996). This characteristic is reflected in the diagnostic criteria for PVD: 1) severe

pain upon vestibular touch or attempted vaginal entry; 2) tenderness to pressure localized to the vulvar vestibule; and 3) physical findings limited to the presence of vestibular redness (Friedrich, 1987). Bergeron, Binik, Khalifé, Pagidas, Glazer, Meana et al. (2001) found evidence of reliability and validity for the first two of Friedrich's criteria, but not for the third, indicating that, as stated in the definition of vulvodynia, physical findings do not correlate with pain. The discordance between pain and physical findings is a common report in the pain literature; pain, particularly chronic pain, is most often diagnosed in the absence of identifiable pathology. Absence of physical pathology should not be taken to imply that the pain is 'all in the patient's head'; rather, it is the case that research in chronic pain is in its infancy and we have yet to fully comprehend the mechanisms by which chronic pain may be induced or persist in the absence of visible pathology (Calvino & Grilo, 2006). Currently, the diagnosis of PVD is based on the patient's self-report of pain during sexual intercourse and/or other penetrative activities, such as tampon insertion. The diagnosis is confirmed by a positive (i.e., painful) response to the cotton-swab test, during which areas of the vulva are palpated in order to assess tenderness to pressure localized to the vulvar vestibule (Pukall, Binik, & Khalifé, 2004).

There is no agreed upon etiology of PVD, and researchers have hypothesized that many factors may play a role. The mechanisms involved in the persistence of the pain are also hypothesized to differ. There are currently five major lines of research examining potential causes and mechanisms of PVD progression: neurological (Bohm-Starke, Hilliges, Brodda-Jansen, Rylander, & Torebjork, 2001; Giesecke, Reed, Haefner, Giesecke, Clauw, & Gracely, 2004; Granot, Zimmer, Friedman, Lowenstein, & Yarnitsky, 2004; Granot, 2005; Granot & Lavee 2005a; Lowenstein, Vardi, Deutsch,

Friedman, Gruenwald, Granot et al., 2004; Pukall, Binik, Khalifé, Amsel, & Abbott, 2002; Pukall et al., 2004; Pukall, Strigo, Binik, Amsel, Khalifé, & Bushnell, 2005), musculoskeletal (specifically pelvic floor problems; Bergeron, Brown, Lord, Binik, & Khalifé, 2002; Glazer, Rodke, Swencionis, Hertz, & Young, 1995; Reissing, Binik, Khalifé, Cohen, & Amsel, 2004; Rosenbaum, 2005), dermatological (Gunter, Brewer, & Tawfik, 2004; Tympanidis, Casula, Yiangou, Terenghi, Dowd, & Anand, 2004), genetic (Bester, De Felipe, & Hunt, 2001; Gerber, Bongiovanni, Ledger, & Witkin, 2002, 2002a; Jeremias, Ledger, Witkin, 2000), and psychological, which includes the examination of psychosocial and psychosexual components (Consoli, 2003; Gordon, Panahian-Jand, McComb, Melegari, & Sharp, 2003; Granot, 2005; Jadresic, Barton, Neill, Staughton, & Marwood, 1993; Schmidt, Bauer, Greif, Merker, Elsner, & Strauss, 2001). Treatment studies have addressed each of these five mechanisms separately with varying degrees of success. It appears that PVD may stem from and be maintained by a complex combination of the five (and perhaps additional) factors, supporting the use of a multidimensional approach to the understanding and treatment of PVD (Bergeron, Binik, Khalifé, Meana, Berkeley, & Pagidas, 1997; Pukall et al., 2005, 2005a).

The current study examined the interplay between various physiological and psychological factors involved in the etiology and/or maintenance of PVD. This approach is consistent with current multidimensional conceptualizations of pain (e.g., Melzack & Wall, 1996) that emphasize the importance of examining both physiological (e.g., peripheral and central nervous system function) and psychological factors (e.g., catastrophization and somatization) involved in the pain experience. The next section will contain a review of the literature relevant to the physiological aspect of the current study.

This section will be followed by a review of the literature relevant to the psychosocial profiles of women with PVD.

Quantitative Sensory Testing

One way to investigate the integrity of the peripheral nervous system in patients with pain conditions is through psychophysical measurement, or quantitative sensory testing (QST). This type of methodology encompasses a wide variety of non-invasive tests for the assessment and objective quantification of sensory nerve function and has been widely used in individuals with pain conditions (Bergeron, Pukall, & Mailloux, 2005a). In addition, ratings can be collected during testing to investigate different subjective dimensions of pain, such as intensity and unpleasantness. A number of recent research studies have applied this methodology to examine sensory functioning in women with PVD and have revealed patterns of sensitivity commonly observed in other pain patients. Women with PVD have been found to display hyperalgesia (i.e., increased response to painful stimuli) and allodynia (i.e., pain in response to non-painful stimuli). For example, in a study by Pukall et al. (2002), women with PVD exhibited lower pain thresholds and greater distress to painful stimuli as compared to control women both at the vulvar vestibule and over the deltoid muscle. This increased sensitivity has been attributed to both peripheral and central nervous system mechanisms given that the increase in sensitivity is present in, but not restricted to, the vestibule. Other studies have supported these findings (Giesecke et al., 2004; Granot, Friedman, Yarnitsky, & Zimmer, 2002; Pukall, Baron, Amsel, Khalifé, & Binik, 2006). Current theory suggests that while local changes in the vulvar vestibule, such as hyperinnervation, may initiate PVD, central nervous system factors may function to maintain the pain (Pukall et al., 2003). However,

it is not known whether the local and general pain sensitivity develop simultaneously or whether one precedes the other.

Physiological Basis of Pain in PVD

The vulvar vestibule is innervated by the pudendal nerve (Krantz, 1958) which contains two distinct types of fibers associated with the sensation of pain. Myelinated A-delta fibers mediate the initial pain sensation and unmyelinated C-fibers mediate ongoing pain (Bohm-Starke, Hilliges, Falconer, & Rylander, 1998). When a nociceptive (i.e., painful) stimulus is encountered, nerve signals encoding the nociceptive stimulus travel along both A-delta and C fibres to the dorsal horn of the spinal cord. When the peripheral pain signals arrive at these synaptic regions in the spine, they are processed through a gate-control mechanism (Melzack & Wall, 1996). Messages are processed from both the peripheral and central nervous system in order to determine whether the signals are inhibited or facilitated in reaching the brain and thus resulting in the perception of pain.

Melzack and Wall's gate-control theory of pain (1965) postulates that the pain message is facilitated or inhibited from reaching the brain based on the opening or closing of a gate-like mechanism located in the spinal cord. The gate consists of two types of signals which work in combination to determine which peripherally signaled messages are transferred up the spinal cord to the brain. Excitatory signals, which are activated by a pain stimulus, open the gate and send the pain message to the brain. Inhibitory signals close the gate, preventing the pain message from being sent to the brain. The balance between inhibition and facilitation is actively modulated by multiple endogenous neural systems. Pain is perceived only when the balance of input to the

dorsal horn of the spinal cord tips in favour of the excitatory influences, either because of excessive nociceptive activity or deficient inhibitory influences.

Inhibitory signals can be produced in at least two distinct ways: peripherally and centrally. Some inhibitory signals are produced by the activation of touch fibers (A-beta fibers) within the same region of the body in which the pain signal is produced. For example, rubbing a hurt elbow can decrease pain intensity through competing tactile (i.e., touch) stimulation. This type of inhibitory signal is controlled by the cells in the dorsal horn of the spinal cord; it is independent of any influence from the brain (Melzack & Wall, 1996). Other inhibitory signals descend from the brain to the synapses within the spinal cord. One example of a centrally-modulated source of inhibitory signals is diffuse noxious inhibitory control (DNIC).

Diffuse Noxious Inhibitory Control

DNIC is a supraspinal measure of descending endogenous pain inhibition (Roby-Brami, Bussel, Willer, & Le Bars, 1987; Edwards, Ness, Weigent, & Fillingim, 2003a) which is involved in the coding of nociceptive information (Price & McHaffie, 1988). DNIC is activated by both A-delta and C fibers. It exists only for the nonspecific nociceptive neurons, also known as wide dynamic range (WDR) neurons, found in the dorsal horn of each spinal cord segment. DNIC decreases pain by supraspinally-generated inhibition of the WDR neurons (Hu, 1990). DNIC can be experimentally produced in response to stimulation of pain fibers in an area of the body distal from the pain site, that is, a site that does not share the same excitatory receptive field. Noxious stimulation of a second body site increases the descending control of pain signaling from the spinal cord, thus providing an inhibitory input and closing the pain-gate to the original site of pain (Le

Bars, 2002). In other words, pain from one site may mask pain from another site by inhibiting the nociceptive neurons activated by the weaker stimulus (Calvino & Grilo, 2006). The more intense the nociceptive input, the more inhibition, and thus the stronger the DNIC effect (Edwards et al., 2003). The powerful inhibitory effect produced by DNIC can persist for several minutes following the application of a second noxious stimulus.

Typically, pain signals are decreased by DNIC. Studies of healthy, pain-free individuals reveal intact DNIC functioning: the application of one noxious stimulus inhibits the perception of pain produced by the application of a second noxious stimulus (Edwards, Fillingim, & Ness, 2003). However, studies of patients with chronic pain conditions (e.g., fibromyalgia, chronic back pain, irritable bowel syndrome), suggest that they have either a diminished or non-existent DNIC response, and thus, experience increased pain intensity (Kosek & Hansson, 2002; Price, Staud, Robinson, Mauderli, Cannon, & Vierck, 2002; Staud, Vierck, Robinson, & Price, 2004; Wilder-Smith, Schindler, Lovblad, Redmond, & Nirkko, 2004). In other words, chronic pain patients may not experience any reduction in pain during the application of two simultaneous pain stimuli.

Because DNIC is relatively easy to induce in a laboratory setting, it offers a functional test of central pain-modulatory mechanisms (Lautenbacher & Rollman, 1997), which applies to both the experience of clinical pain and responses to experimental noxious stimuli (Ren & Dubner, 2002). The experimental study of DNIC requires the application of two simultaneous pain stimuli to different areas of the body. Noxious stimuli can be thermal, mechanical, or chemical in nature. The premise is that if DNIC is

functioning, two simultaneous pain stimuli will result in less pain (as measured by threshold, tolerance, and subjective pain ratings) than if applied at different times (Lautenbacher, Roscher, & Strian, 2002). There are a number of slightly different experimental procedures used to induce DNIC in the laboratory. Each of these procedures involves the application of a phasic (test) pain stimulus before, during and after the application of a conditioning stimulus. In order to activate DNIC, both the phasic and conditioning stimuli must be nociceptive.

Given that women with PVD exhibit patterns shown in many other pain conditions, one possible explanation for their lower pain thresholds is that they have diminished DNIC functioning as compared to non-affected women. This pattern would suggest that their central nervous system is not sending enough inhibitory signals to the pain-gate to outweigh the excitatory action that is opening the gate. To date, there has been only one study examining DNIC function in a group of women with PVD. Johannesson, Nygren de Boussard, Jansen, and Bohm-Starke (2006) found that women with PVD displayed an intact DNIC response, indicating the existence of endogenous pain inhibition. This result may appear to contradict the idea that PVD is a chronic pain condition; however, it may be the nature of the chronic pain that determines the DNIC response. Findings of diminished DNIC response have been found in chronic pain conditions in which the pain is constant and unrelenting (e.g., fibromyalgia, chronic back pain). The term 'chronic' in the pain literature refers both to the length of time of the pain symptoms (usually a minimum of 6 months) as well as to the temporal characteristics of the pain (i.e., the pain is experienced almost all the time, almost every day). Both parts of this definition apply to chronic back pain, for example. However, although the diagnosis

of PVD requires a minimum duration of 6 months, corresponding with the first part of the definition, the pain of PVD is not constant; it is provoked and can be successfully avoided. Thus, PVD is a chronic intermittent pain. Despite previous findings that DNIC function is intact, diminished functioning in comparison to control participants may provide an explanation of a central mechanism involved in the development and/or maintenance of PVD and could potentially explain the heightened neural response to pain found in this condition. Further examination of DNIC function in PVD is warranted to provide further information about the extent to which this mechanism is functioning.

Johannesson et al. (2006) examined DNIC in women with PVD by eliciting pressure pain on the leg and arm. The current study used a slightly different protocol, and will thus build upon existing findings regarding PVD and DNIC response. The current study examined DNIC effects of heat pain by assessing pain tolerance and temporal summation (i.e., wind up) of heat pain. Temporal summation procedures activate two distinct types of fibres: A-delta fibres, which are associated with first pain, defined as the initial sharp pain felt with each pulse and C-fibers, which are associated with second pain, defined as the burning after sensation that follows each pulse. Temporal summation is defined as the increase in perceived second pain as a function of continued application of a painful stimulus (Harkins, Davis, Bush, & Kasberger, 1996). Although second pain increases with time, the temporal summation procedure produces a decrease in first pain over time.

Temporal summation is a centrally-mediated phenomenon which has been shown to differ between patients with chronic pain disorders and healthy participants. For example, patients with fibromyalgia report greater increases in subjective pain ratings for

a noxious stimulus of constant intensity than do pain-free matched controls (Price et al., 2002). Temporal summation is believed to contribute to neural processes that lead to hyperalgesia and persistent pain; it is therefore relevant to the development of chronic pain conditions (Staud, Robinson, Vierck, & Price, 2003), such as PVD. DNIC effects can be found by examining both first and second pain, but they are greatest on measures of second pain, a type of pain which is most easily assessed through temporal summation (Price and McHaffie, 1999).

Psychosocial Aspects of Pain

Quality and intensity of pain are not just based on physiological mechanisms; they are also influenced by psychosocial variables. Psychological processes can intervene between a stimulus and perception of the stimulus, therefore creating a high degree of variability between the two, leading to individual differences in pain perception (Melzack & Wall, 1996). It is evident from the wide variety of outcomes occurring from the same stimulus that pain is not just a mathematical relationship between stimulus intensity and pain intensity, but a complex multimodal phenomenon which incorporates a combination of biological, psychological, and environmental mechanisms (Melzack & Wall, 1996). Supporting this complex relationship is the lack of a direct relationship between self-reported pain severity (psychological) and actual pain threshold or tolerance (physiological; Edwards & Fillingim, 2007). Given the multimodal experience of pain, the current study also examined the roles of subjective and psychosocial aspects of pain.

Psychosocial factors play an important role in the modulation of pain intensity in chronic pain populations (Edwards, 2005; Heyneman, Fremouw, Gano, Kirkland, & Heiden, 1990; Keefe, Rumble, Scipio, Giordana, & Perri, 2004; Price & McCaffie, 1999;

Turk & Okifuji, 2002). There is an abundant literature examining the relationship between chronic pain and psychosocial functioning (Keefe et al., 2004); anxiety and depression, for example, are commonly reported in chronic pain patients. Women with PVD also report reduced psychosocial functioning, such as higher levels of catastrophization and somatization, and lower levels of sexual functioning, relationship adjustment, and overall quality of life as compared to control women (Arnold, Bachmann, Rosen, Kelly, & Rhoads, 2006; Bergeron, Pukall, & Binik, 2005; Danielsson, Sjoberg, & Wikman, 2000; Gates & Galask, 2001; Masheb, Wang, & Lozano, 2005; Meana et al., 1997; Pukall et al., 2002; Pukall, Lahaie, & Binik, 2005b; White & Jantos, 1998). The current study will focus on somatization, catastrophization, and self-efficacy in women with PVD; these factors have been shown to be intimately tied to the experience of pain (Danielsson et al., 2000; Eriksen & Ursin, 2002; France, France, al'Absi, Ring, & McIntyre, 2002; Sullivan, Thorn, Haythornthwaite, Keefe, Martin, Bradly et al., 2001; Turk & Okifuji, 2002), but have not yet been examined in relation to psychophysical functioning in women with PVD. Due to the fact that this particular pain condition is tied so closely with sexual activity, sexual functioning will also be examined.

Somatization is the tendency to selectively focus on and display hypersensitivity to a number of relatively weak or infrequent physical sensations (Ak, Sayer, & Yontem, 2004). A recent study on psychological characteristics of chronic pain patients found that, in comparison to healthy controls, individuals with chronic pain displayed greater amplification of their somatic sensations (Ak et al., 2004). As well, women with PVD report more somatic symptoms as compared to control women (Danielsson et al., 2000). This increase in somatization could be due to increased pain sensitivity and decreased

pain inhibitory capacity. Catastrophizing, the tendency to magnify and ruminate about pain (France et al., 2002), has been associated with lower pain thresholds and enhanced central nervous system pain processing (Edwards, 2005). In other words, higher levels of catastrophizing are linked with greater pain reports (France et al., 2002). Women with PVD have been shown to catastrophize more in response to their vulvar pain than to their most distressing, regularly experienced non-vulvar pain; as well, they catastrophize more about their most distressing non-vulvar pain than do pain-free women (Pukall et al., 2002, 2005a). Bergeron et al. (2005) found that high levels of pain catastrophizing and low levels of self-efficacy explained 44% of the variance in pain intensity ratings in women with PVD. Given the higher levels of somatization and catastrophization reported in women with PVD, it is not surprising that self-efficacy can also be adversely affected.

Self-efficacy is the personal conviction that one can successfully perform a set of required behaviours in a particular situation. Self-efficacy has been found to play an important role in the perception of pain (Turk & Okifuji, 2002). For example, Keefe, Affleck, Lefebvre, Starr, Caldwell, and Tennen (1997) found that patients with higher levels of self-efficacy reported lower levels of pain and psychological distress. Keefe et al. (1997) also showed that improvement in a patient's self-efficacy resulted in subsequent improvement of their pain. In a case such as PVD, where the pain is chronic, but of a provoked rather than constant nature, it is important to study self-efficacy in the particular domain of patient's life that is most clearly affected by the pain. Sexual self-efficacy examines an individual's confidence that he/she can successfully perform a set of sexual behaviours. Research has shown that, just as other chronic pain patients rate themselves more negatively in terms of the areas of life in which their pain is interfering,

women with PVD rate themselves more negatively as sexual individuals (Reed, Advincula, Fonde, Gorenflo, & Haefner, 2003). Women with PVD have been found to experience increased levels of sexual impairment and sexual dysfunction (e.g., Meana et al., 1997; Sackett, Gates, Heckman-Stone, Kobus, & Galask, 2001; Masheb, Lozano-Blanco, Richman, Minkin, & Kerns, 2004).

Chapter 3

Hypotheses

1) In keeping with previous research, it is hypothesized that group differences between women with PVD and non-affected women will exist in tactile, pressure, and thermal sensory thresholds at both genital and non-genital sites. It is also predicted that group differences will exist for the psychosocial variables of somatization, catastrophization, sexual self-efficacy, and sexual functioning.

2) It is hypothesized that, as in other chronic pain conditions, women with PVD will have less descending inhibition, specifically, diminished DNIC, in comparison with non-affected women

3) It is hypothesized that group membership will be predicted by DNIC function. Psychosocial variables are hypothesized to play a role in DNIC function, thus, it is predicted that these variables will act as mediators in the relationship between group and DNIC function.

Chapter 4

Methods

Participants

Data were collected from a total of 44 individuals (20 women with PVD, 24 pain-free control women) recruited through local doctor's offices, newspaper ads, and other posted advertisements around the community (Appendix A). Participants completed the study between September 2006 and June 2007. Women in the two groups did not differ significantly in age, $t(42) = -.267, ns$ (PVD $M = 26.15, SE = 2.07$; Control $M = 25.46, SE = 1.61$), parity, $\chi^2(1, N = 44) = 0.80, ns$, or hormonal contraceptive use, $\chi^2(1, N = 44) = 0.70, ns$. Approximately 1/5 of the participants had given birth at least once (PVD = 20%; Control = 17%), and just over one half were currently using a hormonal contraceptive (PVD = 50%; Control = 63%).

In order to be included in the PVD group, participants were required to be over the age of 18, meet criteria for a diagnosis of PVD during a standardized gynecological examination, and report pain symptoms for a minimum of 6 months. Participants in the control group were included if they reported pain-free intercourse and had an average pain rating of less than 4 on the Likert scale during the cotton-swab-test portion of the standardized gynecological examination (see below). Exclusion criteria for both groups were: (1) current pregnancy; (2) diagnosis or history of hypertension, circulatory disorders, or other cardiac problems; (3) current use of any centrally acting medications (e.g., anti-depressants); (4) other chronic pain conditions; (5) major medical and/or psychiatric illness; (6) active vaginal infections; (7) concurrent gynecological problems; and (8) surgical treatment involving the urogenital region.

Thirty-nine potential participants did not meet our inclusion criteria during the telephone screening (N = 1 reported a current pregnancy, N = 12 reported current use of a centrally acting medication, N = 2 reported another pain condition; N = 1 reported major medical and/or psychiatric illness, N = 13 reported concurrent gynecological problems, N = 2 had never had a previous gynecological examination, N = 8 chose not to participate after completing the screening). A further 13 were excluded following the gynecological examination (N = 1 was on a centrally acting medication, N = 3 had other gynecological problems, N = 5 did not meet the diagnostic criteria for PVD, N = 4 did not finish the exam due to reported anxiety). Each of these women was debriefed and referred appropriately when necessary. The drop-out rate for participants meeting criteria after the gynecological examination was quite low; of the 50 women eligible to participate, 44 (88%) completed the study. Of the six women who did not complete the study, two moved away and four were no longer interested in participating due to ‘personal reasons.’

Procedures

Interested participants were directed to contact the Sexual Health Research Laboratory at Queen’s University in order to receive detailed information regarding the study procedures. If, after hearing more about the study, the participants were still interested, they were screened for eligibility using a brief (10 minute) screening interview (Appendix B). Those not excluded during the screening interview were invited to attend a gynecological examination to confirm their eligibility. The study as a whole consisted of the informed consent process and gynecological examination (20-30 minutes), an interview (30-45 minutes), questionnaires (30 minutes), and a quantitative sensory testing (QST) session (2 hours). All participants underwent QST during the late follicular phase

(days 7 to 12) of their menstrual cycles in order to control for cyclic variations in pain thresholds and tolerance (Besson, Piguet, Desmeules, Oestreicher, Grandjean, Hermann, et al., 2004). Depending upon the participants' schedules, they attended 1 to 3 sessions in order to complete the study. However, regardless of how many times the participant chose to come in, all of the sensory testing was completed over the course of the same session with the same experimenter who administered the interview and questionnaires. The interview was always administered prior to the sensory testing in order to build rapport with the participant and to allow time for any questions that might arise. For their time and inconvenience, participants were compensated CAN \$100.00 upon completion of the study. For those deemed not eligible after the gynecological examination or who chose to withdraw from the study, a partial sum of this amount was paid for the time invested.

Gynecological examination: Eligible women were scheduled for an appointment in the Department of Obstetrics & Gynecology at Kingston General Hospital, during which time the study procedures were re-explained. Participants were given a letter of information (Appendix C), a consent form (Appendix D), and a brief medical and pain history questionnaire (Appendix E). Once consent was obtained, participants underwent a brief gynecological examination (10 minutes) conducted by the study gynecologist, Dr. Susan Chamberlain. The purpose of this examination was to confirm participant eligibility for either the PVD or control group. The examination involved a standardized protocol involving a visual and manual examination of the external and internal reproductive organs (Appendix F). As well, it consisted of a cotton-swab palpation of five areas of the vulvar vestibule (1, 4-5, 6, 7-8, and 11 o'clock), three

midline areas (between urethra and vaginal opening, vaginal opening, posterior fourchette, perineum), and the labia (Appendix G). The cotton-swab test of the vulvar vestibule is the standard gynecological method for diagnosing PVD (Friedrich, 1987). The current study included cotton-swab palpations of the entire vulvar region in order to differentiate between women with PVD and those with generalized vulvodynia, a pain condition affecting a more widespread region of the genitals. A research assistant was present throughout the gynecological examination in order to record participant's pain intensity ratings for the cotton swab palpations and the speculum insertion. The verbal ratings given by the participant were recorded as whole numbers on a numerical rating scale (*0 = no pain, 1-3 = mild pain, 4-6 = moderate pain, 7-9 = severe pain, 10 = worst pain imaginable*) which was explained in detail to the participant prior to the examination. Prior to commencing, participants were informed of their ability to control the pace of the examination and to terminate the examination at any point without question.

Interview and psychosocial questionnaires. The structured interview (30-45 minutes) included questions pertaining to sociodemographic information, medical and gynecological history, sexual and relationship functioning, and pain during intercourse and other activities (Appendix H). After the interview, participants filled out four questionnaires (30 minutes). **(1) The physical sub-scale of the Short-Form-36 Health Survey** (SF-36; Ware & Sherbourne, 1992; Appendix I) was used as a measure of physical health status, in particular somatization. The SF-36 has been validated on a variety of populations, including chronic pain patients. This measure was administered to all participants. The internal consistency was in the moderate range ($\alpha = 0.64$) for the

current study. **(2) The Pain Catastrophizing Scale (PCS;** Sullivan, Bishop, & Pivik, 1995; Appendix J) is a 13-item measure consisting of descriptions of various thoughts and feelings people might experience related to pain. The respondent indicates on a Likert-type scale of 0 (*not at all*) to 4 (*all the time*) how often they experience that particular thought or feeling when they are in pain. This scale was administered to all women in relation to their most distressing non-vulvar pain, and again to women with PVD in relation to their vulvar pain. This measure demonstrated good internal consistency for the present study ($\alpha = 0.91$). **(3) The Sexual Self-Efficacy Scale for Female Function (SSES-F;** Creti, Bailes, Fichten, Libman, Amsel, Liederman, et al., 1989; Appendix K) is a 37-item measure assessing a woman's perceived competence in the behavioural, cognitive, and affective dimensions of female sexual response. The SSES-F showed good internal consistency ($\alpha = .93$) and has been validated against other measures of sexual functioning. This questionnaire was completed by all women in the study. **(4) The Female Sexual Function Index (FSFI;** Rosen et al., 2000; Appendix L) is a 19-item measure assessing six domains of sexual functioning: desire, arousal, lubrication, orgasm, satisfaction, and pain. The FSFI has been validated on control women as well as women with sexual dysfunctions. It has proven to be a reliable measure, with both clinical and psychometric validity. Internal consistency for this measure was high ($\alpha = 0.96$).

Quantitative sensory testing (QST) measures. Three measures were used to assess various aspects of pain during QST. Each time a stimulus was applied, participants were asked to verbally rate the **intensity and unpleasantness** on two separate 0-10 numerical rating scales for non-painful (*0 = no sensation/not at all unpleasant; 10 = maximum*

intensity prior to pain/most unpleasant) or painful stimuli (*0 = no pain at all/not at all unpleasant; 10 = worst pain ever/most unpleasant ever*). For each of the scales, participants were required to provide their response in whole numbers, where numbers 1-3 referred to mild, 4-6 to moderate, and 7-9 to severe sensation/pain/unpleasantness. Although the participants did not physically mark their responses on the numerical scales, they were able to refer to the scales posted on the wall beside them throughout the testing procedures (Appendix M). The **Perceived Diffuse Noxious Inhibitory Control (DNIC) Measure** (Edwards, 2003a; Appendix N) was administered to all participants after each of the DNIC trials in order to assess the extent to which immersion of the dominant hand in the cold pressor test (CPT; see below) reduced pain and unpleasantness ratings from the heat test stimulus. This two-question measure used a 0 to 10 scale (*0 = no reduction in pain, 10 = complete reduction in pain*) to assess the degree to which participants perceived a decrease in pain during the DNIC trials.

Quantitative sensory testing (QST). Prior to starting the two-hour sensory testing session, participants were familiarized with the testing materials and were explicitly debriefed as to the QST procedures. Participants were reminded that they were in control of the session and were able to stop testing at anytime throughout the procedure. Participants underwent testing at the right volar forearm (i.e., the underside of the lower arm between the wrist and the elbow) and three sites on the vulva (the perineum, the labia, and the vulvar vestibule). Each participant underwent tactile, pressure, and thermal QST testing. Testing was always performed on the forearm first in order to familiarize participants with the protocol prior to the more invasive genital portion of the testing. Previous research has shown that site order in the testing of vulvar and non-vulvar sites

has no significant impact on results in sensitivity testing (Reed, Sen, & Gracely, 2007). Please refer to Appendix O for a brief outline depicting the order and timing of the testing procedures.

Tactile and pressure-pain threshold testing procedures. Tactile and pressure-pain thresholds were measured on the volar forearm and on the vulvar areas. Although all participants received testing on the arm first, the stimuli were administered to the vulvar sites in a computer-randomized order. Participants were instructed to either look away or close their eyes while mentally focusing on the particular body site being tested. Having the participants look away ensured that they were not processing having felt the stimulus because they observed it touching them. This procedure also allowed for the blank trials (see below) to be administered without the participant's knowledge.

For the tactile threshold procedure, a computer was programmed to prompt the researcher to apply the various filaments using a 2-down 1-up staircase method. In other words, the program required the participant to feel a particular filament twice in a row before moving down to a lower stimulus level (i.e., a lighter touch), but required only one trial of not feeling the stimulus to warrant the application of a heavier touch. Seventeen modified von Frey filaments, with log-force values ranging from 1.18 (where $1.18 \log^{-1}/10 = 1.51 \text{ mg}$) to 5.07 (11749 mg), were applied manually so that they formed a semi-circle perpendicular to the skin surface (Pukall et al., 2002; Appendix P). A research assistant entered the participants' responses into the computer program, which then indicated the filament number to be applied next. In order to detect false positive response levels, the computer was programmed to insert blank trials 20% of the time. During the blank trials, forceps not containing a filament were positioned close to the

participants' body as if a filament was being applied. The program stopped the trials after six reversals; the last four were averaged to provide the tactile threshold in grams and log values. The first reversal was not used in the average because in order to minimize testing time, the filaments were applied using only every third filament until the participant reported two positive responses to the same stimulus. Because not every filament is applied prior to a report of sensation, the first reversal often does not represent the participant's actual threshold accurately. Because the second threshold value is not considered a steady state measure, this value was also excluded from the final threshold calculation (Pukall et al., 2002).

In order to measure pressure pain thresholds, the experimenter used a set of 5 vulvalgesiometers (Appendix Q), exerting pressure from a range of 10g to 950g. For each increase in pressure the participant was asked to rate the intensity and the unpleasantness of the stimulus. Pressure was increased manually until the participants indicated that the sensation of touch had turned to a painful sensation.

Thermal testing procedures. For each location, an average of three trials was taken in order to establish an individual baseline for warmth detection (i.e., the temperature at which participants report feeling an initial change from skin temperature to a non-painful warmth sensation), heat pain threshold (i.e., the temperature at which participants report feeling initial heat pain), and heat pain tolerance level (i.e., the point at which the participant indicates that the heat pain is no longer tolerable). Between each set of three trials, a resting period of two minutes was observed in order to allow the participants' skin to return to baseline temperature. Heat testing was conducted in a randomized order of the upper, middle, and lower sections of the volar forearm using a

Medoc Thermal Sensory Analyzer (Medoc Advanced Medical Systems, Durham, N.C.) with a 9 cm² contact thermode. Testing at the vulvar vestibule was done in a randomized order at positions 3, 6, and 9 o'clock using a Medoc Thermal Genital Sensory Analyzer with a 10 mm² contact thermode. Contact heat stimuli were delivered starting at skin temperature (approximately 32 degrees Celsius) and increased by .5 degrees per second in an ascending method of limits paradigm (Edwards et al., 2003). Upon feeling the appropriate sensation (i.e., heat detection, heat pain, heat pain tolerance), participants pressed a hand-held control and the apparatus quickly returned to skin temperature. At stimulus detection, participants were asked to rate the intensity and unpleasantness of the sensation on the non-painful ratings scale. At pain threshold and tolerance, they were asked to rate the intensity and unpleasantness on the pain ratings scale.

DNIC procedures. DNIC protocols involve the experience of a tonic (conditioning) pain stimulus, in this case immersion of the non-dominant forearm into a cold water bath, presented simultaneously with a phasic (test) stimulus, in this case either heat pain tolerance or temporal summation. The magnitude of DNIC is measured as the decrease in phasic stimulus pain and unpleasantness ratings observed during concurrent administration of the tonic stimulus.

Following the initial establishment of heat pain threshold and tolerance, participants were given a 5-minute break in order for their bodies to return to baseline prior to the DNIC trial. For the DNIC trial, participants were required to immerse their non-dominant arm up to the elbow joint in a NESLAB circulating water bath (e.g., cold pressor test [CPT], Thermo Electron Corp, Waltham, MA), with dimensions of 15.5 (l) X 8³/₄ (w) X 12 inches (d), maintained at 5 degrees Celsius. After 15 seconds of immersion

in the water bath, participants were asked to rate pain intensity and unpleasantness for the cold water. While participants still had their arm immersed in the cold water, the heat test stimulus was delivered, either to the opposite forearm or the genitals, and ratings for three trials of heat pain tolerance were obtained. After the application of the test stimulus, participants were once again asked for their pain intensity and unpleasantness ratings for the cold water. After providing the ratings, participants were able to withdraw their arm from the CPT. The amount of time the participants had their arm in the cold water was recorded by the research assistant. The Perceived DNIC Ratings Scale was also administered at this point. Two minutes after the end of the first DNIC trial, the test stimulus was re-applied without the conditioning stimulus and intensity and unpleasantness ratings for pain tolerance were re-assessed over three trials.

DNIC testing was conducted three times throughout the testing session (heat tolerance/volar forearm; temporal summation/volar forearm; heat tolerance/vulva), with a resting period of 5 minutes between the application of the initial phasic stimulus and the simultaneous application of the phasic and tonic stimulus.

Temporal summation. The temporal summation portion of the testing was administered 10 minutes following the pain tolerance DNIC trials and 10 minutes prior to genital testing. Sequences of ten brief, repetitive, noxious heat stimuli, set to each participant's pain tolerance, as measured in the previous section, were administered to the mid-section of the volar forearm to assess temporal summation (i.e., wind-up) of heat pain. Each heat pulse lasted approximately .5 seconds, with an inter-stimulus interval of 3 seconds. Participants were asked to verbally rate the intensity of each of the ten heat pulses on the pain intensity scale. Temporal summation is calculated by taking the

difference between the intensity of first heat pulse and the highest heat-pulse rating (Edwards et al., 2003a) as measured by the pain intensity rating scale. Temporal summation was also conducted within the DNIC paradigm. Ten pulses were delivered prior to immersion of the opposite arm in the cold water bath, followed by a 5 minute break. Next, the same ten pulses were administered during immersion of the opposite arm in the cold water bath, and once again 2 minutes following the CPT.

Data Analysis

Analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 14. The significance level was set at $p < .05$ and data were expressed as mean +/- standard deviation.

Four main data analytic strategies were used: **1.** Mixed model analyses of variance (ANOVAs) were conducted in order to answer the first research question regarding differences between groups on the psychophysical variables. For each of the analyses, the between-subjects variable was group. For analyses pertaining to tactile and pressure-pain stimuli, the within-subjects variable was body site (forearm, perineum, labia, vulvar vestibule). The first ANOVA examined differences in tactile thresholds in milligrams, the second investigated pressure-pain thresholds in grams, and the third examined subjective ratings to pressure-pain thresholds. Analyses examining the thermal stimuli used two within-subjects variables: body site (forearm, vulvar vestibule) and type of heat stimulus (heat detection, pain thresholds, and tolerance). Tukey's HSD post hoc tests of significance were conducted where necessary. **2.** In order to answer the second part of the first research question on group differences in psychosocial variables, a series of ANOVAs were conducted.

3. In order to answer the second question regarding group differences in DNIC function, difference scores were taken for **temperature tolerance** and **subjective temperature tolerance**, which consists of an amalgamated variable of pain intensity and unpleasantness ratings for temperature tolerance both before and during the CPT trial. Temporal summation was calculated by subtracting the first heat pulse pain rating from the highest heat pulse pain rating. DNIC function was examined again using difference scores for **peak temporal summation ratings** before and during the CPT trial. These three difference score calculations resulted in one objective measure of temperature change in degrees Celsius and two subjective measures of pain. T-tests were conducted to assess group differences between control women and women with PVD on the three DNIC variables. In order to further examine the effects of DNIC, a mixed-model analysis of variance (ANOVA) was conducted with a between-subjects variable of group and a within-subjects variable of DNIC trial type.

A multivariate analysis of variance (MANOVA) was conducted to calculate differences between groups for time in cold water, ratings for cold water, and perceived DNIC in order to assess whether any of these variables needed to be covaried out of the DNIC analyses.

4. In order to determine whether psychosocial function (catastrophization, somatization, sexual-self-efficacy, sexual function) mediated the relationship between group membership and DNIC function, four mediation models were conducted, each examining one of the psychosocial variables as a mediator.

Chapter 5

Results

Data Considerations

Prior to conducting analyses, the data were examined to check for missing data points, and univariate and multivariate outliers. If less than 20% of the data points were missing, then missing data were replaced using means replacement for the group. When greater than 20% of the data points were missing for a particular individual or measure, that participant or measure was excluded from subsequent analyses. For the psychosocial questionnaires, 3 PVD participants did not complete the PCS with respect to their vulvar pain, thus a means replacement was conducted. All other measures were completed in their entirety by all of the participants. The only measure that had to be excluded from analysis due to missing data was the DNIC measure at the genital site, as 11 participants (PVD N = 7 [35%], Control N = 10 [50%]) reached the maximum temperature exerted by the equipment during the pain tolerance trials. Reaching the maximum temperature prior to the DNIC trial excludes the possibility of finding positive DNIC function, as there will not be any difference scores in a positive direction. Thus, those participants who reached the maximum temperature prior to DNIC testing were excluded from the DNIC trial. Therefore, these missing data points for DNIC at the genitals were reflective of a ceiling effect for pain tolerance during the pre-DNIC testing. There was also a ceiling effect for pressure pain at the arm; however, in this case, the data were still analyzed because they were not part of the DNIC analysis, so difference scores were not required. No participants were excluded from the tactile threshold analyses. The majority of participants (PVD N = 23 [96%], Control N = 19 [95%]) correctly detected over 80% of

the blank trials, meaning that they indicated that they did not feel the stimulus when the stimulus was, in fact, not applied. The data were also checked to determine if they met the assumptions for t-tests, analysis of variance, and regression. Where assumptions were not met, appropriate accommodations were made (i.e., Levene's Test for Equality of Variances, Greenhouse-Geisser Correction).

Participant Characteristics

Forty-four women, 20 suffering from PVD and 24 control women, completed the testing sessions. There were no significant differences between groups with respect to education, income, religious affiliation, or handedness (all $p > .05$). Participants were asked a variety of questions pertaining to their health and physical functioning, and these results are presented in Table 1.

Table 1.

Means (M) and Standard Deviations (SD) for Women with PVD and Controls on Health and Physical Functioning Variables

Health and physical functioning	PVD M (SD)	Controls M (SD)	Significance
Mean pain intensity ratings during menstruation (0-10)	4.79* (2.75)	2.94 (2.74)	$t(42) = -2.41, p < .05$
Mean unpleasantness ratings during menstruation (0-10)	4.45 (2.72)	3.31 (2.67)	$t(42) = -1.39, ns$
Number of ailments	7.55* (4.59)	5.00 (3.41)	$t(42) = -2.11, p < .05$
Mean intensity ratings of general pain over the last month (0-6)	3.00 (1.08)	2.79 (1.28)	$t(42) = -1.07, ns$
Mean pain interference ratings in activities of daily living over the last month (0-6)	1.65 (0.99)	1.38 (0.71)	$t(42) = -1.07, ns$
Mean number of sexually transmitted infections	0.10 (0.31)	0.17 (0.38)	$t(42) = -0.63, ns$
Mean number of urinary tract infections	2.94* (3.73)	0.40 (0.60)	$t(42) = -1.63, p < .05$

* = significant at $p < .05$ when between-groups comparisons were conducted.

Women were also asked to report on their sexual and relationship history. These results are presented in Table 2.

Table 2.

Means (M) and Standard Deviations (SD) for Women with PVD and Controls on Sexual and Relationship History Variables

Variables	PVD M (SD)	Controls M (SD)	Significance
Age at first intercourse (years)	17.75 (3.24)	17.31 (2.67)	$t(42) = -0.49, ns$
% experiencing pain during first intercourse	80.00** (41.04)	37.50 (49.45)	$\chi^2(2, N= 44) = 8.22, p < .01$
Pain intensity rating (0-10)	5.00** (3.25)	2.10 (2.96)	$t(42) = -3.07, p < .01$
Pain unpleasantness rating (0-10)	3.67* (3.64)	1.69 (2.97)	$t(42) = -2.01, p < .05$
Total number of sexual partners	4.35 (3.67)	5.54 (5.90)	$t(42) = 0.79, ns$
% currently in a relationship	75.00 (44.40)	87.50 (33.80)	$\chi^2(1, N=44) = 1.15, ns$
% currently having or attempting intercourse	75.00 (44.40)	87.50 (33.80)	$\chi^2(1, N=44) = 1.15, ns$
Frequency of intercourse (per month)	6.42 (4.52)	6.95 (5.09)	$t(32) = 0.31, ns$
% of the time the participant initiates intercourse	40.00 (26.79)	44.67 (19.26)	$t(34) = 0.61, ns$
Confidence initiating intercourse (0-10)	7.05* (2.92)	8.81 (1.45)	$t(26.7) = 2.46, p < .05$
Confidence engaging in intercourse when partner initiates (0-10)	6.90** (3.25)	9.31 (0.86)	$t(21.2) = 3.22, p < .01$
% of time foreplay leads to intercourse	68.15 (27.19)	78.83 (16.44)	$t(30) = 1.54, ns$

Note. Only participants who reported pain during first intercourse were included in the pain intensity and unpleasantness ratings at first intercourse (N=37). * = significant at $p < .05$; ** = significant at $p < .01$ when between-groups comparisons were conducted.

Women with PVD and control women did not differ with regard to the sexual activities they engaged in with their current or most recent sexual partner (Table 3). The

only significant between-groups difference was in the area of masturbation; women with PVD were significantly less likely than control women to engage in masturbation, $t(32.2) = -2.09, p < .05$.

Table 3.

Percent of Sexual Activities Engaged in by Women with PVD and Controls

Sexual activities	PVD (%)	Control (%)
Kissing	90.0	95.7
Non-genital touching	90.0	91.3
Touching partner's genitals	85.0	95.7
Partner touching her genitals	85.0	95.7
Giving oral sex	80.0	87.0
Receiving oral sex	75.0	87.0
Masturbating	58.8*	81.3

* = significant at $p < .05$ when between-groups comparisons were conducted.

In addition to the above information, women with PVD were asked to report on various aspects of their vulvar pain experience (Table 4).

Table 4.

Means (M) and Standard Deviations (SD) of PVD Characteristics

PVD variables	M (SD)	Range
Pain duration (years)	4.22 (3.07)	(1-10)
% of women with primary PVD	45.00	—
% of women who consulted a health professional	50.00	—
Number of health professionals consulted	2.10 (3.26)	(0-12)
% of the time intercourse is painful	80.75 (19.42)	(50-100)
Average pain intensity rating during intercourse (0-10)	6.42 (1.96)	(2-10)
Average pain unpleasantness ratings during intercourse (0-10)	6.95 (2.09)	(2-10)

Note. Standard deviations and ranges are not reported for dichotomous variables.

Of the women in the PVD sample, (N = 9; 45%) had primary PVD (i.e., their pain existed since their first intercourse experience/tampon insertion). The remaining women (N = 11; 55%) had secondary PVD, indicating that their pain developed after a period of pain-free intercourse. Women with secondary PVD were provided with a list of possible events related to the onset of their pain and asked to check all that applied. They reported a number of hypothesized reasons for the onset of their pain, including childbirth (N = 2), change of partner (N = 2), repeated urinary tract infections (UTIs; N = 1), with onset of menopause (N = 1), since birth control use (N = 1), associated with life stress (N = 1), and unsure (N = 5). A regression analysis was conducted to assess whether years of pain, frequency of painful intercourse or pain intensity were related to whether or not a women has contacted a health professional. None of the above variables were significant predictors of health professional contact, $r^2 = 0.27$, $F(4,15) = 1.41$, *ns*.

Gynecological Examination

Consistent with the literature (e.g., Bergeron, Binik, Khalifé, et al., 2001), women with PVD reported significantly higher pain intensity ratings ($M = 5.09$, $SD = 1.48$) during the cotton-swab test than control women ($M = 1.47$, $SD = 1.44$), $t(42) = -8.21$, $p < .001$. Women with PVD ($M = 3.55$, $SD = 2.04$) also reported significantly higher pain intensity ratings during speculum insertion than did control women ($M = 1.28$, $SD = 1.53$), $t(42) = -4.21$, $p < .001$.

Data Analyses

In order to examine the psychophysical characteristics of the sample, including DNIC function, a series of mixed-model analyses were conducted. For each analysis reported below, the Greenhouse-Geisser correction was used when assumptions of sphericity were violated. Where there were significant main effects or simple main effects for variables with greater than two levels, Tukey's HSD post-hoc tests were conducted. For a summary of between-group differences on the psychophysical variables, please refer to Appendix R. For pressure and heat stimuli, Pearson correlations were performed to assess the strength of the relationship between the subjective pain rating measures of intensity and unpleasantness. Where correlations were above .60, the variables were combined to create a single subjective pain rating score.

Psychophysical Characteristics of PVD and Control Women

Tactile thresholds in grams. A mixed model ANOVA was conducted to examine tactile thresholds in grams via the application of the von Frey filaments. The main effect of body site was significant, $F(1.7, 42) = 7.81$, $p < .01$, partial $\eta^2 = 0.16$, with the posterior portion of the vulvar vestibule ($M = 0.02$, $SD = 0.03$) being significantly less

sensitive than the labia ($M = 0.01$, $SD = 0.01$), $q(4,72) = 5.24$, $p < .05$ and perineum ($M = 0.01$, $SD = 0.01$), $q(4,72) = 6.67$, $p < .05$. There were no significant differences between the arm ($M = 0.02$, $SD = 0.01$) and any of the genital sites. The main effect for group was also significant, $F(1, 42) = 4.56$, $p < .05$, partial $\eta^2 = 0.10$; women with PVD reported lower thresholds ($M = 0.01$, $SD = 0.01$) than control women ($M = 0.02$, $SD = 0.02$). There was no significant interaction between body site and group.

Pressure-pain thresholds in grams. A mixed model ANOVA was conducted to examine pressure-pain thresholds in grams via the vulvalgesiometers. The main effect of body site was significant, $F(2.7,42) = 79.42$, $p < .001$, partial $\eta^2 = 0.65$, as was the main effect for group, $F(1,42) = 35.68$, $p < .001$, partial $\eta^2 = 0.46$. As well, there was a significant interaction between body site and group, $F(1,42) = 25.85$, $p < .001$ (Figure 1).

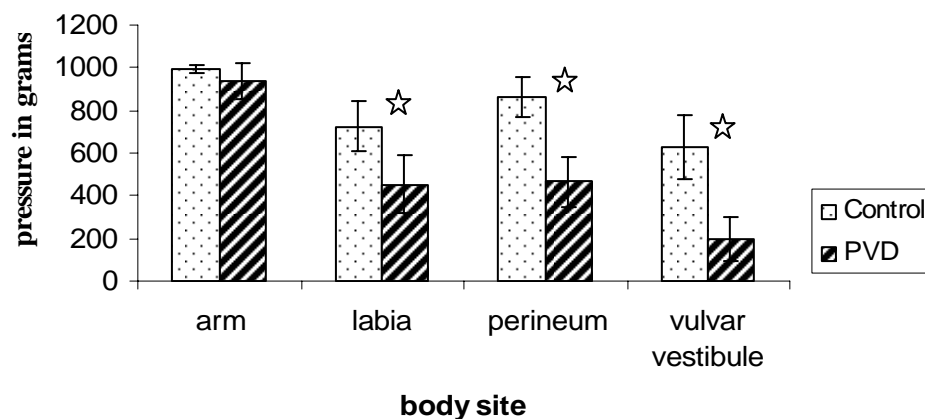


Figure 1. Pressure-pain thresholds of women with PVD and control women at four body sites. ☆ indicates significant between-groups differences ($p < .001$).

Simple main effects were examined to determine whether there were differences between women with PVD and control women at each of the four body sites. Women with PVD ($M = 935.00$, $SD = 172.52$) and control women ($M = 991.67$, $SD = 40.82$) did not differ significantly in their pressure-pain thresholds on the forearm, $F(1,42) = 2.44$, *ns*. However, as predicted, the two groups did differ significantly at all three genital sites ($p < .001$). Women with PVD reported lower pressure pain thresholds ($M = 451.75$, $SD = 272.87$) than control women ($M = 726.19$, $SD = 726.19$) at the labia, $F(1,42) = 12.16$, $p < .001$, perineum (PVD $M = 464.71$, $SD = 240.40$; control $M = 861.90$, $SD = 184.10$), $F(1,42) = 38.50$, $p < .001$, and posterior portion of the vestibule (PVD $M = 197.25$, $SD = 625.91$; control $M = 625.91$, $SD = 301.89$), $F(1,42) = 29.48$, $p < .001$.

Subjective pressure pain thresholds. Pain intensity and unpleasantness ratings were highly correlated for each of the four body sites and were thus amalgamated into a single variable for each site labeled subjective responses (Appendix S). A mixed model ANOVA was conducted to examine subjective responses to pressure pain thresholds. There was a significant main effect for body site, $F(2.9,42) = 33.49$, $p < .001$, partial $\eta^2 = 0.44$. Pressure pain on the arm ($M = 0.15$, $SD = 0.61$) was rated as significantly less painful/unpleasant than on the labia ($M = 2.71$, $SD = 2.08$), $q(4,126) = 10.93$, $p < .05$, the perineum ($M = 2.80$, $SD = 2.23$), $q(4,126) = 11.36$, $p < .05$, and the posterior portion of the vulvar vestibule ($M = 2.96$, $SD = 1.83$), $q(4,126) = 11.95$, $p < .05$. There was no significant main effect for group, $F(1,42) = 1.21$, *ns*, partial $\eta^2 = 0.03$, indicating that the groups did not differ in their subjective ratings to pressure-pain threshold stimuli.

Thermal stimuli in degrees Celsius. Each participant underwent each of the heat procedures (i.e., heat detection, heat pain threshold, heat pain tolerance) three times in a

randomized order on the volar forearm (lower, middle, upper) and the vulvar vestibule (3, 6, 9 o'clock). The following analyses are reported using the average scores of the three trials. A mixed model MANOVA was conducted to assess heat detection, pain thresholds, and pain tolerance at the arm and genitals. There was a significant main effect for body site, $F(1,42) = 492.36, p < .001$, partial $\eta^2 = 0.92$. Results indicated that the arm had significantly lower thresholds (i.e., was more sensitive) overall ($M = 39.66, SD = 2.13$) than the genital regions ($M = 46.60, SD = 2.92$). There was also a significant main effect for stimulation type, $F(2,80) = 336.80, p < .001$, partial $\eta^2 = 0.89$, and a significant interaction between body site and stimulation type, $F(2,75) = 48.45, p < .001$, partial $\eta^2 = 0.54$ (Figure 2).

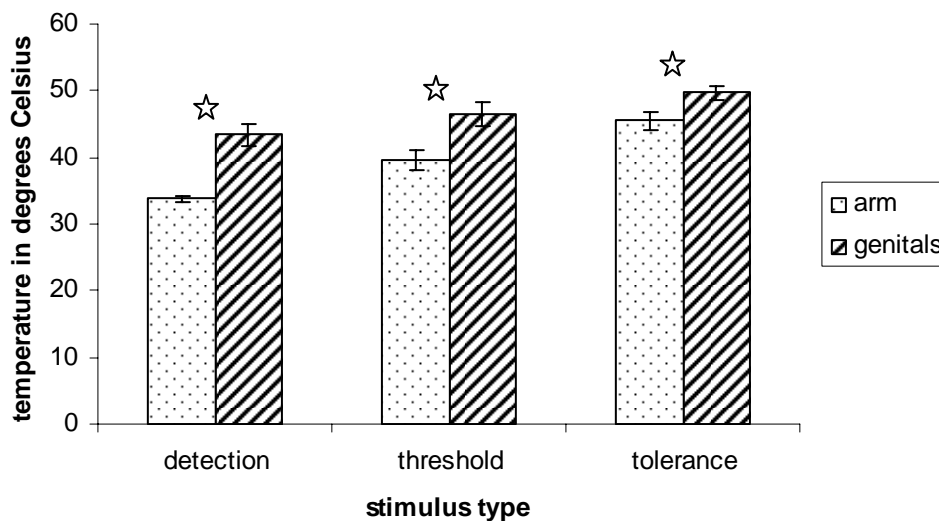


Figure 2. Differences between the arm and genitals for three types of heat stimulation. ☆ indicates significant between-groups differences ($p < .001$).

Simple main effects were examined to determine whether there were differences between warmth detection threshold, pain threshold, and pain tolerance levels on the arm and the genitals. Warmth was detected at a significantly lower temperature on the arm ($M = 33.83$, $SD = 0.91$) than on the genitals ($M = 43.44$, $SD = 3.22$), $F(1,42) = 424.90$, $p < .001$, partial $\eta^2 = 0.91$. Heat pain thresholds were significantly lower on the arm ($M = 39.75$, $SD = 2.88$) than on the genitals ($M = 46.54$, $SD = 3.44$), $F(1,42) = 219.30$, $p < .001$, partial $\eta^2 = 0.84$, and heat pain tolerance was significantly lower on the arm ($M = 45.46$, $SD = 2.60$) than on the genitals ($M = 49.69$, $SD = 2.10$), $F(1,42) = 117.72$, $p < .001$, partial $\eta^2 = 0.74$. There was a trend towards a significant interaction between group and stimulus type, $F(2,80) = 3.06$, $p = 0.055$, partial $\eta^2 = 0.07$ (Figure 3).

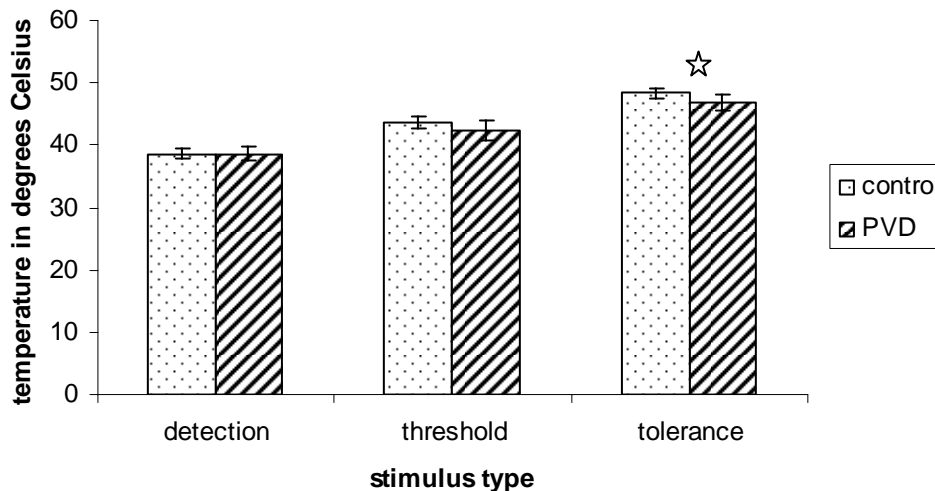


Figure 3. Three types of thermal stimulation between women with and without PVD. ☆ indicates a significant between-groups difference ($p < .01$).

Simple main effects were examined to determine whether there were differences between women with PVD and control women for each of the stimulation types. No

significant group differences were found between women with PVD ($M = 38.67$, $SD = 2.37$) and control women ($M = 38.62$, $SD = 1.83$) with respect to warmth detection, $F(1,42) = 0.01$, *ns*, partial $\eta^2 = 0.00$, or heat pain threshold (PVD $M = 42.40$, $SD = 3.23$; Control $M = 43.72$, $SD = 2.01$; $F(1,42) = 2.61$, *ns*, partial $\eta^2 = 0.06$). However, women with PVD had significantly lower pain tolerance levels ($M = 46.82$, $SD = 2.60$) than control women ($M = 48.33$, $SD = 1.67$), $F(1,42) = 7.19$, $p < .01$, partial $\eta^2 = 0.15$.

Subjective ratings in response to heat threshold stimuli. Where correlations for intensity and unpleasantness ratings were above .60, the subjective variables were amalgamated into a single variable for each of the heat stimuli and body sites (Appendix T). This new variable was labeled as subjective responses. A mixed model MANOVA was conducted to examine subjective responses to heat stimuli. There was a significant main effect for stimulation type, $F(2,84) = 145.47$, $p < .001$, partial $\eta^2 = 0.78$, and a significant interaction between body site and stimulation, $F(2,63) = 7.98$, $p < .05$, partial $\eta^2 = 0.16$ (Figure 4).

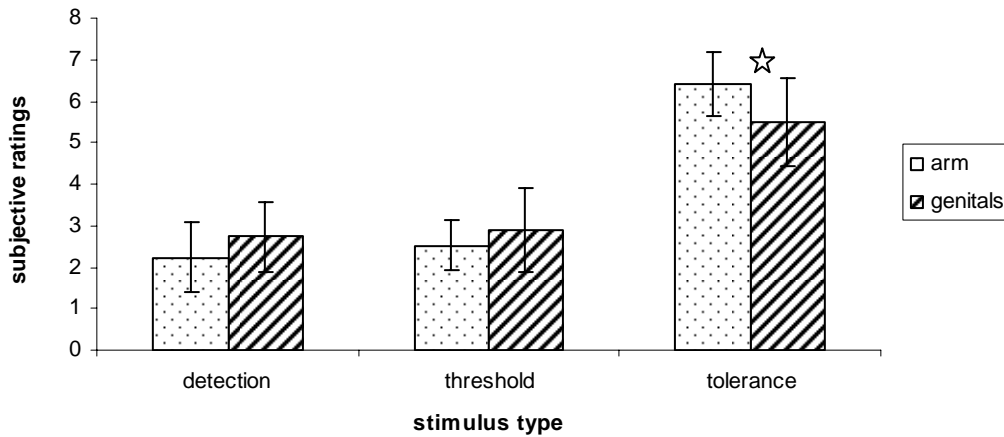


Figure 4. Subjective ratings for three different types of thermal stimulation on the arm and genitals. ☆ indicates a significant between-site difference ($p < .05$).

Simple main effects were examined to assess whether there were differences in subjective ratings between the arm and genitals for warmth detection thresholds, heat pain thresholds, and pain tolerance levels. There were no significant differences between the arm ($M = 2.24$, $SD = 1.65$) and the genitals ($M = 2.74$, $SD = 1.70$) for warmth detection ratings, $F(1,42) = 2.05$, ns , partial $\eta^2 = 0.05$. There were also no significant differences between the arm ($M = 2.53$, $SD = 1.24$) and the genitals ($M = 2.89$, $SD = 1.98$) for heat pain threshold ratings, $F(1,42) = 1.71$, ns , partial $\eta^2 = 0.04$; however, there was a significant difference between the arm and the genitals for heat pain tolerance, $F(1,42) = 7.26$, $p < .01$, partial $\eta^2 = 0.15$, with the genital ratings ($M = 5.48$, $SD = 2.12$) being significantly lower than the arm ($M = 6.39$, $SD = 1.54$). There was also a significant main effect for group, with control women reporting lower pain ratings ($M = 3.37$, $SD = 1.59$) than women with PVD ($M = 4.03$, $SD = 1.73$), $F(1,42) = 4.92$, $p < .05$,

partial $\eta^2 = 0.11$. In addition, there was a trend toward a significant interaction between body site and group, $F(1,42) = 3.98$, $p = .052$, partial $\eta^2 = 0.09$ (Figure 5).

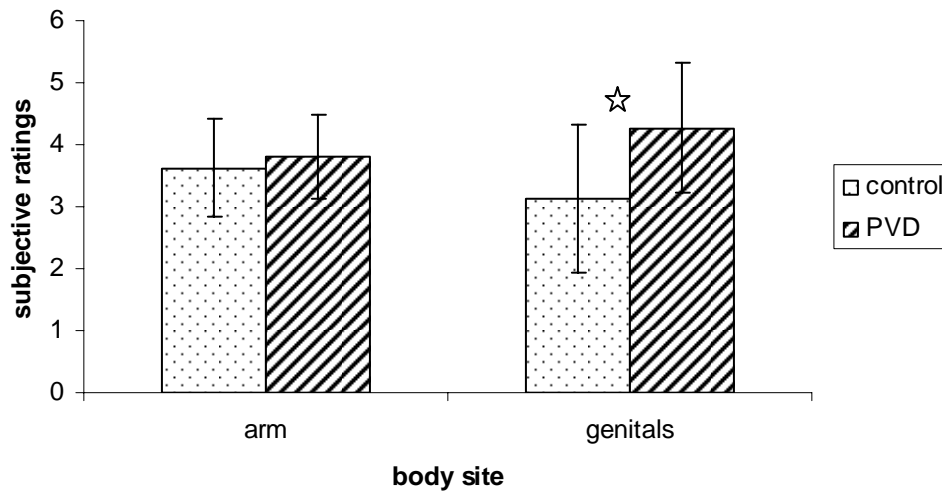


Figure 5. Subjective ratings at the arm and the genitals in the PVD and control groups. ☆ indicates a significant between-groups difference ($p < .05$).

Simple main effects were examined to assess whether there were differences between women with PVD and non-affected women at the two body sites. There were no significant differences in subjective ratings between women with PVD ($M = 3.81$, $SD = 1.35$) and control women ($M = 3.62$, $SD = 1.58$) at the arm, $F(1,42) = 0.40$, ns , partial $\eta^2 = 0.01$. However, there were significant differences in subjective ratings between women with PVD and control women at the genitals, $F(1,42) = 6.66$, $p < .05$, partial $\eta^2 = 0.14$. Control women reported significantly lower subjective ratings ($M = 3.13$, $SD = 2.41$) than women with PVD ($M = 4.26$, $SD = 2.11$).

DNIC Analyses

T-tests were conducted to determine whether there were group differences on any of the variables related to the conditioning stimulus (i.e., the cold water bath). There were no significant group differences in subjective ratings for the cold water bath, time spent in the cold water bath, or perceived DNIC ratings (all $p > .05$). Results are presented in Table 5.

Table 5.

Means (M) and Standard Deviations (SD) of DNIC Measures.

DNIC measures	PVD <i>M</i> (SD)	Control <i>M</i> (SD)
Perceived DNIC rating for test stimulus; tolerance trial (0-10)	4.55 (2.35)	5.22 (2.57)
Perceived DNIC rating for conditioning stimulus tolerance trial (0-10)	2.20 (1.96)	2.55 (2.18)
Time in water bath in seconds (tolerance)	70.53 (27.07)	82.13 (24.43)
CPT pain rating (tolerance)	7.18 (1.55)	7.00 (1.74)
CPT unpleasantness rating (tolerance)	7.65 (1.46)	7.17 (2.01)
Perceived DNIC rating for TS; test stimulus trial (0-10)	4.63 (2.78)	5.89 (3.04)
Perceived DNIC rating for TS; conditioning stimulus trial (0-10)	1.63 (1.27)	2.36 (1.81)
Time in water bath in seconds (TS)	55.47 (18.32)	58.57 (12.20)
CPT pain rating (TS)	7.63 (2.03)	7.46 (1.72)
CPT unpleasantness rating (TS)	7.74 (2.45)	7.50 (1.58)

Note. CPT = Cold pressor task (i.e., cold water bath); TS = temporal summation trials of DNIC.

DNIC ratings were calculated using **1.** heat pain tolerance scores in degrees Celsius, **2.** heat pain tolerance subjective ratings, **3.** peak temporal summation ratings,

and **4.** degree of temporal summation. Subjective ratings consist of a combination of pain intensity and unpleasantness scores, which were highly correlated, $r^2 = 0.82$, $p < .01$, and thus amalgamated together. **1.** Heat pain tolerance in degrees Celsius was converted to difference scores by subtracting baseline heat pain tolerance from immersion-associated heat pain tolerance. A DNIC response is considered to be a positive difference score. **2.** Subjective ratings for heat pain tolerance were converted to difference scores by subtracting ratings during the cold water immersion from ratings prior to the cold water immersion. A DNIC response is considered to be a positive difference score. **3.** Peak pain ratings from the temporal summation procedures were also used to assess DNIC by subtracting ratings during the cold-water trial from ratings prior to the cold water trial. **4.** In order to assess the average degree of temporal summation, the first pain rating in the series of ten heat pulses was to be subtracted from the highest pain rating (Edwards et al., 2003). DNIC response for degree of temporal summation would be calculated by subtracting the degree of temporal summation during the cold water trial from the degree of temporal summation before the cold water trial. A DNIC analysis was not conducted for temporal summation because a temporal summation response was not found for either of the groups, rather, a habituation response was found, indicating that women were responding to first pain, as opposed to second pain (Figure 6).

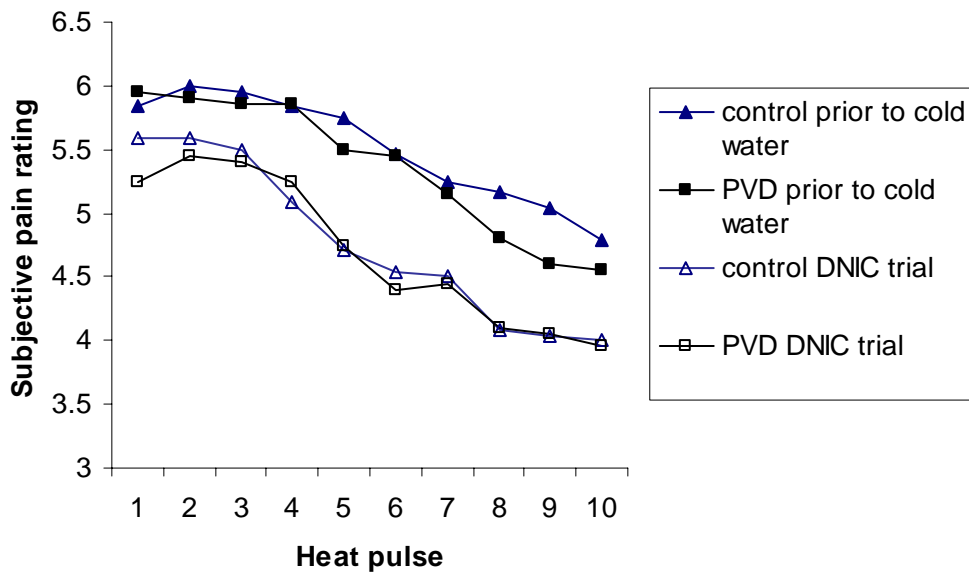


Figure 6. Average temporal summation responses by group before and during immersion in the cold water bath.

For the above analyses, a DNIC response was considered to be a positive difference score, and the greater the difference score, the stronger the DNIC response. In terms of the difference score for heat pain tolerance in degrees Celsius, 79% of control women and 80% of women with PVD had a DNIC response. There was no significant difference between groups in terms of number of responders, $t(42) = -0.07$, *ns*. In terms of the difference score for subjective ratings, 75% of control women and only 45% of women with PVD had a DNIC response, resulting in a significant difference between groups, $t(42) = 2.06$, $p < .05$. For the peak ratings during temporal summation, 75% of control women and 80% of women with PVD had a DNIC response. There was no significant difference between groups, $t(42) = -0.39$, *ns*.

Analyses were first conducted with all participants, including those who did not display a DNIC response. There was only found to be a significant group difference for heat pain tolerance, as measured by the change in degrees Celsius, $t(42) = -2.46, p < .05$, with women with PVD displaying a greater DNIC response ($M = 1.99, SD = 1.87$) than control women ($M = 0.65, SD = 1.74$). There was no significant difference between women with PVD ($M = 0.00, SD = 1.50$) and control women ($M = 0.55, SD = 1.17$) on subjective ratings. There was no significant difference between women with PVD ($M = 0.06, SD = 1.64$) and control women ($M = 0.83, SD = 1.66$) for peak subjective rating scores during temporal summation.

Analyses were also conducted after removing participants who did not show a DNIC response. No differences in significance were found when only those who had a response with degrees Celsius were included, however the PVD group no longer showed a positive DNIC response for subjective pain tolerance ratings. There were no differences found when only those who had a DNIC response with subjective scores were included. However, when examining only those women who responded to the trials based on peak difference scores, the significant difference found between women with PVD ($M = 2.03, SD = 1.97$) and control women ($M = 0.83, SD = 1.91$) during heat pain tolerance in degrees Celsius remained in the same direction but was no longer significant, $t(32) = -1.81, ns$.

The above three variables were converted into z-scores and a mixed model ANOVA was conducted to assess whether there was a relationship between the type of DNIC trial (tolerance in degrees Celsius, subjective ratings, peak temporal summation) and group (PVD, control) using only those participants who had a positive non-subjective

DNIC response. There were no significant main effects, but a trend towards a significant interaction between trial type and group was found, $F(2, 66) = 3.39$, $p < .05$, partial $\eta^2 = 0.09$ (Figure 7).

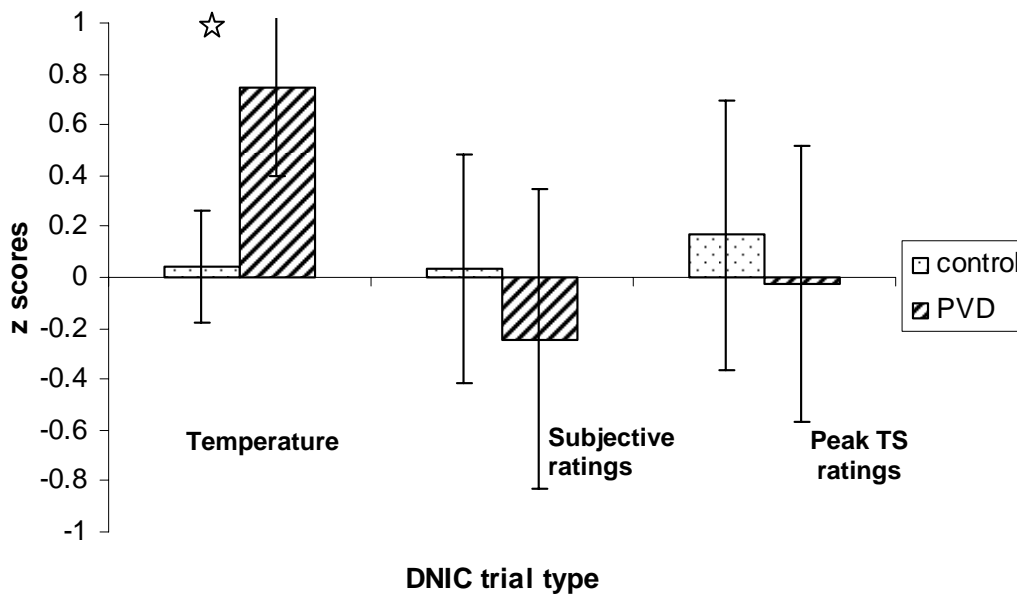


Figure 7. Scores for women with PVD and controls for three DNIC trial types, as expressed in z-scores. ☆ indicates a significant between-groups difference ($p < .05$).

Simple main effects were examined to assess whether there were group differences for each of the three trials, pain threshold in degrees Celsius, subjective pain ratings, and peak temporal summation ratings. There was a significant difference between women with PVD and control women for DNIC in degrees Celsius, $F(1,33) = 13.15$, $p < .05$, partial $\eta^2 = 0.29$. While both groups had a positive DNIC response, women with PVD displayed a greater DNIC response ($M = 0.75$, $SD = 0.15$) than control women ($M = 0.04$, $SD = 0.13$). There were no significant group differences between women with PVD ($M = -0.24$, $SD = 0.26$) and control women ($M = 0.03$, $SD = 0.24$) on subjective pain

ratings, $F(1,33) = 0.60$, *ns*, partial $\eta^2 = 0.02$ or between women with PVD ($M = -0.02$, $SD = 0.27$) and control women ($M = 0.17$, $SD = 0.25$) on peak temporal summation ratings, $F(1,33) = 0.28$, *ns*, partial $\eta^2 = 0.01$.

Psychosocial Analyses

In order to examine group differences between women with PVD and control women on measures of somatization, catastrophization, sexual self-efficacy, and sexual function, univariate analyses of variance (ANOVAs) were conducted. The independent variable was group with two levels (PVD and controls) and the dependent variables were the scores obtained on the SF-36, PCS, SSES-F, and FSFI to measure somatization, catastrophization, sexual self-self-efficacy, and sexual function, respectively.

Somatization: SF-36. A one-way analysis of variance (ANOVA) was conducted to assess group differences in somatization as measured by the SF-36 physical domain subscale. There was a significant group difference on the total physical function score, $F(1,42) = 6.07$, $p < .05$, partial $\eta^2 = 0.13$. Women with PVD had significantly lower scores, indicating increased somatization scores ($M = 74.84$, $SD = 18.65$) as compared to control women ($M = 85.63$, $SD = 9.70$).

Catastrophization: PCS. One-way ANOVAs were conducted to examine PCS scores. Women with PVD filled out the PCS questionnaire twice, once with respect to their worst non-vulvar pain and once with respect to their vulvar pain. For the following analyses, the pain which they rated to be the highest on a scale of 0-10 was compared to the worst pain experienced by control women. Women with PVD and control women differed significantly on the PCS total score, $F(1,42) = 10.82$, $p < .01$, partial $\eta^2 = 0.21$,

with control women ($M = 24.33$, $SD = 7.57$) reporting lower scores (i.e., less catastrophization) than women with PVD ($M = 33.30$, $SD = 10.48$).

Sexual Self-Efficacy: SSES-F. One-way ANOVAs were conducted to examine the SSES-F total score, as well as the subscales examining self-efficacy in relation to sensuality, affection, communication, body acceptance, and sexual refusal. Women with PVD and control women differed significantly on the total score, $F(1,42) = 20.75$, $p < .001$, partial $\eta^2 = 0.33$, with control women reporting higher levels of sexual self-efficacy than women with PVD. Control women also reported higher levels of self-efficacy in terms of sensuality, $F(1,42) = 12.63$, $p < .01$, partial $\eta^2 = 0.23$, affection, $F(1,42) = 6.35$, $p < .05$, partial $\eta^2 = 0.13$, and communication, $F(1,42) = 8.48$, $p < .01$, partial $\eta^2 = 0.17$. There were no significant group differences for body acceptance, $F(1,42) = 0.94$, *ns*, partial $\eta^2 = 0.02$ or sexual refusal, $F(1,42) = 1.47$, *ns*, partial $\eta^2 = 0.03$. Means and standard deviations are reported in Table 6.

Table 6.

Means (M) and Standard Deviations (SD) for Women with PVD and Controls on the SSES-F.

SSES scales	PVD M (SD)	Control M (SD)
SSES-F total score	6.53*** (1.94)	8.48 (0.74)
Sensuality	8.00** (2.03)	9.53 (0.54)
Affection	7.28* (2.95)	9.01 (1.48)
Communication	7.04** (2.14)	8.50 (1.10)
Body acceptance	7.90 (1.33)	8.43 (2.16)
Refusal	6.98 (2.39)	7.81 (2.19)

Note. SSES-F = Sexual Self-Efficacy Scale – Females. Higher scores indicate greater sexual self-efficacy. SSES-F scores for the total scale and each of the subscales are average scores ranging between 0 and 10. * = significant at $p < .05$; ** = significant at $p < .01$; *** = significant at $p < .001$ when between-groups comparisons were conducted.

Sexual function: FSFI. One-way ANOVAs were conducted to examine the FSFI total score and its subscales measuring levels of sexual desire, arousal, lubrication, orgasm, satisfaction, and pain. Control women reported better overall sexual functioning than women with PVD, $F(1,42) = 16.98, p < .001, \text{partial } \eta^2 = .29$. A significant difference was found between groups on the desire, $F(1,42) = 7.11, p < .05, \text{partial } \eta^2 = .15$, arousal, $F(1,42) = 5.77, p < .05, \text{partial } \eta^2 = .12$, lubrication, $F(1,42) = 14.14, p < .01, \text{partial } \eta^2 = .25$, orgasm, $F(1,42) = 11.71, p < .01, \text{partial } \eta^2 = .22$, satisfaction, $F(1,42) = 4.10, p < .05, \text{partial } \eta^2 = .09$ and pain subscales, $F(1,42) = 27.99, p < .001, \text{partial } \eta^2 = .40$, with control women reporting better sexual functioning than women with PVD. Means and standard deviations are reported in Table 7.

Table 7.

Means (M) and Standard Deviations (SD) for Women with PVD and Controls on the FSFI.

FSFI scales	PVD M (SD)	Control M (SD)
FSFI total score	16.96*** (7.51)	26.96 (8.41)
Desire	3.42* (1.25)	4.28 (0.87)
Arousal	3.29* (1.91)	4.60 (1.72)
Lubrication	2.60** (1.34)	4.55 (1.97)
Orgasm	2.40** (1.64)	4.23 (1.87)
Satisfaction	3.56* (1.60)	4.52 (1.53)
Pain	1.70*** (1.50)	4.78 (2.22)

Note. FSFI=Female Sexual Functioning Index. Higher scores on the FSFI indicate greater sexual functioning. Arousal, lubrication, orgasm, and pain scores can range from 0-6.0, desire scores can range from 1.2 – 6.0, and satisfaction scores can range from 0.8 - 6.0. Total scores on the FSFI range from 2-36. * = significant at $p < .05$; ** = significant at $p < .01$; *** = significant at $p < .001$ when between-groups comparisons were conducted.

Psychosocial Variables as Mediators in the Relationship between Group Membership and DNIC.

In order to examine the relationship between group (PVD vs. control) and DNIC function, a series of mediation analyses, as outlined by Baron and Kenny (1986), were conducted. These analyses examined whether observed between-group differences in DNIC function were due to the independent variable of group or to the mediational effect of the psychosocial variables. Mediation occurs when an intervening variable completely or partially reduces the impact that an independent variable has on an outcome variable (Kenny, 2003). As outlined by Baron and Kenny (1986), a series of regression analyses were conducted to ensure that the data met the requirements for mediation analyses. The first step is to determine whether there is a relationship between the predictor and the dependent variable. In order to find path C (Figure 8), linear regression analyses were conducted on the entire sample of women ($N = 44$) to assess whether any of the DNIC function measures could be predicted by group membership.

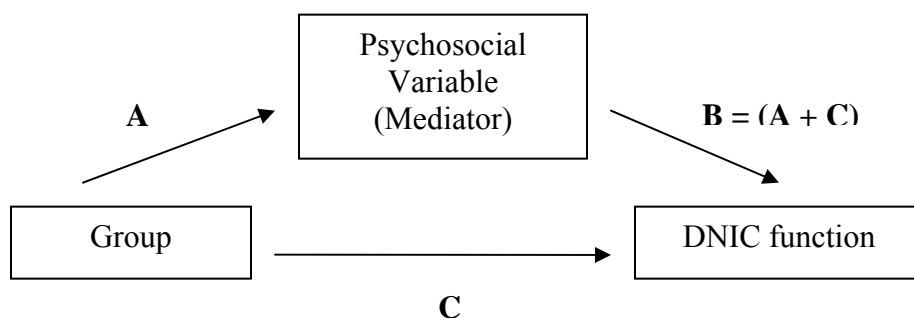


Figure 8. Example of the mediation model.

Group membership was only found to predict DNIC function when measured in degrees Celsius, with group membership accounting for 12.6% of the variance in DNIC, $r^2 = .13$, $F(1,42) = 6.03$, $p < .05$. The second step in mediation is to assess whether the mediator variable is significantly related to the independent variable (Path A). Four regression analyses were run to assess whether each of the psychosocial variables, independent of the others, was significantly related to group membership. It was found that group was significantly predictive of somatization, $r^2 = .13$, $F(1,42) = 6.03$, $p < .05$, catastrophization, $r^2 = .21$, $F(1,42) = 10.82$, $p < .001$, sexual self-efficacy, $r^2 = .33$, $F(1,42) = 20.75$, $p < .001$ and sexual function, $r^2 = .29$, $F(1,42) = 16.98$, $p < .001$.

The third step is to assess whether the strength of the relationship between the predictor variable and the dependent variable is diminished by adding the mediator into the equation. Path B examines the effects of the mediator and the predictor variable on the dependent variable. In the current analysis, there was a trend toward significance when group and somatization were entered together as predictors of DNIC, $r^2 = .13$, $F(2,41) = 3.04$, $p = .06$, indicating that when somatization was included as a mediating variable, the relationship between group and DNIC function diminished in strength. There were trends toward significance when group and catastrophization were entered together as predictors of DNIC, $r^2 = .13$, $F(2,41) = 3.00$, $p = .06$, when group and sexual self-efficacy were entered together as predictors of DNIC, $r^2 = .13$, $F(2,41) = 3.001$, $p = .06$, and when group and sexual function were entered together as predictors of DNIC, $r^2 = .13$, $F(2,41) = 2.95$, $p = .06$. The fourth step is to examine whether the relationship between the predictor and the dependent variable is reduced by a significant amount, which would indicate that there is in fact a mediating effect. Sobel's Tests were

conducted for each of the four models to assess whether or not psychosocial functioning significantly reduced the effect of group on DNIC function (Preacher & Leonardelli, 2001). None of the psychosocial variables had a significant mediating effect between group and DNIC function. There was no significant mediating effect of somatization, $z = 0.42$, *ns*, catastrophization, $z = -0.32$, *ns*, sexual self-efficacy, $z = -0.33$, *ns*, or sexual function, $z = 0.11$, *ns*.

The mediation model was also run with all four psychosocial variables entered as mediators at the same time in order to determine to whether the collective set of psychosocial variables mediates the relationship between group and DNIC function conditional on the presence of the other mediators. When the psychosocial variables were entered together, there were still found to be no significant mediation effects, as path b was found to be non-significant, $F(4,43) = 1.64$, $p = .18$.

Chapter 6

Discussion

The purpose of my thesis was to examine the relationship between psychophysical functioning, specifically DNIC, and psychosocial functioning in women with PVD and control women. I first examined whether there were group differences in genital and non-genital sensitivity. I found that women with PVD exhibited significantly lower genital and non-genital tactile and pressure-pain thresholds and decreased heat pain tolerance levels as compared to control participants. When asked for subjective ratings to painful stimuli, women with PVD reported significantly higher pain and unpleasantness ratings at heat pain tolerance in the genitals than control women. I also examined group differences in psychosocial functioning. As hypothesized, women with PVD had higher levels of catastrophization and somatization and lower levels of sexual self-efficacy and sexual function.

Although I predicted that, as in other chronic pain conditions, women with PVD would exhibit diminished DNIC function as compared to control women, results from the current study suggest that DNIC function was intact in women with PVD. In fact, women with PVD appeared to experience a significantly greater magnitude of DNIC function as compared to control participants. This finding is inconsistent with much of the chronic pain literature examining DNIC function, which typically demonstrates that individuals with chronic pain conditions display diminished DNIC responses in comparison to control groups (e.g., Lautenbacher & Rollman, 1997; Kosek & Hansson, 1997). Finally, I examined the relationship between psychophysical and psychosocial functioning. In particular, I investigated whether somatization, catastrophization, sexual self-efficacy, or

sexual functioning mediated the relationship between group (PVD or control) and DNIC function. The mediations conducted were not significant: None of the psychosocial variables were found to mediate the relationship between group and DNIC function.

Psychophysical Functioning

Tactile stimuli. Based on previous findings (Pukall et al., 2002), I predicted that women with PVD would experience an increase in genital and non-genital sensitivity to non-painful stimuli as compared with control women. In the current study, women with PVD exhibited significantly lower tactile thresholds in all areas tested as compared with control women, indicating that it required fewer milligrams of pressure for women with PVD to detect a non-painful sensation. This result is consistent with previous findings (Pukall et al., 2002).

A previous study reported that although the vulvar vestibule was the least sensitive of several genital and non-genital areas tested in control women, it was the most sensitive area in women with PVD (Pukall et al., 2002). This finding is consistent with the clinical presentation of PVD. However, results from the present study indicated that the vulvar vestibule was significantly less sensitive than the labia, perineum, and arm for women in both groups, not just for control women. The discrepancy in relative sensitivity between studies for women with PVD could potentially be explained by differences in mean pain intensity ratings during the cotton-swab test. The average rating in the current study was in the moderate range (5.1), whereas Pukall et al. (2002) reported ratings in the moderate to severe range (6.7). The lower pain ratings in the current study could account for the threshold differences between studies, as research suggests that differences in the severity of PVD could translate into differences in quantitative sensory testing (QST)

results (Lowenstein, Vardi, Deutsch et al., 2004). In fact, Lowenstein et al. (2004) demonstrated that QST techniques are capable of discriminating levels of severity in women with PVD, indicating that women with more mild cases of PVD do not display the same increases in sensitivity as women with more severe forms of this condition.

Pressure-pain thresholds. Consistent with previous research (Giesecke et al., 2004; Pukall et al. 2004), the current study found that, as compared to control participants, women with PVD exhibited significantly lower genital pressure-pain thresholds. In other words, women with PVD reported experiencing pain in the labia, perineum, and vulvar vestibule at lower pressures than did control women. However, despite their increased sensitivity, women with PVD in the current study reported higher pressure-pain thresholds for each of these sites than did affected participants in previous studies. In the present study, women with PVD reported pain at an average of 197.0 grams, as compared to 135.0 grams (Giesecke et al., 2004) and 16.4 grams (Pukall et al., 2002). The higher pain threshold in the current sample could be explained by the lower pain ratings of the participants during the gynecological examination, perhaps reflecting the inclusion of more mild PVD cases.

Although significant between-groups differences were found for genital pressure-pain thresholds, there were no significant differences for pressure-pain thresholds over the forearm. This non-significant finding is likely due to the fact that the majority of women (PVD N = 17 [85.0%]; Control N = 21 [87.5%]) did not report experiencing pain in response to the maximum pressure (1 kg) applied to this area. In cases such as these, thresholds were coded as 1 kg, thereby underestimating participants' true pain thresholds.

Group differences in pain intensity and unpleasantness ratings to pressure-pain threshold were also examined. In contrast to previous findings indicating that women with PVD experience greater distress than control women in response to painful pressure (Giesecke et al., 2004; Pukall et al., 2002, 2004), there were no significant between-groups differences in the present study. As with the inconsistent findings for tactile thresholds, a potential explanation for this discrepancy could be the difference in pain ratings during the gynecological examination. Although many studies examining women with PVD include a positive response (i.e., pain) to the cotton-swab test as an inclusion criterion (Giesecke et al., 2004; Granot et al., 2002), they often do not report pain ratings collected during the cotton-swab test. In fact, many investigators may not even collect such data. This lack of information renders it difficult to compare results between studies. One study included such information, allowing for comparison. The current sample reported lower pain ratings during the cotton-swab test than did the participants in the study by Pukall et al. (2002). The current study also included women with very heterogeneous cotton-swab test pain ratings, ranging from 2.9 to 7.8, likely leading to the large standard deviations observed during psychophysical testing within the PVD group. This within-group heterogeneity may have led to an overlap in the ranges of the subjective ratings between control women and women with PVD, which may not have been present in previous studies examining subjective responses to psychophysical stimulation in PVD.

Thermal stimuli. Although the vulvalgesiometers exert a pain that is typically described as sharp and burning by women with PVD (Pukall et al., 2004), one of the aims of the current study was to further examine the burning sensation described by women

with PVD by using heat stimuli. Therefore, in addition to examining tactile and pressure-pain thresholds, the current study examined warmth detection thresholds, heat pain thresholds, and heat pain tolerance levels. Thermal thresholds, beginning with warmth detection, were first examined on the forearm. There are no published studies examining warmth detection in women with PVD and control participants. Results indicated no significant group differences, suggesting that women with PVD and control women report feeling the sensation of warmth at comparable temperatures on the forearm.

As with the results for the warmth detection thresholds, and inconsistent with the results of a previous study (Granot et al., 2002), findings from the current study indicate a lack of group differences with respect to heat pain thresholds on the forearm. It is of note that, in the current study, pain thresholds on the arm in affected and non-affected women were approximately 4 degrees Celsius lower than those reported in a study conducted by Granot et al. (2002). This discrepancy is not unusual, given that thermal thresholds have been found to be susceptible to methodology, duration of testing, and number of investigators (Chong & Cros, 2004).

The current study was the first in the PVD literature to examine the temperature at which participants reached heat pain tolerance through an ascending method of limits. A previous study in a related area restricted its examination to subjective ratings during the application of predetermined suprathreshold thermal pain stimuli, and found that women with PVD reported higher subjective pain ratings than control women (Granot et al., 2004). The current study examined pain tolerance levels in addition to subjective ratings (see below) in response to such stimuli. Results indicated that women with PVD exhibited significantly lower heat pain tolerance levels on the arm than control women.

Despite the lack of normative data regarding heat pain tolerance in women with PVD, the temperature reached by control women in the current study was within one degree Celsius of heat pain tolerance reported by 244 healthy women in a study by Bhalang, Sigurdsson, Slade, and Maixner (2004). Findings of decreased heat pain tolerance on the arm are consistent with the bulk of the literature suggesting that women with PVD experience increased sensitivity at non-genital body sites to a variety of stimuli (Pukall et al., 2002; Giesecke et al., 2004).

I also predicted significant between-groups differences with respect to vulvar warmth detection thresholds, heat pain thresholds, and heat pain tolerance levels. As with the forearm, significant differences were only found for pain tolerance levels, with affected women having lower heat pain tolerance levels than control women. No significant differences were found for vulvar warmth detection or pain threshold. The lack of significant genital heat pain thresholds in the current study is in contrast with the results of other studies. Bohm-Starke et al. (2001) and Lowenstein et al. (2004) found that women with PVD detected heat pain at significantly lower temperatures than control women.

A potential explanation for the non-significant findings related to heat pain thresholds is the use of different sensory testing equipment (Chong & Cros, 2004). The current study used circular thermode with a diameter of 10 mm², whereas Bohm-Starke et al. (2001) used a slightly larger (7 x 15 mm²), rectangular thermode. In addition, given that the current study found group differences in pain tolerance, but not pain threshold, it is possible that the level of PVD pain severity might influence pain threshold to a greater extent than pain tolerance. Pain threshold and tolerance are not simple extremes of a pain

scale and are influenced by different physiological and psychological variables (Bhalang et al., 2004). An examination of the processes involved in pain threshold versus pain tolerance in women with different severities of PVD could be an area of future research in understanding the underlying pain mechanisms in PVD. Such research could help researchers to further understand the etiological and maintaining factors in PVD.

It is interesting to note that regardless of group membership, the arm was more sensitive to thermal stimuli than the vulva. This result is consistent with findings that a larger thermode size, as was used on the arm as compared to the genitals, results in lower thermal thresholds (Chong & Cros, 2004). As well, the volar forearm has been found to be one of the most sensitive body sites to thermal stimuli (Dyck, Karnes, O'Brien, & Zimmerman, 1993). Heat pain thresholds have been found to be the lowest in the face and the volar forearm and highest in the legs and feet (Chong & Cros, 2004). This increased sensitivity at the arm as compared to the vulva could also be due to the fact that the vulvar area is an internal mucosal area of the body, which already has a naturally higher body temperature than areas on the surface of the body, such as the arm (Burton, 1935). Thus, it would take longer to detect warmth thresholds, heat pain thresholds, and heat pain tolerance levels over the vulva as opposed to the arm. This explanation is consistent with findings of increased heat pain thresholds in other mucosal areas as compared to non-mucosal body sites, such as the inside of the mouth as compared to the cheek (Green, 1985).

In addition to the measurement of thermal thresholds in genital and non-genital areas of the body, women were asked to rate the intensity and unpleasantness of the thermal sensations. There were no significant differences between the arm and genitals

for warmth detection or heat pain thresholds. The lack of differences in ratings between body sites can be due to the fact that women are consistent in attributing similar ratings to the point at which they first feel a change in sensation (e.g., warmth detection or pain threshold). For example, pain threshold would always be reported at the same rating regardless of the type or site of pain because that is the point at which they sense the beginning of pain. Likewise, detection ratings would be in the low range of the rating scale. There may be less variability in detection and threshold ratings because they will always be reported as a mild sensation, regardless of body site. In contrast, given the emotional arousal associated with a particular body site being tested, tolerance ratings could vary a great deal on the subjective rating scale.

When asked for subjective ratings for heat pain tolerance, participants rated arm stimulation as more painful and unpleasant than genital stimulation. This finding may be the result of a ceiling effect in heat pain tolerance at the genitals. Many women (PVD N = 4 [20%]; Control N = 9 [37.5%]) reached the maximum temperature (51 degrees Celsius) exerted by the thermode and were asked to provide ratings for this temperature. Again, given that the maximum temperature in such cases was an underestimate of their true pain tolerance levels, the associated ratings were also necessarily underestimations. Another potential explanation for this finding is that women may have allowed the heat pain increase to higher subjective ratings on the arm than they did on the genitals due to fear of experiencing too much pain in the genital region. However, fear of pain was not specifically measured in this study.

The finding that women with PVD reported higher pain and unpleasantness ratings in response to painful stimulation of the vulvar vestibule than control women is

consistent with previous literature (Granot et al., 2002; Pukall et al., 2004). However, the non-significant result with respect to unpleasantness ratings due to painful arm stimulation is inconsistent with previous reports (Pukall et al., 2002). As with the discrepancies in the subjective ratings in response to pressure-pain, this incongruent finding might be explained by the heterogeneity of pain severity in the PVD group. If PVD involves both the peripheral and central nervous system (CNS), perhaps those with milder cases or a shorter course of PVD have a more peripherally-based pain than those with more severe PVD (Staud et al., 2002). It is possible that cases of PVD with peripherally-based pain would manifest an increased sensitivity at the vulva, but not the arm. This hypothesis linking severity with type of nervous system involvement would help to explain the lack of group differences in terms of objective and subjective stimuli on the arm, as many of the current participants would be more likely to experience peripheral, rather than central nervous system dysfunction because they do not represent a sample of women with severe PVD.

Psychosocial Functioning

Based on a combination of the chronic pain and PVD literatures, it was predicted that women with PVD would report higher levels of somatization and catastrophization and lower levels of sexual self-efficacy and sexual function as compared to control women. As hypothesized, women with PVD had significantly higher levels of somatization than control women. This finding is congruent with much of the previous literature stating that individuals with chronic pain, including those with PVD, exhibit increased somatic complaints and symptoms as compared to control participants (Danielsson et al., 2000; Schover, Youngs, & Cannata, 1992; Wylie, Hallam-Jones, &

Harrington, 2004). However, some researchers report no significant differences in non-vulvar somatic complaints between PVD and control women (Meana et al., 1997; Reed Haefner, Punch, Roth, Gorenflo, & Gillespie, 2000). The use of different methodologies and assessment tools may result in slightly different ways of defining somatization, which can contribute to the discordant findings in the literature. The present study found that in addition to group differences on the Physical subscale of the SF-36, which is often used as a measure of somatization, women with PVD reported a experiencing a significantly higher number of ailments as compared to control women. This finding is consistent with previous studies reporting that women with PVD report having experienced increased rates of yeast infections (Pukall et al., 2002), significantly more bodily pain (Johannesson et al., 2006), and more regularly experienced pains (Pukall et al., 2006) than control women. However, the current study found that women with PVD did not report significantly higher associated pain intensity ratings than control women, and they were no more likely than control participants to report that these ailments interfered with their activities of daily living. This finding is inconsistent with previous literature reporting increased levels of pain and interference of pain in activities of daily living in PVD versus control women (Pukall et al., 2006). This finding could be potentially explained by the likely inclusion of women with mild PVD. Further research is necessary to determine if pain severity is related to somatization in women with PVD.

Catastrophization is a highly studied construct in the area of chronic pain, as it has emerged as one of the most important predictors of pain, accounting for 7-31% of variance in pain ratings (Sullivan et al., 2001). It also appears to be sensitive to changes in pain state. For example, previous research has shown that reduced levels of

catastrophization are associated with diminished chronic pain (France et al., 2002; Keefe et al., 2004). Research suggests that women with PVD are more likely than non-PVD women to catastrophize about their pain (Pukall et al., 2002). This increase in catastrophization was found to be true when comparing vulvar pain in women with PVD to the worst regularly experienced non-vulvar pain for control women (Pukall et al., 2002). In the current study, the PCS (Sullivan et al., 1995) was used to compare women with and without PVD on their worst regularly experienced pain, determined by the pain associated with the highest pain intensity ratings. In many cases, but not all, women with PVD reported vulvar pain as their most intense pain. Using this comparison method, women with PVD were found to catastrophize to a greater extent than control women.

Based on findings that chronic pain patients rate themselves more negatively and as less self-efficacious in the areas of their lives affected by the pain (Turk & Okifuji, 2002), and that increased levels of self-efficacy are associated with improvement in chronic pain (Jansen et al., 2001), it was predicted that women with PVD would report lower levels of sexual self-efficacy than control women. Consistent with findings in the current study of reports of lower confidence initiating and engaging in intercourse, women with PVD rated themselves as less able to be sensual and affectionate with their partners as compared to control women. The finding of reduced sexual self-efficacy is consistent with findings by Sackett et al. (2001), who reported that women with PVD experience decreases in their perceived ability to satisfy their partners sexually. Results from the present study also indicated that women with PVD were less likely to report self-efficacy in the domain of sexual communication.

Sexual communication is a particularly important area of sexual self-efficacy, as communication is an essential tool to dealing effectively with sexual and relationship problems that might arise following the pain caused by PVD. Although this link was not specifically studied in the current thesis, the lack of self-efficacy in sexual communication may help to explain the finding that there were very few differences in sexual behaviors between women with and without PVD. Sackett et al. (2001) found that women with PVD reported feeling guilty or inadequate as a sexual partner. Although the current study found no differences between women with PVD and control women in terms of their reported self-efficacy in refusal of sex and ability to cope with a partners' refusal, women with PVD may still feel guilty or lack confidence to discuss pain-free alternatives to penile-vaginal intercourse. This hypothesis is supported by the fact that women with PVD report similar frequencies and types of sexual activities as women without pain (e.g., Reed et al., 2000). In other words, it appears that the difference in confidence, an internal psychological concept, does not extend to the sexual behaviors themselves.

This similarity in sexual behaviors between groups held true as long as the sexual behaviours involved a partner. Despite no group differences in partner-related sexual activities, women with PVD were significantly less likely to engage in masturbation than control women. This finding suggests that perhaps women with PVD pursue intercourse despite the pain, for reasons related to their partner and their relationship. Current studies are examining relationship factors in women with PVD and should provide insight related to this area.

Finally, it was predicted that, based on the existing literature (e.g., Gates & Galask, 2001; Nunns & Mandal, 1997; Reed et al., 2003) and the clinical presentation of PVD, women with PVD would report diminished sexual functioning in comparison to control women. Results indicated that women with PVD experience diminished sexual functioning in the areas of desire, arousal, lubrication, orgasm, and satisfaction. Masheb et al. (2004) reported similar levels of sexual functioning for women with PVD ($M = 15.50$) and control women ($M = 30.50$) as those reported in the current study (PVD $M = 16.96$; Control women $M = 26.96$). As expected, and consistent with previous studies, women with PVD also experienced significantly more intercourse-related pain than control women (White & Jantos, 1998).

Findings of group differences on psychosocial functioning indicate that regardless of whether these variables mediate the relationship between group and DNIC function and regardless of whether PVD is found to be associated with central nervous system (CNS) functioning, it is essential to incorporate a psychological component into treatment. It is imperative that the psychosocial components of pain found to be present in women with PVD are addressed along with the psychophysical components.

DNIC Function

It was hypothesized that, regardless of whether or not they displayed a positive DNIC response, women with PVD would display a decreased magnitude in DNIC response in comparison to non-affected women. The current study used a number of measures of DNIC, including change scores of heat pain tolerance measured in degrees Celsius and change scores in subjective ratings of heat pain tolerance and temporal summation. When measured in degrees Celsius, results indicated that the majority of

women in both groups (control = 80%; PVD = 79%) had a positive DNIC response, indicating that the temperature at which they reached pain tolerance was higher when their opposite arm was in the cold water bath. In other words, most participants were less sensitive to the heat-evoked pain during the cold water immersion, indicating an intact DNIC response. This finding is consistent with a recently published study demonstrating that women with PVD do not experience diminished DNIC function (Johannesson et al., 2006). In addition, Leffler et al. (2002) examined DNIC in patients with rheumatoid arthritis and found that, despite their increased sensitivity to pain as compared to control women, patients with rheumatoid arthritis displayed an intact DNIC response. The finding of intact DNIC function in individuals with PVD and rheumatoid arthritis is not consistent with the bulk of the chronic pain literature.

The majority of studies examining DNIC and chronic pain report that individuals with chronic pain conditions experience diminished DNIC function (e.g., Lautenbacher & Rollman, 1997). A potential explanation for the discrepancy between the findings of the present and past studies is that, as discussed above, women with PVD experience pain of a chronic, intermittent nature, whereas many other chronic pain conditions are of a constant and unremitting nature. It is possible that DNIC dysfunction may only play a role in chronic pain conditions of a temporally constant nature. The DNIC system is dynamic, and it is possible that its function varies with the course of the pain condition. For example, DNIC may be a factor in the extent to which central sensitization occurs and may thus play a role in the transition from acute to chronic pain states (Staud et al., 2003) or from provoked to constant pain states. Perhaps the expected pattern of results would have been shown in a sample of women with generalized

vulvodynia; this condition involves constant pain over the entire vulva, and is therefore, more chronically experienced than the pain of PVD. Future studies should examine DNIC function in women with generalized vulvodynia.

Alternatively, the intact DNIC function in women with PVD could be due to methodological problems. The current study used measures of pain tolerance as opposed to pain threshold, the latter of which is most commonly used in the chronic pain literature. Pain tolerance was used in the current study in an attempt to maximize DNIC response given that women, as a group, tend to experience less of a DNIC response than men (Filligim et al., 1998; France & Suchowiecki, 1999). As well, research indicates that, the more painful the stimuli, the greater the DNIC response (Edwards et al., 2003). Therefore, heat pain tolerance was chosen as the measure for the first DNIC trial. In hindsight, the choice of heat pain tolerance as a DNIC measure also added a limitation to the study, as it restricted the data range. There is much more room for variability when measuring heat pain thresholds, because the temperatures are at the lower end of the pain spectrum and have plenty of leeway to increase.

The fact that the current results of intact DNIC function when examining DNIC using degrees Celsius are discrepant with the chronic pain literature could also be due to the fact that many studies used subjective pain ratings to assess DNIC function, as opposed to examining actual differences in threshold or tolerance. Perhaps there is a difference in findings between the use of psychophysical versus subjective rating methods for measuring DNIC. The subjective rating method was also used in the current study and although there were no significant differences between groups, the trend in the

results for women with PVD to display a dysfunctional DNIC response was consistent with the bulk of the chronic pain literature.

Of interest in the current study is that there were significant group differences in the amount of DNIC function, with control women displaying a smaller difference score than women with PVD. This difference in magnitude suggests that the women in the PVD group had a larger DNIC response than the women in the control group. This group difference was certainly an unexpected finding. It was first thought that this result could be explained by examining group differences in the pain experienced by the conditioning stimulus (the cold water bath). However, despite the fact that women with PVD reported heat pain tolerance at lower temperatures than control women, there were no group differences on the pain measures associated with the cold water bath. There were also no group differences in the participants' perception of DNIC; when asked whether or not they felt having their arm in the cold water reduced the amount of pain exerted by the heat stimulus, both groups reported a moderate decrease in heat pain. Thus, the difference in degree of DNIC cannot be explained by the amount of pain exerted by the cold water, time spent in the cold water, or perception of how much the cold water reduced the heat pain. The finding could be due, in part, to the fact that, in the current study, women with PVD displayed lower pain tolerance levels prior to the cold water bath immersion; therefore, their pain tolerance levels had more opportunity to increase than those of control women, who already had higher levels of pain tolerance. This difference in pre-DNIC tolerance scores could provide opportunity for a greater difference score in women with PVD. Differences in pre-testing tolerance levels could potentially explain the greater magnitude of DNIC function in women with PVD as compared to control women.

Most studies examining DNIC with thermal stimuli use pain intensity ratings associated with temporal summation as opposed to actual temperature changes in pain thresholds or tolerance. Temporal summation is an excellent technique for assessing ‘second pain’ (Edwards et al., 2003), because it is hypothesized that DNIC function may play a greater role in the modulation of second pain as opposed to first pain (Staud et al., 2003). The pain of PVD is most commonly described as sharp and burning (Bergeron et al., 2001), the two words associated with first and second pain, respectively (Price & McHaffie, 1988). This similarity between descriptors implies that a strong first and second pain response may exist in PVD. Unfortunately, the current study was unable to examine subjective ratings for temporal summation of second pain, as the ratings collected were not consistent with second pain reports; however, subjective ratings associated with first pain from the heat pain tolerance trials and peak subjective ratings during the temporal summation trials were assessed.

DNIC analyses were first conducted with the inclusion of all the participants and then performed again with only the DNIC responders (see Results section). When all participants were included, both groups displayed a positive DNIC response, with the control group displaying a slightly greater magnitude than women with PVD. The subjective DNIC result is consistent with results of a study indicating that women with PVD display an intact DNIC response (Johannesson et al., 2006). It is of interest that when only those women who displayed a positive DNIC response in degrees Celsius were included in the analyses, women with PVD no longer displayed a positive DNIC response when asked to rate the pain tolerance subjectively. This contradiction suggests that, despite displaying increases in pain tolerance during the DNIC trials, women with

PVD subjectively rated the heat stimuli as more painful during the simultaneous application of cold pain than when the heat stimulus was applied alone. In other words, the pain ratings for heat pain tolerance during the cold water immersion were higher than the pain ratings for heat pain tolerance prior to the cold water immersion. It is possible that these increased ratings occurred because participants allowed the thermode to increase to higher temperatures during the trials in which their opposite arm was immersed in the water bath.

After participants reported their pain ratings, they were asked to rate the extent to which the pain they experienced due to the heat stimulus was reduced from having their other arm in the cold water. Surprisingly, and in contradiction with their subjective ratings of heat pain, the women's responses suggested a reduction in heat pain ratings during cold water immersion. Unlike the findings for DNIC function as measured in degrees Celsius, this particular finding is consistent with previous chronic pain literature indicating diminished DNIC response in chronic pain patients (e.g., Pielsticker, Haag, Zaudig, & Lautenbacher, 2005). It appears that there is an increase in the amount of heat that can be tolerated during the DNIC trials and that this increase in temperature is mirrored by an increase in subjective pain ratings for women with PVD, but not for control women. However, despite the fact that women with PVD did not display a positive DNIC response and control women did, there were no significant group differences in magnitude of DNIC responding. Surprisingly, even though both groups reported similar perceived decreases in pain during the DNIC trial, subjective pain ratings for heat pain tolerance increased in women with PVD. This is a result which suggests

DNIC dysfunction. It is unclear why this pattern of findings may have resulted, and further research should investigate this interesting finding.

Psychosocial Mediation of the Relationship between Group and DNIC function.

Based on previous research examining the relationship between psychosocial functioning and pain (e.g., France et al., 2002; Edwards et al., 2004), it was predicted that psychosocial functioning would mediate the relationship between group and DNIC function. Mediation analyses were conducted using two methods. The first method assessed whether each of the psychosocial variables mediated the relationship regardless of the other psychosocial variables, second assessed the mediating role of the group of psychosocial variables entered simultaneously within a single model. To assess the variables individually, four analyses were conducted to assess the mediating role of somatization, catastrophization, sexual self-efficacy, and sexual function on DNIC function. Step one of the mediation model found that group membership was predicted by DNIC function (in degrees Celsius) and by each of the psychosocial variables. As predicted, women with PVD reported higher levels of somatization and catastrophization as well as lower levels of sexual self-efficacy and sexual function. However, in contrast to my predictions, women with PVD displayed a greater DNIC response than control women. Perhaps one of the reasons that none of the psychosocial variables mediated the relationship between group and DNIC function was because this relationship was not in the predicted direction (see above). Analyses were not conducted for subjective ratings of DNIC function, as there were no significant group differences in DNIC function. Possibilities for the lack of significant findings could also be attributable to the small sample size in the current study. Conducting these analyses with a larger sample size in

the future will allow for greater power and potentially significant findings of the combined effect of group and psychosocial variables on DNIC function (path b).

Limitations

Although the current study had many strengths, it also had a number of limitations that should be acknowledged. First were some methodological flaws that should be addressed in future studies. Rather than using a visual analogue scale (VAS) in which participants record their pain/unpleasantness ratings by marking a line on a 0-10 or 0-100 scale, participants provided oral responses for their pain/unpleasantness ratings. The use of a VAS, as opposed to a numerical rating scale with verbal responses, would have allowed for more fine-tuned data analysis, as responses need not have been confined to whole numbers and could have thus been interpreted more appropriately as a continuous variable. Although researchers in the area of PVD use both verbal numerical rating scales and visual analogue scales, most researchers in the area of chronic pain and DNIC use the VAS technique, thus the use of this methodology in the current study would have rendered the results easier to compare with the chronic pain and DNIC literatures. As mentioned above, temporal summation procedures assess two distinct types of pain, first pain, which can be described as a sharp sensation, and second pain, which is described as a burning sensation (Staud et al., 2002). The original aim of including temporal summation in the current study was to examine the effects of second pain in the DNIC paradigm. Unfortunately, results suggest that participants were focusing on first pain, as they were habituating to the stimuli, rather than experiencing a summation response. Most studies examining temporal summation allow for a lengthy period of practice time for the participants to become familiar with the difference between first and second pain.

However, due to time constraints, women were not given the chance to undergo many practice trials in the present study. Another limitation arose from the use of heat pain tolerance, as opposed to heat pain threshold, for the DNIC trials. As discussed above, the use of this measure may have greatly restricted the data range. Using tolerance as the DNIC measure also prevented me from analyzing the DNIC data at the genital site. DNIC was originally to be measured at both the arm and the genitals; however, due to ceiling effects of heat pain tolerance at the genitals, the current study was only able to examine DNIC function on the arm. A final limitation exists due to the differing needs of competing research questions. I was interested in both between- and within-group analyses. The within-group analyses required that participants with PVD display cotton-swab ratings during the gynecological examination that range from mild to severe. This requirement resulted in a heterogeneous group of women. Examining the standard deviations reveals that for all variables assessed, the PVD group was indeed heterogeneous – and to a greater degree than the control group. Although I sought a heterogeneous sample in order to be able to conduct within-group analyses examining the effect of pain frequency and severity, this strategy limited my power for between-groups analysis, as it minimized group differences. For the current study, within-PVD-group analyses were not reported, as none of the findings were significant. The lack of significant findings is likely a result of lack of power due to the small sample size (N = 20).

Implications & Future Directions

Although there is a great deal of research currently being conducted to examine the pain components of PVD, further research is needed in order to tease apart the roles

of the peripheral and central nervous systems. The results of the current study support many previous findings, while also adding new information to the PVD literature. A finding of increased sensitivity in women with PVD at both genital and non-genital sites implies that the central nervous system may play a role in the etiology or maintenance of this disorder. Furthering our understanding of somatosensory function in the peripheral and central nervous systems, in combination with the development of a greater understanding of the interaction between psychophysical and psychosocial components of chronic pain, will aid in the development of better assessment tools and treatment strategies. It is important to note that the current findings reporting intact DNIC function in women with PVD do not imply that PVD is not a chronic pain condition. As discussed above, there are other findings of intact DNIC function in chronic pain conditions (i.e., rheumatoid arthritis; Leffler et al., 2002).

DNIC is a complex, dynamic process and it warrants further study using different stimuli and different paradigms. For example, future research should use temporal summation protocols to examine the effects of second pain in women with PVD using a DNIC paradigm (e.g. Edwards et al., 2003). Participants would be explicitly trained in distinguishing between the sensations of first and second pain prior to commencing the testing procedures. The temporal summation and DNIC protocol could be administered while examining brain and spinal cord responses during functional magnetic resonance imaging (fMRI). In this way, both subjective (ratings to the stimuli) and objective (neural activation as measured via fMRI) responses to pain could be examined. To date, temporal summation protocols have examined only the participant's subjective responses to pain; thus, including the measurement of brain activation levels through the use of fMRI

would add a unique component to the research. Such a study will allow researchers to gain a better understanding of the brain's responses to pain and the mechanisms behind temporal summation and DNIC.

Another interesting addition to the research would be to focus on differences within the PVD group, rather than focusing on between-group differences, as was done in the current study. For example, it would be useful for both assessment purposes and treatment decisions to examine psychosocial functioning as a mediator of the relationship between PVD severity and DNIC function. This analysis will be conducted once I collect a larger sample size of women with PVD. At present, the sample size is too small to detect any significant relationships. Findings from this research could provide researchers and clinicians with information related to important psychosocial areas on which to focus for preventative or remedial strategies in dealing with PVD depending on its severity. Severity could be measured as the degree of pain intensity, the amount of time intercourse is painful, and/or the length of time the woman has suffered from the condition. Once researchers have a better understanding of the role that psychosocial functioning plays in PVD, it would be useful to conduct a treatment study to examine the effectiveness of psychological treatments that focus specifically on the psychosocial factors associated with pain severity in women with PVD.

Chapter 7

Conclusion

The current study adds a number of important contributions to the research literature:

1. Many of the findings from this study are consistent with the previous literature on PVD and chronic pain conditions, which reports that women with PVD (and patients with chronic pain conditions) are more sensitive to tactile, pressure, and thermal stimuli relative to control groups.

2. Adding to the psychosocial literature is the finding that women with PVD report lower levels of sexual self-efficacy than control women. Consistent with previous literature, women with PVD reported higher levels of somatization and catastrophization, and lower levels of sexual self-efficacy and sexual functioning than control women.

3. Consistent with the results of a recently published study on DNIC function in women with PVD, the current study also indicated that women with PVD have intact DNIC function. A novel finding is that women with PVD may actually have significantly greater DNIC function than control women when measured in actual temperature change but that their DNIC function may be less when measured by subjective ratings. This finding is consistent with previous research indicating that women with PVD display increased subjective responses to pain.

4. There was no mediating effect of psychosocial functioning on the relationship between group and DNIC function. Once the state of DNIC function in women with PVD has been more clearly determined, this mediator model should be re-examined with a

larger sample size. It would also be worthwhile to examine the role of psychosocial and psychophysical functioning in PVD of differing severities.

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Appendix A

Dear Dr. _____,

We are writing to inform you of a study being conducted by a multidisciplinary group of psychologists and gynecologists at Queen's University. The purpose of the study is to examine sensory functioning in women with provoked vestibulodynia. As you may know, PVD is a condition involving pain upon contact of the vaginal opening during activities such as sexual intercourse, tampon insertion, and pelvic examinations.

In order to recruit women with PVD, we are placing posters, brochures, and advertisements in various medical clinics, community centers, and local newspapers. We are also contacting local physicians and gynecologists to ask for aid in recruiting women with PVD, as well as women without this condition to act as control participants. We would greatly appreciate your help with our recruitment, and hope that you will inform your patients about our study. Potential participants can telephone our research team at **(613) 533-3276** or email us at SHRL@post.queensu.ca for more information about the study. Along with this letter we have included brochures and posters with the hope that you could display them in your office and/or distribute them to your patients.

Women who participate in these studies will undergo a standardized gynaecological examination for the purpose of pain diagnosis, an interview including questionnaires, and a sensory testing session involving the application of stimuli of varying intensity to both genital and non-genital areas of the women's bodies. The gynecological examinations will take place at the Department of Obstetrics and Gynecology, Kingston General Hospital and will be conducted by Dr. Susan Chamberlain. The interview, questionnaires, and sensory testing sessions will take place at the Sexual Health Research Laboratory, Department of Psychology, Queen's University. Women will receive compensation for their participation in these studies.

We are hoping that this study will provide us with important information regarding the processes involved in chronic vulvar pain problems. Ultimately, we hope that the results of this study will inform treatment approaches for women with PVD. Thank you very much for your help. If you have any questions, please feel free to contact the Sexual Health Research Laboratory, (613) 533-3276 or SHRL@post.queensu.ca, or Dr. Caroline Pukall, (613) 533-3200; pukallc@post.queensu.ca.

Sincerely,

Caroline F. Pukall, Ph.D
Assistant Professor
Department of Psychology
Queen's University

Susan Chamberlain, M.D.
Assistant Professor
Department of Ob/Gyn
Queen's University

Kate S. Sutton, B.A.(Hons)
M.A. Student
Department of Psychology
Queen's University

Do You Have Pain During Sexual Intercourse?



The Departments of Psychology and Obstetrics & Gynecology at Queen's University Departments of need **women aged 18-45 with genital pain** to participate in a research study on pain sensitivity

Study Procedures:

Eligible participants will complete a gynecological examination, interview/ questionnaires, and a laboratory session involving sensitivity testing of non-genital and genital parts of the body.

Participation takes approximately 3 hours

All information is strictly confidential.

*****Compensation Provided – \$100.00*****



Interested?

For more information, please contact the Sexual Health Research Lab

(613) 533-3276

SHRL@post.queensu.ca

Investigators:

Caroline Pukall Ph.D., Susan Chamberlain M.D.,
Kate Sutton, B.A.(Hons), M.A. Student

Women's Sexual Health Study



The Departments of Psychology and Obstetrics & Gynecology at Queen's University Departments need **women aged 18-45** to participate in a research study on pain sensitivity

Study Procedures:

Eligible participants will complete a gynecological examination, interview/ questionnaires, and a laboratory session involving sensitivity testing of non-genital and genital parts of the body.

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All information is strictly confidential.

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Interested?

For more information, please contact the
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(613) 533-3276

SHRL@post.queensu.ca

Investigators:

Caroline Pukall Ph.D., Susan Chamberlain M.D.,
Kate Sutton, B.A.(Hons), M.A. Student

Appendix B

ID # _____

Telephone screening interview: DNIC 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) Doctor's Office
- 5) Other: How? _____

Study information

****Before beginning ASK THE WOMAN if her pain is genital (opening to vagina) or pelvic (near cervix or cramping) in nature. If it is ONLY pelvic explain that that is not the type of pain that we are studying. This will save you and her a lot of wasted time!**

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 questions.

The main goal of this study is to determine differences in pain characteristics, psychosocial functioning, and genital and non-genital sensitivity between women with provoked vestibulodynia (PVD) and control women. PVD is the most common form of vulvodynia (i.e. chronic vulvar pain), affecting 12% of women in the general population. Despite the prevalence, we still do not know exactly what causes or maintains this pain. It is hoped that the results of this study will provide further information regarding the underlying mechanisms of PVD and possibly lead to some further treatment options.

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. For the appointment at the hospital, you will be seen for about a half-hour by a gynecologist and a research assistant. The second part consists of an interview/questionnaires and should take approximately 1-1.5 hours. The third part of the study is a sensory testing session and should take approximately 2 hours to complete. You can attend the interview/questionnaire and sensory testing sessions in one day or split them over two appointments.

There is also a study on vulvodynia and relationships currently ongoing in our lab. If you would like to participate or have participated in this study you will be reimbursed for another 100\$. However, it is not necessary to undergo another gynecological exam as we will use this data for both studies if you are interested.

The interview will be done by a trained female researcher. The interview will cover information such as sociodemographics, medical history, vulvar pain history and pain

characteristics (if you suffer from chronic genital pain), sexual functioning, relationship functioning, and body image. There will also be questionnaires on a computer asking about pain, body image and sexual and relationship functioning. You are under no obligation to answer any questions that you feel uncomfortable answering.

The sensory testing will be done by the same researcher from the interview along with another female research assistant present to run the computer. The sensory testing session consists of two major parts – genital and non-genital. The non genital testing will be done first so that you can get an idea of what the genital testing entails. If after the sensory testing on your arm, you are not comfortable and do not wish to continue with the genital testing you have that option. The researcher will be applying pressure and thermal (hot and cold) stimuli to your forearm and asking you about your touch and temperature detection (e.g., when do you feel touch or a change in temperature), your pressure and thermal pain thresholds (e.g., when do you first feel pain), and your pain tolerance to pressure and thermal stimuli. The temperature and the pressure increase in small increments and stop increasing when you indicate that you can no longer tolerate the pain. We do not increase to a standard temperature for all the participants; it is entirely based on your own levels of pain tolerance. For some of the trials your other forearm will be in a cold water bath. The second part of the testing involves a similar procedure on parts of the vulva or external genitals. The genital sites include the labia minora, the vestibule and the perineum (ask if they are familiar with these anatomical parts and explain where these sites are if necessary). None of the stimuli will be applied internally. The stimuli will be of various pressures and temperatures - some will be non-painful and some will be painful.

For all sections of the sensory testing, the researcher will ask you at each time she applies a stimulus to your body if you feel pain or not and will ask you to rate the intensity and unpleasantness of the stimuli on scales. Although some pain may be experienced during this examination, no health risks are posed, and the painful sensations do not last for long periods of time. You are able to stop or control the session at any time. For your time and inconvenience, you will be reimbursed 100.00\$ upon completion of all parts of the study.

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: _____

ID number: _____

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

1a. Are you currently in a relationship? YES NO

If YES – How long have you been in this relationship? _____

**1b. Are you currently in a cohabiting/married relationship with this person?
YES NO**

**If YES - How long have you and your partner been married or cohabiting?
_____**

**If NO – Have you ever been in a relationship? _____
How long has it been since your last relationship? _____
How long were you in your most recent relationship? _____**

2. Is this relationship HETEROSEXUAL or SAME SEX ?

3. How old are you? _____

4. Do you mind answering some questions about your medical history to determine if you are eligible for the study?

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.

5. Are you currently suffering from any medical or psychiatric conditions?

YES* NO → go to #6

→ 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 → Go to #6

→ If yes, which one(s)? _____

6. Have you ever suffered, or are you currently suffering, from a chronic or recurrent pain condition (other than genital pain)? Note: Chronic pain refers to persistent pain that often lasts for months (e.g., back pain). Recurrent pain refers to pain episodes that reoccur that are interspersed with pain-free episodes (e.g., migraine headaches).

YES* NO → go to #7

→ 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 currently taking painkillers for this/these conditions? YES* NO → go to #7

→ If yes, which one(s)? _____

7. Do you currently experience pain in your genital region? YES NO

YES: For how long have you had this pain? _____ (min 6 months)
 → Go to #8 and use present tense

NO: Have you **ever** had recurrent and persistent genital pain?

→ YES: Why do you no longer have the pain? _____

 _____ (Go to #8 and use past tense)

→ NO: Go to #13

8. In what situations do/did you feel the pain?

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?

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? _____

9. In which genital areas do/did you feel the pain?

A) At the vaginal opening

B) Everywhere on the vulva

C) Inside the vagina

D) In the pelvic or abdominal region*

E) Other: _____

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

11. Did you receive any diagnosis for this pain? YES NO → go to #12

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

→ By whom? _____

→ When? _____

12. Have you ever undergone any treatment for the pain? YES NO → go to #13

→ If **yes**, which one(s)? _____

→ Are you currently undergoing any treatment? YES NO → go to #13

→ If **yes**, which one/s? _____

13. Do you have any difficulty at all with vaginal penetration or insertion?

YES* NO → go to #14

→ If **yes**, please describe: _____

14. When was your last gynecological examination?

**Make sure that if they respond in terms of a physical you make sure that the physical included a gynecological examination. Ensure that partaking in a gyne exam is okay with them (NOT ELIGIBLE if they have never had one)

→ Was it painful? YES NO

→ Do you use tampons or any other kind of internal feminine hygiene product (e.g., Keeper/Diva Cup)?

YES NO → go to #15

→ Do you experience pain when you insert/remove tampons/product?

YES NO

15. Are you currently taking oral contraceptives? YES NO

16. Have you ever given birth? YES NO → go to #17

→ If yes: How many children do you have? _____

→ Through what method/s of delivery?

A) Vaginal delivery: How many? _____

B) Caesarean-section: How many? _____

→ Are you currently breast-feeding? YES* NO

*If YES, thank the woman for her time, but she is not eligible. Remind her that she is welcome to contact the lab for future studies or to complete the online study.

17. Is there any possibility that you might currently be pregnant? YES* NO

*If YES, thank the woman for her time, but she is not eligible. Remind her that she is welcome to contact the lab for future studies or to complete the online study.

18. What was the start date of your last menstrual period? _____

*Explain to participant why we ask this – that pain thresholds vary throughout the menstrual cycle and testing will be done between day 7 and 12 to standardize our results.

Initial Decision

NOT ELIGIBLE* _____ (If they are not eligible, explain to them why and thank them for their time. Suggest that they might be interested in Kelly's study or the online study.)

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.)

GVD _____ † (Tell them that they are eligible for this study.)

PVD _____ † (Tell them that they are eligible for this study.)

†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: Book the gynecological exam according to Sue's schedule.

Gynecological Exam Date/time booked: _____

Interview Date/time booked: _____

Sensory Testing Date/time booked (day 7-12 of cycle): _____

*** (Day 1 is first day of your period)

→ 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.

Home: _____ Can we leave you a message? YES NO

Work: _____ Can we leave you a message? YES NO

Cell: _____ Can we leave you a message? YES NO

Email address: _____

Interviewer's Name: _____

Appendix C

Letter of Information

The Impact of Pain Sensitization and Psychosocial Functioning in Provoked Vestibulodynia (PVD)

Investigators:

Caroline F. Pukall, PhD, Department of Psychology, Queen's University
Susan Chamberlain, MD, Dept of Obstetrics and Gynecology, Kingston General Hospital
Katherine Sutton, BA(Hons), MA Candidate, Department of Psychology, Queen's University

Introduction

This study is being carried out by a multidisciplinary group of psychologists and gynecologists. The principal psychologist is Dr. Caroline Pukall, Department of Psychology, Queen's University (533-3200), and the principal gynecologist is Dr. Susan Chamberlain, Department of Obstetrics and Gynecology, Kingston General Hospital (548-1327).

Purpose of the study

The purpose of this study is to investigate processes of pain regulation in order to test how your body responds to and how your brain perceives pain. The current study will examine whether or not there is a difference in pain regulation between women with provoked vestibulodynia (PVD; a common cause of painful intercourse) and control women. Measures of psychosocial function will also be examined to assess whether or not they are related to the experience of pain in terms of the quality, unpleasantness and intensity of the pain.

Study procedures

Your participation in this study involves undergoing the following procedures: 1) a gynecological examination; 2) a semi-structured interview and the completion of questionnaires; and 3) a sensory testing session. The gynecological examination will take place at the Department of Obstetrics and Gynecology, Kingston General Hospital. The interview, questionnaires, and sensory testing session will take place at the Sexual Health Research Laboratory, Department of Psychology, Queen's University.

Gynecological examination: During the gynecological examination (5-10 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 a medical student may be, present during the examination.

Interview and questionnaires: The semi-structured interview and questionnaires will take approximately 1 hour to complete and will cover sociodemographic information, gynecological and medical history, vulvar pain history, current physical and psychological symptoms, and sexual functioning.

Sensory testing session: During the sensory testing session, temperatures of various intensities (non-painful and painful) will be applied on your forearm, labia minora (i.e., inner lips of the vulva), perineum (i.e., the skin between the vaginal and anal opening), and posterior vestibule (i.e., the vaginal opening) in order to test for detection of warmth and coolness, hot and cold pain thresholds, and maximum temperature tolerance for heat pain. These tests will be carried out by a trained research assistant. The heat application lasts only a few seconds, after which you will be asked to rate the sensations on intensity and unpleasantness scales.

Touch and pressure stimuli of varying intensity (some non-painful and some painful) will also be applied on your forearm, labia minora (i.e., inner lips of the vulva), perineum (i.e., the skin between the vaginal and anal opening), and posterior vestibule (i.e., the vaginal opening). These tests will be carried out by a trained research assistant who will touch these areas with nylon threads of different thicknesses as well as with a spring-based cotton-swab applicator. The touching lasts only a few seconds, after which you will be asked to rate the sensations on intensity and unpleasantness scales.

During the final portion of the sensory testing session, heat of varying intensities (non-painful and painful) will be applied over your inner ankle and forearm. These tests will be carried out by a trained research assistant. The heat application lasts only a few seconds, after which you will be asked to rate the sensations on intensity and unpleasantness scales. You will also be asked to put your dominant forearm in a cold bath of water while the heat is being applied to your inner ankle and non-dominant forearm. Once your arm is removed from the cold water, you will undergo one final heat application to your ankle and forearm.

Although some of the stimuli in the sensory testing session may feel uncomfortable or painful to you, none will damage your skin. Also, you can withdraw from and terminate any stimulus that is too uncomfortable at any time.

Compensation

Upon completion of the gynecological examination, the interview/questionnaire session, and the sensory testing session, you will receive \$100.00 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

The information obtained from this study will potentially help our understanding of the processes involved in the development and maintenance of chronic genital pain problems.

In addition, it will aid in guiding appropriate treatment for women who suffer from PVD, a common form of vulvar/genital pain in women.

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 session) may be uncomfortable or painful. The stimuli used during the sensory testing session (i.e., nylon threads, cotton-swab applicator, thermode, cold water bath) 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 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. 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.

Appendix D

Consent form

I, _____, have volunteered to participate in the study entitled *The Impact of Diffuse Noxious Inhibitory Control (DNIC) Function on Pain Sensitization and Psychosocial Functioning in Women with Provoked Vestibulodynia (PVD)*, conducted by Katherine Sutton, and Drs. Caroline Pukall and Susan Chamberlain.

I consent to the information contained in the Letter of Information and understand what is required for participation in the study. 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 depression and sexual functioning. Further, I understand that I will undergo a sensory testing session that involves the application of non-painful and painful stimuli to various genital and non-genital parts of my body. I understand that the stimuli include touch, pressure, and temperature applications. I understand that my participation in the study is completely voluntary and that I am free to withdraw at any time. I also understand that my confidentiality will be protected throughout 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).

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

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

Signature: _____

Date: _____

Sexual Health Research Lab

62 Arch Street, Kingston, Ontario K7L 3N6

Email: *SHRL@post.queensu.ca*

Phone: (613) 533-3276

Information about Confidentiality

All information disclosed during your participation in this research study is confidential and **will not** be disclosed to anyone without your written and informed consent **except** where reporting is required by law, that is –

1. where there is suspicion that a child or children (that is, an individual who is PRESENTLY under the age of 16) has been or is being abused,
2. where the research participant is likely to harm herself or himself unless protective measures are taken,
3. where the research participant presents a serious danger of violence to others, and
4. if the research participant reveals that she has been sexually abused by a health care provider (for example, a psychologist or physician) covered by the Regulated Health Professionals Act, it is necessary by law to report the name of the perpetrator to his/her governing body.

IF YOU HAVE ANY CONCERNS ABOUT THESE MATTERS, OR ABOUT THIS FORM, PLEASE DISCUSS THESE WITH ME.

 PLEASE SIGN THE ACKNOWLEDGEMENT BELOW TO INDICATE THAT YOU
 HAVE READ THIS INFORMATION ABOUT CONFIDENTIALITY

I acknowledge the circumstances that limit confidentiality and I accept them.

 Participant's name

 Participant's signature

 Date

 Witness' name

 Witness' signature

 Date

Appendix E

Past Medical History

Major illnesses & hospitalizations

Cardiovascular/vascular (e.g., angina, heart attack, transient ischemic attack, stroke, etc)

Respiratory (e.g., asthma, chronic obstructive pulmonary disease, emphysema, etc)

Gastrointestinal/renal (e.g., irritable bowel syndrome, interstitial cystitis, etc)

Musculoskeletal/rheumatological (e.g., fibromyalgia, arthritis, etc)

Endocrinological (e.g., hypothyroidism, diabetes, etc)

Gynecological (e.g., endometriosis, PID, recurrent yeast infections, etc)

Psychiatric/psychological (e.g., depression)

Reproductive history

Number of pregnancies: _____

Number of live births: _____

Mode of delivery: _____

Pregnancy complications: _____

Sexually transmitted infections (e.g., Chlamydia, gonorrhea, herpes, HPV)

Past surgeries

Current medications

Allergies

Other

Age: _____

Pain location(s): _____

Previous diagnoses and treatment:

Description of pain:

When the pain starts:

Situation/s that elicit the pain:

Appendix F

GYNECOLOGICAL EXAMINATION

Participant ID Number: _____ Date: _____

Examining physician: _____ Research Assistant: _____

SECTION I: INSPECTION OF THE VULVA

Clitoris

No abnormalities <input type="checkbox"/>	Partially hooded <input type="checkbox"/>	Complete phimosis <input type="checkbox"/>
---	---	--

Labia minora

No abnormalities <input type="checkbox"/>	Partially fused <input type="checkbox"/>	Completely fused <input type="checkbox"/>
---	--	---

Posterior fourchette

No abnormalities <input type="checkbox"/>	Scar from previous fissure <input type="checkbox"/>	Active fissure <input type="checkbox"/>
---	---	---

Vestibule: BEFORE the cotton-swab test

No abnormalities <input type="checkbox"/>	Erythema <input type="checkbox"/>	Fissure <input type="checkbox"/>	Synechia <input type="checkbox"/>
---	-----------------------------------	----------------------------------	-----------------------------------

Pubic Hair

Sparse <input type="checkbox"/>	Normal <input type="checkbox"/>	Shaved <input type="checkbox"/>
---------------------------------	---------------------------------	---------------------------------

Labia

Dry, atrophic <input type="checkbox"/>	In between atrophic and full <input type="checkbox"/>	Full <input type="checkbox"/>
--	---	-------------------------------

SECTION II: COTTON-SWAB TEST

LABIA MAJORA: pain intensity ratings

Patient's right, anterior: _____

Patient's left, anterior: _____

Patient's right, mid-point: _____

Patient's left, mid-point: _____

Patient's right, posterior: _____

Patient's left, posterior: _____

INNER LABIA MINORA: pain intensity ratings

Patient's right, anterior: _____

Patient's left, anterior: _____

Patient's right, posterior: _____

Patient's left, posterior: _____

MIDLINE AREAS and VESTIBULE (random order): pain intensity ratings

Between vagina and urethra: _____

1 o'clock: _____

Inside vagina: _____

4-5 o'clock: _____

Posterior fourchette: _____

6 o'clock: _____

Perineum: _____

7-8 o'clock: _____

11 o'clock: _____

Appearance of vestibule after cotton-swab test:

No erythema <input type="checkbox"/>	Erythema <input type="checkbox"/>	Other <input type="checkbox"/>
--------------------------------------	-----------------------------------	--------------------------------

Ask women with provoked pain during sexual activity only:

Does this pain feel like the pain you experience during sexual activity?

Yes No Maybe

If **no**, how was it different? _____***ANAL WINK TEST***

Present <input type="checkbox"/>	Weak <input type="checkbox"/>	Absent <input type="checkbox"/>
----------------------------------	-------------------------------	---------------------------------

SECTION III: MUSCLE TENSION ASSESSMENT (random order)

Apply pressure inside the vagina for 3 seconds at 8, 6, and 4 o'clock. Record pain intensity ratings.

8 o'clock: _____**6 o'clock:** _____**4 o'clock:** _____**Evaluation of muscle tension by the examining physician**

Relaxed <input type="checkbox"/>	Tense <input type="checkbox"/>	Severe tension <input type="checkbox"/>
----------------------------------	--------------------------------	---

Kegel evaluation: degree of contraction

None <input type="checkbox"/>	Weak <input type="checkbox"/>	Strong <input type="checkbox"/>	Very strong <input type="checkbox"/>
-------------------------------	-------------------------------	---------------------------------	--------------------------------------

Kegel evaluation: degree of relaxation

None <input type="checkbox"/>	Relaxed <input type="checkbox"/>	Tense <input type="checkbox"/>
-------------------------------	----------------------------------	--------------------------------

SECTION IV: SPECULUM EXAMINATION

Speculum insertion: pain intensity rating _____

Skin elasticity and turgor:

Poor <input type="checkbox"/>	Fair <input type="checkbox"/>	No abnormalities <input type="checkbox"/>
-------------------------------	-------------------------------	---

Vaginal mucosa:

Atrophic <input type="checkbox"/>	No abnormalities, rugal appearance <input type="checkbox"/>
-----------------------------------	---

Vaginal depth:

Shortened <input type="checkbox"/>	No abnormalities <input type="checkbox"/>
------------------------------------	---

SECTION V: BIMANUAL PALPATION

Palpate the uterus, the adnexae, and the cervix. Describe any and all abnormalities, including pain (fibroids, cysts, endometriosis, etc):

Introitus:

<1 fingerbreadth <input type="checkbox"/>	1 fingerbreadth <input type="checkbox"/>	2 fingerbreadths <input type="checkbox"/>	+2 fingerbreadths <input type="checkbox"/>
--	---	--	---

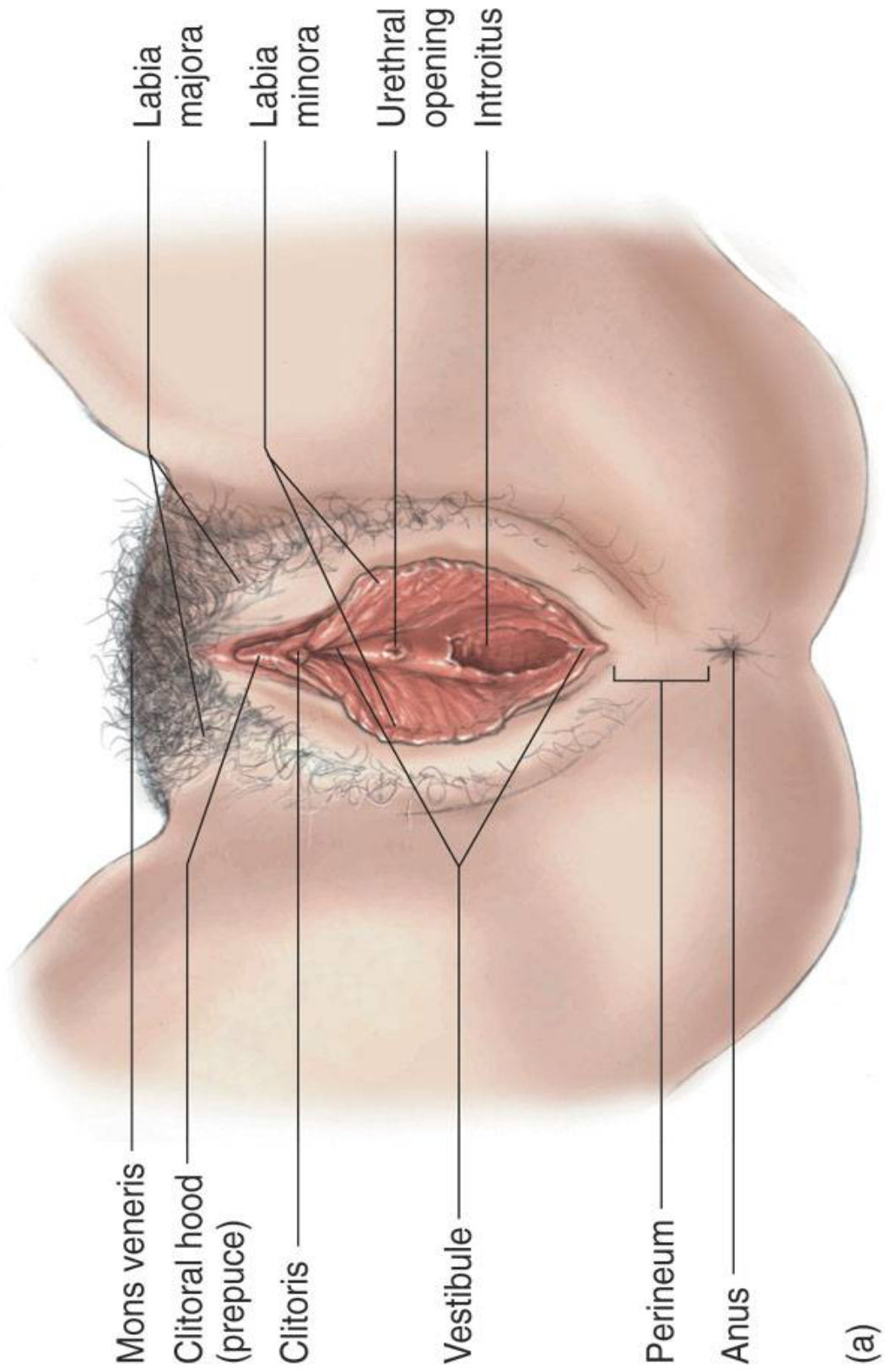
SECTION VI: OVERALL UNPLEASANTNESS OF GYNECOLOGICAL EXAMINATION

Ask: On a scale from 0 to 10, how unpleasant overall was the gynecological examination? _____

SECTION VII: DIAGNOSTIC IMPRESSION

No gynecological diagnosis _____	Lichen planus _____
Provoked Vestibulodynia _____	Lichen sclerosus _____
Generalized vulvodynia _____	Heightened muscle tension _____
Vaginal atrophy _____	Other _____ please specify: _____
Vulvar fissures _____	_____

Appendix G



Appendix H

Structured Interview

DNIC Study

PVD Women

Participant ID Number _____

Group _____

Interviewer _____

Date of Interview _____

PART B: Relationship History

1) Which of the following best describes your sexual orientation?

- 1) heterosexual
- 2) homosexual
- 3) bisexual
- 4) hetero-flexible
- 5) not sure

2) Which of the following best describes your current situation?

- 1) not dating at the moment
- 2) no regular partner at the moment
- 3) dating one partner regularly
- 4) living with a partner
- 5) married

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

4) How old were you when you had intercourse for the first time? _____ years old.

5) Do you remember it as being painful? 1) YES 2) NO (N/A for #6)

→ if yes, describe

→ if no, go to #7

6) On a **scale** of 0 to 10, please rate the intensity of the pain you experienced during your first intercourse. _____ N/A

7) Do you remember it as being unpleasant? 1) YES 2) NO (N/A for #8)

→ if no, go to #9

8) On a **scale** of 0 to 10, please rate the degree of unpleasantness you experienced during your first intercourse. _____ N/A

- 9) What is the total number of partners you have had intercourse with (including one-night stands)? _____
 How many of these were one night stands? _____
 How many of these were short term? _____
 How many of these were long term (i.e., longer than three months)? _____
- 10) How many long term (i.e., longer than three months) relationships have you been in? _____
 ➤ How many of the long-term relationships reported above have you been in since your vulvar pain (i.e., genital pain) started? _____
- 11) How many casual dating (i.e., relationships that you did not consider yourself committed to) relationships have you been in? _____
 ➤ How many of the dating relationships reported above have you been in since your vulvar/genital pain started? _____
- 12) Were you in a relationship at the time that your vulvar/genital pain started?
 Yes _____ 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? _____
- 13) How has your relationship status changed since the onset of your vulvar/genital pain?

- 14) On a scale from 0 to 10, how comfortable do you feel asking someone on a date?

 Please explain why you chose that rating.

- 15) On a scale from 0 to 10, how comfortable do you feel being asked on a date?

 Please explain why you chose that rating.

PART C: Gynecological and Medical History

1) Do you menstruate regularly (approximately once a month)? 1) YES 2) NO

If no, why not? _____

2) What was the start date of your last menstrual period? _____ / _____ / _____
mo day year

[coding: 1) Follicular (few days after menstruation)
2) Ovulatory (about 2 weeks after start of last menstruation)
3) Luteal (after ovulation, few days before menstrual onset)
4) Menstrual]

3) On a scale of 0 to 10, please rate the intensity of the pain you experience during your menstrual periods (over the last year). _____ N/A

4) On a scale of 0 to 10, please rate the degree of unpleasantness you experience during your menstrual periods (over the last year). _____ N/A

5) If has **current partner**: Do you and/or your partner use any method(s) of contraception?

1) YES 2) NO

If **no current partner**: Did you and/or your past partners use any method(s) of contraception?

1) YES 2) NO 3) DEPENDENT ON WHICH PARTNER

If **no** to either question, why not? _____

If **yes** to either question, which one(s)? _____

If using the pill, which brand? _____

How long have you been using the pill? _____

6) How many yeast infections have you had? _____

→ if 0, go to # 9, and N/A for # 7 and 8.

7) Have you suffered from repeated yeast infections? 1) YES 2) NO 3) DK 4) N/A

→ If yes, since what age? _____

8) How were the yeast infections diagnosed?

N/A

1) clinical plus positive culture: Number of times _____

2) clinical only: Number of times _____

3) self-diagnosed: Number of times _____

9) What gynecological problems have you had?

- | | |
|-------------------------------------|---------------------------------|
| 1) Chlamydia _____ | 2) Gardnerella vaginalis _____ |
| 3) Genital herpes _____ | 4) HPV/Genital warts _____ |
| 5) Gonorrhea _____ | 6) H.I.V. _____ |
| 7) Syphilis _____ | 8) Trichomoniasis _____ |
| 9) Bladder/urinary infections _____ | 10) Interstitial cystitis _____ |
| 11) P.I.D. _____ | 12) Endometriosis _____ |
| 13) Other (please specify: _____) | 14) None _____ |

10) What kind of gynecological interventions have you had?

- | | |
|----------------------------------|-------------------------|
| 1) Hysterectomy _____ | 2) Laparoscopy _____ |
| 3) Ovariectomy _____ | 4) Tubal ligation _____ |
| 5) C & T _____ | 6) Abortion _____ |
| 7) Other (please specify: _____) | 8) None _____ |

11) Have you ever been diagnosed with any chronic pain condition?

- 1) YES 2) NO

If yes, what condition(s)? _____

12) Are you currently taking any analgesics? 1) YES 2) NO

If yes, why? _____

For how long? _____

13) Are you currently taking any medications? 1) YES 2) NO

If yes, why? _____

For how long? _____

14) 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 _____ |

15) During the past 4 weeks, how much did bodily pain interfere with your work, including both work outside the home and housework?

- | | |
|---------------------|-----------------------|
| 1) Not at all _____ | 2) A little bit _____ |
| 3) Moderately _____ | 4) Quite a bit _____ |
| 5) Extremely _____ | |

16) Do you *regularly* (i.e., once a month or more) suffer from pain/discomfort in any of the following body sites?

→ for each “yes” response, ask: a) **How serious of a problem is this for you?**
(0 = not at all serious, 5 = moderately serious, 10 = extremely serious)

→ and **How much does this pain/discomfort interfere with your usual activities?**
(0 = not at all, 5 = moderately, 10 = totally)

→ and **How often do you find yourself thinking and/or worrying about the pain?**
(0 = not at all, 5 = some of the time, 10 = all of the time)

Body Area (indicate if yes)	Seriousness (0 – 10)	Interference (0 – 10)	Rumination (0 – 10)
Head			
Face (jaw, eyes, ears, etc)			
Mouth (teeth, gums, etc)			
Neck			
Throat			
Back			
Arms			
Hands			
Chest			
Breast			
Stomach/abdomen			
Pelvic area			
Bladder			
Kidney			
Ovary			
Uterus			
Gall bladder			
Rectum			
Legs			
Feet			
Joints (specify _____)			
Skin (specify _____)			
Muscles (specify _____)			
Other (specify _____)			

17) Have you ever experienced or been diagnosed with any of the following problems, which can cause pain or discomfort?

→ for each “yes” response, ask: a) **How serious of a problem is this for you?**
(0 = not at all serious, 5 = moderately serious, 10 = extremely serious)

→ and **How much does this pain/discomfort interfere with your usual activities?**
(0 = not at all, 5 = moderately, 10 = totally)

→ and **How often do you find yourself thinking and/or worrying about the pain?**
(0 = not at all, 5 = some of the time, 10 = all of the time)

Conditions (indicate if yes)	Seriousness (0 – 10)	Interference (0 – 10)	Rumination (0 – 10)
Headaches/migraines			
Menstrual cramps			
Ovulatory pain			
Endometriosis			
Cystitis			
Yeast infections			
Vaginal infections			
Urinary/bladder infections			
Other viral/bacterial infections			
Sexually transmitted diseases			
Pre-menstrual syndrome			
Fibromyalgia			
Chronic fatigue syndrome			
Arthritis			
Angina			
Osteoporosis			
Burns			
Scars			
Muscle spasms/pain			
Neuralgia			
Colitis/Crohn’s disease/IBS			
Hemorrhoids			
Constipation			
Indigestion			
Other (specify _____)			

- 18) If more than one pain was chosen, which is the worst? _____ N/A
- 19) On a scale of 0 to 10, please rate the intensity of this/the worst pain. _____ N/A
- 20) On a scale of 0 to 10, please rate the degree of unpleasantness you experience during this/the worst pain. _____ N/A
- 21) Do you presently experience, or have you ever experienced, recurrent and persistent pain during intercourse? _____

- ask whether she has experienced intercourse pain in the past 6 months
- if *yes*, proceed to **PART F** and **PART G**
- if *no*, proceed to **PART F** and **PART H**

5) Have you ever attempted to treat or alleviate the pain? NO YES

→ 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., vestibulectomy, laser, D&C)
- 6) Other medical treatments (e.g., hormones, interferon, antibiotics)
- 7) Small changes (e.g., cotton underwear, mild soaps, changing mattresses)
- 8) Other (please specify: _____)

PART G: (All women presently having intercourse)

1) Over the past 6 months, approximately how many times have you attempted intercourse per month? _____

1b) Are you happy with this frequency of intercourse? YES NO Not Sure
 → If no or not sure, would you like intercourse to be less or more frequent?

Why do you suppose that the actual frequency of intercourse does not match your desired frequency? _____

2) How many of these times did you initiate intercourse? _____

3) On a scale of 0 to 10, with 0 representing no confidence and 10 representing complete confidence, how confident do/did you feel initiating intercourse with your partner(s)?

Please explain why you chose that rating in terms of initiating intercourse.

4) On a scale of 0 to 10, with 0 representing no confidence and 10 representing complete confidence, how confident do/did you feel engaging in intercourse with your partner(s)?

Please explain why you chose that rating in terms of engaging intercourse.

5) Typically, what percentage of foreplay occasions lead to intercourse? _____

→ Are you happy with this situation? YES NO Not Sure

Why/Why Not?

6) Are you currently engaging in any of the following sexual activities?

- 1) Deep kissing
- 2) Petting
- 3) Touching of partner's genitals
- 4) Partner touching your genitals
- 5) Giving oral sex
- 6) Receiving oral sex
- 7) Anal play/sex on partner
- 8) Anal play/sex on you
- 9) Other (Explain): _____

7) Typically, what percentage of intercourse occasions have been painful? _____

8) When does the pain typically start?

- 1) before the penis touches the vaginal opening; 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 (please specify: _____)

9) How long does the pain typically last?

- 1) during penile entry only
- 2) during penile thrusting only
- 3) only for a period after penile exit
- 4) during penile entry and after penile exit
- 5) during penile entry and during penile thrusting
- 6) during penile thrusting and for some time after penile exit
- 7) during penile entry, during penile thrusting, and after penile exit
- 8) it is never the same: there is no typical pattern

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

Time: _____ minutes _____ hours _____ days

10) Where do you typically feel the pain during intercourse? Is there a specific spot you can show me? If yes, where? (show vulva diagram)

- 1) at the vaginal opening
- 2) everywhere on the vulva
- 3) inside the vagina

11) If chose only one location, proceed to correct #.

If more than one pain, can you differentiate among these different pains?

1) YES 2) NO 3) DK

→ If *yes*, or *don't know*, continue to the appropriate #

→ If *no*, proceed to # 18

12) On a scale of 0 to 10, please rate the average intensity of the pain at the *vaginal opening* (past 6 months). _____ N/A

13) On a scale of 0 to 10, please rate the average degree of unpleasantness you experience because of this pain. _____ N/A

14) On a scale of 0 to 10, please rate the average intensity of the pain *everywhere on the vulva* (past 6 months). _____ N/A

15) On a scale of 0 to 10, please rate the average degree of unpleasantness you experience because of this pain. _____ N/A

16) On a scale of 0 to 10, please rate the average intensity of the pain *inside the vagina* (past 6 months). _____ N/A

17) On a scale of 0 to 10, please rate the average degree of unpleasantness you experience because of this pain. _____ N/A

18) On a scale of 0 to 10, please rate the average intensity of pain you experience during intercourse. _____

19) On a scale of 0 to 10, please rate average degree of unpleasantness you experience during intercourse. _____

→ **Administer psychosocial measures**

Discontinue interview

PART H: (Women not currently having intercourse)

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

2) What is the reason 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 have no desire
- 4) I fear pain
- 5) I am too anxious
- 6) I don't want penetration
- 7) my partner has erection problems
- 8) my partner has no desire
- 9) my partner is concerned about hurting me
- 10) Other (please specify: _____)

3) Are you currently engaging in any of the following sexual activities?

- 1) Deep kissing
- 2) Petting
- 3) Touching of partner's genitals
- 4) Partner touching your genitals
- 5) Giving oral sex
- 6) Receiving oral sex
- 7) Anal play/sex on partner
- 8) Anal play/sex on you
- 9) Other (Explain): _____

4) In the past, approximately how many times per month were you attempting intercourse per month? _____

5) How many of these times did you initiate intercourse? _____

6) On a scale of 0 to 10, with 0 representing no confidence and 10 representing complete confidence, how confident do/did you feel initiating intercourse with your partner(s)?

Please explain why you chose that rating in terms of initiating intercourse.

7) On a scale of 0 to 10, with 0 representing no confidence and 10 representing complete confidence, how confident do/did you feel engaging in intercourse with your partner(s)?

Please explain why you chose that rating in terms of engaging intercourse.

8) Typically, what percentage of foreplay occasions lead to intercourse? _____

→ Are you happy with this situation? YES NO Not Sure

Why/Why Not?

9) Typically, what percentage of intercourse occasions were painful? _____

10) When did the pain typically start?

- 1) before the penis touches the vaginal opening; 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 (please specify: _____)

11) How long did the pain typically last?

- 1) during penile entry only
- 2) during penile thrusting only
- 3) only for a period after penile exit
- 4) during penile entry and after penile exit
- 5) during penile entry and during penile thrusting
- 6) during penile thrusting and for some time after penile exit
- 7) during penile entry, during penile thrusting, and after penile exit
- 8) it is never the same: there is no typical pattern

If it lasted after penile exit, please state for how long after the pain was felt.

Time: _____ minutes _____ hours _____ days

12) Where did you typically feel the pain during intercourse? Is there a specific spot you can show me? If yes, where? (show vulva diagram)

- 1) at the vaginal opening
- 2) everywhere on the vulva
- 3) inside the vagina

13) If chose **only one location**, proceed to appropriate number.

If **more than one location**, can you differentiate these different pains?

- 1) YES 2) NO 3) DK
- If *yes, or don't know*, continue to appropriate #
- If *no*, proceed to #20

14) On a scale of 0 to 10, please rate the average intensity of the pain at the *vaginal opening*. _____ N/A

15) On a scale of 0 to 10, please rate the average degree of unpleasantness you experienced because of this pain. _____ N/A

16) On a scale of 0 to 10, please rate the average intensity of the pain *everywhere on the vulva*. _____ N/A

17) On a scale of 0 to 10, please rate the average degree of unpleasantness you experienced because of this pain. _____ N/A

18) On a scale of 0 to 10, please rate the average intensity of the pain *inside the vagina*. _____ N/A

19) On a scale of 0 to 10, please rate the average degree of unpleasantness you experienced because of this pain. _____ N/A

20) On a scale of 0 to 10, please rate the average intensity of pain you experienced during intercourse. _____

21) On a scale of 0 to 10, please rate the average degree of unpleasantness you experienced during intercourse. _____

→ **Administer psychosocial measures**

Discontinue interview

Appendix I

SF-36 Survey

Instructions: This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities.

Please answer every question by checking one box per question. If you are unsure about how to answer, please give the best answer you can.

1. In general, would you say your health is:

- Excellent
- Very good
- Good
- Fair
- Poor

2. Compared to one year ago, would you say your health is:

- Much better
- Somewhat better
- About the same
- Somewhat worse
- Much worse

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

a) Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

b) Moderate activities such as moving a table, pushing a vacuum cleaner, bowling or playing golf:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

c) Lifting or carrying groceries:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

d) Climbing several flights of stairs:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

e) Climbing one flight of stairs:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

f) Bending, kneeling, or stooping:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

g) Walking more than one mile:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

h) Walking several blocks:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

i) Bathing or dressing yourself:

- Yes, limited a lot
- Yes, limited a little
- No, not limited at all

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

a) Cut down on the amount of time you spent on work or other activities:

- Yes
- No

b) Accomplished less than you would like:

- Yes
- No

c) Were limited in the kind of work or other activities:

- Yes
- No

d) Had difficulty performing the work or other activities (for example, it took extra effort):

- Yes
- No

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

a) Cut down on the amount of time you spent on work or other activities:

Yes

No

b) Accomplished less than you would like:

Yes

No

c) Didn't do work or other activities as carefully as usual:

Yes

No

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

Not at all

A little bit

Moderately

Quite a bit

Extremely

7. How much bodily pain have you had during the past 4 weeks?

None

Very mild

Mild

Moderate

- Severe
- Very severe

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the house and housework)?

- Not at all
- A little bit
- Moderately
- Quite a bit
- Extremely

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks:

a) Have you felt full of pep?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

b) Have you been a very nervous person?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

c) Have you felt so down in the dumps that nothing could cheer you up?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

d) Have you felt calm and peaceful?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

e) Did you have a lot of energy?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

f) Have you felt downhearted and blue?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time

- A little of the time
- None of the time

g) Did you feel worn out?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

h) Have you been a happy person?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

i) Did you feel tired?

- All of the time
- Most of the time
- A good bit of the time
- Some of the time
- A little of the time
- None of the time

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives etc.)?

- All of the time
- Most of the time
- Some of the time
- A little of the time
- None of the time

11. How TRUE or FALSE is each of the following statements for you?

a) I seem to get sick a little easier than other people.

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

b) I am as healthy as anybody I know.

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

c) I expect my health to get worse.

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

d) My health is excellent.

- Definitely true
- Mostly true
- Don't know
- Mostly false
- Definitely false

Appendix J

Pain Catastrophizing Scale

Non-Vulvar Pain Directions: Everyone experiences painful situations at some point in their lives. Such experiences may include headaches, tooth pain, joint or muscle pain. People are often exposed to situations that may cause pain such as illness, injury, dental procedures or surgery.

- A. What is your worst regularly experienced (i.e., once a month or more) non-vulvar/genital pain? _____.
- B. Please rate the intensity of this pain (that is, how strong the pain feels) you might have felt on a **scale from 0 (no pain at all) to 10 (worst pain imaginable)**.

- C. Please rate the unpleasantness of this pain (that is, how much the pain bothers you) on a **scale from 0 (not unpleasant at all) to 10 (most unpleasant experience imaginable)**. _____

Vulvar Pain Directions: Please fill out the questions below with respect to your vulvar pain.

We are interested in the types of thoughts and feelings that you have when you are in pain. Listed below are thirteen statements describing different thoughts and feelings that may be associated with pain. Please indicate the degree to which you have these thoughts and feelings when you are experiencing the pain you listed above. To indicate your answer, please check one box per question.

When I am in pain...

1. I worry all the time about whether the pain will end.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

2. I feel I can't go on.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

3. It's terrible and I think it's never going to get any better.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

4. It's awful and I feel that it overwhelms me.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

5. I feel I can't stand it anymore.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

6. I become afraid that the pain will get worse.

- Not at all
- To a slight degree
- To a moderate degree

To a great degree

All the time

7. I keep thinking of other painful events.

Not at all

To a slight degree

To a moderate degree

To a great degree

All the time

8. I anxiously want the pain to go away.

Not at all

To a slight degree

To a moderate degree

To a great degree

All the time

9. I can't seem to keep it out of my mind.

Not at all

To a slight degree

To a moderate degree

To a great degree

All the time

10. I keep thinking about how much it hurts.

Not at all

To a slight degree

To a moderate degree

To a great degree

All the time

11. I keep thinking about how badly I want the pain to stop.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

12. There's nothing I can do to reduce the intensity of the pain.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

13. I wonder whether something serious may happen.

- Not at all
- To a slight degree
- To a moderate degree
- To a great degree
- All the time

Appendix K

The Sexual Self-Efficacy Scale for Females

Instructions: The attached form lists sexual activities that women engage in. Under column I (*Can Do*), check the activities you think you could do if you were asked to do them today. For only those activities you checked in column I, rate your degree of confidence that you could do them by selecting a number from 10-100 using the scale given below. Write this number in column II (*Confidence*).

10	20	30	40	50	60	70	80	90	100
<i>Quite uncertain</i>				<i>Moderately certain</i>				<i>Quite certain</i>	

1. Anticipate (think about) sexual relations without fear or anxiety.
2. Feel comfortable being nude with the partner.
3. Feel comfortable with your body.
4. In general, feel good about your ability to respond sexually.
5. Be interested in sex.
6. Feel sexual desire for the partner.
7. Feel sexually desirable to the partner.
8. Initiate an exchange of affection without feeling obliged to have sexual relations.
9. Initiate sexual activities.
10. Refuse a sexual advance by the partner.
11. Cope with the partner's refusal of your sexual advance.
12. Ask the partner to provide the type and amount of sexual stimulation needed.
13. Provide the partner with the time and amount of sexual stimulation requested.
14. Deal with discrepancies in sexual preference between you and your partner.
15. Enjoy an exchange of affection without having sexual relations.
16. Enjoy a sexual encounter with a partner without having intercourse.
17. Enjoy having your body caressed by the partner (excluding genitals and breasts).
18. Enjoy having your genitals caressed by the partner.
19. Enjoy having your breasts caressed by the partner.
20. Enjoy caressing the partner's body (excluding genitals).
21. Enjoy caressing the partner's genitals.
22. Enjoy intercourse.
23. Enjoy a lovemaking encounter in which you do not reach orgasm.
24. Feel sexually aroused in response to erotica (pictures).
25. Become sexually aroused by masturbating when alone.
26. Become sexually aroused during foreplay when both partners are clothed.
27. Become sexually aroused during foreplay when both partners are nude.
28. Maintain sexual arousal throughout a sexual encounter.
29. Become sufficiently lubricated to engage in intercourse.
30. Engage in intercourse without pain or discomfort.
31. Have an orgasm while masturbating when alone.
32. Have an orgasm while the partner stimulates you by means other than intercourse.

33. Have an orgasm during intercourse with concurrent stimulation of the clitoris.
34. Have an orgasm during intercourse without concurrent stimulation of the clitoris.
35. Stimulate a partner to orgasm by means other than intercourse.
36. Stimulate a partner to orgasm by means of intercourse.
37. Reach orgasm within a reasonable period of time.

Appendix L

Female Sexual Function Index

INSTRUCTIONS: These questions ask about your sexual feelings and responses during the past 4 weeks. Please answer the following questions as honestly and clearly as possible. Your responses will be kept completely confidential. In answering these questions the following definitions apply:

Sex, sexual activity, lovemaking, and foreplay refer to:

- caressing, kissing, manual stimulation of the genitals/anus/breasts by yourself or your partner
- oral stimulation of the genitals/anus/breasts
- vaginal or anal penetration with penis, fingers, or sex toys

Sexual intercourse refers to:

- penetration of your partner's vagina/anus with fingers or sex toys
- receiving vaginal/anal penetration with penis, fingers, or sex toys

Sexual stimulation refers to sexual situations such as the following:

- foreplay with your partner, stimulating your partner, receiving stimulation from your partner,
- self-stimulation (masturbation), sexual fantasy
- viewing erotic films, pictures, or reading erotic material

CHECK ONLY ONE BOX PER QUESTION.

Sexual desire or interest is a feeling that includes wanting to have a sexual experience, feeling receptive to a partner's sexual initiation, and thinking or fantasizing about having sex.

1. Over the past 4 weeks, how **often** did you feel sexual desire or interest?
 - Almost always or always
 - Most times (more than half the time)
 - Sometimes (about half the time)
 - A few times (less than half the time)
 - Almost never or never

2. Over the past 4 weeks, how would you rate your **level** (degree) of sexual desire or interest?
 - Very high
 - High
 - Moderate
 - Low
 - Very low or none at all

Sexual arousal is a feeling that includes both physical and mental aspects of sexual excitement. It may include feelings of warmth or tingling in the genitals, lubrication (wetness), or muscle contractions.

3. Over the past 4 weeks, how **often** did you feel sexually aroused (“turned on”) during sexual activity or intercourse?
 - No sexual activity
 - Almost always or always
 - Most times (more than half the time)
 - Sometimes (about half the time)
 - A few times (less than half the time)
 - Almost never or never

4. Over the past 4 weeks, how would you rate your **level** of sexual arousal (“turn on”) during sexual activity or intercourse?
 - No sexual activity
 - Very high
 - High
 - Moderate
 - Low
 - Very low or none at all

5. Over the past 4 weeks, how **confident** were you about becoming sexually aroused during sexual activity or intercourse?
 - No sexual activity
 - Very high confidence
 - High confidence
 - Moderate confidence
 - Low confidence
 - Very low or no confidence

6. Over the past 4 weeks, how **often** have you been satisfied with your arousal (excitement) during sexual activity or intercourse?
 - No sexual activity
 - Almost always or always
 - Most times (more than half the time)
 - Sometimes (about half the time)
 - A few times (less than half the time)
 - Almost never or never

7. Over the past 4 weeks, how **often** did you become lubricated (“wet”) during sexual activity or intercourse?
- No sexual activity
 - Almost always or always
 - Most times (more than half the time)
 - Sometimes (about half the time)
 - A few times (less than half the time)
 - Almost never or never
8. Over the past 4 weeks, how **difficult** was it to become lubricated (“wet”) during sexual activity or intercourse?
- No sexual activity
 - Extremely difficulty or impossible
 - Very difficult
 - Difficult
 - Slightly difficult
 - Not difficult
9. Over the past 4 weeks, how often did you **maintain** your lubrication (“wetness”) until completion of sexual activity or intercourse?
- No sexual activity
 - Almost always or always
 - Most times (more than half the time)
 - Sometimes (about half the time)
 - A few times (less than half the time)
 - Almost never or never
10. Over the past 4 weeks, how **difficult** was it to maintain your lubrication (“wetness”) until completion of sexual activity or intercourse?
- No sexual activity
 - Extremely difficulty or impossible
 - Very difficult
 - Difficult
 - Slightly difficult
 - Not difficult
11. Over the past 4 weeks, when you had sexual stimulation or intercourse, how **often** did you reach orgasm (climax)?
- No sexual activity
 - Almost always or always
 - Most times (more than half the time)
 - Sometimes (about half the time)
 - A few times (less than half the time)
 - Almost never or never

12. Over the past 4 weeks, when you had sexual stimulation or intercourse, how **difficult** was it for you to reach orgasm (climax)?
- No sexual activity
 - Extremely difficulty or impossible
 - Very difficult
 - Difficult
 - Slightly difficult
 - Not difficult
13. Over the past 4 weeks, how **satisfied** were you with your ability to reach orgasm (climax) during sexual activity or intercourse?
- No sexual activity
 - Very satisfied
 - Moderately satisfied
 - About equally satisfied and dissatisfied
 - Moderately dissatisfied
 - Very dissatisfied
14. Over the past 4 weeks, how **satisfied** have you been with the amount of emotional closeness during sexual activity between you and your partner?
- No sexual activity
 - Very satisfied
 - Moderately satisfied
 - About equally satisfied and dissatisfied
 - Moderately dissatisfied
 - Very dissatisfied
15. Over the past 4 weeks, how **satisfied** have you been with your sexual relationship with your partner?
- Very satisfied
 - Moderately satisfied
 - About equally satisfied and dissatisfied
 - Moderately dissatisfied
 - Very dissatisfied
16. Over the past 4 weeks, how **satisfied** have you been with your overall sexual life?
- Very satisfied
 - Moderately satisfied
 - About equally satisfied and dissatisfied
 - Moderately dissatisfied
 - Very dissatisfied

17. Over the past 4 weeks, how **often** did you experience discomfort or pain during vaginal penetration?

- Did not attempt intercourse
- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

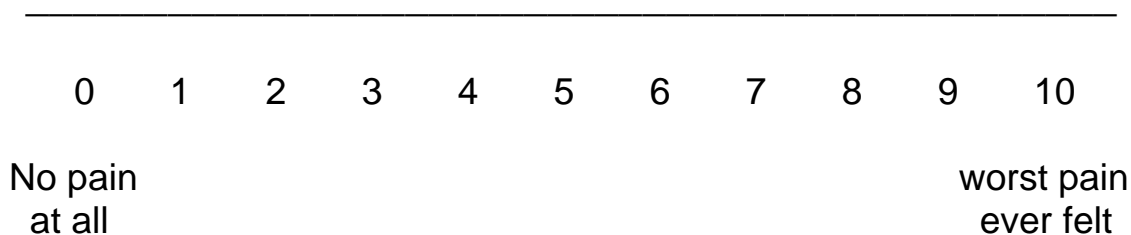
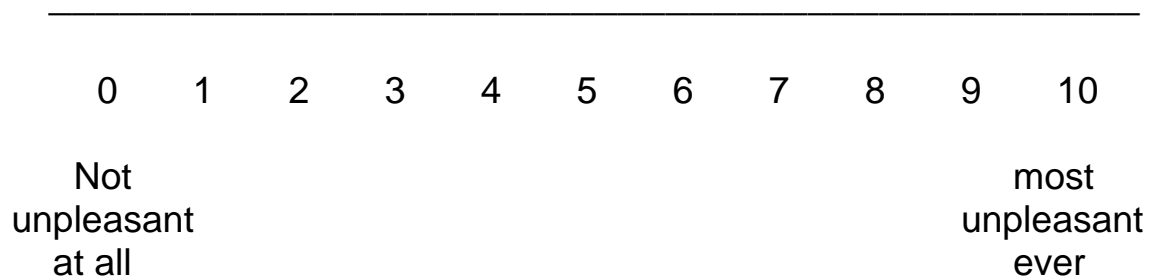
18. Over the past 4 weeks, how **often** did you experience discomfort or pain following vaginal penetration?

- Did not attempt intercourse
- Almost always or always
- Most times (more than half the time)
- Sometimes (about half the time)
- A few times (less than half the time)
- Almost never or never

19. Over the past 4 weeks, how would you rate your **level** (degree) of discomfort or pain during or following vaginal penetration?

- Did not attempt intercourse
- Very high
- High
- Moderate
- Low
- Very low or none at all

Appendix M

PAIN SCALES**Pain Intensity:****Pain Unpleasantness:**

Touch Scales

Touch Intensity:



Touch Unpleasantness:



Appendix N

Perceived DNIC Pain Tolerance

1. The cold water procedure on my arm decreased how painful the thermal stimuli on my volar forearm felt

1 2 3 4 5 6 7 8 9 10

Not at All

Very Much

2. The thermal stimuli on my volar forearm decreased how painful the cold water felt

1 2 3 4 5 6 7 8 9 10

Not at All

Very Much

Perceived DNIC Temporal Summation

1. The cold water procedure on my arm decreased how painful the thermal heat pulses on my volar forearm felt

1 2 3 4 5 6 7 8 9 10

Not at All

Very Much

2. The thermal stimuli on my volar forearm decreased how painful the cold water felt

1 2 3 4 5 6 7 8 9 10

Not at All

Very Much

Perceived DNIC Genitals

1. The cold water procedure on my arm decreased how painful the thermal stimuli on my genitals felt

1 2 3 4 5 6 7 8 9 10

Not at All

Very Much

2. The thermal stimuli on my genitals decreased how painful the cold water felt

1 2 3 4 5 6 7 8 9 10

Not at All

Very Much

Appendix O

Testing Procedures for DNIC Study

Forearm Testing

A. Filament tactile threshold

B. Thermal testing

1. Warm temperature detection (3 trials)
→ 2 minute break
 2. Heat pain threshold (3 trials)
→ 2 minute break
 3. Heat pain tolerance (3 trials)
→ 5 minute break
 4. Heat pain tolerance with CPT (DNIC trials)
→ 2 minute break (administer Perceived DNIC Measure)
 5. Heat pain tolerance post CPT (3 trials)
-

C. Take a 10 minute break while administering Vulvagesiometer on forearm

D. Temporal Summation

1. Temporal summation heat pain
→ 5 minute break
 2. Temporal summation with CPT (DNIC trials)
→ 2 minute break (administer Perceived DNIC Measure)
 3. Temporal summation post CPT
-

Genital Testing (after a 10 minute washroom/changing break):

A. Filament tactile threshold labia/vestibule/perineum

B. Vulvagesiometer pain threshold vestibule/labia/perineum

C. Thermal Testing (WIN GSA program)

1. Warm temperature detection (3 trials)

→ 2 minute break

2. Heat pain threshold (3 trials)

→ 2 minute break

3. Heat pain tolerance (3 trials)

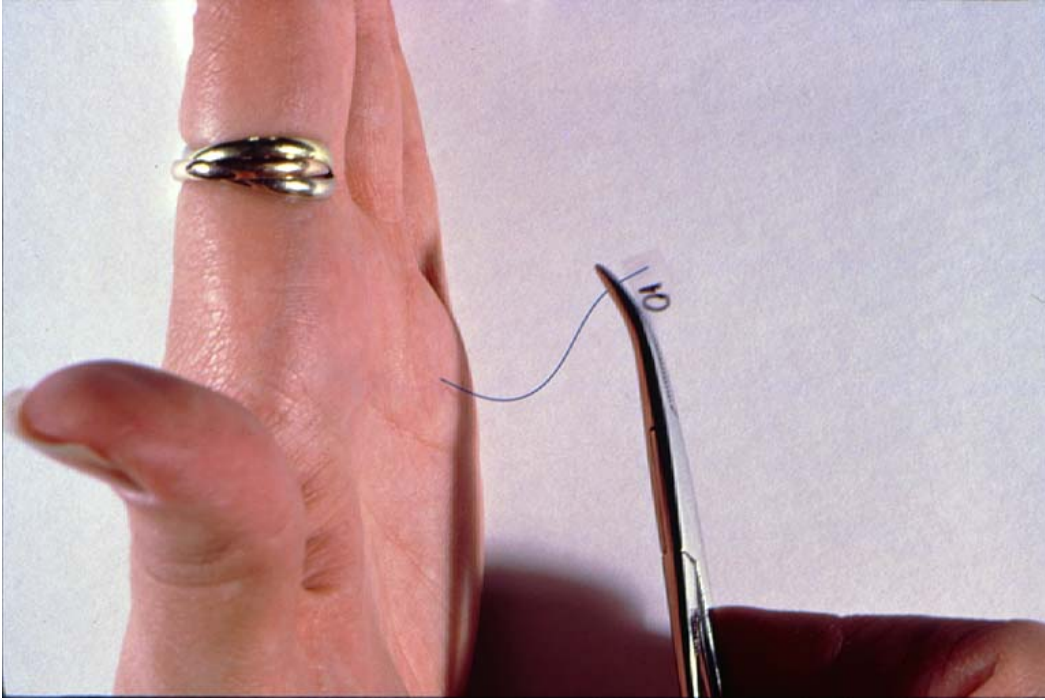
→ 5 minute break

4. Heat pain tolerance with CPT (DNIC trials)

→ 2 minute break (administer Perceived DNIC Measure

5. Heat pain tolerance post CPT (3 trials)

Appendix P



Appendix Q



Appendix R

Summary of Between-Group Differences on Psychophysical Variables

Psychophysical variables	PVD M (SD)	Control M (SD)
Tactile Thresholds		
Arm	0.13 (0.07)	0.17 (0.15)
Perineum	0.10 (0.07)	0.13 (0.11)
Labia	0.06 (0.05)	0.11 (0.11)
Vulvar vestibule	0.15 [^] (0.15)	0.28 (0.29)
Pressure Pain Thresholds		
Arm	935.00 (172.52)	991.67 (40.82)
Perineum	464.71*** (240.40)	861.90 (184.10)
Labia	451.75** (272.87)	726.19 (229.19)
Vulvar vestibule	197.25*** (199.94)	625.91 (301.89)
Subjective Pressure Pain		
Arm	0.30 (0.88)	0.02 (0.10)
Perineum	2.80 (1.62)	2.63 (2.43)
Labia	3.45 (1.94)	2.27 (2.36)
Vulvar vestibule	2.95 (1.43)	2.95 (2.15)
Thermal Stimuli		
Detection Arm	38.94 (2.67)	40.21 (2.98)
Detection Genitals	45.84 (3.79)	47.23 (3.05)
Pain Threshold Arm	38.94 (2.67)	40.21 (2.98)
Pain Threshold Genitals	45.84 (3.79)	47.23 (3.05)

Pain Tolerance Arm	44.72 [^] (2.37)	46.19 (2.64)
Pain Tolerance Genitals	48.91 ^{**} (2.83)	50.46 (0.69)
Subjective Thermal Stimuli		
Detection Arm (Pain)	2.33 (1.23)	2.14 (1.95)
Detection Arm (Unpl)	0.43 (1.07)	0.35 (0.82)
Detection Genitals	3.19 (2.13)	2.29 (1.13)
Pain Threshold Arm	2.60 (1.39)	2.45 (1.13)
Pain Threshold Genitals	3.38 (2.21)	2.40 (1.68)
Pain Tolerance Arm	6.51 [^] (2.14)	5.71 (2.10)
Pain Tolerance Genitals	6.19 [*] (2.00)	4.69 (2.01)

* = significant at $p < .05$; ** = significant at $p < .01$; *** = significant at $p < .001$; [^] trend

$p < .07$

Appendix S

Bivariate Correlations Among Pressure Pain and Unpleasantness Ratings at Four Body Sites

Body Site	Unpleasantness (arm)	Unpleasantness (labia)	Unpleasantness (perineum)	Unpleasantness (vestibule)
Pain (arm)	.86**	--	--	--
Pain (labia)	--	.69**	--	--
Pain (peri)	--	--	.83**	--
Pain (vest)	--	--	--	.59**

Note: Correlations between body sites were not assessed. * = significant at $p < .05$; ** = significant at $p < .01$; *** = significant at $p < .001$

Appendix T

Bivariate Correlations between Pain and Unpleasantness Ratings for Thermal Stimuli.

Unpleasantness / Pain Ratings	Detection (arm)	Threshold (arm)	Tolerance (arm)	Detection (genitals)	Threshold (genitals)	Tolerance (genitals)
Detection (arm)	.30	--	--	--	--	--
Threshold (arm)	--	.65**	--	--	--	--
Tolerance (arm)	--	--	.62**	--	--	--
Detection (genitals)	--	--	--	.72**	--	--
Threshold (genitals)	--	--	--	--	.81**	--
Tolerance (genitals)	--	--	--	--	--	.86**

Note: Correlations between body sites were not assessed. * = significant at $p < .05$; ** = significant at $p < .01$; *** = significant at $p < .001$