

ARE FORMER FEMALE ELITE ATHLETES MORE LIKELY TO EXPERIENCE  
URINARY INCONTINENCE LATER IN LIFE THAN NON-ATHLETES?

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Running head: former female elite athletes and urinary incontinence

## ABSTRACT

The aim of the present study was to investigate whether former female elite athletes are more likely to experience urinary incontinence (UI) later in life than non-athletes and to assess possible risk factors for UI in athletes. 331 former elite athletes (response rate 81%) and 640 controls replied to a postal questionnaire including validated questions on UI. 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. 9,1% and 9,4% reported urge incontinence. Among former elite athletes, those with 2 or 3 children were more likely than nulliparous women to have UI now. Also, among former athletes, UI was more common in women with, versus those without UI while competing (aOR 8,57, 95% CI: 3,55-20,71). Age, menopause and being regularly physically active now were not associated with UI in either group. Based on this study, the prevalence of UI does not seem to be higher in former athletes than in controls. However, the results indicate that UI early in life, as reported during elite sport, is a strong predictor of UI later in life.

Key-words: elite athletes, pelvic floor dysfunction, prevalence, urinary incontinence

## INTRODUCTION

Strenuous physical activity has been suggested as one factor promoting pelvic floor dysfunction in women (Bø 2004, Wilson et al 2005). The pelvic floor muscles (PFM) comprise the pelvic diaphragm and the urogenital diaphragm. The muscles and fascias are important in giving structural support to all the internal organs and to close the pelvic openings (Ashton –Miller & DeLancey 2007). Pelvic floor dysfunction can cause urinary and fecal incontinence, pelvic organ prolapse (POP), pain, and sexual disorders (Bump and Norton 1998).

Urinary incontinence (UI) is a common complaint in the general female population with prevalence rates varying between 10-55 % in 15-64 year old women (Hunskar et al 2005). UI is defined as “the complaint of any involuntary leakage of urine” and the two most frequent forms of UI in women are stress urinary incontinence (SUI), defined as “involuntary leakage on effort or exertion, or on sneezing or coughing” and urge incontinence defined as “involuntary leakage accompanied by or immediately preceded by urgency” (Abrams et al 2002). Several studies have documented a high prevalence of UI among female elite athletes and dancers (Bø 2004), with the highest prevalence found in high impact activities, and 80% in trampoline jumping (Eliasson et al 2002).

There are two opposing hypotheses about how strenuous exercise or hard work might affect the pelvic floor: 1. physical activity may strengthen the pelvic floor muscles, and 2. physical activity may overload, stretch and weaken the pelvic floor (Bø 2004). However, little is known about the direct impact of physical activity on pelvic floor anatomy and function. Ree et al (2007) found that there was a short term fatigue of the pelvic floor muscles in young nulliparous women with symptoms of SUI after 90 minutes of strenuous physical exercises,

but concluded that further research was needed to understand long-term effects. O'Dell et al (2007) measured vaginal pressures during different exercises and found that the exercises studied generally produced lower pressure than cough, but individuals varied in pressure exerted. In addition, although the prevalence of UI is high among female athletes, to date there is scant knowledge about the long-term effect of strenuous physical activity on prevalence of UI (Nygaard 1997, Bø 2004). In addition, there are very few studies on risk factors of UI in elite athletes. Hence, the aim of the present study was to investigate whether former female elite athletes are more likely to experience urinary incontinence later in life than non-athletes and to assess possible risk factors for UI in elite athletes.

## MATERIAL AND METHODS

In 1989 the total population of female elite athletes in Norway aged 13-39 years (n=603) representing the senior and junior national teams from 38 different sports, were invited to participate in a study aiming to determine the prevalence of eating disorders (Sundgot-Borgen 1993). Eighty six percent (n=522) participated in the study. These former athletes were the target group for the present study. We managed to get hold of 411 out of the total number (n=522) of the former athletes. Of these 411 women, 331 former elite athletes answered the questionnaire (response rate 81%)

In addition a bureau of statistics picked a randomly selected sample of controls from the total population of female citizens in Norway aged 30-50 years. Every county was represented and an approximate identical percentual age and geographical distribution in relation to the total population was done. The controls were chosen based on the present age distribution of the former elite athletes. None of the controls had a history of representing junior or senior national teams in sports, and thus were classified as non-athletic controls. Out of the total number of controls (N= 1777), 640 responded (response rate 36%). Data collection started in September 2005 and ended in September 2007, and the controls were between 30 and 50 years when the data collection began.

Both former athletes and controls replied to a postal questionnaire on a battery of questions regarding training and/or physical activity patterns, menstrual, dietary and weight history, oral contraceptive use and disordered eating. The study was approved by the Regional Ethics Committee and the Norwegian Social Science Data Service. All women gave written consent to participate.

### Definition of urinary incontinence

Urinary incontinence during the elite athlete period was asked retrospectively and was defined as urge urinary incontinence (UUI) explained as urinary leakage before they could reach the toilet, stress urinary incontinence (SUI) when coughing and sneezing or during physical activity, or leakage during sleep, after voiding, without any reason and all the time (Avery et al 2004). Both the controls and the former athletes were asked the same questions about present urinary incontinence, but specified to last month (Avery et al 2004). Both from urinary incontinence was reported on a 10 point scale (Avery et al 2004).

### Mechanical loading.

The former elite athletes (n=331) represented 38 sports, which were divided into three groups based upon the degree of mechanical loading: low-impact (LI), medium impact (MI) and high impact (HI) sports. A study investigating bone mineral density in elite athletes used this classification and has been published elsewhere (Torstveit & Sundgot- Borgen 2004).

Classification was based on a method evolved by Groothausen & Siemer (1997).

Participating in regular physical activity now was defined as participating in  $\geq$  one fitness activity each week, each lasting at least 30 minutes. Time and frequency for each listed activity (walking, jogging, swimming, bicycling, strength/weight training, ball-games, cross-country skiing/roller skiing, skating/rollerblades, martial arts, aerobics, stretching/ relaxation, dance and other) were reported.

### Statistical analyses

Data analysis was done by use of SPSS version 15. Data are presented as means with standard deviation (SD), frequencies and percentages. Independent sample test was used to compare

continuous background variables. Analysis of differences in prevalence of urinary incontinence between groups was done by Chi-Square and Fisher Exact Test. P-value was set to  $\leq 0,05$ . Logistic regression analysis was used and the results are reported as adjusted odds ratios (aOR) with 95% confidence intervals (95% CI).

## RESULTS

Background variables for the two groups are presented in Table 1. There were statistically significant differences between groups in all background variables.

When competing in elite sport 10,9 % and 2,7% of the former elite athletes reported SUI and urge incontinence, respectively. Presently, 36,5% of the former athletes and 36,9% of the controls reported SUI. Nine percent versus 9,4% reported urge incontinence in the same groups, respectively. Seventy-eight % of the elite athletes reporting SUI during their athletic carrier also reported SUI now. Significantly more former athletes reported urinary leakage during physical activity than controls (20,4% versus 15,3%,  $p= 0,048$ ) now, but not during coughing and sneezing. Mean bother score was 2,3 (SEM 0,15) and 2,4 (SEM 0,12) in the former elite athletes and controls, respectively.

aOR with 95% CI are presented in Table 2. In the former elite athlete group parity and having urinary incontinence while competing in sports was associated with urinary incontinence now. In the control group BMI and parity was associated with urinary incontinence. Age, menopause and being regularly physically active now were not associated with urinary incontinence in either group.

There were no significant differences in prevalence of UI or SUI when the athletes were classified in low, medium or high impact sports groups neither when competing or at present. Prevalence of SUI in the former elite athletes classified as participating in low, medium and high impact activities were 5,3%, 10,7% and 13,0% when competing ( $p= 0,267$ ) and 36,8%, 36,9% and 36,1% now.



Twenty-seven percent of the former elite athletes and 30 % of the controls reported to exercise the PFM  $\geq$  once a week now.

## DISCUSSION

The main findings of this study were that former female elite athletes were not more likely to have more SUI or urge urinary incontinence later in life than a control group from the same geographical area. In addition, high impact activities did not seem to affect prevalence of UI neither when participating in sport or at present. Nevertheless, in an analysis restricted to former elite athletes, urinary leakage when participating in competitive sport was strongly associated with urinary incontinence later in life.

To date there is scant knowledge about the long-term effect of competitive sport or fitness activities on symptoms of pelvic floor dysfunction e.g. urinary incontinence (Bø 2004). Nygaard et al (1997) asked former Olympians on prevalence of urinary incontinence while participating (retrospectively) in the Olympics and 20 years later. They compared low impact (swimming) and high impact (gymnastics and track and field) athletes and found that participation in regular, strenuous high impact activity when younger did not predispose women to a higher rate of significant urinary leakage in later life. Nygaard et al (1997) compared long term prevalence between athletic groups and not former athletes versus a control group, prevalence of SUI symptoms in their study was slightly higher than in our study (41% in the former gymnastic and track and field group and 50% in the former swimmers) and both the sample size (N=104) and response rate was lower (51%) than in our study. Hence, a direct comparison of their results with ours is not possible. However, the results of our study are in line with their results showing no association between former strenuous exercise and UI.

The prevalence of urinary incontinence in the general female adult population is high, ranging from 10 to 55% (Hunnskaar et al 2005). Hence, the prevalence found in the former athletes and

the control group now in the present study was in line with results found in other prevalence studies. However, the reported prevalence of UI while competing in sports was lower among the participants in this study compared to what has been found in other studies (Nygaard et al 1994, Bø & Sundgot Borgen 2001, Thyssen et al 2002). This may be due to the retrospective design of the present study and a possible underestimation due to recall bias. In a former study of Norwegian elite athletes Bø & Sundgot-Borgen (2001) found a prevalence of 41% of SUI and 16% of urge incontinence and no difference compared to age-matched controls.

There is limited knowledge about associated factors in female athletes and urinary incontinence. In a study of college varsity athletes, Nygaard et al (1994) found no significant association between incontinence and amenorrhea, weight, hormonal therapy or duration of athletic activity. In a study of former Olympians they found that among factors such as age, BMI, parity, Olympic sport group, and incontinence during Olympic sport 20 years ago, only current BMI was significantly associated with regular stress or urge incontinence symptoms (Nygaard et al 1997). Bø & Sundgot Borgen (2001) reported that significantly more elite athletes with eating disorders had symptoms of both stress and urge incontinence, and Eliasson et al (2002) showed that incontinent trampolinists were significantly older (16 versus 13 years), had been training longer and more frequently and were less able to interrupt the urine stream by voluntarily contracting the PFM than the non-leaking group.

Our control group was drawn to match the age of the former elite athletes. Nevertheless, the two groups were statistically different in all background variables. The control group was significantly older, had a higher BMI and parity and the percentage being postmenopausal was higher than the former elite athletes. These factors are all listed to be associated with UI, and a higher prevalence of UI would therefore have been expected among the controls

(Hunnskaar et al 2005). However, although statistically significant, the differences between groups are very small, eg mean age 37 and 39 years, and not expected to be clinically relevant. The response rate of the controls was low and thus the responders may have been more interested in physical activity and regular exercise than the general population. This may have given a higher prevalence of UI than in a more sedentary population. However, the prevalence is comparable to other Norwegian studies on UI (Hunnskaar et al 2005).

To date, there are controversial findings on physical activity and urinary incontinence in the general female population. Danforth et al (2007) did a prospective analysis from the Nurses' Health Study of women aged 54-79 years. They found that increasing levels of total physical activity were significantly associated with a reduced risk of urinary incontinence. Walking was related to 26% lower risk of developing urinary incontinence. Hannestad et al (2003) found that increasing levels of low intensity physical activity had a weak and negative association with incontinence, while there were no important effects of high intensity physical activity. In contradiction to this, Eliasson et al (2005) found that high impact physical activity was an independent risk factor for urinary leakage in a sample of primiparous women that had recently given birth. It is difficult to conclude from these studies as they have all studied different populations, used different definitions on physical activity, including definitions on high and low impact activities, and used different definitions on UI. In addition, with a cross sectional design it is not possible to rule out a cause-effect relationship; eg are women able to exercise because they are not leaking or is regular exercise preventing incontinence? In our study former participation in high impact activities did not predict UI later in life.

Among former elite athletes the strongest association with reported prevalence of urinary incontinence at present was experiencing urinary leakage while competing in sport. Hence,

early interventions may be warranted to treat the condition and prevent further chronification. PFMT has level A evidence to treat SUI and mixed incontinence in women and is recommended to be first line treatment for these conditions (Wilson et al 2005). However, there is scant knowledge about the effect of PFM training on prevention of UI, and we have not been able to find any studies on the effect of such training programs in elite athletes (Bø 2004). In the present study 27 and 30% of the elite athletes and controls reported to train the PFM regularly at least once a week. The number participating in regular fitness activities was significantly higher in both groups. The high prevalence of UI among women implies that PFMT should be included as a natural part of strength training programs for women of all ages (Bø 2004). To date there is no knowledge about how widespread PFM training is in regular fitness classes for women, and there is scant knowledge of the effect of this specific training conducted in a general fitness class setting (Brubaker et al 2008).

Given the cross sectional design of the present study we cannot conclude whether former participation in elite sport is a risk factor for developing pelvic floor dysfunctions and UI later in life. However, it may be considered unethical and very difficult to conduct a randomized controlled trial to answer this question. Our results showed that former elite athletes were not more likely to have a higher prevalence of UI later in life than controls. Unfortunately we did not ask the controls about their prevalence of UI 15 years ago. This fact, and the lack of clinical assessment of pelvic floor muscle function are limitations of our study. Further experimental studies on both short and long term effect of physical activity on PFM function are warranted.

## PERSPECTIVES

This study did not find that being a former elite athlete was associated with a higher prevalence of urinary incontinence later in life. There is a need to conduct more basic experimental studies to understand both short and long term impact of different types of strenuous physical activity and training on the pelvic floor muscles.

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Table 1. Background variables for former female elite athletes (N=331) and controls (N=640)

	Elite athletes	Controls	p-value
Age (years)	37,5 (SD 4,0)	39,3 (SD 5,4)	0,001
BMI (kg/m <sup>2</sup> )	23,2 (SD 3,3)	25,2 (SD 4,7)	0,001
Parity	2,2 (SD 0,8)	2,3 (SD 1,1)	0,016
Percentage of postmenopausal women	1,5 %	11,5%	0,001
Percentage with higher education	66,6%	46,3%	0,001
Percentage married/cohabitant	85,5%	79,7%	0,026
Percentage with hysterectomy	0,6%	3,3%	0,009
Percentage being regularly physically active now	81,2%	68,8%	0,001

Table 2. Adjusted Odds ratio (aOR) with 95% confidence intervals (CI) for having symptoms of urinary incontinence at present in former female elite athletes (N= 331) and controls (N= 640).

	Female elite athletes	n	Controls	n
Age (per 1 year)	1,01 (0,94-1,07)	322	1,02 (0,98-1,06)	543
BMI (per 1kg/m <sup>2</sup> )	1,08 (1,00-1,16)	322	1,07* (1,03-1,12)	543
Parity 1	1,87 (0,79-4,43)	49	1,41 (0,75-2,68)	83
Parity 2	2,66* (1,32-5,36)	128	1,77* (1,05-2,98)	212
Parity 3	2,69* (1,23-5,89)	67	2,03* (1,13-3,66)	115
Parity 4	3,04 (0,76-12,23)	11	2,68* (1,06-6,83)	25
Parity 5	0,000	1	2,30 (0,55-9,61)	9
Menopause	2,83 (0,30-26,36)	5	0,83 (0,42-1,64)	55
Hysterectomy	1,06 (0,05-22,08)	2	0,49 (0,16-1,46)	16
Urinary	8,57*	39		

incontinence while participating as elite athlete	(3,55-20,71)			
Regularly physically active now	0,809 (0,437-1,498)	262	0,841 (0,573-1,235)	371

\* p-value < 0.05