Musculoskeletal Science and Practice 34 (2018) 47–53

Contents lists available at ScienceDirect

Musculoskeletal Science and Practice

journal homepage: www.elsevier.com/locate/msksp

Original article

Association between lumbopelvic pain and pelvic floor dysfunction in women: A cross sectional study

Sinéad Dufour, PT PhD[a,*], Brittany Vandyken, MScPT[a], Marie-Jose Forget, BScPT[b], Carolyn Vandyken, BScPT[b]

[a] McMaster University, School of Rehabilitation Science, Hamilton, Ontario, Canada
[b] Pelvic Health Solutions, Cambridge, Ontario, Canada

ARTICLE INFO

Keywords:
Lower back pain
Lumbopelvic pain
Pelvic floor
Women's health

ABSTRACT

Background: The prevalence, cost and disability associated with lumbopelvic pain continues to rise despite the range of available therapeutic interventions, indicating a deficiency in current approaches. A literature base highlighting a correlation between lumbopelvic pain and pelvic floor function is developing; however, the features that characterize this correlation have yet to be fully established.
Purpose: The purpose of this study was to determine the prevalence and characteristics of pelvic floor muscle function among women with lumbopelvic pain.
Methods: A cross – sectional study was conducted on non-pregnant women presenting with lumbopelvic pain to one of seven outpatient orthopaedic clinics in Canada. Potential participants underwent a screening process to assess for pelvic floor muscle dysfunction.
Results: A total of 182 women were recruited and 97 were excluded, leaving 85 participants (n = 85). Of these, 95.3% were determined to have some form of pelvic floor dysfunction. Specifically, 71% of the participants had pelvic floor muscle tenderness, 66% had pelvic floor weakness and 41% were found to have a pelvic organ prolapse. Participants with combined low back pain and pelvic girdle pain presented with higher levels of disability and increased characteristics of pelvic floor dysfunction.
Conclusions: Our findings corroborate and extend recent research supporting the hypothesis that a high proportion of pelvic floor muscle dysfunction is present among women with lumbopelvic pain. Specifically, increased pelvic floor muscle pressure-pain sensitivity represented the most frequent characteristic, the clinical implications of which require further study.

1. Introduction

Low back pain (LBP) is the number one cause of global disability and accounts for the greatest number of years lost to disability (Vos et al., 2015). LBP also represents the number one reason for visiting a primary healthcare provider (Beaudet et al., 2013). A 2012 Systematic Review found the global point prevalence of LBP to be 11.9% ± 2.0% with a one-month prevalence of 23.2 ± 2.95% (Hoy et al., 2012). Furthermore, the highest prevalence of LBP occurred in women aged 40–80 years (Hoy et al., 2012). The economic burden of LBP is significant as its prevalence is greatest in the population of middle-aged workers resulting in costs in multiple spheres of society from the individual, employee/organization, and government/healthcare (Hoy et al., 2012). From 1990-2013, there was a 57% increase in the global prevalence of LBP (Vos et al., 2015). In addition, these numbers are expected to rise in the coming years as the population continues to age (Hoy et al., 2012).

In the past decade, there have been several clinical practice guidelines published globally to enhance the treatment outcomes related to LBP (eg. Chou, 2007; Koes et al., 2010; Delitto et al., 2012). Despite the presence of these guidelines and a high volume of scientific literature to guide practice approaches, specific direction for applying which treatment to which LBP subgroup remains unclear (Hay et al., 2008).

The link between LBP and pelvic floor dysfunction (PFD), particularly in women, is becoming evident in the literature (Arab et al., 2010; Eliasson et al., 2008; Smith et al., 2006; Van Wingerden, 2013). However, characteristics that define this correlation have yet to be established. The pelvic floor consists of bony attachments, muscles and connective tissues and has five functions: support of the internal organs, vaginal and rectal walls (Faubion et al., 2012; Sapsford et al., 2009;

* Corresponding author.
E-mail address: sdufour@mcmaster.ca (S. Dufour).

https://doi.org/10.1016/j.msksp.2017.12.001
Received 2 January 2017; Received in revised form 5 December 2017; Accepted 7 December 2017
2468-7812/

Kegel, 1948); sphincteric control of the urethra, vagina and rectum to maintain continence (Faubion et al., 2012; Sapsford et al., 2009; Kegel, 1948); sexual function for orgasm and blood flow (Kegel, 1948; Junginger et al., 2010); sump-pump action for venous and lymphatic return (Mitchell and Esler, 2009); and has been speculated to optimize "stability" of the pelvic joints (Lee and Lee, 2004; Hodges et al., 2007).

Pelvic floor dysfunction (PFD) is multifaceted, and can be characterized by parameters such as weakness, poor endurance, excessive tension, shortened length and over activity. When there is impaired muscle contraction, relaxation or both, the pelvic floor cannot effectively engage in its five determined functions and can result in incontinence, pelvic organ prolapse, and/or pain (Faubion et al., 2012). With respect to LBP specifically, the pelvic floor is thought to contribute to the management of intra-abdominal pressure to support the transfer of loads during functional movement (Arab et al., 2010). Using a self-report construct, Eliasson and colleagues found that in 200 women with primary complaints of LBP, 78% reported urinary incontinence; the prevalence of incontinence and signs of PFD were significantly increased in the LBP group compared to women without LBP (Eliasson et al., 2008). Smith and colleagues found that women who reported urinary incontinence, gastrointestinal problems, or respiratory problems were more likely to have low back pain (Smith et al., 2006). Finally, using a self-report questionnaire, Van Wingerden determined that in 1636 patients with low back pain/pelvic girdle pain, 57% of women had pelvic floor complaints (Van Wingerden, 2013). Considering PFD, urinary incontinence is the most prevalent reported urogynaecological symptom. Estimates of the prevalence of urinary incontinence in women vary between 25% and 45% in most studies (Dumoulin et al., 2014); as such the prevalence of PFD appears to be notably higher among individuals with LBP.

Despite established literature highlighting the correlation between PFD and LBP, a systematic review of 15 international clinical practice guidelines for LBP demonstrated that the contribution of the pelvic floor remains a neglected aspect of care (Chou, 2007; Hay et al., 2008; Koes et al., 2010; Delitto et al., 2012). The lack of consideration of the pelvic floor in recent LBP guidelines might reflect the lack of robust evidence explicating features of this connection. Specifically, previous studies have not included a digital assessment of the pelvic floor musculature.

2. Purpose

The purpose of this study was to determine the prevalence and characteristics of pelvic floor muscle function among women with lumbopelvic pain. We hypothesized that both pelvic floor weakness and pelvic floor tenderness would constitute features of PFD among women with lumbopelvic pain.

3. Methods

A cross-sectional design was used in accordance with the STROBE checklist (von Elm et al., 2008) and ethics approval was received from the XXXXXX XXXXXX XXXXX.

Data was collected between October 2014 and February 2016. A pilot study was conducted in advance to enhance operationalization of the data collection. All participants provided full and informed consent prior to commencing any of the study procedures.

3.1. Setting

Seven Canadian private practice physiotherapy clinics, served as the recruitment sites for this study. Each of these clinics were orthopaedic-focused practices with a rostered Pelvic Health Physiotherapist who had a mixed caseload of orthopedics and pelvic health. In Ontario Canada, a rostered Pelvic Health Physiotherapist has completed advanced training in urogynaecology and is deemed competent by the College of Physiotherapists of Ontario to digitally exam and treat the pelvic musculature (CPO, 2017). The clinic administrator was responsible for recruiting participants who came from a list of all women presenting to the respective clinic with a complaint of lumbopelvic pain. The rostered Pelvic Health Physiotherapist carried out all of the clinical procedures.

To promote consistency and enhance rigor through the data collection process, all staff from participating sites, including physiotherapists and the clerical staff, attended a mandatory half day workshop that was led by one of the investigators (XX). Both the organizational aspects of the study and the specific clinical tests related to standardization of the clinical procedures were reviewed. In addition, written and video based resources were created to supplement this workshop. Further, quarterly teleconferences with the research team and monthly email correspondence between the research co-ordinator (XX) and all practicing sites served as key quality control measures.

3.2. Participants

Women who were 18 years of age or older and who presented to an orthopaedic physiotherapy practice with the complaint of lumbopelvic pain were invited to participate. Potential participants were excluded if one of the following conditions were met: 1) narcotic use; 2) high levels of catastrophization (score of > 30 on the Pain Catastrophization Scale); 3) physical examination findings indicative of radiculopathy (leg dominant symptoms below the level of the buttocks); and 4) refusal to participate in a digital pelvic floor exam. A post-hoc analysis determined 15 participants who were pregnant and thus also excluded (Fig. 1).

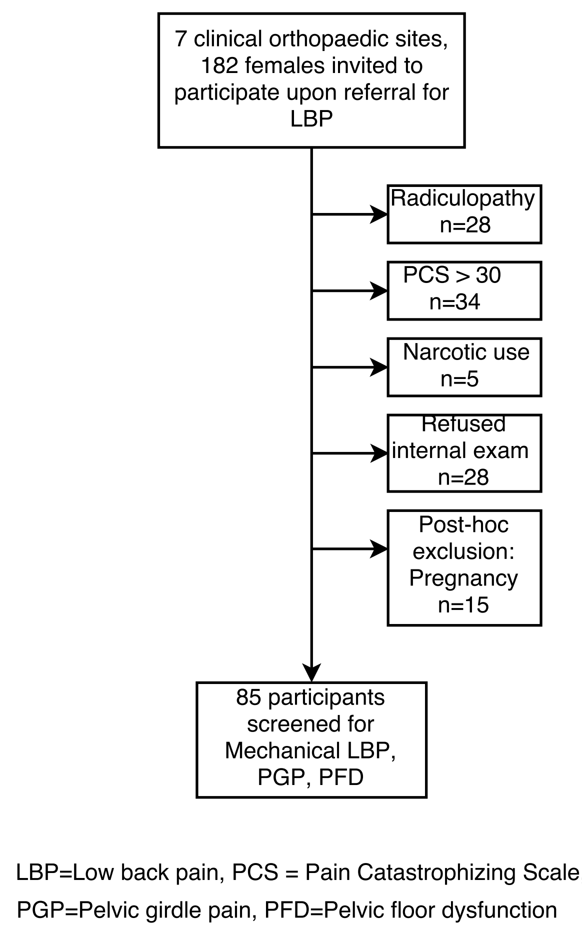

Fig. 1. Flow Diagram - separate file.

Table 1
Operational definitions of characteristics.

Characteristic	Operational Definition
Minimal Disability (Oswestry Index: 0–20%)	The individual can cope with most living activities. Usually no treatment is indicated apart from advice on lifting sitting and exercise. (Fairbank and Pynsent, 2000)
Moderate Disability (Oswestry Index:21–40%)	The individual experiences more pain and difficulty with sitting, lifting and standing. Travel and social life are more difficult and they may be disabled from work. Personal care, sexual activity and sleeping are not grossly affected and the patient can usually be managed by conservative means (Fairbank and Pynsent, 2000).
Severe Disability (Oswestry Index: 41–60%)	Pain remains the main problem in these individuals but activities of daily living are also affected. These individuals require detailed assessment (Fairbank and Pynsent, 2000).
Crippled Disability (Oswestry Index: 61+%)	Back pain impinges on all aspects of the individual's life. Positive intervention is required (Fairbank and Pynsent, 2000).
Urinary Incontinence	The complaint of any involuntary loss of urine (Doggweiler et al., 2017)
Fecal Incontinence	The complaint of any involuntary loss of feces (Doggweiler et al., 2017)
Chronic Constipation	The complaint of persistent difficult, infrequent or incomplete defecation (Messelink et al., 2005)
Chronic Pelvic Pain	The complaint of pain (sharp, burning, aching, shooting, stabbing, pressure, discomfort)as abnormal sensations felt by the individual that can be continuous or discontinuous in the lowest part of the abdomen and pelvis suggestive of lower urinary tract, sexual, bowel or gynaecological dysfunction, with no infection or obvious pathology (Doggweiler et al., 2017)
Dysparaunia (painful Intercourse)	The complaint of pain (sharp, burning, aching, shooting, stabbing, pressure, discomfort) during sexual intercourse (Doggweiler et al., 2017)

3.3. Procedures

Participants who met the inclusion criteria underwent four components of assessment including: 1) completion of self-report measures including the Oswestry Low Back Disability Questionnaire and self-report check list of conditions associated with pelvic floor dysfunction (Table 1); 2) repeated movement testing to determine mechanically oriented LBP; 3) a battery of four tests to determine the presence of pelvic girdle pain (Table 2) and 4) digital vaginal palpation of the pelvic floor which included three different procedures: assessment for pelvic floor weakness, assessment for pelvic floor tenderness and assessment for the presence of pelvic organ prolapse (POP).

All of the clinical procedures were chosen for their established utility and perceived relevance in diagnosing musculoskeletal dysfunction related to lumbopelvic pain (Gutke et al., 2010; Vleeming et al., 2008; Neville et al., 2012; Frawley et al., 2006). Operational definitions and psychometric properties of the key examination procedures are listed in Table 3.

Upon completion of the physical examination, each therapist was asked to determine which sub-group of lumbopelvic pain the participant was to be classified in to one of four groups: LBP; PGP; Combined (LBP and PGP) and non-specific LBP, of those remaining who did not fit in the other categories.

3.4. Statistical analysis

Summary statistics were performed using Microsoft Excel 2010. Further statistical analysis with the goal to obtain a p-value were conducted. Fisher's exact tests were used owing to some cell sizes being less than the recommended minimum of 5 for chi square analysis. The standard p-value of 0.05 to mark significance was used. Pairwise comparisons were then run on variables of significance. All results are summarized in Table 4.

4. Results

A total of 182 subjects were recruited with 97 excluded, leaving a final sample of 85 (n = 85). Of the four exclusion criteria, refusal to undergo an internal digital exam (N = 28) and presenting with high levels of catastrophization (N = 34) were the most common reasons for exclusion (Fig. 1). The final sample had a mean age of 43.4 years old (SD ± 13.8). Of the total sample, 95.3% were determined to have some form of PFD on digital examination, many of which had multiple characteristics of PFD. Specifically, 70.6% of the participants were

Table 2
Examination Procedures for Classification Lower Back Pain (LBP) and Pelvic Girdle Pain (PGP).

Assessment of mechanical LBP 1 out of 3 required to be positive: (Gutke et al., 2010)	Assessment of PGP pain 3 out of 4 of were required to be positive: (Guke et al., 2010; Vlemming et al., 2008)
1. Presence of relieving AND aggravating movements in standing and lying so that a directional preference (flexion, extension, or lateral gliding) could be established.	1. Active Straight Leg Raise Test (ASLR): With both legs straight, lying supine, the patient is instructed to raise one foot 20 cm. off of the table, keeping the leg straight; the patient was asked to rate the heaviness of lifting the leg from 0 = no effort to 5 = impossible to lift the leg off of the bed. The test was repeated on the other side, and the total score for both legs was added together to get a composite score. A positive test was a score of > or equal to 3
2. Centralization of pain with repeated movements. Centralization is defined as the movement of a painful sensation from a distal to a proximal location	2. ASLR with lateral compression: the test was repeated as above but a lateral compression force was provided by the therapist equally on the lateral aspect of the pelvic girdle in a medial direction. The patient was asked to re-assess the heaviness of lifting each leg, and the scores were totaled to get a composite score. A positive test was an improvement of the score from the ASLR test when lateral compression was applied laterally through the pelvic girdle.
3. Peripheralization of pain with repeated movements. Peripheralization is defined as the movement of a painful sensation from a proximal to a distal location.	3. Posterior Pelvic Pain Provocation Test (P4): With the patient in a supine position the clinician stands on examination side. The clinician places the leg into 90 degrees of hip flexion and applies a light manual pressure along the longitudinal axis of the femur. The pelvis is stabilized by the examiner's hand on the contralateral ASIS; a positive test is reproduction of the patient's typical pain 4. Forced FABER test providing force on the ipsilateral knee: With the patient in supine, the clinician passively flexes, abducts, and externally rotates the involved leg to place the heel on the opposite knee. The therapist puts a stabilizing hand on the ipsilateral ASIS, and forces the “test” knee into more external rotation. A positive test is reproduction of the patient's typical pain.

Table 3
Operational Definitions and Psychometric Properties of Examination Procedures.

Examination Procedure	Description of Procedure	Indicator of MSK Dysfunction	Reported Psychometric Properties
Forced FABER test	Positive: patient reported pain when her leg is flexed, abducted and externally rotated while in supine. Painis provoked in SIJ when examiner applies overpressure to knee and opposite ASIS.	Pain in hip or pelvic girdle joints	kappa = 0.38–0.62, Sensitivity 40–77%, Specificity 16–100%.
Pelvic Floor Muscle Tenderness	Positive: Pain is elicited during firm digital vaginal palpation of right or left pelvic floor muscles (Weiss, 2001).	Muscular tenderness and/ or myofascial pain	kappa = 0.76–0.91 (Slieker-ten Hove et al., 2009).
Pelvic Floor Muscle Strength	Positive test for weakness if the subject was unable to lift, squeeze, and maintain a pelvic floor contraction of the right and left pelvic floor muscles for at least 5 s during digital vaginal muscle test of less than Grade 4/5 (Laycock et al., 2001).	Pelvic floor muscle weakness	kappa = 0.17–0.56 (Slieker-ten Hove et al., 2009).
Pelvic Organ Prolapse Identification	Positive: If the therapist (assessor) was able to visualize the descent of the posterior or anterior vaginal wall, or uterine descent during a valsalva maneuver with the participant in supine.	Weakened connective tissues of the pelvic organs	kappa = 0.61–0.87 (Slieker-ten Hove et al., 2009).

determined to have pelvic floor tenderness, 65.9% were found to have pelvic floor weakness and 41.2% were found to have POP. Additionally, 83.5% of our sample were found to have one or more reported condition relating to PFD.

Highlighted findings for this analysis include: urinary incontinence representing the most frequent self-report condition (across all subgroups), followed by pelvic pain and dyspareunia. The between group analysis reveals higher disability, frequency of reported conditions and frequency of positive pelvic floor findings in the combined pain group. Notably the mean age of this group is also higher than the other groups. Further, despite excluding participants with high PCS scores (over 30) our sample had relatively high proportions of moderate and severe disability. Lastly, a high proportion of participants had a positive forced FABERs test (62.4%), which was particularly high in the PGP group (88.9%) and combined pain group (94.%). Statistical analysis demonstrated a statistically significant difference between groups for the forced FABERs test variable. Pairwise comparisons demonstrated differences between the combined pain and LBP groups (p = .001) and the combined pain and non-specific pain group (p = .004).

5. Discussion

To date, our study is the first to have verified the state of the pelvic floor muscles through digital examination in order to better understand the correlation of PFD to lumbopelvic pain. Results of this study demonstrated a high correlation of PFD (95.3%), and that tenderness, weakness and the presence of POP are all correlated with lumbopelvic pain in women. The presence of pelvic floor tenderness was the most pervasive finding, followed by pelvic floor weakness. Further the combination of LBP and PGP appears to be associated with more disability and more PFD.

5.1. Pelvic floor tenderness & lumbopelvic pain

The high proportion of pelvic floor tenderness found within our sample represents an important finding. Pelvic floor muscle tenderness is often associated with higher resting tone and decreased relaxation capacity (Slieker-ten Hove et al., 2009). Engeler et al. (2012), have outlined that elevated pain sensitivity, inclusive of increased resting tone and decreased relaxation capacity is associated with chronic pelvic pain (Level 2 evidence). Loving et al. (2014) validated measures of pelvic floor muscle overactivity included higher resting tone (hypertonicity), impaired relaxation capacity, decreased maximal strength and increased experiences of pain during palpation to blindly identify women with chronic pelvic pain from pain-free women (Loving et al., 2014). In previous studies, pelvic floor muscle tenderness has also been demonstrated in women with CPP compared to controls. (Tu et al., 2008; Montenegro et al., 2010). Loving et al. (2014) demonstrated that 79.2% of women with chronic pelvic pain experienced pressure pain by palpation compared to 30.8% of controls. This finding has been corroborated in our study of women with lumbopelvic pain who have a similar incidence of tenderness on palpation of the pelvic floor muscles.

Table 4
Summary of Results.

Characteristics	All (N = 85)	LBP (N = 56)	PGP (N = 9)	Combined[a] (N = 17)	Non-specific pain (N = 3)	Fisher's Exact Test P-value
Mean Age (SD)	43.4(13.8)	41.6(12.5)	43.7(13.7)	47.9(17.7)	52.0(7.5)	NT
Oswestry Disability Index (%)						NT
Minimal Disability	41.2	46.4	55.6	17.6	33.3	NT
Moderate Disability	44.7	44.6	33.3	47.1	66.7	NT
Severe Disability	12.9	8.9	11.1	29.4	0	NT
Crippled Disability	1.2	0	0	5.9	0	NT
Urinary Incontinence (%)	62.4	57.1	66.7	76.5	66.7	0.54
Fecal Incontinence (%)	5.9	3.6	11.1	11.8	0	0.35
Chronic Constipation (%)	25.9	23.3	55.6	17.6	33.3	0.15
Pelvic Pain (%)	50.6	44.6	55.6	64.7	66.7	0.78
Dyspareunia (%)	47.1	44.6	55.6	52.9	33.3	0.86
Overall Subjective PFD (%)	83.5	82.1	100	94.1	100	0.47
Pelvic Organ Prolapse (%)	41.2	33.9	44.4	64.7	33.3	0.14
Pelvic Floor Tenderness (%)	70.6	83.9	66.7	88.2	66.7	0.36
Pelvic Floor Weakness (%)	65.9	58.9	66.7	88.2	66.7	0.12
Positive Forced FABERs (%)	62.4	51.8	88.9	94.1	0	< 0.001
Positive Forced FABERs + Pelvic Floor Tenderness (%)	56.5	51.8	55.6	82.4	0	0.77
Overall Objective PFD (%)	95.3	92.8	100	100	100	0.57

[a] Combined lower back pain (LBP.) and pelvic girdle pain (PGP); NT = Not Teste.

An overactive pelvic floor represents an often-overlooked source of pain that may present as musculoskeletal, gynaecological, urological or colorectal symptoms since very few health care providers palpate the pelvic floor during routine exams (Kavvadias, 2011). Since our study found such a high correlation between pelvic floor tenderness and self-reported perineal pain, digital palpation of the pelvic floor may represent an effective screening tool for health practitioners to identify perineal pain of musculoskeletal origin.

Neville et al. (2012) investigated multiple musculoskeletal factors that could predictively identify women with chronic pelvic pain besides intravaginal palpation. They concluded that a combined positive Forced FABER test and pelvic floor tenderness upon palpation achieved 100% specificity in identifying women with self-reported chronic pelvic pain. In our study, 82.4% of women in the combined pain group had both a positive Forced FABER and pelvic floor muscle tenderness on palpation. This finding does contrast those in the mechanical lower back pain group, in which just over half (51%) demonstrated these findings. As such, our findings corroborate previous research suggesting the potential utilization of a Forced FABER test as a predictive test for the presence of pelvic floor tenderness, a parameter of PFD.

Another important finding in our study was the high prevalence of self-reported dyspareunia (painful intercourse) and perineal pain. Notably, a link between an overactive pelvic floor and dyspareunia has been established in the literature. Specifically, investigations of the most common form of dyspareunia in women, provoked vestibulodynia (pain at the opening of the vagina), have observed elevated resting EMG of the pelvic floor muscles (Glazer, 1998; Gentilcore-Saulnier et al., 2010). Further, multiple studies have also looked at the presence of overactive pelvic floor muscles in many chronic pelvic pain conditions known to contribute to both perineal pain and dyspareunia (Bassaly et al., 2011; Doggweiler-Wiygul and Wiygul, 2002; Itza et al., 2010; Patore and Katzman, 2012).

5.2. Pelvic floor weakness & lumbopelvic pain

The second most common characteristic of PFD in our study was pelvic floor muscle weakness (65.9%). However, the majority of our sample presented with both pelvic floor muscle weakness and pelvic floor muscle tenderness. As such, the pelvic floor muscles may be presenting as weak because they actually have higher resting tone, that is the weakness is more a function of tension, versus frank weakness. Conventional physiotherapy approaches for lumbopelvic pain often assumes weakness of the inner unit muscles, inclusive of the pelvic floor, emphasizing stability training (Hodges and Richardson, 1996; Radebold et al., 2000: Barr et al., 2005; Barr et al., 2007). Many studies have looked at the role of pelvic floor co-activation with the abdominal muscles in the management of intra-abdominal pressures and trunk load transfer to improve pelvic stability and maintain urinary control (Sapsford et al., 2009; Sapsford, 2004; Dumoulin and Hay-Smith, 2010; Price et al., 2010; Richardson and Hodges, 1999). As such, common orthopaedic practice includes prescribing pelvic floor muscle strengthening exercises with co-activation of other trunk muscles. Since pelvic floor tenderness specifically was found to be highly linked to all of these self-reported symptoms, careful consideration of the state of the pelvic floor muscles may be required before initiating pelvic floor strengthening exercises and associated stability training protocols. Further, physiotherapists in conventional orthopaedic practices routinely question bladder and bowel function as part of standard medical screening during an assessment to rule out serious conditions such as cauda equine syndrome. However, bowel and bladder functional questions as they pertain to Stress Urinary Incontinence (SUI), Urge Urinary Incontinence (UUI), Pelvic Organ Prolapse (POP), Dyspareunia and Chronic Constipation are rarely considered and our findings suggest that they should be.

Consistent with the literature, we found that UI was the most prevalent reported urogynaecological symptom among our sample. Across the different pain groups UI ranged from 57.1%-76.5%. The link between low back pain and UI is corroborated in the literature (Eilasson et al., 2008; Kim et al., 2010; Bush et al., 2013; Van Wingerden, 2013). Our findings indicate that both pelvic floor weakness and pelvic floor tenderness are associated with UI among women who present with lumbopelvic pain. Further, we found that participants in all pain groups had both self-reported symptoms of incontinence and concurrent symptoms of painful intercourse. These findings highlight the notion that UI is not solely a feature of weak, low tone musculature. Moreover, a recent Cochrane review provides support for the widespread recommendation that pelvic floor muscle training, with internal palpation, be the first-line conservative management for women with any type of urinary incontinence (Dumoulin et al., 2014).

5.3. Comprehensive lumbopelvic pain assessment: digital pelvic floor exam

In total, 28 potential participants were excluded from this study because they did not wish to undergo a digital pelvic floor exam. Notably, the rate of refusal to participate in the pelvic exam was lowest (7.4%) in the clinical site in which the study therapist (together with her administrative team) had the highest level of clinical experience in pelvic health. Therefore, the experience of the clinic staff appeared to impact the rate of participant exclusion. For example, one of the study therapists had almost 17 years' experience in pelvic health; however, at the time of the study her administrative team had minimal experience discussing aspects of pelvic health physiotherapy to respective clients. This clinic had a 45% exclusion rate based primarily on refusal to undergo a digital pelvic exam. Clinic sites that reported the highest rate of participation in pelvic floor exams commented on both the experience of their physiotherapists and proper training of their office staff in normalizing the digital pelvic exam for prospective clients. A study by Shagam (2006) found that stigma, embarrassment, and the belief that pelvic floor dysfunction is a natural part of aging prevents many women from seeking treatment. Reducing the stigma and fears surrounding a digital pelvic floor exam will allow women to receive appropriate treatment and should be a priority in our health care system. Digital pelvic floor examination is inexpensive, portable and reliable (Frawley et al., 2006) and may play a key role in better understanding the type of dysfunction present and thus guide the most appropriate treatment plan.

5.4. Central pain mechanisms in lumbopelvic pain

Pain catastrophizing was initially identified as an exclusion criterion because current evidence suggests catastrophization as a significant cognitive-process variable in persistent pain, including both cognitive behavioral studies and physical therapy studies (Quartana et al., 2009). A score of > 30 on the Pain Catastrophization Scale (PCS) has been highly correlated with a severe risk of ongoing disability at one-year post-injury (Giesecke et al., 2004). PCS scores of > 30 were the highest reason for participant exclusion from this study. Despite this high rate of exclusion, psychosocial measures such as PCS are rarely used in standard orthopaedic practice (Hoeger Bement et al., 2013). Although our study did not directly seek to examine central mechanisms involved in lumbopelvic pain, an important finding that emerged through our research process reinforces the notion that central pain mechanisms represent a significant component of lumbopelvic pain presenting to orthopaedic practices. Further research is needed to better understand central pain mechanisms within the context of lumbopelvic pain and PFD.

5.5. Strengths

The completion of a pilot study, participation of multiple clinical sites, standardized training of all participating clinical sites and systematic follow up with the study research co-ordinator were all important quality control measures taken to improve inter-rater reliability and the associated rigor of this study. Our study is the first to incorporate a digital pelvic exam to better understand the correlation between lumbopelvic pain and pelvic floor muscle function.

5.6. Limitations

The major limitation of this study relates to the risk of assessor bias since the physiotherapist completing the examination procedures could not be blinded. Additionally, despite efforts to standardize the data collection procedures across the seven participating sites we acknowledge that difference in procedures and associated assessor bias may have transpired. Also, heterogeneity, which may point to sampling bias, was noted in the areas of total recruitment and participant exclusion due to refusal to undergo a digital pelvic floor exam. Finally, due to the observational study design used, lumbopelvic pain and pelvic floor variables that have been established here are correlational. Insights related to causation of PFD as related to lumbopelvic pain remains an important issue, which requires further investigation, through suitable study design.

6. Conclusion

Our findings corroborate and extend the findings of recent research supporting the hypothesis that pelvic floor muscle dysfunction is highly correlated with lumbopelvic pain. Specifically, increased pelvic floor muscle pressure-pain sensitivity represented the most frequent characteristic, the clinical implications of which require further study. Contemporary treatment approaches for lumbopelvic pain may need to be reconsidered and normalization of the utility of a digital assessment of the pelvic floor relative to lumbopelvic pain may require realization.

Acknowledgements

The authors would like to acknowledge Caitlin Kuzyk, Caitlin Price and Jackie Fiorali who assisted with the pilot component of this project. We would also like to thank Professor Paul Stratford and Shirley Deng for assistance with the statistical analysis. Furthermore, we would like to thank Dr. Linda MacLean for her assistance in final preparation of this manuscript. Finally, we would like to thank the participating clinics, pelvic health physiotherapists, as well as the study participants for their time and candor.

References

Arab, A., Behbahani, R., Lorestani, L., Azari, A., 2010. Assessment of pelvic floor muscle function in women with and without low back pain using transabdominal ultrasound. Man. Ther. 15 (3), 235–239.
Barr, K., Griggs, M., Cadby, T., 2005. Lumbar stabilization: core concepts and current literature, part 1. Am. J. Phys. Med. Rehabil. 84 (6), 473–480.
Barr, K., Griggs, M., Cadby, T., 2007. Lumbar stabilisation: a review of core concepts and current literature, part 2. Am. J. Phys. Med. Rehabil. 86 (1), 72–80.
Bassaly, R., Tidwell, N., Bertolino, S., Hoyte, L., Downs, K., Hart, S., 2011. Myofascial pain and pelvic floor dysfunction in patients with interstitial cystitis. Int. Urogynecol. J. 22 (4), 413–418.
Beaudet, N., Courteau, J., Sarret, P., Vanasse, A., 2013. Prevalence of claims-based recurrent low back pain in a Canadian population: a secondary analysis of an administrative database. BMC Musculoskelet. Disord. 14 (1).
Bush, H., Pagorek, S., Kuperstein, J., Guo, J., Ballert, K., Crofford, L., 2013. The association of chronic back pain and stress urinary incontinence: a cross-sectional study. J. Womens Health Phys. Ther. 37 (1), 11–18.
Chou, R., 2007. Diagnosis and treatment of low back pain: a joint clinical practice guideline from the American College of physicians and the American pain society. Ann. Int. Med. 147 (7), 478.
College of Physiotherapists of Ontario, 2017. Rostering for Authorized Activities/ Controlled Acts. Retrieved on June 23, 2017. http://www.collegept.org/Physiotherapists/Rostering.
Delitto, A., George, S., Van Dillen, L., Whitman, J., Sowa, G., Shekelle, P., et al., 2012. Low back pain. JOSPT 42 (4), A1–A57.
Doggweiler, R., Whitmore, K.E., Meijlink, J.M., Drake, M.J., Frawley, H., Nordling, J., Hanno, P., Fraser, M.O., Homma, Y., Garrido, G., Gomes, M.J., Elneil, S., van de Merwe, J.P., Lin, A.T.L., Tomoe, H., 2017. A standard for terminology in chronic pelvic pain syndromes: a report from the chronic pelvic pain working group of the international continence society. Neurourol. Urodyn. 36, 984–1008.
Doggweiler-Wiygul, R., Wiygul, J., 2002. Interstitial cystitis, pelvic pain, and the relationship to myofascial pain and dysfunction: a report on four patients. World J. Urol. 20 (5), 310–314.
Dumoulin, C., Hay-Smith, J., 2010. Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women. Cochrane Database Syst. Rev.(1) CD005654.
Dumoulin, C., Hay-Smith, J., Habée-Séguin, G., Mercier, J., 2014. Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women: a short version Cochrane systematic review with meta-analysis. Neurourol. Urodyn. 34 (4), 300–308.
Eliasson, K., Elfving, B., Nordgren, B., Mattson, B., 2008. Urinary incontinence in women with low back pain. Man. Ther. 13 (3), 206–212.
Engeler, D., Baranowski, A.P., Elneil, S., Hughes, J., Messelink, E.J., Oliveira, P., Ophoven, A. Van, Williams, A.C.D.C., 2012. Guidelines on chronic pelvic pain, European association of urology. Eur. Urol. 1–131.
Fairbank, J.C.T., Pynsent, P.B., 2000. The Oswestry disability index. Spine 25 (22), 2940–2953.
Faubion, S., Shuster, L., Bharucha, A., 2012. Recognition and management of nonrelaxing pelvic floor dysfunction. Mayo Clin. Proc. 87 (2), 187–193.
Frawley, H., Galea, M., Phillips, B., Sherburn, M., Bø, K., 2006. Reliability of pelvic floor muscle strength assessment using different test positions and tools. Neurourol. Urodyn. 25 (3), 236–242.
Gentilcore-Saulnier, E., McLean, L., Goldfinger, C., Pukall, C., Chamberlain, S., 2010. Pelvic floor muscle assessment outcomes in women with and without provoked vestibulodynia and the impact of a physical therapy program. J. Sex. Med. 7, 1003–1022.
Giesecke, T., Gracely, R., Grant, M., Nachemson, A., Petzke, F., Williams, D., et al., 2004. Evidence of augmented central pain processing in idiopathic chronic low back pain. Arthritis Rheum. 50 (2), 613–623.
Glazer, H., 1998. Electromyographic comparisons of the pelvic floor in women with dysesthetic vulvodynia and asymptomatic women. J. Reprod. Med. 43, 959–962.
Gutke, A., Kjellby-Wendt, G., Öberg, B., 2010. The inter-rater reliability of a standardised classification system for pregnancy-related lumbopelvic pain. Man. Ther. 15 (1), 13–18.
Hay, E., Dunn, K., Hill, J., Lewis, M., Mason, E., Konstantinou, K., et al., 2008. A randomised clinical trial of subgrouping and targeted treatment for low back pain compared with best current care. The STarT Back Trial Study Protocol. BMC Musculoskelet. Disord. 9 (1), 58.
Hodges, P.W., Richardson, C., 1996. Inefficient muscular stabilization of the lumbar spine associated with low back pain. A motor control evaluation of transversus abdominus. Spine 21 (22), 2640–2650.
Hodges, P.W., Sapsford, R., Pengel, L.H.M., 2007. Postural and respiratory functions of the pelvic floor. Neurourol. Urodyn. 26, 362–371.
Hoeger Bement, M., St. Marie, B., Nordstrom, T., Christensen, N., Mongoven, J., Koebner, I., et al., 2013. An interprofessional consensus of core competencies for prelicensure education in pain management: curriculum application for physical therapy. Phys. Ther. 94 (4), 451–465.
Hoy, D., Bain, C., Williams, G., March, L., Brooks, P., Blyth, F., et al., 2012. A systematic review of the global prevalence of low back pain. Arthritis Rheum. 64 (6), 2028–2037.
Itza, F., Zarza, D., Serra, L., et al., 2010. Myofascial pain syndrome in the pelvic floor: a common urological condition. Actas Urol. Esp. 34 (4), 318–326.
Junginger, B., Baessler, K., Sapsford, R., Hodges, P., 2010. Effect of abdominal and pelvic floor tasks on muscle activity, abdominal pressure and bladder neck. Int. Urogynecol. J. 21 (1), 69–77.
Kavvadias, et al., 2011. Pelvic pain in urogynaecology. Part 1: evaluation, definitions and diagnoses. Int. Urogynecol. J. 22 (4), 385–393.
Kegel, A.H., 1948. Progressive resistance exercises in the functional restoration of the perineal muscles. Am. J. Obstet. Gynecol. 56 (2), 238–248.
Kim, S., Oh, D.W., Choi, J.D., 2010. Correlation between the severity of female urinary incontinence and concomitant morbidities: a multik-center cross-sectional clinical study. Int. Neurourol. J. 14 (4), 220–226.
Koes, B., van Tulder, M., Lin, C., Macedo, L., McAuley, J., Maher, C., 2010. An updated overview of clinical guidelines for the management of non-specific low back pain in primary care. Eur. Spine J. 19 (12), 2075–2094.
Laycock, J., Crothers, E., Naylor, D., Frank, M., Garside, S., 2001. Clinical Guidelines for the Physiotherapist Management of Females Aged 16 to 65 with Stress Urinary Incontinence. Chartered Society of Physiotherapy, London.
Lee, D., Lee, L.J., 2004. Stress urinary incontinence – consequence of failed load transfer through the pelvis? In: Presentation. World Conference on Low Back Pain and Pelvic Pain. Melbourne Australia.
Loving, S., Thomsen, T., Jaszczal, P., Nordling, J., 2014. Pelvic floor muscle dysfunction are prevalent in pelvic pain: a cross-sectional populational-based study. Eur. J. Pain 18, 1259–1270.
Messelink, B., Benson, T., Berghmans, B., Bø, K., Corcos, J., Fowler, C., Laycock, J., Lim, P.H.-C., van Lunsen, R., Nijeholt, G.L., Pemberton, J., Wang, A., Watier, A., Van Kerrebroeck, P., 2005. Standardization of terminology of pelvic floor muscle function and dysfunction: report from the pelvic floor clinical assessment group of the International Continence Society. Neurourol. Urodyn. 24, 374–380.
Mitchell, D., Esler, D.M., 2009. Pelvic instability – painful pelvic girdle in pregnancy. Aust. Fam. Phys. 38 (6), 409–410.
Montenegro, M.L.L.D.S., Mateus-Vasconcelos, E.C.L., Rosa e Silva, J.C., Nogueira, A.A., Dos Reis, F.J.C., Poli Neto, O.B., 2010. Importance of pelvic muscle tenderness evaluation in women with chronic pelvic pain. Pain Med. 11, 224–228.

Neville, C., Fitzgerald, C., Mallinson, T., Badillo, S., Hynes, C., Tu, F., 2012. A preliminary report of musculoskeletal dysfunction in female chronic pelvic pain: a blinded study of examination findings. J. Bodyw. Mov. Ther. 16 (1), 50–56.
Patore, E.A., Katzman, W.B., 2012. Myofascial pelvic pain in the female patient with chronic pelvic pain. J. Obstet. Gynecol. Neonatal. Nurs. 41 (5), 680–691.
Price, N., Daywood, R., Jackson, S., 2010. Pelvic floor exercises for urinary incontinence: a systematic literature review. Maturitas 67 (4), 309–315.
Quartana, P., Campbell, C., Edwards, R., 2009. Pain catastrophizing: a critical review. Expert Rev. Neurother. 9 (5), 745–758.
Radebold, A., Cholewicki, J., Panjabi, M., Patel, T., 2000. Muscle response pattern to sudden trunk loading in healthy individuals and in patients with low back pain. Spine 25 (8), 947–954.
Richardson, C., Hodges, P., 1999. Therapeutic Exercise for Spinal Segmental Stabilization in Low Back Pain. Edinburgh Churchill Livingston, pp. 134.
Sapsford, R., 2004. Rehabilitation of the pelvic floor muscles utilizing trunk stabilization. Man. Ther. 9 (1), 3–12.
Sapsford, R.R., Hodges, P.W., Richardson, C.A., Cooper, D.H., Markwell, S.J., Jull, G.A., 2009. Co-activaion of the abdominal and pelvic floor muscles during voluntary exercises. Neurourol. Urodyn. 20, 31–42.
Shagam, J.Y., 2006. Pelvic organ prolapse. Radiol. Technol. 7 (5), 389–403.
Slieker-ten Hove, M., Pool-Goudzwaard, A., Eijkemans, M., Steegers-Theunissen, R., Burger, C., Vierhout, M., 2009. Face validity and reliability of the first digital assessment scheme of pelvic floor muscle function conform the new standardized terminology of the international continence society. Neurourol. Urodyn. 28, 295–300.
Smith, M.D., Russell, A., Hodges, P.W., 2006. Disorders of breathing and continence have a stronger association with back pain than obesity and physical activity. Aust. J. Physiother. 52 (1), 11–16.
Tu, F.F., Fitzgerald, C.M., Kuiken, T., Farrell, T., Harden, R.N., 2008. Vaginal pressure-pain thresholds: initial validation and reliability assess- ment in healthy women. Clin. J. Pain 24, 45–50.
Van Wingerden, 2013. Pelvic Floor Complaints, Gynaecologic Problem, Orthopaedic Problem or Both? Presentation. Spine & Joint Centre, The Netherlands.
Vleeming, A., Albert, H., Östgaard, H., Sturesson, B., Stuge, B., 2008. European guidelines for the diagnosis and treatment of pelvic girdle pain. Eur. Spine J. 17 (6), 794–819.
von Elm, E., Altman, D.G., Egger, M., et al., 2008. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J. Clin. Epidemiol. 61, 344–349.
Vos, T., Barber, R.M., Bell, B., Bertozzi-Vill, A., et al., 2015. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. The Lancet 386 (9995), 743–800.