International Urogynecology Journal (2018) 29:1717–1725
https://doi.org/10.1007/s00192-018-3651-1

REVIEW ARTICLE

Prevalence of urinary incontinence in female athletes: a systematic review with meta-analysis

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Received: 3 October 2017 / Accepted: 30 March 2018 / Published online: 13 April 2018

Abstract

Urinary incontinence (UI) is any involuntary loss of urine. In female athletes, physical exercise may be a risk factor for UI because of increased intra-abdominal pressure generated during high-impact exercises, which overloads the pelvic organs, predisposing them to UI. This is a systematic review of the prevalence of UI in female athletes in different sports. A search for articles was carried out in the PEDro, Scopus, Cinahl, PubMed, LILACS, SciELO, Science Direct, Web of Science, Embase, and Cochrane databases as well as a manual search of the references of studies already published on the subject with the keywords "athlete," "urinary incontinence," and "women" in Portuguese and English. Only articles published from 2000 to 2016 were included. Observational studies assessing the prevalence of UI in female athletes were selected. Methodological quality was assessed using the Downs and Black scale, and the data collected from the studies were analyzed through meta-analysis. Eight studies met the eligibility criteria. Meta-analysis showed a 36% prevalence of UI in female athletes in different sports, and compared with sedentary women, the athletes had a 177% higher risk of presenting with UI. There is a higher prevalence of UI in female athletes compared with sedentary women. There have been reports of UI in different sports.

Keywords Athlete · Urinary incontinence · Women

Introduction

Urinary incontinence (UI) is defined by the International Continence Society as any involuntary loss of urine. It affects women more frequently than men, affecting from 10 to 55% of them during their lifetimes, with higher prevalence in adulthood, between 15 and 60 years of age [1–3]. In addition, UI can interfere with social and mental well-being, causing social isolation, low self-esteem, and depression, which negatively impact the quality of life [4].

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Although UI is more prevalent in adult women and the subject of many studies, athletes are another population that is severely affected by this pelvic floor dysfunction. Because they practice high-impact activities, the continence mechanism may be affected by the force of the reaction of the feet with the ground, transferring that shock to the pelvic floor [5, 6]. In addition, the lack of contraction of the pelvic floor muscles during exercises that increase intra-abdominal pressure, along with the continence mechanism impaired by the sports, may contribute to the occurrence of UI in this population [7].

There are several risk factors for UI, including age, obesity, parity, types of birth, newborn weight, menopause, gynecological surgeries, intestinal constipation, chronic diseases, being white, drug use, caffeine consumption, smoking, and exercise. Associated with these factors, other causes are loss of bladder capacity, pelvic floor injuries, hypoestrogenism, and increased intra-abdominal pressure, among others [8].

In athletes, Bo [9] describes two hypotheses about pelvic floor dysfunction associated with the practice of sports: (1) female athletes have strong pelvic floor muscles, but due to the high impact of their physical activity, their intra-abdominal pressure increases, predisposing them to the appearance of UI; (2) female athletes' pelvic floor muscles are overloaded,

stretched, and weak because of increased intra-abdominal pressure. The highest prevalence of UI in high-impact physical activity practitioners is in elite female athletes who are young and nulliparous [10]. In a study from the 1990s, 156 nulliparous young athletes were analyzed with reports of urine loss during sports practice. The physical activity with the highest prevalence of UI was gymnastics, followed by basketball, tennis, and hockey [11].

Thus, it is known that some micturition disorders may be pre-existing and others may be exacerbated during sports. Considering that this problem can interfere with athletes' lives, socially and by affecting their performance, it is necessary to pay special attention to this population, seeking to understand the factors triggering their urinary symptoms.

There are two systematic reviews on this topic in the literature. However, Almousa et al. [12] only included studies with nulliparous female athletes in their research, and Bo [9] included articles published up to 2001 with elite female athletes, which justifies carrying out a new study with more current articles and a wider sample. This is the relevance of this systematic review, whose main goal was to identify the prevalence of UI in different sports. The secondary goal was to research the prevalence of UI among female athletes and women who are not athletes from 2000 to 2016.

Methods

This systematic review followed the recommendations proposed by the Cochrane Collaboration [13] and the PRISMA Statement [14].

Search strategy

A systematic search was performed in the PEDro, Scopus, Cinahl, PubMed, LILACS, SciELO, Science Direct, Web of Science, Embase, and Cochrane electronic databases, with a manual search of the references of studies already published on the subject. Articles indexed and published from 2000 to 2016 were selected in Portuguese, English, and Spanish. The keywords included in the search were "athlete," "urinary incontinence," and "women" in English and Portuguese. The complete search strategy used for PubMed is shown in Table 1.

Eligibility criteria

This review included observational studies that assessed the prevalence of UI in female athletes. Inclusion criteria were studies that: (1) were performed with female athletes aged between 18 and 60 years, who had answered specific questionnaires for UI assessment and/or assessments for pelvic floor dysfunction, (2) correlated possible variables such as sports modality and UI, and (3) had been published since the year 2000. Exclusion criteria were (1) studies performed with pregnant athletes or which only assessed other pelvic floor dysfunctions and (2) articles not available in full. All studies that assessed men or pregnant women were excluded, even if they used stratified data, to reduce selection bias.

Table 1 Search strategy used on PubMed

1. "Athletes" [MeSH] OR "athletes" OR "Athlete" OR "athlete"
2. "Urinary Incontinence" [MeSH] OR "urinary incontinence" OR "Incontinence, Urinary"
3. "Women" [MeSH] OR "women" OR "woman" OR "Women's Groups" OR "Group, Women's" OR "Groups, Women's" OR "Women Groups" OR "Women's Group"
4. #1 AND #2 AND #3

Study selection and data extraction

The titles and abstracts of all articles identified in the searches were analyzed by two independent reviewers. Abstracts that did not provide sufficient information on the eligibility criteria were selected to be read in full. In the second step, the same reviewers independently assessed the articles in full and selected them, following the eligibility criteria specified above. The main outcome extracted from the studies was the prevalence of UI in the athletes; in addition, a standardized questionnaire was used to extract data such as study design, sample size, sports modality, UI assessment protocol, UI type, and outcomes. Disagreements were resolved by consensus or by a third reviewer.

Methodological quality assessment

The methodological quality assessment was performed independently by two reviewers following the Downs and Black scale [15]. The scale was developed and validated for assessing quality and risk of bias in randomized and observational studies. It has 27 items that assess domains reporting the external validity, study bias, confounding/selection bias, and power of the study. For the assessment of the observational studies, an adaptation was performed, as suggested by the Cochrane Collaboration [13], excluding items related to experimental studies [4, 7, 8, 13–20] because they did not fit the methodological design of the analyzed studies.

In this systematic review, the included articles were classified as having high methodological quality when they presented scores ≥ 70% on the scale (10 points for case control studies and cohort studies and 8 points for cross-sectional studies). Disagreements were resolved by consensus or by a third reviewer.

Data analysis

To assess the prevalence of UI, a single-arm meta-analysis with a random effect model was performed on Excel [21]. Subgroup analyses were performed in relation to the type of UI and the type of sport (high and low impact). A meta-analysis was also performed to assess the risk of UI among athletes and sedentary subjects. The number of events in each group was considered, and a random model was used. The relative risk was calculated with a 95% confidence interval with the Review Manager 5.1 software. The heterogeneity was assessed using the inconsistency test (I^2) in which values of 25% and 50% were considered indicative of moderate and high heterogeneity, respectively.

Results

Selection of the studies

Among the 670 studies identified in the database research, 8 met the eligibility criteria (Fig. 1), resulting in a total of 1714 participants, with average age of 23.8 years. The studies included in this systematic review addressed the following physical activities: basketball, handball, volleyball, track and field, futsal, aerobics, running, hockey, bodybuilding, swimming, and cross-country skiing, among other activities.

To assess the athletes' complaints of UI, the studies used the following questionnaires: International Consultation Incontinence Questionnaire-Short Form (ICIQ-SF) [16, 21, 22], Bristol Female Low Urinary Incontinence [17], Urogenital Distress Inventory (UDI-6) [23], and questionnaires prepared by the researchers [3, 24, 25].

Quality of the studies

The methodological quality of the studies was assessed using the Downs and Black scale. Four studies [3, 16, 24, 25] were considered of high quality, reaching a score ≥ 70%, while the others presented low methodological quality [17, 21–23]. The studies included were cohort, case control, and cross-sectional studies and received an average of 8.6 points (Table 2).

Descriptive analyses of the studies

Different from the other studies, two authors compared the prevalence of UI between two groups. Araújo et al. [16] divided the groups into athletes (EG) and sedentary women (CG) and Fozzati et al. [22] between women who went to the gym (EG) and women who did not (CG). Both found a higher prevalence of UI in the experimental group. In addition, Fozzati et al. [22] also classified the activities as high impact performed at the gym and low impact for women who did not go to the gym or practice high-impact sports. Simeone et al. [17] classified the sports into four different categories: high impact/resistance, high impact/strength, low impact/resistance, and low impact/strength; among all athletes, 187 presented UI.

Jacomé et al. [3], in addition to comparing different sports, also presented the general prevalence of UI in their sample, showing that almost half of the women included in the study had reported episodes of UI. Araújo et al. [16] also presented their findings without differentiating between sports and found a higher prevalence of UI among female athletes compared with sedentary women. Larsen and Yavorek [25] found the lowest prevalence of UI among all the studies included in this systematic research.

Of the eight selected articles, four [3, 18, 23, 24] presented results comparing UI in different sports; three [3, 16, 25] analyzed athletes in general, without differentiating between the sports; two studies [16, 22] divided the sample into experimental groups (EGs) composed of athletes and a control group (CG) with sedentary women and compared the results; two articles [17, 22] classified sports as being of low and high impact (Table 3).

Borin et al. [23] analyzed results collected from groups of athletes participating in three team sports, volleyball, handball, and basketball, which had the lowest prevalence of UI. Jacomé et al. [3] studied athletes who reported having had UI at least once, specifying the results in soccer, basketball, and track and field athletes, and found that half of the athletes who complained of UI played indoor soccer. Patrizzi et al. [18] also divided their sample into three different sports, comparing the prevalence of UI in muscle training, aerobics, and swimming; muscle training had the highest prevalence among the groups. Poswiata et al. [24] analyzed cross-country skiing athletes and runners, but no significant difference in UI prevalence was found between groups.

Prevalence of UI

The meta-analysis of the eight articles included in this systematic analysis showed that the weighted average of UI prevalence in this population was 36.1% (CI 95% 26.5%–46.8%; I^2: 88.788) (Table 3; Fig. 2). The lowest prevalence of UI found in the included studies among female athletes was 19.4% [24] and the highest prevalence 76% [21]. A prevalence of 44% was found when analyzing stress urinary incontinence (SUI), which was only described by six studies [3, 16, 17, 22–24] (Fig. 3). In addition, we were able to perform a meta-analysis on two studies [16, 22], which compared athletic and sedentary women and observed that athletes are 2.77 times more likely to present complaints of UI when compared with sedentary women (Fig. 4). Also, we performed a meta-analysis regarding the type of sport: high impact included eight types and low impact three types, according to the

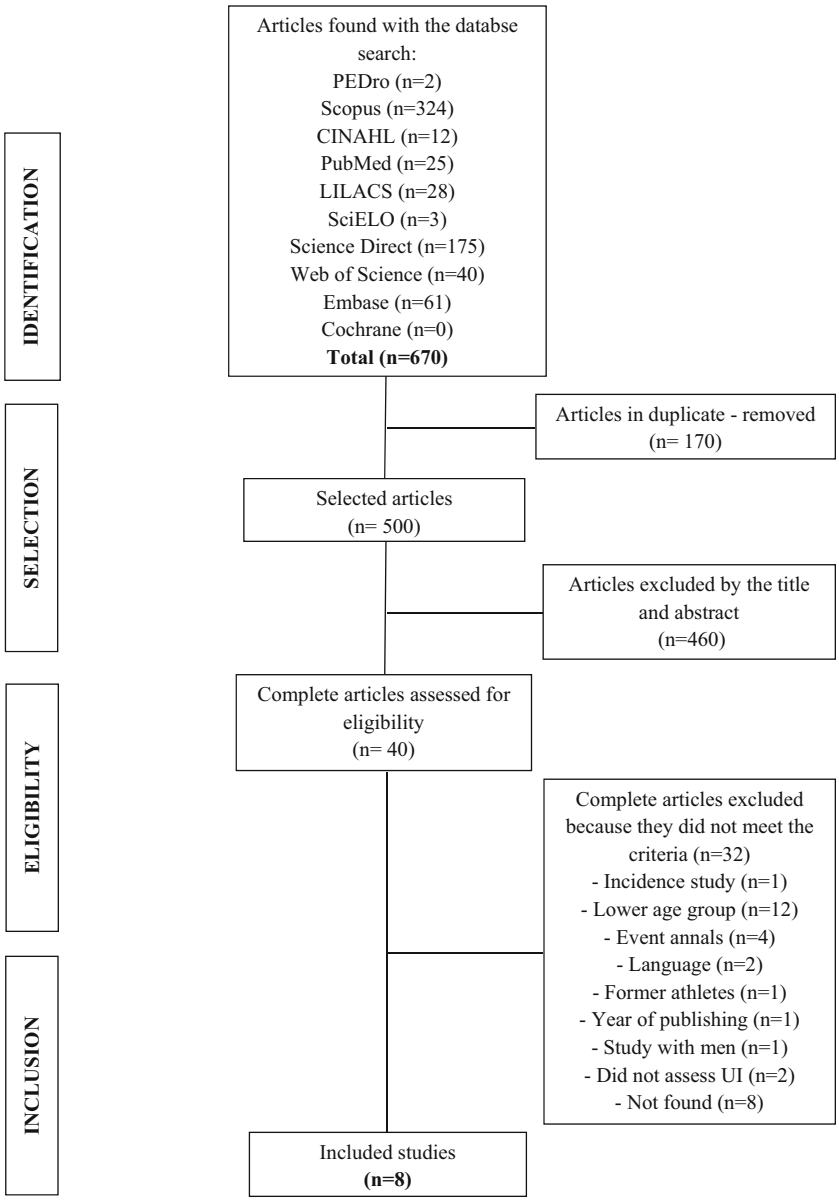


Fig. 1 Flowchart of the included studies. n = number of studies

n = number of studies.

Table 2 Assessment of the quality of the studies

Reference	Report	External validity	Bias	Selection variable	Final score
Jacomé et al. [3]	5	0	3	0	**8**
Araújo et al. [16]	5	0	3	1	**9**
Fozzati et al. [22]	6	0	3	1	**10**
Simeone et al. [17]	5	0	3	0	**8**
Borin et al. [23]	5	0	2	0	**7**
Poswiata et al. [24]	5	0	2	1	**8**
Larsen and Yavorek [25]	5	0	3	3	**11**
Patrizzi et al. [18]	6	0	3	0	**9**

The values refer to the score of the studies on certain domains of the adapted Downs and Black questionnaire

Table 3 Characteristics of the included studies

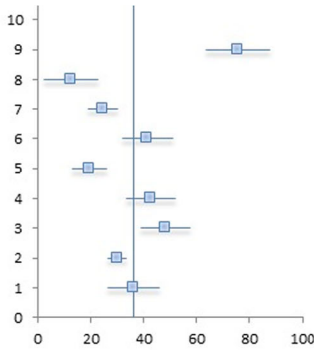
Reference	Type	Sample (n)	Average age (years)	Division of the sample	Activity	Protocol	% of UI
Araújo et al. [16] BRAZIL	Control case	93	20.5	Two groups: Study (49) Comparative (44)	Track and field, basketball and gymnastics	ICIQ-SF	G. Study: 76 G. Comparative: 16
Borin et al. [23] BRAZIL	Prospective Observational	40	24	Four groups: Basketball (10) Volleyball (10) Handball (10) Sedentary (10)	Volleyball, handball, basketball	Bristol female low urinary incontinence	(SUI) G. Volleyball: 20 G. Handball: 20 G. Basketball: 10
Fozzati et al. [22] BRAZIL	Comparative prospective	488	25.06	Two groups: Study (244) Comparative (244)	Jump, step, running, abs, targeted exercises, hydrogymnastics, bodybuilding, stretching, walking, cycling, swimming, Pilates	ICIQ –SF	G. Study: 24.6 G. Comparative: 14.3
Jacomé et al. [3] PORTUGAL	Cross-sectional study	106	23	Three groups of athletes: Track and field (32) Basketball (36) Futsal (38)	Track and field, basketball, futsal	Specific questionnaire Demographic data and sports data Characteristics of the urine loss Risk factors for UI	G. T&F: 31.3 G. Basketball: 41.7 G. Futsal: 50
Larsen and Yavorek [25] UNITED STATES	Prospective observational	144	19.6	One group: Athletes (144)	Running, going up and down stairs, aerobics, rowing, swimming and cycling	Specific questionnaire: characteristics of the urine loss. - Impacts of the UI	Total sample: 19.4
Patrizzi et al. [18] BRAZIL	Cross-sectional study	108	24.16	Three groups of athletes: Muscle training (36) Aerobics (36) Swimming (36)	Muscle training, aerobics (jump, step, dance) and swimming	Specific questionnaire: "Do you experience loss of urine while practicing these physical exercises?"	G. Musc.: 61.1 G. Aerobics: 41.6 G. Swimming: 25
Poswiata et al. [24] POLAND	Cross-sectional study	112	28.05	Two groups of athletes: Cross-country skiing (57) Running (55)	Cross-country skiing and Running	UDI-6	Total sample: 50
Simeone et al. [17] ITALY	Cross-sectional study	623	26.44	Four groups of athletes: high impact/resist. (315) High impact/strength (223) Low impact/resist. (22) Low impact/strength (63)	Soccer, volleyball, aerobics, bodybuilding, Cycling, swimming, basketball, martial arts, skiing, running, hockey, and tennis	ICIQ-SF	Total sample: 30

UI urinary incontinence, *SUI* stress urinary incontinence, *G* group, *ICIQ-SF* International Consultation Incontinence Questionnaire-Short Form, *UDI* Urogenital Distress Inventory

Fig. 2 Prevalence of urinary incontinence in female athletes

Study	Events	Sample Size	Outcome	CI lower	CI upper
Araújo 2015	37	49	0,755102	0,634695	0,87551
Borin 2013	5	40	0,125	0,022509	0,227491
Fozzati 2012	60	244	0,245902	0,191869	0,299934
Jacomé 2011	44	106	0,415094	0,321291	0,508898
Larsen 2006	28	144	0,194444	0,129802	0,259087
Patrizzi 2014	46	108	0,425926	0,332666	0,519186
Poswiata 2014	54	112	0,482143	0,389601	0,574685
Simeone 2012	187	623	0,300161	0,26417	0,336151
Summary			0,361809	0,265581	0,458037
Prevalência final			**36,1%**	26,5%	45,8%

I^2_v	88,788071



classification prepared for this study. The study considered those sports that had some type of impact with the ground and collective sports as high impact and those practiced individually and with no impact with the ground as low impact. In these sports, the participants presented a UI risk of 40% and 44%, respectively (Figs. 5 and 6, respectively).

Discussion

This systematic review and meta-analysis found that the prevalence of UI among female athletes was 36.1%. When we analyzed only SUI, a 44% prevalence among the athletes was found. When comparing athletes and sedentary women, it was more likely that athletes presented UI; when the prevalence of UI in high- and low-impact activities was analyzed, similar values were obtained for the risk of having UI.

UI is considered the most common PFD of the female PF, affecting 15% to 17% of women every day [19]. Tyssen et al. [26] assessed the presence of UI in athletes active in eight sports—gymnastics, badminton, basketball, volleyball, track and field, handball, aerobics, and ballet—and found results higher than those found in our study, showing that, among the athletes, approximately 52% had UI while practicing sports or in everyday situations. In addition, the authors also identified that athletes from all sports reported cases of UI, the same result found by our study. In the study by Nygaard et al. [11], of the nine sports evaluated, only golf athletes did not report having UI; women participating in all other sports—gymnastics, basketball, tennis, hockey, track and field, swimming, volleyball, and softball—reported UI, corroborating the results found by our study and that of Tyssen et al. [26].

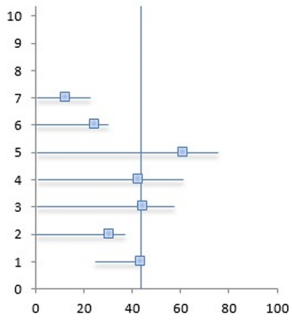
Among the types of UI reported by the athletes, the most common was SUI [7], and this prevalence increased in women who exercise regularly [10]. Concerning this, Almeida and Machado [27] found that loss of urine due to effort affects 50% to 83% of incontinent women when the intra-abdominal pressure on the pelvic floor is constantly high [20]. Our results found that muscle training was the activity leading to the highest prevalence of UI. This can be explained by this increase in intra-abdominal pressure when lifting the weight, sometimes accompanied by the valsava maneuver. Reis et al. [10] found a 50% prevalence of SUI in basketball athletes and 30% in volleyball athletes, classifying these sports as of high risk for UI. Similarly, our study found a 44% prevalence of SUI among the different sports described in the included articles.

Corroborating our study, which found that athletes present a higher risk of having UI compared with the control group, Diaz Mohedo et al. [28] found 79% UI in athletes and 40% in the control group. According to Araújo et al. [16], this can be explained by the possible relation of the displacement of the pelvic floor during jumps and changes in direction, common movements among athletes. Thus, to reduce the risk of UI during the practice of sports, it would be necessary to perform a pre-contraction of the muscles during the activity,

Fig. 3 Prevalence of stress urinary incontinence

Study	Events	Sample Size	Outcome	CI lower	CI upper
Borin 2013	5	40	0,125	0,002734	0,227491
Fozzati 2012	60	244	0,245902	0,00076	0,299934
Jacomé 2011	27	44	0,613636	0,005388	0,757511
Larsen 2006	12	28	0,428571	0,008746	0,611874
Poswiata 2014	25	56	0,446429	0,004413	0,576633
Simeone 2012	57	187	0,304813	0,001133	0,370791
Summary			0,436618	0,243862	0,446878
Prevalência final			**43,6%**	24%	44%

I^2_v	69,90664



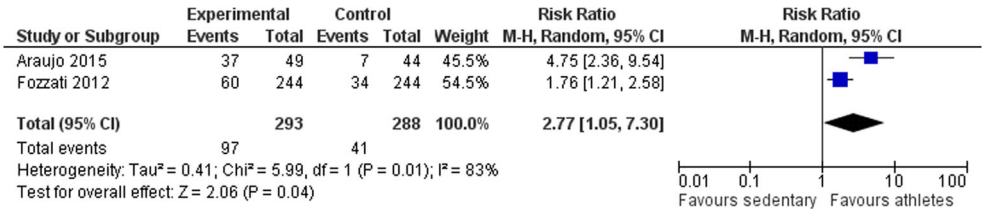


Fig. 4 Prevalence of urinary incontinence in female athletes and sedentary women

neutralizing the displacement of the pelvic floor. Conversely, Bo and Borgen [29] did not find a significant difference when comparing the occurrence of UI in athletes and a control group.

To characterize the high-impact activities, we considered the performance of several jumps and actions related to maximum abdominal contractions, which increase intra-abdominal pressure and exert an impact force directly on the pelvic floor [10]. Thus, we classified all sports that involved jumping and running as "high impact," following a classification already mentioned in the literature. We found 40% prevalence among all high-impact sports, which included team sports, track and field, and aerobics. Almeida and Machado [27] found that 37.5% of women who practice *jumps*—an aerobic activity with repeated jumping—related they had experienced loss of urine. Corroborating the previous studies, Eliasson et al. [30] found 80% prevalence of UI among trampoline athletes.

Nygaard [6] compared the prevalence of UI in women who practice high- (gymnastics and track and field) and low-impact sports (swimming), similar to our study's classification. The study observed that the high-impact group had the most complaints, but there was no significant difference (41.1% and 50%). These numbers are in accordance with our research, where the high- and low- impact numbers were similar, but there was no comparison between them. Following the same logic of classification, Davis et al. [31] found that, among physical activities, aerobics had the highest number of complaints, and cycling had the lowest number, followed by swimming and golfing, showing a higher prevalence of UI in high-impact sports.

One hypothesis that could justify the prevalence of UI in low-impact sports is muscle fatigue. In the study by Davis et al. [31], in which the prevalence of UI was significant in female athletes, 21% of the women who went on walks, a low-impact activity, complained of UI; according to Araújo et al. [32], muscle fatigue is common for this activity. According to Yeung, Au, and Chow [33], muscle fatigue is recurrent in resistance sports and daily activities. Muscle fatigue is defined as the inability of the skeletal muscle to produce or maintain a certain level of strength during an exercise. The authors state that it depends on several factors: type of exercise, duration, intensity, type of muscle fiber being used, and physical shape of the individual [33]. For this reason, all these matters must be taken into consideration when analyzing UI in athletes.

Thyssen et al. [26] relate that athletes use strategies to minimize the loss of urine, like emptying the bladder before competitions, lowering the ingestion of liquids and restricting certain activities, and avoiding some types of exercise that cause loss of urine, like jumping and running, increasing the lack of female participation in certain sports [7]. In other studies, 20% of women abandoned the practice of sports because of the presence of UI [34], which proved how much this dysfunction harms the performance of female athletes and causes social, emotional, and physical problems. Among the studies included in this systematic review, three [17, 18] reported complaints of UI during the practice of physical activity.

In a comparative study between elite athletes and a control group, Carvalhais et al. [35] found a high prevalence of UI among the athletes, with the probability of UI three times higher than in the control group. Middlekauff et al. [36] carried out one of the few comparative studies on the impact of vigorous and light exercise on the PFM in nulliparous women

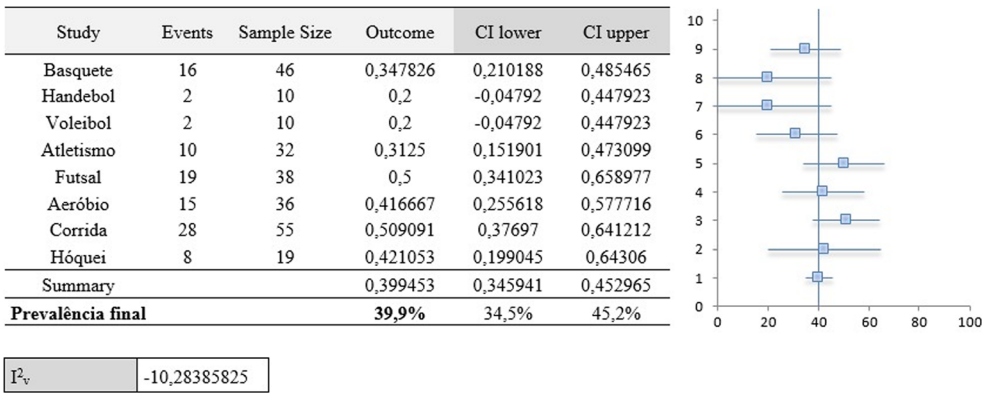
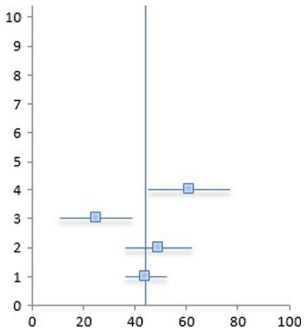


Fig. 5 Prevalence of urinary incontinence in high-impact sports

Fig. 6 Prevalence of urinary incontinence in low-impact sports

Study	Events	Sample Size	Outcome	CI lower	CI upper
Musculação	22	36	0,611111	0,451862	0,77036
Natação	9	36	0,25	0,108549	0,391451
Esqui cross country	28	57	0,491228	0,361444	0,621012
Summary			0,4418549	0,3606707	0,523039
Prevalência final (%)			44,1	36,06	52,3%

I^2_v	-0,311641254



and found there was a reduction of vaginal support in both groups after exercising and that chronic vigorous exercise did not affect the strength or support of the PFM [36].

Considering the benefits physical activity brings to women and the aspects discussed previously, the need to make the presence of UI among athletes from different sports more visible becomes evident. It is also of the utmost importance that the professionals who work in this field know about UI and its triggering factors so they can instruct female athletes. Studies mention that athletes should be taught to perform a pre-contraction or simultaneous contraction of the pelvic floor muscles while practicing physical activities, strengthening the muscles and preparing them for that function with the goal of preventing UI [7]. In a recent review, Janet and Naygaard [37] found that the current literature is not conclusive about the influence of chronic exercise on the strength and function of the pelvic floor. Data on the long-term effects of intra-abdominal pressure on UI are scarce.

One of the limitations of this systematic review was the heterogeneity among the studies, mainly considering the methodologies they used, as well as the size of the samples. Also, a few of the studies presented low methodological quality. Another limitation was the lack of longitudinal studies published in the literature on the subject. Studies with poor methodological quality may generate limited confidence in the observed effect, and better delineated future work is likely to have a significant impact on the confidence of the effect estimate. In addition, comparative data between athletes and sedentary women were inconclusive because of the scarcity of studies (only two). New studies with better defined methodologies are needed.

Final considerations

This systematic review and meta-analysis found that there is a higher prevalence of UI in female athletes compared with sedentary women. The study showed that UI reports are present for athletes who practice different sports. SUI was found to be a very common dysfunction among physically active women. The analysis of high- and low-impact sports resulted in the same prevalence of UI, but further research and studies on the subject are needed. Considering that the practice of physical exercise is becoming more popular among women, and also the importance of this subject, studies on urinary dysfunctions are needed to encourage physical practice among women and to minimize negative impacts on their quality of life.

Compliance with ethical standards

Conflicts of interest None.

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