ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DOTTORATO DI RICERCA IN

# SALUTE, SICUREZZA E SISTEMI DEL VERDE

Ciclo 36

**Settore Concorsuale:** 06/N1 - SCIENZE DELLE PROFESSIONI SANITARIE E DELLE TECNOLOGIE MEDICHE APPLICATE

**Settore Scientifico Disciplinare:** MED/48 - SCIENZE INFERMIERISTICHE E TECNICHE NEUROPSICHIATRICHE E RIABILITATIVE

# MUSCULOSKELETAL DISORDERS, RESEARCH QUALITY, AND PELVIC FLOOR HEALTH IN SPORTS: EXPLORING CURRENT EVIDENCE AND NEW PERSPECTIVES

**Presentata da:** Silvia Giagio

**Coordinatore Dottorato**

Patrizia Tassinari

**Supervisore**

Paolo Pillastrini

**Co-supervisore**

Daniele Torreggiani

Esame finale anno 2024

# TABLE OF CONTENTS

# CHAPTER 1

General Introduction

The present thesis, titled *" Musculoskeletal Disorders, Research Quality, and Pelvic Floor Health in Sports: Exploring Current Evidence and New Perspectives,"* represents the final elaboration of the PhD program in "Health, Safety, and Green Systems" promoted by the University of Bologna, Imola district.

This thesis encompasses three distinct research lines, which will be reported upon in the subsequent chapters, accompanied by corresponding references to published articles. The research trajectory over the academic period from 2020 to 2023 is graphically summarised in **Figure 1.** The first research line focuses on musculoskeletal disorders, with particular emphasis on neck and low back pain. The second research line delves into the quality and transparency of research methods, specifically pertaining to the rehabilitation field. Finally, the third research line, which holds paramount importance within this dissertation, pertains to pelvic floor health. The conducted studies primarily focused on pelvic floor dysfunction (PFD) among the sports population, specifically among female athletes. Consequently, a significant amount of attention and discussion is dedicated to this topic.

All three-research field have been developed with colleagues from various universities, fostering a multidisciplinary approach. National and international collaborations have been crucial in facilitating these research endeavours, including partnerships with Monmouth University (USA), Vrije Universiteit Amsterdam (the Netherlands), Cardiff Metropolitan University (UK), different Italian universities, and colleagues specialising in rehabilitation from the University of Genova, Molise, IRCCS Istituto Ortopedico Galeazzi, and the University of Roma Tor-Vergata. Moreover, an intra-departmental partnership has been established with the Division of Gynaecology and Physiopathology of Human Reproduction at IRCCS Azienda Ospedaliero Universitaria di Bologna. The research teams involved professionals from diverse disciplines such as research methodology, epidemiology, rehabilitation, urogynecology, musculoskeletal, and pelvic floor physical therapy. At the end of the thesis, Chapter 10 will offer a concise overview of the international mobility program experience at Monmouth University USA, under the mentorship of Prof. Tamara Rial-Rebullido.

**Figure 1.** Graphic executive summary of the research pathway and fields (A.Y. 2020-2023).

# CHAPTER 2

Musculoskeletal Disorders

The articles presented in this chapter were part of a broader project that aimed to investigate the effectiveness of physical therapy interventions on various musculoskeletal disorders, including neck (n=4), shoulder (n=2), and low back pain (n=1). This chapter comprises six published articles and one randomised-controlled clinical trial that is ongoing. Main research questions are summarised in Table 1.

**Table 1.** Main research questions regarding published studies on musculoskeletal disorders.

| **Article #** | **Main research questions** | **Musculoskeletal disorder** |
|---|---|---|
| 1 | From an individual perspective, what is the relationship between low back pain and sexual life in the physical, psychological, and social aspects? | Low back pain |
| 2 | Is surgical rotator cuff repair more effective than nonoperative treatment in patients with shoulder pain due to rotator cuff tears? | Shoulder pain |
| 3 | What is the available evidence on red flags for gastrointestinal and hepatic diseases in the assessment of patients with shoulder pain? | Shoulder pain |
| 4 | Are Pump techniques and Pompages effective in adults with chronic neck pain? | Neck pain |
| 5 | Which are the most effective interventions for people with chronic non-specific neck pain? | Neck pain |
| 6 | Is Spinal Manipulative Therapy more effective than Clinical Practice Guidelines-recommended (CPG) and CPG-non-recommended interventions in adults with recent and persistent neck pain? | Neck pain |
| 7 | Is a combination of Pompage techniques and an active intervention more effective than the active treatment alone for patients with chronic non-specific neck pain? | Neck pain |

## ABBREVIATIONS

| | |
|---|---|
| **LBP** | Low Back Pain |
| **CPG** | Practice Guidelines-recommended |
| **RCT** | Randomized Controlled Clinical Trial |

**Article #1**

**Reference:** Ferrari S, Vanti C, Giagio S, et al. Low back pain and sexual disability from the patient's perspective: a qualitative study. Disabil Rehabil. 2022;44(10):2011-2019. doi:10.1080/09638288.2020.1817161

**Objectives:** 1) To investigate, from the patient's perspective, the different aspects of the relationship between LBP and sexual life on the physical, psychological and social aspects of an individual's life; 2) to explore patients' opinions on the possible role of health professionals in addressing and treating LBP-related sexual problems.

**Main findings:** Patients with low back pain consider sexual disability severely limiting and correlated to pain. This study emphasized the perception of invalidity, the importance of the relationship with the partner, the emotions and gender roles in the couple, and the relevance for health care providers to take part in the clinical management. The physical therapist is believed to be a qualified figure to address this issue and specific suggestions on sexual activity could be useful.

**Article #2**

**Reference:** Brindisino F, Salomon M, Giagio S, Pastore C, Innocenti T. Rotator cuff repair vs. nonoperative treatment: a systematic review with meta-analysis. J Shoulder Elbow Surg. 2021;30(11):2648-2659. doi:10.1016/j.jse.2021.04.040

**Objectives:** 1) To analyse the evidence on repair and conservative treatments for patients with any type of rotator cuff tear through meta-analysis; 2) to identify the most common indications to

repair, as it would be helpful for clinicians to understand if the presence of structural failure (confirmed by imaging assessment), pain refractory to conservative treatment, persistent strength deficits or the combination of these aforementioned features could be considered decision criteria for surgical approach.

**Main findings:** Six trials were included. Pooled results showed improvement in function and pain perception in favour of the repair group at 6 months (mean difference 1.26 [CI 95% -2.34 to 4.85, p=0.49] and 0.59 [95% CI -0.84 to -0.33, p< 0.00001], respectively), at 12 months (mean difference 5.25 [CI 95% 1.55 to 8.95, p= 0.005] for function and mean difference -0.41 [CI 95% -0.70 to -0.12, p=0.006] for pain) and at 24 months (mean difference 5.57 [CI 95% 1.86 to 9.29 p= 0.003] for function and mean difference -0.92 [CI 95% -1.31 to -0.52 p<0.00001] for pain) in rotator cuff tear patients. However, these differences did not reach the minimum clinically important difference. The certainty of evidence ranged from low to moderate due to imprecision in the studies included.

**Article #3**

**Reference:** Pennella D, Giagio S, Maselli F, et al. Red flags useful to screen for gastrointestinal and hepatic diseases in patients with shoulder pain: A scoping review [published online ahead of print, 2022 Mar 1]. Musculoskeletal Care. 2022;10.1002/msc.1628. doi:10.1002/msc.1628

**Objectives:** To map and summarise findings so as to identify any studies that reported red flags for gastrointestinal and hepatic diseases in the assessment of patients with shoulder pain.

**Main findings:** A total of 157 records have been identified, with 40 studies meeting the inclusion criteria (37 case reports, 2 retrospective studies and 1 systematic review with meta-analysis). The most prevalent red flags associated with shoulder pain were abdominal pain (14 cases) and abdominal discomfort (3 cases), reported by 47% of patients. As for comorbidities, hepato-gastric, cardiac, visceral and systemic diseases were the most common ones.

**Article #4**

**Reference:** Vanti C, Golfari M, Pellegrini G, Panizzolo A, Turone L, Giagio S, Pillastrini P. The Effectiveness of Pump Techniques and Pompages: A Systematic Review. Applied Sciences. 2021; 11(9):4150. https://doi.org/10.3390/app11094150

**Objective:** To investigate the effectiveness of pump techniques and pompages in adults on subjective (e.g., pain, physical function) and objective outcomes (e.g., pulmonary function).

**Main findings:** Twenty-five RCTs were included: 20 concerning the pump techniques and five concerning pompages. Due to the extensive heterogeneity of such studies, it was not possible to perform a meta-analysis. The risk of bias resulted from moderate to high and the quality of the evidence was from very low to high. Singular studies suggested some effectiveness of pump techniques on pain and length of hospitalization. Pompage technique seems also to help improve walking distance and balance.

**Article #5**

**Reference:** Castellini G, Pillastrini P, Vanti C, et al. Some conservative interventions are more effective than others for people with chronic non-specific neck pain: a systematic review and network meta-analysis. J Physiother. 2022;68(4):244-254. doi:10.1016/j.jphys.2022.09.007

**Objective:** To compare the available choices for patients with chronic non-specific neck pain in terms of benefits and harms, via a systematic review with network meta-analysis.

**Main findings:** Overall, 119 RCTs (12,496 patients; 32 interventions) were included. Risk of bias was low in 50.4% of trials, unclear in 22.7% and high in 26.9%. Compared with inert treatment, a combination of active and/or passive multimodal non-pharmacological inventions (eg, exercise and manual therapy) were effective for pain on a 0-to-10 scale at 1 month (MD range 0.84 to 3.74) and at 3 to 6 months (MD range 1.06 to 1.49), and effective on disability on a 0-to-100 scale at 1 month (MD range 10.26 to 14.09) and 3 to 6 months (MD range 5.60 to 16.46). These effects ranged from possible to definite clinical relevance. Compared with inert treatment, anti-inflammatory drugs alone or in combination with another non-pharmacological treatment did

not reduce pain at 1 month or 3 to 6 months. At 12 months, no superiority was found over inert treatment on both outcomes. Most mild adverse events were experienced following acupuncture/dry needling intervention. On average, the evidence varied from low to very low certainty.

**Award:** Best paper of the year (2022) in Journal of Physiotherapy.

**Article #6**

**Reference:** Minnucci S, Innocenti T, Salvioli S, et al. Benefits and harms of Spinal Manipulative Therapy for treating recent and persistent nonspecific neck pain: a systematic review with meta-analysis [published online ahead of print, 2023 Aug 10]. J Orthop Sports Phys Ther. 2023;1-53. doi:10.2519/jospt.2023.11708

**Objectives:** To examine the effectiveness of cervical Spinal Manipulative Therapy compared with Clinical Practice Guidelines-recommended (CPG) and CPG-non-recommended interventions in adults with recent and persistent neck pain.

**Main findings:** We included 28 RCTs. There was very low to low certainty of evidence that SMT is clinically more effective than CPG-recommended interventions for pain at short-term (standardized mean difference [SMD] 0.66; confidence interval [CI] 0.35 to 0.97) and long-term (SMD 0.73; CI 0.31 to 1.16), and for disability at short-term (SMD 0.95; CI 0.48 to 1.42) and long-term (SMD 0.65; CI 0.23 to 1.06). Only transient side effects were found with lowest proportion compared to exercise.

**Article #7**

**Tile:** Comparison Between Two Physical Therapy Treatments in Patients With Nonspecific Chronic Neck Pain

**Authors:** Vanti C, Giagio S, Barbieri G, Burioli A, Giudici M, Perachiotti G, Savorani G, Turolla A, Pillastrini P.

**Objectives:** To evaluate the effectiveness of Pompage techniques added to an active intervention, including education and self-treatment exercises, in subjects with chronic nonspecific neck pain.

**Trial registration number:** ClinicalTrials.gov Identifier NCT04695730

**Status:** On going.

# CHAPTER 3

Research Quality and Transparency

Articles included in this research area have been planned and conducted with the main collaboration of colleagues from the Vrije Universiteit Amsterdam.

As reported in Table 2, the primary research questions of these meta-research studies were to assess adherence to reporting guidelines (RGs) across various study designs (e.g., CONSORT and PRISMA statements), aiming to enhance research transparency and reproducibility. Additional articles focused on outcome analysis, particularly the use of core outcome sets, and addressed potential biases in outcome measurement. This section comprises seven published articles.

**Table 2.** Main research questions regarding published meta-research studies.

| Article # | Main research questions |
|---|---|
| **1** | Did authors who published in high-impact rehabilitation journals declare to use RGs? If they used RGs, did the authors report appropriately in their declaration? |
| **2** | How complete is the reporting in randomised controlled trials published among rehabilitation journals? Is there an association between the completeness of reporting, the risk of bias, and the characteristics of studies and journals? |
| **3** | Did authors adhere to the PRISMA statement of systematic reviews published in rehabilitation journals? |
| **4** | What are the rehabilitation journals' editors' opinions and beliefs about the importance of RGs? Which methods do rehabilitation journals use to check the use of RGs? |
| **5** | Are core outcome set and core outcome measurement set used for non-specific chronic low back pain in clinical trials? |
| **6** | What are the relationships between the risk of bias and estimates of the treatment effect of exercise therapy interventions in randomised controlled trials including patients with chronic low back pain? |
| **7** | How did the authors interpret the clinical relevance of the effect of physiotherapy compared to no intervention in randomised controlled trials on chronic low back pain? |

**ABBREVIATIONS**

| | |
|---|---|
| **CONSORT** | CONsolidated Standards of Reporting Trials |
| **COS** | Core Outcome Set |
| **NSLBP** | Non-Specific Low Back Pain |
| **PRISMA** | Preferred Reporting Items for Systematic reviews and Meta-Analyses |
| **RGs** | Reporting guidelines |
| **RoB** | Risk of Bias |
| **ROBIS** | Risk Of Bias In Systematic Reviews |
| **SWE** | Smallest Worthwhile Effect |

**Article #1**

**Reference:** Innocenti T, Salvioli S, Giagio S, Feller D, Cartabellotta N, Chiarotto A. Declaration of use and appropriate use of reporting guidelines in high-impact rehabilitation journals is limited: a meta-research study. J Clin Epidemiol. 2021;131:43-50. doi:10.1016/j.jclinepi.2020.11.010

**Primary objectives:** Among high-impact rehabilitation journals, 1) to evaluate the frequency of the declared use of RGs by authors; 2) to categorize the declared use as appropriate or inappropriate.

**Main findings:** Among the 200 selected studies, 17.5% (95% CI: 12.2-22.8%) declared using RGs. Among these studies, 48.6% (95% CI: 32-65.1%) declared an appropriate use. There was an increasing trend over time for authors to report the use of RGs (OR: 1.31; 95% CI: 1.13-1.53). Systematic reviews (n = 54) reported more frequently the use of RGs than other study designs (35.2%).

**Article #2**

**Reference:** Innocenti T, Giagio S, Salvioli S, et al. Completeness of Reporting Is Suboptimal in Randomized Controlled Trials Published in Rehabilitation Journals, With Trials With Low Risk

of Bias Displaying Better Reporting: A Meta-research Study. Arch Phys Med Rehabil. 2022;103(9):1839-1847. doi:10.1016/j.apmr.2022.01.156

**Primary objectives:** 1) To evaluate the completeness of reporting of RCTs published in rehabilitation journals through the evaluation of the adherence to the CONSORT checklist; 2) to investigate the relationship between the completeness of reporting and the risk of bias (ROB) assessed with the Cochrane risk-of-bias tool 2.0 (RoB 2) tool.

**Main findings:** The mean overall CONSORT adherence across studies was 65%. Studies with high ROB have less adherence than those with low ROB (-5.5%; CI, 10.9 to 0.0). There was a 10.2% (% CI, 6.2-14.3) increase in adherence if the RCT protocol was registered. Studies published in first quartile journals displayed an overall adherence of 11.7% (% CI 17.1-6.4) higher than those published in the fourth quartile.

**Article #3**

**Reference:** Innocenti T, Feller D, Giagio S, et al. Adherence to the PRISMA statement and its association with risk of bias in systematic reviews published in rehabilitation journals: A meta-research study. Braz J Phys Ther. 2022;26(5):100450. doi:10.1016/j.bjpt.2022.100450

**Primary objectives:** 1) To evaluate the completeness of reporting in systematic reviews published in rehabilitation journals through the evaluation of the adherence to the PRISMA checklist; 2) to investigate the relationship between the completeness of reporting and the risk ROB assessed with the ROBIS tool.

**Main findings:** The mean overall PRISMA adherence across the 200 studies considered was 61.4%. Regression analyses show that having a high overall ROB is a significant predictor of lower adherence (B=-7.1%; 95%CI -12.1, -2.0). Studies published in fourth quartile journals displayed a lower overall adherence (B= -7.2%; 95%CI -13.2, -1.3) than those published in first quartile journals; the overall adherence increased (B= 11.9%; 95%CI 5.9, 18.0) if the systematic review protocol was registered. No association between adherence, publication options, and publication year was found.

**Article #4**

**Reference:** Innocenti T, Ostelo R, Verhagen A, et al. Rehabilitation journal editors recognize the need for interventions targeted to improve the completeness of reporting, but there is heterogeneity in terms of strategies actually adopted: A cross-sectional web-based survey [published online ahead of print, 2023 Mar 29]. J Evid Based Med. 2023;10.1111/jebm.12527. doi:10.1111/jebm.12527

**Objectives:** 1) To explore editors' opinions and beliefs about the importance of RGs, 2) to map which methods journals use to check the use of RGs, 3) to explore the editors' thoughts and opinions about the importance of RGs and their use during the peer-review process.

**Main findings:** Of 479 editors invited, 142 (29.6%) completed the survey. Nearly all (n=130; 91.5%) believed that RGs should be adopted by all refereed rehabilitation journals. Most of the participants learned about the RGs by doing research themselves in which a reporting guideline is needed (n=100; 70.4%), only a small minority attended specific courses targeted to the editors (n=16; 11.3%) and 32.4% of the participants 'always' check for the correct use of the RGs. Most of the participants (n=88; 62.0%) declare that their journal does not explicitly ask the peer-reviewers to check for the use of RGs in the manuscripts reviewed.

**Article #5**

**Reference:** Innocenti T, Salvioli S, Logullo P, Giagio S, Ostelo R, Chiarotto A. The uptake of the core outcome set for non-specific low back pain clinical trials is poor: a meta-epidemiological study of trial registrations [published online ahead of print, 2023 Aug 19]. J Pain. 2023;S1526-5900(23)00510-2. doi:10.1016/j.jpain.2023.08.006

**Objectives:** 1) to assess the uptake of the core outcome set (COS) in non-specific low back pain (NSLBP) clinical trials; 2) to assess the uptake of the COMs for NSLBP and to analyse whether specific study characteristics (i.e. registration year, sample size, country of origin, follow-up du ration, trial phase, intervention, and funding source) were associated with COS uptake.

**Main findings:** Only 50 (20.8%) entries showed a full COS uptake, and this rate did not increase over time. Most registry entries that planned to measure physical functioning (n = 152) used the Roland-Morris Disability Questionnaire (n = 74; 48.7%); a small percentage used the numeric rating scale (n = 60; 27.3%) or Short Form-12 (n = 5; 8.3%) if they planned to measure pain intensity (n = 220) or health-related quality of life (n = 60), respectively. Only the planned sample size (OR = 1.02; 95% CI = 1.01, 1.03) showed a significant but small association with COS uptake. The uptake of the COS for NSLBP is poor. Only 21% of the randomized controlled trials aimed to measure all COS domains in their study registration and COS uptake is not increased over time. Great heterogeneity in measurement instruments was also observed, revealing poor core outcome measurement set uptake.

**Article #6**

**Reference:** Innocenti T, Hayden JA, Salvioli S, Giagio S, Piano L, Cosentino C, Brindisino F, Feller D, Ogilvie R, Gianola S, Castellini G, Bargeri S, Twisk JW, Ostelo RW, Chiarotto A. Bias in the measurement of the outcome is associated with effect sizes in randomised clinical trials on exercise therapy for chronic low back pain: a meta-epidemiological study. J Clin Epidemiol. 2023 Sep 11:S0895-4356(23)00234-2. doi: 10.1016/j.jclinepi.2023.09.001. Epub ahead of print. PMID: 37704114.

**Objectives:** To explore the relationships between the risk of bias and treatment effect estimates for exercise therapy interventions on pain intensity and physical functioning outcomes in randomised controlled trials (RCTs) involving patients with chronic low back pain.

**Main findings:** The meta-regression included 220 (pain intensity) and 203 (physical functioning) effect sizes. Unadjusted and adjusted meta-regression models showed no significant associations between the bias domains and pain intensity effect sizes. Only domain ‘bias in the measurement of the outcome’ was significantly associated with physical functioning (standardised mean difference: −0.40, 95% confidence interval: −0.77 to −0.02) when adjusted for flowchart reported (yes/no), prospective trial registration, sample size, and comparator type.

**Article #7**

**Reference:** Innocenti T, Schleimer T, Salvioli S, Giagio S, Ostelo R, Chiarotto A. In trials of physiotherapy for chronic low back pain, clinical relevance is rarely interpreted, with great heterogeneity in the frameworks and thresholds used: a meta-research study. J Physiother. 2024;70(1):51-64. doi:10.1016/j.jphys.2023.11.007

**Objectives:** 1) to evaluate if authors have interpreted the clinical relevance of the effect of physiotherapy compared to no intervention on pain intensity, physical functioning and time to recovery following their a-priori definition; 2) to re-interpret the clinical relevance of the between-group differences of the published RCTs based on the available SWE estimates for physiotherapy compared to no intervention in patients with chronic low back pain.

**Main findings:** We included 23 RCTs with 1,645 participants. Twenty-two and 18 studies were included in the analysis of pain intensity and physical functioning, respectively. No studies investigated time to recovery. Sixteen studies reported varying thresholds to interpret clinical relevance for physical functioning and pain intensity. Discrepancies between interpretation with minimal important difference and SWE values were observed in five studies. Study power ranged from 9% to 98%, with only four studies having a power > 80%.

# CHAPTER 4

Pelvic Floor Health

This subgroup of projects includes two published articles regarding general pelvic health. Both of the articles were conducted in collaboration with the Department of Gynaecology and Physiopathology of Human Reproduction, IRCCS Azienda Ospedaliero-Universitaria of Bologna. Main research questions are presented in Table 3.

**Table 3.** Main research questions regarding published studies on pelvic floor health.

| Article # | Main research questions |
|---|---|
| **1** | Is a 54-week administration of testosterone undecanoate combined with the 5a-reductase inhibitor dutasteride more effective compared to placebo on muscle strength in transmen? |
| **2** | How complete is the reporting of Pelvic Floor Muscle Training in all published randomized controlled trials in women with pelvic organ prolapse? |

## ABBREVIATIONS

| | |
|---|---|
| **CERT** | Consensus on Exercise Reporting Template |
| **DT** | 5a-reductase inhibitor dutasteride |
| **PFMT** | Pelvic Floor Muscle Training |
| **RCTs** | Randomized Controlled Trials |
| **TIDieR** | Template for Intervention Description and Replication |
| **TU** | Testosterone Undecanoate |

**Article #1**

**Reference:** Gava G, Armillotta F, Pillastrini P, et al. A Randomized Double-Blind Placebo-Controlled Pilot Trial on the Effects of Testosterone Undecanoate Plus Dutasteride or Placebo on Muscle Strength, Body Composition, and Metabolic Profile in Transmen. J Sex Med. 2021;18(3):646-655. doi:10.1016/j.jsxm.2020.12.015

**Objectives:** 1) To compare the effects on muscle strength of 54-week administration of TU combined with the DT or placebo; 2) to evaluate body composition, bone, cutaneous androgenic effects, and metabolic variations.

**Main findings:** Handgrip and lower limb strength increased significantly in both groups with no differences between the two groups. Fat mass decreased and lean mass increased significantly similarly in both groups. Metabolic parameters remained stable in the two groups except for high-density lipoprotein cholesterol that was reduced in both groups. Hepatic and renal function remained normal in both groups and no major adverse effects were registered in either group.

**Article #2**

**Reference:** Giagio S, Innocenti T, Salvioli S, et al. Completeness of exercise reporting among randomized controlled trials on pelvic floor muscle training for women with pelvic organ prolapse: A systematic review. Neurourol Urodyn. 2021;40(6):1424-1432. doi:10.1002/nau.24712

**Objective:** To assess the completeness of exercise reporting among all published RCTs on PFMT in women with POP.

**Main findings:** Twenty-six RCTs were included. None of the studies completely reported all intervention descriptors. On average 57.1% (6.8 ± 2.4; out of 12) of the overall TIDieR items and 35.3% (6.7 ± 2.9; out of 19) of the CERT were well described. In particular, 7 and 5 items were completely reported more than 50% of the time for the TIDieR and CERT, respectively. Frequent shortcomings were the undetailed reporting of information regarding tailoring and modifications of exercises and their adherence. Detailed descriptions of exercise repetitions to enable replication

were missing in 53.8%. According to the CERT, only 11.5% of the RCTs sufficiently described the main providers' characteristics.

**International oral presentation:** 2021 International Continence Society (ICS) Congress, “Podium Session 6 Live Conservative Management 1 - Best of Rehabilitation: from Clinical Reasoning to Cost Analysis.

# CHAPTER 5

Pelvic Floor and Sports

This series of articles represents the main and the key research area of the present thesis. Investigations primarily concentrated on PFD among the sports population, with a particular emphasis on female athletes. This section encompasses four articles that have been published to date. Furthermore, two ongoing studies are currently underway, each of which adds valuable contributions to the comprehension of PFD. In the following paragraph will deepen in detail the rational and the articles.

## ABBREVIATIONS

| | |
|---|---|
| **AI** | Anal Incontinence |
| **FI** | Fecal Incontinence |
| **IAP** | Intra-Abdominal Pressure |
| **MUI** | Mixed Urinary Incontinence |
| **OAB** | Overactive Bladder Syndrome |
| **PFD** | Pelvic Floor Dysfunction |
| **PFMs** | Pelvic Floor Muscles |
| **POP** | Pelvic Organ Prolapse |
| **RED-s** | Relative Energy Deficiency In Sports |
| **SUI** | Stress Urinary Incontinence |
| **UUI** | Urge Urinary Incontinence |
| **UI** | Urinary Incontinence |

## BACKGROUND

### What Is The Pelvic Floor?

The female pelvic floor is a complex network of muscles, ligaments, and connective tissues that form a supportive structure at the base of the pelvis, across the area between the pubic bone and the tailbone, supporting the pelvic organs like the bladder, uterus, and rectum [1] (**Figure 2**).

The pelvic floor muscles (PFMs) consist of both slow-twitch (66%) and fast-twitch (34%) muscle fibers, organized into superficial and deep layers. The superficial PFMs include the bulbospongiosus, ischiocavernosus, and superficial and deep transverse perineal muscles. On the other hand, the deep PFMs, lining the inner walls of the pelvis, include the levator ani (puborectalis, pubococcygeus, and iliococcygeus) and coccygeus, along with the endopelvic fascia, forming the pelvic diaphragm. The puborectalis forms a U-shaped sling around the rectum and, together with the pubococcygeus, contributes to the continence mechanism. The perineal body, located between the vagina and anus, acts as a convergence point for the PFMs and sphincters, providing support to the pelvic floor [1].

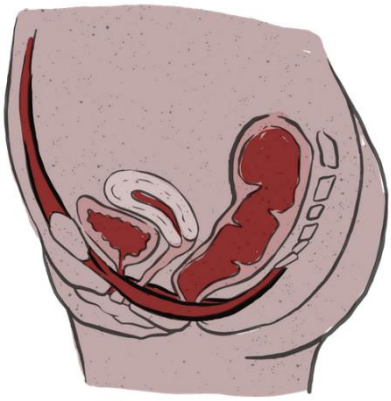
They are under prominent reflex and relatively weak voluntary control, with few and poor proprioception, which is sensory data contributing to awareness of the muscles, . Furthermore, their neural control mechanism is fragile due to its relative phylogenetic recency, and is exposed to trauma and disease due to its expansive anatomy (from frontal cortex to the endpart of spinal cord) and extensive peripheral innervation, both somatic and autonomic [2].

The primary functions of the female PFMs include maintaining urinary and anal continence, supporting the pelvic organs (bladder, uterus, and rectum), aiding in sexual function, representing the birth canal and part of the core. In addition, PFMs physiologically act as expiratory muscles in synergy with the anterolateral abdominal muscles, contracting during expiration and relaxing during inspiration [3]. These functions are ensured by a constant state of muscular activity,

maintaining continuous, coordinated and responsive contraction and relaxation to task, alongside passive support from the surrounding tissues and fascia [4,5].

PFMs contractions lead to a circular closure of the pelvic orifices and an elevation of the pelvic floor in a ventral and cranial direction. PFMs relaxation results in a release of the muscular closure mechanisms allowing for the opening of the urethra, vagina, and anus, but also in a reduction in the support of the pelvic organs, allowing for their caudal displacement together with the descent of the pelvic floor. During an intra-abdominal pressure (IAP) rise, the PFMs should contract in order to maintain the support function of the pelvic floor and to close the urethra, anus, and vagina; thus, preventing incontinence and pelvic organ prolapse. On the other hand, during micturition, defecation, or childbirth, the PFMs must relax in order to reduce the support given to the urethra, anus, and vagina and to release the closure mechanisms [3,6].

**Figure 2.** Female pelvic floor anatomy, sagittal plane.



**Pelvic Floor Dysfunction (PFD)**

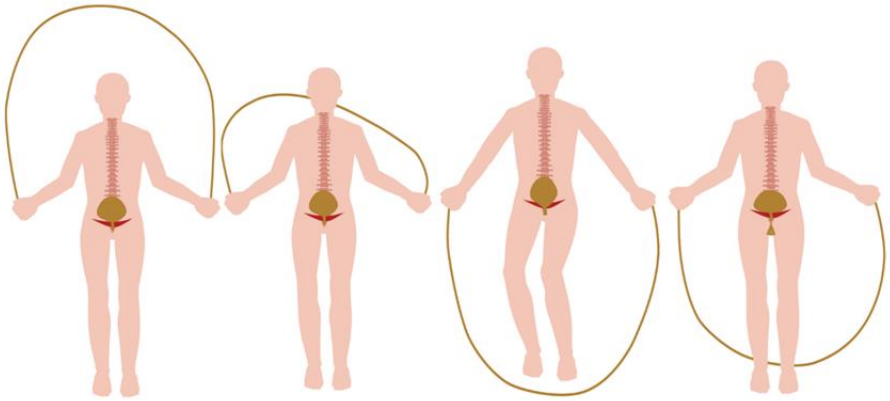
Anything that impacts the natural behaviour of the PFMs can lead to PFD symptoms such as pain, reduced pelvic organ support or compromised continence, voiding, and defecation. As such, PFD is an umbrella term that encompasses several diagnoses. Specifically, the following are all examples of PFD: urinary incontinence, fecal incontinence, pelvic organ prolapse, voiding dysfunction, obstructive defecation, dyspareunia, vaginismus, and vulvodynia.

For the aims of this chapter, the main definitions are reported below [7–10].

- *Urinary Incontinence (UI)*

  UI is the most prevalent PFD symptom in women, and it is described by the International Continence Society (ICS) as the involuntary loss of urine. There are three primary types: 1) stress urinary incontinence (SUI) (**Figure 3**), which can occur during activities such as coughing, sneezing, laughing, or exercising; 2) urge urinary incontinence (UUI), characterized by a sudden, intense need to urinate and 3) mixed urinary incontinence (MUI) which has both components. Athletic incontinence is then a specific definition proposed in 2017 by Araujo considering that is a specific condition that occurs in young and nulliparous women only while they are practicing sports [11].

**Figure 3**. Anatomy of SUI during rope skipping: urine loss during floor impact (credits to Prof. Tamara Rial-Rebullido).



- *Pelvic Organ Prolapse (POP)*

  POP is described as the descent of one or more of the anterior vaginal wall, posterior vaginal wall, uterus (cervix) or vaginal vault (cuff scar after hysterectomy). The presence of any such sign should be correlated with relevant POP symptoms. Women may experience pressure or a sensation of bulging in the pelvic area, and in severe cases, the organs may protrude from the vaginal opening.

- *Pelvic Pain Syndromes*

  Chronic pelvic pain is a complex condition that can have various underlying causes, including muscular, nerve-related, or organ-related issues. It can lead to pain and discomfort in the pelvic region, lower back, or hips, and may also be associated with pain during sexual intercourse.

- *Anal and Fecal Incontinence (AI, FI)*

  It is described as the complaint of involuntary loss of flatus or feces.

- *Overactive Bladder (OAB) syndrome*

  OAB is defined by ICS as urinary urgency, usually accompanied by increased daytime frequency and/or nocturia, with urinary incontinence (OAB-wet) or without (OAB-dry), in the absence of urinary tract infection or other detectable disease.

**Table 4** represents and summarises the main pelvic floor functions and dysfunctions.

**Table 4.** Most common pelvic floor functions and dysfunctions.

| **FUNCTION** | **DYSFUNCTION** |
|---|---|
| To ensure continence | SUI, UUI, MUI, athletic incontinence |
| | AI, FI |
| | OAB |
| To support of pelvic organs | POP |
| To collaborate during sexual activity | Pelvic pain |
| To represent birth canal | |
| To represent part of the core system | |

**The Vital Role Of The Pelvic Floor In Sports**

During sports and physical activities, the pelvic floor undergoes several physiological responses to support the body, maintain continence, and adapt to the demands of the movements involved. The response and role of the pelvic floor during sports may be summarized as follows:

- *Physiological responses*

  Current understanding of the behaviour and functionality of the PFMs is that they respond to movement-related load in an anticipatory and reflexive manner [12]. In activities such as running and jumping, studies have demonstrated that there is a lengthening of the PFMs and feed-forward muscle activation prior to an individual making impact with ground. This is then followed by reflex PFM activity in response to impact. This activation provides essential support to the pelvic organs (bladder, uterus, and rectum) and helps maintain urinary and fecal continence during high-impact activities such as running, jumping, and weightlifting. The responds have to be adjusted and adapted in relation to these forces and the demands. Although the evidence is conflicting regarding the role and speed of response of PFM activity and PFD, such as incontinence, the anticipatory and reflexive activation during movement has been consistently reported [12].

  In recent years, knowledge has advanced to take a more holistic view of the complex synergies and functions of the PFMs in connection with breathing mechanisms. Even if not with an unanimous scientific consensus, based on physiological studies, Talasz et all. proposed a basic concept from a theoretical viewpoint on PFMs activation and breathing. Authors supported a close coordination and co-contraction of expiratory muscle actions between the PFMs and the abdominal muscles, during intense physical exertion. This coordination seems to help strengthen the PFM and safeguard the pelvic floor against elevated IAP. Holding breath in an inspiratory pattern during exertion stresses the pelvic floor because the high IAP impinges on the relaxed, hence insufficiently protected, PFMs [5].

- *Impact and load absorption*

  Sports activities may involve high impact or heavy loads that put stress on the pelvic floor. The pelvic floor has not only to be strong enough, but also to be flexible to manage and distribute the forces appropriately, just like a trampoline.

- *Core stabilization*

  The pelvic floor is an integral part of the core musculature, working in tandem with the abdominal, diaphragm, and deep spinal muscles to provide stability to the trunk during sports movements. This stabilization is essential for maintaining balance and optimizing overall body control during dynamic activities, such as jumping, running, torsions or changing direction rapidly.

- *Relaxation and release*

  The pelvic floor also needs to relax and release to allow for proper breathing patterns and movement.

On the contrary, in case of these physiological modifications doesn't occur and there is a loss of adaptability to functional needs, athletes could have onset of symptoms.

**Impact Of Physical Activity And Sports On Pelvic Floor**

In 2004, Kari Bø proposed two hypotheses on the effects of physical activity and exercise training on the pelvic floor [15]:

1. *General exercise training strengthens the pelvic floor*

   According to this hypothesis, the impacts that occur during physical activity may stretch and fatigue the PFM, leading to an indirect training effect. In this case, practising sports could reduce the risk of PFD.

2. *General exercise training overloads, stretches, and weakens the pelvic floor*

   The hypothesis suggests that physical activity increases intra-abdominal pressure, and if the PFMs lack the ability to co-contract quickly or strongly enough to handle the task or

lack sufficient firmness and elasticity, the levator hiatus could widen, and the pelvic floor might descend.

Contemporary evidence provides updates on the support for each of these hypotheses [16]. Notably, no one of these considered breathing mechanisms and related physiological changes during physical exertion [3].

Anyway, it is reasonable to assume that the pathophysiology of PFD development is influenced by a combination of modifiable and nonmodifiable risk factors. As regards it is fundamental to underline that athletes are a unique group of patients who have higher functional demands, different behaviours and risk factors than the general population and may need a more detailed assessment [17].

Modifiable risk factors could include general factors like higher body mass and long-term constipation, as well as sport-related factors such as activities with higher impact, intensity, and the sport-specific motor gesture (e.g. individual technique, breathing pattern).

Nonmodifiable risk factors encompass general factors like age and family history, pregnancy-related factors like advanced maternal age and increasing parity, and labor-related factors like assisted deliveries and perineal trauma.

Therefore, it can be concluded that the threshold for optimal or negative effects on the pelvic floor likely varies from person to person. The two hypotheses coexist, indicating that there is no inherently "good" or "bad" activity/sport. Instead, it is probable that certain activities play a role in the development and exacerbation of PFD, particularly in women who already have other risk factors. In such cases, engaging in sports may reveal and exacerbate the condition.

**Specification Related to Sports-impact Classification**

Current sports classifications related to impact are based on the degree of mechanical loading in relation to bone mineral density reported by Torstveit in 2005[13] or definitions proposed by Sundgot-Borgen in 1993 [14] . However, there is no specific sports classification relating to the impact of such activities on the pelvic floor.

Considering that the impact of sports practice on the pelvic floor is closely linked to increased intra-abdominal pressure and ground reaction force, in the present thesis we considered sports as high-impact if: a) there is a recurrent jumping component as part of the required athletic gesture (e.g., gymnastics, basketball, volleyball, high jump, trampoline) or b) there are recurrent increases in intra-abdominal pressure as a gesture required for the athlete (e.g., powerlifting). Sports are considered medium-impact if, although not an integral part of every athlete's gesture, the sport includes phases in which a jumping component and increase in intra-abdominal pressure are required (running, tennis, karate, football, etc.). Sports that a) do not involve jumping and abdominal contraction as the pivotal activity, b) in which no direct ground contact is involved (e.g., swimming, cycling, figure roller skating), or c) in which the athlete's gesture requires no significant use of jumping or increased intra-abdominal pressure (softball, golf, yoga, walking) are treated as low-impact.

**The Paradox of Sports: The Complex Relationship Between Athleticism, Health, and PFD in Athletes**

The World Health Organization [18] advocates for the significance of exercise as a means of promoting overall health. However, it is essential to recognize that being an athlete does not automatically equate to being a healthy individual [19]. Notably, elite athletes often push themselves beyond conventional "healthy" limits. This includes practices such as training and competing despite experiencing pain or failing to allow sufficient time for recovery from injuries and illnesses, ultimately leading to conditions like overtraining or overreaching [19].

In addition to well-known conditions like Relative Energy Deficiency in Sports (RED-s) [20] and musculoskeletal disorders (e.g., stress fractures, muscle injuries, and ACL tears), athletes are also at risk of suffering from PFD. Research suggests that regular or light physical activity is associated with a reduced prevalence of urinary incontinence (UI) symptoms in sedentary individuals, but this relationship is not applicable for female athletes [19].

**The "Costs" Of PFD In Female Athletes' Lives And Sport Participation**

PFD can have varying impacts on daily life, usually slights impact on daily lives since symptoms are commonly presented during trainings or competitions [21,22].

A recent review highlighted that nine studies out 32 reported the impact of PFD on the athletes' emotions and there was limited information given in some of these studies. Embarrassment was the most frequently reported emotion followed by fear, concern and anxiety [23].

Among female athletes, PFD can result in decreased performance and even withdrawal from sports [23,24]. There are also long-term health problems associated with PFD in athletes, with early UI correlating to later-life symptoms [25]. These symptoms also pose significant barriers for women returning to exercise after childbirth [26]. Both the lack of physical activity and urinary incontinence come at a cost to women and society, underscoring the need for pelvic health awareness and rehabilitation as a public health priority in sports medicine [12].

## REFERENCES


1 Abrams P, Cardozo L, Wagg A, *et al. Incontinence*. 6th Editio. ICI-ICS. International Continence Society, Bristol UK 2017.

2 Bo K, Berghmans BC, Morkved S, *et al. Evidence-based physical therapy for the pelvic floor.* Second Edi. Elsevier 2015.

3 Talasz H, Kremser C, Talasz HJ, *et al.* Breathing , ( S ) Training and the Pelvic Floor — A Basic Concept. 2022;:1–11.

4 Eickmeyer SM. Anatomy and Physiology of the Pelvic Floor. *Phys Med Rehabil Clin N Am* 2017;**28**:455–60. doi:10.1016/j.pmr.2017.03.003

5 Okeahialam NA, Oldfield M, Stewart E, *et al.* Pelvic floor muscle training: a practical guide. *BMJ* 2022;**378**. doi:10.1136/bmj-2022-070186

6 Messelink B, Benson T, Berghmans B, *et al.* 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* 2005;**24**:374–80. doi:10.1002/nau.20144

7 Abrams P, Cardozo L, Fall M, *et al.* The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn* 2002;**21**:167–78. doi:10.1002/nau.10052

8 Haylen BT, De Ridder D, Freeman RM, *et al.* An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Int Urogynecol J* 2010;**21**:5–26. doi:10.1007/s00192-009-0976-9

9 Haylen BT, Maher CF, Barber MD, *et al.* An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic organ prolapse (POP). *Int Urogynecol J* 2016;**27**:655–84. doi:10.1007/s00192-016-

3003-y

10 D'Ancona C, Haylen B, Oelke M, *et al.* The International Continence Society (ICS) report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction. *Neurourol Urodyn* 2019;**38**:433–77. doi:10.1002/nau.23897

11 Araujo MP De, Girao MJBC, Sartori MGF. Athletic Incontinence : Proposal of a New Term for a New Woman Incontinência de atletas : proposta de novo termo para uma nova mulher. *Rev Bras Ginecol e Obstet* 2017;**39**:441–2.

12 Donnelly GM, Moore IS. Sports Medicine and the Pelvic Floor. *Curr Sports Med Rep* 2023;**22**:82–90. doi:10.1249/JSR.0000000000001045

13 Torstveit MK, Sundgot-Borgen J. Low bone mineral density is two to three times more prevalent in non-athletic premenopausal women than in elite athletes: A comprehensive controlled study. *Br J Sports Med* 2005;**39**:282–7. doi:10.1136/bjsm.2004.012781

14 Sundgot-Borgen J, Larsen S. Pathogenic weight-control methods and self-reported eating disorders in female elite athletes and controls. *Scand J Med \& Sci Sport* 1993;**3**:150–5. doi:https://doi.org/10.1111/j.1600-0838.1993.tb00379.x

15 Bø K. Urinary incontinence, pelvic floor dysfunction, exercise and sport. *Sport Med* 2004;**34**:451–64. doi:10.2165/00007256-200434070-00004

16 Bo K, Nygaard IE. Is Physical Activity Good or Bad for the Female Pelvic Floor? A Narrative Review. *Sports Med* 2020;**50**:471–84. doi:10.1007/s40279-019-01243-1

17 Giagio S, Innocenti T, Pillastrini P, *et al.* What is known from the existing literature about the available interventions for pelvic floor dysfunction among female athletes? A scoping review. *Neurourol Urodyn* 2022;**41**:573–84. doi:10.1002/nau.24883

18 Bull FC, Al-Ansari SS, Biddle S, *et al.* World Health Organization 2020 guidelines on physical activity and sedentary behaviour. *Br J Sports Med* 2020;**54**:1451–62. doi:10.1136/bjsports-2020-102955

19 Carvalhais A, Da Roza T, Sacomori C. Pelvic floor in female athletes: From function to dysfunction. *Lect Notes Comput Vis Biomech* 2018;**29**:145–53. doi:10.1007/978-3-319-

71574-2_12

20 Mountjoy M, Sundgot-Borgen JK, Burke LM, *et al.* IOC consensus statement on relative energy deficiency in sport (RED-S): 2018 update. *Br J Sports Med* 2018;**52**:687–97. doi:10.1136/bjsports-2018-099193

21 Jácome C, Oliveira D, Marques A, *et al.* Prevalence and impact of urinary incontinence among female athletes. *Int J Gynecol Obstet* 2011;**114**:60–3. doi:10.1016/j.ijgo.2011.02.004

22 Da Roza T, Brandão S, Mascarenhas T, *et al.* Volume of training and the ranking level are associated with the leakage of urine in young female trampolinists. *Clin J Sport Med* 2015;**25**:270–5. doi:10.1097/JSM.0000000000000129

23 Culleton-Quinn E, Bø K, Fleming N, *et al. Elite female athletes' experiences of symptoms of pelvic floor dysfunction: A systematic review*. Springer International Publishing 2022. doi:10.1007/s00192-022-05302-6

24 Nygaard I, Girts T, Fultz NH, *et al.* Is urinary incontinence a barrier to exercise in women? *Obstet Gynecol* 2005;**106**:307–14. doi:10.1097/01.AOG.0000168455.39156.0f

25 Eliasson K, Edner A, Mattsson E. Urinary incontinence in very young and mostly nulliparous women with a history of regular organised high-impact trampoline training: Occurrence and risk factors. *Int Urogynecol J* 2008;**19**:687–96. doi:10.1007/s00192-007-0508-4

26 Moore IS, James ML, Brockwell E, *et al.* Multidisciplinary, biopsychosocial factors contributing to return to running and running related stress urinary incontinence in postpartum women. *Br J Sports Med* 2021;**55**:1286–92. doi:10.1136/bjsports-2021-104168

## AIMS OF THE THESIS

### Overall aim

This PhD project aimed to investigate and summarise the available evidence on PFD prevalence data and interventions for female athletes, to improve the screening referral and pathway, and to disseminate evidence-based information to all sports field stakeholders.

The ultimate goal is to raise awareness of the topic among athletes, their teams, and all medical professionals working in sports medicine, such as physiotherapists and sports medicine doctors. The integration of pelvic floor health into sports medicine aims to improve overall athletes' health management through constant support and monitoring.

### Specific aims

**Study 1:** To provide an overview of the available evidence concerning PFD epidemiological data among female and male athletes, through a review of the literature.

**Study 2:** To provide an overview of the available evidence concerning interventions for PFD among female athletes, through a review of the literature.

**Study 3:** Using data of previous articles, to develop a screening tool for PFD in female athletes for use by sports medicine clinicians, which guides referral to a PFD specialist (eg, pelvic floor/women's health physiotherapist, gynaecologist, urogynaecologist, urologist), through a worldwide e-survey using the Delphi technique.

**Study 4:** To disseminate and raise awareness through truthful, accurate and evidence-based information on the topic between sports medicine stakeholders: athletes, healthcare professionals (e.g. uro/gynecologists and pelvic floor physiotherapists) and coaches.

## ABSTRACT

**Background.** Pelvic floor dysfunction (PFD) is an umbrella term that includes a myriad of conditions such as urinary (UI) and anal incontinence, pelvic organ prolapse, pelvic pain, and sexual dysfunction. Literature showed high prevalence rates of PFD among athletes, especially UI with high-impact sports have been linked with an increased risk of developing symptoms. However, comprehensive research summarising PFD prevalence across sexes, exploring treatment options, and the absence of a standardised referral screening tool are notable gaps. Misinformation is also prevalent in the sports medicine field.

**Methods and aims.** This doctoral project comprises four studies addressing different aspects of pelvic health in athletes. The first two studies were scoping reviews of epidemiological PFD data in male and female athletes, as well as available interventions. Study 3 concerned the development of a new screening tool for PFD in female athletes, aiming to guide sports medicine clinicians in referring patients to PFD specialists through a worldwide Delphi consensus. Study 4 summarised all previous findings, integrating data into an infographic.

**Results and conclusions.** In Study 1, the findings of 100 articles on PFD in both sexes have been collected, highlighting a higher prevalence of studies on female athletes evaluating UI across multiple sports. Other conditions remain rarely investigated. Study 2 found a diverse range of interventions for female PFD, with a notable emphasis on conservative approaches. Recommendations for clinical practice often relied on the transferability of results from the nonathlete population or expert opinions. In Study 3, 41 international experts took part in the consensus development of the Pelvic Floor Dysfunction-ScrEeNing Tool IN fEmale athLetes (PFD-SENTINEL). It incorporates a cluster of PFD symptoms, items (risk factors, clinical, and sports-related characteristics), and a clinical algorithm. Lastly, Study 4 included ten evidence-based information with a relative description concerning pelvic floor health in athletes.

## LIST OF ARTICLES

| # | REFERENCE |
|---|---|
| **1** | Giagio S, Salvioli S, Pillastrini P, Innocenti T. Sport and pelvic floor dysfunction in male and female athletes: A scoping review. Neurourol Urodyn. 2021;40(1):55-64. doi:10.1002/nau.24564 |
| **2** | Giagio S, Innocenti T, Pillastrini P, Gava G, Salvioli S. What is known from the existing literature about the available interventions for pelvic floor dysfunction among female athletes? A scoping review. Neurourol Urodyn. 2022;41(2):573-584. doi:10.1002/nau.24883 |
| **3** | Giagio S, Salvioli S, Innocenti T, et al. PFD-SENTINEL: Development of a screening tool for pelvic floor dysfunction in female athletes through an international Delphi consensus. Br J Sports Med. 2023;57(14):899-905. doi:10.1136/bjsports-2022-105985 |
| **4** | Giagio S, Stracciolini A, Faigenbaum A, Pillastrini P, Rial Rebullido T. Infographic. Ten naked truths about the pelvic floor in athletes [published online ahead of print, 2023 Sep 4]. Br J Sports Med. 2023;bjsports-2023-107241. doi:10.1136/bjsports-2023-107241 |

## 5.1 SPORT AND PELVIC FLOOR DYSFUNCTION IN MALE AND FEMALE ATHLETES: A SCOPING REVIEW

**Reference:** Giagio S, Salvioli S, Pillastrini P, Innocenti T. Sport and pelvic floor dysfunction in male and female athletes: A scoping review. Neurourol Urodyn. 2021;40(1):55-64. doi:10.1002/nau.24564

**Objective:** To systematically map and summarize findings to identify any study that reported epidemiological data on pelvic floor dysfunction (PFD) among male and female athletes.

**International oral presentation:** 2020 International Continence Society (ICS) Congress, "Podium Short Oral Session 23 Pelvic Floor Dysfunction 1 #360". Presenter: Silvia Giagio.

## ABSTRACT

**Aims.** The aims of the present scoping review were to systematically map and summarize findings in order to identify any study that reported epidemiological data on pelvic floor dysfunction (PFD) among male and female athletes.

**Methods.** Six medical databases were searched up to March 2020. No language, study design and publication type restrictions were applied. Additional studies were identified through grey literature and the reference lists of articles were screened. The results were presented numerically and thematically.

**Results.** 4,358 records were identified with an initial search. 100 studies met the criteria for inclusion. The number of studies published annually increased over the years. Cross-sectional studies (n=62), urinary incontinence (n=64), multiple sports (n=58), female athletes (n=83) are the most investigated study design, condition, sport and population, respectively. Only 12 studies explored PFD in the male population. Authors focused selectively on elite athletes in 21 studies.

**Conclusions.** This is the first scoping review to provide a comprehensive overview of the topic. The major gaps in literature include studies focused on male participants, other PFD (e.g. anal incontinence, pelvic organ prolapse, pelvic pain), with appropriate study design.

This review may be useful to raise awareness of the issue among clinicians and stakeholders in sport and it may represent a starting point for future research.

## INTRODUCTION

Pelvic floor dysfunction (PFD) is a term used to describe symptoms, signs and conditions primarily affecting women, with or without moderate to severe impairment of the pelvic floor muscles (PFM)[1–5]. The true incidence is unknown, but it is common in both sexes [6]. These functional and anatomic changes may cause social, psychological, physical and sexual dysfunction, and can dramatically reduce the quality of life (QoL) of people affected [7,8].

The existing literature suggests that regular lifelong exercise is clearly linked to better health conditions and longer life expectancy and there is evidence that "exercise is medicine" for a wide range of diseases and conditions[9]. While the sport population is presumed to be very fit and healthy compared to the corresponding sex and age-group populations [10], this is not always the case. Beyond the most investigated overuse injuries and musculoskeletal disorders[11–13], the main example to cite is the pelvic floor, which has been overlooked [14].

For females, it is already known that some sports, such as high-impact ones (e.g. gymnastics), are associated with an increased risk of developing PFD [14,15], in particular urinary incontinence (UI)[16]. A large number of primary studies and reviews have been published on specific sports and/or disorders, but there is a lack of an overall summary of evidence.

Considering males, some authors [17] highlighted an important sex bias in research dealing with PFD in favor of woman. Furthermore, studies have primarily focused on diagnosis and treatment of incontinence after radical prostatectomy[18,19] and erectile dysfunction (ED) [20,21]. As regards athlete population and risk factors, as early as 1997, Andersen et al.[22] showed that cycling could be associated with an increased risk of developing ED. However, less is known about other epidemiological data and the effect of different sports on the pelvic floor of males. To date, no reviews have been published including all sports and any possible related PFD.

Therefore, what did the literature focus on? What are the current research fields? To our knowledge, there is no comprehensive overview of PFD among athletes.

An exploration of the existing literature in the field will increase awareness of the problem in this population at different levels. In fact, it is important that clinicians who monitor and treat athletes

are informed of the epidemiological data on sport and PFD. This awareness should be also extended to team coaches and athletic trainers who are constantly in contact with the athlete. From a researcher's perspective, knowing literature gaps should also stimulate further studies. In these respects, exhaustive research on the topic including a comparison between the female and male population may represent a starting point.

As maintained by the Joanna Briggs Institute (JBI)[23], a scoping review approach may be used to map and clarify key concepts, identify gaps in the research knowledge base, and report on the types of evidence that address and inform practice in the field. These aims corresponded to the objectives of this project. For this reason, other types of review, such as systematic reviews, or rapid reviews, were not deemed to be methodologically effective. In particular, this scoping review aims to:

1. Systematically map and summarize the literature in order to identify any study that reported epidemiological data on sport and PFD. More specifically, it aims to identify and summarize studies based on the type of sport, PFD and the athlete's sex. Pelvic floor dysfunctions are classified following the International Continence Society (ICS) standardized terminology[1–5] (**SUPPLEMENTARY FILE 1**).
2. Identify any knowledge gaps on the topic.

## METHODS

The latest review process proposed in 2020 by the Joanna Briggs Institute [23] and The Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist for reporting were used [24]. This scoping review was registered prospectively with the Open Science Framework [25].

### Identification of the research question

The following research question was formulated: "What is known from the existing literature about studies that reported epidemiological data on sport and PFD?".

**Inclusion criteria**

Studies were included if they met the following population, concept and context criteria.

- *Type of participants.* We included athletes of any age, practicing any type of sport and performance level (e.g. professional/elite, amateurs/master/recreational athletes), male and female. We accepted the definition of 'athlete' used in an individual study, as a main criterion. Articles were also eligible for inclusion if a subgroup analysis considering the specific "athlete" population was performed.
- *Concept.* Any PFD reported by each study.
- *Context.* Any context.
- *Types of sources of evidence.* This review considered any study design or publication type that reported epidemiological data on athletes practicing sport and PFD. No time, geographical, setting and language restrictions were applied.

*Exclusion criteria*

- Studies did not meet the specific above-stated criteria.

**Search strategy**

An initial limited search of MEDLINE was undertaken by a librarian to identify articles on the topic and then index terms to develop a full search strategy were used (**SUPPLEMENTARY FILE 2**). Literature research was carried out on the following database: MEDLINE, Cochrane Central, Scopus, CINHAL, Embase and PEDro. Additional records were identified through grey literature (e.g. Google scholar). We checked the reference lists of all relevant studies. Searches were conducted on 18th March 2020 with no date limit.

**Study selection**

Once the search strategy was successfully completed, search results were collated and exported to EndNote V.X9 (Clarivate Analytics, PA, USA). Duplicates were automatically removed. The review process consisted of two levels of screening using Rayyan QCRI online software [26]: (1) a

title and abstract review and (2) full-text review. For both of levels, two authors independently screened the articles with conflicts resolved by a third author. The reasons for the exclusion were recorded and presented in the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram.

**Data extraction**

For each outcome, key information from the included texts was extracted into an ad-hoc data form. This form was reviewed by the research team and pre-tested by all reviewers before implementation to ensure that the form collected the information accurately. Information included author, year, country (where the study was published/conducted), study design, population characteristics, pelvic floor dysfunction and sport. For data extraction, we considered UI, stress urinary incontinence (SUI) and urgency urinary incontinence (UUI) as a single group of "urinary incontinence".

**Data synthesis**

The results were presented in two ways.

1. Numerically. We summarized and reported collated data as a descriptive analysis: mapping the data, showing distribution of studies by period of publication, country, study design and theme. Results are reported in tabular and diagrammatic form.
2. Thematically. A thematic summary pertaining to pelvic floor dysfunction in the subgroups of male and female athletes was performed. A specific analysis for the elite group was reported.

The classification used to establish the different degrees of mechanical loading for each group of sport was the one reported by Torstveit [27] in 2005 and recently used by De Mattos [15]. As for the performance level, analysis was performed on the basis of the classification described by each author.

## RESULTS

Of the 4,358 studies identified by the initial literature searches, 4,258 were excluded and 100 studies were included. The reasons for exclusion and the corresponding references are reported in online supplementary file (**SUPPLEMENTARY FILE 3)**. An overview of the study identification process is provided in the PRISMA flow-diagram (**SUPPLEMENTARY FILE 4**).

### Study characteristics

A complete summary and references of studies is reported in the online supplementary file (**SUPPLEMENTARY FILE 5**). A taxonomy [28] of research designs is shown in detail graphically (**SUPPLEMENTARY FILE 6**). Most study designs were cross-sectional (n=62), while 17 were narrative reviews. In the reviews published in the last 2 years [15,16,29–32], the search strategy and the number of studies included were clearly defined. Among systematic reviews, only one study conducted a metanalysis [32]. Research studies were identified from 25 different countries and in 5 languages: Portuguese [33–36], French [37], Spanish [38], Italian [39] and English. Figure 1 illustrates the distribution of the studies included by country and year of publication (**FIGURE 1)**. In particular, 6 studies were published between 1990 and 1999, 23 in the years 2000-2009 and 71 between 2010 and March 2020. United States and Brazil yielded the highest number of publications (n=26 and n= 20, respectively).

### Participants

This scoping review summarizes the results of a total of about 46,977 participants. The target population in the 100 studies examined included female athletes (**TABLE 1**). Participants represented a variety of sport participation level: 21 studies focused only on elite athletes and 6 on amateur/recreational athlete [37,40–44]. In 61 articles the authors defined the participants as "athletes", but the performance level is not clearly specified.

**Elite athletes**

For the descriptive analysis, we included in this subgroup athletes described as top level/high level/professional/elite. In particular, only one study involved male elite athletes [45]. In this case, authors assessed the presence of ED among football players. On the other hand, high impact sports (gymnastic, n=2[46,47]; cheerleading, n=1) and multiple sports (n=17) were investigated among elite female athletes.

**Sport**

Considering studies that focused only on one sport, cycling (n=11), running (n=5) and CrossFit (n=5) were the most investigated. Authors explored the relationship between multiple sports and PFD in 58 studies. The analysis of the sports divided into three groups based on the degree of mechanical loading [27] is described in Table 2 (**TABLE 2**).

In our summary, trampolinists and rhythmic gymnasts were considered as gymnastics athletes. In detail, Figure 2 graphically illustrates the classification divided by the sex of the athletes (**FIGURE 2**).

**Pelvic floor dysfunction**

Urinary incontinence was the most common pelvic floor symptom assessed; it is present in 64 studies. A paucity of authors specifically investigated other pelvic floor symptoms; for example, anal incontinence (AI) (n=2) [48,49], pelvic organ prolapse (POP) (n=1)[50] and pelvic pain (n=2)[51,52] (**TABLE 3**). 26 studies reported results on more than one PFD.

**Female athletes and PFD**

Considering only the female population, the majority of studies focused on high impact (CrossFit, n=5; gymnastic, n=4) and medium impact sports (running, n=4). Table 3 shows the complete analysis according to PFD, sex and study design.

**Male athletes and PFD**

Only 12% of authors explored pelvic floor dysfunction in male athletes. Cycling (a low impact sport) and ED were the most frequent types of sport and PFD evaluated, respectively (**TABLE 3**).

## DISCUSSION

In the present scoping review, we mapped and summarized the current literature reporting epidemiological data on PFD in the athlete population.

As of today, considering that there is no existing comprehensive published overview in this field, a scoping review represents the most effective and appropriate study design [23].

The annual frequency of studies has risen considerably in recent years highlighting the global interest (**FIGURE 2**) in this field. This positive trend also includes a higher number of countries and research teams worldwide. In 1990-1994 three studies were published from two different countries, while we identified 54 studies from more than 20 countries between 2015 and March 2020.

This review highlighted two major problems in the current literature: the definition of "athlete" and the issue of standardized terminology for PFD.

Across the studies, we found the use of non-standardized terms. For example, some authors defined urinary incontinence as "urine leakage" and "urine loss". This fact refers not to recent studies in most cases, but must be considered during the search process.

On the other hand, the issue of the "athlete" is more consistent. Current definitions of an athlete range from being loosely defined to overly restrictive or are based on different qualitative subjective descriptors. In the last 4 years, several authors [10,53] have discussed how to define and characterize the population of patients considered as athletes; different standardizations have been proposed to the research community, but a consensus has not yet been reached. To overcome this problem, an accurate and clear description of the athlete's characteristics should at least be reported. However, considering the studies included in this review, these details were poorly

reported; in 61% of articles authors defined the participants generically as “athletes”. In the remaining studies, elite group (n=21) is described in several ways such as high level, top level and professionals. The lack of shared descriptors and the simultaneous lack of details negatively impact comparison between studies and transferability of results.

**Greater focus on female athletes and urinary incontinence**

We have shown areas where the evidence base is well developed, and areas where findings are limited or mixed (**TABLE 2, 3**).

Females and males differ in key areas of anatomy and physiology relevant to sports training, but perhaps the biggest difference is the often overlooked pelvic floor [14]. This disparity reflects the number of studies available: 83 of the 100 articles reviewed focused only on female athletes. Although data supporting the two hypotheses of PFD are still scant [14], high impact sports (Crossfit, gymnastics) are the activities most explored among females. In particular, several systematic reviews showed a high prevalence of UI in athletes practicing this type of sport, especially in gymnastics [54]. In this case, gymnasts may have a pelvic floor that can withstand the forces generated from landing on the floor exercise mat, but which may leak when an athlete lands on the beam [14] (**SUPPLEMENTARY FILE 7**).

Due to the limited data available from other sports and populations, it is possible that PFD may be an underestimated condition. Studies evaluating the incidence of disorders, as well as prevalence data, are also needed. This consideration could be extended to male athletes, too. Differently from research involving female participants, several authors investigated PFD in males practicing low impact sports (e.g. cycling).

More than one sport was considered in the majority of studies (n=58); unfortunately, in most cases results are not presented divided by each sport. Similarly to the results of Cerruto et al.[16], there is a lack of studies exploring AI in athletes. Moreover, very few studies have estimated POP and pelvic pain in all types of athletes.

**Implications for clinical practice**

Scoping reviews are not conducted to develop trustworthy clinical guidelines and recommendations, but implications for practice may be provided in terms of guidance provided from a clinical point of view[23].

The current literature and the present findings give rise to many considerations, as follows. Although with the limitations discussed below, several authors have investigated PFD among athletes looking at different conditions, different populations and different type of sports practiced by both sexes. Despite this growing interest, the condition has received limited attention by sports medicine healthcare practitioners and exercise science organizations [55]. For instance, the recently updated consensus statement on the issues of female athletes addressed to the team physician did not make any specific reference to PFD [56].

Furthermore, considering that the threshold for optimal or negative effects on the pelvic floor almost certainly differs from person to person [14,55], and that the problem is not openly discussed, the assessment of potential PFD should be encouraged in clinical practice. In these terms, specific clinical questions to screen for incidence of PFD should be included during an initial examination. In addition, a constructive dialogue among different professionals (e.g. clinicians in the areas of sports medicine, physical therapy, gynecology, urology), team coaches and athletic trainers should be promoted.

**Research implications**

From the perspective of planning future research, the gaps and issues in literature highlighted in this scoping review may assist in its development.

First, the results of this study encourage researchers to better document their reporting concerning the population's characteristics, also aligning with the standardized terminology of clinical conditions.

Our findings are in line with some suggestions recently proposed by Bo [14]. Further studies should evaluate understudied outcomes such as AI and POP, enhancing under-represented research

design (e.g. prospective cohort, large and generalizable sample). The collection of studies included in this review offers other opportunities in various directions: a) the assessment of PFD in a large number of sports, b) a more detailed analysis in the male population and c) up-to-date systematic review including both sexes.

This review has also identified a literature gap in articles published from several countries, which could limit the understanding of the burden at a global level. Recent findings suggest that there are many disparities in the general female population with pelvic floor disorders including race [57].

**Strengths and limitations**

This is the first scoping review of such a broad range of studies that has reported epidemiological data on sport and pelvic floor dysfunction. This review considered both the male and female population, and it identified the volume and distribution of the evidence base. We have also mapped the key concepts and research priorities within the literature.

The strength of this study is the methodology. In order to collect the highest possible number of studies in the field, we carried out a sensitive search strategy including different terms (**SUPPLEMENTARY FILE 2).** In addition, the search strategy was conducted on the main databases without any type of restriction. In accordance with the aims of scoping reviews the inclusion criteria were deliberately very broad[40] and it has been possible to gather findings from different sources. Furthermore, to document the completeness and the transparency of the reporting, the PRISMA for Scoping Reviews Checklist was used.

On the other hand, there are some limitations to consider. First, we accepted the definition of 'athlete' as it was used in an individual study. As discussed below, given that this definition is still controversial, different studies may have described athletes in different ways.

In addition, scoping reviews are comprehensive, but not exhaustive, in identifying literature; we focused only on studies that reported epidemiological data as their main outcome. Although we

followed a rigorous approach and included any type of publication, this strategy may have excluded findings from studies responding to other research questions.

## CONCLUSION

This study identified 100 studies investigating PFD among male and female athletes. This review showed an increasing research interest since 1990. Findings displayed a higher prevalence rate of studies among female athletes, evaluating UI in multiple sports. Anal incontinence, pelvic organ prolapse, pelvic pain were conditions infrequently investigated. Few studies focused on male participants.

We also identified two issues in literature; the scare use of the standardized terminology for PFD and the limited descriptors reported by authors to outline athlete participants.

PFD in this population is an evident clinical issue that could differ from athlete to athlete. Clinicians should be encouraged to screen for incidence of any possible dysfunction. This review may be useful to raise awareness of the issue among clinicians and stakeholders in sport. Despite the growth in the evidence base, given the importance of topic, several evidence gaps were still identified. This review may serve as a starting point for future research initiatives.

## FUNDING

None declared.

**REFERENCES**


1. Abrams P, Cardozo L, Fall M, et al. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn*. 2002;21(2):167-178. doi:10.1002/nau.10052

2. D'Ancona C, Haylen B, Oelke M, et al. The International Continence Society (ICS) report on the terminology for adult male lower urinary tract and pelvic floor symptoms and dysfunction. *Neurourol Urodyn*. 2019;38(2):433-477. doi:10.1002/nau.23897

3. Haylen BT, Maher CF, Barber MD, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic organ prolapse (POP). *Int Urogynecol J*. 2016;27(4):655-684. doi:10.1007/s00192-016-3003-y

4. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29(1):4-20. doi:10.1002/nau.20798

5. Rogers RG, Pauls RN, Thakar R, et al. An international Urogynecological association (IUGA)/international continence society (ICS) joint report on the terminology for the assessment of sexual health of women with pelvic floor dysfunction. *Int Urogynecol J*. 2018;29(5):647-666. doi:10.1007/s00192-018-3603-9

6. Silviera M, Keller DS. Chapter 150 - Pelvic Floor Dysfunction. In: Yeo 2 Volume Set (Eighth Edition) CJBT-SS of the AT, ed. Philadelphia 2019;1750-1760. doi:https://doi.org/10.1016/B978-0-323-40232-3.00150-3

7. Mazi B, Kaddour O, Al-Badr A. Depression symptoms in women with pelvic floor dysfunction: a case-control study. *Int J Womens Health*. 2019;11:143-148.

doi:10.2147/IJWH.S187417

8. Verbeek M, Hayward L. Pelvic Floor Dysfunction And Its Effect On Quality Of Sexual Life. *Sex Med Rev*. 2019;7(4):559-564. doi:https://doi.org/10.1016/j.sxmr.2019.05.007

9. Pedersen BK, Saltin B. Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scand J Med Sci Sports*. 2015;25 Suppl 3:1-72. doi:10.1111/sms.12581

10. Araujo CGS, Scharhag J. Athlete: a working definition for medical and health sciences research. *Scand J Med Sci Sports*. 2016;26(1):4-7. doi:10.1111/sms.12632

11. Aasa U, Svartholm I, Andersson F, Berglund L. Injuries among weightlifters and powerlifters: a systematic review. *Br J Sports Med*. 2017;51(4):211-219. doi:10.1136/bjsports-2016-096037

12. Wright AA, Taylor JB, Ford KR, Siska L, Smoliga JM. Risk factors associated with lower extremity stress fractures in runners: a systematic review with meta-analysis. *Br J Sports Med*. 2015;49(23):1517-1523. doi:10.1136/bjsports-2015-094828

13. Tooth C, Gofflot A, Schwartz C, et al. Risk Factors of Overuse Shoulder Injuries in Overhead Athletes: A Systematic Review. *Sports Health*. 2020;12(5):478-487. doi:10.1177/1941738120931764

14. Bo K, Nygaard IE. Is Physical Activity Good or Bad for the Female Pelvic Floor? A Narrative Review. *Sports Med*. 2020;50(3):471-484. doi:10.1007/s40279-019-01243-1

15. de Mattos Lourenco TR, Matsuoka PK, Baracat EC, Haddad JM. Urinary incontinence in female athletes: a systematic review. *Int Urogynecol J*. 2018;29(12):1757-1763. doi:10.1007/s00192-018-3629-z

16. Cerruto MA, Balzarro M, Rubilotta E, et al. Lower urinary tract and gastrointestinal dysfunction in sportswomen: systematic review and meta-analysis of observational

studies. *Minerva Urol Nefrol*. November 2019. doi:10.23736/S0393-2249.19.03582-3

17. Cohen D, Gonzalez J, Goldstein I. The Role of Pelvic Floor Muscles in Male Sexual Dysfunction and Pelvic Pain. *Sex Med Rev*. 2016;4(1):53-62. doi:10.1016/j.sxmr.2015.10.001

18. Das AK, Kucherov V, Glick L, Chung P. Male urinary incontinence after prostate disease treatment. *Can J Urol*. 2020;27(S3):36-43.

19. Anderson CA, Omar MI, Campbell SE, Hunter KF, Cody JD, Glazener CMA. Conservative management for postprostatectomy urinary incontinence. *Cochrane Database Syst Rev*. 2015;(1). doi:10.1002/14651858.CD001843.pub5

20. Capogrosso P, Boeri L, Pozzi E, et al. Is It Compulsory to Investigate for Erectile Dysfunction in Patients Presenting for Low Urinary Tract Symptoms? *Eur Urol Focus*. August 2019. doi:10.1016/j.euf.2019.08.007

21. Stridh A, Pontén M, Arver S, Kirsch I, Abé C, Jensen KB. Placebo Responses Among Men With Erectile Dysfunction Enrolled in Phosphodiesterase 5 Inhibitor Trials: A Systematic Review and Meta-analysis. *JAMA Netw open*. 2020;3(3):e201423. doi:10.1001/jamanetworkopen.2020.1423

22. Andersen K V, Bovim G. Impotence and nerve entrapment in long distance amateur cyclists. *Acta Neurol Scand*. 1997;95(4):233-240. doi:10.1111/j.1600-0404.1997.tb00104.x

23. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Chapter 11: Scoping Reviews (2020 version). In: Aromataris E MZ (Editors), ed. *Joanna Briggs Institute Reviewer's Manual, JBI* ; 2020.

24. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;169(7):467-473.

doi:10.7326/M18-0850

25. Giagio S, Salvioli S, Bortolami B, Pillastrini P, Innocenti T. Sport and pelvic floor dysfunction in male and female athletes: A scoping review protocol. OSF. Published online 2020. doi:10.17605/OSF.IO/KGS9T

26. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. *Syst Rev*. 2016;5(1):210. doi:10.1186/s13643-016-0384-4

27. Torstveit MK, Sundgot-Borgen J. Low bone mineral density is two to three times more prevalent in non-athletic premenopausal women than in elite athletes: A comprehensive controlled study. *Br J Sports Med*. 2005;39(5):282-287. doi:10.1136/bjsm.2004.012781

28. Cartabellotta A. [Evidence-based medicine. 1. The transfer of research results to clinical practice. The Italian Group for Evidence-Based Medicine-GIMBE]. *Recenti Prog Med*. 1998;89(3):140-150.

29. Panara K, Masterson JM, Savio LF, Ramasamy R. Adverse Effects of Common Sports and Recreational Activities on Male Reproduction. *Eur Urol Focus*. 2019;5(6):1146-1151. doi:10.1016/j.euf.2018.04.013

30. Chisholm L, Delpe S, Priest T, Reynolds WS. Physical Activity and Stress Incontinence in Women. *Curr Bladder Dysfunct Rep*. 2019;14(3):174-179. doi:10.1007/s11884-019-00519-6

31. Almousa S, Bandin Van Loon A. The prevalence of urinary incontinence in nulliparous female sportswomen: A systematic review. *J Sports Sci*. 2019;37(14):1663-1672. doi:10.1080/02640414.2019.1585312

32. Teixeira RV, Colla C, Sbruzzi G, Mallmann A, Paiva LL. Prevalence of urinary incontinence in female athletes: a systematic review with meta-analysis. *Int Urogynecol J*. 2018;29(12):1717-1725. doi:10.1007/s00192-018-3651-1

33. Araujo MP de, Oliveira E de, Zucchi EVM, Trevisani VFM, Girao MJBC, Sartori MGF. [The relationship between urinary incontinence and eating disorders in female long-distance runners]. *Rev Assoc Med Bras*. 2008;54(2):146-149. doi:10.1590/s0104-42302008000200018

34. Araujo MP de, Parmigiano TR, Negra LG Della, et al. Avaliação do assoalho pélvico de atletas: Existe relação com a incontinência urinária? *Rev Bras Med do Esporte*. 2015;21(6):442-446. doi:10.1590/1517-869220152106140065

35. Martins LA, Santos KM dos, Dorcínio MBA, Alves JO, Roza T da, Luz SCT da. A perda de urina é influenciada pela modalidade esportiva ou pela carga de treino? Uma revisão sistemática. *Rev Bras Med do Esporte*. 2017. doi:10.1590/1517-869220172301163216

36. Patrizzi LJ, Viana DA, Silva LMA, Pegorari MS. Incontinência Urinária em Mulheres Jovens Praticantes de Exercício Físico. *Rev Bras Ciência e Mov*. 2014;22(3):105-110. doi:10.18511/0103-1716/rbcm.v22n3p105-110

37. Abitteboul Y, Leonard F, Mouly L, Riviere D, Oustric S. Incontinence urinaire chez des coureuses de loisir de marathon. *Prog en Urol*. 2015;25(11):636-641. doi:10.1016/j.purol.2015.05.009

38. Cabrera Guerra M. Revisión La incontinencia urinaria en la mujer deportista de élite Urinary incontinence in the elite woman athlete. *Rev Iberoam Fisioter y Kinesiol*. 2006;2:78-89.

39. Gulino G, Sasso F, D'Onofrio A, et al. [Sport, infertility and erectile dysfunction]. *Urologia*. 2010;77(2):100-106.

40. Piazza N, Silvestre P, Mazzariol C, Di Tonno F, Beffa F Della, Pianon C. Prevalence of erectile dysfunction and lower urinary tract symptoms in cyclists. *J Andrological Sci*. 2008;15(3-4):170-176.

41. Salvatore S, Serati M, Laterza R, Uccella S, Torella M, Bolis PF. The impact of urinary stress incontinence in young and middle-age women practising recreational sports activity: An epidemiological study. *Br J Sports Med*. 2009;43(14):1115-1118. doi:10.1136/bjsm.2008.049072

42. Kim DG, Kim DW, Park JK. Does bicycle riding impact the development of lower urinary tract symptoms and sexual dysfunction in men? *Korean J Urol*. 2011;52(5):350-354. doi:10.4111/kju.2011.52.5.350

43. Fernandes A, Fitz F, Silva A, Filoni E, Filho JM. Evaluation of the Prevalence of Urinary Incontinence Symptoms in Adolescent Female Soccer Players and their Impact on Quality of Life. *Occup Environ Med*. 2014;71(Suppl 1):A59 LP-A60. doi:10.1136/oemed-2014-102362.184

44. Reagan KM, Steinberg AC. Impact of pelvic floor dysfunction on recreational runners. *Female Pelvic Med Reconstr Surg*. 2016;22(Suppl1)(5):P142.

45. Grashow R, Weisskopf MG, Miller KK, et al. Association of Concussion Symptoms with Testosterone Levels and Erectile Dysfunction in Former Professional US-Style Football Players. *JAMA Neurol*. 2019;76(12):1428-1438. doi:10.1001/jamaneurol.2019.2664

46. Eliasson K, Larsson T, Mattsson E. Prevalence of stress incontinence in nullipanous elite trampolinists. *Scand J Med Sci Sport*. 2002;12(2):106-110. doi:10.1034/j.1600-0838.2002.120207.x

47. Gram MCD, Kari B. High level rhythmic gymnasts and urinary incontinence: Prevalence, risk factors, and influence on performance. *Scand J Med Sci Sport*. 2020;30(1):159-165. doi:10.1111/sms.13548

48. Sullivan SN, Wong C, Heidenheim P. Does running cause gastrointestinal symptoms? A survey of 93 randomly selected runners compared with controls. *N Z Med J*.

1994;107(984):328-331.

49. Vitton V, Baumstarck-Barrau K, Brardjanian S, Caballe I, Bouvier M, Grimaud JC. Impact of high-level sport practice on anal incontinence in a healthy young female population. *J Women's Heal*. 2011;20(5):757-763. doi:10.1089/jwh.2010.2454

50. Forner LB, Beckman EM, Smith MD. Symptoms of pelvic organ prolapse in women who lift heavy weights for exercise: a cross-sectional survey. *Int Urogynecol J*. 2019. doi:10.1007/s00192-019-04163-w

51. Zhang R, Chomistek AK, Dimitrakoff JD, et al. Physical activity and chronic prostatitis/chronic pelvic pain syndrome. *Med Sci Sports Exerc*. 2015;47(4):757-764. doi:10.1249/MSS.0000000000000472

52. Bartoletti R, Cai T, Mondaini N, et al. Cycling and genitourinary symptoms: Results from an observational analytical cohort study. *J Andrological Sci*. 2009;16(2-3):98-103.

53. MacMahon C, Parrington L. Not All Athletes Are Equal, But Don't Call Me an Exerciser: Response to Araujo and Scharhag(1). *Scand J Med Sci Sports*. 2017;27(8):904-906. doi:10.1111/sms.12864

54. Almousa S, Bandin Van Loon A. The prevalence of urinary incontinence in nulliparous female sportswomen: A systematic review. *J Sports Sci*. 2019;37(14):1663-1672. doi:10.1080/02640414.2019.1585312

55. Rebullido TR, Chulvi-Medrano I, Faigenbaum AD, et al. Pelvic Floor Dysfunction in Female Athletes. Strength Cond J 2018; [Epub Ahead of Print]. doi: 10.1519/SSC.0000000000000440

56. Female Athlete Issues for the Team Physician: A Consensus Statement-2017 Update. *Med Sci Sports Exerc*. 2018;50(5):1113-1122. doi:10.1249/MSS.0000000000001603

57. Hartigan SM, Smith AL. Disparities in Female Pelvic Floor Disorders. *Curr Urol Rep*.

2018;19(2):16. doi:10.1007/s11934-018-0766-3

## LEGENDS

**TABLE 1.** Population characteristics: athletes (total no. of studies =100).

**TABLE 2.** Total of studies dealing with specific sports divided into three groups based on the degree of mechanical loading (no. of total studies = 42).

**TABLE 3.** Analysis of the studies according to PFD, sex of population and study design.

**FIGURE 1.** Distribution of studies by country and year of publication.

**FIGURE 2.** Classification of studies on specific sports, based on the degree of mechanical loading, divided by the sex of the athletes.

**SUPPLEMENTARY FILE 1.** Main terminology: pelvic floor dysfunction, male and female. International Continence Society (ICS) Glossary of Terminology.

**SUPPLEMENTARY FILE 2.** Search strategies.

**SUPPLEMENTARY FILE 3**. Studies excluded with reasons (n=21).

**SUPPLEMENTARY FILE 4.** Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram, modified.

**SUPPLEMENTARY FILE 5.** Tables with references.

**SUPPLEMENTARY FILE 6.** Taxonomy of research design for the literature included (No. of studies =100).

**SUPPLEMENTARY FILE 7.** Functional anatomy of the pelvic floor. The figure represents a gymnast during athletic movement; the pelvic floor muscles have to demonstrate a continuum of positive and negative responses to impact.

**TABLE 1**.

| Variable[a] | No. of studies |
|---|---|
| **Sex** | |
| Male | 12 |
| Female | 83 |
| Both sexes | 5 |
| **Level of performance** | |
| Amateur/Recreational | 6 |
| Competitive | 10 |
| Elite/High level/Top level/Professional | 21 |
| Different levels | 2 |
| Not specified – primary research | 38 |
| Not specified – reviews | 23 |

[a] Not specified = Population defined as "athlete" by the authors, but specific level of performance was not specified.

**TABLE 2**.

| High impact[a] (n=23) | Medium impact[b] (n=7) | Low impact[c] (n=12) |
|---|---|---|
| Basketball (n=1) | Running (n=5) | Cycling (n=11) |
| Cheerleading (n=1) | Triathlon (n=2) | Horseback riding (n=1) |
| Crossfit (n=5) | | |
| Football (n=2) | | |
| Gymnastic (n=4) | | |
| High sport/HIIT (n=2) | | |
| Netball (n=1) | | |
| Power/weightlifting (n=3) | | |
| Rope-skipping (n=1) | | |
| Soccer (n=1) | | |
| Volleyball (n=2) | | |

[a] Includes weight bearing sports with high mechanical loading. Sports where jumping activities and/or rapid movements are widespread are included in this group.
[b] Includes weight bearing sports and sports with moderate mechanical loading. Sports including elements of sprinting and turning actions are included in this group.
[c] Includes non-weight bearing sports or sports with low mechanical loading.

**TABLE 3.**

| Variable[a] | No. of studies | | | | | | |
|---|---|---|---|---|---|---|---|
| | All studies | Female athletes | | Male athletes | | Male and female athletes | |
| | | Primary research | Review[b] | Primary research | Review | Primary research | Review |
| **UI** | 64 | 49 | 13 | - | - | 1 | 1 |
| **Multiple PFD** | 26 | 13 | 5 | 3 | 3 | 1 | 1 |
| **ED** | 4 | - | - | 2 | 2 | - | - |
| **Pelvic Pain** | 2 | - | - | 2 | - | - | - |
| **AI** | 2 | 1 | - | - | - | 1 | - |
| **POP** | 1 | 1 | - | - | - | - | - |
| **Dyspareunia** | 1 | 1 | - | - | - | - | - |
| **Total no. of studies** | 100 | 65 | 18 | 7 | 5 | 3 | 2 |

[a] UI= Urinary Incontinence; PFD= Pelvic Floor Dysfunction; ED= Erectile Dysfunction: AI= Anal Incontinence; POP= Pelvic Organ Prolapse.
[b] Review = Systematic and Narrative reviews.

**FIGURE 1.**

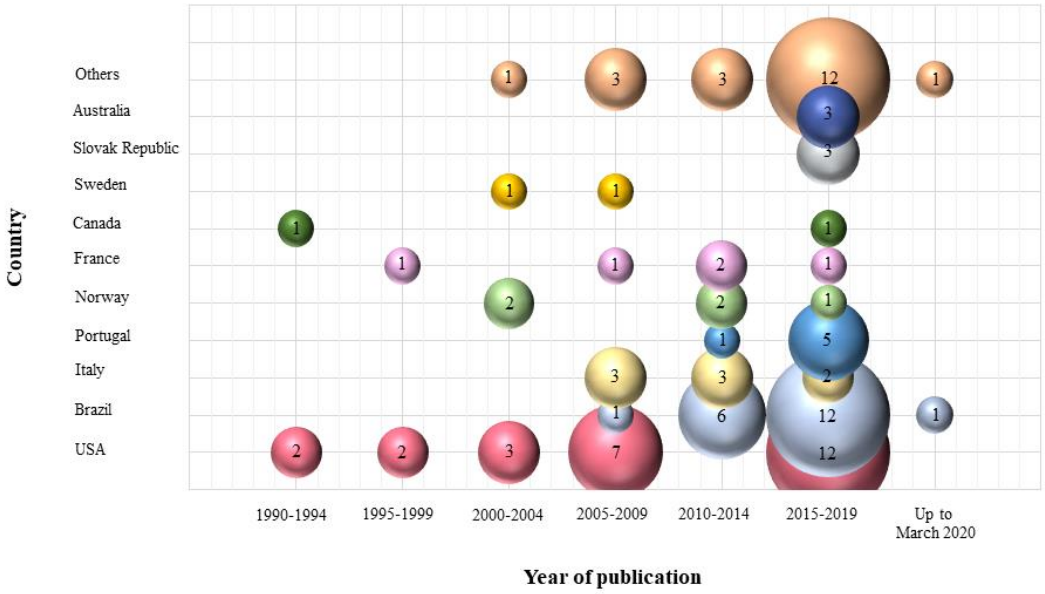
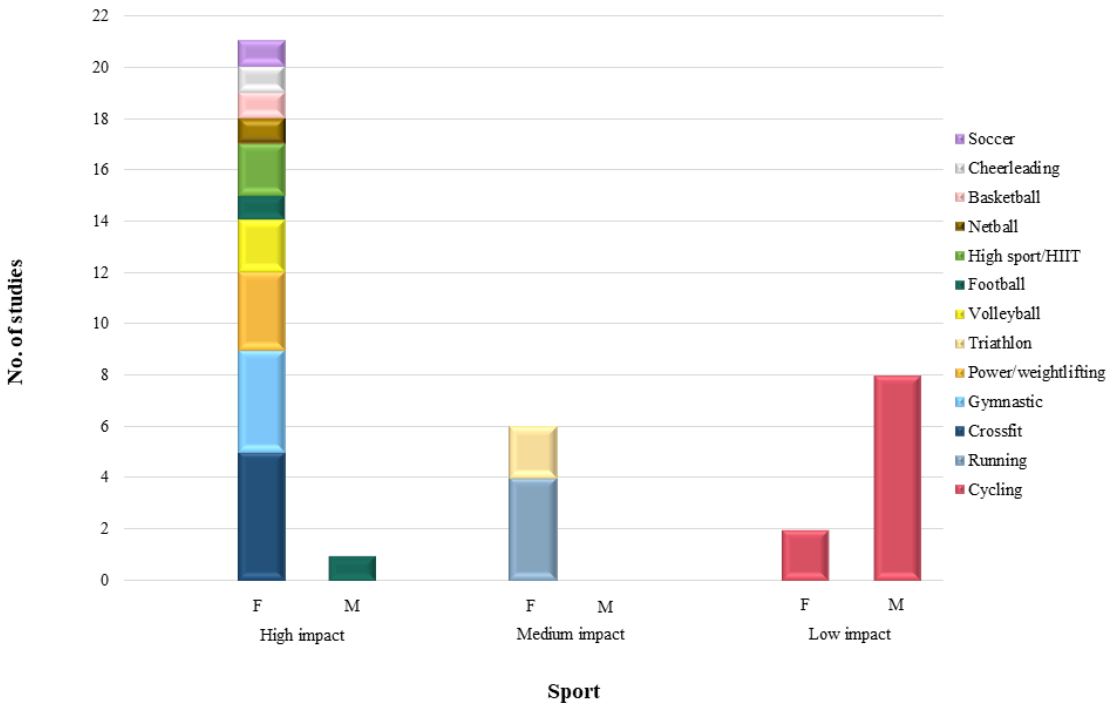


**FIGURE 2.**


No. of studies
22
20
18
16
14
12
10
8
6
4
2
0
F
M
F
M
F
M
High impact
Medium impact
Low impact
Sport
Soccer
Cheerleading
Basketball
Netball
High sport/HIIT
Football
Volleyball
Triathlon
Power/weightlifting
Gymnastic
Crossfit
Running
Cycling

## 5.2 WHAT IS KNOWN FROM THE EXISTING LITERATURE ABOUT THE AVAILABLE INTERVENTIONS FOR PELVIC FLOOR DYSFUNCTION AMONG FEMALE ATHLETES? A SCOPING REVIEW

**Reference:** Giagio S, Innocenti T, Pillastrini P, Gava G, Salvioli S. What is known from the existing literature about the available interventions for pelvic floor dysfunction among female athletes? A scoping review. Neurourol Urodyn. 2022;41(2):573-584. doi:10.1002/nau.24883

**Objectives:** To map and summarize the literature to identify the available interventions for pelvic floor dysfunction (PFD) among female athletes.

**International oral presentation:** 2022 International Continence Society (ICS) Congress, "Podium Session 20 Best Conservative Management 2 #286". Presenter: Silvia Giagio.

## ABSTRACT

**Background.** Female athletes may be at higher risk of developing Pelvic Floor Dysfunction (PFD). However, despite the great number of epidemiologic studies, the interventions have not been standardized.

**Aim.** The present scoping review aimed to map and summarize the literature to identify the available interventions for PFD among female athletes.

**Methods.** Seven databases were searched up to May 2021. Studies considering female athletes practising sports at any performance level with any type of PFD were eligible for inclusion. Any clinical intervention and any context were considered. No language, study design and publication type restrictions were applied. Additional studies were identified through grey literature and the reference lists of articles included. The results were presented numerically and thematically.

**Results.** From 2625 initial records, 35 studies met inclusion criteria. The majority of articles were narrative reviews, considering athletes with urinary incontinence practising multiple or high impact sports. Authors discussed a wide range of interventions: preventive (n=8); conservative (n=35), pharmacological (n=12) and surgical (n=10). In particular, the Pelvic Floor Muscle Training was considered in 30 studies.

**Conclusions.** This is the first scoping review to provide a comprehensive overview of the topic. Besides the great number of available interventions, specific programs and randomized controlled clinical trials for female athletes are still limited. Findings highlighted evident gaps in the primary research confirming that the current management is based on expert opinion. This review may be useful for the overall management, and it may represent a starting point for future research.

## INTRODUCTION

Pelvic floor dysfunction (PFD) refers to a group of symptoms, signs, and conditions primarily affecting women, with or without moderate-to-severe impairment of the pelvic floor muscles[1] (PFM).

Recently, a scoping review reported a wide range of published studies providing epidemiological data about different PFD in athletes practising various sports[2], highlighting that almost 90% of the literature focused only on females[2].

Compared with nonathlete control women, athletes have a higher risk of developing urinary incontinence (UI)[3] and also a greater prevalence rate of UI, ranging from 0% to 80% in trampolinists[4]. Regarding other PFD (e.g. pelvic organ prolapse, POP; anal incontinence, AI) evidence are still scant[2]. Anyway, several authors have already discussed that it is reasonable to assume that the overall epidemiological data of PFD could be underestimated[2,5].

Additionally, these disorders could interfere not only with personal and social athletes' lives, but also could affect their performance[4,6].

Despite these findings, the high prevalence of dysfunctions that emerged from several reviews[5,7,8], and the increasing interest in this topic[2], there is little research regarding the management of PFD to guide clinical practice within this group.

Hence, what are the available evidence-based interventions for female athletes with PFD? To the authors' knowledge, no review has been conducted to answer this research question and, as a consequence, there is no comprehensive overview both for clinicians and researchers.

This study aimed to highlight and begin to fill that gap using a scoping review design. Clinical data synthesis could add meaningful information for the overall management of the athletes and could stimulate further research in this field.

As maintained by the Joanna Briggs Institute (JBI)[9], scoping review approach may be used to map and clarify key concepts, identify gaps in the research knowledge base, and report on the types of evidence that address and inform practice in the field. These aims corresponded to the

objectives of this project. For this reason, other types of review, such as systematic reviews, umbrella reviews or rapid reviews, were not deemed methodologically effective.

This scoping review aimed to:

(1) Provide a comprehensive overview of all studies addressing PFD interventions in female athletes, summarizing studies according to PFD classification provided by the International Continence Society (ICS) standardized terminology, the type of sport and treatments.

(2) Identify any gap in the knowledge of the topic.

## METHODS

The present scoping review was conducted following the JBI methodology[9] for scoping reviews. The Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR)[10] Checklist for reporting was used. The scoping review protocol was registered in MedRxiv[11].

### Research team

To facilitate robust and clinically relevant review findings, the research team included authors with expertise in evidence synthesis, quantitative and qualitative research methodology, urogynecology, sport and pelvic floor rehabilitation.

### Review question

We formulated the following research question: "What is known from the existing literature about the interventions for PFD among female athletes?"

### Eligibility criteria

Studies were eligible for inclusion if they met the following Population, Concept, and Context (PCC) criteria.

- *Population*. We included female athletes of any age, practising any type of sport and performance level (e.g., professional/elite, amateurs/master/recreational athletes) with any type of PFD. Given that we aimed to focus only on this particular subgroup of sport population, the definition of "athlete" used in an individual study as the main criterion was considered.
- *Concept.* Any intervention (i.e. preventive, conservative, pharmacological, surgical) was considered.
- *Context.* This review considered studies conducted in any context.
- *Types of sources of evidence.* This scoping review included any study designs or publication type. No time, geographical, setting and language restrictions were applied.

*Exclusion criteria*

Studies that did not meet the specific PCC criteria were excluded.

**Search strategy**

An initial limited search of MEDLINE through PubMed interface was undertaken to identify articles on the topic and then index terms used to describe the articles were used to develop a full search strategy for MEDLINE. The search strategy, including all identified keywords and index terms, was adapted for use in Cochrane Central, Scopus, CINAHLComplete, Embase, PEDro and SPORTDiscus and completely reported in the Supplementary file 1 (**SUPPLEMENTARY FILE 1**). In addition, also grey literature (e.g. Google Scholar, direct contact with experts in the field of PFD and sports medicine) and the reference lists of all relevant studies were searched. Searches were conducted on 9$^{th}$ May 2021 with no date limit.

**Study selection**

Once the search strategy has been completed, search results were collated and imported to EndNote V.X9 (Clarivate Analytics, PA, USA). Duplicates were removed using the EndNote deduplicator before the file containing a set of unique records is made available to reviewers for

further processing. The selection process consisted of two levels of screening using Rayyan QCRI online software[12]: (1) a title and abstract screening and (2) a full-text selection. For both levels, two authors independently screened the articles with conflicts resolved by a third author.

The entire selection process and reasons for the exclusion were recorded and reported according to the latest published version of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA 2020) flow diagram[13].

**Data extraction and data synthesis**

Data extraction was conducted using an ad-hoc data extraction form which was developed a priori, based on the JBI data extraction tool. Key information (authors, country, year of publication, study design[14], athletes' characteristics, PFD, sport, type of intervention and related procedures) on the selected articles were collected. Descriptive analyses were performed, and the results were presented in two ways:

3. Numerically. Studies identified and included were reported as frequency and percentage, and the description of the search decision process was mapped. In addition, extracted data were summarized in tabular and diagrammatic form according to the main characteristics.
4. Thematically. A thematic summary was performed about themes and key concepts relevant to the research questions and according to outcomes (e.g. PFD, sport, type of intervention). Specific analysis for the conservative treatment was reported.

**RESULTS**

As presented in the PRISMA 2020-flow diagram (**FIGURE 1**), from 2625 records identified by the initial literature searches, 2590 were excluded and 35 articles were included[3,15–48]. The reasons for exclusion and the corresponding references are reported in online Supplementary file 2 (**SUPPLEMENTARY FILE 2)**.

**Characteristics of included studies**

Table 1 synthesize the main characteristics of the studies (**TABLE 1**). To provide a transparent report, Supplementary file 3 shows the complete extracted data for each included study (**SUPPLEMENTARY FILE 3**). In particular, the majority of research designs were narrative review (n=19; 54.3%), while seven (20%) were primary research ranging from case reports to randomized controlled trials (RCTs), and only two systematic reviews on the topic were published[3,17]. Regarding ongoing studies, searches identified one mixed-method protocol[45] for athletic women with stress urinary incontinence (SUI).

Research studies were identified from 12 different countries and in four languages (English, French, Spanish and Slovenian). Authors from the United States of America yielded the highest number of publications (n=13; 37.1%).

**Participants: the female athletes**

Table 1 summarizes data regarding female athletes of different age groups with PFD practising several types of sport and a variety of participation levels (**TABLE 1**).

In the majority of articles (n= 27; 77.1%), authors defined participants as "athletes", but performance level was not clearly reported. Seven studies (20%) focused only on elite/high-level athletes. A few authors reported about particular subgroups, such as post-partum triathletes[40], adolescents [19–21 33] and wheelchair athletes [49].

Regarding the PFD, UI was the most common pelvic floor symptom explored (n=24; 68.6%). The type of UI was not clearly reported in all studies, but in most cases, athletes suffered from SUI (n=19, 54.9%). In one article (narrative review plus case report), Louis-Charles[23] *et al.* investigated and explained the therapeutic possibilities for pelvic pain. For other disorders, in ten studies (28.6%) more than one PFD was considered, such as POP, AI, and fecal incontinence (FI). Nearly 70% of articles included more than one sport, mainly the high-impact ones. Considering studies that focused only on one sport, volleyball (n=3; 8.6%) and running (n=2; 5.7%) were the

most frequently investigated. Other sports taken into consideration were Basic Combat Training, soccer and triathlon.

**Preventive, conservative, pharmacological and surgical treatments**

Twenty-three percent of considered articles (8 out of 35) reported and discussed only preventive interventions to manage PFD. Vaginal tampons and pads were the most frequent aid used by athletes. Some authors also mentioned other options for example Pelvic Floor Muscle Training (PFMT), education, use of a pessary, and lifestyle interventions.

Conservative approaches were suggested by all authors of the included studies. Among these, PFMT, alone or combined with other treatments, is explicitly cited as an effective treatment in 85.7% of studies (30/35). In particular, the analysis of treatments proposed for SUI showed a wide range of other possibilities, including biofeedback, bladder training, lifestyle interventions, education, electrical stimulation, hypopressive techniques, intra-abdominal pressure management, modification of the sport technique, vaginal tampons, pads and vaginal cones.

Table 2 reports all the conservative interventions that were considered (**TABLE 2**) in each article, while Figure 2 graphically illustrates the pooled results (**FIGURE 2**). Only two RCTs were conducted on female athletes by Ferreira[16] in 2014 and Pires[27] in 2020. In both studies, the participants were volleyball players. Additional information about the protocols of the overall primary studies were provided in **SUPPLEMENTARY FILE 4**.

Concerning other interventions, pharmacological options for PFD were rarely cited (n=12; 34.3%) and in general, were not supported by the opinion of the authors.

The surgical approach was discussed in 10 articles (28.6%), however, the majority of researchers considered it not appropriate for the female athlete. To the current date, no study has yet been conducted to evaluate the effectiveness and safety of both pharmacological and surgical treatments among female athletes.

## DISCUSSION

In the present scoping review, we mapped and summarized literature considering interventions for PFD in female athletes. Among the 35 included articles, the majority focused on multiple or high-impact sports and UI, while other types of PFD (e.g. POP, AI, pelvic pain syndrome) were rarely considered. These findings were in accordance with the epidemiological data summarized in our previous review[2].

As already underlined by other authors[2,50], a large amount of epidemiological studies reporting a high prevalence of PFD among female athletes has been published. However, research on PFD' treatment in female athletes is still scarce. Although authors discussed a wide variety of interventions ranging from preventive or conservative treatments to surgery, the present scoping review confirmed that only a few authors evaluated the effectiveness of interventions dedicated to this population. In particular, merely seven primary studies evaluating the effectiveness of conservative approach are currently available.

Considering different kinds of sports involving female athletes with PFD authors focused on volleyball, running and on Basic Combat Training or multiple sports, while other sports remained unexplored. In six of these, athletes referred SUI.

We highlighted an overall huge knowledge gap in this field. As consequence, suggestions and considerations for practice were supported by the transferability of the nonathlete population's results or by the experts' opinions.

PFMT is the main example. We found that in 30 articles out of 35, PFMT is suggested as a intervention for PFD. Even if strength training of the PFM could be effective in treating UI in women and it is recommended by International clinical practice guidelines as first-line treatment (Evidence level 1, recommendation Grade A)[51], evidence of the effect of PFMT in female elite athletes is limited. In our opinion, as affirmed by Bø[5], PFM strengthening, just like training other muscle groups, should be an essential component of strength and conditioning programs for all female athletes regardless of athletic prowess, and however, additional research is necessary[50].

Our full search strategy did not find any trial that has evaluated the effectiveness of any kind of surgical procedure in female athletes for any type of PFD. Already in 2004, Bø[15] has hypothesized that surgery may be inappropriate in elite athletes, due to the clinical presentation of symptoms and personal characteristics. Athletes are frequently young and nulliparous and, especially for UI, most of them reported symptoms only during sports, not during other activities. Moreover, it could be questionable if surgical procedures can have a lower duration of efficacy in athletes performing in high-impact sports.

Whilst the paucity of specific literature on female athletes with PFD is evident, there is a growing literature on other subgroup populations that could represent a starting point for further investigations. Besides the standard physiotherapy, an interesting preliminary study was presented in 2019 by Koenig et al.[52]: even if participants were not specifically athletes, the authors focused on involuntary reflexive PFM contraction while running. Alvarez-Saez[53] in 2016 showed that a supervised 8-week program of hypopressive technique could be used to enhance abdominal and perineal function among 11 female rugby players without any type of PFD.

Thirty years later from the first published reports in the early 1990s, the scientific community is still learning how to effectively treat PFD in female athletes[50].

Based on today's knowledge, our literature search highlighted a few publications on the topic confirming that treatment options remain based on experts' and clinicians' expertise, generalizing interventions available for the nonathlete population.

**Research implications and suggestions for clinical practice**

Athletes are a unique group of patients who have higher functional demands than the general population and may need a different and specific approach than nonathletic women.

Indeed, as happens with other disorders, like the musculoskeletal ones[54], several factors should be taken into account, both intrinsic and extrinsic. And therefore, after an individual assessment, a specific intervention plan should be drawn. The overall management should be specific and tailored to the athlete, considering the type of PFD and other factors such as: a) training volume,

b) type of sport, c) performance level, d) other associated disorders (e.g. musculoskeletal) and e) individual risk and contributing factors within multidisciplinary management. To provide better guidance for clinical practice and to fill the current gaps, these variables should guide high-quality research.

As we wait for and encourage high-quality RCTs, we extracted and summarized general suggestions and treatment options for the clinical management of SUI provided by different authors along with the included studies (**FIGURE 3**). We integrated Figure 3 with additional information drawn from our clinical practice. It is important to underline that these suggestions are not recommendations or evidence. Scoping reviews are not conducted to develop trustworthy clinical guidelines and recommendations, but implications for practice may be provided in terms of guidance provided from a clinical point of view[9].

Concerning other PFD (e.g. pelvic pain, AI, POP), considering the paucity of studies, we are not able to propose analogue considerations and comments.

**Strengths and limitations**

*Answering evidence gap.* To our knowledge, this is the first study to map and summarize the literature to identify the available interventions for PFD among female athletes using a scoping review design. We answered a relevant research question identifying the volume and distribution of the evidence base. We have also mapped the key concepts and research priorities within the literature.

*Methodology.* An extensive search strategy in the main databases with very broad inclusion criteria was conducted. Moreover, to conduct the review we followed the JBI manual, to describe the selection process we applied the updated PRISMA 2020, and for reporting we used the PRISMA for Scoping Reviews Checklist.

*Clinical practice.* Although, as a scoping review[9], we did not evaluate the methodological quality of the individual studies and conclusions cannot be drawn regarding the most effective

intervention for female athletes with PFD, a comprehensive overview of the available interventions was provided.

*Athlete definition.* Given that we aimed to focus on athletes, as a particular group of sport population, we accepted the definition of 'athlete' as it was used in an individual study. Considering that this definition is still controversial[55] and different studies may have described athletes in different ways, this may have excluded findings from other studies.

## CONCLUSIONS

This scoping review identified 35 studies exploring and discussing the available interventions for PFD among female athletes. Findings displayed a higher number of narrative reviews addressing UI in multiple and high-impact sports.

The authors discussed a wide variety of interventions ranging from prevention to conservative, pharmacological or surgical treatments. Among these, the conservative approach was the most frequently suggested. Besides the great number of listed interventions, specific programs and RCTs for female athletes are still limited.

The findings of the present study showed that suggestions for clinical practice were basically supported by the transferability of the non-athlete population's results or by the expert opinion.

Therefore, there is a great need of primary research considering individual characteristics, related-variables sport and PFD within multidisciplinary management.

**REFERENCES**


1. Haylen BT, de Ridder D, Freeman RM, et al. An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn*. 2010;29(1):4-20. doi:10.1002/nau.20798

2. Giagio S, Salvioli S, Pillastrini P, Innocenti T. Sport and pelvic floor dysfunction in male and female athletes: A scoping review. *Neurourol Urodyn*. 2021;40(1):55-64. doi:10.1002/nau.24564

3. Sorrigueta-Hernández A, Padilla-Fernandez B-Y, Marquez-Sanchez M-T, et al. Benefits of Physiotherapy on Urinary Incontinence in High-Performance Female Athletes. Meta-Analysis. *J Clin Med*. 2020;9(10):3240. doi:10.3390/JCM9103240

4. Teixeira RV, Colla C, Sbruzzi G, Mallmann A, Paiva LL. Prevalence of urinary incontinence in female athletes: a systematic review with meta-analysis. *Int Urogynecol J*. 2018;29(12):1717-1725. doi:10.1007/s00192-018-3651-1

5. Bo K, Nygaard IE. Is Physical Activity Good or Bad for the Female Pelvic Floor? A Narrative Review. *Sports Med*. 2020;50(3):471-484. doi:10.1007/s40279-019-01243-1

6. Gram MCD, Kari B ø. High level rhythmic gymnasts and urinary incontinence: Prevalence, risk factors, and influence on performance. *Scand J Med Sci Sport*. 2019. doi:10.1111/sms.13548

7. Almousa S, Bandin Van Loon A. The prevalence of urinary incontinence in nulliparous female sportswomen: A systematic review. *J Sports Sci*. 2019;37(14):1663-1672. doi:10.1080/02640414.2019.1585312

8. Cerruto MA, Balzarro M, Rubilotta E, et al. Lower urinary tract and gastrointestinal dysfunction in sportswomen: systematic review and meta-analysis of observational studies. *Minerva Urol Nefrol*. 2019. doi:10.23736/S0393-2249.19.03582-3

9. Peters MDJ, Godfrey C, McInerney P, Munn Z, Tricco AC, Khalil H. Chapter 11: Scoping Reviews (2020 version). In: Aromataris E MZ (Editors)., ed. *Joanna Briggs Institute Reviewer's Manual, JBI.* ; 2020.

10. Tricco AC, Lillie E, Zarin W, et al. PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation. *Ann Intern Med*. 2018;169(7):467-473. doi:10.7326/M18-0850

11. Giagio S, Salvioli S, Pillastrini P, Fiorucci M, Innocenti T. What is known from the existing literature about the available treatments for pelvic floor dysfunction among female athletes? A scoping review protocol. *medRxiv*. 2021. doi:10.1101/2021.05.10.21256950

12. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. *Syst Rev*. 2016;5(1):210. doi:10.1186/s13643-016-0384-4

13. Page MJ, Moher D, Bossuyt PM, et al. PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. *BMJ*. 2021;372:n160. doi:10.1136/bmj.n160

14. Cartabellotta A. [Evidence-based medicine. 1. The transfer of research results to clinical practice. The Italian Group for Evidence-Based Medicine-GIMBE]. *Recenti Prog Med*. 1998;89(3):140-150.

15. Bo K. Urinary incontinence, pelvic floor dysfunction, exercise and sport. *Sports Med*. 2004;34(7):451-464. doi:10.2165/00007256-200434070-00004

16. Ferreira S, Ferreira M, Carvalhais A, Santos PC, Rocha P, Brochado G. Reeducation of pelvic floor muscles in volleyball athletes. *Rev Assoc Med Bras*. 2014;60(5):428-433. doi:10.1590/1806-9282.60.05.010

17. García-Sánchez E, Rubio-Arias JA, Ávila-Gandía V, Ramos-Campo DJ, López-Román J. Effectiveness of pelvic floor muscle training in treating urinary incontinence in women: A current review. *Actas Urol Esp*. 2016;40(5):271-278. doi:10.1016/J.ACURO.2015.09.001

18. Goldstick O, Constantini N. Urinary incontinence in physically active women and female athletes. *Br J Sports Med*. 2014;48(4):296-298. doi:10.1136/bjsports-2012-091880

19. Greydanus DE, Patel DR. The female athlete: Before and beyond puberty. *Pediatr Clin North Am*. 2002;49(3):553-580. doi:10.1016/S0031-3955(02)00005-6

20. Greydanus D, Patel D. Medical aspects of the female athlete at puberty : review article. *Int Sport J*. 2004;5(1):1-25. doi:10.10520/EJC48539

21. Greydanus DE, Omar H, Pratt HD. The Adolescent Female Athlete: Current Concepts and Conundrums. *Pediatr Clin North Am*. 2010;57(3):697-718. doi:10.1016/J.PCL.2010.02.005

22. Laffitte A. Incontinence urinaire de la sportive adolescente: Prise en charge. *Arch Pediatr*. 2015;22(5):196-197. doi:10.1016/S0929-693X(15)30098-1

23. Louis-Charles K, Biggie K, Wolfinbarger A, Wilcox B, Kienstra CM. Pelvic Floor Dysfunction in the Female Athlete. *Curr Sports Med Rep*. 2019;18(2):49-52. doi:10.1249/JSR.0000000000000563

24. Neels H, Roosens E, Buley R, Struyf F, Aerenhouts D, Vermandel A. Introducing pelvic floor muscle training in weekly training sessions of young adult female athletes: a pilot study. *Neurourol Urodyn*. 2017;(September).

25. Painter EE, Ogle MD, Teyhen DS. Lumbopelvic dysfunction and stress urinary incontinence: A case report applying rehabilitative ultrasound imaging. *J Orthop Sports Phys Ther*. 2007;37(8):499-504. doi:10.2519/JOSPT.2007.2538

26. Bourcier AP, Juras JC. Nonsurgical therapy for stress incontinence. *Urol Clin North Am*. 1995;22(3):613-627.

27. Pires TF, Pires PM, Moreira MH, et al. Pelvic Floor Muscle Training in Female Athletes: A Randomized Controlled Pilot Study. *Int J Sports Med*. 2020;41(4):264-270. doi:10.1055/A-1073-7977

28. Podschun L, Hanney WJ, Kolber MJ, Garcia A, Rothschild CE. Differential diagnosis of deep gluteal pain in a female runner with pelvic involvement: a case report. *Int J Sports Phys Ther*. 2013;8(4):462-471. http://www.ncbi.nlm.nih.gov/pubmed/24175132.

29. Prather H. Pelvis and sacral dysfunction in sports and exercise. *Phys Med Rehabil Clin N Am*. 2000;11(4):805-836.

30. Rial Rebullido T, Chulvi-Medrano I, Faigenbaum AD, Stracciolini A. Pelvic Floor Dysfunction in Female Athletes. *Strength Cond J*. 2020;42(4):82-92. doi:10.1519/SSC.0000000000000440

31. Rivalta M, Sighinolfi MC, Micali S, de Stefani S, Torcasio F, Bianchi G. Urinary

Incontinence and Sport: First and Preliminary Experience With a Combined Pelvic Floor Rehabilitation Program in Three Female Athletes. *Health Care Women Int*. 2010;31(5):435-443. doi:10.1080/07399330903324254

32. Rzymski P, Burzyński B, Knapik M, Kociszewski J, Wilczak M. How to balance the treatment of stress urinary incontinence among female athletes? *Arch Med Sci*. 2021;17(2):314-322. doi:10.5114/AOMS.2020.100139

33. Sekhon V, Lewis JM. Competitive exercise-induced urinary incontinence in adolescent female: Aware and prepare! *Ann Pediatr Surg*. 2018;14(2):108-109. doi:10.1097/01.XPS.0000525979.63934.56

34. Shangold MM. Gynecologic Concerns in the Woman Athlete. *Clin Sports Med*. 1984;3(4):869-879. doi:10.1016/S0278-5919(20)31285-0

35. Caetano AS, Tavares M da CGCF, Lopes MHB de M. Urinary incontinence and physical activity practice. *Rev Bras Med do Esporte*. 2007;13(4):270-274. doi:10.1590/S1517-86922007000400012

36. Sousa M, Viana R, Viana S, et al. Effects of a pelvic floor muscle training in nulliparous athletes with urinary incontinence: biomechanical models protocol. *Lect Notes Comput Vis Biomech*. 2015;21:83-90. doi:10.1007/978-3-319-15799-3_6

37. Bourcier AP. Incontinence during sports and fitness activities. *Pelvic Floor Re-education Princ Pract*. 2008:267-270. doi:10.1007/978-1-84628-505-9_32

38. Švegl P, Bilban M. Pelvic floor dysfunction in young female athletes. *Sport Rev Za Teor Prakt Vprasanja Sport*. 2017;65(1):95-102.

39. Teitz CC, Hu SS, Arendt EA. The Female Athlete: Evaluation and Treatment of Sports-Related Problems. *J Am Acad Orthop Surg*. 1997;5(2):87-96. doi:10.5435/00124635-199703000-00004

40. Thein-Nissenbaum J. The postpartum triathlete. *Phys Ther Sport*. 2016;21:95-106. doi:10.1016/J.PTSP.2016.07.006

41. Bø K. Chapter 13 - Pelvic floor dysfunction, prevention and treatment in elite athletes.

In: Bø K, Berghmans B, Mørkved S, Van Kampen MBT-E-BPT for the PF (Second E, eds. Churchill Livingstone; 2015:397-407. doi:https://doi.org/10.1016/B978-0-7020-4443-4.00013-3

42. Bo K. Exercise and pelvic floor dysfunction in female elite athletes. *Handb Sport Med Sci - Female Athl*. 2015:76-85.

43. Bryan ST, Coleman NJ, Blueitt D, Kilmer NI. Bladder problems in athletes. *Curr Sports Med Rep*. 2008;7(2):108-112. doi:10.1097/01.CSMR.0000313397.17688.51

44. Cabrera Guerra M. Urinary incontinence in the elite woman athlete . *Rev Iberoam Fisioter y Kinesiol*. 2006;9(2):78-89. doi:10.1016/S1138-6045(06)73119-7

45. Campbell KG, Batt ME, Drummond A. A feasibility study of the physiotherapy management of urinary incontinence in athletic women: Trial protocol for the POsITIve study. *Pilot Feasibility Stud*. 2020;6(1). doi:10.1186/s40814-020-00638-6

46. Casey EK, Temme K. Pelvic floor muscle function and urinary incontinence in the female athlete. *Phys Sportsmed*. 2017;45(4):399-407. doi:10.1080/00913847.2017.1372677

47. Crepin G, Biserte J, Cosson M, Duchene F. Appareil génital féminin et sport de haut niveau [The female urogenital system and high level sports]. *Bull Acad Natl Med*. 2006;190(7):1479-1493.

48. Da Roza T, Jorge R, Mascarenhas T, Duarte J. Urinary Incontinence in Sport Women: from Risk Factors to Treatment – A Review. *Curr Womens Health Rev*. 2014;9(2):77-84. doi:10.2174/1573404809021401021520 31

49. Bryan ST, Coleman NJ, Blueitt D, Kilmer NI. Bladder problems in athletes. *Curr Sports Med Rep*. 2008;7(2):108-112. doi:10.1097/01.CSMR.0000313397.17688.51

50. Skaug KL, Bø K. RE: Pelvic Floor Dysfunction in Female Athletes. *Strength Cond J*. 2019;41(6). https://journals.lww.com/nsca-scj/Fulltext/2019/12000/RE__Pelvic_Floor_Dysfunction_in_Female_Athletes.13.aspx.

51. Abrams P, Cardozo L, Wagg A, Wein A. *Incontinence*. 6th Editio. ICI-ICS. International Continence Society, Bristol UK; 2017.

52. Koenig I, Eichelberger P, Leitner M, et al. Pelvic floor muscle activity patterns in women

with and without stress urinary incontinence while running. *Ann Phys Rehabil Med*. 2020. doi:10.1016/j.rehab.2019.09.013

53. Álvarez Sáez M, Rial Rebullido T, Chulvi Medrano I, García Soidán J, Cortell Tormo JM. Puede un programa de ocho semanas basado en la técnica hipopresiva producir cambios en la función del suelo pélvico y composición corporal de jugadoras de rugby? *Retos*. 2016;(30):26-29. https://doi.org/10.47197/retos.v0i30.37194

54. Lin I, Wiles L, Waller R, et al. What does best practice care for musculoskeletal pain look like? Eleven consistent recommendations from high-quality clinical practice guidelines: systematic review. *Br J Sports Med*. 2020;54(2):79-86. doi:10.1136/bjsports-2018-099878

55. Araujo CGS, Scharhag J. Athlete: a working definition for medical and health sciences research. *Scand J Med Sci Sports*. 2016;26(1):4-7. doi:10.1111/sms.12632

**LEGENDS**

**TABLE 1.** Summary of main characteristics of included studies**.**

**TABLE 2.** Conservative treatments for PFD among female athletes reported by each study.

**FIGURE 1.** Preferred Reporting Items for Systematic Reviews and Meta-analyses 2020 (PRISMA) flow-diagram.

**FIGURE 2.** Overall conservative treatments for PFD among female athletes.

**FIGURE 3**. Suggestions for clinical practice of Stress urinary incontinence (SUI) for female athletes: summary.

**SUPPLEMENTARY 1.** Complete search strategies for databases.

**SUPPLEMENTARY 2.** Studies excluded with reasons.

**SUPPLEMENTARY 3.** Data extraction form.

**SUPPLEMENTARY 4**. Data extraction form for primary studies.

**TABLE 1.**

| Variable[a] | No. of studies (%) |
|---|---|
| **Year of publication** | |
| 1984 - 1990 | 1 (2.8) |
| 1991 - 2000 | 3 (8.6) |
| 2001 - 2010 | 11 (31.4) |
| 2011 - 2020 | 19 (54.9) |
| Up to 2021 | 1 (2.8) |
| **Study design** | |
| Primary research | 7 (20) |
| Case series | 1 (2.8) |
| Pre-post study | 1 (2.8) |
| RCT | 2 (5.7) |
| Case report | 3 (8.6) |
| Secondary research | 2 (5.7) |
| Systematic review | 2 (5.7) |
| Traditional sources | 25 (71.4) |
| Conference proceeding | 1 (2.8) |
| Editorial | 1 (2.8) |
| Narrative review plus case report | 1 (2.8) |
| Book chapter | 3 (8.6) |
| Narrative review | 19 (54.9) |
| Protocol | 1 (2.8) |
| **Level of performance** | |
| Agonistic | 1 (2.8) |
| Elite/High level | 7 (20) |
| Not reported level | 27 (77.1) |

| | |
|---|---|
| **Sport** | |
| Basic Combat Training | 1 (2.8) |
| Soccer | 1 (2.8) |
| Triathlon | 1 (2.8) |
| Running | 2 (5.7) |
| Volleyball | 3 (8.6) |
| Not reported | 3 (8.6) |
| Multiple sport | 24 (68.6) |
| **PFD** | |
| Pelvic pain | 1 (2.8) |
| Multiple PFD | 10 (28.6) |
| UI | 24 (68.6) |
| SUI | 19 (54.9) |
| **Interventions** | |
| Preventive, conservative | 4 (11.4) |
| Preventive, conservative, surgical | 1 (2.8) |
| Preventive, conservative, surgical, pharmacological | 3 (8.6) |
| Conservative | 16 (45.7) |
| Conservative, pharmacological | 2 (5.7) |
| Conservative, surgical | 2 (5.7) |
| Conservative, surgical, pharmacological | 7 (20) |

PFD = Pelvic Floor Dysfunction; UI = Urinary Incontinence; SUI = Stress Urinary Incontinence
[a] Not reported level = Population defined as "athlete" by the authors, but specific level of performance was not specified.
Multiple sport = Studies in which authors considered different type of sport (more than one).
Multiple PFD = Studies in which authors considered more than one PFD.
RCT = Randomized Controlled Trial

**TABLE 2.**

| | Author, year | PFMT | Biofeedback | Education | Lifestyle interventions | Bladder training | Manual therapy | Electrical stimulation[a] | Vaginal cones | Pessary | Vaginal tampons | Pad | Others[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1** | Bø, 2004 | X | | | | | | | | | | | X |
| **2** | Bø, 2015a | X | X | | | X | | X | X | | | | |
| **3** | Bø, 2015b | X | | | X | X | | | | | | | |
| **4** | Bourcier, 1995 | X | X | | | | | X | X | | | | |
| **5** | Bourcier, 2008 | X | X | | | | | | | X | X | | X |
| **6** | Bryan, 2008 | X | X | | X | X | | | | | X | X | X |
| **7** | Cabrera Guerra, 2006 | | | | | | | | | | X | | X |
| **8** | Campbell, 2020 | | | | | | | | | | | | X |
| **9** | Casey, 2017 | X | | | | X | | | | | X | X | X |
| **10** | Crepin, 2006 | X | | | | | | | | | X | | |
| **11** | Da Roza, 2013 | X | X | | | | | X | X | | | | |
| **12** | Ferreira, 2014 | X | | X | X | X | | | | | | | |
| **13** | García-Sánchez, 2016 | X | | | | | | | | | | | |
| **14** | Goldstick, 2014 | X | X | | X | | | X | X | | | | |
| **15** | Greydanus, 2002 | X | X | X | X | | | X | X | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **16** | Greydanus, 2004 | X | X | X | X | | | X | X | | | | |
| **17** | Greydanus, 2010 | X | X | X | X | | | X | X | | | | |
| **18** | Laffitte, 2015 | X | | X | | | | | | | | | X |
| **19** | Louis-Charles, 2019 | | | X | | | X | X | | | | | X |
| **20** | Neels, 2017 | X | | X | | | | | | | | | |
| **21** | Painter, 2007 | X | X | | X | | | | | | | | X |
| **22** | Pires, 2020 | X | | X | | | | | | | | | |
| **23** | Podschun, 2013 | X | X | | | | X | | | | | | X |
| **24** | Prather, 2000 | X | X | | X | | X | X | | | | | X |
| **25** | Rial Rebullido, 2020 | X | | | | | | | | | | | X |
| **26** | Rivalta, 2010 | X | X | | | | | X | X | | | | |
| **27** | Rzymski, 2021 | X | X | | X | X | X | | | | | | X |
| **28** | Sekhon, 2018 | X | | X | X | | | | | | | | X |
| **29** | Shangold, 1984 | | | | X | | | | | | | | |
| **30** | Silva Caetano, 2007 | X | | X | | | | | | | | | |
| **31** | Sorrigueta-Hernández, 2020 | | | | | | | | | | | | X |
| **32** | Sousa, 2015 | X | | X | | | | | | | | | |
| **33** | Švegl, 2017 | X | X | | | | | | X | | | X | |

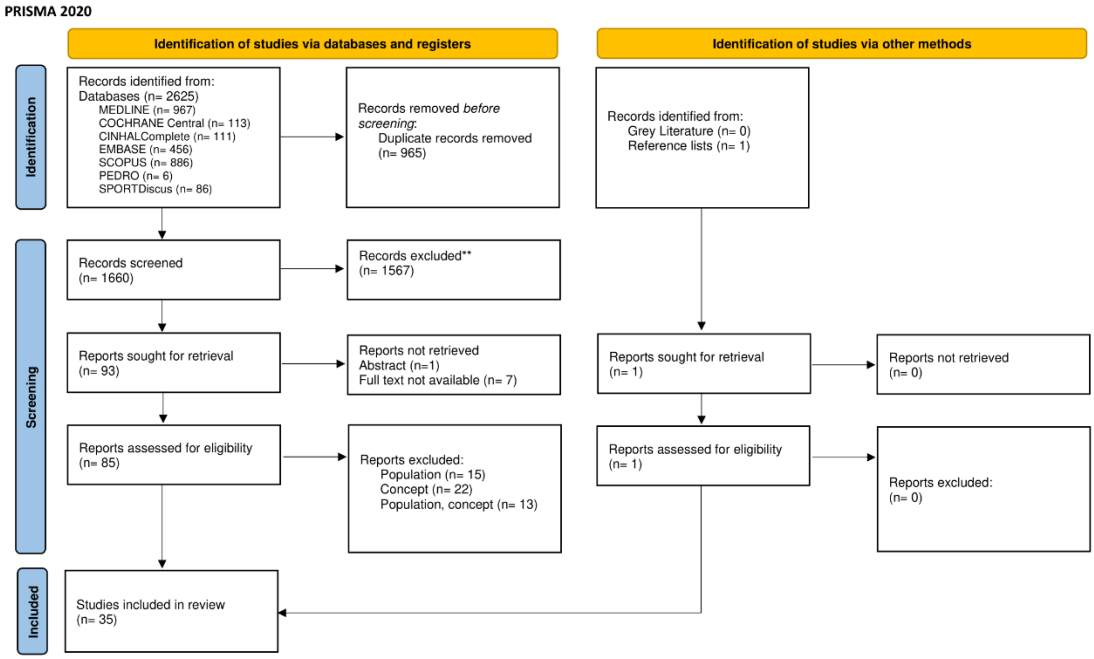
| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **34** | Teitz, 1997 | X | X | | | | | X | X | | | | |
| **35** | Thein-Nissenbaum, 2016 | X | | | | | | X | | | | | |
| | Total n° | 30 | 16 | 11 | 12 | 6 | 4 | 12 | 10 | 1 | 5 | 3 | 15 |

PFMT = Pelvic Floor Muscle Training.

[a] Electrical stimulation category includes different type of interventions such as Percutaneous Tibial Nerve Stimulation (PTNS), and Transcutaneous Electrical Nerve Stimulation (TENS).

[b] Others: Heat/cold; Intermittent catheterization; Intra-abdominal pressure management; Multidisciplinary management; Muscle strengthening (transversus abdominis, obliques abdominal muscles, serratus major etc.); "Physiotherapy" intervention not clearly specified; PFM Synergistic Training (Breathing techniques, Hypopressive technique); Running technique. Vaginal dilators. For detailed descriptions (PFD and related treatment); see **SUPPLEMENTARY FILE 3**.

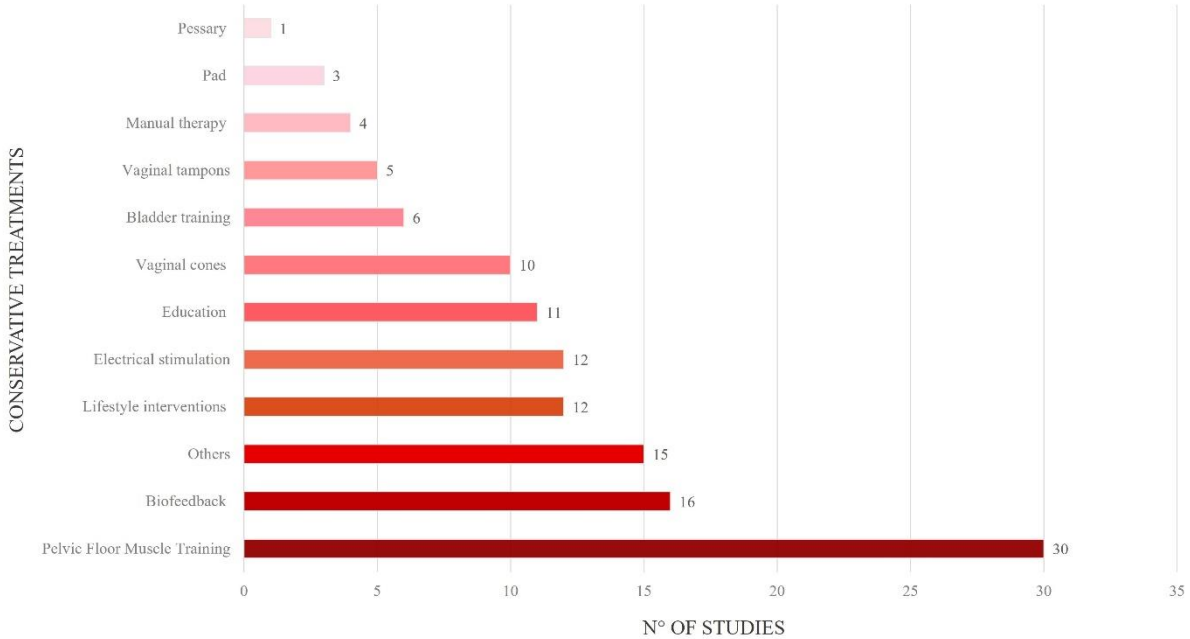
## FIGURE 1.




*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

*From:* Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

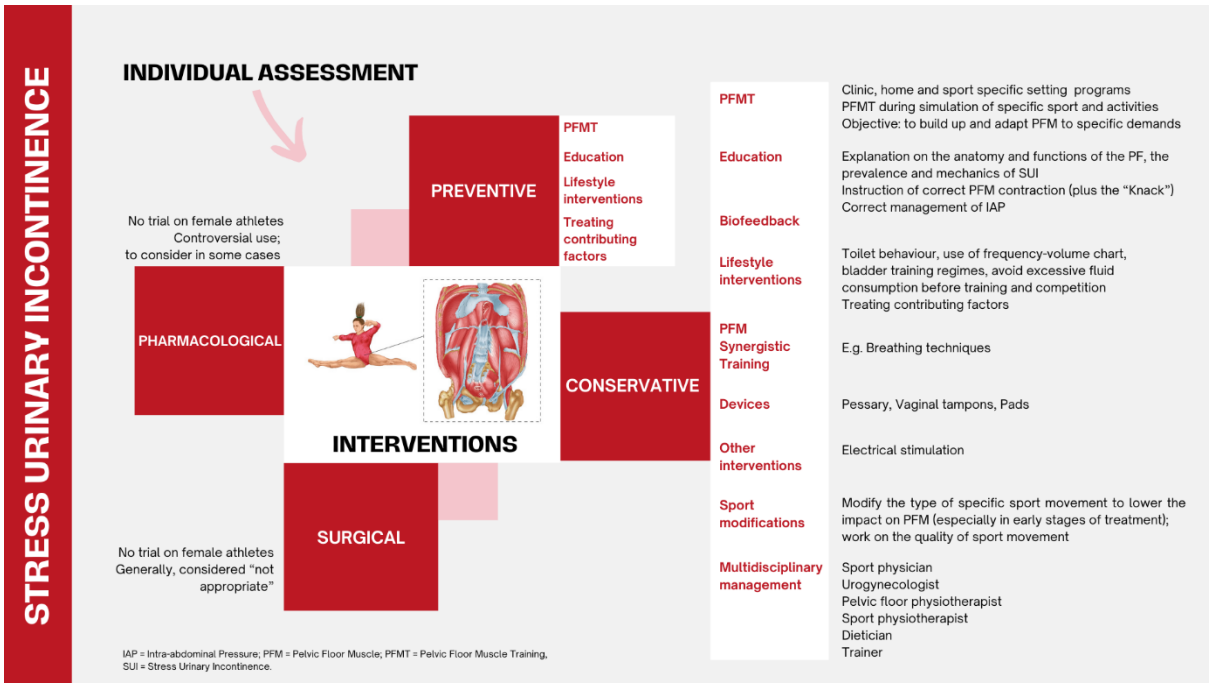
## FIGURE 2.




Electrical stimulation category includes different type of interventions such as Percutaneous Tibial Nerve Stimulation, and Transcutaneous Electrical Nerve Stimulation.

Others: Heat/cold; Intermittent catheterization; Intra-abdominal pressure management; Multidisciplinary management; Muscle strengthening; "Physiotherapy" intervention not clearly specified; PFM Synergistic Training (Breathing techniques, Hypopressive technique); Running technique. Vaginal dilators. For detailed descriptions see **SUPPLEMENTARY FILE 3.**

**FIGURE 3.**


STRESS URINARY INCONTINENCE
INDIVIDUAL ASSESSMENT
PREVENTIVE
PFMT
Education
Lifestyle interventions
Treating contributing factors
No trial on female athletes
Controversial use;
to consider in some cases
PHARMACOLOGICAL
INTERVENTIONS
CONSERVATIVE
SURGICAL
No trial on female athletes
Generally, considered "not appropriate"
PFMT
Clinic, home and sport specific setting programs
PFMT during simulation of specific sport and activities
Objective: to build up and adapt PFM to specific demands
Education
Explanation on the anatomy and functions of the PF, the prevalence and mechanics of SUI
Instruction of correct PFM contraction (plus the "Knack")
Correct management of IAP
Biofeedback
Lifestyle interventions
Toilet behaviour, use of frequency-volume chart, bladder training regimes, avoid excessive fluid consumption before training and competition
Treating contributing factors
PFM Synergistic Training
E.g. Breathing techniques
Devices
Pessary, Vaginal tampons, Pads
Other interventions
Electrical stimulation
Sport modifications
Modify the type of specific sport movement to lower the impact on PFM (especially in early stages of treatment); work on the quality of sport movement
Multidisciplinary management
Sport physician
Urogynecologist
Pelvic floor physiotherapist
Sport physiotherapist
Dietician
Trainer
IAP = Intra-abdominal Pressure; PFM = Pelvic Floor Muscle; PFMT = Pelvic Floor Muscle Training, SUI = Stress Urinary Incontinence.

## 5.3 PFD-SENTINEL: DEVELOPMENT OF A SCREENING TOOL FOR PELVIC FLOOR DYSFUNCTION IN FEMALE ATHLETES THROUGH AN INTERNATIONAL DELPHI CONSENSUS

**Reference:** Giagio S, Salvioli S, Innocenti T, et al. PFD-SENTINEL: Development of a screening tool for pelvic floor dysfunction in female athletes through an international Delphi consensus [published online ahead of print, 2022 Dec 14]. Br J Sports Med. 2022;bjsports-2022-105985. doi:10.1136/bjsports-2022-105985

**Objectives:** To develop a screening tool for pelvic floor dysfunction (PFD) in female athletes for use by sports medicine clinicians (eg, musculoskeletal/sports physiotherapists, sports and exercise medicine physicians), which guides referral to a PFD specialist (eg, pelvic floor/women's health physiotherapist, gynaecologist, urogynaecologist, urologist).

**Oral presentation:** This article has been accepted as an oral presentation at the national AIFI congress that will be held on November 10–11, 2023, in Bologna (Italy). Presenter: Silvia Giagio.

## ABSTRACT

**Objective:** To develop a screening tool for pelvic floor dysfunction (PFD) in female athletes for use by sports medicine clinicians (e.g., musculoskeletal/sports physiotherapists, sports and exercise medicine physicians) which guides referral to a PFD specialist (e.g., pelvic floor/women's health physiotherapist, gynecologist, urogynecologist, urologist).

**Methods:** Between February and April 2022, an international 2-round modified Delphi study was conducted to assess expert opinion on which symptoms, risk factors, and clinical and sports-related characteristics (items) should be included in a screening tool. We defined consensus *a priori* as > 67 % response agreement to pass each round.

**Results:** Forty-one and thirty-four experts participated in Rounds 1 and 2, respectively. Overall, seven general statements were endorsed as relevant by most participants highlighting the importance of screening for PFD in female athletes. Through consensus, the panel developed the Pelvic Floor Dysfunction - ScrEeNing Tool IN fEmale athLetes (PFD-SENTINEL) and agreed to a cluster of PFD symptoms (n=5) and items (risk factors, clinical and sports-related characteristics; n=28) that should prompt specialist care. A clinical algorithm was also created: a direct referral is recommended when at least one symptom or 14 items are reported. If these thresholds are not reached, continuous monitoring of the athlete's health is indicated.

**Conclusion:** Despite increasing awareness and clinical relevance, barriers to identify PFD in female athletes are still present. The PFD-SENTINEL is a new resource for sports medicine clinicians who regularly assess female athletes and represents the first step toward early PFD identification and management. Further studies to validate the tool are needed.

**KEYWORDS:** Athlete, Pelvic Floor Disorder, Screening, Sports Medicine, Women.

## INTRODUCTION

Several epidemiological studies have reported a high prevalence of Pelvic Floor Dysfunction (PFD) [1–3] among female athletes [4]. Compared with non-athletic women, athletes have a higher risk of developing urinary incontinence (UI) and also a greater prevalence rate of UI, reaching 80% in trampolinists [5,6]. Evidence is still scant about other PFD such as pelvic organ prolapse (POP) and anal incontinence (AI) evidence is still scant [4].

According to various authors, PFD in female athletes may be an under-researched, under-recognised and under-treated problem [4,7,8] for several reasons. Studies showed that the athletes' knowledge of the pelvic floor is low [9,10], and few discuss their condition with medical staff [9,11]. Moreover, only a minority of professionals are aware of the possible dysfunction that could occur [12], screening for potential PFD is frequently delayed, and risk factors are not often assessed [12]. For example, 30.4% of Australian sports medicine professionals do not screen for PFD, because pelvic floor questions are not currently included in existing screening tools, or because they are not aware of which questions to ask [12]. As a consequence of unrecognised diagnosis, worsening symptoms, negative influence on performance and withdrawal from sports may occur [5,9,11].

Different screening tools for other conditions have been developed. These include the Sport Concussion Assessment Tool 5 (SCAT5), The International Olympic Committee Sport Mental Health Assessment Tool 1 (SMHAT-1) and the Brief Eating Disorder in Athletes Questionnaire (BEDA-Q) [13–15]. However, to our knowledge, there is currently no existing tool or instrument including PFD screening that can be used by sports medicine clinicians. These healthcare professionals, who traditionally see and treat athletes, are usually not specialists in pelvic floor health, but they may play an important role in pelvic floor health care in athletes [16]. This study aimed to develop a practical screening tool for PFD in female athletes for use by sports medicine clinicians (e.g musculoskeletal/sports physiotherapists, sports and exercise medicine physicians) which guides referral to a PFD specialist (e.g., pelvic floor/women's health physiotherapist, gynecologist, uro-gynecologist, urologist) through a Delphi consensus.

## METHODS

An Italian research team worked on the development of the present screening tool using a Delphi modified consensus through a web-based survey (SurveyMonkey, Palo Alto, CA). The research team included seven researchers and/or clinicians: SG, SS, TI, PP, GG, MV and AT. The committee's expertise included: epidemiology, primary and secondary research methodology, sports medicine, musculoskeletal/sports physiotherapy, pelvic floor physiotherapy, and urogynecology.This Delphi study was conducted following the Conducting and Reporting of Delphi Studies (CREDES) [17] recommendations, while the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guidelines [18] was used for the reporting.

The study was approved by the Bioethics Committee of the University of Bologna, Italy (No 0240048). Full information, details and data protection policies are reported in the prospectively registered protocol [19].

### Definitions

*Target population.* The present screening tool is tailored specifically to female athletes of any age, performance level and practicing any type of sports. Regarding the term "athlete", the definition and criteria proposed in 2016 by Araujo and Scharhag [20] was used in the present Delphi consensus.

*Clinical condition.* We considered any type of PFD including the most common UI, POP, AI, overactive bladder syndrome (OAB) and pelvic pain [1–3].

*Target end users.* The aim was to create a screening tool for sports medicine clinicians who assess and are in close contact with athletes but are non-specialists in pelvic floor health. In most cases, these professionals are musculoskeletal/sports physiotherapists and sports medicine physicians (including team physicians).

*Sports.* Considering that the impact of sports practice on the pelvic floor is closely linked to increased intra-abdominal pressure and ground reaction force [21], we used both these factors to identify high, medium and low-impact sports. High-impact sports include gymnastics, basketball,

volleyball, high jump, trampoline and powerlifting. Sports like tennis, running, karate, football were considered medium-impact. Sports that do not involve jumping and abdominal contraction or in which no direct ground contact is involved such as swimming, cycling and walking were considered low-impact.

**Patient and public involvement**

This consensus process did not include patients or the public in the design, conduct, reporting, or dissemination plans of our research.

**Equity, diversity and inclusion**

The Italian author team included two women and five men, clinician, senior and junior investigators from a variety of specialties. On behalf of 14 nationalities, participants included women and men from different ages, disciplines, and levels of expertise. The female athlete is the focus of this article: great attention has been given to medical conditions that strongly impact athletes' life and health.

**Identification of risk factors and clinical and sports-related characteristics to include in the screening tool**

In addition to the risk factors for PFD in women of the general population [3,22–24], the research team conducted a comprehensive search in MEDLINE on January, 13$^{th}$ 2022. Among the female athlete population, the objective was to identify published primary and secondary studies that reported a) specific risk factors significantly associated with PFD; b) clinical conditions investigated by authors potentially but not significantly associated with PFD; c) sports-related characteristics investigated by authors potentially but not significantly associated with PFD. These data were presented as *items* in the survey. The search strategy is reported in Supplementary file 1 (**SUPPLEMENTARY FILE 1**), while all extracted data with references are presented in Supplementary file 2 (**SUPPLEMENTARY FILE 2**).

**Delphi study**

*Approach.* An online modified Delphi technique was chosen as it is a commonly used method to establish an agreement on various health- and research-related issues, especially applied to address research topics that are not yet well developed in the literature [25]. The "modified Delphi" approach may include any variation of Delphi method [26,27], and was chosen as we proposed to the experts a set of carefully selected items from the literature as described above.

The ideal number of panelists for a Delphi to reach consensus is not clear [28] and it depends on the investigated subject [29,30]. Since we asked the opinion of experts in a specific knowledge topic, no sample size calculation was performed.

*Participant recruitment.* Non-random, purposive sampling was used to identify target participants through a literature scan of MEDLINE. In order to preserve the anonymity of participants, the complete search strategy is not reported. Eligible participants were authors of at least two publications of any study design concerning PFD among athletes. We chose this criterion as the most objective method possible to define the degree of panel's expertise. After this phase, a set of unique authors' names and contact information was extracted. To characterise the panel, participants were asked about sociodemographic (e.g., nationality, age, sex) and professional characteristics (e.g., educational background, their current field of work and role, experience and number of studies on the topic). Participation was voluntary and no incentives were offered.

*Procedure and pilot testing.* Two Delphi rounds were run. The first round was performed in February 2022 and the second one in April 2022. Before invitation, the content of each round was pilot tested by all the research team members for control purposes, and the survey redesigned based on feedback.

Together with the research team, all eligible authors were then invited by an e-mail from the first author (SG) to participate. The mail included a brief note underlining a) the aim of the study, b) contact name and address of the first author, c) data handling, d) privacy policy, e) informed consent, f) instructions for the completion of the survey and g) the related link invitation. All participants were invited to participate in both rounds unless they explicitly indicated that they do

not wish to participate. During each round, to minimise the non-response bias, one e-mail reminder was sent. To prevent biases, participants' IP address was used to identify potential duplicate entries from the same user and questions were randomized. Participants were able to review and check the completeness of the survey and eventually change responses using a back button, before submitting their answers.

Participants were ensured that their identities would not be disclosed. Data were downloaded and stored in an encrypted file and all personal data were de-identified to maintain confidentiality and data protection; only the first author had access to information during all stages of the study [31].

*Data collection.* The items presented in the Delphi survey were closed questions in which participants could score the endorsement of each item for inclusion in the screening tool on a 5-point Likert scale: "Strongly disagree/Absolutely no", "Disagree", "Neutral", "Agree" and "Strongly agree/Absolutely yes" (e.g. *Strongly agree to include the item in the screening tool for referral*). A consensus was set *a priori* at 67% of the total number of participants (dis)agreeing with a proposal (ie, "Strongly (dis)agree" and "(Dis)Agree" answers) were pooled together. This criterion is in line with other Delphi studies [32–34] and it was selected considering the nature of the field. We chose to be more conservative as this is a research area that is still in development. Only completed questionnaires were analysed.

**Delphi Round 1**

Preliminary general statements regarding the use and the importance of screening in the field were incorporated into the survey. In addition, clinical and sports-related characteristics along with risk factors extracted from a preliminary literature search were presented as *items*. Subsequently, participants were asked whether they agree or disagree with the endorsement of each item for inclusion in the screening tool. Criteria for referral were identified by the participants in this phase. Finally, two open questions were asked for additional items and general feedback on the Delphi.

**Delphi Round 2**

Items without a consensus were presented again for voting only if they had at least 50% of participants in favor of the endorsement or if any substantial remark favored their endorsement. In the case of no consensus, all potential items were presented again for rating. Additional items, based on first-round participant suggestions, were added in this round.

**Results from the Delphi survey**

Item scores were summarised as appropriate (e.g, frequency and proportions) accompanied by a narrative summary of findings, comments, and suggestions. For the analysis, "Strongly (dis)agree" and "(Dis)Agree" answers were pooled together. In the final phase, the research team participated in a meeting group revising a dummy version of the tool for control purposes. Once approval was obtained from all the members, the screening tool was considered ready for reporting.

**RESULTS**

The complete Delphi process is presented in the flow-diagram **(FIGURE 1)**. Eighty-three experts' names and contact information were extracted from the initial MEDLINE search and 70 email valid addresses were found. Together with the research team (n=7), a total of 77 participants were invited to participate. Forty-one respondents took part in Round 1 and 34 in Round 2, representing 53.2% (41/77) and 44.2% (34/77) of participants. The average time of completion during Round 1 was 11 minutes, while for Round 2 participants took about six minutes. Completion rate was 100% for both rounds.

**Characteristics of participants**

Females, Italians, and physiotherapists were the most prevalent sex, nationality, and educational background, respectively. Most participants were currently working as clinicians and researchers

(n=22; 53.6%) and reported considerable experience, with 43.9% having worked for more than 10 years in this field. Table 1 illustrates the main characteristics of the participants (**TABLE 1**).

**Consensus**

The responses provided by participants are divided into 4 sections: (1) general statements; (2) items; (3) agreement for referral; (4) cluster of PFD symptoms.

Six statements gained immediate consensus by Round 1, while one additional statement was suggested by participants. Figure 2 graphically illustrates the final consensus (**FIGURE 2**).

Table 2 details specific items included (n=28) under each section and the level of agreement for both rounds (**TABLE 2**).

Participants agreed to identify the benchmark of total item score for suggesting referral to a PFD specialist. The only option that reached the minimum consensus was "Total item score ≥ 50% of all items included in the screening tool" (n=28; 68.3%).

During Round 1, experts suggested introducing symptoms into the tool. For this reason, we developed a new section "Symptoms", and in Round 2 participants were asked whether they agree or disagree with the endorsement for the inclusion. Symptoms presented in this phase were selected and adapted from validated questionnaires. Supplementary file 3 displays the rationale behind this selection with references (**SUPPLEMENTARY FILE 3**). Thirty-one participants (91.2%) agreed to incorporate the new section and then, five out of six symptoms reached the minimum agreement (**TABLE 3**).

In Round 2, the majority of experts chose the Pelvic Floor Dysfunction - ScrEeNing Tool IN fEmale athLetes (PFD-SENTINEL) as the official name for the tool (n=16; 47.1%).

All sections of relevant information for the application of PFD-SENTINEL are available in A4-printable version (**SUPPLEMENTARY FILE 4**).

To provide a transparent analysis, the complete data, agreement, feedback and comments for each section and round are reported in Supplementary files (**SUPPLEMENTARY FILE 5A-M**).

## DISCUSSION

This 2-round Delphi study involving 41 experts worldwide reached a multidisciplinary consensus on the proposal of the first screening tool for PFD in female athletes. Despite an increasing interest in pelvic floor research among female athletes [4], relevant barriers for identifying the real prevalence and burden of these conditions are still present [7,8,12]. In an expanding but still grey area, we asked for the experts' opinion with the main purpose to reduce this gap. The result was the development of the PFD-SENTINEL: a simple, practical, and friendly-to-use screening tool for sports medicine clinicians who regularly assess female athletes and are not usually specialists or trained in pelvic floor health.

The choice to consider any type of PFD was made for two main reasons: 1) the heterogeneity of epidemiological studies among female athletes [4], and 2) the aim of the tool. The PFD-SENTINEL is not a diagnostic or prognostic tool but describes the cluster of symptoms (n=5) and risk factors, clinical and sports-related characteristics (n=28) that should prompt a referral to specialist care.

Most of the proposed symptoms and items were included in the final tool. This is possibly because they were derived from a preliminary literature search and validated questionnaires. Although some items suggested by participants do not currently have strong evidence, from our perspective the inclusion of these data was appropriate, as our aim to maximise the inclusion of clinically relevant information in the tool. The overall agreement for these items was high, suggesting their clinical relevance and the importance for inclusion in further investigations. Participants provided positive feedback, highlighting the importance of screening as part of comprehensive model of care based on early identification and intervention. However, further prospective research is warranted to validate the tool.

### How to use and apply the PFD-SENTINEL

The tool consists of two consecutive sections. The first part aims to screen for symptoms, while the second part investigates the presence of general clinical and sports-related risk factors

potentially associated with PFD. For each section, the clinician is required to score one point for each referred symptom or satisfying item. In implementing the tool, we have proposed the following algorithm:

1) *SCORE A:* direct referral to a PFD specialist should be encouraged if at least one symptom is reported. Only in the case that no symptom is referred, the clinician may proceed to the next section, named "Total item score".

2) *SCORE B:* referral to a PFD specialist should be suggested if the total item score is ≥ 14 (50% of all items included).

3) *SCORE C*: referral to a PFD specialist should not be suggested if the total item score is < 14 which represents the 50% of all items included. Instead, continuous monitoring of the athlete's health within a multidisciplinary team is indicated.

According to experts' opinion, the PFD-SENTINEL should ideally be administered on a regular basis to check any changes in health and athletic activity. In particular, the tool should be embedded within the pre-season period to test the athlete's health before the upcoming training and competitions. We also suggest using the tool whether the athlete experienced an enforced stop that has significantly affected her performance or if she has suffered an injury potentially connected to the pelvic floor. During mid-season, a new administration of the tool could be considered for athletes who are forced to take long-term breaks from competitive activities (i.e., winter breaks for team sports championships in countries with low temperatures). It may also be reasonable to retest the tool in case the athlete joins a new team during the current season. It is also important to underline that, in case of return to sport after pregnancy and among para-athletes, experts agreed that additional screening is required.

**Clinical implications**

The PFD-SENTINEL aims to be a key resource where the implementation of the tool may facilitate the referral pathway to a PFD specialist (e.g., pelvic floor/women's health physiotherapist, gynecologist, urogynecologist, urologist) and may represent the first step toward

early diagnosis and accessing appropriate PFD management. This is important as the 6th International Consultation on Incontinence [35] suggested lifestyle interventions and pelvic floor muscle training (PFMT) as the first line treatment with level 1A evidence/recommendation for some PFD presentations such as UI.

**Facilitators and barriers to application**

Our aim was to create a tool that includes general medical and pelvic floor questions that considers all relevant information without the need for a pelvic floor assessment. The tool is designed to be used quickly and easily by sports medicine clinicians. Including the specific questions for screening symptoms and the clinical checklist, the PFD-SENTINEL provides clear step-by-step support for easy implementation. However, as for other medical conditions [36], education of a clinician not specialised in pelvic floor health, using the tool in a confidential setting where such information can be shared may support the application.

**Strengths and limitations**

Overall, the main strengths of the current study are related to the novelty of the topic and the transparency of the Delphi process. To our knowledge, this is the only existing study to develop a screening tool for pelvic floor health, in female athletes. An extensive preliminary search was conducted to identify risk factors along the available clinical and sports-related characteristics, and the current guidelines (CHERRIES, CREDES) were used. Moreover, we reported any information and data, as supplementary files.

While our findings are of interest, we note some study limitations. First, although we attempted to be comprehensive in inviting participants worldwide and in minimising non-response bias, the geographical representativity of experts' community could not be fully representative. Second, the Expert coefficient competence "K" for determining the specific level of expertise in the field has not been calculated; this may also represent a potential limitation of this study. Concerning the participation of the authorship panel, five out of seven authors matched the criterion of

eligibility as “experts” and two authors are developing a research background in the field. The participation of authors on the Delphi process may represent a consensus bias. Lastly, athletes were not involved in any phase of this study.

Further validation studies are necessary to test the screening tool accuracy, thus confirming or modifying the proposed referral options in consideration of the multifactorial etiology of PFD.

## CONCLUSIONS

According to existing literature, PFD is an under-recognised and under-treated condition among female athletes. The proposed PFD-SENTINEL tool consisting of 5 symptoms and 28 items represents a novel resource to reduce this gap. The tool was developed to aid sports medicine clinicians (e.g., musculoskeletal/sports physiotherapists, sports medicine physicians) in referring female athletes to a PFD specialist such a urogynecologist and pelvic floor/women’s health physiotherapist. This step could be a starting point toward early PFD specialist management. Additional prospective studies are needed to validate the tool and assess its accuracy and performance.

**Contributors** Conceptualisation: SG; methodology: SG, AT, SS and TI; formal analysis: SG and SS; investigation: SG, SS, TI; data curation: SG, SS, AT; writing—original draft preparation: SG; writing—review and editing, SG, TI, AT, MV, GG, PP, SS; supervision, AT, PP; project administration, SG. All authors have read and agreed to the submitted version of the manuscript.

**Funding** None declared.

**Acknowledgments** The authors would like to thank the experienced participants for their time and effort required to complete the Delphi survey. In particular, the authors gratefully acknowledge experts who expressly gave the consensus to report their name along this section: Alice Carvalhais, PT, MS; Jennifer Kruger, Dr; Jean Hay-Smith, PhD; Lori Forner BScH, MPhtySt, PhD candidate; Maíta Poli De Araujo MD, PhD; Orly Goldstick, MD; Thuane Huyer da Roza, PhD; William Stuart Reynolds, MD, MPH, FACS.

**Competing interests** None declared. No support from any organisation for the submitted work; no financial relationships with any organisations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work.

**Patient consent for publication** Not required.

**Ethics approval** No ethical clearance is required for the present study.

**Provenance and peer review** Not commissioned; externally peer reviewed.

**Data sharing statement**. All data relevant to the study are included in the article or uploaded as supplementary information.

**REFERENCES**


1 Haylen BT, de Ridder D, Freeman RM, *et al.* An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic floor dysfunction. *Neurourol Urodyn* 2010;**29**:4–20. doi:10.1002/nau.20798

2 Haylen BT, Maher CF, Barber MD, *et al.* An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female pelvic organ prolapse (POP). *Int Urogynecol J* 2016;**27**:655–84. doi:10.1007/s00192-016-3003-y

3 Bump RC, Norton PA. Epidemiology and natural history of pelvic floor dysfunction. *Obstet Gynecol Clin North Am* 1998;**25**:723–46. doi:10.1016/s0889-8545(05)70039-5

4 Giagio S, Salvioli S, Pillastrini P, *et al.* Sport and pelvic floor dysfunction in male and female athletes: A scoping review. *Neurourol Urodyn* 2021;**40**:55–64. doi:10.1002/nau.24564

5 Teixeira RV, Colla C, Sbruzzi G, *et al.* Prevalence of urinary incontinence in female athletes: a systematic review with meta-analysis. *Int Urogynecol J* 2018;**29**:1717–25. doi:10.1007/s00192-018-3651-1

6 Sorrigueta-Hernández A, Padilla-Fernandez B-Y, Marquez-Sanchez M-T, *et al.* Benefits of Physiotherapy on Urinary Incontinence in High-Performance Female Athletes. Meta-Analysis. *J Clin Med* 2020;**9**:3240. doi:10.3390/JCM9103240

7 Rebullido T, Chulvi-Medrano I, Faigenbaum A, *et al.* Pelvic Floor Dysfunction: An Urgent Matter for Female Athletes. *Strength Cond J* 2019;**41**:1. doi:10.1519/SSC.0000000000000510

8 Bo K, Nygaard IE. Is Physical Activity Good or Bad for the Female Pelvic Floor? A Narrative Review. *Sports Med* 2020;**50**:471–84. doi:10.1007/s40279-019-01243-1

9 Skaug KL, Engh ME, Frawley H, *et al.* Urinary and anal incontinence among female gymnasts and cheerleaders-bother and associated factors. A cross-sectional study. *Int*

*Urogynecol J* Published Online First: February 2021. doi:10.1007/s00192-021-04696-z

10 Dos Santos KM, Da Roza T, Tonon da Luz SC, *et al.* Quantification of Urinary Loss in Nulliparous Athletes During 1 Hour of Sports Training. *PM R* 2019;**11**:495–502. doi:10.1016/j.pmrj.2018.08.383

11 Gram MCD, Bo K. High level rhythmic gymnasts and urinary incontinence: Prevalence, risk factors, and influence on performance. *Scand J Med Sci Sports* 2020;**30**:159–65. doi:10.1111/sms.13548

12 Dakic J, Hay-Smith J, Cook J, *et al.* Screening and management of pelvic floor symptoms in exercising women: online survey of 636 health and exercise professionals. [*Congress presentation abstract]*. International Continence Society (ICS) Congress 2021, online. https://www.youtube.com/watch?v=wC_JS32mGI8 ; https://www.ics.org/2021/abstract/52

13 Sport concussion assessment tool - 5th edition. Br. J. Sports Med. 2017;**51**:851–8. doi:10.1136/bjsports-2017-097506SCAT5

14 Gouttebarge V, Bindra A, Blauwet C, *et al.* International Olympic Committee (IOC) Sport Mental Health Assessment Tool 1 (SMHAT-1) and Sport Mental Health Recognition Tool 1 (SMHRT-1): towards better support of athletes' mental health. *Br J Sports Med* 2021;**55**:30–7. doi:10.1136/bjsports-2020-102411

15 Martinsen M, Holme I, Pensgaard AM, *et al.* The development of the brief eating disorder in athletes questionnaire. *Med Sci Sports Exerc* 2014;**46**:1666–75. doi:10.1249/MSS.0000000000000276

16 Donnelly GM, Moore IS, Brockwell E, *et al.* Reframing return-to-sport postpartum: the 6 Rs framework. Br. J. Sports Med. 2022;**56**:244–5. doi:10.1136/bjsports-2021-104877

17 Jünger S, Payne SA, Brine J, *et al.* Guidance on Conducting and REporting DElphi Studies (CREDES) in palliative care: Recommendations based on a methodological systematic review. *Palliat Med* 2017;**31**:684–706. doi:10.1177/0269216317690685

18 Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results

of Internet E-Surveys (CHERRIES). J. Med. Internet Res. 2004;**6**:e34. doi:10.2196/jmir.6.3.e34

19 Giagio S, Turolla A, Innocenti T, *et al.* Development of a screening tool for pelvic floor dysfunction in female athletes: protocol of a Delphi consensus. *medRxiv* Published Online First: 2022. doi:10.1101/2022.01.12.22269000

20 Araujo CGS, Scharhag J. Athlete: a working definition for medical and health sciences research. Scand. J. Med. Sci. Sports. 2016;**26**:4–7. doi:10.1111/sms.12632

21 Bo K. Urinary incontinence, pelvic floor dysfunction, exercise and sport. *Sports Med* 2004;**34**:451–64. doi:10.2165/00007256-200434070-00004

22 Milsom I, Gyhagen M. Breaking news in the prediction of pelvic floor disorders. *Best Pract Res Clin Obstet Gynaecol* 2019;**54**:41–8. doi:10.1016/j.bpobgyn.2018.05.004

23 Bazi T, Takahashi S, Ismail S, *et al.* Prevention of pelvic floor disorders: international urogynecological association research and development committee opinion. *Int Urogynecol J* 2016;**27**:1785–95. doi:10.1007/s00192-016-2993-9

24 Delancey JOL, Kane Low L, Miller JM, *et al.* Graphic integration of causal factors of pelvic floor disorders: an integrated life span model. *Am J Obstet Gynecol* 2008;**199**:610.e1-5. doi:10.1016/j.ajog.2008.04.001

25 Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *J Adv Nurs* 2000;**32**:1008–15.

26 McKenna HP. The Delphi technique: a worthwhile research approach for nursing? *J Adv Nurs* 1994;**19**:1221–5. doi:https://doi.org/10.1111/j.1365-2648.1994.tb01207.x

27 Nasa P, Jain R, Juneja D. Delphi methodology in healthcare research: How to decide its appropriateness. *World J Methodol* 2021;**11**:116–29. doi:10.5662/wjm.v11.i4.116

28 Veugelers R, Gaakeer MI, Patka P, *et al.* Improving design choices in Delphi studies in medicine: the case of an exemplary physician multi-round panel study with 100% response. *BMC Med Res Methodol* 2020;**20**:156. doi:10.1186/s12874-020-01029-4

29 Akins RB, Tolson H, Cole BR. Stability of response characteristics of a Delphi panel:

application of bootstrap data expansion. *BMC Med Res Methodol* 2005;**5**:37. doi:10.1186/1471-2288-5-37

30 Beiderbeck D, Frevel N, von der Gracht HA, *et al.* Preparing, conducting, and analyzing Delphi surveys: Cross-disciplinary practices, new directions, and advancements. *MethodsX* 2021;**8**:101401. doi:10.1016/j.mex.2021.101401

31 de Leeuw ED, Hox JJ, Dillman DA. International handbook of survey methodology. 2008.

32 Chiarotto A, Boers M, Deyo RA, *et al.* Core outcome measurement instruments for clinical trials in nonspecific low back pain. *Pain* 2018;**159**:481–95. doi:10.1097/j.pain.0000000000001117

33 Sconfienza LM, Albano D, Allen G, *et al.* Clinical indications for musculoskeletal ultrasound updated in 2017 by European Society of Musculoskeletal Radiology (ESSR) consensus. *Eur Radiol* 2018;**28**:5338–51. doi:10.1007/s00330-018-5474-3

34 Page MJ, Huang H, Verhagen AP, *et al.* Identifying a core set of outcome domains to measure in clinical trials for shoulder disorders: a modified Delphi study. *RMD open* 2016;**2**:e000380. doi:10.1136/rmdopen-2016-000380

35 Abrams P, Cardozo L, Wagg A, *et al. Incontinence*. 6th Editio. ICI-ICS. International Continence Society, Bristol UK 2017.

36 Weber B, Bos J, Clancy EM, *et al.* Role of club doctors in the mental health management of Australian rules football players: a Delphi study. *Br J Sports Med* 2022;**56**:320–6. doi:10.1136/bjsports-2021-104388

**LEGENDS**

**TABLE 1.** International experts panel: participants' characteristics (n= 41).

**TABLE 2.** Results of two rounds Delphi showing level of agreement with items for PFD in female athletes to include in the screening tool for referral.

**TABLE 3.** Results of Round 2: questions regarding PFD symptoms to include in the screening tool for referral. Question: “Do you agree to include the following symptoms?”.

**FIGURE 1.** Delphi flow-chart: from planning to results.

**FIGURE 2.** Results of two rounds Delphi showing level of agreement with “General statements”.

**SUPPLEMENTARY FILE 1.** Search strategy for MEDLINE: initial identification of risk factors, clinical and sports-related characteristics for the female athlete to be proposed to experts.

**SUPPLEMENTARY FILE 2.** Preliminary research: data extracted from epidemiological studies.

**SUPPLEMENTARY FILE 3.** Proposed symptoms cluster and relative rationale for selection.

**SUPPLEMENTARY FILE 4.** PFD-SENTINEL: A4-printable version.

**SUPPLEMENTARY FILE 5A-M.** Complete data and responses of general statements, items, symptoms, criteria for referral and participants’ feedback: Round 1 and Round 2.

**TABLE 1.**

| Variable[a] | n (%) |
|---|---|
| **Age (years)** | |
| 20-29 | 3 (7.3) |
| 30-39 | 12 (29.3) |
| 40-49 | 12 (29.3) |
| 50-59 | 7 (17.1) |
| 60 or more | 7 (17.1) |
| **Sex** | |
| Female | 26 (63.4) |
| Male | 15 (36.6) |
| **Nationality** | |
| Italian | 11 (26.8) |
| Brazilian | 5 (12.2) |
| Australian | 4 (9.7) |
| Norwegian | 3 (7.3) |
| Spanish | 3 (7.3) |
| US-American | 3 (7.3) |
| Austrian | 2 (4.9) |
| New Zealand | 2 (4.9) |
| Portuguese | 2 (4.9) |
| Slovak | 2 (4.9) |
| Others | 4 (9.7) |
| **Educational background** | |
| Physiotherapy | 19 (46.3) |
| Uro-gynecology/Gynecology | 8 (19.5) |
| Sports medicine | 6 (14.6) |
| Physical medicine and rehabilitation | 5 (12.2) |
| Urology/Female Pelvic Medicine and Reconstructive Surgery | 2 (4.9) |
| Physical education professional | 1 (2.4) |
| **Current field of work** | |

| | |
|---|---|
| Physiotherapy | 16 (39.0) |
| Sports medicine | 7 (17.1) |
| Uro-gynecology/Gynecology | 7 (17.1) |
| Physical medicine and rehabilitation | 5 (12.2) |
| Not a specific field (Academic) | 3 (7.3) |
| Urology/Female Pelvic Medicine and Reconstructive Surgery | 2 (4.9) |
| Women's health, exercise and sports | 1 (2.4) |
| **Current role** | |
| Clinician and researcher | 22 (53.6) |
| Researcher | 10 (24.4) |
| Clinician | 4 (9.7) |
| Academic and researcher | 2 (4.9) |
| Academic | 2 (4.9) |
| Academic, researcher, clinician | 1 (2.4) |
| **Workplace** | |
| University hospital | 14 (34.1) |
| Multiple settings (e.g. University/Private clinic/Hospital) | 13 (31.7) |
| Private clinic | 7 (17.1) |
| University | 6 (14.6) |
| Hospital | 1 (2.4) |
| **Experience in the pelvic floor dysfunction field (years)** | |
| None | 6 (14.6) |
| Less than 5 | 9 (21.9) |
| 5 - 10 | 8 (19.5) |
| More than 10 | 18 (43.9) |
| **Average number of patients with pelvic floor dysfunction visited in the last year** | |
| None | 11 (26.8) |
| Less than 20 per month | 21 (51.2) |
| 20 - 50 per month | 4 (9.7) |
| More than 50 per month | 5 (12.2) |
| **Number of publications regarding pelvic floor dysfunction** | |

| | |
|---|---|
| None | 2 (4.9) |
| Less than 5 | 17 (41.5) |
| 5 - 10 | 12 (29.3) |
| More than 10 | 10 (24.4) |

[a]Others: Canadian (n=1; 2.4), Greek (n=1; 2.4), Israeli (n=1; 2.4) and Swiss (n=1; 2.4).
Academic = expert who works primarily in the University setting. Researcher = expert who carries out scientific research in any other setting.

**TABLE 2.**

| | Items | **Round 1 Agreement[a] (%)** | **Round 2 Agreement[a] (%)** |
|---|---|---|---|
| **1** | Age < 18 | 43.9 | - |
| **2** | Age ≥ 28 | 53.7 | 32.3 |
| **3** | BMI > 30 | 80.5 | - |
| **4** | BMI < 18.5 | 87.8 | - |
| **5** | Childbirth | 82.9 | - |
| **6** | Type of delivery: cesarean section | - | 55.9 |
| **7** | Type of delivery: vaginal birth | - | 94.1 |
| **8** | Menopause | 82.9 | - |
| **9** | Medications (e.g. psychotropic medications, ACE inhibitors, diuretics) | 58.5 | 70.6 |
| **10** | Smoking | 63.4 | 55.9 |
| **11** | Higher age of menarche | 46.3 | - |
| **12** | Irregular menstrual cycle | 70.7 | - |
| **13** | Hormonal therapy, oestrogen deficiency states | 70.7 | - |
| **14** | History of urinary tract infections (LUTS) | 82.9 | - |
| **15** | Family history of urinary incontinence (UI) | 68.3 | - |
| **16** | Family history of pelvic organ prolapse (POP) | - | 76.5 |
| **17** | Constipation | 78.0 | - |
| **18** | Nerve, muscle damage, tissue disruption (pelvic floor) | 90.2 | - |
| **19** | Pelvic surgery, radiation | 92.7 | - |
| **20** | Lung disease | 63.4 | 50 |
| **21** | Diabetes mellitus | 58.5 | 70.6 |
| **22** | Connective tissue disease | 87.8 | - |
| **23** | Hypermobility syndrome | 90.2 | - |
| **24** | Relative energy deficiency in sport (RED-s; Mountjoy, 2014) | 90.2 | - |
| **25** | Eating disorders | 80.5 | - |
| **26** | Other musculoskeletal disorders (e.g. Low back pain, hip pain) | 78.0 | - |

| | | | |
|---|---|---|---|
| **27** | Daily drinking carbonated beverages | 29.3 | - |
| **28** | Excessive caffeine consumption | 34.1 | - |
| **29** | High-impact sports (e.g. volleyball, gymnastics, powerlifting) | 95.1 | - |
| **30** | Medium-impact sports (karate, triathlon) | 92.7 | - |
| **31** | Low-impact sports (e.g. swimming, cycling) | 58.5 | 32.3 |
| **32** | Age at start of training < 14 years | 58.5 | 70.6 |
| **33** | Years of training/sports practice ≥ 9 | 70.7 | - |
| **34** | Training hours/day ≥ 2 | 78.0 | - |
| **35** | Training hours/week ≥ 8 | 82.9 | - |
| **36** | Training frequency/week ≥ 4 | 80.5 | - |
| **37** | High-level sports/Athlete's national ranking | 82.9 | - |

[a] Green indicates > 67% of agreement to include the item in the tool.

Red indicates ≤ 67% of agreement to include the item in the tool.

In case of 50-67% of agreement during Round 1, items were presented again in Round 2 for rating.

**TABLE 3.**

| **Main symptoms** | **Question** | **Round 2 Agreement[a] (%)** |
|---|---|---|
| Urinary incontinence (Any type) | Do you usually experience urine leakage? | 100 |
| Anal incontinence | Do you usually lose stool or gas beyond your control? | 100 |
| Overactive bladder syndrome | Do you usually experience urinary urgency (that is a strong sensation of needing to go to the bathroom) usually accompanied by frequent urination and nocturia? | 97.1 |
| Pelvic Organ Prolapse | Do you usually have a bulge or something falling out that you can see or feel in your vaginal area? | 100 |
| | Have you ever had to push in the perineal area with your fingers to start or complete a bowel movement or to start or complete urination? | 61.8 |
| Pelvic pain | Do you usually experience pain or discomfort in the lower abdomen or genital region? | 82.4 |

[a] Green indicates > 67% of agreement to include the symptom in the tool.

**FIGURE 1.**

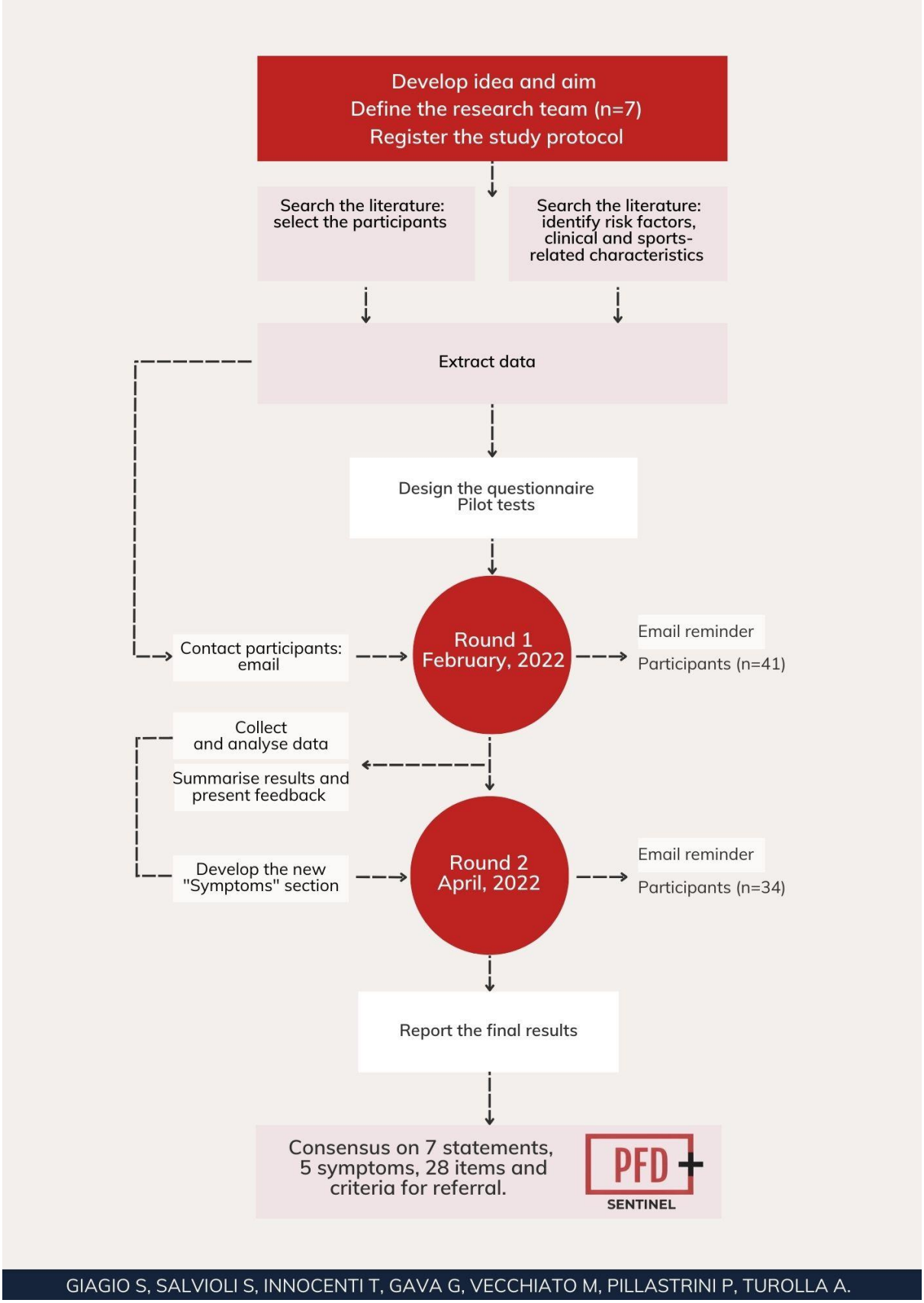
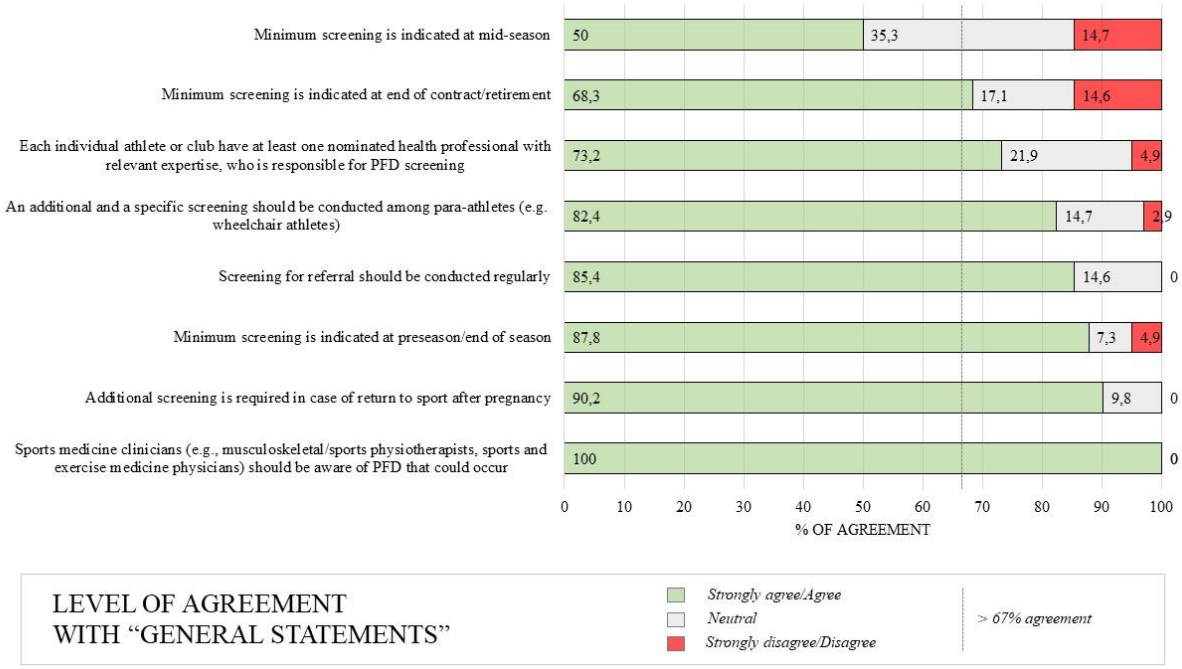

Develop idea and aim
Define the research team (n=7)
Register the study protocol
Search the literature: select the participants
Search the literature: identify risk factors, clinical and sports-related characteristics
Extract data
Design the questionnaire
Pilot tests
Contact participants: email
Round 1
February, 2022
Email reminder
Participants (n=41)
Collect and analyse data
Summarise results and present feedback
Develop the new "Symptoms" section
Round 2
April, 2022
Email reminder
Participants (n=34)
Report the final results
Consensus on 7 statements, 5 symptoms, 28 items and criteria for referral.
PFD
SENTINEL
GIAGIO S, SALVIOLI S, INNOCENTI T, GAVA G, VECCHIATO M, PILLASTRINI P, TUROLLA A.

**FIGURE 2.**


Minimum screening is indicated at mid-season
50
35,3
14,7
Minimum screening is indicated at end of contract/retirement
68,3
17,1
14,6
Each individual athlete or club have at least one nominated health professional with relevant expertise, who is responsible for PFD screening
73,2
21,9
4,9
An additional and a specific screening should be conducted among para-athletes (e.g. wheelchair athletes)
82,4
14,7
2,9
Screening for referral should be conducted regularly
85,4
14,6
0
Minimum screening is indicated at preseason/end of season
87,8
7,3
4,9
Additional screening is required in case of return to sport after pregnancy
90,2
9,8
0
Sports medicine clinicians (e.g., musculoskeletal/sports physiotherapists, sports and exercise medicine physicians) should be aware of PFD that could occur
100
0
0 10 20 30 40 50 60 70 80 90 100
% OF AGREEMENT
LEVEL OF AGREEMENT WITH "GENERAL STATEMENTS"
Strongly agree/Agree
Neutral
Strongly disagree/Disagree
> 67% agreement

**SUPPLEMENTARY FILE 4**. PFD-SENTINEL tool.



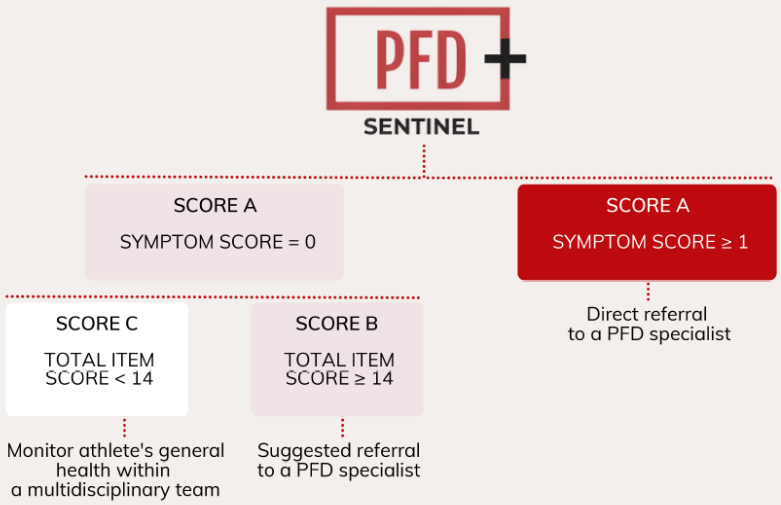
# Pelvic Floor Dysfunction - Screening Tool in Female Athletes: PFD - SENTINEL

**ATHLETE'S NAME** _____

## MAIN INFORMATION ABOUT THE TOOL

| | | |
|---|---|---|
| 1 | What it is | Screening tool for PFD in female athletes useful for guiding referral to a PFD specialist (e.g. pelvic floor/women's health physiotherapist, gynecologist, uro-gynecologist, urologist). |
| 2 | Why you should use it | The prevalence of PFD among female athletes is high. However, screening for potential dysfunctions is often delayed, a specific tool is lacking, and risk factors are not often evaluated. As consequences, withdrawal from sports, negative influence on performance, worsening symptoms and unrecognised diagnosis may occur. Facilitating the referral pathway, the implementation into clinical practice may represent the first step toward PFD specialist management. |
| 3 | Who should use it | Sports medicine clinicians: e.g. musculoskeletal/sports physiotherapists, sports medicine physicians, team physicians. |
| 4 | To whom it applies | Female athletes of any age, of any performance level, practicing any type of sports. |
| 5 | When to use it | Screening for referral should be conducted regularly. |
| 6 | What it includes | Two consecutive sections: 1) cluster of PFD symptoms, 2) items including risk factors, general clinical and sports-related characteristics. |

## THE TOOL ALGORITHM




CREDITS TO: GIAGIO S, SALVIOLI S, INNOCENTI T, GAVA G, VECCHIATO M, PILLASTRINI P, TUROLLA A.

Giagio S, *et al. Br J Sports Med* 2022;0:1–7. doi: 10.1136/bjsports-2022-105985

## INSTRUCTIONS

Check the box whether symptoms are reported and items are satisfied.
Score 1 point for each one.

PFD + SENTINEL

## SYMPTOMS

Do you ....

- ☐ Usually experience urine leakage?
- ☐ Usually experience urinary urgency (that is a strong sensation of needing to go to the bathroom) usually accompanied by frequent urination and nocturia?
- ☐ Usually have a bulge or something falling out that you can see or feel in your vaginal area?
- ☐ Usually lose stool or gas beyond your control?
- ☐ Usually experience pain or discomfort in the lower abdomen or genital region?

SYMPTOM SCORE = ..... /5

Whether none symptom is reported, you may proceed to the next section.

## ITEMS

### Clinical characteristics

- ☐ BMI < 18.5
- ☐ BMI > 30
- ☐ Childbirth
- ☐ Type of delivery: vaginal birth
- ☐ Diabetes mellitus
- ☐ Connective tissue disease
- ☐ Hypermobility syndrome
- ☐ Eating disorders
- ☐ Relative energy deficiency in sport (RED-s)
- ☐ Musculoskeletal disorders (e.g. Low back pain, hip pain)
- ☐ Medications (e.g. psychotropic medications, ACE inhibitors, diuretics)
- ☐ Menopause
- ☐ Hormonal therapy, oestrogen deficiency states
- ☐ Irregular menstrual cycle
- ☐ Constipation
- ☐ Nerve, muscle damage, tissue disruption (pelvic floor)
- ☐ Pelvic surgery, radiation
- ☐ History of urinary tract infections (LUTS)
- ☐ Family history of urinary incontinence (UI)
- ☐ Family history of pelvic organ prolapse (POP)

### Sports-related characteristics

- ☐ Years of training/sport practice ≥ 9
- ☐ Age at start of training < 14 years
- ☐ Training hours/day ≥ 2
- ☐ Training hours/week ≥ 8
- ☐ Training frequency/week ≥ 4
- ☐ High-level sports/Athlete's national ranking
- ☐ Medium-impact sports (e.g. running, football, tennis, karate)
- ☐ High-impact sports (e.g. volleyball, basketball, gymnastics, powerlifting)

TOTAL ITEM SCORE = ..... /28

CREDITS TO: GIAGIO S, SALVIOLI S, INNOCENTI T, GAVA G, VECCHIATO M, PILLASTRINI P, TUROLLA A.

Giagio S, *et al. Br J Sports Med* 2022;0:1–7. doi: 10.1136/bjsports-2022-105985

## 5.4 TEN NAKED TRUTHS ABOUT THE PELVIC FLOOR IN ATHLETES

**Reference:** Giagio S, Stracciolini A, Faigenbaum A, Pillastrini P, Rial Rebullido T. Infographic. Ten naked truths about the pelvic floor in athletes [published online ahead of print, 2023 Sep 4]. Br J Sports Med. 2023;bjsports-2023-107241. doi:10.1136/bjsports-2023-107241

## INFOGRAPHIC

Pelvic floor dysfunction (PFD) is an umbrella term including a myriad of conditions including urinary and anal incontinence, pelvic organ prolapse, pelvic pain, and sexual dysfunction (1). High-impact sports have been linked with an increased risk of developing PFD. For instance, up to 76% of female volleyball players reported urinary symptoms (2).

Despite the widespread occurrence and consequences of PFD, it remains underreported by athletes (1,2). Misinformation, misperceptions, and miseducation about PFD for both clinicians and athletes can adversely impact an athlete's health, care, training, and performance (2,3).

We aimed to summarize ten evidence-based truths regarding the athlete's pelvic floor (see figure):

1. Physical activity may be protective for PFD, but the individual threshold for negative effects on the pelvic floor remains unclear (3).
2. Stress urinary incontinence is not the only symptom of PFD affecting athletes (1-4).
3. Intrinsic and extrinsic risk factors (e.g, training volume and intensity) have been associated with PFD in athletes (5). PFD may occur in any sport, but high-impact sports may increase risk.
4. Male athletes are not immune to PFD. A larger number of reports have focused on investigating prevalence data among female athletes while overlooking male athletes (1).
5. Although parity and chronological age are well-known risk factors for PFD, nulliparous and adolescent athletes also suffer from PFD (1,3).
6. Conditioning programs should be inclusive of individualized pelvic floor muscle training due to their multifunctional role (2-3,5).
7. PFD is a burden for many athletes by impacting their psychosocial domain, overall performance, and ultimately leading to drop-out (1-5).
8. Health professionals involved in the care of athletes should screen routinely for signs and symptoms of PFD regardless of an athlete's age, gender, or sports practice (2,5). The PFD-SENTINEL was developed to screen female athletes for PFD (5).

9. Special consideration should be placed on the athlete's perinatal period to ensure a continuum of support during this transitional phase by providing access to pelvic health evaluations and implementation of a tailored return to sport framework (2,4).
10. The overall management plan for PFD should be individualized to the athlete's specific needs withing a multidisciplinary team that includes (uro)gynecologists and pelvic floor physiotherapists (1-5).

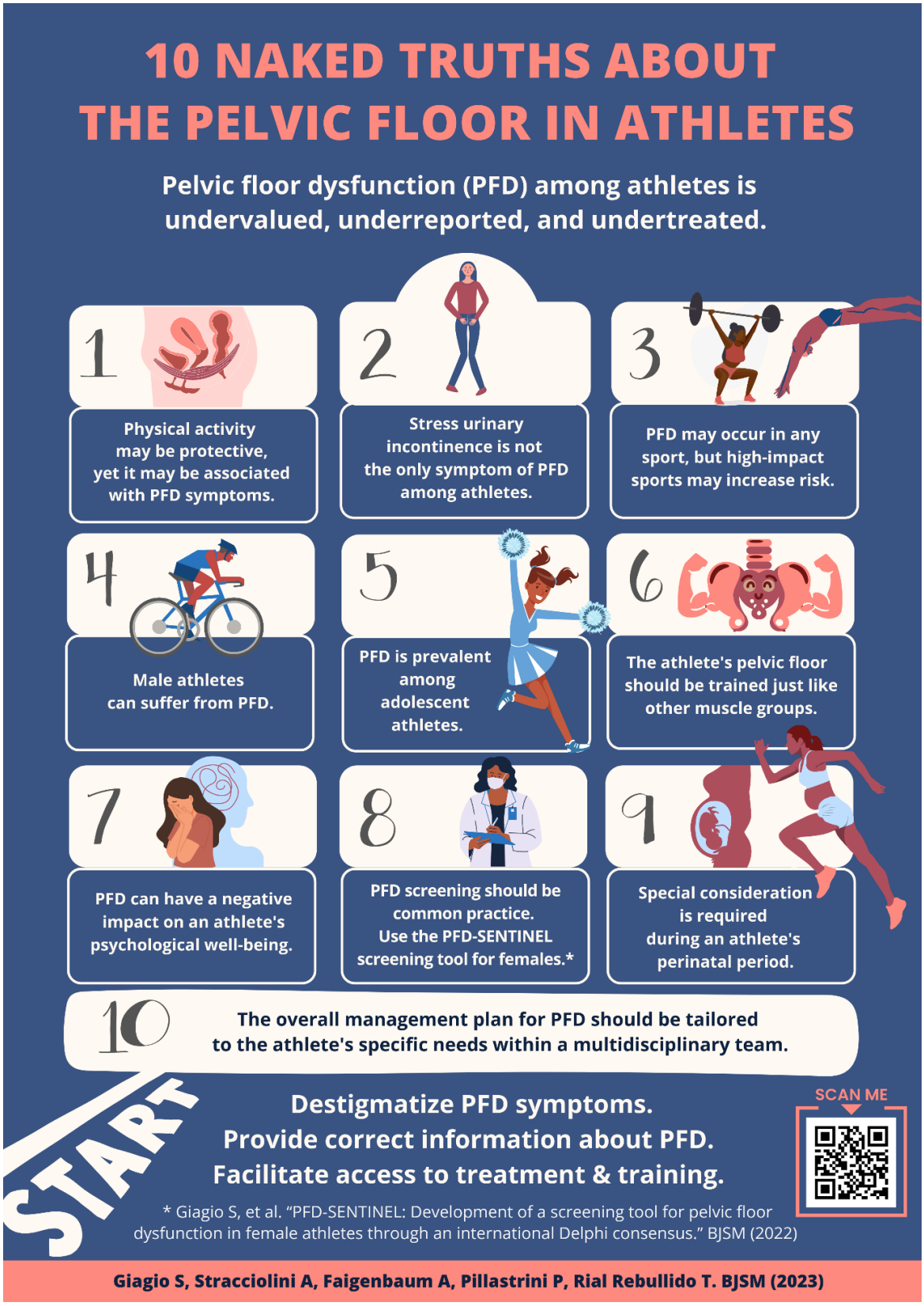
The stigma and normalization of PFD symptoms may be deterring some athletes from seeking appropriate health care. Improving athlete and clinician education is a critical first step, followed by facilitating access to pelvic health treatment, incorporating pelvic floor muscle training into conditioning programs, and improving sport stake holder education about PFD.

**REFERENCES**


1. Giagio S, Salvioli S, Pillastrini P, et al. Sport and pelvic floor dysfunction in male and female athletes: A scoping review. Neurourol Urodyn 2021;40:55–64. doi:10.1002/nau.24564
2. Donnelly GM, Moore IS. Sports Medicine and the Pelvic Floor. *Curr Sports Med Rep*. 2023;22(3):82-90. Published 2023 Mar 1. doi:10.1249/JSR.0000000000001045
3. Bo K, Nygaard IE. Is Physical Activity Good or Bad for the Female Pelvic Floor? A Narrative Review. Sports Med 2020; 50:471–84. doi:10.1007/s40279-019-01243-1
4. Donnelly GM, Moore IS, Brockwell E, et al. Reframing return-to-sport postpartum: the 6 Rs framework. Br. J. Sports Med. 2022;56:244–5. doi:10.1136/bjsports-2021-104877
5. Giagio S, Salvioli S, Innocenti T, et al. PFD-SENTINEL: Development of a screening tool for pelvic floor dysfunction in female athletes through an international Delphi consensus. Br J Sports Med Published Online First: December 2022. doi:10.1136/bjsports-2022-105985

**LEGEND**

**Infographic.** Ten naked truths about the pelvic floor in athletes.



## 5.5 OTHER RELATED ONGOING PROJECTS

The following studies are planned to be concluded in 2024 in collaboration with international colleagues from Monmouth University (USA), Cardiff Metropolitan University (UK), and MSH Medical School Hamburg (GE), among others.

**Study #1**

**Title:** #diastasisrecti: a mixed-method study analysing and interpreting Instagram posts about diastasis recti abdominis, exercise, and sports-related content

**Authors:** Giagio S, Rial Rebullido T, Salvioli S, Innocenti T, Pillastrini P, Moore IS, Donnelly GM.

**Objectives:** 1) To evaluate the health information and suggestions in Instagram (IG) posts concerning diastasis recti abdominis (DRA), exercise and sports through an observational study design; 2) to explore how women with DRA perceive IG content and to understand the impact of this content in their daily lives through a qualitative study design.

**Status:** Ongoing

**Study #2**

**Title:** Cross-cultural adaptation of the Pelvic Floor Dysfunction SENTINEL screening tool for German-speaking female athletes

**Authors:** Albers N, Giagio S, Turolla A, Pillastrini P, Stein-Brueggemann D, Rudolph F, Juhasz-Boess I, Huebner M, Hollander K, Marques CJ.

**Objectives:** To conduct the cross-cultural adaptation and validation of the PFD-SENTINEL Screening Tool (Giagio, 2022) in the German language.

**Status:** Ongoing

# CHAPTER 6

General Discussion And Conclusion

**Comprehensive Insights Into The Clinical Pathway: What It Is Known From Screening To Treatment**

Despite the increasing interest on pelvic floor health in athletes, the fundamental role of the pelvic floor during sports and the impact of exercise on it, PFMs are often disregarded in various healthcare disciplines, including sports medicine [1,2].

These muscles are frequently considered the responsibility of obstetrics, gynecology, urology, and colorectal specialties, with many medical practitioners assuming them to be outside their scope. For instance, certain well-established sports medicine reports on groin pain fail to even mention the PFMs, despite their close proximity to the focal structures. This shared attachment and dual muscle function underscore the significance of considering the PFMs in the differential diagnoses of lumbar, pubic, groin, or hip pain. Furthermore, traditional return-to-sport frameworks lack considerations specific to females and do not include pelvic floor specialists (e.g., gynecologists or pelvic health physical therapists) as part of the multidisciplinary team.

In this context, the present thesis emphasizes the clinical need of integrating pelvic floor health within sports medicine, summarising current evidence and research gaps.

As graphically shown in Figure 4, it outlines crucial clinical reasoning steps and pathways from the screening of potential PFD to therapeutic interventions and treatment modalities, providing a comprehensive view of the most effective approaches to managing PFD in female athletes.

**Figure 4.** Clinical reasoning and pathway for female athletes PFD with relative references.

PELVIC FLOOR DYSFUNCTION

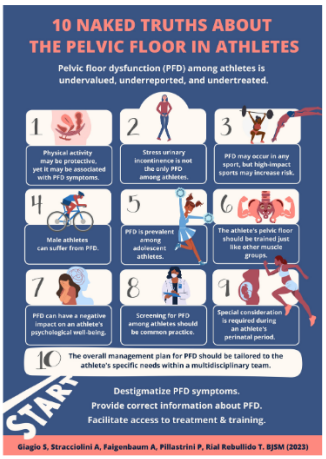
# CLINICAL AND RESEARCH PATHWAY

## AWARENESS, EXPERTISE, INFORMATION

1

- Sport stakeholders' (athlete, coach, sports/msk physio, sports medicine physician, athlete's family) awareness about PF health and PFD
- Specialised expertise in PF and sports
- Multidisciplinary team
- Correct information dissemination

(Giagio, 2023)




## SCREENING

2

PFD-SENTINEL: Pelvic Floor Dysfunction - ScrEeNing Tool IN fEmale athLetes

(Giagio, 2022)

## ASSESSMENT

3

Main findings:

- Female athletes: 83 studies
- Male athletes: 12 studies
- High-impact sports: 23 studies
- Urinary incontinence: 64 studies
- UI prevalence rates: 63,6% high-impact sports

Importance of individual assessment

(Giagio, 2020)

## TREATMENT

4

Main findings:

- Conservative: 35 studies
- Pharmacological: no evidence
- Surgical: no evidence

(Giagio, 2021)

Female stress UI management:

- Pelvic Floor Muscle Training,
- Lifestyle interventions, education,
- Pelvic floor synergistic training,
- Devices (pessaries, vaginal tampons, pads),
- Electrical stimulation,
- Sport modifications (technique, IAP management...)
- ...

Individualised treatment

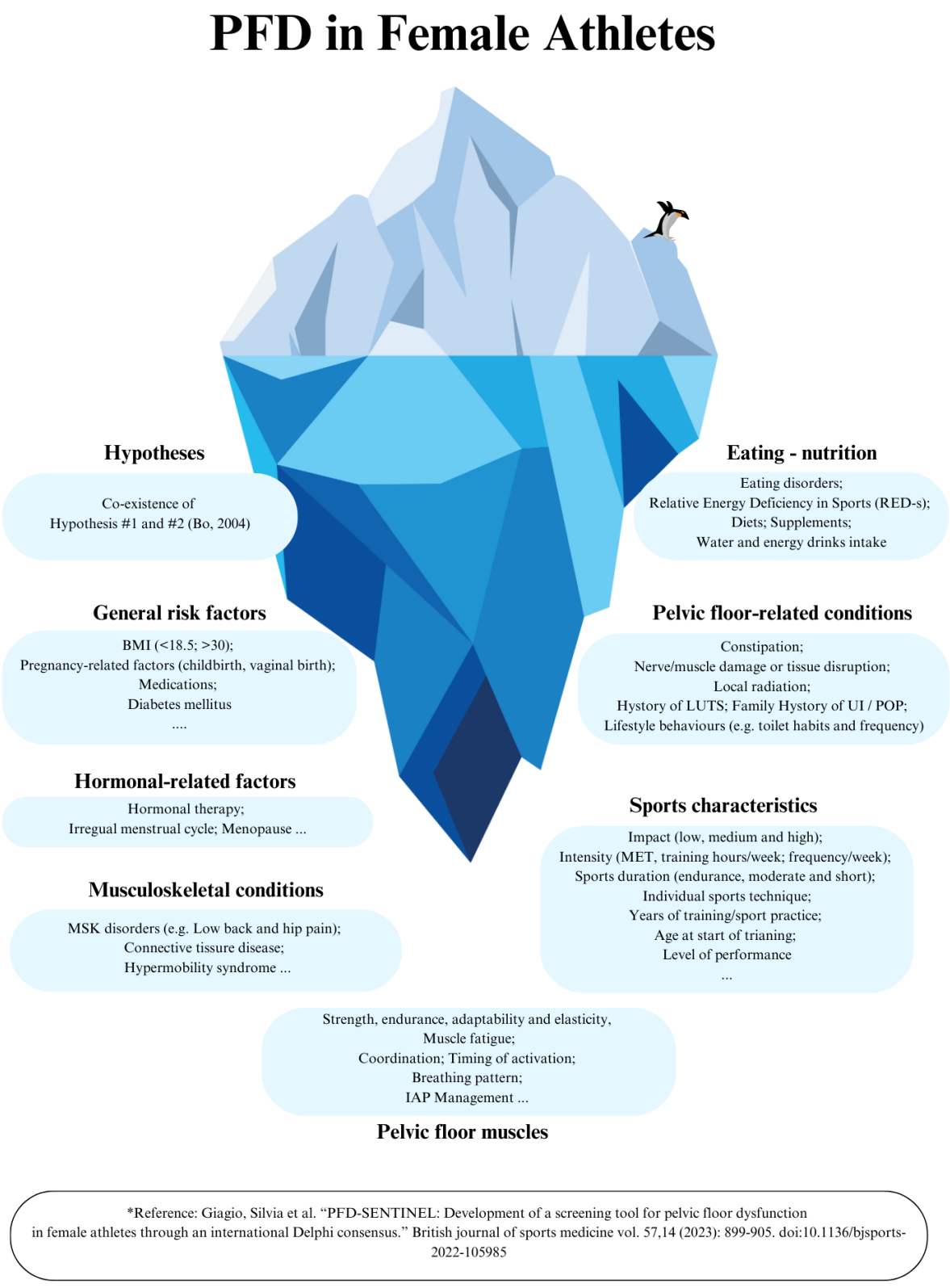
***Screening*** *(Giagio, 2022)*

Various screening tools have been devised for other medical conditions, such as the Sport Concussion Assessment Tool 5 [3], The International Olympic Committee Sport Mental Health Assessment Tool 1 (SMHAT-1) [4], and the Brief Eating Disorder in Athletes Questionnaire [5]. However, it came to light that there was currently no existing tool or instrument specifically designed for PFD screening, which could be easy use by sports medicine clinicians. As previously mentioned, the absence of a dedicated tool poses a significant obstacle in recognizing female athletes who may be at risk of dysfunction or experiencing related symptoms.

Given the aforementioned reasons and considerations, these factors served as the driving force behind the development of the PFD-SENTINEL [2], a practical screening tool for PFD in female athletes. This tool is intended for use by sports medicine clinicians, including musculoskeletal/sports physiotherapists. The tool is based on risk factors, clinical and sports characteristics that have been rated by a group of worldwide experts, through a Delphi consensus. As mentioned in Chapter 5, compared to the women of the general population, it is relevant to account for specific factors when discussing the "Female Athlete" This includes considering individual intrinsic and external characteristics, and advocating for a comprehensive health assessment.

To summarise this concept, in Figure 5 for the first the new theoretical framework "The PFD Iceberg Metaphor" is introduced to elucidate the contributing and risk factors associated with the development of PFD in female athletes. This framework is constructed through an extensive synthesis of the available literature integrating recent scientific findings spanning the past two decades, including the PFD-SENTINEL item, with my personal clinical reasoning.

**Figure 5.** Introduction of the "The PFD Iceberg Metaphor": new framework to summarise contributing and risk factors associated with the development of PFD in female athletes.




*Reference: Giagio, Silvia et al. "PFD-SENTINEL: Development of a screening tool for pelvic floor dysfunction in female athletes through an international Delphi consensus." British journal of sports medicine vol. 57,14 (2023): 899-905. doi:10.1136/bjsports-2022-105985

***Epidemiological data*** *(Giagio, 2020)*

In 2021, we conducted a comprehensive review of literature to examine and summarise the epidemiological data on PFD in athletes, encompassing both males and females (article entitled *"Sport and pelvic floor dysfunction in male and female athletes: A scoping review)* [6]. Notably, males and females exhibit distinct anatomical and physiological characteristics that are pertinent to sports training, with the pelvic floor being a particularly overlooked aspect. This discrepancy is evident in our analysis, where 83 out of 100 studies exclusively focused on female athletes.

While the available data supporting the two hypotheses of PFD remain limited (Chapter 5), it is noteworthy that high-impact sports, such as Crossfit and gymnastics, have received the most attention in studies involving female athletes. Nevertheless, due to the paucity of data from other sports and populations, it is reasonable to assume that the prevalence of PFD may be underestimated. Hence, there is a pressing need for studies investigating the incidence and prevalence of PFD across various sports and populations.

Moreover, it is crucial to extend this consideration to male athletes as well. Unlike research involving female participants, several authors have explored PFD in males engaged in low-impact sports, such as cycling. Therefore, further investigation into PFD among male athletes is warranted to enhance our understanding of this condition comprehensively. In Table 5, the main information and prevalence rates extracted from the article and the updated literature [7] are presented.

**Table 5.** PFD aggregated prevalence extracted from systematic reviews.

| | Sports impact | Prevalence rates (%)* | |
|---|---|---|---|
| **Urinary incontinence** | | | |
| | High | 63 | |
| | Medium | 50 | |
| | Low | 36.3 | |
| | High | 48.6 | Adolescent female athletes |
| **Pelvic Organ Prolapse** | | | |
| | High | 23 | |
| | Medium | No data | |
| | Low | No data | |
| **Anal and fecal incontinence, pelvic pain** | | | |
| | High | No data | |
| | Medium | | |
| | Low | | |

Although the high reported prevalence rates, according to various authors, PFD in female athletes is still an under-researched, under-recognised and undertreated problem for several reasons:

1. *Little knowledge of pelvic floor*

   Studies showed that the athletes' knowledge of the PFMs is low [8,9].

2. *Athlete's mindset*

   Athletes often refrain from reporting symptoms to their physicians, coaches, staff, or other health professionals due to feelings of embarrassment and shame associated with their condition [8,10]. Furthermore, it is essential to take into account the mentality of athletes, as they are accustomed to enduring challenges, pushing themselves to the point of pain, and going beyond their physical limits. Consequently, many athletes consider experiences like urinary leakage as a "normal" part of their athletic endeavors.

3. *Clinicians, coaches, team staff expertise on pelvic floor*

   Clinicians (including PFD specialists and non-specialists, as well as healthcare professionals) and coaches may be part of the PFD underestimation. Existing research

has underscored that screening for potential dysfunctions is frequently delayed and risk factors are not assessed. Additionally, a pervasive lack of awareness surrounding this issue and challenges related to introducing and discussing the topic have been identified as prominent barriers [11].

4. *Social media misinformation*

   Social media digital creators (professionals and athletes) often spread misinformation and harmful messages, normalising PFD symptoms such as urinary incontinence during powerlifting.

As a consequence of undiagnosed conditions, athletes may experience the exacerbation of symptoms, leading to a negative impact on their performance and possibly resulting in withdrawal from sports activities [8,10].

***Treatment options*** *(Giagio, 2021)*

Following an appropriate screening process and clinical assessment of PFD, the subsequent clinical step involves strategizing the optimal treatment tailored to the specific condition and the athlete's characteristics. In alignment with this objective, an exhaustive literature review was undertaken, aiming to comprehensively map all the available evidence-based interventions.

In *"What is known from the existing literature about the available interventions for pelvic floor dysfunction among female athletes? A scoping review"* [12], the ultimate goal was intended to offer a consolidated resource, serving as a comprehensive summary of interventions, for the benefit of clinicians and researchers alike. We mapped preventive, conservative, pharmacological, and surgical treatments highlighting that Pelvic Floor Muscle Training (PFMT), alone or combined with other treatments, is explicitly cited as an effective treatment in 85.7% of studies (30/35). Pharmacological and surgical options for PFD were rarely cited and in general, were not supported by the opinion of the authors and no study has yet been conducted to evaluate the effectiveness and safety of both interventions among female athletes.

As above reported in the section Chapter 5, athletes are a unique group of patients who have higher functional demands than the general population and may need a different and specific approach than nonathletic women. Indeed, after an individual assessment, a specific intervention plan should be drawn. The overall management should be specific and tailored to the athlete, considering the type of PFD and other factors such as: (a) training volume, (b) type of sport, (c) performance level, (d) other associated disorders (e.g., musculoskeletal), and (e) individual risk and contributing factors within multidisciplinary management. Importance of incorporating pelvic floor exercises in training routines.

**Personal Considerations On Interventions And PFMT For Female Athletes**

As a researcher and clinician, I suggest the following rehabilitation programme, presented as two phases that have to be declined for subjectivity as reported above.

Initial phase:

- Follow the evidence-based approach as defined and reported by the ICS international guidelines [13] for women in the general population. Among all, it may include education, lifestyle interventions, basic PFMT, bladder training, electrical stimulation, use of devices (e.g., pessaries) if necessary.

Advanced phase:

- Modify and correct contributing factors related to sport-related behaviours (e.g., nutrition, hydration), along with the treatment of any possible associated medical conditions, within a multidisciplinary approach.
- Consider the analysis and experience of new strategies for motor gesture (e.g., modifying pelvic tilt, foot position) compatible with performance and sport in collaboration with a personal trainer and coach to minimise symptoms.
- Integrate PFMT into sports, especially into high-demand activities that could trigger symptoms.

Actually, in the previous paragraph, it emerged that PFMT, alone or combined with other treatments, is acknowledged by the authors as an effective treatment for female athletes. Unfortunately, literature showed that PFMT descriptors reporting in the general population are suboptimal [14–16] and among athletes the data are even lower due to the paucity of studies on the topic [12]. Currently, no study offers precise indications or recommendations for integrating PFMT into athletes' training routines. How can PFMT be implemented? How much PFMT is needed for athletes?

First of all, we may synthetise PFMT as a therapeutic exercise for the pelvic floor, consisting of a series of exercises to improve pelvic floor muscle strength, endurance, power, relaxation, or a combination of these parameters [17]. And as regular skeletal muscles, PFMs respond to and follow the same principles of strength training [18].

For athletes, it is crucial to consider the dose-response relationship; focusing on the mode of exercise, frequency, intensity, and duration of PFMT could be considered part of the overall training. All these parameters should be specifically planned and integrated with athletic motor gestures, especially if we consider SUI during activities. In this regard, particular attention should also be given to athletic gestures and strategies that could minimise pelvic floor symptoms. The main principles for achieving outcomes could be overload, progression, and maintenance. Even though specificity may represent a primary goal in the early phases of rehabilitation, athletes need a more comprehensive approach in the later phases. The main goal is then to train all the system (e.g., diaphragm and breathing mechanisms, core and abdominal wall, low back, hip) in association with the physical demands. However, currently, there are no published articles on this approach.

All therapeutic modalities have to be collaboratively discussed between healthcare practitioners, staff, and female athletes, encompassing a comprehensive analysis of objectives and expectations. On my personal standpoint, in case of treatment proved inefficacious, the clinical objective remains the minimization of symptoms. In any case, I strongly recommend to avoid the normalization or passive acceptance of PFD symptoms and to prioritize the holistic well-being of

females. This personal recommendation encompasses not only the short-term but also the long-term perspective, considering eventual future pregnancies and the menopause period.

**It Is Crucial To Disseminate Evidence-Based Information**

Misinformation, misperceptions, and miseducation regarding PFD among both clinicians and athletes can have adverse implications for an athlete's health, care, training, and performance. Consequently, fostering awareness through the dissemination of truthful, accurate, and evidence-based information within the sports medicine community, encompassing athletes, healthcare professionals (including uro/gynaecologists and pelvic floor physiotherapists), and coaches, is crucial.

From the athletes' perspective, it is imperative for them to have information about PFD symptoms, available treatments, and the potential benefits of seeking guidance from medical professionals, such as pelvic floor physical therapists. Such informed engagement can prove advantageous in addressing specific concerns and enhancing overall pelvic health.

Conversely, professionals operating in the sports medicine field should undergo specialised training and acquire expertise concerning PFD to provide comprehensive support to athletes, both in terms of physical health and psychological well-being. Each professional with their own unique skill set and competencies can contribute significantly, ultimately guiding them through specialised pelvic floor treatments.

Coaches, as stakeholders in athletes' well-being, should be aware that PFD among their athletes could occur. They should also actively promote open dialogues with athletes and be ready to refer them to specialised PFD experts if necessary.

Our overarching goal has led us to the final article, wherein we introduce an infographic designed to disseminate evidence-based information concerning pelvic floor health in athletes. This infographic can be printed and distributed in clinics and clubs and shared widely on social media, aiming for broad accessibility. We believe that this resource will significantly and positively impact athletes’ health.

## CLINICAL IMPLICATIONS

The existing literature and the present findings highlighted the importance of raising awareness and conducting assessments for PFD among athletes, regardless of performance level and sports impact. Given the individual variability in pelvic floor stress response and the lack of open discussion on this issue, it is crucial to encourage the screening of potential PFD. The PFD-SENTINEL tool could now be a valuable resource, as it streamlines the referral process and promotes early diagnosis, thereby significantly contributing to improved outcomes and quality of care for athletes. Furthermore, athletes require a specific and tailored approach to clinical management. Clinicians can rely on suggestions and treatment options from our literature synthesis and review to provide clinical guidance, particularly for stress urinary incontinence. However, further robust RCTs are necessary. Moreover, the present findings have the strength to break down taboos surrounding pelvic floor health, increase awareness, and disseminate evidence-based information among all stakeholders. This represents the first crucial step in the clinical pathway.

It is essential to establish a constructive dialogue among various professionals, including sports medicine clinicians, physical therapists, gynaecologists, urologists, team coaches, and athletic trainers, to adopt a holistic approach to athletes' health.

## FURTHER RESEARCH

From the perspective of planning future research, the gaps and issues in the literature highlighted in this thesis may assist in its development. Some examples and suggestions are reported as follows:

- Further studies should assess PFD prevalence data and risk factors in the male population.
- Further studies should evaluate understudied outcomes such as AI and POP, enhancing underrepresented research design (e.g., prospective cohort, large, and generalizable sample) among male and female athletes.
- Further studies should assess PFD in a large number of sports, regardless of the impact and sex.
- There is a need to evaluate the effectiveness of multimodal interventions, specifically tailored to the athlete, considering the type of PFD and other factors such as: (a) training volume; (b) type of sport; (c) performance level; (d) other associated disorders (e.g., musculoskeletal); and (e) individual risk and contributing factors.
- Clarity on terminology and descriptors of intervention reporting is encouraged to ensure reproducibility and transferability.
- Validation studies are necessary to test the PFD-SENTINEL accuracy, thus confirming or modifying the proposed referral options in consideration of the multifactorial aetiology of PFD.

**REFERENCES**


1 Donnelly GM, Moore IS. Sports Medicine and the Pelvic Floor. *Curr Sports Med Rep* 2023;**22**:82–90. doi:10.1249/JSR.0000000000001045

2 Giagio S, Salvioli S, Innocenti T, *et al.* PFD-SENTINEL: Development of a screening tool for pelvic floor dysfunction in female athletes through an international Delphi consensus. *Br J Sports Med* Published Online First: December 2022. doi:10.1136/bjsports-2022-105985

3 Sport concussion assessment tool - 5th edition. Br. J. Sports Med. 2017;**51**:851–8. doi:10.1136/bjsports-2017-097506SCAT5

4 Gouttebarge V, Bindra A, Blauwet C, *et al.* International Olympic Committee (IOC) Sport Mental Health Assessment Tool 1 (SMHAT-1) and Sport Mental Health Recognition Tool 1 (SMHRT-1): towards better support of athletes' mental health. *Br J Sports Med* 2021;**55**:30–7. doi:10.1136/bjsports-2020-102411

5 Martinsen M, Holme I, Pensgaard AM, *et al.* The development of the brief eating disorder in athletes questionnaire. *Med Sci Sports Exerc* 2014;**46**:1666–75. doi:10.1249/MSS.0000000000000276

6 Giagio S, Salvioli S, Pillastrini P, *et al.* Sport and pelvic floor dysfunction in male and female athletes: A scoping review. *Neurourol Urodyn* 2021;**40**:55–64. doi:10.1002/nau.24564

7 Rebullido TR, Gómez-Tomás C, Faigenbaum AD, *et al.* The Prevalence of Urinary Incontinence among Adolescent Female Athletes: A Systematic Review. *J Funct Morphol Kinesiol* 2021;**6**. doi:10.3390/jfmk6010012

8 Skaug KL, Engh ME, Frawley H, *et al.* Urinary and anal incontinence among female gymnasts and cheerleaders-bother and associated factors. A cross-sectional study. *Int Urogynecol J* Published Online First: February 2021. doi:10.1007/s00192-021-04696-z

9 dos Santos KM, Da Roza T, da Silva LL, *et al.* Female sexual function and urinary incontinence in nulliparous athletes: An exploratory study. *Phys Ther Sport* 2018;**33**:21–

6. doi:10.1016/j.ptsp.2018.06.004

10 Gram MCD, Kari B. High level rhythmic gymnasts and urinary incontinence: Prevalence, risk factors, and influence on performance. *Scand J Med Sci Sport* 2020;**30**:159–65. doi:10.1111/sms.13548

11 Dakic JG, Hay-Smith J, Cook J, *et al.* Screening for pelvic floor symptoms in exercising women: a survey of 636 health and exercise professionals. *J Sci Med Sport* 2023;**26**:80–6. doi:10.1016/j.jsams.2023.01.008

12 Giagio S, Innocenti T, Pillastrini P, *et al.* What is known from the existing literature about the available interventions for pelvic floor dysfunction among female athletes? A scoping review. *Neurourol Urodyn* 2022;**41**:573–84. doi:10.1002/nau.24883

13 Abrams P, Cardozo L, Wagg A, *et al. Incontinence*. 6th Editio. ICI-ICS. International Continence Society, Bristol UK 2017.

14 Giagio S, Innocenti T, Salvioli S, *et al.* Completeness of exercise reporting among randomized controlled trials on pelvic floor muscle training for women with pelvic organ prolapse: A systematic review. *Neurourol Urodyn* 2021;**40**:1424–32. doi:10.1002/nau.24712

15 Charette M, Bérubé M-È, Brooks K, *et al.* How well do published randomized controlled trials on pelvic floor muscle training interventions for urinary incontinence describe the details of the intervention? A review. *Neurourol Urodyn* 2020;**39**:35–44. doi:10.1002/nau.24208

16 Hall LM, Aljuraifani R, Hodges PW. Design of programs to train pelvic floor muscles in men with urinary dysfunction: Systematic review. *Neurourol Urodyn* 2018;**37**:2053–87. doi:10.1002/nau.23593

17 Bo K, Frawley HC, Haylen BT, *et al.* An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the conservative and nonpharmacological management of female pelvic floor dysfunction. *Neurourol Urodyn* 2017;**36**:221–44. doi:10.1002/nau.23107

18 Bo K, Berghmans BC, Morkved S, *et al. Evidence-based physical therapy for the pelvic floor*. Second Edi. Elsevier 2015.

# CHAPTER 7

Acknowledgements

This PhD project and the other studies would not have been possible without many people contributing in different ways. My sincere gratitude goes to all of you:

- My supervisor, Prof. Paolo Pillastrini, for his invaluable personal and professional guidance and unwavering support and trust throughout the entire journey of this PhD experience.
- Tiziano, my future husband. Thank you for pushing me, even when I didn't even believe in myself.
- Tamara and Avery, unique professionals, and researchers and now friends, for their moral support, stimulating discussions, and the best welcome in the USA that I could even imagine. See you in Tuscany soon.
- My "second" Tuscan family for their understanding and open listening in every moment of this journey.
- To the research team and each colleague that contributed to this project, especially Stefano Salvioli; thank you for your friendship, dedication and professionalism.
- Every Reviewer I "met" in these three years taught me something, for better or for worse.

Lastly, but not least, I want to express my heartfelt thanks to my family (Luca, Rossella, Anna and Paolo) for their unwavering belief in my abilities and their constant encouragement throughout my academic pursuits.

Thank you all for being part of this academic endeavour.

# CHAPTER 8

About the Author

Silvia Giagio was born in 1993 in Padua, Italy. She received a BA (2015) in Physical therapy and a Master's degree (2019) from the University of Padova, and a Master's degree in "Treatment of pelvic floor dysfunction" (2021) from the University of Milano-Bicocca. In 2020, she joined the faculty of Bologna University at the Department of Biomedical and Neuromotor Sciences (DIBINEM).

Her current research agenda is focused on musculoskeletal disorders, research methods, and pelvic floor dysfunction (PFD). Silvia's personal and clinical experience in sports and her passion concerning pelvic floor rehabilitation have been applied to the investigation of PFD among athletes. Her main contribution to this research project tends to be through the development and application of a screening tool useful for clinicians to identify female athletes at risk of dysfunction. Her final objective is to raise awareness among stakeholders, especially clinicians, and the general population concerning the relevance and burden of these conditions that are still underestimated and underdiagnosed. In this field, she has also developed an emerging interest in analysing the impact and accuracy of social media information. Her articles have been published in esteemed scientific journals, including Neurourology & Urodynamics and the British Journal of Sports Medicine, among others. Over the past three consecutive years, she has presented her research findings at the International Continence Society (ICS) Congress.

During her participation in the international mobility programme at Monmouth University, a preeminent institution for athletes in the United States of America, Silvia engaged in a diverse range of research activities under the mentorship of Professor Tamara Rial-Rebullido. Notably, in the US, she delivered a lecture entitled 'Pelvic Floor in Athletes: Ten Clinical Implications' **(Figures 6a-d).** She is a researcher but also a clinician; she carries out clinical activity in a private practice.

**Scopus Author ID:** 57211843850

**Figures 6a-d**. International mobility programme at Monmouth University (USA): photos.