

REVIEW

What is known from the existing literature about the available interventions for pelvic floor dysfunction among female athletes? A scoping review

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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 gray 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.

KEYWORDS

athlete, management, pelvic floor disorder, physical therapy, sport, sports medicine, women

1 | 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 muscles¹ (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 study 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.

2 | METHODS

The present scoping review was conducted following the JBI methodology⁹ 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

2.1 | 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.

2.2 | Review question

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

2.3 | 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.

2.3.1 | Exclusion criteria

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

2.4 | 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 Supporting Information File S1. In addition, also gray 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 May 9th, 2021 with no date limit.

2.5 | Study selection

Once the search strategy has been completed, search results were collated and imported to EndNote V.X9 (Clarivate Analytics). 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 software¹²: (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

2.6 | 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:

1. 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.

2. 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.

3 | 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 Supporting Information File S2.

3.1 | Characteristics of included studies

Table 1 synthesizes the main characteristics of the studies. To provide a transparent report, Supporting Information File S3 shows the complete extracted data for each included study. 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 protocol⁴⁵ 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%).

3.2 | Participants: The female athletes

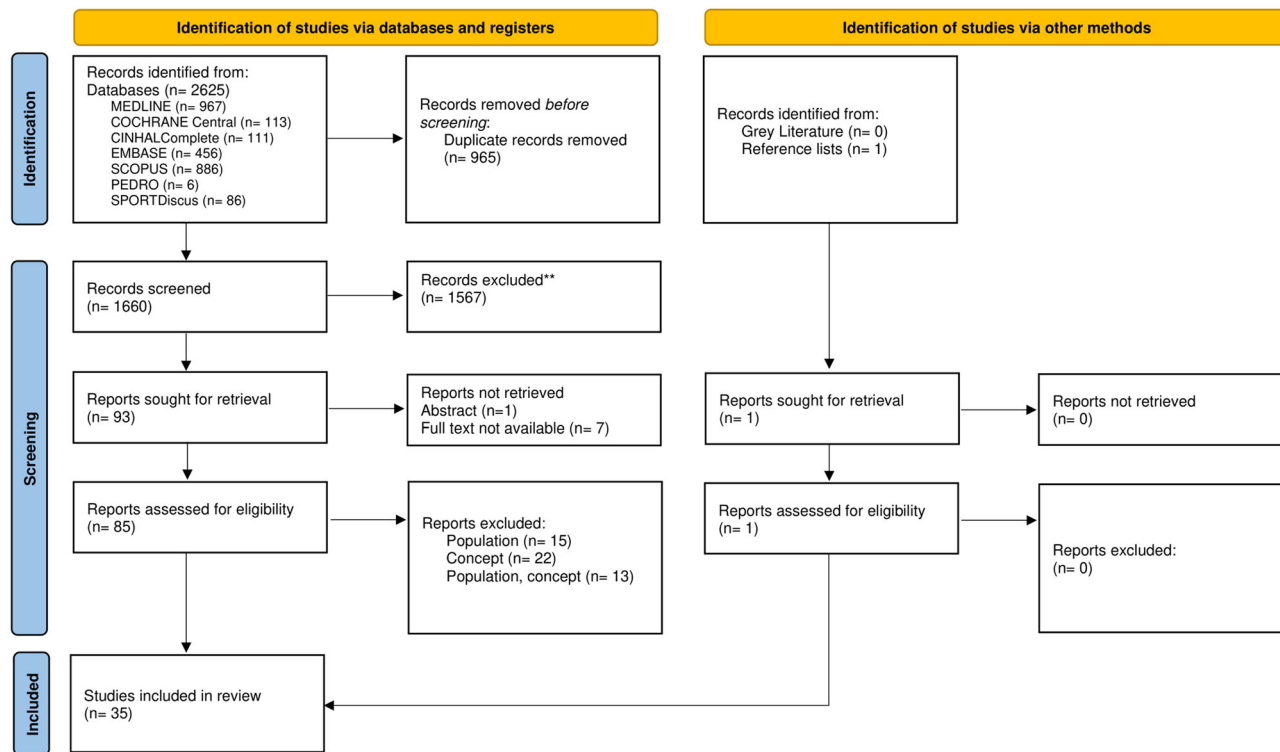
Table 1 summarizes data regarding female athletes of different age groups with PFD practising several types of sport and a variety of participation levels.

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.⁴³

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

PRISMA 2020



*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 1 Preferred reporting items for systematic reviews and meta-analyses 2020 (PRISMA) flow-diagram

(narrative review plus case report), Louis-Charles et al.²³ investigated and explained the therapeutic possibilities for pelvic pain. For other disorders, in 10 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.

3.3 | 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 in each article, while Figure 2 graphically illustrates the pooled results.

Only two RCTs were conducted on female athletes by Ferreira¹⁶ in 2014 and Pires²⁷ in 2020. In both studies, the participants were volleyball players.

Additional information about the protocols of the overall primary studies were provided in Supporting Information File S4.

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.

TABLE 1 Summary of main characteristics of included studies

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)

(Continues)

TABLE 1 (Continued)

Variable ^a	No. of studies (%)
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)

Abbreviations: PFD, pelvic floor dysfunction; RCT, randomized controlled trial; SUI, stress urinary incontinence; UI, urinary incontinence.

^aNot 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.

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.

4 | 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,^{2,49} 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.

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

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				

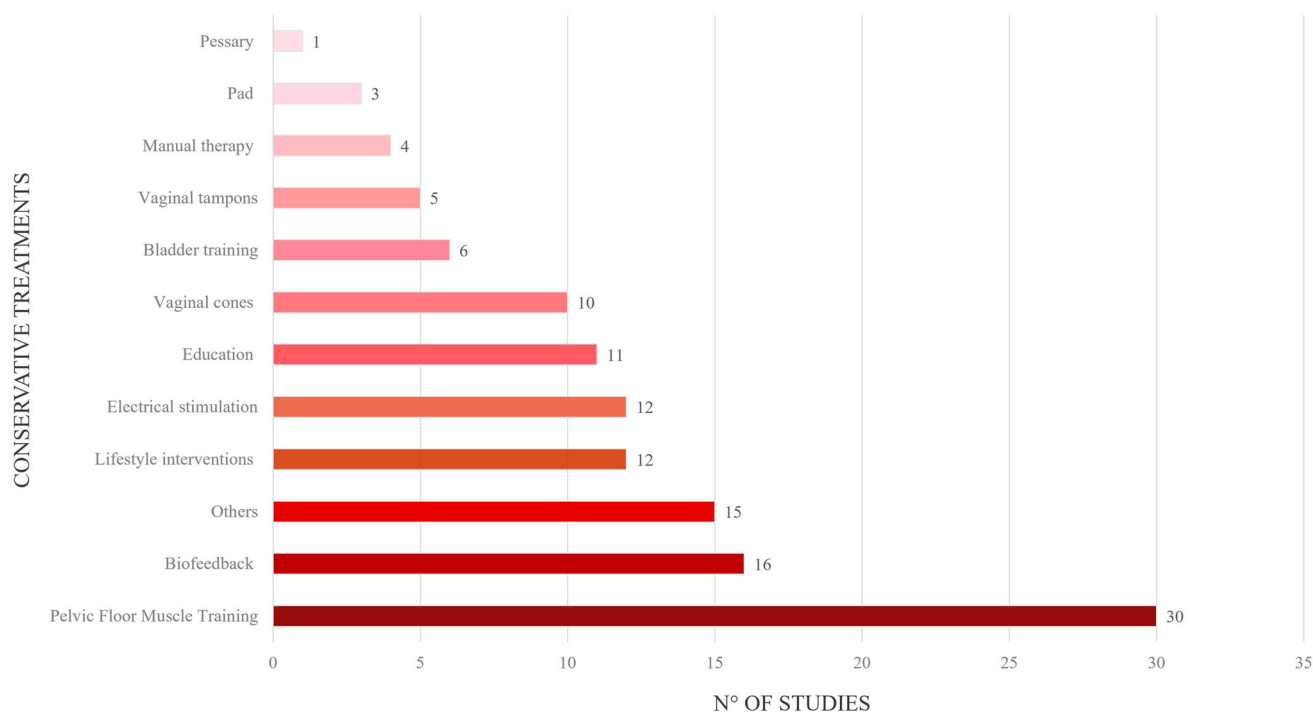
TABLE 2 (Continued)

Author, year	PFMT	Biofeedback	Education	Lifestyle interventions	Bladder training	Manual therapy	Electrical stimulation ^a	Vaginal cones	Pessary	Vaginal tampons	Pad	Others ^b
27 Rzymiski, 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 Sorriquetá-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

Abbreviation: PFMT, pelvic floor muscle training.

^aElectrical stimulation category includes different type of interventions such as percutaneous tibial nerve stimulation (PTNS), and transcutaneous electrical nerve stimulation (TENS).

^bOthers: 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 techniques); running technique. Vaginal dilators. For detailed descriptions (PFD and related treatment); see Supporting Information File S3.



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 2 Overall conservative treatments for PFD among female athletes. PDF, pelvic floor dysfunction

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 non-athlete 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),⁵⁰ 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.⁴⁹

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, Bø¹⁵ 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.

While 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.⁵¹: even if participants were not specifically athletes, the authors focused on involuntary reflexive PFM contraction while running. Alvarez-Saez⁵² 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.⁴⁹

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.

4.1 | 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 non-athletic women.

Indeed, as happens with other disorders, like the musculoskeletal ones,⁵³ 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.

4.2 | Strengths and limitations

4.2.1 | 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.

4.2.2 | Methodology

An extensive search strategy in the main databases with very broad inclusion criteria was conducted. Moreover,

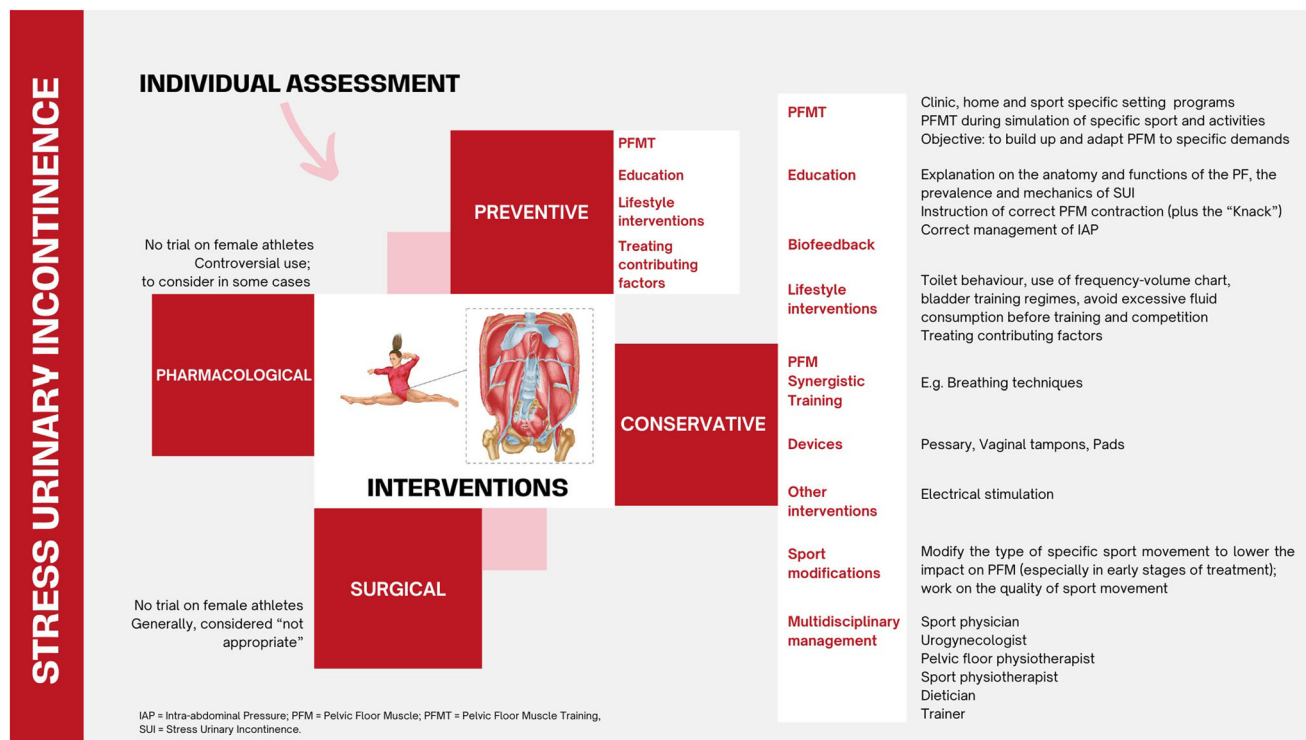


FIGURE 3 Suggestions for clinical practice of stress urinary incontinence (SUI) for female athletes: summary

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.

4.2.3 | 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.

4.2.4 | 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 controversial⁵⁴ and different studies may have described athletes in different ways, this may have excluded findings from other studies.

5 | 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 nonathlete 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.

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CONFLICT OF INTERESTS

Authors are Ph.D. candidates, lecturers for research methods courses, University professors, clinicians, researchers with no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years and no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTIONS

Silvia Giagio proposed the review project and identified the framework. Silvia Giagio and Tiziano Innocenti proposed the methodology. Stefano Salvioli identified the search strategy. Silvia Giagio and Stefano Salvioli extracted and analyzed the data. Paolo Pillastrini, Giulia Gava, Tiziano Innocenti, Stefano Salvioli, and Silvia Giagio supervised the methodology. All authors conducted the review and developed the first and subsequent drafts of the manuscript.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

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