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Review

The Pelvic Floor and Posture: Exploring the Foundations of Functional Balance

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Abstract

Pelvic floor muscles (PFMs) play a crucial role in the support of pelvic organs, the maintenance of continence, and the preservation of postural stability. The functions of the pelvic floor (PF) extend beyond localized muscular activity; they are intrinsically linked to postural control and respiration dynamics. This complex and integrated relationship can be elucidated through neuromuscular interactions, which significantly influence spinal alignment and pelvic positioning. Pelvic floor dysfunction (PFD) may result in postural deviation, diminished spinal stability, and the onset of chronic pain syndromes. This review critically explores the effects of pelvic floor musculature on posture and examines the bidirectional interactions between these systems. Additionally, the clinical implications of the PF–posture relationship are discussed in the context of physiotherapy and rehabilitation approaches. In this regard, emerging evidence underscores the efficacy of exercise programs targeting the pelvic floor to improve postural control and spinal stability. Ultimately, a more comprehensive understanding of the interplay between the pelvic floor and posture may pave the way for innovative, integrative approaches for the prevention and management of PFDs. In this regard, interdisciplinary research and clinical practice will contribute significantly to advancing our understanding of the PF–posture nexus. This review synthesizes a range of perspectives to provide a thorough evaluation of the complex relationship between PF and posture.

Keywords: Pelvic floor, postural stability, postural balance, postural instability, rehabilitation.

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The pelvic floor is a complex system composed of muscles, ligaments, and fascia that supports intrapelvic structures such as the bladder, reproductive organs, and rectum. This structure acts as a sling, ensuring the positioning of pelvic organs and supporting functional stability. The PF originates from the ilium, ischium, and pubic bones, merging posteriorly with the sacrum to form a supportive framework. Active support is achieved through continuous muscle contraction, while passive support from surrounding connective tissues and fascia adds further stability.

The pelvic region contains a complex neural network. This nervous system has a bilateral structure, transmitting information both from the periphery to the central nervous system (CNS) and from the CNS to the periphery. Motor fibers are divided into two main groups: somatic fibers and autonomic fibers. The autonomic nerves consist of two primary components: sympathetic nerves (originating from the spinal nerves between T1 and L2) and parasympathetic nerves (originating from the spinal nerves between S2 and S5). The pudendal nerve is the main nerve of the

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perineum, providing sensory innervation to the external genital organs, anus, and perineal region, as well as motor innervation to the pelvic muscles, including the external anal and urethral sphincters. The pudendal nerve remains tightly anchored to the surrounding tissues along its course, which makes the nerve susceptible to damage due to factors such as compression, entrapment, and tension in the surrounding tissues.[1] This can result in nerve injury caused by conditions like PFD, pelvic organ prolapse, and vaginal delivery, leading to stretching of the pudendal nerve and subsequent pain. As a result, pudendal neuralgia may develop, causing neuropathic pain. Due to the heightened sensitivity in this region, even mild touch can trigger pain, and the pain response may be exacerbated in the presence of painful stimuli. Depending on the severity of the damage to the pudendal nerve, partial or complete urinary and/or fecal incontinence, along with muscle function loss, may be observed in some cases.[2]

When intra-abdominal pressure increases, the PFMs reflexively contract upward to counterbalance this pressure increase. The active and passive support mechanisms of the pelvic floor not only maintain the positioning of pelvic organs but also play a critical role in postural control and spinal stability. Postural alignment is directly linked to the functional capacity of the PF; optimal posture supports the proper alignment and effective function of the PF, whereas poor posture may lead to insufficient contraction or overloading of the PFMs. Notably, the synchronized functioning of PFMs, abdominal muscles, and the diaphragm during breathing and core stabilization supports both postural balance and pelvic stability.[3]

Electromyography (EMG)-based studies reveal that PFM activity is influenced by body position, indicating a significant relationship between posture and PF function. The highest PFM activity is observed in the standing position, while the lowest activity is reported in the supine position with bent knees. There is a strong synergistic relationship between the PFMs and abdominal muscles; abdominal muscle activation, particularly in standing positions, enhances PFM activity. However, when the anterior abdominal wall is relaxed, a notable reduction in PFM activity occurs. This finding underscores the critical role of proper posture and abdominal muscle tone in maintaining optimal PF tension.[4]

The coordinated activity of PFMs with the abdominal muscles and diaphragm is essential not only for maintaining continence but also for ensuring spinal stability. The co-activation of the transversus abdominis (TrA) muscle with the diaphragm, PFMs, and other spinal stabilizer muscles is recognized as a key factor in lumbar spine stabilization. Research has demonstrated that specific abdominal muscle movements activate the PFMs. These findings highlight the relationship between abdominal muscle activation and PFM activity while emphasizing the importance of proper posture in supporting pelvic floor functions. Ensuring optimal PFM activity, particularly in functional postures such as the standing position, is crucial for maintaining spinal stability and achieving pelvic region rehabilitation goals.[5]

Therefore, rehabilitation programs should assess the PF not only in the context of pelvic organ function but also as an integrated system with postural control and body biomechanics. This review aims to explore the relationship between PFM functions and posture from various perspectives, compiling the existing literature on the subject. Furthermore, understanding the interactions between posture and PFMs aims to contribute to the development of new approaches for the prevention and management of pelvic floor disorders (PFDs). In this context, different therapeutic methods and approaches will be comprehensively evaluated, and clinical recommendations will be provided.

Materials and Methods

This traditional review was conducted to examine the components of the relationship between the pelvic floor and posture. In this study, the PubMed, Google Scholar, Wiley, and Springer Nature databases were searched. The analysis included randomized controlled trials and clinical studies. The inclusion criteria for the studies were based on keywords such as "pelvic floor," "relationship between pelvic floor and posture," "postural stability and instability conditions," and "studies involving postural control." A search was conducted using these keywords for randomized controlled trials and clinical studies published between 2020 and 2025. Exclusion criteria for the study involved articles unrelated to the topic, studies that did not establish a direct relationship with pelvic floor muscles, studies focusing solely on posture or spinal stability without addressing pelvic floor functions, and studies involving children. Out of 640 studies, 10 met the inclusion criteria.

Co-activation Relationship between Pelvic Floor and Abdominal Muscles

The pelvic floor muscles are one of the key components of the core structure that supports pelvic and abdominal organs and play a significant role in stabilizing body posture. While the PFMs form the lower base of the core system, the diaphragm constitutes the upper base, the abdominal muscles provide anterior support, and the gluteal and paraspinal muscles ensure posterior stability. The harmonious interaction of these structures is critical for both functional movements and postural stability. Research has shown that abdominal muscles undergo co-contraction during PFM activation, and this synergistic relationship is directly linked to postural control. Studies conducted on healthy individuals have demonstrated that PFMs co-activate in conjunction with the activation of abdominal muscles. This synergy aids in regulating intra-abdominal pressure, thereby supporting pelvic and spinal stability.[6]

Furthermore, studies have indicated that the PFMs cannot contract effectively without the activation of the TrA and internal oblique (IO) muscles. This finding underscores the importance of the combined action of the PF and abdominal muscles, particularly during standing, walking, and other postural activities.[7] The TrA is located in the deepest layer of the abdominal region and is also known as the "deep abdominal muscle." It plays a crucial role in increasing spinal stability. The timing of TrA contraction is particularly critical for maintaining postural control. The TrA muscle typically activates before the body begins to move, which refers to a "pre-emptive" contraction aimed at ensuring stability before the movement.[8] The timing of TrA contraction improves coordination between the upper and lower parts of the body, and its activation can help prevent issues such as low back pain by reducing the stress placed on the spine.[9]

The IO muscles, similar to the TrA, are located in the deep layers of the abdominal region and contribute to rotational movements as well as flexion and lateral flexion. The contraction of the IO muscle generally occurs in synchronization with that of the TrA. The coordination and timing of IO contraction are particularly important for dynamic postural control and supporting stability during rotational movements.[10–12] Early activation of the TrA increases spinal stability, while the contraction of the IO particularly supports dynamic postural control and rotational movements. The correct timing and synchronized action of these two muscles have emerged as a significant rehabilitation strategy for individuals with back pain and lumbar issues.[8,10]

The synergistic relationship between the PFMs and abdominal muscles also provides an effective mechanism for maintaining postural stability. Postural dysfunction or poor muscle coordination can adversely affect PFM functions. Therefore, in PF rehabilitation, focusing not only on muscle strength but also on postural control and the integration of abdominal muscles into rehabilitation programs may offer an effective approach for preventing and managing dysfunctions.

Pelvic Floor – Lumbopelvic Region Relationship

The pelvic floor muscles and paraspinal muscles provide support to the lumbar spine, enabling an upright posture. Both muscle groups must work in coordination to maintain stability. While PFM activation supports the pelvis in a neutral position, the paraspinal muscles contribute to balancing spinal curvatures. This interaction plays a critical role in maintaining the body's center of gravity during postural activities such as standing, sitting, or walking.[13]

Dysfunction of the PFMs can lead to misalignment of the pelvis, resulting in increased or decreased lumbar lordosis. This condition may cause asymmetric overloading or inadequate activation of the paraspinal muscles, thereby contributing to the development of postural disorders. Conversely, weakness or asymmetry in the paraspinal muscles can negatively affect the supportive function of the PF, potentially leading to pelvic region dysfunctions.[14]

The effects of the PFMs and paraspinal muscles on posture are also associated with pain and movement restrictions. The increased risk of lumbar pain in individuals with PFD underscores the clinical significance of the relationship between these two muscle groups. Therefore, integrating the assessment and improvement of postural control with a focus on both the PF and paraspinal muscles is a key aspect of the rehabilitation process.

The relationship between the PF and paraspinal muscles is essential not only for core stability but also for maintaining a healthy posture. In this context, holistic approaches targeting the coordination of these muscle groups can provide an effective strategy for preventing and managing postural disorders.

Urinary Incontinence

Urinary incontinence (UI), defined as the involuntary loss of urine, is a common health issue that negatively impacts individuals' quality of life, leading to social and psychological constraints. This condition is more prevalent in women and is closely associated with PFM weakness or dysfunction. Urinary incontinence is classified into three main subtypes based on its etiology. Stress urinary incontinence (SUI) is the most common type and is characterized by urine leakage during activities that increase intra-abdominal pressure, such as coughing, sneezing, or physical exertion. Urgency urinary incontinence (UUI) involves a sudden and uncontrollable need to urinate, accompanied by involuntary leakage. Mixed urinary incontinence (MUI) is a combination of both stress and urgency incontinence.[15]

Cochrane reviews and numerous clinical studies have demonstrated the effectiveness of pelvic floor muscle training (PFMT) in the treatment of urinary incontinence, establishing it as the "gold standard" in management. PFMT aims to enhance both muscle strength and neuromuscular control, enabling PFMs to function more powerfully and in a more coordinated manner. This coordination is particularly critical in SUI, where the timing and strength of PFM activation must counterbalance increases in intra-abdominal pressur.[16] The PFMs play a central role in the development and management of incontinence. Anatomically, the PF surrounds and supports the urethra, bladder, vagina, and rectum. The tone and upward contraction capacity of the PFMs contribute to the closure of the urethra and other openings while lifting pelvic organs upward, counteracting the effects of gravity. During situations that increase intra-abdominal pressure, both automatic and voluntary activation of the PFMs maintain urethral closure pressure, preventing urine leakage.[13]

Additionally, the motor control of the PF is closely linked to the coordination between abdominal muscles such as the TrA and IO. Dysfunction in the timing and coordination of these muscles can contribute to weakened bladder control. For instance, it is known that the TrA activates prior to any movement, helping to stabilize the pelvic region and support continence. In contrast, delays or the absence of proper contraction in the TrA and PFMs can impair their functions, thereby increasing the risk of urinary incontinence.[17] Furthermore, motor control rehabilitation aimed at improving the timing and coordination of these muscles has been shown to significantly enhance continence in individuals experiencing UI.[18]

Pelvic floor dysfunction can result from motor control issues such as PFM weakness, delayed activation, or excessive contraction. These issues can contribute to urinary incontinence. Insufficient activation of the muscles may reduce urethral closure pressure, leading to urine leakage, while the inability to adequately balance involuntary bladder contractions can exacerbate symptoms.[19] The functional role of the PFMs extends beyond continence; they also play a significant role in overall pelvic stability. The synergistic relationship between the PFMs and abdominal muscles is essential for maintaining intra-abdominal pressure and pelvic stability. Thus, in the rehabilitation of UI, it is crucial not only to assess and train the PFMs individually but also to address their holistic interactions with abdominal muscles. Multidisciplinary strategies targeting the anatomical and functional characteristics of the PFMs can effectively control urinary incontinence symptoms and improve quality of life.

Rehabilitation Approaches

Conservative methods play a significant role in the treatment of PFD. These include a variety of current, comprehensive techniques such as PF physiotherapy, electrical stimulation, biofeedback, hypopressive exercises, and postural correction therapy. Weaknesses in PFMs caused by risk factors require an effective rehabilitation process. In this process, re-strengthening the PFMs and restoring their functional control are critical. During PF rehabilitation, a holistic approach should be adopted, ensuring that the lumbopelvic region and abdominal muscles are also addressed. Recent studies have demonstrated the impact of PFMs on postural control. This approach aims to maintain posture and optimally support the musculoskeletal system.[20]

Biofeedback has emerged as an effective method in the treatment of urological dysfunctions. It provides patients with analytical feedback regarding the position and contractility of PFMs, offering the opportunity to monitor progress. Especially in cases of instability or enuresis, biofeedback provides functional training that helps patients learn to control their PFMs and maintain this control in daily activities. Passive stimulation during this process triggers proprioceptive sensations, offering feedback about the muscle's position, size, and strength.[20] The contribution of biofeedback to rehabilitation is particularly significant due to its role in enhancing postural muscles, which has led to its increased use in clinical settings.

Electrical stimulation is a practical and successful method that can be applied both in outpatient settings and as part of home-based rehabilitation programs. It is an effective approach to increase neuromuscular activation of PFMs, offering both therapeutic and preventive benefits. This technique is particularly preferred for treating conditions linked to weaknesses in PFMs, abdominal muscles, and lumbopelvic region muscles. Electrical stimulation works by activating motor units through low-frequency electrical impulses, strengthening muscle fibers and enhancing their contractile power. This process supports dynamic stabilization of muscles, contributing to the balance between the PFMs and postural alignment.[21] Research highlights that electrical stimulation improves the neuromuscular control of PFMs, thereby supporting postural stability. Moreover, integrating functional electrical stimulation into home-based programs enhances treatment adherence and strengthens postural control mechanisms in the long term.[18] However, studies on electrical stimulation often lack standardized parameters, emphasizing the need for further comprehensive research.[22]

Pelvic floor muscle training is widely recommended due to its capacity to improve PFM strength, endurance, and proprioceptive input. Recently, hypopressive exercises have gained popularity for their positive effects on PFM strength, postural control, deep core muscle activation, and ventilation capacity. These exercises aim to balance thoracic, abdominal, and perineal compartments by reducing intra-abdominal pressure. Hypopressive exercises also play a key role in the reflexive activation of deep core muscles and striated muscle fibers within the PFM.[23] Hypopressive techniques, by relaxing the diaphragm and reflexively activating the abdominal muscles, reduce intra-abdominal pressure while increasing the tone of PFMs and other postural stabilizers. During the process, coordinated activation is achieved among deep stabilizers such as the diaphragm, TrA, and multifidus, alongside the PFM.[24] The implementation of hypopressive exercises consists of three main stages: slow diaphragmatic inspiration, complete expiration, and diaphragmatic aspiration. During diaphragmatic aspiration, the abdominal wall retracts toward the lumbar spine, and the respiratory diaphragm moves upward, reducing intra-abdominal pressure. This reflexively activates both the PFM and abdominal muscles, enhancing their endurance over time.[25] Hypopressive exercises, as an adjunct to traditional methods, provide a holistic approach to supporting postural control and improving PFM function.

Pelvic floor muscles are not only responsible for continence and supporting pelvic organs but also play a critical role in maintaining postural stability.[26] In the synergistic activation between posture and PFMs, postural imbalances can negatively affect PFM functions, while PFM weakness may contribute to postural disorders.[27] Good postural alignment requires coordinated activity between PFMs and core muscles. The synergistic relationship between PFMs and deep stabilizers such as the TrA, multifidus, and the diaphragm supports both mechanical stability and pressure management.[28]

Postural correction therapy is a holistic approach targeting the functional integration of PFMs and core muscles to strengthen this relationship. This therapy contributes to the improvement of both functional and structural problems by maximizing PFM activation and ensuring postural alignment. Postural correction therapy has proven effective in managing conditions such as pelvic organ prolapse, urinary incontinence, and chronic low back pain.[29] Literature indicates that posture-focused interventions combined with PFMT improve muscle activation and enhance quality of life.[30]

Discussion

The PF is a complex system composed of muscles, ligaments, and fascia structures that play a critical role in maintaining the body's posture. While it ensures biomechanical balance between the spine, pelvis, and lower extremities, it also contributes to essential functions such as continence, organ support, and mobility. Posture is directly related to mechanical integrity, and proper posture significantly influences the effective functioning of PFMs. Postural dysfunctions can lead to unnecessary strain on the PFMs, causing either insufficient or excessive muscle activity. Therefore, the relationship between PFMs and posture is of paramount importance for both biomechanical and clinical alignment. Postural adjustments can support optimal PF functioning, which can, in turn, significantly contribute to quality of life.

Two studies by Bayramoğlu Demirdöğen et al.[31] (2024) and Fuentes-Aparicio et al.[32] (2022) investigate the relationship between postural or stability interventions and PFM function in women. Bayramoğlu Demirdöğen et al. reported that PFMT and spinal stabilization exercises (SSE) effectively improved PFM strength and quality of life. They found that SSE had superior effects on body stability, balance, and spinal posture, which suggests broader applicability for patients with additional postural or stability issues. They advocate for the inclusion of SSE as part of a comprehensive rehabilitation approach addressing both incontinence and associated postural dysfunctions. Fuentes-Aparicio et al. compared the effects of an abdominal-pelvic exercise program with a modified version containing postural instructions (AEPPI). Their EMG data showed superior improvement in PFM strength in the AEPPI group, highlighting the importance of postural commands in rehabilitation. Although UI symptoms improved in both groups, no significant differences were found at the three-month assessment, suggesting that AEPPI primarily enhances muscle strength efficiency. In summary, both studies underscore the critical interaction between PF function and posture. We believe that a multidisciplinary evaluation approach would further support the relationship between PF and posture in women with stress urinary incontinence (SUI).

The studies by Denizoglu Kulli and Gurses[33] (2022) and Qu et al.[34] (2021) explore the relationship between PFMs and posture in terms of childbirth history, respiratory muscle strength, and balance. Kulli and Gurses assessed postural control and PF function in women with diastasis recti abdominis (DRA) through balance tests, abdominal endurance, and respiratory muscle strength measurements. They found that an increased inter-recti distance (IRD) was associated with poorer postural control. However, no direct relationship was found between PF function and respiratory muscle strength. The study highlighted the potential impact of DRA on postural control and argued that postural evaluation should be integrated into physical therapy approaches. Qu et al. focused on postpartum women and aimed to develop ultrasound diagnostic criteria for DRA. They used ultrasound to measure IRD at three points (around the umbilicus) and also evaluated PF function using ultrasound. They developed improved diagnostic criteria for DRA but found no direct relationship with pelvic floor dysfunction (PFD). The severity of DRA was positively correlated with age in postpartum women but showed no relationship with BMI or birth weight. The study emphasized the importance of ultrasound diagnostic accuracy in assessing DRA. Both studies highlighted the significance of evaluating DRA, although Qu et al. emphasized the importance of ultrasound accuracy. Overall, the relationship between DRA and posture and pelvic dynamics remains a complex area in need of further research.

The studies by Jórasz et al.[35] (2022) and Gao et al.[36] (2021) investigated the interaction between PFM control and posture, though they differed in methodology and findings. Jórasz et al. explored the effects of postural correction therapy in women with SUI. The study applied a postural correction program supported by manual therapy and home stretching exercises. They found improvements in PFM strength and endurance in both groups, but postural correction therapy did not provide additional benefits. This suggests that postural correction has a limited impact on the direct functional development of PFMs. Gao et al. focused on the combined effects of global postural re-education (GPR) and PFMT in pregnant women. The GPR program incorporated respiratory and posture-focused exercises, while PFMT concentrated on muscle contraction and relaxation cycles. Their study suggested that the combined effect of GPR and PFMT could significantly improve muscle function and reduce the incidence of SUI, with particular emphasis on strengthening the connection between PFMs and posture. In conclusion, both studies present different findings on the relationship between PFMs and posture, emphasizing the need for a broader perspective on this connection.

Chhibber et al.[37] (2022) and Ehsani et al.[38] (2020) examined the relationship between PFMs and posture. Chhibber et al. studied the effects of lumbar lordosis on PFM function in osteoporotic postmenopausal women and found that changes in lumbar lordosis affected rectus abdominis muscle activity and vaginal pressure. Women in the normal lordosis group had the highest PFM function, while those with hyperlordosis exhibited the lowest function. These findings clearly highlight the impact of lumbar posture on PFMs. Ehsani et al. investigated the effects of stabilization exercises on TrA and PFM activity in women with postpartum lumbo-pelvic pain. They found significant increases in TrA and PFM activity in the stabilization exercise group, suggesting that TrA activity could indirectly improve PF function. Both studies focus on the connection between posture and PFMs. While Chhibber et al. used a static approach based on postural analysis, Ehsani et al. employed a dynamic approach through exercise interventions. These findings highlight the need for a multidisciplinary approach when addressing the relationship between posture and PFMs.

The studies by Loyolla Montanari Leme et al.[39] (2021) and Wojcik et al.[40] (2023) also examined the relationship between PFMs and posture. Loyolla Montanari Leme et al. used functional electrical stimulation to assess postural balance and mobility but found no significant effects on postural balance, mobility, or walking speed. They noted that expecting dual-task performance during PFM contraction could negatively impact postural balance, leading to increased balance shifts. Wojcik et al. used two-dimensional photogrammetry to assess lumbar lordosis and pelvic horizontal alignment and applied hypopressive exercises. While hypopressive exercises did not result in significant changes in lumbar lordosis or pelvic alignment, abdominal circumference measurements showed significant reductions in both groups, with no differences between athletic and sedentary groups in lumbar and pelvic angles. Both studies investigated the role of PFMs on posture and balance using different methods, yet no direct improvements were observed. However, Wojcik's findings suggest that reductions in abdominal circumference may indirectly indicate potential improvements in pelvic alignment and posture, highlighting the need for long-term studies with different age groups and training protocols.

Conclusion

Consequently, muscle training applied to the PF or abdominal muscles should be incorporated into rehabilitation protocols not only to strengthen these muscle groups but also as a method to optimize their effect on postural control. The relationship between the PFMs and postural stability plays a critical role in the proper functioning of body posture and spinal health. Additionally, individual differences should be considered during the treatment process, and personalized rehabilitation plans should be developed. Specifically, when PF rehabilitation is combined with postural dysfunction, the integration of muscle strengthening and postural control may lead to improved outcomes and functional recovery. In clinical practice, it is important to support this holistic approach with further clinical studies and demonstrate its effectiveness. This would allow rehabilitation approaches targeting both PFMs and postural stability to be more widely applied as an effective treatment method, thereby aiding in recovery.

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