Risk of pelvic floor dysfunctions in young athletes

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Summary

Purpose of investigation: Numerous epidemiological studies have shown a correlation between sport and the development of pelvic floor dysfunction. Therefore, the aim of the present study was to evaluate the prevalence of urinary incontinence in female young athletes. *Materials and Methods:* The epidemiological study was conducted on 105 female volleyball players, who were given a questionnaire, self-compiled, consisting of four main domains (personal data and medical history, urinary incontinence, urinary disorders, and judgment on the questionnaire). *Results:* In a total of 105 athletes, the present authors observed that 65.7% had reported at least one symptom of stress urinary incontinence (SUI) and/or urgency, during sport or in daily life situations. In particular, the 49.52% reported urge urinary incontinence, 20% urine loss for urgency, and 29.52% SUI. In addition, the present authors observed that nocturia was reported in 70.48% of cases, incomplete bladder emptying in 55.24%, urinary hesitancy in the 36.19%, and pelvic pain in 52.38%. In all cases, the symptoms were occasional and low. In relation to the coexistence of symptoms, the present authors observed that 22.85% of athletes had only symptoms of urge urinary incontinence, 6.66% mixed incontinence, and 6.66% symptoms of urge urinary incontinence associated to urine loss for SUI. *Conclusion:* The present authors observed a relationship between the sport and the pelvic floor dysfunction, in particular urinary incontinence.

Key words: Pelvic floor dysfunction; Urinary incontinence; Young athletes.

Introduction

Urinary incontinence is defined by the International Continence Society (ICS) as "a condition in which involuntary loss of urine is a social or hygienic problem and is objectively demonstrable" [1]. The most common type of urinary incontinence in women is stress urinary incontinence (SUI), defined as the involuntary loss of urine during coughing, sneezing, or physical exertion such as sporting activities, heavy lifting, or sudden change of positions. Genuine stress incontinence (GSI) is urodynamically proved involuntary loss of urine when the intravesical pressure exceeds that of the urethra with no simultaneous detrusor contraction. Urge incontinence is defined as involuntary loss of urine associated with a sudden, strong desire to void (urgency), and can occur alone or in combination with SUI (mixed incontinence) [1]. The most common type of urinary incontinence in women is SUI, followed by urge and mixed incontinence. Urinary incontinence is not a life-threatening or dangerous condition. However, it is socially embarrassing and may cause withdrawal from social situations and reduced quality of life [2, 3]. SUI implies that urine loss occurs during increases in abdominal pressure. If the condition is present, is therefore likely that urine loss will occur during physical activity [4].

The incidence of the urinary incontinence and consequently the susceptibility to urinary tract infections are increasing. Given the size of the problem, and considered that this dysfunction also affects young women and young athletes [5-7], the diagnostic [8, 9] and treatment of SUI has been the aspects of greatest interest for the urogynecological research [10-12]. Thus, sedentary women who are less exposed to physical exertion may not manifest stress incontinence, although the underlying condition may be present. SUI has shown to lead to withdrawal from participation in sport and fitness activities [13] and may be considered a barrier for life-long participation in health and fitness activities in women [14]. Strenuous physical activity has been suggested as one factor promoting pelvic floor dysfunction in women [15]. 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. Pelvic floor dysfunction can cause urinary and fecal incontinence, pelvic organ prolapse, pain, and sexual disorders [16]. There are two opposing hypotheses about how strenuous exercise or hard work might affect the pelvic floor: physical activity may strengthen the PFM and physical activity may overload, stretch, and weaken the pelvic floor [17]. However, little is known about the direct impact of physical activity on pelvic floor anatomy and function. Ree *et al.* [18] 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 the long-term effects. O'Dell *et al.* [19] measured vaginal pressures during different exercises and found

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that the exercises studied generally produced lower pressure than cough, but individuals varied in pressure exerted. In addition, although the prevalence of urinary incontinence is high among female athletes, to date, there is scant knowledge about the long-term effect of strenuous physical activity on the prevalence of urinary incontinence [20]. In addition, there are very few studies on risk factors of urinary incontinence 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 urinary incontinence in elite athletes. The aim of this study was to elaborate on the problem of urinary incontinence among female volleyball players while participating in their sport and during daily life activities.

Materials and Methods

A questionnaire about urinary symptoms was distributed to female volleyball players in nine different clubs. The present authors enrolled athletes ≥ 16 years of age and who were undergoing three weekly training sessions of two hours each. A total of 105 women were included in the study; all the women answered the questionnaire. The women were first asked if they experienced urine loss while participating in their sport or in daily life. If their answers to both these questions were negative, they did not complete the rest of the questionnaire. All women who had experienced urine leakage complete the questionnaire. They were asked about medication, deliveries, incontinence during training, competition and daily life activities, incontinence treatment, pad use, and voiding habits. The present authors evaluated the frequency of individual symptoms, the association of multiple symptoms, years of sport, and hours of weekly training.

The study was approved by the local scientific ethical committee and informed consent was obtained from all the women. Data analysis was performed using by use of SPSS version 15. Data are presented as means with standard deviation (SD), frequencies, and percentages.

Results

The average age of the 105 athletes answering the questionnaire was 21.96 years (± 5.6) and they were nulliparous. The average BMI of the 105 athletes answering the questionnaire was 22.50 (± 4.2). Sixty-nine athletes (65.71%) were undergoing to ≥ eight but ≤ ten hours of weekly training. The remaining women are undergoing to ten hours of weekly training. Fifty-seven women (54.59%) practiced volleyball for more than ten years. All the women had a negative medical history for chronic diseases and surgeries and were not taking medication.

A total of 69 (65.7%) had reported at least one incontinence symptom while participating in their sport or in daily life situations, or urge incontinence or stress urinary incontinence or mixed type of incontinence. A total of 42 (40%) used pads during the competitions.

In particular, in relation to each specific symptom, 49.52% (52) reported urge urinary incontinence, 20% (21) reported urine loss for urgency, 29.52% (31) reported urine loss for SUI. Furthermore the present authors observed that the nocturia was reported by 74 athletes (70.48%), the feeling of incomplete bladder emptying was reported by 58 athletes (55.24%), and urinary hesitation was reported by 38 athletes (36.19%), and pelvic pain was reported by 55 athletes (52,38%). The athletes reported that these symptoms were occasional.

In relation to the coexistence of symptoms, the present authors observed that 24 (22.85%) athletes reported only urge urinary incontinence symptoms, seven (6.66%) mixed incontinence, and seven (6.66%) reported urge urinary incontinence symptoms associated to urine loss for stress urinary incontinence.

The present authors observed that any athlete had pure urge urinary incontinence and any had coexistence of symptoms of urge and SUI. The SUI was caused by laughter and physical activity, respectively, in 35.45% in the first case and in the 32.26% in the second case.

The frequency of loss urine was once a month in the 23 women (74.19%) who reported SUI and in 17 women (80.95%) who reported urge urinary incontinence. This urine loss was defined low in quantity.

The present authors evaluated the frequency of urinary incontinence in relation to the years of playing volleyball. They observed in 57 athletes who played volleyball for more than ten years: 25 athletes (43.85%) had no urge and/or SUI 13 athletes (22.8%) reported urge urinary incontinence, Nine athletes (15.78%) reported SUI, five athletes (8.77%) reported urge and SUI, and five (8.77%) reported urgency and SUI. Instead, the present authors observed in the 35 athletes who played volleyball for more than five years: seven athletes (20%) had no urge and/or SUI, nine athletes (25.71%) reported urge urinary incontinence, eight athletes (22.85%) reported SUI, eight athletes (22.85%) reported urge and SUI, and three (8.57%) reported urgency and SUI.

In 13 athletes who played volleyball for less than five years: four athletes (30.76%) had no urge and/or SUI, three athletes (23.07%) reported urge urinary incontinence, three athletes (23.07%) reported SUI, two athletes (15.38%) reported urge and SUI, and one (7.69%) reported urgency and SUI.

Finally the present authors evaluated the frequency of urinary incontinence in relation to the hours of weekly training. They observed in the 69 athletes who played volleyball for less than ten hours/week: 27 athletes (39.13%) had no urge and/or SUI, 13 athletes (18.84%) reported urge urinary incontinence, 12 athletes (17,39%) reported SUI, ten athletes (14.49%) reported urge and SUI, and seven (10.60%) reported urgency and SUI.

Instead, the present authors observed in the 36 athletes who played volleyball for more than ten hours/week: nine athletes (25%) had no urge and/or SUI, 11 athletes (30.55%) reported urge urinary incontinence, five athletes

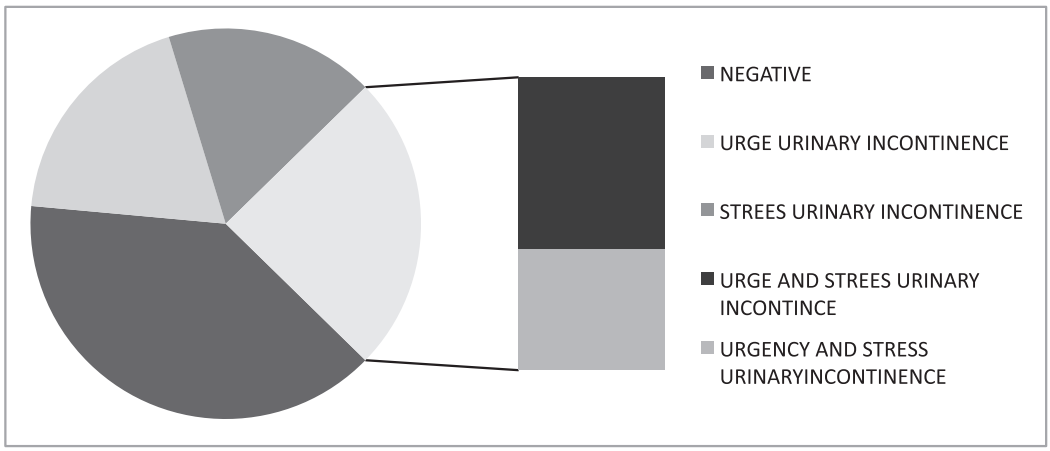

Figure 1. — Results for training ≤ ten hours per week.

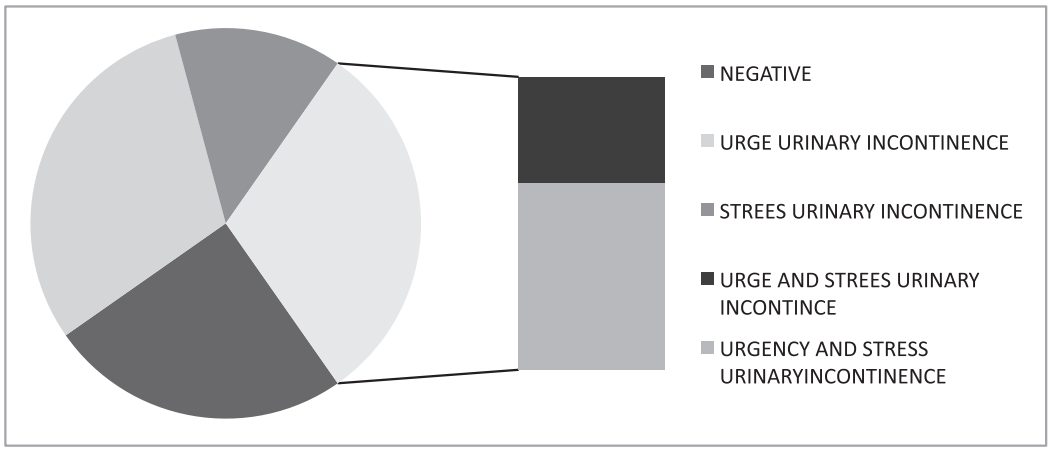

Figure 2. — Results for training ≥ ten hours per week.

(13.88%) reported SUI, four athletes (1111%) reported urge and SUI, and seven (19.44%) reported urgency and SUI.The results are summarized in Figures 1 and 2.

Discussion

The present study shows results in agreement with the studies in the literature that have investigated the prevalence of urinary incontinence in female athletes. The present results showed leakage of urine essentially due to stress occurring less than once a month and in small quantities. The problem of urinary incontinence in female athletes is still not widespread and the athletes live the problem with superficiality, this for the infrequency with which it occurs and for the low level of losses. This leads to a delay in diagnosis and a lack of knowledge of the potential for treatment and prevention. The approach considered as a first choice for prevention is pelvic floor muscle training (PFMT); this treatment has scientific evidence level 1 and Grade A and devoid of adverse effects. It would be appropriate therefore to subject athletes to PFMT to prevent the onset of urinary incontinence; it is absolutely necessary that the training is specific for the muscles of the pelvic floor. The results of the present study demonstrated a high prevalence of both SUI and urge incontinence in young female athletes. Bø *et al.* [21, 22] reported 26% prevalence in young physical education students, and Nygaard *et al.* [20] reported 28% in college athletes. According to the ICS definition, urinary leakage should be objectively demonstrable to fulfil the criteria of incontinence. This requires urodynamic assessment, and is not possible in the setting of an epidemiological study. Whether the subjects responding to the questionnaire in the present study had stress or urge urinary incontinence can therefore not be confirmed, and the results must be interpreted with caution. Urinary incontinence is not a life-threatening condition. However, it has been shown to affect quality of life, participation in social activities, and self-esteem. In elite athletes, it may affect concentration and performance, especially in sports with minimal and tight clothing such as figure skating and gymnastics. The high prevalence reported in aesthetic sports may reflect that the condition is visible and easier to recognize in those sports.

Factors contributing to urinary incontinence in young nulliparous women are not fully understood. Weak connective tissue combined with high-intensity and high-impact activity may unmask the condition [7]. Nygaard *et al.* [20] demonstrated that in 17% of women, the condition was only recognized during physical activity. Davis and Goodman [23] studied 512 of 2,651 female soldiers who entered the airborne infantry and found that nine developed urinary incontinence during the training period. Urodynamic investigation demonstrated detrusor instability in three, and GSI in six of the women. Four of the women reported feeling a tearing pain in their "lower quadrant" on impact during parachute jump, and one subject related a similar event during heavy lifting and doing sit-ups. However, 9 of 512 is a very low incidence. In addition, parachute jumping is an extreme high-impact activity.

The present study demonstrated that more than 60% of female volleyball athletes have experienced urine loss. Only the incontinent women completed the questionnaire, for which reason the authors cannot make comparisons between incontinent and continent athletes. In particular 65.71% of the athletes who had experienced urine leakage considered it to be a social or hygienic problem, and 40% occasionally wore pads. Thus physical exertion seems to be a significant provocative factor. Nygaard [20] reported that 20% of young women exercisers stopped because of urine leakage. Consequently, the frequency of regular urinary incontinence in a 'normal population' seems to be significantly higher than the findings in the present population of elite athletes and dancers. The activity most likely to provoke leakage was jumping. This explains why gymnastics, which involves many high-impact jumps, has the highest degree of leakage of the different sports. The study demonstrates that significantly more athletes experienced urine loss during training rather than competition: 95.2% versus 51.2%, respectively. This is an interesting finding that may be explained by the higher catecholamine levels during competition versus training [20]. As the urethra contains α-receptors, the higher catecholamine level during competition may tend to keep it closed. Other factors, such as the ritual bladder and bowel emptying which is common before competition, or changes in diuresis, may also play a role.

The present results, in accordance with literature, provides more evidence as to the surprisingly high prevalence of urinary incontinence in young, physically fit athletes. Although relatively few women experienced frequent symptoms, we traditionally would not expect any incontinence at all in this group. It seems that the relatively high pressure generated by certain activities, especially jumping and ball games, is sufficient to overcome the continence mechanism in these women. Now that we know the prevalence of incontinence is higher in athletes than previously suspected, the next step will be investigating the pathophysiology. Do repeated impacts somehow damage pelvic supporting structures? Despite their overall level of physical fitness, is their pelvic muscle function abnormal for some reason? Just as isolated enzyme deficiencies have led to a greater understanding of cellular biochemistry, out of proportion to the actual incidence of those clinical conditions, unraveling the pathophysiology of incontinence in unusual study populations may help advance our understanding of continence and incontinence. The rationale would be that any physical activity that increases abdominal pressure will lead to a simultaneous or pre-contraction of the PFM, and the muscles will be trained. Based on this assumption, general physical activity would prevent and treat SUI. However, women leak during physical activity and they report worse leakage during high-impact activities. No sports involve a voluntary contraction of the PFM. Many women do not demonstrate an effective simultaneous or pre-contraction of the PFM during increased abdominal pressure. In nulliparas this may be due to genetically weak connective tissue, location of the PFM at a lower, caudal level inside the pelvis, lower total number of muscle fibres (especially fast twitch fibres) or untrained muscles in those leaking. To date, there is little knowledge about PFM function in elite athletes. Bø *et al.* [24] measured PFM function in sport and physical education students with and without urinary incontinence and did not find any difference in PFM strength. The increase in PFM pressure during a voluntary contraction was 16.2 cm H_2O in the group with SUI and 14.3 cm H_2O in the continent ones. However, this study was limited by its small sample size and no strong conclusion can be drawn. Statistically significant differences in PFM function and strength between continent and incontinent women have been shown in the adult population [25]. Bø *et al.* assessed PFM strength in four elite female power lifters and compared them to 20 physical therapy students. Mean muscle strength during voluntary contraction in power lifters was 22.6 cm H_2O and in the physical therapy students it was 19.3 cm H_2O which was not significant. Only one of the elite athletes in the above-mentioned ongoing study had exercised the PFM systematically. She reported to have trained her PFM regularly in order to increase low back stability and abdominal pressure during lifting. Her mean PFM strength was 36.2 cm H_2O. She was totally continent even when competing in World championships, but so too were those who had not trained the PFM [24].

Heavy lifting and strenuous work have been listed as risk factors for the development of pelvic organ prolapse and SUI. Nichols and Milley [26] suggested that the cardinal and uterosacral ligaments, PFM, and the connective tissue of the perineum might be damaged chronically because of repeated increases in abdominal pressure due to hard manual work and chronic cough. To date, there are still little data to support the hypothesis. In a study of Danish nursing assistants, it was found that they were 1.6 times more likely

to undergo surgery for genital prolapse and incontinence than women in the general population [27]. However, the study did not control for parity and, therefore, it is difficult to conclude whether heavy lifting is an aetiological factor. Twenty-six percent of women in the US Air Force female crew, capable of sustaining up to 9G, reported urinary incontinence [28]. However, more women had incontinence off duty than while flying and it was concluded that flying high-performance military aircraft did not affect the rate of incontinence. Davis and Goodman [23] found that nine out of 420 nulliparous female soldiers entering the airborne infantry training programme developed severe incontinence. Hence, most women were not negatively affected by this high-impact activity. Hay [29] reported the maximum vertical ground reaction forces during different sport activities to be: three to four times bodyweight for running, five to 12 times for jumping, nine times for landing from front somersault, 14 times for landing after double-back somersault, 16 times during landing in long jumps, and nine times bodyweight in the lead foot in javelin throwing. Thus, one would anticipate that the pelvic floor of athletes needs to be much stronger than in the normal population to counteract these forces. To date, it has been concluded that there is no evidence that strenuous exercise causes SUI or pelvic organ prolapse. Although the prevalence is high, most athletes do not leak during strenuous activities and high increases in abdominal pressures. However, from a theoretical understanding of functional anatomy and biomechanics, it is likely that heavy lifting and strenuous activity may promote these conditions in women already at risk, e.g. those with benign hypermobility joint syndrome. Physical activity may unmask and exaggerate the condition. From the data available today, it is not possible to conclude whether high-impact activity itself can cause connective tissue or PFM damage. In a retrospective study of former female Olympians competing in either low- (swimming) or high-impact (gymnastics) activities, no difference in prevalence in urinary incontinence was seen after 20 years of cessation of the sport carrier [23]. It was concluded that participation in regular, strenuous, high-impact activities when younger did not predispose for significant urinary incontinence later in life. In a consensus statement from the first WHO Consultation on Incontinence [29], it was concluded that strenuous exercise is likely to unmask the condition in otherwise asymptomatic women. However, there is no evidence that strenuous exercise causes the condition of incontinence. Evidently, more basic research is needed to understand the function and role of the pelvic floor during strenuous physical activity. A higher prevalence of both SUI and urge symptoms was demonstrated in eating disordered athletes than healthy athletes. Hextall *et al.* [30] compared 30 women with anorexia nervosa (mean age, 26.5 ± 7.3) with 25 healthy age-matched controls, and found that 93% of the women with anorexia nervosa had one or more urinary symptom compared with 36% of the control group ($p = 0.01$). The prevalence of both SUI and urge incontinence was 41%.

The female lower urinary tract is a target site for sex steroids and sensitive to fluctuations in the level of circulating estrogen and progesterone. However, the association between low estrogen levels and prevalence and degree of SUI and urge incontinence is not clear. Nineteen percent of the athletes compared with 37 (9%) of non-athletes reported that they were using oral contraceptive pills to regulate their cycle. This may have influenced the results. More research is needed on hormonal status in this specific group of female athletes. Since there is a lack of longitudinal studies in this area, it is difficult to draw any conclusion on incidence, remission, and natural history. Remission of one-third of females with urinary incontinence has been reported in older women. However, whether this is because of, for example, medical care, reduction of participation in physical activity, or unreliable measurements is difficult to say. Urinary incontinence can be treated with PFM exercise with and without biofeedback, electrical stimulation, or surgery. Randomized controlled trials have demonstrated that PFM exercise is significantly more effective than no treatment and more effective than electrical stimulation. Miller *et al.* [31] demonstrated that simply teaching women to voluntarily contract before and during coughing significantly reduced the leakage after only one week of practice. Bø et al. [21] demonstrated that after specific strength training of the PFMs, 17 of 23 women had improved during jumping and running, and 15 during lifting. In addition, significant improvement was obtained while dancing, hiking, during general exercise classes, and in overall score on ability to participate in different activities. Measured by pad test with standardized bladder volume comprising running, jumping jacks, and sit-ups, there was a significant reduction in urine loss from a mean of 27 g (95% CI, 8.8–45.1) to 7.1 g (95% CI, 0.8–13.4) ($p = 0.01$). So far there are no randomized controlled trials assessing the effect of PFMT in female elite athletes. Elite athletes are motivated and used to regular training. Since most of these athletes are nulliparous, there are no ruptures of ligaments, fascias, and PFM fibers, or peripheral nerve damage caused by pregnancy and childbirth. One may therefore expect the strength training to be equally or even more effective than in parous women. PFM exercise is non-invasive, has no known side effects, and can be very cost-effective (especially when combining individual assessment and group training), and is suggested as the first treatment option. There is a need for randomized controlled trials to evaluate the effect of strength training of the PFMs in this group of women. Devices that involve external urinary collection, intravaginal support of bladder neck, and blockage of urinary leakage by occlusion at the external meatus or intraurethral occlusion are available, and can be recommended to be used during physical exertion.

Conclusion

The results of the present study indicate that almost 60% of volleyball players surveyed reported a problem of urinary incontinence. Therefore, urinary incontinence is a common symptom among athletes but still too underestimated. We need to give a greater awareness of the problem is that the athletes and athletic trainers and it is necessary to introduce the specific PFMT to prevent the onset of urinary incontinence among young athletes.

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