REVIEW PAPER

Stress urine incontinence especially in elite women athletes extremely practicing sports

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

Józef Opara[1ABD], Teresa Socha[2ABE], Mariola Bidzan[3ABE], Krzysztof Mehlich[1AB], Anna Poświata[1AB]

[1] Department of Physiotherapy, Jerzy Kukuczka Academy of Physical Education, Katowice, Poland
[2] Department of Physical Education, Jerzy Kukuczka Academy of Physical Education, Katowice, Poland
[3] Faculty of Psychology, University of Gdańsk, Gdańsk, Poland

Source of support: Departmental sources

Received: 14 July 2011; **Accepted:** 6 October 2011; **Published online:** 14 November 2011

Abstract

Urinary incontinence according to the International Consultation on Incontinence – ICI, is objectively established involuntary urine flow causing hygiene problems in society because it relates to more than 5% of the population. Urinary incontinence is often hidden from family and the doctor. It is estimated that about 2/3 of all cases of urinary incontinence is kept secret because of shame and embarrassment, and insufficient information about treatment options. This ailment is twice more likely in women than in men, and its frequency increases with age. Urinary incontinence is defined as a condition in which the, independent urine flow will result in social and/or hygiene problems.

There are relatively few reports on stress urinary incontinence in female athletes. Stress Urinary Incontinence occurs in about 25–30% of young athletes. It is particularly noticeable in certain sports such as gymnastics, basketball, jumping and running (i.e. track and field events); less commonly implicated sports include skiing, tennis and skating. Risk factors for exercise-induced Stress Urinary Incontinence are: female gender, hypoestrogenic amenorrhea, involvement in high-impact sports activity, heavy exertion and child bearing.

In this review paper some basic knowledge on Stress Urinary Incontinence in women extremely practicing sports, relating to epidemiology, etiopathogenesis, diagnostic procedures, treatment and prevention is described.

Key words: athletes • epidemiology • female athletes • stress urinary incontinence • urinary incontinence

Author's address: Józef Opara, Jerzy Kukuczka Academy of Physical Education, Mikołowska 72A, 40-065 Katowice, Poland; e-mail: jozefopara@wp.pl

Background

The adolescent female athlete has become a common part of the sports environment at all levels from childhood games to professional adult sports. This article considers various issues common to this athlete to prevent stress urine incontinence (SUI). Greydanus et al reviewed basic sports physiology and then specific conditions were considered, including iron deficiency anaemia, stress urinary incontinence, breast issues (i.e. pain, asymmetry, galactorrhoea, injury), the female athlete triad (i.e. menstrual dysfunction, abnormal eating patterns, and osteopenia or osteoporosis), and injuries. Clinical conundrums were considered including difficulty in caring for a dedicated athlete whose intense training may lead to menstrual and bone loss complications. They stated that the knowledgeable clinician in the twenty-first century can be of considerable help to the female athlete who is at and beyond puberty [1].

Stress urinary incontinence

Urinary incontinence is perceived by the World Health Organization (WHO) as a disease which, owing to the

Athletes – [1] persons who are involved in athletics (sport), which involves track and field events, long distance, cross-country and road running, and race walking; [2] sportspersons, persons who participate regularly in a sport.

Epidemiology – study of health-event, health-characteristic, or health-determinant patterns in a society. It is the cornerstone method of public health research, and helps inform policy decisions and evidence-based medicine by identifying risk factors for disease and targets for preventive medicine.

Female athletes – females practicing sports.

Stress urinary incontinence – accidental overflowing of urine through the urethra at the time of increased intra-bladder pressure not accompanied by a feeling of urge to urinate. A sudden increase in intra-bladder pressure is caused by tensioning of the abdominal muscles during coughing, sneezing, laughing or lifting heavy objects.

Urinary incontinence – involuntary urine flow causing hygiene problems in society.

prevalence in the aging population is one of the most important current health problems. Urinary incontinence is defined as a condition in which the independent urine flow will result in a social problems and/or hygiene [2]. Data from various sources indicate that symptoms of urinary incontinence as a symptom of various disease entities should be regarded as a social disease, because it relates to more than 5% of the population. Urinary incontinence is often hidden from family and the doctor. It is estimated that about 2/3 of all cases of urinary incontinence is suppressed because of the shame and embarrassment, and insufficient information about treatment options. An average time from the beginning of symptoms and presenting to a doctor is usually nine years.

This incontinence occurs twice more often in women than in men, and its frequency increases with age. In their controversial article Cartwright and Cardozo aimed to assess the impact of the 2002 International Continence Society (ICS) standardization report on the usage of lower urinary tract terminology in research publications. They searched articles indexed in the Scopus database for pairs of words or phrases (i.e. "Stress Incontinence" *vs.* "Stress Urinary Incontinence"), where the former was introduced by the 2002 report, making the latter obsolete or discouraged. They calculated frequencies of publications using each word or phrase yearly. They distributed an email questionnaire to members of the British Society of Urogynecologists (BSUG), asking them to identify which items from the list of terms were current standardized or obsolete terminologies. In conclusion the 2002 ICS standardization report was associated with significant shifts in the usage of some items of terminology [3,4].

Approximately 25% of women of childbearing age and 50% of postmenopausal women have problems with incontinence [5]. The disease also affects younger people, about 65% of pregnant women and about 30% of women in the first year after parturition are incontinent. Hunskaar et al. collected data using a postal survey which was sent to 29 500 community - dwelling women aged ≥18 years in France, Germany, Spain and the UK. Subjects were asked about the type of urinary incontinence they had experienced and their treatment behaviour. Of the women who responded, 35% reported involuntary loss of urine in the preceding 30 days. Stress urinary incontinence (SUI) was the most prevalent type. The lowest prevalence was in Spain (23%), while the prevalence was 44%, 41% and 42% for France, Germany and the UK, respectively. About a quarter of women with urinary incontinence in Spain (24%) and the UK (25%) had consulted a doctor; in France (33%) and Germany (40%) the percentages were higher. Overall, <5% of the women had ever undergone surgery for their condition. While pads were used by half of the women, there were some differences among the countries [6].

More than half of all cases of incontinence is stress incontinence. Stress urinary incontinence in women (SUI) is the accidental overflowing of urine through the urethra at the time of increased intra-bladder pressure not accompanied by a feeling of urge to urinate.

A sudden increase in intra-bladder pressure is caused by tensioning of the abdominal muscles during coughing, sneezing, laughing or lifting heavy objects [7]. The causes of this symptom are changes in the fascio-cutaneous-pelvic floor muscle. Such changes can occur as a result of pregnancy and childbirth, lowering of genital tract and genitalia, the genital tract congenital anomalies, history of injuries and surgeries. Among the risk factors an obesity, heavy physical work, professional sports, perimenopausal estrogen deficiency, and constitutional weakening of connective tissue are listed.

While strenuous, high impact activity may provoke urinary incontinence, little is known about relations with moderate physical activity. Townsend et al examined recreational activity and incident urinary incontinence in middle-aged women. In prospective study of women 37 to 54 years old they identified 4,081 incident cases with at least monthly urinary incontinence. In results the risk of at least monthly SUI decreased with increasing quintiles of moderate physical activity (RR 0.80, 95% CI 0.72–0.89 comparing extreme quintiles). Women who were more physically active had lower rates of incontinence than those who were less active. RRs were 0.75 (95% CI 0.59–0.96 for top *vs.* bottom quartile) for stress urinary incontinence and 0.53 (95% CI 0.31–0.90) for urge urinary incontinence. After adjustment for body mass index, the overall association with at least monthly incontinence attenuated, but remained significant (RR 0.89, 95% CI 0.80–0.99 comparing extreme quintiles). In conclusion, long-term, moderate physical activity was inversely associated with urinary incontinence. The role of exercise in weight maintenance may partly explain this association [8].

Clinically three degrees of stress urinary incontinence are distinguished (by Stamey, 1979): first-degree – leakage of urine at any sudden increase in pressure within the abdominal cavity; second-degree – leaking when standing up, walking, movement; third-degree – leakage in the lying position.

There are factors predisposing to incontinence: a family predisposition, congenital defects of the anatomy of the lower urinary tract disease, or acquired, and some

diseases or injuries of the nervous system. The factors that promote incontinence include medications, menopause, cognitive and behavioural disturbances, urinary tract infection, obesity, certain coexisting diseases, age, injuries of the tissues surrounding the bladder, pregnancy, childbirth, miscarriage, and increased pressure in intra-abdominal area [9,10]. Studies have shown a significantly higher incidence of incontinence in young nulliparous female athletes professionally performing physical exercise resulting increase in abdominal pressure, as compared to sedentary.

The initial investigation involves performing a detailed history, physical examination and urine test, which allows the determination of the initial diagnosis and initiation of treatment.

The gynaecological examination is necessary – during which the patient is strongly recommended to cough (Bonney test). It is complemented by a urinalysis to rule out urinary tract inflammation, and neurological consultation when warranted. The choice of treatment is determined by urodynamic investigation that provides valuable information about the type of incontinence [2]. One can also perform a series of examinations and tests that allow the development of a diagnosis and treatment plan. They are: ultrasound, analysis and urine culture, pad-weighing test, voiding diaries, electromyography, in some patients – urography [7,10]. Some tests and questionnaires specific for SUI are used, i.e. Sandvik Index, Urogenital Distress Inventory (UDI-6 Short Form), Incontinence Impact Questionnaire (IIQ-7 Short Form [7,11]. SUI reduces patient`s quality of life [12,13]. The specific questionnaires evaluating quality of life in SUI are: King's College Health Questionnaire and Bristol Female Lower Urinary Tract Symptoms questionnaire (BFLUTS) [14–17]. As for treatment one should mention as well pharmacotherapy, conservative therapy, surgical therapy, electrotherapy, biofeedback and physiotherapy [5,18–22]. The pelvic muscle training is urgent in prevention of SUI especially after childbirth [19,22]. In Dumoulin and Hay-Smith' Cochrane database systematic review fourteen trials involving 836 women (435 pelvic floor muscle training – PFMT, 401 controls) met the inclusion criteria; twelve trials (672) contributed data to the analysis. In conclusion: the review provided support for the widespread recommendation that PFMT should be included in first-line conservative management programmes for women with stress, urge, or mixed, urinary incontinence. Statistical heterogeneity reflecting variation in incontinence type, training, and outcome measurement made interpretation difficult. The treatment effect seems greater in women with SUI alone, who participate in a supervised PFMT programme for at least three months, but these and other uncertainties require testing in further trials [18].

Stress urinary incontinence in elite athletes

There are relatively few reports on stress urinary incontinence (SUI) in female athletes. In their comprehensive article on health problems in female athletes, entitled "The female adolescent athlete: current concepts and conundrums" Greydanus et al indicate that SUI occurs in about one-quarter of nulliparous young athletes – with an average age of 20. It is particularly noticeable in certain sports such as gymnastics, basketball, jumping and running (i.e. on track and field events); less commonly implicated sports include skiing, tennis and skating. As for risk factors of exercise-induced SUI: female gender, hypoestrogenic amenorrhea, involvement in high-impact sports activity, heavy exertion and higher number of deliveries [1]. Bø and Sundgot-Borgen investigated three hundred and thirty-one former elite athletes (response rate 81%) and 640 controls using a postal questionnaire including validated questions on SUI. While competing in sport, 10.9% and 2.7% of the former elite athletes reported stress urinary incontinence (SUI) and urge incontinence, respectively. Presently, 36.5% of the former elite athletes and 36.9% of the controls reported SUI. Among former athletes, SUI was more common in women with *vs.* those without UI while competing (odds ratio 8.57, 95% confidence interval: 3.55–20.71). Age, menopause and being regularly physically active were not associated with SUI in either group. Based on this study, the prevalence of SUI does not seem to be higher in former athletes than in controls. However, the results indicate that SUI early in life, as reported during elite sport, is a strong predictor of SUI later in life [23].

Carls' research has demonstrated that young female athletes participating in high-impact sports may be at higher risk for urinary incontinence. Using a modified Bristol Female Lower Urinary Tract Symptoms Questionnaire, a group of young adult female athletes was surveyed. Results indicated that more than 25% of those completing surveys experienced incontinence and that more than 90% had never told anyone about their problem and had no knowledge of preventive measures; 16% reported incontinence negatively impacted their quality of life [24].

Caylet et al. indicated a very high prevalence of urinary incontinence in elite women athletes. An anonymous self-questionnaire was collected transversally from women aged 18 to 35 years. A total of 157 answers from elite athletes and 426 from control subjects were available for analysis. Urinary incontinence prevalence was 28% for athletes and 9.8% for control subjects (p=.001). There was no significant difference in the relative prevalence of SUI between the athletes and

control subjects. Athletes reported urine loss more frequently during the second part of the training session ($p<0.0003$), and the second part of competition ($p < 0.05$). Urinary incontinence prevalence was 9.87% in physically-active control subjects *vs.* 9.84% in sedentary control subjects (NS). Most incontinent women did not speak of their condition to anybody [25].

Eliasson et al studied the prevalence of SUI in female elite trampolinists. The prevalence of urinary incontinence was assessed by a questionnaire, sent to all 35 elite trampolinists (mean age 15, range 12–22 years) in Sweden. Eighty percent of the trampolinists reported involuntary urinary leakage, but only during trampoline training. The leakage started after 2.5 (range 1–4) years of training. Age ($P<0.001$), duration of training ($P=0.04$), and training frequency ($P=0.01$) were significantly associated with leakage. All women above 15 years of age ($n=23$) reported urinary leakage ($P<0.001$). Eighteen incontinent women continued the study and their leakage were verified by a pad test. The leakage averaged 28 g during a jump session. The muscle strength was measured with perineometry in 10 women and showed good strength in the pelvic floor muscles [26].

Imamura et al. performed a Cochrane database systematic review to assess the clinical effectiveness and cost-effectiveness of non-surgical treatments for women with SUI. The study comprised three distinct elements. (1) A survey of 188 women with SUI to identify outcomes of importance to them (activities of daily living; sex, hygiene and lifestyle issues; emotional health; and the availability of services) was performed. (2) A systematic review and meta-analysis of non-surgical treatments for SUI to find out which are most effective by comparing results of trials (direct pairwise comparisons) and by modelling results (mixed-treatment comparisons - MTCs) was published. A total of 88 randomised controlled trials (RCTs) and quasi-RCTs reporting data from 9721 women were identified, considering five generic interventions [pelvic floor muscle training (PFMT), electrical stimulation (ES), vaginal cones (VCs), bladder training (BT) and serotonin-noradrenaline reuptake inhibitor (SNRI) medications], in many variations and combinations. Data were available for 37 interventions and 68 treatment comparisons by direct pairwise assessment. Mixed-treatment comparison models compared 14 interventions, using data from 55 trials (6608 women).

(3) Economic modelling, using a Markov model, to find out which combinations of treatments (treatment pathways) are most cost-effective for SUI. In results: direct pairwise comparison and MTC analysis showed that the treatment was more effective than no treatment. Delivering PFMT in a more intense fashion, either through extra sessions or with biofeedback (BF), appeared to be the most effective treatment [PFMT extra sessions *vs.* no treatment (NT) odds ratio (OR) 10.7, 95% credible interval (CrI) 5.03 to 26.2; PFMT + BF *vs.* NT OR 12.3, 95% CrI 5.35 to 32.7]. Only when success was measured in terms of improvement was there evidence that basic PFMT was better than no treatment (PFMT basic *vs.* NT OR 4.47, 95% CrI 2.03 to 11.9). In conclusion: more intensive forms of PFMT appear worthwhile, but further research is required to define an optimal form of more intensive therapy along with further definitive evidence from large, well-designed studies [21].

Jean Baptiste and Hermieu identified the intensive exercise as a risk factor for urinary incontinence, defined as "the complaint of any involuntary leakage of urine". It is essentially SUI, occurring because of the phenomenon of intrabdominal hypertension, inherent with certain activities, and excess capacity of sphincters. Some sports are more risk than others, and high-level sportswomen are the most exposed [27].

Lynch and Hoch stated that female runners have special issues in relation to pregnancy and aging. The female athlete triad is a critical, complex physiologic, and often psychological, condition that affects young runners [28].

Salvatore et al. made an epidemiological study to evaluate the prevalence of SUI in menstruating women practicing recreational sports activity, to detect specific sports with a stronger association with SUI, and to evaluate risk factors possibly related to this condition. From 679 women SUI was reported by 101 women (14.9%). Of these, 32 (31.7%) complained of SUI only during sports activity, 48 (47.5%) only during daily life and 21 (20.8%) in both circumstances. Body mass index and parity were significantly associated with the risk of SUI. Looking at the different sports activities, a higher rate of incontinence was found in women participating in basketball (16.6%), athletics (15%), and tennis or squash (11%). About 10.4% of women abandoned their favourite sport, because of SUI, and a further 20% limited the way they practiced their favourite sport to reduce leakage episodes. In conclusion: SUI affects a significant proportion of young women practicing non-competitive sports activity; it can cause abandonment of the sport or limitation of its practice. In discussion the authors stated that these women could benefit from a programme of pelvic floor exercises (unfortunately performed by less than 5% in their study population), whose efficacy in the treatment of UI, even when it occurs during sports activity, has been largely demonstrated in literature [29]. Simeone et al assessed the prevalence of lower urinary tract symptoms (LUTS) and incontinence in female athletes and tried

to determine the etiological factors. An anonymous self-questionnaire was collected from 623 casual female athletes aged 18 to 56 years, who were involved in 12 different sports. The prevalence of LUTS was 54.7%, and 30% for urinary incontinence. Changes in urinary frequency were detected in 91 (14.6%) women. Prevalence of dysuria was 13.3%, urinary straining was present in 173 (27.8%) athletes, whereas urinary urgency had an estimated prevalence of 37.2% with 232 athletes suffering from this disorder. Urgency was very common in volleyball players, as was dysuria among hockey and basketball players, whereas straining mainly affected aerobic participants and cyclists. Long training hours and competitive practices were correlated with the onset of LUTS. High-impact sports were more frequently associated with incontinence, while low-impact sports with LUTS. The sport with the main number of incontinent people was football. Urge incontinence affected a lot of athletes, mainly cyclists and football players. Stress incontinence was more frequent in hockey and volleyball players. In conclusion, LUTS and incontinence are prevalent in female athletes. In many cases, the disorders were present only during sports activities. In this sample, the presence of urinary disorders did not seem to be a barrier during sports or exercise [30].

Acknowledgment

Authors would like to thank prof. Michael P. Barnes from Newcastle upon Tyne for reviewing the manuscript.

References:

1. Greydanus DE, Omar H, Pratt HD: The adolescent female athlete: current concepts and conundrums. Pediatr Clin North Am, 2010; 57(3): 697–718
2. Chapple CR, Wein AJ, Artibani W et al: A critical review of diagnostic criteria for evaluating patients with symptomatic stress urinary incontinence. BJU Int, 2005; 95(3): 327–34
3. Abrams P, Cardozo L, Fall M et al: Standardisation sub-committee of the International Continence Society. The standardization of terminology of lower urinary tract function: Report from the standardization sub-committee of the International Continence Society. Neurourol Urodyn, 2002; 21: 167–78
4. Cartwright R, Cardozo L: Usage of International Continence Society standardized terminology: A bibliometric and questionnaire study. Neurourol Urodyn, 2010; 29(8): 1373–79
5. Thakar R, Stanton S: Regular review: management of urinary incontinence in women. BMJ, 2000; 321(7272): 1326–31
6. Hunskaar S, Lose G, Sykes D et al: The prevalence of urinary incontinence in women in four European countries. BJU Int, 2004; 93: 324–30
7. Dowling-Castronovo A, Spiro EL: Urinary Incontinence Assessment in Older Adults: Part II – Established Urinary Incontinence. Best Practices in Nursing Care to Older Adults, 2008; 11: 2–3.
8. Townsend MK, Danforth KN, Rosner B et al: Physical Activity and Incident Urinary Incontinence in Middle-Aged Women. J Urology, 2008; 179(3): 1012–17
9. Bidzan M, Smutek J, Bidzan L: Psychosexual biography and the strategies used by women afflicted with stress urinary incontinence during intercourse: two case studies. Med Sci Monit, 2010; 16(1): CS6–10
10. Sandvik H, Seim A, Vanvik A et al: A severity index for epidemiological surveys of female urinary incontinence: comparison with 48-hour pad-weighing tests. Neurourol Urodyn, 2000; 19(2): 137–45
11. Uebersax JS, Wyman JF, Shumaker SA et al: Short forms to assess life quality and symptoms distress for urinary incontinence in woman: the Incontinence Impact Questionnaire and the Urogenital Distress Inventory. Neurourol Urodyn, 1995; 14: 131–39
12. Lasserre A, Pelat C, Guéroult V et al: Urinary Incontinence in French Women: Prevalence, Risk Factors, and Impact on Quality of Life. European Urology, 2009; 56(1): 177–83
13. Monz B, Chartier-Kastler E, Hampel C et al: Patient characteristics associated with quality of life in European women seeking treatment for urinary incontinence: results from PURE. Eur Urol, 2007; 51(4): 1073–81
14. Gotoh M: Quality of Life assessment for patients with urinary incontinence. Nagoya J Med Sci, 2007; 69: 123–31
15. Kelleher CJ, Cardozo LD, Khullar V et al: A new questionnaire to assess the quality of life of urinary incontinent women. Br J Obstet Gynaecol, 1997; 104(12): 1374–79
16. Kwon BE, Kim GY, Son YJ et al: Quality of life of women with urinary incontinence: a systematic literature review. Int Neurourol J, 2010; 14(3): 133–38
17. Brookes ST, Donovan JL, Wright M et al: A scored form of the Bristol Female Lower Urinary Tract Symptoms questionnaire: data from a randomized controlled trial of surgery for women with stress incontinence. Am J Obstet Gynecol, 2004; 191(1): 73–82
18. Dumoulin C, Hay-Smith J: Pelvic floor muscle training versus no treatment, or inactive control treatments, for urinary incontinence in women. Cochrane Database Syst Rev, 2010; (1): CD005654
19. Hay-Smith J, Mørkved S, Fairbrother KA et al: Pelvic floor muscle training for prevention and treatment of urinary and faecal incontinence in antenatal and postnatal women. Cochrane Database Syst Rev, 2008; (4): CD007471
20. Holroyd-Leduc JM, Straus SE: Management of Urinary incontinence in women: Scientific review. JAMA, 2004; 291(8): 986–95
21. Imamura M, Abrams P, Bain C et al: Systematic review and economic modelling of the effectiveness and cost-effectiveness of non-surgical treatments for women with stress urinary incontinence. Health Technol Assess, 2010; 14(40): 1–188, iii–iv
22. Labrie J, van der Graaf Y, Buskens E et al: Protocol for Physiotherapy Or TVT Randomised Efficacy Trial (PORTRET): a multicentre randomised controlled trial to assess the cost-effectiveness of the tension free vaginal tape versus pelvic floor muscle training in women with symptomatic moderate to severe stress urinary incontinence. BMC Womens Health, 2009; 9: 24–32
23. Bø K, Sundgot-Borgen J: Are former female elite athletes more likely to experience urinary incontinence later in life than non-athletes? Scand J Med Sci Sports, 2010; 20(1): 100–4
24. Carls C: The prevalence of stress urinary incontinence in high school and college-age female athletes in the midwest: implications for education and prevention. Urol Nurs, 2007; 27(1): 21–24
25. Caylet N, Fabbro-Peray P, Marès P et al: Prevalence and occurrence of stress urinary incontinence in elite women athletes. Can J Urol, 2006; 13(4): 3174–79
26. Eliasson K, Larsson T, Mattsson E: Prevalence of stress incontinence in nulliparous elite trampolinists. Scand J Med Science in Sports, 2002; 12(2): 106–10
27. Jean-Baptiste J, Hermieu JF: Sport and urinary incontinence in women. Prog Urol, 2010; 20(7): 483–90 [in French]
28. Lynch SL, Hoch AZ: The Female Runner: Gender Specifics. Clin Sports Med, 2010; 29: 477–98
29. Salvatore S, Serati M, Laterza R et al: 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: 1115–18
30. Simeone C, Moroni A, Pettenò A et al: Occurrence rates and predictors of lower urinary tract symptoms and incontinence in female athletes. Urologia, 2010; 77(2): 139–46