Chapter 8

Exercise and pelvic floor dysfunction in female elite athletes

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Pelvic floor anatomy, function, and dysfunction

The pelvic floor muscles (PFM) forms the bottom of the pelvis and the floor of the abdominal cavity. They comprise a three-layer muscle plate with two mayor muscle groups: the pelvic and the urogenital diaphragm. The area surrounding the pelvic openings in women (the urethra, vagina, and the anus) bordering the medial layer of the muscles on both sides is named levator hiatus and is the largest hernia port in the body. The PFM is the only muscle group in the body capable of giving structural support for the pelvic organs, and during contraction, the pelvic openings are narrowed preventing leakage of urine, flatus, or stool. Correct contraction of the PFM has been described as a squeeze around the pelvic openings (a 25% narrowing of the levator hiatus area has been measured on ultrasound) and a forward/inward lift of the muscles (a lift of approximately 1 cm has been measured on ultrasound).

Unfortunately, some women are not able to contract the PFM correctly, and several studies from different countries have found that more than 30% of pregnant women, and women with pelvic floor dysfunction, may not be able to contract correctly at their first consultation. Common errors are to use gluteal hip adductors and abdominal muscles instead of the PFM, and one study found that 25% of women were straining instead of squeezing and lifting. Pushing down/straining might further weaken and stretch the PFM, and pushing is a risk factor for the development of pelvic organ prolapse. Proper teaching and assessment of ability to perform a correct contraction is therefore necessary before starting a PFM training (PFMT) program. Lack of an automatic, unconscious co-contraction or delayed or weak co-contraction of the PFM may lead to urinary incontinence, fecal incontinence, and pelvic organ prolapse (Bump and Norton, 1998).

Symptoms of pelvic floor dysfunction/ definitions

The symptom of urinary incontinence is defined as "complaint of involuntary loss of urine" with prevalence rates in the general population of women aged between 15 and 64 years varying between 32% and 64%. Most studies report prevalence rates between 25% and 45%. The most common symptom of female urinary incontinence is stress urinary incontinence which is defined as "complaint of involuntary loss of urine on effort or physical exertion or on sneezing and coughing." Urgency urinary incontinence is defined as "complaint of involuntary loss of urine associated with urgency" (typically leaking before reaching the toilet) and mixed urinary incontinence is a combination of stress and urgency incontinence. According to these definitions, it is easy to understand that stress urinary incontinence may unmask during physical activity.

The Female Athlete, First Edition. Edited by Margo L. Mountjoy.

Anal incontinence is defined as the involuntary loss of feces—solid or liquid (fecal incontinence) and involuntary loss of flatus. Anal and urinary incontinence often coexist, and prevalence rates of anal incontinence vary between 11% and 15% in the adult population.

Pelvic organ prolapse refers to loss of support for the uterus, bladder, colon, or rectum, leading to descent of one or more of these organs into the vagina. Pelvic organ prolapse quantification examination defines prolapse by measuring the descent of specific segments of the reproductive tract during valsalva strain relative to the hymen:

Stage 0: No prolapse is demonstrated.

Stage I: Most distal portion of the prolapse is more than 1 cm above the level of the hymen.

Stage II: Most distal portion of the prolapse is 1 cm or less proximal to or distal to the plane of the hymen.

Stage III: The most distal portion of the prolapse is more than 1 cm below the plane of the hymen.

Stage IV: Complete eversion of the total length of the lower genital tract is demonstrated. The prevalence of anatomic prolapse is about 30%, whereas sysmptomatic prolapse (a sensation of a mass bulging into the vagina) is ranging betweeen 5% and 10%.

Well-established etiological factors for pelvic floor dysfunction include pregnancy and vaginal childbirth (instrumental deliveries increase the risk), older age, obesity, and gynecological surgery. Other factors are less clear, such as strenuous work or exercise, constipation with straining on stool, chronic coughing, or other conditions that increase abdominal pressure chronically.

Pelvic floor and strenuous physical activity

There are two hypotheses about the pelvic floor and strenuous exercise, going in totally opposite directions.

Hypothesis one: female athletes have strong pelvic floor muscles

The rationale behind this hypothesis is that any physical activity that increases intra-abdominal pressure will lead to a simultaneous co-contraction or precontraction of the PFM, thereby giving a training stimulus to the muscles. Based on this assumption, general physical activity would prevent and treat stress urinary incontinence, but has also raised concern that elite athletes develop a stiff and rigid pelvic floor that may increase the risk of prolonged second stage of labor and lead to instrumental delivery. However, women leak during physical activity, and they report worse leakage during high-impact activities. To date, there is scant knowledge about elite athletes and delivery outcomes, but there is no strong evidence that elite athletes have more difficult childbirth than their sedentary counterparts. To the author's knowledge, no sport activities involve a direct voluntary contraction of the PFM, and it is unlikely that the athletes would be aware of the pelvic floor during activity. Furthermore, many women do not demonstrate an effective simultaneous or precontraction of the PFM during increased abdominal pressure, this being the reason for why they leak. In nulliparous women, stress urinary incontinence may be due to genetically weak connective tissue, location of the PFM at a lower, caudal position inside the pelvis, lower total number of muscle fibers (especially fast-twitch fibers), or untrained muscles in those leaking.

To date, there is little knowledge about PFM function in elite athletes. Our group 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 cmH_2O (SD 8.7) in the group with stress urinary incontinence and 14.3 cmH_2O (SD 8.2) in the continent group. However, this study was limited by its small sample size, and no strong conclusion can be drawn.

Hypothesis two: female athletes may overload, stretch, and weaken the pelvic floor

Heavy lifting and strenuous work have been listed as risk factors for the development of pelvic organ prolapse and stress urinary incontinence. It has been suggested that the cardinal and uterosacral ligaments, PFM, and the connective tissue of the perineum might be damaged chronically because of repeatedly increase in abdominal pressure due to hard manual work and chronic cough. To date, there are still few 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. However, the study did not control for parity. Hence, it is difficult to conclude whether heavy lifting is an etiological factor.

In the United States Air Force female crew, 26% of women capable of sustaining up to 9 G reported urinary incontinence. 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. Nine of 420 nulliparous female soldiers entering the airborne infantry training program developed severe incontinence. Hence, most women were not negatively affected by this high-impact activity.

The maximum vertical ground reaction forces during different sport activities have been reported to be 3–4 times body weight for running, 5–12 times for jumping, 9 times for landing from front somersault, 14 times for landing after double back somersault, 16 times during landing in long jumps, and 9 times body weight 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. Several studies have found that coughing and valsalva (as in defecation) increase intra-abdominal pressure to a significantly higher degree than different daily movements and exercises. Many exercises including abdominal exercise did not increase the intra-abdominal pressure more than rising up from a chair. In a recent study, PFM strength was compared in 10 handball, 10 volleyball, and 10 basketball players, as well as a nonexercising control group, and weaker muscles were found in the volleyball and basketball players compared with the controls. Lower strength correlated with increased symptoms of urinary incontinence.

Our group found that one bout of 90 minutes of strenuous exercise significantly reduced maximum voluntary contraction of the PFMs in nulliparous women with stress urinary incontinence with 17%. No change was seen in muscle endurance or vaginal resting pressure, and we do not know how long the reduced strength was present or whether this improved strength later on. In another study, 10 elite athletes were compared with 10 age-matched controls using MRI and found that there was no difference in the area of the levator hiatus, but there was a 20% higher cross-sectional area of the levator ani muscle in the athletes. The authors speculated whether this may give longer second stage of labor. In a follow-up study, they assessed 24 nulliparous elite athletes (with at least 5 years at national or international standard involving high-impact activity sports) and compared them with age- and body mass index (BMI)-matched controls. They confirmed the higher muscle diameter of the PFMs, but found larger levator hiatus area and more descent of the bladder in the athletes versus the controls during valsalva. There was no difference in hiatal area at rest or during PFM contraction. A larger levator hiatus area may facilitate normal vaginal birth and contradicts the first hypothesis. More research is needed in this important area of female elite athletes and the pelvic floor.

Although the prevalence of urinary incontinence is high, many athletes do not leak during strenuous activities and high increases in intra-abdominal pressure. 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 or a large levator hiatus area may be predisposed for pelvic floor dysfunction). Physical activity may unmask and exaggerate the condition. Two studies investigated former elite athletes 15–20 years after their sport career and did not find any difference in urinary incontinence between those who had participated in low- versus high-impact activities or between former athletes and controls, respectively. However, women experiencing urinary incontinence at an early stage were more likely to report urinary incontinence later in life. Hence, it is important to start prevention and early treatment of the condition. There is a need for further studies to understand the influence of different exercises and strenuous physical activity on the pelvic floor.

Prevalence of pelvic floor dysfunction in female elite athletes

Urinary incontinence

An overview of published studies on prevalence of urinary incontinence in elite athletes is shown in Table 8.1. There is a high prevalence of symptoms of both stress and urgency urinary incontinence in young nulliparous, as well as parous elite athletes. Two studies compared the prevalence of incontinence in elite athletes with that of age-matched controls. Equal prevalences of stress and urgency urinary incontinence were found in athletes and controls. However, the prevalence of leakage during physical activities was significantly higher in the elite athletes. One study found a significantly higher prevalence in elite athletes compared with both physically active and sedentary controls.

As seen from Table 8.1, the question on incontinence was posed in different ways (e.g., leakage during past week or last 6 months) and was not always well described. One research group also measured urinary leakage in the elite trampolinists who reported the leakage to be a problem during trampoline training. The leakage was verified in all participants with a mean leakage of 28 g (range 9–56) in a 15-minute test on the trampoline. PFM function was measured in a subgroup of 10 women. They were all classified as having strong voluntary contractions by vaginal palpation, pointing out that timing of the automatic response by the PFM has not been adequate. Urinary incontinence has been reported to occur more frequently during the learning phase of new movements and during the last part of the training sessions and competitions.

There is limited knowledge about associated factors with stress urinary incontinence in athletes. In a study of college athletes, no significant association between incontinence and amenorrhea, weight, hormonal therapy or duration of athletic activity was found. In a study of former Olympians, they found that among factors such as age, body mass index (BMI), parity, Olympic sport group, and incontinence during Olympic sport 20 years ago, only current BMI was significantly associated with regular stress or urgency urinary incontinence symptoms. One study reported that significantly more elite athletes with eating disorders had symptoms of both stress and urgency urinary incontinence, and one study found that incontinent trampolinists were significantly older (16 vs. 13 years), had been training longer and more frequently, and were less able to interrupt the urine flow stream by voluntarily contracting the PFM than the nonleaking group.

A high proportion of athletes report that the leakage is embarrassing, affects their sport performance, or is a social or hygienic problem. One study reported that even small quantities of urine loss caused embarrassment, and 84% of the athletes had never spoken to anyone about the condition. One can imagine that urinary incontinence is more of a problem in sports with focus on the individual and where leakage is visible, for example, esthetic sports. In some sports such as gymnastics, lack of focus and concentration during sport can be dangerous.

Anal incontinence

There is sparse knowledge about anal incontinence during physical activity. Anecdotally, both male and female athletes may pass wind and feces during heavy lifting. One recent study included female students, age 18–40, years from sport, physiotherapy, and nursing in southern France. They found a statistically significant higher prevalence of anal incontinence in those performing intensive sport, defined as training more than 8 hours per week compared with all other subjects (14.8% vs. 4.9%, respectively, $p = 0.001$). Anal incontinence was mainly represented by loss of flatus (84%). As for urinary incontinence, anal incontinence is probably more of a problem in sports where this can be seen or heard.

Table 8.1 Prevalence of urinary incontinence in female elite athletes

	Design	Population/sample	Response rate	Question	Results
Nygaard *et al.* 1994	Cross-sectional Postal survey	All women participating in competitive varsity athletics at a large state university in USA (n = 156) Mean age 19.9 years ± 3.3 (SD) Nulliparous	92%	Have you ever experienced unanticipated urinary leakage during participation in your sport, coughing, sneezing, heavy lifting, walking to the bathroom, sleeping, and upon hearing the sound of running water?	28% reported at least one episode of urinary incontinence while practicing or competing in their sport Gymnastics: 67% Tennis: 50% Basketball: 44% Field hockey: 32% Track: 26% Volleyball: 9% Swimming: 6% Softball: 6% Golf: 0% 42% experienced urine loss during daily activities 38% felt embarrassed
Nygaard 1997	Retrospective and cross-sectional Postal survey	Former American female Olympians (between 1960 and 1976) participating in gymnastics and track and field compared with swimmers (n = 207) Mean age: 44.3 years (range 30–63) Mean number of years since beginning training: 30	51.2%	Do you now/did you while being Olympian participant experience urinary leakage related to feeling of urgency, or related to activity, coughing, or sneezing	While Olympians: Swimming: 4.5% Gymnastics/track and field: 35.0% (p<0.005) Now: Swimming: 50% Gymnastics/track and field: 41% (ns)
Bø and Borgen (2001)	Cross-sectional, case–control Postal questionnaire	All female elite athletes on national team or recruiting squad in Norway (n = 660) and age-matched controls (n = 765) Age: 15–39 years Parity: 5% in elite athletes, 33% in controls	Athletes: 87% Controls: 75%	Do you currently leak urine during coughing, sneezing and laughter, physical activity (running and jumping, abrupt movements, and lifting) or with urge to void (problems in reaching the toilet without leaking)?	Stress urinary continence (SUI) Athletes: 41% Controls: 39% Range between sports: 37.5–52.2% Urge: Athletes: 16% Controls: 19% Range between sports: 10–27.5% Social/hygienic problem: Athletes: 15% Controls: 16.4% Moderate/severe problem: Athletes/controls: 5%

Thyssen *et al*. 2002	Cross-sectional Postal survey	Eight Danish sport clubs (including ballet) competing at national level (*n* = 397) Mean age: 22.8 years (range 14–51) 8.6% were parous	73.7%	Do you experience urine loss while participating in your sport or in daily life?	51.9% experienced urine loss during sport or in daily life. 43% while participating in their sport: Gymnastics: 56% Ballet: 43% Aerobics: 40% Badminton: 31% Volleyball: 30% Athletics: 25% Handball: 21% Basketball: 17%
Eliasson *et al*. 2002	Cross-sectional Postal survey Clinical assessment: pad test during trampoline training (*n* = 18), measurement of PFM strength (*n* = 10)	All 35 female Swedish trampolinists at national level between 1993 and 1996 Mean age 15 (range 12–22) Nulliparous	100% on survey 51.4% on pad test 28.6% on strength measurement	Do you leak urine during trampoline training/competition/daily life?	80% reported to leak urine during trampoline training/competition and sport None leaked during coughing, sneezing, or laughing 51.4% reported the leakage to be embarrassing Mean leakage on pad testing: 28 grams (range 9–56)
Caylet *et al.* 2006	Cross-sectional study comparing athletes and controls Postal survey	157 elite athletes at highest national level in Nimes, France, compared with random sample of 426 controls Age: 18–35 years Nulliparous	55.6% of athletes and 70% of controls	Do you leak urine during coughing, sneezing, laughing, sudden change in position, cold exposure, hand washing, loud noises, anxiety, or physical activity (first or second part of training or competition? Rating as slight or marked and frequency as daily, weekly, or monthly. Embarrassment on visual analog scale (VAS) scale	Athletes: 28% Physically active controls and sedentary controls: 9.8% Most reported only a few episodes per month. 8% several episodes per day
Vitton *et al*. 2011	Cross-sectional study Postal questionnaire comparing high-level sport (>8 hours per week) and nonintensive sport (all other groups) participants	393 of 750 eligible women age 18–40, from Sport University, School of Physiotherapy and School of Nursing in Marseille, France Nulliparous	52.4%	Did you have an accidental anal leakage of solid, liquid, mucus, or gas at least once in the last 6 months? If yes: type of protection worn, leakage composition, leakage duration, and frequency Did you have an accidental urinary leakage at least once during the last 6 months? If yes: type of protection worn, leakage duration, and frequency	Anal incontinence: 14.8% in intensive sport (IS) versus 4.9% in nonintensive sport (NIS) ($p<0.01$) Anal incontinence was mainly flatus: 84% Urinary incontinence: 33.1% versus 18.3% ($p<0.01$)

Pelvic organ prolapse

Although there are anecdotal reports of pelvic organ prolapse in young, nulliparous marathon runners and weight lifters, there are few studies on pelvic organ prolapse in exercising women. In a study comparing nulliparous women before and after 6 weeks of summer military training, it was found that women attending paratrooper training were significantly more likely to have stage II prolapse. They were also significantly more likely to have worsening in their pelvic support regardless of initial prolapse stage.

Prevention of pelvic floor dysfunction

There are no studies applying PFMT for primary prevention of urinary incontinence, anal incontinence, or pelvic organ prolapse in the general female population or in elite athletes. Theoretically, one could argue that strengthening the PFM by specific training would have the potential to prevent stress urinary incontinence, anal incontinence, and pelvic organ prolapse. Strength training of the PFM has shown to increase the thickness of the muscles, reduce muscle length, reduce the levator hiatus area, and lift the levator plate to a more cranial level inside the pelvis in women with pelvic organ prolapse. If the pelvic floor possesses a certain "stiffness," it is likely that the muscles could counteract the increases in intra-abdominal pressures occurring during physical exertion.

Preventive devices and absorbing products

Devices that involve external urinary collection, intravaginal support of the bladder neck, or blockage of urinary leakage by occlusion are available, and some have shown to be effective in preventing leakage during physical activity. A vaginal tampon can be such a simple device. In a Danish study, six women with SUI demonstrated total dryness when using a vaginal device during 30 minutes of aerobics. This was supported by a recent study in 34 Australian women. However, in the latter study, only 47% of the participants reported high acceptability for tampon use. For smaller leakage, specially designed protecting pads can be used during training and competition.

Treatment of pelvic floor dysfunction in elite athletes

Stress urinary incontinence

Stress urinary incontinence can be treated with bladder training, PFMT with or without resistance devices, vaginal cones or biofeedback, electrical stimulation, drug therapy, or surgery. One would assume that the elite athletes would respond in the same way to treatment as other women do. However, given the high impact on their pelvic floor, they may need stronger PFM than nonathletes. To date, there are methodological problems assessing PFM, bladder, and urethral function during physical activity.

Surgery

Elite athletes are mostly young and nulliparous, and it is therefore recommended that PFMT should be the first choice of treatment and is always tried before surgery. The leakage in athletes seems to be related to strenuous high-impact activity, and elite athletes do not seem to have more urinary incontinence than others later in life when the activity is reduced. Therefore, surgery seems inappropriate in young elite athletes.

Bladder training

Anecdotally, most elite athletes empty their bladder before practice and competition, which was also reported to be common in young nulliparous women attending gyms. Therefore, it is unlikely that any of them would exercise with a high bladder volume. However, as in the rest of the population, elite athletes may have a nonoptimal toilet behavior, and the use of frequency–volume chart and bladder training regimens may be an important first step to become aware of toilet habits and try to make them more optimal.

Estrogen

The role of estrogen in incidence, prevalence, and treatment of stress urinary incontinence is controversial. Two meta-analyses of the effect have concluded that there is no change in urine loss after estrogen replacement therapy. Estrogen given alone therefore does not seem to be an effective treatment for stress urinary incontinence. A higher prevalence of eating disorders has been found in athletes compared with nonathletes, and these athletes may be low in estrogen. Amenorrheic elite athletes would be on estrogen replacement therapy because of the risk of osteoporosis. Estrogen may have adverse effects such as a higher risk of coronary heart disease and some cancer forms.

Pelvic floor muscle training

Based on systematic reviews and meta-analysis of randomized controlled trials, it has been stated that conservative treatments with lifestyle interventions and PFMT should be first-line treatment for stress and mixed urinary incontinence. Cochrane reviews conclude that PFMT is an effective treatment for adult women and consistently better than no treatment or placebo treatments. Subjective cure and improvement rates after PFMT for stress urinary or mixed incontinence reported in randomized controlled trials to be up to 70%. Cure rates, defined as ≤2 g of leakage on pad tests, vary between 44 and 70% in stress urinary incontinence. Supervised training shows better results than unsupervised training. Adverse effects have only been reported in one study. One woman out of 54 reported pain with PFM contractions; three had an uncomfortable feeling during exercise; and two felt that they did not want to be continually occupied with the problem.

No randomized controlled trials on the effect of PFMT on urinary incontinence have been conducted in elite athletes. In one study, 39 female soldiers, mean age 28.5 years (SD 7.2), with exercise-induced urinary incontinence were randomized to PFMT with or without biofeedback. All improved subjectively and showed normal readings on urodynamic assessment after treatment. Only eight subjects desired further treatment after 8 weeks of training.

Two small case series on elite athletes and sport students have been published. One study reported total relief of reported symptoms and no leakage on pad testing after 3 months of a combination of electrical stimulation, PFMT with biofeedback, and vaginal cones. In another study it was reported that seven nulliparous sport students significantly improved PFM strength and reduced urinary incontinence score, frequency and amount of leakage after 8 weeks of training.

Elite athletes are accustomed to regular training and are highly motivated for exercise. Adding three sets of 8–12 close to maximum contractions, 3–4 times a week of the PFM to their regular strength-training program does not seem to be a big task. However, there is no reason to believe that they are more able than the general population to perform a correct PFM contraction. Therefore, thorough instruction and assessment of ability to contract is mandatory. Because most elite athletes are nulliparous, there are no ruptures of ligaments, fascias, muscle fibers, or peripheral nerve damage. One would expect that the effect would be equal or even better in this specific group of women. On the other hand, the impact and increase in abdominal pressure that has to be counteracted by the PFM in athletes performing high-impact activities is much higher than what is required in the sedentary population. The pelvic floor therefore probably needs to be much stronger in elite athletes.

There are two different theoretical rationales for the effect of PFMT. A voluntary contraction of the PFM before and during cough reduced leakage by 98 and 73% during a medium and deep cough, respectively. Kegel first described the PFMT method in 1948 as "tightening" of the pelvic floor. The rationale behind a strength-training regimen is to increase muscle tension and cross-sectional area and increase stiffness of connective tissue, thereby lifting the pelvic floor into a higher pelvic position and reduce the levator hiatus area. This effect has been verified in a randomized controlled trial.

It is unlikely that continent elite athletes or participants in fitness activities think about the

PFM or precontract them voluntarily. A contraction of the PFM most likely occurs automatically and simultaneously or even before the impact or abdominal pressure increase. It seems impossible to voluntarily precontract the PFM before and during every increase in abdominal pressure while participating in sport and leisure activities. The aim of the training program therefore would be to build up the PFM to a firm structural base where such contractions occur automatically.

Most likely, very few, if any, athletes have learned about the PFM, and one could assume that none have tried to train them systematically. The potential for improvement in function and strength is therefore huge. PFMT has proved to be effective when conducted intensively and with a close follow-up in the general population. It is a functional and physiological noninvasive treatment with no known serious adverse effects, and it is cost-effective compared with other treatment modalities. However, there is a need for high-quality randomized controlled trial (RCTs) to evaluate the effect of PFM strength training in female elite athletes.

Prevention and treatment of anal incontinence

There are no randomized controlled trials on the effect of surgical or conservative management of anal incontinence in the nulliparous population or in athletes. The results of PFMT in women with perineal tears after childbirth and in women with anal incontinence following childbirth are inconsistent and inconclusive. There is some evidence that women performing antenatal PFMT are less likely to have anal incontinence postpartum.

Prevention and treatment of pelvic organ prolapse

No randomized controlled trials, or studies using other designs, have been found to evaluate the effect of lifestyle interventions or PFMT on pelvic organ prolapse in primary prevention, that is, to stop prolapse from developing. To date, eight randomized controlled trials have evaluated the effect of PFMT to treat anatomical prolapse or symptoms. Typically, most randomized controlled trials compared PFMT plus lifestyle intervention, against lifestyle interventions alone. Lifestyle intervention included the use of precontraction of the PFM before and during increase in intra-abdominal pressure, "the Knack" and advice to avoid pushing down during defecation or general lifestyle advice. None have compared the effect of these lifestyle interventions with untreated controls, and there is no report of adherence to these protocols. Hence, the effect of lifestyle interventions on pelvic organ prolapse is still unknown. In one randomized controlled trial, there was no effect of advice to use the Knack on PFM morphology.

The results of the randomized controlled trials are all in favor of PFMT to be effective in treating pelvic organ prolapse, demonstrating statistically significant improvement in symptoms and/or prolapse stage. Typically, anatomical position of the prolapse is improved by one stage.

Conclusion

The prevalence of urinary incontinence and especially stress urinary incontinence among young, nulliparous elite athletes is high. The highest prevalence rates were found in those involved in high-impact activities such as trampolining, gymnastics, track and field, and ball games. Anal incontinence in the form of loss of flatus is also common. Both urinary and anal incontinence is perceived as embarrassing, and it may influence performance especially in sports where incontinence is visible or hearable. There is scant knowledge about the prevalence of pelvic organ prolapse in female athletes. There are no randomized controlled trials on the effect of prevention or treatment of incontinence or pelvic organ prolapse in female elite athletes. There is strong evidence that PFMT is effective in the treatment of stress and mixed urinary incontinence and pelvic organ prolapse in the general population, it has no adverse effects and is recommended as first-line treatment in the adult female population. There is a need for more basic research on PFM function during physical activity, exercise as an etiological factor for pelvic floor dysfunction, and the effect of PFMT in female elite athletes.

Recommendations for effective PFMT for elite athletes

- Be sure that correct contraction is performed before starting the program. This is best assessed by a trained women's health/pelvic floor physiotherapist.
- Self-test of correct PFM contraction can be done by trying to stop the dribbling at the end of voiding or placing one hand on the perineum. If performed correctly, the woman will feel the lift away from the hand.
- Use positions with legs apart to avoid too much co-contraction of other muscle groups.
- Perform 8–12 close to maximum contraction for 6–8 seconds, three sets per day.
- Make progression by contracting harder and increase the holding period without increasing the intra-abdominal pressure.
- Avoid straining on toilet.
- Precontract the PFM before and during coughing and sneezing.

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