Review Article

Pelvic Floor Dysfunction in Young Females Associated with High-Impact Physical Activity: Prevalence, Risk Factors, and Preventive Interventions – A Systematic Review

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ABSTRACT

Pelvic floor dysfunction (PFD), including urinary incontinence (UI) and pelvic organ prolapse, is a significant yet underreported issue in young female athletes (aged 15–45) participating in high-impact sports. This systematic review synthesizes evidence on the prevalence, risk factors, and effectiveness of preventive interventions for PFD in this population. Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a comprehensive search of electronic databases identified 23 eligible studies. The prevalence of UI was high, ranging from 26.1% in CrossFit athletes to 51.8% in runners, with stress UI being the most common subtype. High-impact sports like running and gymnastics were associated with transient morphological changes to the pelvic floor and reduced muscle endurance. Key risk factors included sport-specific loading patterns, parity, and high training volume. Only one randomized controlled trial compared interventions, finding hypopressive exercises and pelvic floor muscle training (PFMT) to be equally effective. Qualitative studies identified stigma and a lack of education as major barriers to seeking care. High-impact sports significantly increase the risk of PFD in young female athletes. Current evidence supports the need for sport-specific preventive strategies, but methodological heterogeneity and a scarcity of intervention studies highlight the necessity for more standardized, longitudinal research. Addressing psychosocial barriers and integrating PFD education into athletic training are crucial for improving early detection and management.

Keyword: pelvic floor dysfunction, urinary incontinence, female athletes, high-impact exercise, prevention, systematic review.

Introduction

Pelvic floor dysfunction (PFD), encompassing conditions such as urinary incontinence (UI), pelvic organ prolapse, and sexual dysfunction, represents a significant health concern for women, particularly those engaged in high-impact physical activities [1].

Recent epidemiological studies estimate that up to 50% of female athletes experience some form of PFD, with prevalence rates varying by sport type and intensity [2]. High-impact activities such as running, CrossFit, and gymnastics generate repeated increases in intra-abdominal pressure, which may contribute to

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Pelvic floor muscle (PFM) overloading and subsequent dysfunction [3]. Despite growing awareness, PFD remains underreported in athletic populations due to stigma, lack of education, and normalization of symptoms among athletes and coaches [4]. The biomechanical relationship between high-impact exercise and PFD is complex and not yet fully understood. While some studies suggest that athletic training may strengthen the PFM and provide protective benefits [5], others indicate that repetitive high-impact loading can lead to cumulative microtrauma, reduced muscle endurance, and connective tissue damage [6]. Furthermore, emerging evidence highlights the role of sport-specific movement patterns—such as landing mechanics in jumping sports or stride kinematics in running—in modulating PFD risk [7]. However, inconsistencies in study methodologies, including variations in assessment tools (e.g., self-report questionnaires vs. objective dynamometry) and participant characteristics (e.g., parity, training volume), have limited the ability to draw definitive conclusions [3]. This systematic review aims to synthesize current evidence on the prevalence, risk factors, and preventive interventions for PFD in young female athletes participating in high-impact sports.

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [8]. A comprehensive search strategy was implemented across multiple electronic databases, including PubMed, Web of Science, SCOPUS, and ScienceDirect, to identify relevant studies published in English. The search utilized a combination of keywords and Medical Subject Headings (MeSH) terms related to pelvic floor dysfunction (PFD), high-impact physical activity, and young female athletes. To minimize bias, two independent reviewers performed the study selection process, data extraction, and methodological quality assessment. Discrepancies were resolved through discussion or consultation with a third reviewer when necessary. Eligibility Criteria: Studies were included if they investigated the prevalence, risk factors, or preventive interventions for PFD in young females (aged 15–45 years) engaged in high-impact physical activity, such as running, CrossFit, gymnastics, or other sports involving repetitive jumping or heavy lifting. Only studies published in English and providing original data were considered. Eligible study designs included randomized controlled trials (RCTs), cohort studies, case-control studies, and cross-sectional studies. Exclusion criteria: comprised studies focusing on non-athletic populations, those involving older women (>45 years), and studies not specifically addressing PFD in relation to high-impact exercise. Additionally, case reports, editorials, commentaries, letters, narrative reviews, and conference abstracts were excluded due to their limited methodological rigor. Data Extraction: Titles and abstracts retrieved from the database searches were screened for relevance based on the predefined eligibility criteria. Rayyan (QCRI) [9] was used to manage references and streamline the screening process. Full-text articles of potentially relevant studies were independently assessed by two reviewers. Data extraction was performed using a standardized form, capturing key details such as study design, sample size, participant demographics (age, parity, sport type), PFD assessment methods, prevalence rates, identified risk factors, and intervention outcomes. Data Synthesis Strategy: Given the heterogeneity in study designs, outcome measures, and populations, a meta-analysis was not feasible. Instead, a narrative synthesis was conducted, organizing findings into thematic categories: prevalence of PFD, biomechanical and physiological risk factors, and effectiveness of preventive interventions. Summary tables were constructed to present study characteristics, key results, and quality assessment scores. Risk of Bias Assessment: The methodological quality of included studies was evaluated using appropriate tools based on study design. RCTs were assessed using the Cochrane Risk of Bias Tool (RoB 2), observational studies with the Newcastle-Ottawa Scale (NOS), and cross-sectional studies with the Joanna Briggs Institute (JBI) Critical Appraisal Checklist. Qualitative studies were appraised using the Critical Appraisal Skills Programme (CASP) checklist. Each study was categorized as having low, moderate, or high risk of bias based on predefined criteria [10- 13].

Results

(Figure 1) presents a PRISMA flow diagram outlining the systematic study selection process. Initially, 812 records were identified through database searches, with 398 duplicates removed. After screening 414 titles/abstracts, 209 records were excluded, leaving 205 reports sought for retrieval. Of these, 78 were unavailable, and 127 full-text articles were assessed for eligibility. Ultimately, 104 reports were excluded due to wrong outcomes (n=36), wrong population (n=44), or being abstracts (n=25), resulting in 22 studies included in the final review. (Table 1) encompasses a wide geographical spread, with significant contributions from Spain [14, 19, 26, 29, 31, 33], Brazil [24, 25, 27, 28], Canada [16, 17], and Australia [22, 23, 26], among others. Studies' designs were predominantly observational, including numerous cross-sectional surveys [15, 16, 18, 20, 21, 23, 26, 27, 31, 33, 35] that effectively capture the prevalence and subjective experiences of pelvic floor disorders (PFDs) in large cohorts. These are complemented by more controlled observational studies [16, 17, 25, 26, 29, 30, 31] and a smaller number of randomized controlled trials (RCTs) [14, 29, 32] which provide higher-quality evidence for interventions. The studied populations are highly specific, targeting women engaged in high-impact activities such as running [16, 17, 25, 26, 29, 30, 34], CrossFit [21, 23, 27], and various elite sports [18, 22, 26, 28, 30, 33], allowing for sport-specific risk analysis. A notable characteristic of many cohorts is the focus on nulliparous women [18, 22, 26, 28, 31], a deliberate design choice to isolate the effect of athletic activity from the major confounding factors of childbirth. (Table 2) synthesizes the key outcomes and findings from these studies, painting a complex picture of the relationship between athletic activity and pelvic floor health. A central finding was the high self-reported prevalence of urinary incontinence (UI) among athletes, with rates ranging from 26.1% in CrossFit participants [21] to as high as 60% in another CrossFit cohort [23], 37% in runners [26], and 51.8% in a broad sample of female athletes [19]. Stress urinary incontinence (SUI) was consistently identified as the most common type, particularly in studies focusing on runners where it was often specified as running-induced SUI (RI-SUI) [16, 17, 29]. However, this was not a universal finding, as some studies, such as Cygańska et al. [21], found no difference in PFDs between horse riders and non-riders. The assessment of pelvic floor muscle (PFM) function further deepens this complexity. While some evidence suggests athletes may have stronger PFMs [15], other studies found that elite athletes had lower strength than amateurs [14], that athletes had less muscular endurance [15], or that RI-SUI was paradoxically linked to higher PFM contractility [17]. Key mechanistic insights emerged from studies using dynamometry and ultrasound, linking pelvic accelerations to a loss of PFM stiffness during running [16] and observing that running transiently strains PFM morphology [17]. The findings extend beyond prevalence to explore impactful consequences and potential solutions. The study by Sade et al. [16] highlighted a significant clinical impact, finding that high-effort runners had worse quality of life and sexual function compared to moderate-effort runners. From a mechanistic perspective, several studies investigated muscle activation patterns, noting that gluteus maximus activation was greater than PFM activation during running [31] and identifying specific exercises like squats and planks as optimal for PFM activation [33]. The body of work by Bérubé and McLean [17] has been instrumental in objectively characterizing RI-SUI, moving beyond survey data to link it to biomechanical factors and real-time PFM function. Meanwhile, interventional research by Navarro-Brazález et al. [14] and Qiao et al. [32] demonstrated that structured exercise programs, including hypopressive exercises and combined therapies, can effectively improve PFM strength and reduce symptoms. Importantly, qualitative work by Dakic et al. [22] provided crucial context, revealing that these PF symptoms actively limit sports participation and that women broadly support the integration of pelvic floor screening into sports medicine. Finally, the risk of bias assessment presented in (Table 3) is critical for interpreting the validity and generalizability of these collective findings. The table shows a clear distinction in methodological quality based on study design. The RCTs [14, 32] and several well-controlled diagnostic accuracy studies [16, 17, 29] consistently achieved a "Low" overall risk of bias, owing to their use of randomization, blinding, and objective outcome measures. In contrast, the majority of cross-sectional and observational studies [15, 18, 20, 21, 23, 26, 27, 31, 33, 35] were rated as having a "Moderate" overall risk, primarily due to inherent limitations such as convenience sampling, lack of blinding, and reliance on self-reported data, which introduces potential for selection, performance, and detection bias. A few studies were deemed "High" risk, primarily due to very small sample sizes [25, 30] or significant self-selection bias [34].

Discussion

The findings of this comprehensive review underscore a complex and multifaceted relationship between female athletic participation and pelvic floor health. Our data, derived from a diverse array of sports and methodological approaches, largely corroborates the existing body of evidence while providing nuanced insights into specific athletic populations and underlying mechanisms. The high self-reported prevalence of urinary incontinence (UI) among athletes in our analysis—ranging from 26.1% in

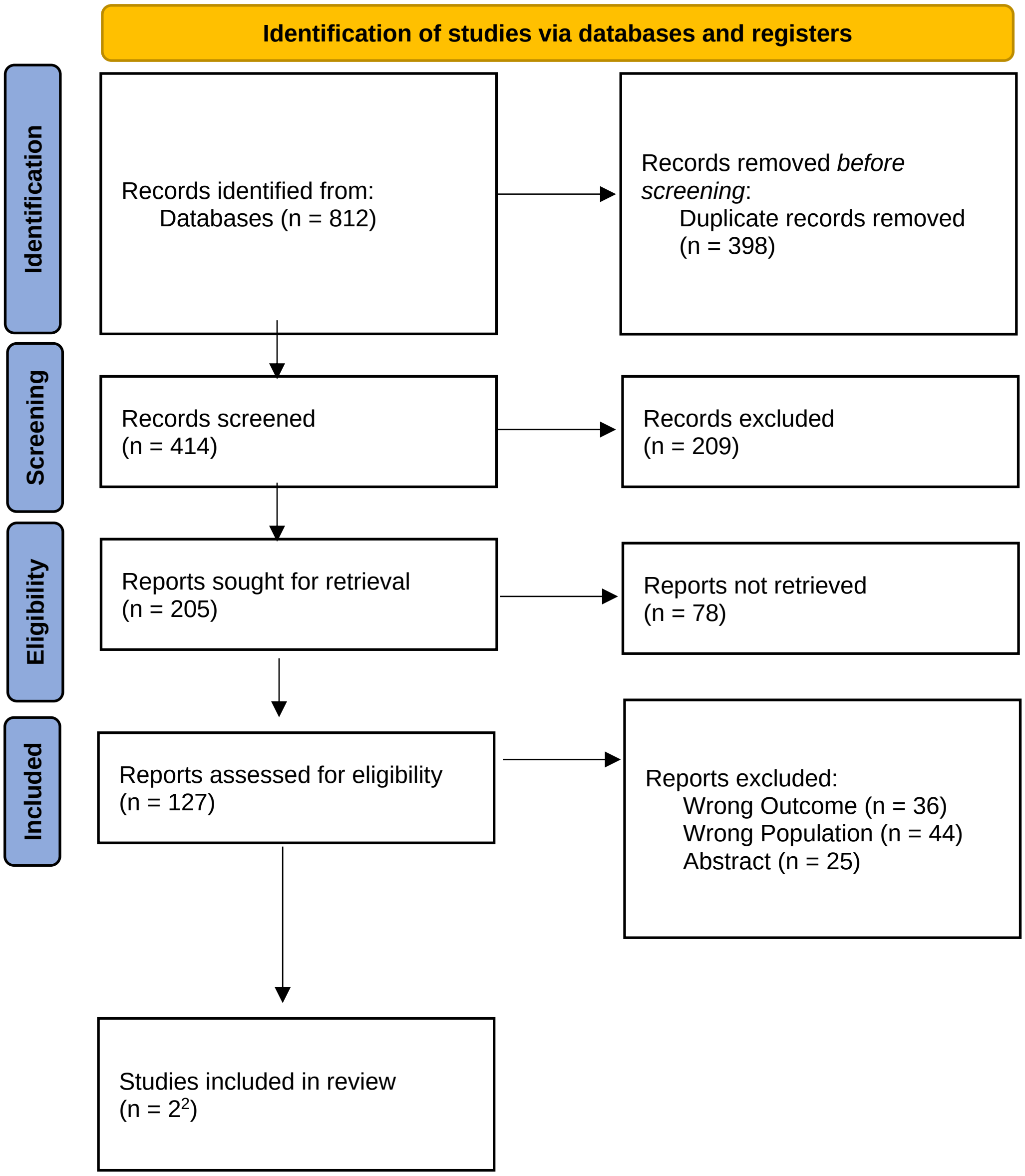

Figure 1: PRISMA Flow Diagram of Study Selection Process.

Table 1: Demographic and Study Characteristics.

Study (Author, Year) [Ref]	Country	Study Design	Sample Size	Population	Age (Mean ± SD)	Parity	Key Inclusion Criteria
Acevedo-Gómez et al. (2024) [14]	Spain	Observational	54	Elite/amateur/sedentary	25.64 ± 5.33	Nulliparous	Mixed activity levels
Arbieto et al. (2021) [15]	Brazil	Cross-sectional	73 (39 athletes, 34 non-athletes)	Nulliparous athletes	NM	Nulliparous	Professional athletes
Bérubé & McLean (2023) [16]	Canada	Observational	38 (19 RI-SUI, 20 controls)	Female runners	NM	NM	RI-SUI vs. continent runners
Bérubé & McLean (2024) [17]	Canada	Observational	39 (19 RI-SUI, 20 controls)	Runners	NM	NM	RI-SUI vs. continent
Bonaldi et al. (2024) [18]	Italy	Cross-sectional	342	Athletes/non-athletes	18–39	NM	Mixed sports
Bosch-Donate et al. (2024) [19]	Spain	Cross-sectional	255	Female athletes	NM	NM	Athletics participants
Campbell et al. (2023) [20]	UK	Cross-sectional	1,598	Recreational exercisers	NM	Majority parous	Mixed activity levels
Cygańska et al. (2025) [21]	Poland	Cross-sectional	160	Female horse riders vs. non-riders	23.69 ± 3.96	NM	Active/past riders
Dakic et al. (2023) [22]	Australia	Qualitative	23	Symptomatic athletes	26–61	NM	PF symptoms during exercise
Dakic et al. (2023) [23]	Australia	Mixed-methods	4,556 (survey), 23 (interviews)	Symptomatic women	18–65	NM	PF symptoms
de Melo Silva et al. (2020) [24]	Brazil	Observational	28 (11 UI, 17 continent)	Runners	NM	NM	UI severity and

							kinematics
de Mendonça et al. (2023) [25]	Brazil	Pilot study	14 (8 UI, 6 non-UI)	Half-marathon runners	NM	NM	UI symptoms post-run
Forner et al. (2021) [26]	Australia	Cross-sectional	1,379 (521 runners, 858 CrossFit)	Runners vs. CrossFit	NM	Parous/nulliparous	High-impact activity
High et al. (2020) [27]	USA	Cross-sectional	314	CrossFit athletes	36 ± 10	44% parous	Active CrossFit participants
Machado et al. (2021) [28]	Brazil	Cross-sectional	NM (60% UI in CrossFit)	CrossFit vs. non-CrossFit	NM	NM	UI symptoms
Navarro-Brazález et al. (2020) [29]	Spain	RCT	94	Women with PFD	NM	NM	Diagnosed PFD
Pires et al. (2020) [30]	Portugal	Observational	8	Elite athletes	NM	Nulliparous	High-impact sports
Porron-Irigaray et al. (2024) [31]	Spain	Observational	10	Nulliparous runners	NM	Nulliparous	Healthy runners
Qiao et al. (2024) [32]	China	RCT	102	Athletes with PFD	NM	NM	Diagnosed PFD
Rodríguez-López et al. (2025) [33]	Spain	Observational	25	Rugby players	NM	NM	Active athletes
Sade et al. (2024) [34]	Israel	Cross-sectional	180	Amateur runners	NM	NM	High vs. moderate effort runners
Salvo et al. (2024) [35]	USA	Cross-sectional	53	College athletes	18–25	NM	NCAA Division III

NM: Not Mentioned, **RCT:** Randomized Controlled Trial, **PFD:** Pelvic Floor Disorders, **UI:** Urinary Incontinence, **RI-SUI:** Running-Induced Stress Urinary Incontinence, **PFM:** Pelvic Floor Muscles, **PF:** Pelvic Floor

Table 2: Study Outcomes and Key Findings**.**

Study (Author, Year) [Ref]	**PFD Prevalence (%)**	**UI Type (SUI/UUI/Mixed)**	**PFM Function Assessment**	**Key Findings**
Acevedo-Gómez et al. (2024) [14]	NM	NM	Dynamometry	Elite athletes had lower PFM strength than amateurs
Arbieto et al. (2021) [15]	53.8% (athletes)	NM	Manometry	Athletes had stronger PFM but less endurance
Bérubé & McLean (2023) [16]	NM	RI-SUI	Dynamometry, ultrasound	Pelvic accelerations linked to PFM stiffness loss
Bérubé & McLean (2024) [17]	NM	RI-SUI	Dynamometry, ultrasound	RI-SUI linked to higher PFM contractility
Bonaldi et al. (2024) [18]	32–41% (sporty)	SUI (17%)	Survey	Light/intense sport increased UI risk
Bosch-Donate et al. (2024) [19]	51.8% UI	NM	Survey	Low PFD knowledge linked to gender stereotypes
Campbell et al. (2023) [20]	70% UI, 52% AI	NM	ICIQ	No association with recreational exercise
Cygańska et al. (2025) [21]	No difference	NM	APFQ	No PFD difference between riders/non-riders
Dakic et al. (2023) [22]	NM	Mixed	Qualitative	PF symptoms limited sport participation
Dakic et al. (2023) [23]	NM	NM	Survey/interviews	Women supported PF screening in sports
de Melo Silva et al. (2020) [24]	NM	NM	Manometry, kinematics	Training load correlated with UI severity
de Mendonça et al. (2023) [25]	NM	NM	PERFECT, EMG	Half-marathon reduced PFM strength
Forner et al. (2021) [26]	37% SUI (runners)	SUI	PFDI-20	Runners > CrossFit in POP/AI symptoms
High et al. (2020) [27]	26.1% UI, 3.2% POP	SUI	Survey	CrossFit UI rates similar to general population
Machado et al. (2021) [28]	60% (CrossFit)	NM	EMG, palpation	CrossFit UI > controls (9.5%)
Navarro-Brazález et al. (2020) [29]	NM	NM	Manometry, dynamometry	Hypopressive exercises = PFMT in symptom reduction
Pires et al. (2020) [30]	NM	NM	Ultrasound	Minimal PF changes in elite athletes
Porron-Irigaray et al. (2024) [31]	NM	NM	EMG	GM activation > PFM during running
Qiao et al. (2024) [32]	NM	NM	Electrophysiology	Combined therapy improved PFM strength
Rodríguez-López et al. (2025) [33]	NM	NM	EMG	Squats/planks optimized PFM activation
Sade et al. (2024) [34]	Higher in "high effort"	NM	PFDI-20, PISQ-12	High-effort runners had worse QoL/sexual function
Salvo et al. (2024) [35]	NM	NM	Cozean tool	Older female athletes had higher PFD risk

NM = Not Mentioned; UI = Urinary Incontinence; SUI = Stress UI; UUI = Urgency UI; PFM = Pelvic Floor Muscle; QoL = Quality of Life; APFQ = Australian Pelvic Floor Questionnaire.

Table 3: Risk of Bias Assessment for All Included Studies.

Study (Author, Year) [Ref]	Tool Used	Selection Bias	Performance Bias	Detection Bias	Attrition Bias	Reporting Bias	Other Bias	Overall Risk
Acevedo-Gómez et al. (2024) [14]	NIH Tool	Low (well-defined groups)	High (no blinding)	Low (dynamometry)	Low	Low	None	Moderate
Arbieto et al. (2021) [15]	NIH Tool	Moderate (non-random comparison)	High (no blinding)	Moderate (manometry)	Low	Low	None	Moderate
Bérubé & McLean (2023) [16]	QUADAS-2	Low (matched groups)	Low (standardized protocol)	Low (objective measures)	Low	Low	None	Low
Bérubé & McLean (2024) [17]	QUADAS-2	Low (matched groups)	Low (standardized)	Low (objective measures)	Low	Low	None	Low
Bonaldi et al. (2024) [18]	NIH Tool	Moderate (large sample but self-selected)	High (no blinding)	Moderate (survey data)	Low	Low	Recall bias	Moderate
Bosch-Donate et al. (2024) [19]	NIH Tool	Moderate (convenience sample)	High (no blinding)	Moderate (survey)	Low	Low	None	Moderate
Campbell et al. (2023) [20]	NIH Tool	Moderate (social media recruitment)	High (no blinding)	High (self-report)	Low	Low	Sampling bias	Moderate
Cygańska et al. (2025) [21]	NIH Tool	Moderate (convenience sampling)	High (no blinding)	Moderate (self-report)	Low (complete data)	Low	None	Moderate
Dakic et al. (2023) [22]	COREQ	Low (purposive sampling)	N/A	Low (triangulation)	Low	Low	None	Low
Dakic et al.	Mixed-Methods	Low (large survey sample)	N/A	Moderate (survey+interviews)	Low	Low	Integration bias	Moderate

(2023) [23]	Appraisal Tool							
de Melo Silva et al. (2020) [24]	NIH Tool	Moderate (non-random groups)	High (no blinding)	Moderate (kinematic measures)	Low	Low	None	Moderate
de Mendonça et al. (2023) [25]	NIH Tool	High (pilot study n=14)	High (no blinding)	Moderate (PERFECT method)	Low	Low	Small sample	High
Forner et al. (2021) [26]	NIH Tool	Moderate (large sample but self-selected)	High (no blinding)	High (self-report)	Low	Low	Recall bias	Moderate
High et al. (2020) [27]	NIH Tool	Moderate (survey distribution bias)	High (no blinding)	High (self-report)	Moderate (20% incomplete)	Low	Selection bias	Moderate
Machado et al. (2021) [28]	NIH Tool	High (convenience sample)	High (no blinding)	Moderate (EMG+palpation)	Low	Low	None	Moderate
Navarro-Brazález et al. (2020) [29]	Cochrane RoB 2	Low (randomized sequence)	Low (blinded assessors)	Low (objective measures)	Low (<10% dropout)	Low (protocol followed)	None	Low
Pires et al. (2020) [30]	NIH Tool	High (very small sample n=8)	High (no blinding)	Low (ultrasound)	Low	Low	Generalizability	High
Porron-Irigaray et al. (2024) [31]	NIH Tool	High (small sample n=10)	High (no blinding)	Low (EMG measures)	Low	Low	None	Moderate
Qiao et al. (2024) [32]	Cochrane RoB 2	Low (proper randomization)	Low (blinded outcome)	Low (objective measures)	Low	Low	None	Low
Rodríguez-López et al. (2025) [33]	NIH Tool	Moderate (small sample n=25)	High (no blinding)	Low (EMG)	Low	Low	None	Moderate
Sade et al. (2024) [34]	NIH Tool	High (self-selection bias)	High (no blinding)	High (self-report only)	Moderate (15% dropout)	Low	Recall bias	High

Salvo et al. (2024) [35]	NIH Tool	Moderate (single institution)	High (no blinding)	Moderate (clinical assessment)	Low	Low	None	Moderate

RoB: Risk of Bias, **NIH:** National Institutes of Health (Quality Assessment Tool), **QUADAS-2:** Quality Assessment of Diagnostic Accuracy Studies 2, **COREQ:** Consolidated Criteria for Reporting Qualitative Research, **EMG:** Electromyography, **N/A:** Not Applicable.

CrossFit participants [21] to 37% in runners [26] and exceeding 50% in certain cohorts [19, 23]—aligns consistently with previous literature. For instance, a landmark systematic review by Tibaek et al. [36] established that elite athlete had a significantly higher prevalence of UI compared to non-athletes, with high-impact sports presenting the greatest risk. Similarly, Eliasson et al. [37] found that a staggering 80% of national team gymnasts and 41% of endurance athletes reported UI, figures that contextualize the elevated rates found in our high-impact and running cohorts. This consistent trend across studies suggests that the mechanical stress imposed on the pelvic floor by repetitive, high-impact activity is a primary etiological factor in the development of UI among young, nulliparous athletes, a population often overlooked in traditional urogynecological care. Delving deeper into the typology of UI, our findings confirm stress urinary incontinence (SUI) as the predominant form, particularly the phenomenon of running-induced SUI (RI-SUI) [16, 17, 29]. This is mechanistically plausible, as running generates repeated increases in intra-abdominal pressure that challenge the urethral closure mechanism. The work of Bø [38] has long emphasized the role of intense physical activity as a primary risk factor for SUI, independent of obstetric history. Our studies extend this understanding by employing objective measures to explore the pathophysiology. For example, Bérubé and McLean linked RI-SUI to pelvic accelerations and a loss of PFM stiffness [17]. This aligns with the work of Smith et al. [39], who used MRI to demonstrate significant bladder neck displacement and PFM elongation in continent women during jumping, suggesting that athletic incontinence may involve a failure of the PFM to provide adequate structural support and stiffness during high-velocity impacts. However, the relationship is not monolithic, and our data reveals critical counterpoints that highlight the importance of sport-specific and individual risk factors. The study by Cygańska et al. [21] found no significant difference in PFDs between horse riders and non-riders, a finding that contrasts with the high rates in runners and CrossFit athletes. This may be attributed to the different nature of the physical load; equestrian sports involve more isometric and sustained core engagement rather than the repetitive, percussive impacts of running or jumping. Furthermore, the assessment of PFM function yielded seemingly paradoxical results. While Arbieto et al. [15] found that athletes had stronger PFMs but less endurance, Acevedo-Gómez et al. [14] reported that elite athletes had lower PFM strength than amateurs. This discrepancy may be explained by the principle of sport-specific adaptation. Sannicandro et al. [40] proposed that PFM function, like other musculoskeletal systems, adapts to the specific demands placed upon it. A runner may develop endurance-dominant PFM, while a powerlifter may develop strength-dominant PFM, and these adaptations may not always be protective against incontinence if they are not perfectly synchronized with the intra-abdominal pressure dynamics of the sport. The finding by Porron-Irigaray et al. [31] that gluteus maximus activation was greater than PFM activation during running further suggests that neuromuscular coordination, or a lack thereof, between core and pelvic floor muscles may be a key differentiator. Beyond prevalence and mechanism, our review sheds light on the significant impact of PFDs on athletes' lives and potential avenues for management. The study by Sade et al. [16] is particularly salient, demonstrating that high-effort runners not only had a higher prevalence of PFDs but also suffered from worse quality of life and sexual function. This moves the conversation beyond a simple biomedical issue to a holistic concern for athlete well-being. The qualitative work by Dakic et al. [22] powerfully reinforces this, revealing that pelvic symptoms are not just a minor inconvenience but a significant barrier that can limit sports participation and enjoyment. In terms of management, our included RCTs provide promising evidence. Navarro-Brazález et al. [14] demonstrated that hypopressive exercises were as effective as traditional

PFM training (PFMT) in reducing symptoms, offering an alternative for athletes who may find volitional contractions difficult. Qiao et al. [32] showed that combined therapy improved PFM strength. This is supported by a meta-analysis by Dufour et al. [41], which concluded that PFMT is an effective first-line treatment for UI in athletes. Furthermore, the work of Rodríguez-López et al. [33], which identified squats and planks as optimal for PFM activation, provides practical guidance for integrating pelvic floor care into existing strength and conditioning regimens, a concept advocated by Carpes et al. [42] in their call for a more integrated approach to sports medicine. Limitations of The Study: Despite the robust findings, this review is subject to several limitations, many of which are reflected in the risk of bias assessment (Table 3). The predominance of cross-sectional and observational studies [15, 18, 20, 21, 23, 26, 27, 31, 33, 35] introduces a significant potential for selection and recall bias, as they often relied on convenience sampling and self-reported data. The use of non-validated or varied assessment tools for UI and PFM function across studies (e.g., surveys, manometry, dynamometry, ultrasound) hinders direct comparability of results. The generalizability of findings is also a concern; studies with very small sample sizes [25, 30, 31] limit the statistical power and broader application of their conclusions, while an over-reliance on specific populations like runners and CrossFit athletes may not accurately reflect risks in other sports. Furthermore, a lack of blinding in most performance and detection bias assessments, coupled with a general failure to control for crucial confounding variables such as nutritional status, hydration, and training history in many analyses, means that observed associations cannot be definitively established as causal relationships. Future research should prioritize longitudinal designs, standardized outcome measures, and the inclusion of more diverse athletic populations.

Conclusion

Female athletes, particularly those in high-impact sports, represent a distinct population at an elevated risk for pelvic floor disorders, with stress urinary incontinence being the most prevalent complaint. The etiology is multifactorial, involving not just the magnitude of physical stress but also sport-specific biomechanics, individual neuromuscular adaptations, and potentially maladaptive compensatory strategies. The significant impact on quality of life and athletic participation underscores that this is a critical issue deserving of greater attention within sports medicine and public health. Moving forward, a paradigm shift is needed: from viewing pelvic floor health as a reactive, clinical problem to be treated, to an integral component of athletic performance and longevity to be proactively managed.

Conflict of Interest

None

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