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Pelvic health physiotherapy for the management of pelvic floor dysfunction in the recreationally active female

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Abstract
This paper discusses the management of pelvic floor dysfunction (PFD) in an active female patient. Pelvic health physiotherapy is a relatively new specialty in some countries, and many healthcare systems only prescribe pelvic floor muscle (PFM) exercises for the treatment of this condition. The importance of a holistic approach to the management of PFD in physically active women is addressed. A biopsychosocial perspective is needed for the assessment and treatment of these individuals. If this is integrated with an understanding of musculoskeletal dysfunction and sports medicine, the physiotherapist can improve their female patients' pelvic health, and individual fitness and sporting performance. "Silent" symptoms (e.g. incontinence and pelvic heaviness) are a major challenge in the management of PFD because women can be too embarrassed to discuss these outside the clinic. The physiotherapist's role must extend beyond the assessment of the pelvis and the PFMs, and a variety of skills are required to treat PFD throughout the course of a woman's life.

Keywords: active female, pelvic floor dysfunction, pelvic floor muscles, physiotherapy.

Introduction

The pelvic floor muscles (PFMs) are part of the neuromyofascial system. As defined by Lee *et al.* (2008), these form a functional unit, and work in conjunction with other muscles in the hip, pelvis and thorax in order to meet the different demands of specific tasks. The functions of the PFMs have been extensively explored. As well as maintaining continence and supporting the pelvic organs, these muscles play an important role in posture, respiration, sexual activity and preparation to undertake an action (e.g. breathing, coughing, and arm, lower extremity and trunk movements) (Nygaard *et al.* 1996; Ashton-Miller & DeLancey 2007; Hodges *et al.* 2007; Sapsford *et al.* 2008; Capson *et al.* 2011; Talasz *et al.* 2011; Park & Han 2015; Zhoolideh *et al.* 2017). These responses are automatic, and human beings go through their lives without consciously activating their PFMs or initiating these muscles for support when talking, singing or swinging a tennis racket, for example. Therefore, following an injury or other form of dysfunction, treatment should ensure that PFM function returns to being an automatic, reflexive and involuntary response.

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Pelvic floor dysfunction and its prevalence

Pelvic floor dysfunction includes a range of conditions, such as: bladder and bowel incontinence; pelvic organ prolapse (POP); altered sensory function and emptying abnormalities; sexual dysfunction; and bladder pain. Physiotherapy can restore the strength and functionality of the PFMs. However, although rehabilitation of the PFM complex has been reported to be effective (Abrams *et al.* 2017), the prevalence of PFD is increasing (Wu *et al.* 2009), and urinary incontinence (UI) is the most prevalent symptom in the female population. This may be related to multiple factors, such as: the female life cycle from childhood and adolescence to the ante- and postnatal, perimenopausal, menopausal and ageing phases of life; anthropological development; and lifestyle. Professional and recreational female athletes are almost equally affected by PFD, and the condition has an impact on physical activity and quality of life (Forsyth & Roberts 2019). Interestingly, if the number of people affected by UI worldwide were represented as a country, this would be the third largest in the world, and only slightly smaller than the population of the USA. Therefore, although the present paper primarily focuses on an active female with UI, the author recognizes that this is just one symptom of PFD, and that many women may experience two or more symptoms at the same time.

Pelvic floor dysfunction and the active female

Almeida *et al.* (2016) found a high prevalence of PFD in female athletes competing in high-impact sports, and this was noted to be equally great in women participating in sports involving the exertion of high intra-abdominal pressure (IAP), such as swimming, judo and cross-country skiing (Almeida *et al.* 2016; Pires *et al.* 2020; Poli de Araújo *et al.* 2020). It is understood that there is a link between IAP and UI regardless of impact. Pires *et al.* (2020) found that UI is more prevalent in female cross-country skiers than those doing CrossFit training, in which high-impact, intensity and overall load are continuous variables. The above authors also found that female runners are more vulnerable to UI than CrossFit athletes when they compared task variability between these two high-impact sports. Furthermore, a cross-sectional online survey by Forner *et al.* (2021) showed that the incidence of POP and anal incontinence was significantly higher in female runners than female CrossFit athletes, but no significant difference was found in terms of the prevalence of stress UI (SUI) between these groups. When comparing how the participants had given birth, the above authors reported a significantly higher incidence of PFD (i.e. POP, UI and anal incontinence) in female runners who had experienced vaginal deliveries. This raises the question of whether there is a case for ranking sporting activities in terms of the impact that these have on the pelvic floor. Would defining the right amount of load for an individual female body and the PFM complex be more helpful?

Pelvic floor muscle activity during running and jumping

It has been argued that involuntary activity of the PFMs generally requires fast reflexive responses (Deffieux *et al.* 2008). This raises the question of whether the voluntary contractions performed as part of rehabilitation are fast enough to provoke the optimal training stimuli for managing load and forces in running (Leitner *et al.* 2017) or jumping (McBride *et al.* 2008; Moser *et al.* 2018). Reflexive activity occurs before and after contact with the ground in both running and jumping (McBride *et al.* 2008; Leitner *et al.* 2017), and the PFMs are recalibrated in subsequent repetitive movements.

Dias *et al.* (2017) further analysed this in a computational modelling study of a healthy nulliparous young female. They observed two peaks of IAP in drop jumps from a 30-cm box, which is higher than the Valsava manoeuvre. Also noted were compression of the bladder against the decelerating pubic bone when leaning forward and a bladder bounce-back effect as a result of elastic recoil energy. The anatomical structures inside the pelvis differ in shape, weight and consistency, and therefore, the velocities of these body parts will vary during impact. In repetitive tasks such as running and jumping, such structures may have asynchronized velocities and internal interactions that may cause deformation of the PFMs. Arguably, such interactions could be modified to decrease any potential distortion of the PFMs, but it is hard to determine the cause(s) of the symptoms without real-time assessment (e.g. in a gym, or on a sports ground or court).

Furthermore, Koenig *et al.* (2021) explored the effectiveness of PFM training (PFMT) by adding reflexive strength training to standard PFM exercises, and found no evidence to support that approach. Scientifically, all studies of the PFMs focus on the effectiveness of PFMT and primarily explore variables in its parameters, but in clinical practice, we see that rehabilitation extends beyond this.

Is there a link between the pelvic floor muscles and the “springs”?

The PFMs have a complex task to perform when absorbing the functional load in training, especially during high-impact sports and activities that induce higher IAP. Sitting at the base of the pelvis, these interact with many other muscles and structures that may be able to assist in the management of load absorption. Depending on the task, the PFMs need to generate the right amount of stiffness or flexibility. If the response is too strong, this creates a harder impact and decreased bounce. If it is too elastic, the pelvic floor may fail to be a supportive structure. However, the PFMs may not be the only tissues involved in load management and the effective maintenance of continence.

If one imagines the pelvic floor complex as a trampoline, then the PFMs would be a jumping mat attached to its frame (i.e. the pelvis) by different muscles, and ligamentous or fascial attachments (i.e. the springs). Each "spring" produces equal tension to support the PFMs during activity. If a spring produces too much rigidity or not enough tension, the distribution of load is affected, especially if one or two springs are broken. Following uncomplicated spontaneous vaginal deliveries, up to 36% of the PFMs may sustain damage to the muscle fibres, and this problem mostly affects the pubococcygeus muscle (Bø *et al.* 2016). Birth can also: lower the position of the bladder neck and perineum; increase bladder neck mobility; reduce PFM strength and endurance; and result in denervation, which affects 80% of women (Bø *et al.* 2016). The latter injury will affect the ability of the pelvic floor complex to respond effectively to tasks during postpartum recovery, which may take a full 12 months (Fig. 1), especially if there is irreversible ligamentous and/or fascia strain or a rupture.

It is equally important to consider the impact of the menopause and ageing on the pelvic floor complex. For example, a loss of ligamentous pliability and hormonal changes may negatively impact the required tension and support provided by the base of the pelvis.

It should also be noted that there are both direct and indirect links between the PFMs and other parts of the body, and these are made via anatomical continuity structures and myofascial slings. For example, while some muscles (e.g. the obturator internus and piriformis) are directly connected to the PFMs, others (e.g. the rectus abdominis and hip adductors) share attachment points, and a number are connected via myofascial slings to the diaphragm, internal obliques, gluteals and latissimus dorsi (Palastanga *et al.* 2011).

Is it important to consider other structures when women present with PFD? Is there a functional link between the hip, thorax and the PFMs? Could these connections have an influence on PFM performance?

Hip influencing factors

It has been suggested that certain hip muscles and motor control may play a role in the ability of the PFMs to manage load absorption. Although the evidence for including hip-strengthening exercises in PFMT has been inconclusive to date (Hay-Smith *et al.* 2011), some studies have drawn attention to the musculoskeletal and biomechanical differences observed in women with UI (Hartigan *et al.* 2020; Marques *et al.* 2020).

In a cross-sectional study of young and healthy women, Amorim *et al.* (2017) found that adding isometric hip adduction or abduction strengthening does not improve PFM strength and endurance. Similar findings were reported in another cross-sectional study by Kruger *et al.* (2019), who reported that co-contractions of the PFMs during the contraction of other hip-related muscles did not elicit a training effect. However, in a randomized controlled trial, Tuttle *et al.* (2016) found that there is some indication that strengthening of the obturator internus three times a week for 12 weeks could improve PFM strength. Interestingly, all three of the above

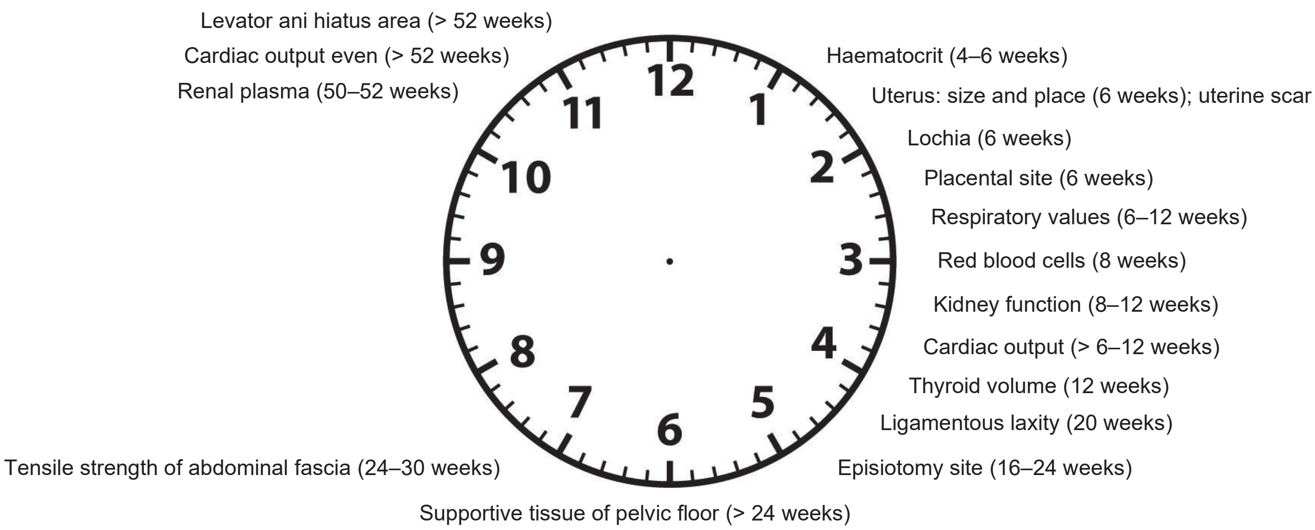

Figure 1. Postpartum recovery over 12 months.

studies included only asymptomatic women; two included nulliparous participants (Tuttle *et al.* 2016; Amorim *et al.* 2017), and one included parous but asymptomatic women (Kruger *et al.* 2019). Furthermore, all three studies used muscle strength or vaginal pressure measured in supine as an outcome measure, but failed to use functional tests. Therefore, the populations studied might be representative of women who already have a well-coordinated and functionally supportive pelvic floor complex.

However, in a randomized controlled trial of women with SUI, Marques *et al.* (2020) reported a decrease in daily UI when twice-weekly hip strengthening was added to PFMT for 10 weeks. Interestingly, there was no improvement in individual muscle strength or quality of life, as measured using the International Consultation on Incontinence Questionnaire – Urinary Incontinence – Short Form and King's Health Questionnaire.

Hartigan *et al.* (2020) described a unique biomechanical difference in their study of women with and without self-reported SUI. Participants with SUI demonstrated altered hip biomechanics and a difference in gait biomechanics in comparison to those who were asymptomatic. Women with SUI demonstrated less hip abduction and external rotation strength bilaterally, and the non-dominant hip also exhibited greater adduction and internal rotation during weight-bearing. Internal rotation angles were maintained during mid-stance. Similarly, Foster *et al.* (2021) found that there was no difference in PFM strength or endurance in women suffering from urge UI with or without frequency, but they noted significant external rotator and abductor weakness in symptomatic women.

Impaired strength and motor control in the hip and pelvis must be taken into account when considering the management of PFD. These biomechanical differences may explain why PFM functional load absorption places a greater demand on the midline, and subsequently, deforms its function. This could occur even prior to the development of the symptoms of PFD.

Thorax influencing factors

Like the structures of the hip, many thorax muscles work in synergy with the PFMs. Some share an attachment point at the symphysis pubis (e.g. the external oblique and rectus abdominis muscles), and some connect via aponeuroses (e.g. the transversus abdominis and diaphragm).

The coordinated action of the transversus abdominis and diaphragm, and the influence that these muscles have on PFM function in continent and incontinent women has attracted the attention of researchers and clinicians alike. Smith *et al.* (2007) postulated that continent women probably do not require greater PFM activation to accomplish a task because these muscles work in a balanced and efficient way. This would explain why they found that women with incontinence had increased PFM and external oblique activation in comparison with those who were continent (Vesentini *et al.* 2019).

A systematic review by Bø *et al.* (2009) found insufficient evidence to support transversus abdominus training alone or in co-activation with the PFMs as a treatment for female UI. However, a more recent literature review by Kennaway & Carus (2020) highlighted the methodological heterogeneity of previous studies, and they concluded that integrating the transversus abdominus in PFM rehabilitation may be beneficial in the treatment of women with SUI. Likewise, an increase in PFM activity has been measured following PFM and abdominal training in women with SUI (Kucukkaya & Kahyaoglu 2021).

Although there is an anatomical link and indications that the synchronized work of the primary myofascial slings of the abdominal wall may play an important role in continence, Smith *et al.* (2007) reported that the superficial abdominal muscles also influence PFM function. In a cross-sectional study, dos Santos *et al.* (2019) found that nulliparous athletes with incontinence, as measured by pad test, had greater abdominal strength than those who were continent. Studies by Moser *et al.* (2017) and dos Santos *et al.* (2019) suggested that the timing of PFM activity with the muscles of the abdominal wall may be essential to maintaining continence and managing load. These findings were confirmed in a systematic review and meta-analysis of the PFMs and abdominal co-contraction by Vesentini *et al.* (2019), who concluded that symptomatic and asymptomatic women display different patterns of abdominal activation. Asymptomatic women showed higher levels of co-activation of the transversus abdominis and the PFMs, while those who were symptomatic showed stronger co-activity of the rectus abdominis, and internal and external oblique muscles. Stronger and faster activation of the abdominal muscles in response to PFM activation could raise IAP, and thus, increase the load on an already insufficient perineal response (Vesentini *et al.* 2019). Therefore, when treating women with PFD, there is a need to look beyond the PFM complex.

Pelvic floor muscle training: evidence-based practice

Pelvic floor muscle training is the first-line treatment for UI (Abrams *et al.* 2017; Dumoulin *et al.* 2018; NICE 2019) and POP (Hagen & Stark 2011), and even when compared to other methods, it is a superior approach in the management of PFD (Hay-Smith *et al.* 2011). However, in daily clinical practice, the treatment of PFD in physically active women extends beyond the specialty of pelvic health *per se*. For example, if a woman presents with SUI, but only experiences this during high-impact exercise, and demonstrates unremarkable PFM integrity, strength and function on digital internal examination, then treatment will involve more than just PFMT. Musculoskeletal assessment may reveal trunk and/or leg motor control weaknesses, which are also crucial to address in the management of PFD. Furthermore, a lack of load distribution through the pelvis in movements such as single-leg squats and hopping may be detected. Although the supporting evidence is sparse, motor control and strength training should be integrated with PFMT where indicated, and it is particularly necessary to do so in an active women, such as competitive and recreational athletes.

Pelvic floor muscle loading strategy: an example

A mother of three children aged 5 months, and 2 and 4 years presented with symptoms of SUI, and a feeling of heaviness after 15 min of running. She trained at least three times a week. Before her last pregnancy, the subject had been running an average of 25 km a week. On digital vaginal examination, she scored 3/5 on the Modified Oxford Scale, and exhibited poor coordination and timing. Musculoskeletal and functional assessment revealed that: her ribcage had an anteroposterior tilt and oblique abdominal dominance; there was tightness in her hip adductors and piriformis; and her hip extensors and external rotators were weak. Her goal was to complete a half-marathon in 3 months' time.

Treatment consisted of a PFM down-training and strengthening programme that included changing patterns of neuromotor control, especially during single-leg tasks. Further analysis of the subject's route, running style and the time when her symptoms manifested was scheduled "in the field", i.e. the present author (B.K.) ran with her. She was advised to continue running the same route, which was mainly flat, within the symptom-free timeframe, and to keep a diary of her symptoms. After 2 weeks, her diary indicated that 15 min was a safe amount of time to run (i.e. a safe load) because she never experienced symptoms up to this point, but these would then manifest between 16 and 20 min. It was concluded from these findings that her maximum PFM load for running was 20 min. Therefore, rehabilitation with the safe load was started on every third day, followed by a moderate speed walk for another 15 min. The subject's training schedule accommodated different parts of her rehabilitation (Table 1), and this helped her to understand that she would have to adjust the timeframe she would need to allow in order to complete a half-marathon. She was able to incorporate plyometric exercises to maximize muscle power and reflexive training of the PFMs soon after. This stage allowed her running load to be gradually increased. It is important to note that the subject performed PFMT every day, and this was gradually incorporated into the functional training in her schedule.

Table 1. Weekly rehabilitation and training schedule

Day of the week	Activity
Monday	Run (15 min)
Tuesday	Plyometrics
Wednesday	Stretch flow and plyometrics
Thursday	Run (15 min)
Friday	Stretch flow and plyometrics
Saturday	Rest day
Sunday	Run (15 min)

Integrating pelvic health, musculoskeletal and sports skills was necessary to ensure that the subject was able to return to running postpartum. She was able to achieve symptom-free completion of a half-marathon, and beat her previous personal best time.

The fear factor

In another example, a patient presented with a year's history of SUI when running. She had repeatedly experienced symptoms about halfway through her regular 8-km run, but had ignored these until now. The subject wore a pad every time she ran and also during her physiotherapy sessions. Over a period of rehabilitation that included plyometrics, the pads remained dry. However, when she was asked to run 2 km without a pad (which was well within her safe, symptom-free distance), she was overwhelmed by a fear of leaking. Her limbic system responded, and there was an observable increase in her respiratory rate with an apical breathing pattern and abdominal gripping. With such an immediate intrinsic response, the risk of experiencing SUI was thought to be higher since this had an effect on several biomechanical properties, such as: a reduced diaphragmatic range of movement that affects the PFMs in turn; and abdominal gripping and guarding of the chest expansion that creates more trunk rigidity and a possible increase in IAP.

As the session went on, the subject reflected on her progress in terms of managing her fear, and her perceptions of leaking and even wetness. This subsequently enabled her to run without a pad.

The human brain continuously processes information. It not only calculates the amount of PFM contraction required for each task, but also processes a myriad of other things; for example, past experience, our current environment, and factors that intrinsically and extrinsically influence our present performance. These are significant elements in identifying readiness for a task or making a progression.

Intrinsic and extrinsic influencing factors

Sports medicine emphasizes the need for a more individualized and holistic approach to the rehabilitation and coaching of recreational and competitive athletes (Gabbett *et al.* 2017; Vanrenterghem *et al.* 2017; O'Sullivan *et al.* 2018; Gabbett 2020). Similarly, in the field of pelvic health, Moore *et al.* (2021) and Donnelly *et al.* (2022) highlighted the importance of a whole-body biopsychosocial approach to facilitating a return to running postpartum. Classification of the biopsychosocial factors involved varies in the literature, but these are generally the same aspects that must be understood and included in the rehabilitation and training of an active individual.

Vanrenterghem *et al.* (2017) defined extrinsic factors as biomechanical and psychological responses (Fig. 2), including general health and fatigue level (fitness fatigue being a mix of physiological and biomechanical factors) (Fig. 3). They also defined further internal and external biomechanical loads. For example, external biomechanical loads could refer to speed or ground reaction forces, while the internal ones could describe joint and muscle load, perceived tissue damage, and perceived effort (i.e. the rating of perceived exertion). Physiological factors that include endocrinology and age-related changes are very important to consider when treating women, especially because those internal and external loads change throughout the female lifetime. External physiological loads refers to such factors as distance and speed threshold, while internal loads describe oxygen uptake and cardiovascular demand.

External influencing factors could equally affect exercise performance in both female recreational and competitive athletes. When considering lifestyle and socioeconomic factors, as well as potential professional pressures or challenges, travel, sleep, nutrition and family dynamics will help a clinician to estimate their patient's ability to respond to a particular load, even when referring to the structure of the PFMs (Kennaway 2020). Therefore, when the structures are ready

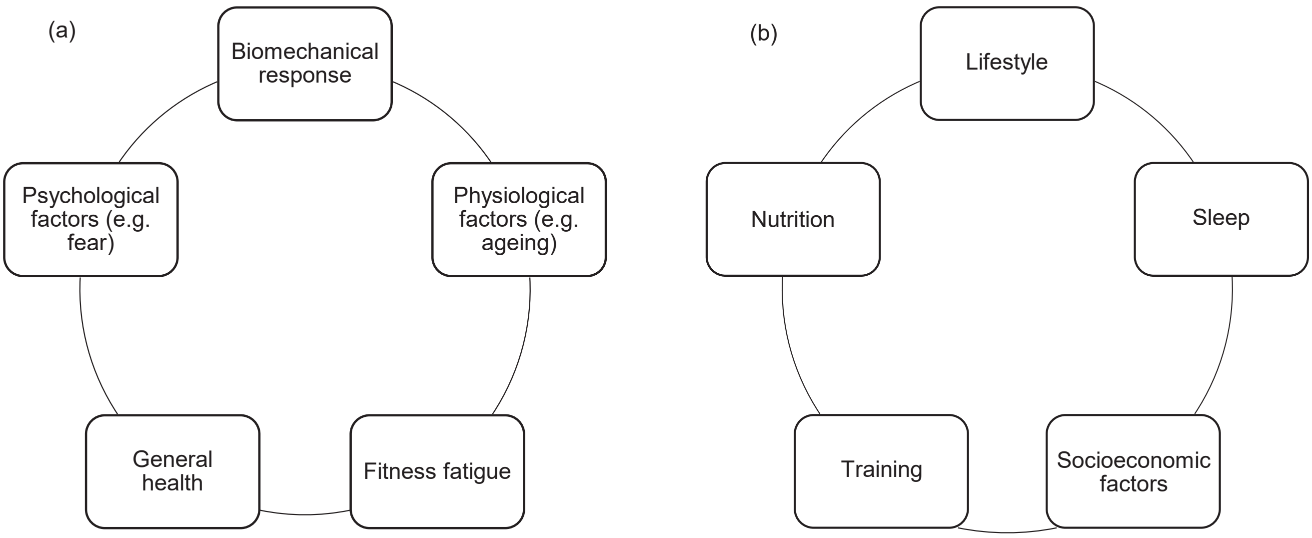

Figure 2. (a) Intrinsic and (b) extrinsic influencing factors (adapted from Vanrenterghem *et al.* 2017).

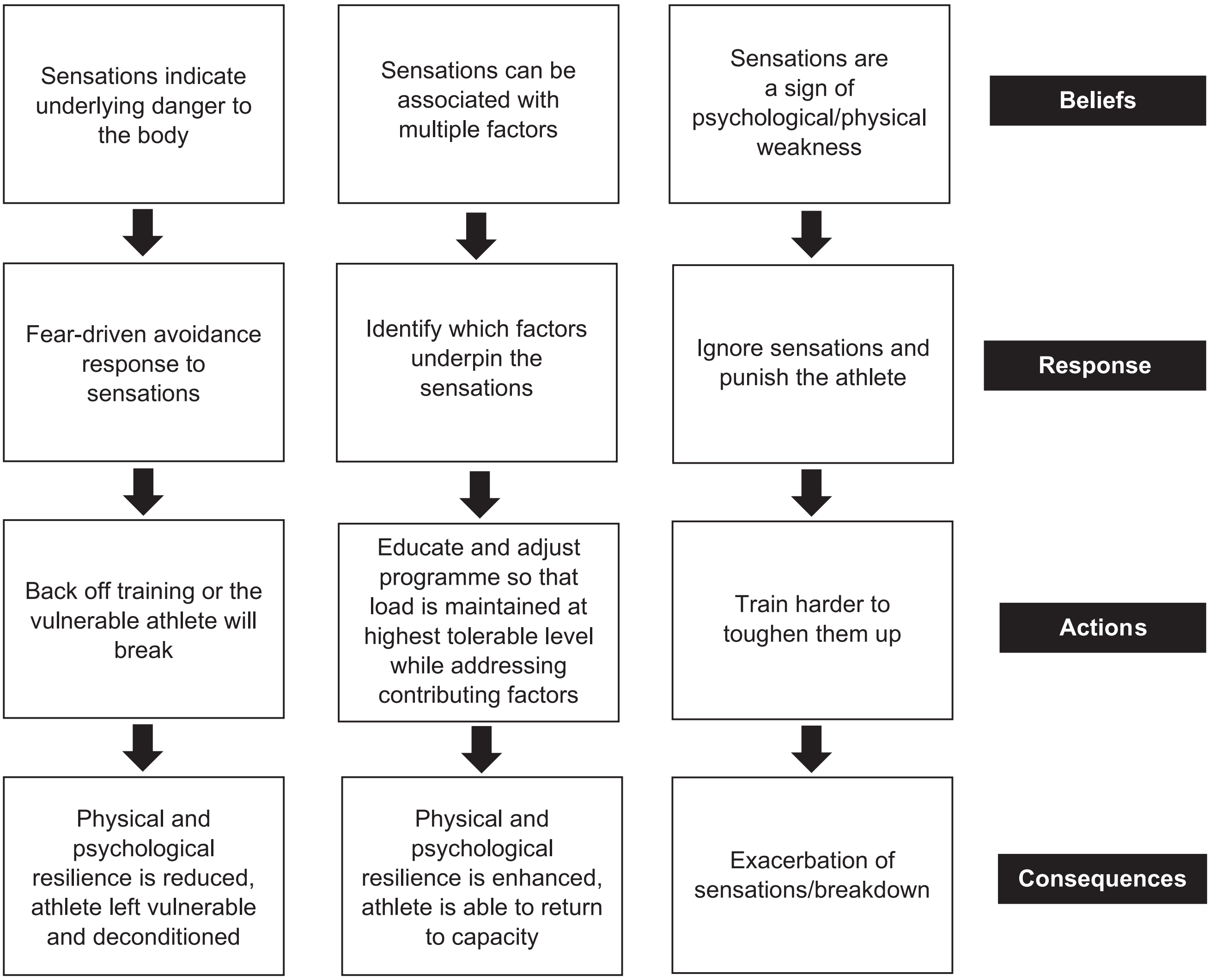

Figure 3. Parallels between the interpretation of pain and fatigue (Kennaway 2020, p. 94, Fig. 6; adapted with permission from O'Sullivan *et al.* 2018, p. 555, Fig. 1).

to load, that does not only refer to an exercise parameter; for example, it could be changing the time of the day for exercise or changing jobs. For an active woman suffering from the symptoms of PFD, this may refer to the multiple changes occurring at their specific time of life.

It is also important to acknowledge that chronic load differs between individuals (Kennaway 2020). For example, a recreational CrossFit athlete who was 29 weeks pregnant demonstrated greater endurance and technical skills when performing modified burpees (i.e. press-ups over a box omitting jumps) than a non-pregnant recreational athlete who was relatively new to this form of training: their chronic loads, and bodies' intrinsic and extrinsic factors were different. Every active woman is an individual, and all aspects of the female lifetime experience should be included in practitioners' analyses.

Finally, where possible, assessments need to extend beyond the clinic when the symptoms of an active female are related to exercise. Observation and management "in the field" allows clinicians to identify the presence and interaction of intrinsic and extrinsic influencing factors, and also to connect with other colleagues in a team (e.g. sports physiotherapists, coaches and families).

Conclusion

Treatment of the physically active female with PFD extends beyond PFM assessment, and conservative management and training. Careful consideration of the internal and external influencing factors in the load management of the PFMs is an important part of pelvic health rehabilitation. Strength and conditioning, plyometric, and endurance exercises are also necessary components of managing an active female. Furthermore, where necessary, we should form partnerships with colleagues in the field of sports medicine. Management of the female athlete with PFD should also extend to her training environment because clinic space can limit both the patient's presentation and performance, and also the clinician's holistic, biopsychosocial approach.

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