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Physical Activity and Stress Incontinence in Women

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Abstract

Purpose of Review—This review aims to discuss the current literature addressing associations between physical activity and stress urinary incontinence in women.

Recent Findings—Multiple cross-sectional studies utilize survey questionnaires to determine prevalence of stress urinary incontinence, impact of various types and intensities of physical activity on stress urinary incontinence, and explain differences in urinary symptoms among active women.

Summary—Although there is evidence for increased rates of stress incontinence among women who are physically active, pathophysiology is not fully understood and there is a need for additional research exploring changes to the pelvic floor during exercise. Future research focusing on the mechanism in which physical activity contributes to urinary symptoms can guide development of primary preventions for stress urinary incontinence.

Keywords

stress incontinence; physical activity; exercise; urine leakage; pelvic floor dysfunction; athletes

Introduction

Many women participate in recreational physical activity as part of their routine to maintain a healthy lifestyle. It is widely known that physical activity helps with blood pressure, weight loss, diabetes, and hypercholesterolemia. However, the role that physical activity has on bladder function is not well understood. Urinary symptoms are often associated with pelvic muscle dysfunction resulting from advanced age, obesity, and parity [1]. In addition to these known risk factors, many studies have reported higher rates of urinary incontinence in athletic women, raising concern for physical activity as a risk factor for urinary symptoms

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Compliance with Ethical Standards

Conflict of Interest
Leah Chisholm, Sophia Delpe, Tiffany Priest, and W. Stuart Reynolds declare that they have no conflict of interest.

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[2–6]. Because physical activity is a modifiable risk factor, understanding the relationship between urinary incontinence and physical activity could guide preventative measures to avoid or delay the development of stress urinary incontinence in physically active women. This review will discuss and summarize findings from evidence-based data over the last 5 years regarding the association between physical activity and stress urinary incontinence in females.

Prevalence of Stress Urinary Incontinence Among Athletic Females

Stress urinary incontinence (SUI) is the defined as a leakage of urine with physical exertion, most commonly from coughing, laughing, or sneezing [7]. Several studies have investigated the association between SUI with physical activity and exercise. Most studies designed to determine the prevalence of SUI among women with varying levels of physical activities were cross-sectional, survey based, and utilized validated questionnaires to assess urinary leakage and measure intensity and volume of physical activity. Among studies, it was consistent that prevalence rates of stress incontinence were higher among active females and were impacted by factors such as level of athleticism and parity.

The majority of the studies looked at young female athletes, at either the university or professional level, while women participating in recreational exercise were represented to a lesser extent. Variability was found in the reported prevalence of SUI in the studies reviewed. Studies limited to nulliparous women reported rates of SUI ranging from 14 – 48%, while studies inclusive of parous and nulliparous women reported a narrower range of 45.5 – 49.3%. The variance in rates may be explained by low sample sizes and the use of participant reported survey data from different questionnaires. While the International Consultation of Incontinence Questionnaire (ICIQ) was more commonly used to assess for presence of SUI [3, 8, 9], the Incontinence Symptom Severity Index (ISSI) [10, 11] and Urogenital Distress Inventory (UDI-6) [12] were also administered. Variance in prevalence persisted even with the addition of objective data to subjective questionnaire data. In a study quantifying urinary leakage in nulliparous athletes with pad testing, 48% of participants reported SUI while 28% had pad tests positive for urine leakage during a predetermined exercise training [8].

The severity of SUI was slightly higher among physically active women who also had a well-established risk factor for urinary leakage. Among 365 women who exercised at gyms or attended gym classes with at least one known risk factor for stress urinary incontinence (ex: parity, pelvic surgery, low back pain), the prevalence of SUI of slight to moderate severity was 49.3% [10]. Additionally, Yang et al reported that while almost half (47.9%) of both nulliparous and parous women participating in Cross Fit have urinary leakage during exercise, parous women more likely to have SUI outside of exercise as well [11]. Although many studies obtained demographic data, including body mass index (BMI), there was no reports on the relationship between SUI, obesity, and physical activity, as the majority of participants were within a normal BMI range.

When comparing athletes and non-athletes, athletic women had a higher prevalence of SUI and were more likely to have leakage during athletic activities [13]. There was a 3.49 odds ratio (OR) of reporting SUI among women of university sports teams compared to non-athletes [9]. A survey study of nulliparous women compared those who attend gyms (active women) and those who did not (inactive), and 24.6% of women in the active group reported SUI vs 14.3% in the inactive group [14]. Additionally, 5.7% of the active women reported urinary leakage during physical activity compared to 0.4% of inactive women [14]. Middlekauf et al performed a randomized control trial assessing nulliparous women participating in Cross Fit workouts for 6 months. After 6 months, 27% of women in the Cross Fit group reported SUI, while 8.5% in the control group reported SUI [15].

Altered Pelvic Floor in Response to Physical Activity

There are two main hypotheses governing the literature explaining how physical activity affects the pelvic floor muscles [13] and possibly contributes to stress urinary incontinence. The "hammock hypothesis" functions on the belief that physical activity weakens pelvic floor muscles due to the stretch of connective tissues from constant force [16, 17]. This hypothesis states that increased intrabdominal pressure stretches the ligaments and fascial tissues of pelvic floor muscles leading to permanent damage of the tissue [2, 18]. Increased intrabdominal pressure is thought to fatigue muscles of the pelvic floor as they balance forces. Therefore, when the downward force from the abdomen is not balanced by the upward force from the pelvic floor muscles, stress urinary continence can occur [11]. This is similar to the mechanism explaining how childbirth damages pelvic floor muscles, and therefore this process is often thought to be the cause of SUI among nulliparous females [2]. The hammock hypothesis suggests that urinary symptoms, such as SUI, occur when the increase in abdominal pressure exceeds the threshold of the urinary sphincter [19–21]. This hypothesis also supports beliefs that SUI is related to muscle fatigue, evidenced by more frequent leakage later in the day and with more exercises [11].

The second major hypothesis explaining how physical activity affects the pelvic floor suggests that rather than weakening pelvic floor muscles, physical activity improves the function of pelvic floor muscles [13]. With some physical activity there is "co-activation" of both abdominal muscles and pelvic floor muscles, and the continued contraction of pelvic floor muscles strengthens the muscles and helps prevent SUI [2, 13]. Changes suggestive of muscle strengthening have been demonstrated by studies measuring the pelvic floor in athletes, which have shown hypertrophy and increased thickness in levator ani muscles [1]. Conservative treatment for SUI involves physical therapy exercises aimed at strengthening the pelvic floor muscles in coordination with abdominal muscles, in order to help compress the urethra to prevent leakage [16, 22]. Further evidence that physical activity may be protective against SUI comes from randomized control trials investigating effect of co-activation [23, 24]. Tajiri and colleages randomized women with SUI to an exercise group that performed exercises simultaneously contacting both abdominal and pelvic muscles or a control group with no exercises, and found that after 8 weeks, 8 out of 9 women (88.9%) in the co-contraction group reported improvement in SUI, while women in the control group reported no change [24]. Ptak and colleagues also performed a randomized trial assessing quality of life among an abdominal and pelvic floor muscle co-contraction intervention group and a control group that only performed pelvic floor muscle contractions, and saw that co-contraction yielded improvement in quality of life scores by 58% among women with

SUI ($p<0.001$) [23]. Da Roza et al provided an explanation for the manifestation of SUI within the co-activation theory hypothesizing that SUI occurs in athletes from delayed contraction of pelvic floor muscles due to alterations in muscle fibers that occur secondary to excessive co-contraction with physical activity [25].

Given these competing hypotheses, the use of computer models can be helpful in understanding the pathophysiology of pelvic floor changes in response to physical activity. Dias et al developed a 3-D computer model of the pelvic floor using MRI images of healthy nulliparous females, observed changes during stimulated exercises, and found that urethral hypermobility was minor during jump landings [21]. They concluded that the pelvic floor is able to balance strong, but quick changes in intrabdominal pressure, and further emphasized the occurrence of SUI with prolonged pressure on urethral sphincters.

Dias et hypothesized that the urethral sphincter could be weakened by physical activity due to repetitive stretching of the pudendal nerve with rises in abdominal pressure [21], which previous studies have referred to has the “neural hypothesis” [16, 23]. Pudendal nerve damage is often thought to be an contributor to post-partum stress urinary incontinence [23]. It is believed that head of the fetus may put strain on nerves within the pelvis resulting in compression injury [23]. A similar strain may be placed on the pudendal nerve with physical activity, leading to de-innervation of the urethral sphincter and insufficient urethral closure [16, 21].

Intensity and Type of Sport as Risk Factor of SUI

Many studies have already identified that the risk of stress urinary incontinence is not associated with all types of physical activities. It is well understood that SUI is highly associated with high-impact sports rather than low-impact sports. Recent studies have also looked at the effect of the intensity of specific types of sports in relation to SUI using metabolic equivalents [9, 18, 26]. A metabolic equivalent (MET) is a measure of the energy expended during physical activity, and therefore is a marker of intensity. When comparing active women (defined as participating in greater than 3000 METs of physical activity) with inactive women (defined as participating in less than 600 METs of physical activity), a positive correlation was seen between intensity of physical activity and SUI [9]. This suggests that the risk of SUI increases with greater intensity of physical activity measured by METs.

A 2017 study of active women (participating in >3000 METs of physical activity) proposed that the cumulative total of METs did not affect prevalence of SUI, but sport type did [18]. This study compared ten different sports among 278 women, and found the highest prevalence of SUI was seen in women who participated in running and playing volleyball, while women participating in sports such as tennis, skating, and soccer had a 0% prevalence of SUI [18].The differences in prevalence were thought to be due of the frequent jumping and forceful landings involved in running and volleyball.

Other studies have looked at the effect of various types of exercises, and have seen that activities involving jumping, forceful landings, or use of combined abdominal and pelvic floor muscles increased severity of urine leakage [27]. Women with SUI that participate in Cross Fit reported increased severity of urine leakage with box jumps and jumping rope, particularly with “double-unders”, in which the rope passes under the feet twice during the jump, highlighting worsening of symptoms with sustained pelvic pressure [11]. A study of 55 Canadian women with urinary leakage during physical activity reported that exercises involving skipping, trampoline, jumping jacks, and running most commonly caused leakage, but burpees, squats, and sit-ups caused greater severity of leakage [27]. Even adolescent athletes endorsed that certain physical activities were more likely to cause SUI. Among high school girls of soccer, track, or field hockey teams who reported having SUI, 35% reported leakage with running, 36% reported leakage with heavy exertion, and 21% reported leakage with jumping [6].

In addition to intensity and type, volume of physical activity seems to also play a role in the development of stress urinary incontinence. A case control study looking at lifetime physical activity reported an increased risk of SUI with overall physical activity throughout the lifespan and an association with higher volume of strenuous activity during the teenage years and SUI later in life [26]. In fact, higher volume of leisure activity had an 0.55 odds ratio of SUI, suggesting leisure activity is protective against SUI [26]. The proposal that high levels of physical activity at an early age impacts SUI later in life was also seen in a study of nulliparous athletes, in which those with SUI had more years of training and started training at younger ages than those without SUI [8]. Furthermore, in study by Da Roza and colleagues, a positive correlation was seen between years and volume of training for trampolinists and frequency and severity of SUI episodes [25]. It appears that regardless of intensity of the activity, increased time participating in exercise per week is associated with increased frequency of SUI episodes [3, 5]. Notably, a 2014 study of elderly Latinos enrolled in a one year walking program was the first to show an increase in physical activity associated with lower rates of urine leakage [28], however this study did not specify type of urinary incontinence such as SUI.

Impact of SUI on Physical Activity

The Prevention of Lower Urinary Tract Symptoms (PLUS) Consortium defines bladder health as “a complete state of physical, mental and social well-being related to bladder function…that permits daily activities [including exercise], adapts to short- term physical or environmental stressors, and allows optimal well-being” [29]. Having a bladder storage dysfunction, such as urinary incontinence, has been shown to impact quality of life, yet few studies with in the last five years assessed the impact of SUI on lifestyle. Results of studies that measured the quality of life in physically active women with SUI were consistent with previous literature – stress urinary incontinence of even mild severity negatively impacts quality of life [3, 9]. It has also been shown that leakage of urine can also be a barrier to physical activity, which in turn can be detrimental to physical health and preclude the benefits of healthy behaviors, like exercising [30–32]. Although none of the women in the studies examined reported avoiding physical activity because of urine leakage, many active women with SUI adapted their routines to minimize leakage during physical activity [10, 27, 31]. Adaptations included voiding immediately before exercise, taking restroom breaks during workouts, limiting fluid intake, using pads, wearing dark pants, decreasing the intensity of physical activity, and changing the type of exercises performed [10, 27].

Other adaptive mechanisms include targeted therapy for the pelvic floor. Active women with SUI were interested in treatment, especially with physical therapy exercises directed at pelvic floor muscles [27]. A randomized control trial in Sweden investigated the efficacy of a phone app with guidance for pelvic floor training exercises and saw high levels of patient compliance to training exercises in addition to improvements in SUI symptoms and quality of life among the app users [33]. It should be noted that although there is interest in treatments, the social stigma around urinary incontinence continues to exist and many women are hesitant to accept their condition and seek therapies due to embarrassment [31]. One of the driving forces for seeking treatment is the negative effects on quality of life, which is why it is important to assess the impact SUI has on physical activity and other lifestyle components [31].

Prevention Strategies and Modifications to Current Management

The optimal strategy for balancing the risk of physical activity related stress urinary incontinence is the development of a preventative measures [34]. Although pelvic floor muscle training (PMFT) is a common treatment for SUI, there are few studies investigating the use of pelvic floor muscle exercises to prevent SUI outside of the peri-partum period [16, 35]. When managing SUI once it has developed, PFMT along with the Knack principle (the contraction of the pelvic floor muscles before an event of increased abdominal pressure) have been shown to reduce urine leakage within 3–5 months [16, 22, 36]. A major limitation in the success of pelvic floor physical therapy is the ability to perform exercises accurately, which is often limited by a variety of factors including activity level and flexibility [16]. Donovan et al proposed the need to perform pelvic muscle training in a variety of positions, including standing, supine and during movement in order to maximize the effect on the pelvic floor [32]. In addition to pelvic floor muscle training, training regimens that focus on strengthening core muscles and improving posture, such as yoga, may also be helpful due to the co-activation hypothesis [32].

Research on more invasive options, such as surgical management or nerve stimulation, for the improvement of physical activity related stress urinary incontinence is limited. Electrical stimulation of the pudendal nerve has been performed to augment the seal of the urethra and activate pelvic floor muscles in order to improve stress urinary incontinence. However the poor reliability of current evidence limits our ability to determine how effective this technique is for the improvement of SUI compared to placebo treatment or pelvic floor muscle training [16, 37].

Discussion

The relationship between physical activity and stress urinary incontinence is complex, and many aspects remain unknown. Current data suggests that stress urinary incontinence affects female athletes and active women at higher rates than more sedentary women. However, research exploring the association between SUI and physical activity is limited by small sample sizes, cross-sectional study designs, and self-reported questionnaires. There is a need for additional research to understand the pathophysiology of how physical activity leads to stress urinary incontinence with studies assessing pelvic muscle function during short interval physical activity as well as sustained physical activity [13]. The pathophysiology of physical activity related SUI is poorly understood, and there remains a disconnect between what is seen in laboratory models and observed clinically. For example, the MRI models by Dias and colleagues showed minor changes to urethral motility with jump landings, yet there is a higher prevalence of SUI among women participating in activities involving forceful landings [21, 18]. Additionally, there is limited data investigating the onset of SUI in relation to physical activity status and a lack of long-term data investigating changes in pelvic floor function with fluctuations in physical activity. Understanding the pathophysiology and onset of stress urinary incontinence in relation to physical activity could help guide therapies to prevent and cure stress urinary incontinence. Recent data suggests the need for increasing interventions and therapies that address and/or prevent SUI in athletes [13, 32, 23]. With pad test studies, urine leakage has been seen in young athletes who do not report having SUI on questionnaires, suggesting that athletes may be unaware of their condition [8]. It is important for providers to increase education of urinary symptoms and screen for SUI in those at risk for urinary leakage, such as active females [27]. Because physical activity has numerous health benefits, there is an increasing demand for professional trainers to design exercise routines to minimize urine leakage, and for physical therapists to explore modifications for stronger pelvic floor muscle training in athletes [13, 27]. Furthermore, the need for research assessing cure rates with objective measures [27], such as pad tests and urodynamic studies, in conjunction with self-reported subjective data is necessary to quantify the clinical significance of differences seen between active and inactive women, as well as the effectiveness of novel therapies.

Conclusion

This review analyzed 36 articles published between 2014 and 2019 that addressed associations between physical activity and stress urinary incontinence. With recent efforts to expand current data identifying risk factors affecting bladder health and urinary symptoms [38], this review emphasizes the importance of exploring physical activity as a modifiable risk factor. Physical activity appears to play a role in the development of stress urinary incontinence in active females of all ages. Future research directions should aim to increase understanding of the mechanisms in which physical activity contributes to the pelvic floor dysfunction and clinical symptoms, establish strategies for medical professionals to aid with the diagnosis of symptoms in at risk women, and evaluate interventions to prevent symptoms in athletic women.

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