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ORIGINAL ARTICLE

Urinary incontinence in female athletes: a systematic review

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Abstract

Introduction and hypothesis People are increasingly aware of healthy lifestyles. Extenuating practice can injure the pelvic floor. Urinary incontinence (UI) is a prevalent condition in women whether they exercise professionally or not. The most common symptom is stress UI. It is reported in a large variety of sports and may interfere with everyday life or training, leading athletes to change or compromise their performance or risk compromising it. We aimed to assess the prevalence of UI in female athletes and to determine whether the type of sport might also influence UI.

Methods A systematic review of the literature was performed by searching PubMed, the Cochrane Library, and LILACS up to 23 January 2017. The search strategy included the keywords pelvic floor disorders, urinary incontinence, athletes, and sports. The inclusion criterion was studies of women who performed any kind of sport with a prevalence of UI. The subjects were female, with no restriction for age, sport modality, or frequency of training. The outcome was prevalence of UI.

Results The search identified 385 studies, 22 of which met the methodologic criteria for complete analysis. In this review, 7507 women aged 12 to 69 years were included. Only five studies compared physically active women to controls. Every study included high or moderate impact activities involving jumping, fast running, and rotational movements. In total, 17 sport modalities were analyzed. The prevalence of UI varied from 5.56% in low-impact activity to 80% in trampolining. In athletes, the prevalence of incontinence ranged from 10.88% to 80%, showing that the amount of training influences UI symptoms. High-impact activities showed a 1.9-fold prevalence over medium-impact activities and 4,59-fold prevalence over impact activities. Factors such as hormone use, smoking, or menopausal status could not be assessed since they were not detailed in most of the studies.

Conclusion These data suggest that sports practice increases the prevalence of UI and that the type of activity performed by women also has a bearing on the disorder.

Keywords Pelvic floor disorders · Urinary incontinence · Athletes and sports

Introduction

Pelvic floor dysfunction involves clinical and anatomic conditions such as pelvic organ prolapse or urinary and fecal incontinence. The pelvic floor is composed of muscles, fascias, and ligaments that support organs and promote continence [5]. The complaint of urinary loss is common and may occur in women of all ages, but it tends to increase as women grow older [15, 17]. Stress urinary incontinence (SUI) is the prevailing type of loss [3] and is characteristic of over half of the women who leak urine [24]; however, urine loss in general may be underdiagnosed as it often goes unreported [8, 15].

The main known causes of pelvic dysfunction are menopausal status, aging, obesity, pelvic surgery, pregnancy, and parity [4, 15, 19, 23, 24]. However, extenuating physical activity is also believed to lead to urinary incontinence (UI) and vaginal prolapse [12, 22, 23, 25, 29].

Women in different sport modalities participate in competitions, and the number of female competitors is increasing. Top performance demands extreme involvement expressed as increasing the time devoted to intense practice. Performances improve every year, and outdoing oneself becomes increasingly difficult. Urinary incontinence in people who practice sports is subject to variation given that it appears to depend on the intensity of activities, movements, and ground impact. An

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increase in abdominal pressure seems to be the main cause of UI in this population, because the abdominal muscles contract without proper pelvic muscles providing support to the bladder and urethra [1, 2, 19].

There are two hypotheses regarding pelvic muscular function during physical activities. The first suggests that an increase in abdominal pressure results in morphologic and functional modifications, such as deformation of ligaments and connective tissue [3, 10, 11, 14, 15, 17, 18, 22]. This is believed to be the cause of urinary dysfunction in young and nulliparous women who have no other risk factor when they reach the pressure threshold on the pelvic floor [22, 23].

The second postulate is that muscles become stronger with sports practice because of coactivation with abdominal muscles [3, 15, 18]. There are no studies assessing pelvic muscle function during physical activities and the changes it undergoes over time. In a long-term analysis, former athletes of high- and low-impact sports showed similar prevalence of urinary incontinence, indicating that high-impact exercises may not provoke permanent muscle harm [20]. Difficulties such as inadequate samples, lack of techniques for muscle characterization during movement, and no standardized impacts hinder effective comparisons. Biases such as comorbidities, body mass index, smoking, pelvic surgery, and parity are frequent.

The majority of people who exercise are not professional athletes, and their aim is to improve their health or simply to enjoy themselves. Nevertheless, athletes who perceive urine loss during sports activities tend to notice this symptom more frequently in everyday life than nonathletes or those who do not leak urine [20, 22]. When considering the duration of weekly training but not of the type of activity performed, Da Roza et al. [10] concluded that the prevalence of UI is directly related to more intensive practice as undertaken by elite athletes, probably as a result of muscle weakness and slower responsiveness to a continuous mechanical stimulus. Professional athletes show a 2.5-fold increased risk of UI compared with sedentary women [10, 11]. Besides the high prevalence reported in the studies, there is no evidence that heavy training or high-impact activities are the main cause of urinary incontinence in this population, for in some age-matched control groups the difference was not significant [4, 27].

Therefore, we propose to establish the prevalence of SUI in different sport modalities and to determine whether there are any differences among them in relation to ground impact for the sake of prevention or further treatment. Also, we attempt to analyze risk factors such as body mass index, parity, and others that may play a role in pelvic floor disorders.

Materials and methods

A systematic review of the literature was carried out according to PRISMA. The consulted databases were PubMed, the Cochrane Library, and LILACS up to 23 January 2017. The protocol was initially proposed in October 2016. The selected studies were published from August 1994 to October 2016. A search strategy was devised with the keywords pelvic floor disorders or urinary incontinence and athletes or sports and synonymous words or expressions with no bar on languages.

The inclusion criteria were cohort and ecologic studies, as well as case series, assessing women who practiced sports with any level of impact. The studies should show the prevalence of UI as a main or secondary outcome. The subjects were women of any age who exercised professionally or not. The main outcome of our analysis was prevalence of SUI either during sports activities or in everyday life.

The exclusion criteria were studies that included pregnant or recent postpartum women. Data were categorized in terms of diagnosis, type of UI, and related assessments carried out with a pad test, perineometer, or urodynamic testing. Also considered were demographic characteristics, eating disorders, oral contraceptives or hormone replacement therapy, parity, menopause, body mass index, and smoking. Controls were considered as not performing impact by sports activities. They were shown in tables but not analyzed. Physical activity was classified by impact according to previous studies [16, 30].

The papers were selected by two of the authors of this study independently and then methodologically analyzed according to Oxford evidence level classification version 1. They were grouped according to type of sample estimation and to validity of the assessment tool for prevalence and potential bias. For the statistical analysis, study heterogeneity was evaluated using I2 statistics. Data are presented as absolute numbers and percentages, and the results are displayed in tables.

The classification used to establish the different degrees of impact for each group of physical activity was the one designed by Groothausen and Siemer based on information in the literature [16]. Four degrees of impact were adopted for the different physical activities. Activities that demand jumps received impact degree 3 (> 4 times the body weight). Activities involving sprints and rotational movements received impact degree 2 (2 to 4 times the body weight), and those that require lifting some weight were labeled as impact degree 1 (1 to 2 times the body weight). Any other activity was considered impact degree 0 (< 1 time the body weight).

In analyzing bone density, Torstveit et al. [30] used the same classification, including each type of activity in one of the categories. Bowling, cycling, horseback riding, swimming, shooting, and curling were examples of low-impact activities (impact degree 1). Field hockey, judo, track and field, dancing, and skating were classified as medium-impact (impact degree 2), while gymnastics, tennis, basketball, volleyball, handball, Alpine skiing, ice hockey, and soccer were considered high-impact activities (impact degree 3).

Results

Initially, 385 studies were identified by the strategy search. This number includes studies extracted from each database along with related articles and references found in the selected studies. There were 383 studies from MEDLINE via PubMed, 1 study from the Cochrane Library, and 1 from LILACS.

We selected 28 studies for a full analysis, but only 22 had the prerequisites needed for this systematic review (Fig. 1). Two studies were excluded for evaluating nonathletes and two for studying women who already had UI. Two more studies were excluded, one for not having prevalence of incontinence as a primary or secondary objective, and the other for comparing two sports that we classify as low impact. One of the selected studies was a systematic review [3] comprising five studies [4, 12, 20, 22, 29]. We selected all of the five, and their data were analyzed individually. This is why this systematic review is shown only in Table 1 (methodologic quality).

A total of 7507 women aged between 12 and 69 years were included. Of these, 5527 were professional or amateur athletes, regardless of frequency of practice. Only five studies compared physically active women—those with frequent physical activity or elite athletes—to physically inactive women or those who barely practice any activity. Nonetheless, only 4 of the studies, which included 1340 controls, were used. The report screened out was a retrospective cohort study, and the data referred to controls compared with former athletes later in life and not during training. We found a 33.69% prevalence of UI in athletes (Table 2) and 24.40% in the control group (Table 3). However, no further assessment was made using the controls. Every study encompassed activities involving jumps, sprints, or rotational movements with moderate or high impact on the ground [16]. Not all of the sports under analysis were described in detail in every study. A total of 17 different activities were examined, from marathons and sports with balls to low-impact sports such as swimming and to no-impact sports such as golf. In our analysis, trampoliners and rhythmic gymnasts were included as gymnastics athletes. No-impact sports were excluded as only golf was described with a small number of women. We considered the data not representative in this case.

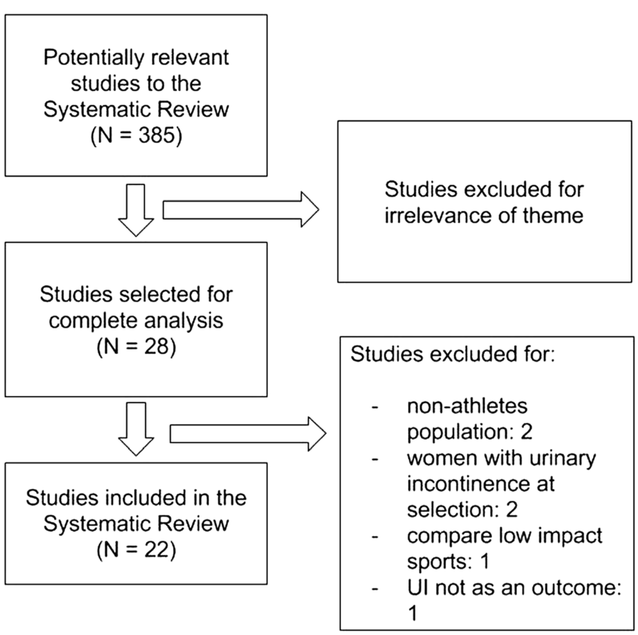

Fig. 1 Flowchart of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

Large heterogeneity was detected in the studies. The most common challenge was imprecision. Most studies reported the number of nulliparous and multiparous women; however, they did not state parity when multiparous women were evaluated, nor did they divide them into different groups to analyze incontinence. A total of 3908 nulliparous and 1147 multiparous women were found. The same inaccuracy occurred with respect to smoking (171 women) and to hormone use for contraception or replacement therapy in menopausal women (1010 women). The latter two were addressed in only four and six studies, respectively. Ten studies did not evaluate menopausal women, a cohort that seems likely to yield more reliable results. Furthermore, eight studies did not mention menopausal status. Some of the studies comparing athletes with control groups used women who exercise minimally as controls, while other studies regarded women engaging in recreational activities or practicing twice a week as athletes. The most often used definition of incontinence was the one set forth by the International Continence Society (ICS); however, a positive diagnosis was made when the question "Do you leak urine during exercise?" or a similar one was answered positively. All study subjects answered a questionnaire with items about urinary symptoms. The International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF) was the most used, i.e., it was applied in six (28.57%) of the studies. The ICIQ-SF is an easy self-administered questionnaire that evaluates urinary loss and how much this dysfunction affects life quality in both sexes. The King's College Health Questionnaire has the same purpose as the previous one. The Urogenital Distress Inventory (UDI-6) is a six-item questionnaire about incontinence symptoms in situations of stress or urgency and about emptying difficulties and pain, producing similar results to those obtained from a pad test, urodynamic testing, and a urinary diary [25]. Finally, the Bristol Female Low Urinary Incontinence is a questionnaire that includes items about sexual symptoms related to urinary incontinence.

Data on the type of incontinence are shown in Table 2. Incontinence was described in different situations, such as sports practice or daily life. The use of pads during training was also evaluated. Some studies described the strategies

Table 1 Methodologic quality

Author	Year	Oxford	Study design	Sample calculation	Bias
Abitteboul	2015	4	Case series	No	Sport heterogenicity
Almeida	2016	2c	Cross sectional	No	Selection bias
Araujo	2008	4	Case series	No	Selection bias
Bo	2001	2c	Ecologic	No	
Bo	2004	3a	Systematic review	No	
Bo	2010	2b	Retrospective cohort	No	
Bo	2011	4	Case series	No	Selection bias
Carls	2007	4	Case series	No	
Caylet	2006	2c	Ecologic	Yes	
Da Roza	2015	4	Case series	No	Small sample
Eliasson	2002	4	Case series	No	
Eliasson	2008	4	Case series	No	
Fozzatti	2012	2c	Ecologic	Yes	Controls-low impact
Jácome	2011	2c	Cross sectional	Triangulation	Previous pelvic surgery
Nygaard	1994	4	Case series	No	Selection bias
Nygaard	1997	2b	Retrospective cohort	Yes	Incontinence > 3×/month
Poswiata	2014	4	Case series	No	
Salvatore	2009	4	Case series	No	Fertility < 52 years old
Schettino	2014	4	Case series	No	
Simeone	2010	4	Case series	No	Previous pelvic surgery
Thyssen	2002	4	Case series	No	Selection bias
Yi	2016	4	Case series	No	

employed to prevent urinary loss, such as use of pads or emptying of the bladder before training or competition. Limiting liquid intake was the least common strategy [17, 26, 29].

Only four studies compared athletes or physically active women with controls (inactive women) [4, 9, 14]. The rate of UI in controls was 24.40%. None of the four studies mentioned menopausal subjects. Non-controls were mostly nulliparous, rendering the results more reliable. However, given the insufficiency of the control group data, we were unable to compare athletes with controls regarding risk factors, for example.

The division of subjects into impact categories revealed that the prevalence of UI is directly related to impact. High-impact sports showed a higher prevalence than low-impact sports (58.10% and 12.48%, respectively), and each group had a fairly similar number of athletes (Table 4). One study [4] included instructors of fitness activities. However, these activities were not classified into exercise or impact categories. Although we used the study data, we were unable to include them in any of our impact categories.

Discussion

The studies of the prevalence of incontinence in a wide range of sports show that increased intra-abdominal pressure may not be caused by ground impact alone. Swimmers, for instance, have a 15% prevalence of incontinence even without ground contact. Abdominal wall muscles are known to be activated in situations that demand spinal stability, accounting for urinary alterations even in activities with mild impact. Yoga and Pilates instructors reported a prevalence of 25.9%, similar to that of the general population [6]. On the other hand, Simeone et al. [28] assumed that constant pressure on pelvic muscles during long training hours could pose a greater risk for incontinence than the sport impact alone.

Running is one of the most popular sports nowadays; nevertheless, the highest prevalence of incontinence is reported by gymnasts [12], because jumping is the movement that may cause incontinence [2, 14, 27, 29]. Nygaard [22] found a 0% prevalence for golf, a sport classified as impact degree 0; since only seven women were included, their data were not deemed representative.

The number of women who complain about urinary incontinence to doctors, trainers, colleagues, etc., is still small, because they might feel ashamed to talk about this issue [17, 22]. They may think it is a normal or even inevitable condition at their age, and some women may adapt to the symptoms [1, 7, 14, 21]. For some patients, urine loss during physical activity limits their exercising or commpels them to stop practicing [14, 17, 24, 26]. Others change their sport modality, choosing walking as their primary activity to reduce urinary symptoms

Table 2 Urinary incontinence prevalence

Author	Year	Evaluated	Athletes	UI athletes	Athlete prevalence	Stress UI	Sport UI	Daily life UI	Urgency	Mixed UI	Questionnaire	Use of pad
Abitteboul	2015	511	511	157	30.72%	96	83	–	63	–	–	37
Almeida	2016	163	67	35	52.24%	–	–	–	–	–	ICIQ-SF	–
Araujo	2008	37	37	23	62.16%	5	–	11	6	–	ICIQ-SF/EAT-26	–
Bo	2001	1146	572	235	41.08%	154	166	–	91	–	EDI + 1	–
Bo	2010	971	331	36	10.88%	36	–	–	9	–	–	–
Caris	2007	86	86	24	27.91%	10	12	–	10	6	Bristol Female modified	–
Caylet	2006	583	157	44	28.03%	–	–	–	15	10	–	1
Da Roza	2015	22	22	16	72.73%	3	16	–	–	–	ICQI-SF	–
Eliasson	2002	35	35	28	80.00%	0	28	–	–	–	–	23
Eliasson	2008	305	305	209	68.52%	–	138	71	–	–	–	79
Fozzatti	2012	488	244	60	24.59%	–	35	–	–	–	ICIQ-SF	–
Jácome	2011	160	106	44	41.51%	27	16	17	9	8	–	–
Nygaard	1994	144	144	71	49.31%	9	40	60	45	–	–	1
Nygaard	1997	104	104	21	20.19%	–	21	–	–	–	–	4
Poswiata	2014	112	112	56	50.00%	51	–	–	31	–	UDI-6	–
Salvatore	2009	679	679	101	14.87%	21	32	48	–	–	–	–
Schettino	2014	105	105	69	65.71%	31	–	–	52	7	–	42
Simeone	2010	623	623	187	30.02%	57	26	115	232	48	ICIQ-SF + 3	–
Thyssen	2002	291	291	151	51.89%	–	125	123	–	–	–	91
Yi	2016	311	311	114	36.66%	114	–	–	51	–	EPIC +1	–
Total		7507	5527	1862	33.69%	689	842	445	653	79		278

[21]. In one study, 12% of trampoliners stopped training because of urinary incontinence, and 38% of them were no longer incontinent after that [13]. In another study, 40% of nulliparous volleyball players said they used pads during training [27]. Many athletes, mostly the younger ones, complained about sporadic loss of small quantities of urine; however, they showed no symptoms of it during their training routine [17]. Perhaps they thought they were not eligible for incontinence treatment; thus, they used the strategies described above to avoid the symptoms.

There is not sufficient information about long-term urinary symptoms in sports players. A comparison of athletes with nonathletes 15 years after the athletes stopped training [5] or of former athletes of low-impact sports with those of high-impact sports [20] showed that prevalence rates did not differ. In contrast, in another study, the incontinence symptoms of half of the trampoliners evaluated 5 to 10 years after they quit training were experienced with low-impact or even sedentary activities [13]. These data strengthen the hypothesis that increased abdominal pressure due to ground impact may not harm the fibers of the pelvic floor muscle. Instead, it may cause slow responsiveness to a contraction order, and after athletes quit training, it may take some time for the response to become normal again.

This review has some limitations concerning the prevalence of other characteristics than urinary incontinence because of the high heterogenicity of the studies selected. Data about parity or use of hormones for instance are seldom given,

Table 3 Prevalence of athletes × controls

Author	Year	Total women	Evaluated	Athletes	IU athletes	Athlete prevalence	Controls	UI control	Control prevelence	p
Almeida	2016	163	163	67	35	52.24%	96	26	27.08%	0.002
Bo	2001	1425	1146	572	235	14.08%	574	224	39.02%	0.009
Caylet	2006	884	583	157	44	28.03%	426	42	9.86%	0.3
Fozzatti	2012	488	486	244	60	24.59%	244	35	14.34%	0.006
Total		2960	2380	1040	374	35.95	1340	327	24.40%	

Table 4 UI prevalence by impact

	Total	UI athletes	%
High impact	Total	UI athletes	Prevalence
Basketball	45	19	42.22%
Football	38	19	50.00%
Gymnastics	371	227	61.19%
Tennis	6	3	50.00%
Volleyball	139	80	57.55%
Total	599	348	58.10%
Medium impact	Total	UI athletes	Prevalence
Hockey	19	6	31.58%
Judo	9	4	44.44%
Running	635	197	31.02%
Softball	16	1	6.25%
Track and field	63	1	6.25%
Total	742	226	30.46%
Low impact	Total	UI athletes	Prevalence
Bodybuilding	164	23	14.02%
Cycling	89	8	10.11%
Hiking	99	12	12.12%
Pilates	36	2	5.56%
Swimming	118	18	15.25%
Total	506	64	12.64%

so confusion factors could not be related to the prevalence found for SUI. The great difference of the number of women in each type of sport does not allow an accurate assessment of the SUI reality of the sport. We suggest a prevalence study including equal numbers of women in each type and each degree of intensity compared with a sedentary population.

Questions about the anatomical causes of urinary incontinence in a population in which this symptom is not common, like young and nulliparous women, remain unanswered. The most reliable theory is that strenuous exercises may prompt the early onset of incontinence symptoms that would appear later in life in predisposed women. Pelvic floor muscle training is the best prevention and treatment for urinary incontinence, be it stress or mixed urinary incontinence, in any kind of physical activity [3, 8, 27]. Women should start prevention as soon as they start exercising. It has no adverse effects and costs less than any other kind of treatment. Prevention tends to focus on creating a structural base so that the muscle can contract during activities [3].

Conclusion

The findings of this review have provided additional evidence that sports practice is a risk factor for UI symptoms and that the prevalence of UI increases as the impact increases. More studies comparing larger and more adequate samples of athletes in different impact sports with nonathletes are needed.

Compliance with ethical standards

Conflicts of interest Jorge M. Haddad has received speaking honoraria from Promedon, Boston Scientific, and Astellas.

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