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Fear-avoidance and pelvic floor muscle function are associated with pain intensity in women with vulvodynia

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Abstract

Objective: To investigate the association between fear-avoidance variables, pelvic floor muscle (PFM) function and pain intensity in women with provoked vestibulodynia (PVD) as well as the moderator effect of partner support.

Methods: A total of 173 women diagnosed with PVD participated in the study. Fear-avoidance variables were evaluated with validated self-administered questionnaires: pain catastrophizing (Pain Catastrophizing Scale), pain-related fear (Pain Anxiety Symptoms Scale), and partner support (Partner Support Questionnaire). Pain intensity was evaluated using a numerical rating scale. PFM function, including maximal strength, speed of contraction, flexibility and muscle tone, was evaluated with a dynamometric speculum.

Results: Pain catastrophizing was significantly associated with pain intensity ($\beta=0.310$, $p<0.001$), as was partner support ($\beta=0.194$, $p=0.004$) and PFM flexibility ($\beta=-0.255$, $p<0.001$). Fear-avoidance, PFM variables and partner support explained 28.3% of the variance in pain during intercourse ($p<0.001$). The addition of PFM was of particular interest since it explained a significant addition of 9% in pain intensity. Partner support was found to moderate the association between pain intensity and catastrophizing. Among women with high partner support, catastrophizing was not significantly related to pain ($b=0.150$, $p=0.142$). When partner support was low, catastrophizing was significantly related to pain ($b=0.068$, $p<0.001$).

Discussion: Findings of this study support that the symptomatology of PVD can be explained partly by fear-avoidance variables and pelvic floor muscle function. This study supports the significant role of PFM function and its importance in the ~~etiology~~ pathophysiology of PVD. It also sheds light on the role of partner support and its moderating effect on pain catastrophizing.

Key words: Provoked vestibulodynia, fear-avoidance, partner support, pelvic floor muscles

Introduction

Vulvodynia, defined as vulvar pain without an identifiable cause, affects as many as 7-8% of premenopausal women (1,2). The most common subtype of vulvodynia is provoked vestibulodynia (PVD) which is pain located at the vulvar vestibule and triggered by the application of pressure or penetration attempt (3). This highly incapacitating condition affects women's sexual function, relationship satisfaction and mental health (6-7). Despite the fact that its etiology remains unclear, many associated factors have been proposed: genetic, hormonal, inflammation, musculoskeletal, central and peripheral neurologic mechanisms, structural and psychosocial defects, including partner variables (1,3-4).

Fear-avoidance variables feature prominently among the most robust correlates of PVD (4,8–12). These variables include pain catastrophizing, self-efficacy, fear-avoidance, fear of pain, hypervigilance and anxiety as well as partner responses. In a scoping review including 30 studies, Desrochers et al. (13) reported that women with PVD have a higher rate of anxiety, fear of pain, hypervigilance and catastrophizing compared to asymptomatic women. In another study, Desrochers et al. (14) investigated the contribution of fear-avoidance and self-efficacy to pain intensity in women with PVD, observing that these variables could explain 15% of the pain intensity experienced. As opposed to previous studies evaluating the level of catastrophizing in women with PVD compared to controls (13), Desrochers et al. showed the involvement of catastrophizing in pain intensity (14). Regarding fear of pain's contribution to pain intensity, most studies have compared PVD women to asymptomatic controls. However, few studies have evaluated its association to pain intensity (13–15).

Alterations in PFM function have also been reported to play a key role in PVD (16,17). Composed of a superficial and a deep layer of muscles, the PFM run from the pubic bone to the coccygeal bone. Available studies generally agreed that PFM function was altered in women with PVD (16,17). Næss et Bø (18) found that PVD patients had significantly higher vaginal resting pressure and lower PFM activity during contraction. Consistently, using a dynamometric speculum, Morin et al. (16) observed an increased general tone as well as a decreased strength, speed of contraction, endurance and coordination among women with PVD. Morin et al. (17) also found that women with PVD had alterations in PFM morphometry using transperineal ultrasound suggesting higher resting tone and weakness. As this methodology is a pain free assessment technique, these findings suggested that PVD resulted in a higher resting tone that is not limited to a protection mechanism. Other interventional studies provided further empirical support about the role of PFM alterations in PVD. In fact, treatments targeting PFM function have been shown

to significantly reduce pain intensity after interventions provided by a physical therapist. However, no studies have investigated the association between PFM alteration and pain intensity thus far (19).

Since chronic pain can affect both the patient and her partner, one of the social variables frequently studied is partner response (20–22). Although it was established that partner response is associated with distress, pain and sexual function for chronic pain conditions in women, including vulvodynia, another determining social variable such as partner support, remains understudied. Partner support is a form of social support linked to health-related quality of life and relationship satisfaction in patients with cancer (23,24). Given the sexual aspect of PVD, it is likely that partner support will have an impact on women's experience of pain. Also, social support was shown to influence multiple variables in other chronic pain conditions such as low back pain (LBP). In fact, social support was associated with chronicity, depressive symptoms and range of motion of the trunk in patients with LBP (25–27). Despite the fact that research on health and partner support usually focuses on its association with outcome variables, it has been recommended that social support should also be investigated as a moderator for its buffering effect on negative cognitions (28). Sullivan et al. (29) postulated through the communal coping model that catastrophizing was associated with a need for partner support expressed through behavioral characteristics of this coping strategy.

Since the etiology of PVD remains misunderstood, the ability to assess the variables contributing to pain intensity could be of great importance for evaluation and treatment. Fear-avoidance and partner variables have already been linked to pain intensity in women with PVD. PFM function was also shown to be different in this population. Therefore, could PFM function add to the prediction of pain intensity above and beyond the contribution of fear-avoidance variables?

The aim of this study was to investigate the association between fear-avoidance variables, partner support, PFM function and pain intensity in women with PVD as well as the moderator effect of partner support on catastrophizing. We hypothesized that the addition of muscular variables would better explain pain intensity among women with PVD. It is also expected that partner support will have a moderating role on catastrophizing.

Materials and methods

Participants

Participants were recruited by means of advertisements, ~~participation in in another PVD studies conducted by our team, visits to~~ physicians' and other health professionals' referrals and word of mouth. The sample of women recruited included 12.7% during physicians' visits, 1.2% at visits to other health professionals (e.g. psychologist, physiotherapist), 70.5% through advertisements, 7.5% via word of mouth and 8.1% unknown. Of the 223 women who underwent a gynecological examination, 173 women participated in the study (30). Other women were excluded because they had other gynecological conditions, infections or dermatological problems. Women included were nulliparous, aged 18 to 45 years and reporting pain intensity of at least 5/10 on the numerical rating scale (NRS) during 90% of attempted sexual intercourse for at least 6 months. Women had pain limited to the vestibule area and had a stable sexual partner to evaluate pain intensity. The exclusion criteria were: urogynecological conditions (incontinence, pelvic organ prolapse >1 stage on the pelvic organ prolapse quantification), vaginismus, current or previous pregnancy that lasted more than 18 weeks, active urinary or vaginal infection (or earlier in the last 3 months), used medication that could affect pain perception, had anterior vulvar or vaginal surgery or were in a post-menopausal status, refusal to abstain from other treatments for a 6-month period, other pelvic pathologies associated with lower genital pain (e.g. deep dyspareunia) and major psychological conditions or any coexisting significant medical condition (depressive symptoms and anxiety that could present a risk for women's health, as well as cardiovascular, hematological, central nervous system, pulmonary and renal conditions). To confirm their diagnosis of PVD, women took part in a medical history interview and a physical examination performed by one of our collaborating gynecologists. The criteria followed during the examination were those defined by Friedrich (31) and recently modified by Bergeron et al. (32) : 1) pain on the vestibule following activities causing pressure (including attempted vaginal penetration); 2) acute pain provoked by the cotton-swab test (random pressure application to the vulvar vestibule). Those criteria were part of the new guidelines for evaluation and treatment of PVD and their inter-rater reliability was already established (32,33).

Procedure

The study was conducted in two university hospitals in large metropolitan areas. Women interested in the project were invited to contact the research coordinator to undertake an eligibility screening questionnaire and thereafter had their diagnosis confirmed by the gynecologist. Eligible women were convened to an assessment session by an ~~experimented~~ experienced pelvic floor physical therapist. After signing the informed consent, women (1) were an interviewed about socio-demographic information, pain, medical and gynecological history, (2) completed the self-

administered validated questionnaires assessing pain, psychosocial and sexual variables, and (3) had a physical examination, including PFM function assessment. The physical examination was completed with an empty bladder. Prior to the examination, the women were instructed how to contract PFM while the physical therapist used digital palpation to ensure it was done correctly.

Dependeant variable

Pain intensity during intercourse or attempted vaginal penetration was evaluated using a NRS from 0 to 10, 0 representing no pain and 10 representing the worst pain imaginable. The NRS was recommended by the IMMPACT as a valid assessment in chronic pain population and (34) and showed adequate reliability (35). Women were asked to report the average pain they felt during attempted or successful intercourse over the last 6 months. Pain intensity was assessed before physical examination, ensuring that women answered according to symptoms during intercourse and not according to what they felt during the examination.

Independent variables

Pain catastrophizing was measured with the Pain Catastrophizing Scale (PCS), which includes three dimensions: rumination, magnification and helplessness (36). Women had to complete it based on their pain during attempted vaginal penetration using a Likert scale with the end points "not at all" and "all the time". It was found that this version had psychometric properties comparable to the original questionnaire, which is a valid and reliable tool to assess catastrophizing (36,37).

Pain-related fear was assessed using the short version of the Pain Anxiety Symptoms Scale (PASS), where a higher score indicates higher fear of pain. Women had to rate 20 assertions based on the feelings they had when pain was experienced during intercourse using a Likert scale ranging from "never" to "always". The short version's predictive and construct validity was found good and its test-retest reliability strong for chronic pain (38).

Partner support was assessed with the Spousal Support Questionnaire, which showed good construct validity (28). The questionnaire includes four affirmations rated on a Likert scale with end points "never", which scores 1, and "always", which scores 5 for a maximum total of 20. This questionnaire evaluates women's perception of the level of support shown by their partners. A higher score was representative of a higher support. To assess its contribution to pain intensity, the total score was used. Here are two examples of items included in the questionnaire: 1) My

partner supports me in my attempts to achieve my goals; 2) My partner understands my way of thinking and feeling things.

PFM function was examined using an intravaginal dynamometric speculum. Its psychometric properties, including its reliability, validity and responsiveness, have been assessed in multiple studies (39–42). Women were in the supine position with hips and knees flexed on a conventional gynecologist's table during the evaluation. Maximal strength was obtained by asking the participant to contract PFM maximally against the dynamometer as much as she could, providing results in newtons. Speed of contraction was measured when the participant executed rapid consecutive contractions for 15 seconds. The measurement was obtained by calculating the slope of the first contraction giving results in newtons/second. Flexibility was evaluated using maximal aperture tolerated by the participant in millimeters (i.e. antero-posterior diameter). Muscle tone was the passive force recorded during dynamic stretches from minimal to maximal aperture. The mean force at 15-mm aperture was measured for the last three stretch-release cycles out of five. Further details on this methodology are provided elsewhere (43).

Statistical Analyses

Statistical analyses were conducted with SPSS® 24.0 (Statistical Package for the Social Sciences, IBM). Pearson ~~and Spearman~~ correlations were first computed to identify correlations between independent variables and pain intensity that could help build the hierarchical regression model. Then, a hierarchical regression analysis was conducted, based on variables identified as relevant in PVD in the current literature and results from bivariate correlations. It allowed us to assess each variable's contribution to pain intensity, as measured by the NRS. Variables were entered in the models in the following order, based on the modified fear-avoidance model presented by Thomtén and Linton (44): (step 1) catastrophizing (PCS total score) and pain-related fear (PASS total score), (step 2) PFM function (dynamometric assessment), (step 3) partner support (Spousal Support Questionnaire total score). In the last step, the interaction terms between partner support and catastrophizing were entered to examine moderation. Following Aiken and West's (1991)(45) recommendations, all predictors were centered to avoid multicolinearity. When an interaction term was significant, simple slopes were computed using the PROCESS macro developed by Hayes (2013) (46). This program computes 95% confidence intervals around the estimates on 5000 bootstrapping samples. Level of significance was set at $p<0.05$. All statistical assumptions were verified, e.g. normality of data and residuals, linearity and independence (considering a correlation threshold of >0.8 for multicollinearity (47).

Results

Sample characteristics

Participant characteristics are detailed in Table 1. On average, women were 24 years of age, were mostly single with a stable partner and had a frequency of five penetrations per month. They had been mostly affected by secondary PVD for a duration of four years. Psycho-social and PFM function variables are presented in Table 2.

Bivariate correlations between variables

Results from ~~Spearman~~ Pearson correlations are shown in Table 3. Maximal strength was significantly and negatively correlated with pain intensity, as were speed of contraction and maximal aperture. Muscle tone was not significantly associated with pain intensity. Catastrophizing, pain-related fear and partner support were positively related to pain.

Fear-avoidance and PFM variables explaining pain intensity

Hierarchical linear regression analysis was used to determine which variable contributed to pain intensity, as measured by the NRS. As shown in Table 4, the model significantly explained 28.3% of pain during intercourse [$F(8,164) = 9.497$, $p<0.001$]. Several variables were significantly related to pain intensity: catastrophizing (PCS total score), partner support (Spousal Support Questionnaire) and PFM flexibility. The PFM function could explain an additional 9% of pain intensity among PVD women beyond that accounted for by fear-avoidance variables. In addition, a significant interaction was found, revealing the moderating role of partner support. As presented in Figure 1, when partner support was viewed as high, catastrophizing was not related to pain (b=0.023, Standard Error (S.E.)=0.016, p=0.142, 95%CI [-0.008, 0.055]), whereas when partner support was viewed as low, catastrophizing was positively related to pain (b=0.068, S.E.=0.016, $p<0.001$, 95%CI [0.037, 0.100]).

Discussion

The aim of this study was to investigate the association between fear-avoidance, muscular variables and pain intensity in women with PVD as well as the moderating effect of partner support on catastrophizing and PFM function. This study found that PFM function was associated with pain intensity among women with PVD beyond the contribution of fear-avoidance variables. The significant moderating role of partner support on catastrophizing was also observed.

Univariate analyses revealed that pain catastrophizing, fear of pain and partner support were all significantly and positively correlated with pain intensity, suggesting that higher levels of pain catastrophizing, fear of pain and partner support were associated with higher pain intensity. This association could be bidirectional, meaning that women with higher pain intensity have higher levels of pain catastrophizing and pain-related fear. The significant association of catastrophizing (one of the fear-avoidance variables) with pain intensity is consistent with the findings of previous studies of women with PVD (14,15,48).

This study shows a positive correlation between partner support and pain intensity. Although partner support was not previously related to pain intensity in women with PVD, it was already linked to pain outcomes in rheumatoid arthritis by several studies (49,50). It was also correlated with quality of life and relationship satisfaction in other chronic pain conditions (23,24). That this variable is positively correlated with pain intensity raises some questions because partner support is generally conceptualized as a positive influence on pain and disability outcomes. Results from this study suggest an opposite association. Higher partner support could be associated with higher pain intensity similarly to partner solicitous responses (21,22). Rosen et al. put forward the idea that solicitous partners could contribute to greater pain in women by triggering an increase in avoidance responses towards intercourse (21,22). Moreover, Jolliffe et Nicholas (51) found that increased attention to pain could positively affect pain intensity scores. Given the results of Corsini-Munt et al. (52) that couple therapy could reduce pain intensity among women with PVD, the importance of partner support still needs to be established more clearly. Similarly, Miller et al. (53) found that among couples with chronic pain, a therapeutic assessment of pain coping strategies could decrease pain intensity and improve mood. It is also possible that women with higher pain intensity perceive that they need more support, explaining the positive association between those variables.

Results from this study show that PFM maximal strength, speed of contraction and flexibility were negatively correlated with pain intensity. These findings corroborate the available literature about the role of PFM function showing that women with PVD had lower strength, speed of contraction and flexibility than asymptomatic controls (16,54). Previous studies also highlighted the importance of muscle tone in women with PVD (16,54). However, we found a non-significant linear association with pain intensity. Given the intricate relationship between flexibility and muscle tone, these results deserve further explanation. It is plausible that a certain level of tone is required to elicit pain, masking the association with pain intensity. Previous studies found that both flexibility and muscle tone play a role in PVD as they were different in

women with PVD compared to asymptomatic controls (16,54). However, Morin et al. (2017) found a higher effect size for flexibility (Cohen d=1.787) than for PFM tone (Cohen d=0.884), which suggested a greater involvement of PFM flexibility when comparing women with and without PVD (16). The results of the current study are thus in line with this previous finding as PFM flexibility is the muscle variable the most strongly associated with pain. This could be explained by the fact that the flexibility measurement involves a pain component which could be more closely related to the patients' symptoms. Furthermore, the findings of the present study are also consistent with studies showing that physical therapy addressing PFM function can successfully decrease pain intensity in women with PVD (41,42,55).

A hierarchical regression model using catastrophizing, pain-related fear, partner support and PFM function significantly explained 28.3% of pain intensity in women with PVD. Fear-avoidance variables have already been investigated in various studies to explain function and pain in women with PVD as well as other pathologies (6,13,14,21,22). Desrochers et al. (14) found that catastrophizing, fear of pain, hypervigilance and low self-efficacy could explain 15% of pain among women with PVD. These results are consistent with the results obtained in the current study, where catastrophizing and pain anxiety could significantly explain 15% of pain intensity. Previous studies have also shown that cognitive-behavioral therapy can significantly reduce pain intensity during intercourse (29,30,34), which is in line with the findings of the present study. The addition of PFM function could explain an additional 9% of pain intensity. PFM function has long been hypothesized as a factor contributing to pain in PVD in conceptual model and case-controlled studies (7,16,44), but the association had not been validated empirically (7,44). Results from this study are therefore a step forward in the confirmation of PFM function as a component of PVD ~~etiology~~ pathophysiology.

Our results also revealed a moderator effect of partner support on catastrophizing (or buffer effect). When partner support was higher, catastrophizing was no longer associated with pain, suggesting a protective effect of partner support. The association between catastrophizing and pain intensity was only significant among women who perceived they had less support from their partner. These results are in line with the communal coping model by Sullivan et al., suggesting that catastrophizing would be a way of asking for support (29). When women perceive their partner as supportive, their catastrophizing behavior is no longer related to their pain intensity. This study provides a better understanding of the effect of partner support as a buffer of the association between catastrophizing and pain intensity. These results suggest that partner support should be investigated further because it could be a relevant treatment target.

This study presents some limitations. First, the pain was self-reported and women had to focus on the pain intensity experienced in the previous ~~week~~ six months, which may have introduced a retrospective recall bias. Despite the limit it introduces, this method of evaluation remains the most widely used in pain studies (33). Daily diaries could have been used to monitor pain more closely to the action causing pain. Women could have recorded in their diary pain intensity during sexual intercourse shortly after it happened. Lastly, since this study was cross-sectional, it is not possible to establish whether PVD causes the alteration of PFM function and fear-avoidance variables or whether it's the other way around. These muscle and psychosocial variables could therefore be involved as an initiator or a consequence of pain. A longitudinal study would be necessary to investigate the sequence of events.

The findings of this study confirm that catastrophizing, partner support and PFM function are associated with pain intensity. Moreover, the addition of PFM function explains the additional role of pain intensity compared to other studies. It was also found that partner support moderates the ~~effect~~ association between catastrophizing and pain intensity. Considering that the etiology of PVD is still misunderstood and that treatment includes a wide variety of modalities, this study shows that PFM function should be considered as well as fear-avoidance variables when treating PVD. Results from this study should be taken into consideration when developing new treatments.

Conflict of interest

Authors state that they have no conflict of interest.

Ethics

The Research Ethics Committees of the Centre hospitalier universitaire de Sherbrooke, Centre hospitalier universitaire de Montréal and Institut Universitaire de Gériatrie de Montréal approved this study.

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References

1. Bornstein J, Goldstein AT, Stockdale CK, Bergeron S, Pukall CF, Zolnoun D, et al. 2015 ISSVD, ISSWSH and IPPS Consensus Terminology and Classification of Persistent Vulvar Pain and Vulvodynia. J Sex Med. 2016;13(4):607–12.

2. Harlow BL, Kunitz CG, Nguyen RHN, Rydell SA, Turner RM, MacLehose RF. Prevalence of symptoms consistent with a diagnosis of vulvodynia: population-based estimates from 2 geographic regions. Am J Obstet Gynecol. 2014 Jan;210(1):40.e1-8.

3. Micheletti L, Radici G, Lynch PJ. Provoked vestibulodynia: Inflammatory, neuropathic or dysfunctional pain ? A neurobiological perspective. J Obstet Gynecol. 2014;34(4):285–8.

4. Rosen NO, Muise A, Bergeron S, Impett EA, Boudreau GK. Approach and Avoidance Sexual Goals in Couples with Provoked Vestibulodynia : Associations with Sexual, Relational and Psychological Well-Being. J Sex Med. 2015;12(8):1781–90.

5. L. Maillé D, Bergeron S, Lambert B. Body Image in Women with Primary and Secondary Provoked Vestibulodynia : A Controlled Study. J Sex Med. 2015;12(2):505–15.

6. Lemieux AJ, Bergeron S, Steben M, Lambert B. Do Romantic Partners' Responses to Entry Dyspareunia Affect Women's Experience of Pain ? The Roles of Catastrophizing and Self-Efficacy. J Sex Med. 2013;10(9):2274–84.

7. Zolnoun D, Hartmann K, Lamvu G, As-Sanie S, Maixner W, Steege J. A Conceptual Model for the Pathophysiology of Vulvar Vestibulitis Syndrome. Obstet Gynecol Surv. 2006;61(6):395–401.

8. Lundberg M, Frennered K, Hägg O, Styf J. The Impact of Fear-Avoidance Model Variables on Disability in Patients With Specific or Nonspecific Chronic Low Back Pain. Spine. 2011;36(9):1547–53.

9. Burrus C, Tuscher J, Vuistiner P, Rivier G, Léger B, Luthi F. Predictive value of the "fear-avoidance" model on functional capacity evaluation (FCE) after orthopaedic trauma. Ann Phys Rehabil Med. 2016;59:e61.

10. Gay CW, Horn ME, Bishop MD, Robinson ME, Bialosky JE. Investigating dynamic pain sensitivity in the context of the fear-avoidance model. Eur J Pain. 2015;19(1):48–58.

11. Nieto R, Miró J, Huguet A. The fear-avoidance model in whiplash injuries. Eur J Pain. 2009;13(5):518–23.

12. Harlow BL, Wise LA, Stewart EG. Prevalence and predictors of chronic lower genital tract discomfort. Am J Obstet Gynecol. 2001;185(3):545–50.

13. Desrochers G, Bergeron S, Landry T. Do Psychosexual Factors Play a Role in the Etiology of Provoked Vestibulodynia? A Critical Review. J Sex Marital Ther. 2008;34:198–226.

14. Desrochers G, Bergeron S, Khalifé S, Dupuis M-J, Jodoin M. Fear Avoidance and Self-efficacy in Relation to Pain and Sexual Impairment in Women With Provoked Vestibulodynia. Clin J Pain. 2009;25(6):520–7.

15. Davis SNP, Bergeron S, Bois K, Sadikaj G, Binik YM, Steben M. A Prospective 2-Year Examination of cognitive and Behavioral Correlates of Provoked Vestibulodynia Outcomes. Clin J Pain. 2015;31(4):333–41.

16. Morin M, Binik YM, Bourbonnais D, Khalifé S, Ouellet S, Bergeron S. Heightened Pelvic Floor Muscle Tone and Altered Contractility in Women With Provoked Vestibulodynia. J Sex Med. 2017;14(4):592–600.

17. Morin M, Bergeron S, Khalifé S, Mayrand M, Binik YM. Morphometry of the pelvic floor muscles in women with and without provoked vestibulodynia using 4D ultrasound. J Sex Med. 2014;11(3):776–85.

18. Næss I, Bø K. Pelvic floor muscle function in women with provoked vestibulodynia and asymptomatic controls. Int Urogynecology J. 2015;26(10):1467–73.

19. Morin M, Carroll M-S, Bergeron S. Systematic Review of the Effectiveness of Physical Therapy Modalities in Women With Provoked Vestibulodynia. Sex Med Rev. 2017 Jul;5(3):295–322.

20. Manne SL, Ostroff J, Winkel G, Grana G, Fox K. Partner unsupportive responses, avoidant coping, and distress among women with early stage breast cancer: patient and partner perspectives. Health Psychol Off J Div Health Psychol Am Psychol Assoc. 2005 Nov;24(6):635–41.

21. Rosen NO, Bergeron S, Glowacka M, Delisle I, Baxter ML. Harmful or Helpful : Perceived Solicitous and Facilitative Partner Responses Are Differentially Associated with Pain and Sexual Satisfaction in Women with Provoked Vestibulodynia. J Sex Med. 2012;9(9):2351–60.

22. Rosen NO, Bergeron S, Leclerc B, Lambert B, Steben M. Woman and partner-perceived partner responses predict pain and sexual satisfaction in provoked vestibulodynia (PVD) couples. J Sex Med. 2010 Nov;7(11):3715–24.

23. Gustavsson-Lilius M, Julkunen J, Hietanen P. Quality of life in cancer patients: The role of optimism, hopelessness, and partner support. Qual Life Res Int J Qual Life Asp Treat Care Rehabil. 2007 Feb;16(1):75–87.

24. Hagedoorn M, Dagan M, Puterman E, Hoff C, Meijerink WJHJ, Delongis A, et al. Relationship satisfaction in couples confronted with colorectal cancer: the interplay of past and current spousal support. J Behav Med. 2011 Aug;34(4):288–97.

25. Villumsen M, Holtermann A, Samani A, Madeleine P, Jørgensen MB. Social support modifies association between forward bending of the trunk and low-back pain: Cross-sectional field study of blue-collar workers. Scand J Work Environ Health. 2016 Mar;42(2):125–34.

26. McKillop AB, Carroll LJ, Jones CA, Battié MC. The relation of social support and depression in patients with chronic low back pain. Disabil Rehabil. 2017 Jul;39(15):1482–8.

27. Aghilinejad M, Tavakolifard N, Mortazavi SA, Kabir Mokamelkhah E, Sotudehmanesh A, Mortazavi SA. The effect of physical and psychosocial occupational factors on the

chronicity of low back pain in the workers of Iranian metal industry: a cohort study. Med J Islam Repub Iran. 2015;29:242.

28. Brassard A, Houle F, Lussier Y. Elaboration and validation of the Questionnaire de Soutien Conjugal (QSC). Can J Behav Sci. 2011;43(2):69–77.

29. Sullivan MJ, Thorn B, Haythornthwaite JA, Keefe F, Martin M, Bradley LA, et al. Theoretical perspectives on the relation between catastrophizing and pain. Clin J Pain. 2001 Mar;17(1):52–64.

30. Morin M, Dumoulin C, Bergeron S, Mayrand M-H, Khalifé S, Waddell G, et al. Randomized clinical trial of multimodal physiotherapy treatment compared to overnight lidocaine ointment in women with provoked vestibulodynia: Design and methods. Contemp Clin Trials. 2016 Jan;46:52–9.

31. Friedrich Jr EG. Vulvar vestibulitis syndrome. J Reprod Med. 1987;32(2):110–4.

32. Bergeron S, Binik YM, Khalife S, Pagidas K, Glazer HI. Vulvar vestibulitis syndrome : reliability of diagnosis and evaluation of current diagnostic criteria. Obstet Gynecol. 2001;98(1):45–51.

33. Goldstein AT, Pukall CF, Brown C, Bergeron S, Stein A, Kellogg-Spadt S. Vulvodynia: Assessment and Treatment. J Sex Med. 2016;13(4):572–90.

34. Ferreira-Valente MA, Pais-Ribeiro JL, Jensen MP. Validity of four pain intensity rating scales. Pain. 2011;152(10):2399–404.

35. Jensen MP, McFarland CA. Increasing the reliability and validity of pain intensity measurement in chronic pain patients. Pain. 1993;55(2):195–203.

36. Sullivan MJL, Bishop SR, Pivik J. The Pain Catastrophizing Scale: Development and Validation. Psychol Assess. 1995;7(4):524–32.

37. French DJ, Noël M, Vigneau F, French JA, Chantal P, Evans RT. L'échelle de dramatisation face à la douleur PCS-CF: Adaptation canadienne en langue française de l'échelle "Pain Catastrophizing Scale." Can J Behav Sci. 2005;37:181–92.

38. McCracken LM, Dhingra L. A short version of the Pain Anxiety Symptoms Scale (PASS-20): preliminary development and validity. Pain Res Manag. 2002;7(1):45–50.

39. Dumoulin C, Gravel D, Bourbonnais D, Lemieux MC, Morin M. Reliability of Dynamometric Measurements of the Pelvic Floor Musculature. Neurourol Urodyn. 2004;23(2):134–42.

40. Morin M, Gravel D, Bourbonnais D, Dumoulin C, Ouellet S. Reliability of Dynamometric Passive Properties of the Pelvic Floor Muscles in Postmenopausal Women With Stress Urinary Incontinence. Neurourol Urodyn. 2008;27(8):819–25.

41. Morin M, Dumoulin C, Bourbonnais D, Gravel D, Lemieux MC. Pelvic Floor Maximal Strength Using Vaginal Digital Assessment Compared to Dynamometric Measurements. Neurourol Urodyn. 2004;23(4):336–41.

42. Dumoulin C, Bourbonnais D, Lemieux MC. Development of a Dynamometer for Measuring the Isometric Force of the Pelvic Floor Musculature. Neurourol Urodyn. 2003;22(7):648–53.

43. Morin M, Bergeron S, Khalife S, Binik I, Ouellet S. Dynamometric assessment of the pelvic floor muscle function in women with and without provoked vestibulodynia. Neurourol Urodyn. 2010;29(6):1140–1.

44. Thomtén J, Linton SJ. A psychological view of sexual pain among women : applying the fear-avoidance model. Womens Health. 2013;9(3):251–63.

45. West SG, Reno RR, Aiken LS. Multiple Regression: Testing and Interpreting Interactions. SAGE Publications, Inc. United States of America: Susan McElroy; 1991.

46. Hayes AF. Introduction to Mediation, Moderation, and Conditional Process Analysis. The Guilford Press. United States of America; 2013.

47. Field A. Discovering Statistics using IBM SPSS Statistics. 4 édition. Sage Publications; 2013. 915 p.

48. Chisari C, Chilcot J. The experience of pain severity and pain interference in vulvodynia patients: The role of cognitive-behavioural factors, psychological distress and fatigue. J Psychosom Res. 2017 Feb;93:83–9.

49. Holtzman S, Delongis A. One day at a time: The impact of daily satisfaction with spouse responses on pain, negative affect and catastrophizing among individuals with rheumatoid arthritis. Pain. 2007 Sep;131(1–2):202–13.

50. Leonard MT, Cano A, Johansen AB. Chronic pain in a couples context: a review and integration of theoretical models and empirical evidence. J Pain Off J Am Pain Soc. 2006 Jun;7(6):377–90.

51. Jolliffe CD, Nicholas MK. Verbally reinforcing pain reports: an experimental test of the operant model of chronic pain. Pain. 2004 Jan;107(1–2):167–75.

52. Corsini-Munt S, Bergeron S, Rosen NO, Mayrand M-H, Delisle I. Feasibility and preliminary effectiveness of a novel cognitive-behavioral couple therapy for provoked vestibulodynia: a pilot study. J Sex Med. 2014 Oct;11(10):2515–27.

53. Miller LR, Cano A, Wurm LH. A motivational therapeutic assessment improves pain, mood, and relationship satisfaction in couples with chronic pain. J Pain Off J Am Pain Soc. 2013 May;14(5):525–37.

54. Gentilcore-Saulnier E, McLean L, Goldfinger C, Pukall CF, Chamberlain S. Pelvic Floor Muscle Assessment Outcomes in Women With and Without Provoked Vestibulodynia and the Impact of a Physical Therapy Program. J Sex Med. 2010;7(2):1003–22.

55. Goldfinger C, Pukall CF, Thibault-Gagnon S, McLean L, Chamberlain S. Effectiveness of Cognitive-Behavioral Therapy and Physical Therapy for Provoked Vestibulodynia: A Randomized Pilot Study. J Sex Med. 2016;13(1):88–94.

56. Goldfinger C, Pukall CF, Gentilcore-Saulnier E, McLean L, Chamberlain S. A Prospective Study of Pelvic Floor Physical Therapy: Pain and Psychosexual Outcomes in Provoked Vestibulodynia. J Sex Med. 2009;6(7):1955–68.

57. Bergeron S, Khalifé S, Dupuis M-J, McDuff P. A Randomized Clinical Trial Comparing Group Cognitive-Behavioral Therapy and a Topical Steroid for Women With Dyspareunia. J Consult Clin Psychol. 2016;84(3):259–68.

Figure legend

Figure 1 – Partner support as a moderator of catastrophizing

*** p<0.001

Table 1 – Participants' characteristics

Characteristics	***Mean ± S.D. or n (%)*** *N* = 173
Age (years)	23.61 ± 4.01
Marital Status	
Single with a stable partner	107 (61.8)
Cohabitating	52 (30.1)
Married	14 (8.1)
Education	
Undergraduate (elementary, high school, college, minor, major)	110 (63.6)
Baccalaureate	43 (24.9)
Masters	16 (9.2)
Doctorate	4 (2.3)
Relationship duration (years)	3.13 ± 2.72
Frequency of intercourse (per month)	5.39 ± 5.72
Pain intensity (Numerical rating scale)	7.27 ± 1.52
Pain duration (years)	4.18 ± 3.32
Use of oral contraceptive	135 (78.0)
Type of PVD (primary / secondary)	68 (39) / 105 (61)

Table 2 –Fear-avoidance and PFM function

Variables	***Mean ± S.D.*** *N*=173
Psychological	
Catastrophizing (PCS total score)	27.65 ± 9.91
Pain-related fear (PASS total score)	40.75 ± 16.16
Social	
Partner Support (Spousal Support Questionnaire)	16.68 ± 2.72
PFM function	
PFM maximum strength (N)	3.26 ± 2.05
PFM contraction speed (N/sec)	5.82 ± 4.68
PFM flexibility – Maximal tolerated aperture (mm)	21.36 ± 8.30
PFM tone – Passive forces at 15 mm aperture (N)	2.20 ± 1.40

PCS Pain Catastrophizing Scale; PASS Pain Anxiety Symptoms Scale

Table 3 – Pearson correlations between fear-avoidance variables, PFM function and pain intensity

Independent variable	***r***	***S.E.***	***p***
Catastrophizing (PCS total score)	0.391	0.067	<0.001
Pain-related fear (PASS total score)	0.328	0.075	<0.001
Partner support (Spousal Support Questionnaire)	0.156	0.082	0.040
PFM maximum strength (N)	-0.152	0.066	0.045
PFM contraction speed (N/sec)	-0.251	0.066	0.001
PFM flexibility – Maximal tolerated aperture (mm)	-0.319	0.063	<0.001
PFM tone – Passive forces at 15 mm aperture (N)	0.038	0.061	0.619

Table 4 – Hierarchical linear regression with pain intensity as dependant variable

Independent variable	Adjusted R^2	Standardized β	b	S.E.	*p*	95% C.I.
Step 1	0.150					
Catastrophizing (PCS total score)		0.310	0.046	0.013	<0.001	[0.020, 0.073]
Pain-related fear (PASS total score)		0.102	0.009	0.008	0.260	[-0.007, 0.026]
Step 2	0.240					
PFM Function						
PFM flexibility – Maximal aperture tolerated (mm)		-0.255	-0.047	0.013	<0.001	[-0.072, -0.021]
PFM maximal strength		0.033	0.024	0.074	0.743	[-0.122, 0.170]
PFM tone – Passive forces at 15 mm aperture		0.005	0.006	0.073	0.939	[-0.138, 0.149]
PFM contraction speed		-0.156	-0.049	0.032	0.130	[-0.113, 0.015]
Step 3	0.261					
Partner Support (Spousal Support Questionnaire total score)		0.194	0.110	0.038	0.004	[0.035, 0.185]
Step 4	0.283					
Partner support X PCS total score		-0.166	-0.009	0.004	0.014	[-0.017, -0.002]
Model p<0.001						

PCS Pain Catastrophizing Scale; PASS Pain Anxiety Symptoms Scale; 95% C.I. 95% Confidence Interval.

Figure 1 – Partner support as a moderator of catastrophizing