DISSERTATION FROM THE
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Kristina Lindquist Skaug

Exercise and the Pelvic Floor

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Errata to the Thesis: «Exercise and the Pelvic Floor"

1. The questionnaires used in the randomized controlled trial to assess self-efficacy to pelvic floor muscle training and self-perceived change in symptoms of stress urinary incontinence is mentioned in the results section, but not previously in the methods section. This should be added in the method section under the heading "Questionnaire data":

"In the RCT (paper IV), we assessed the participants self-efficacy of PFMT at baseline by a reliable and valid self-efficacy scale (Self-Efficacy Scale for Practicing Pelvic Floor Exercises (SESPPFE)) (1), including 17 items. This was repeated after one month of PFMT. At 16 weeks all participants were asked to rate their perceived change of SUI. A validated 7-point Patient Global Impression of Improvement (PGI-I) scale with response choices ranging from "very much better" to "very much worse" was used (2)."

2. The figures for paper IV were not submitted in the thesis. See attached word-document for figure 1 and 2 for paper IV.

References:

1. Sacomori C, Cardoso FL, Porto IP, Negri NB. The development and psychometric evaluation of a self-efficacy scale for practicing pelvic floor exercises. Braz J Phys Ther. 2013;17(4):336-42.

2. Yalcin I, Bump RC. Validation of two global impression questionnaires for incontinence. Am J Obstet Gynecol. 2003;189(1):98-101.

Figure 1 Example of pressure curves of vaginal resting pressure, pelvic floor muscle strength (MVC 1-3), and muscular endurance. MVC; maximum voluntary contraction

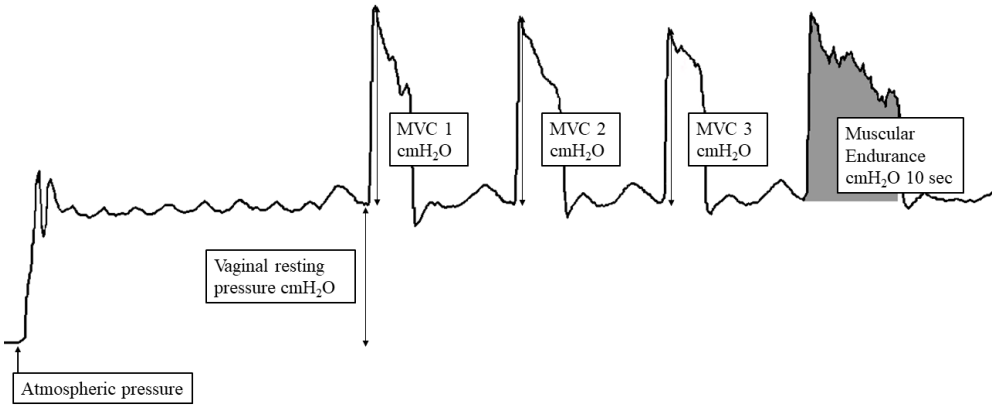
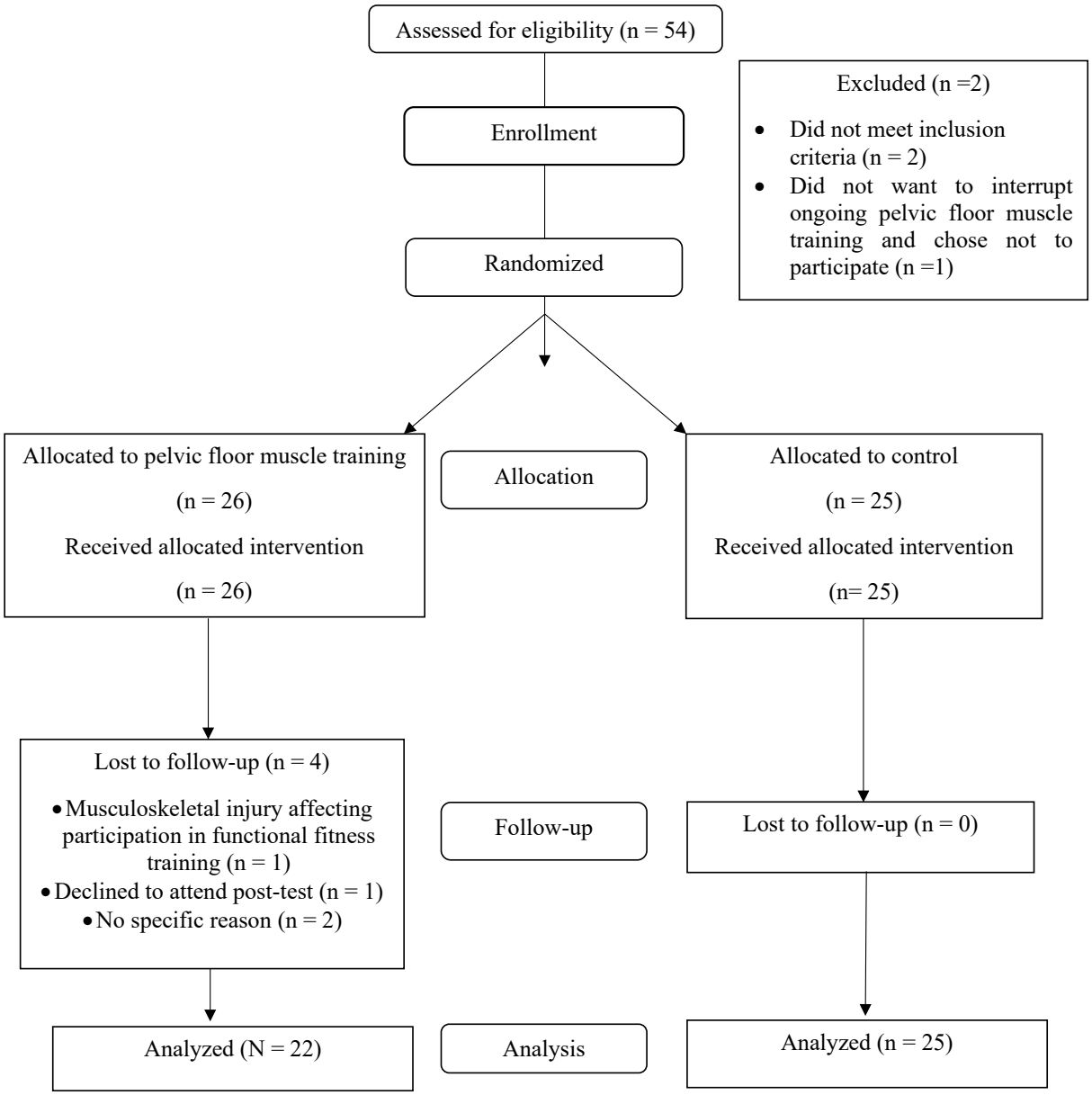


Figure 2 Flowchart of participants through each stage of the randomized controlled trial



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"Even the smallest person can change the course of the future"

J.R.R. Tolkien, Lord of the Rings

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Acknowledgements

The present dissertation was performed at the Department of Sports Medicine ("IIM"), Norwegian School of Sport Sciences, from August 2018 to September 2023. An African proverb says that "it takes a village to raise a child". I would say that this saying also may apply to this PhD. project. This dissertation is a result of a great teamwork, and I wish to express my sincere gratitude and appreciation to all the unique contributors.

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List of papers

This dissertation is based on the following original research papers, which are referred to in the text by their Roman numerals:

I. Skaug KL, Engh ME, Frawley H, Bo K. Urinary and anal incontinence among female gymnasts and cheerleaders-bother and associated factors. A cross-sectional study. Int Urogynecol J. 2021.

II. Skaug KL, Engh ME, Frawley H, Bo K. Prevalence of Pelvic Floor Dysfunction, Bother, and Risk Factors and Knowledge of the Pelvic Floor Muscles in Norwegian Male and Female Powerlifters and Olympic Weightlifters. J Strength Cond Res. 2022

III. Skaug, KL, Engh ME, Bo K. Acute Effect of Heavy Weightlifting on the Pelvic Floor Muscles in Strength-trained Women – An Experimental Crossover Study. In press in *Medicine & Science in Sports & Exercise*, September 6, 2023.

IV. Skaug, KL, Engh ME, Bo K. Pelvic Floor Muscle Training in Female CrossFit® and Functional Fitness Exercisers – An Assessor-blinded Randomized Controlled Trial. Under review in BJSM, September 6, 2023.

Abbreviations

1RM – One repetition maximum

AI – Anal incontinence

BMI – Body mass index

CI – Confidence interval

IAP – Intraabdominal pressure

ICC – Intraclass correlations coefficients

ICF – International Classification of Functioning, Disability and Health

ICI - International Consultation on Incontinence

ICIQ-B - International Consultation on Incontinence Questionnaire Bowel symptoms

ICIQ-UI-SF – International Consultation on Incontinence Questionnaire Urinary Incontinence Short Form

ICIQ-VS - International Consultation on Incontinence Questionnaire of Vaginal Symptoms

IOC – International Olympic Committee

MID – Minimum important difference

MRI – Magnetic resonance imaging

MVC – Maximum voluntary contraction

PFD – Pelvic floor disorders

PFM – Pelvic floor muscles

PFMT – Pelvic floor muscle training

POP – Pelvic organ prolapse

POP-Q – Pelvic organ prolapse quantification

PROMs – Patient-reported outcome measures

RCT – Randomized controlled trial

RIR – Repetitions in reserve

SD – Standard deviation

sEMG – surface electro myography

SUI – Stress urinary incontinence

UI – Urinary incontinence

Summary

Background: Exercise and strenuous work have been suggested, but not established, as possible risk factors for pelvic floor disorders (PFD) in women. Urinary incontinence (UI) has been shown to be highly prevalent in the female athletic population, especially in high-impact sports (such as trampolining, track and field and ball games). However, there is limited knowledge of extent and etiology of UI and other PFD in high-level gymnasts, cheerleaders and strength-athletes. Furthermore, there is a lack of knowledge of the impact of heavy weightlifting on the pelvic floor muscles (PFM) and effects of conservative treatments options for UI, such as PFM training (PFMT), in female strenuous exercisers.

Methods and aims: This doctorial project consist of four separate studies exploring various aspects of pelvic floor disorders in female athletes and exercisers. Study I was a survey of high-level female artistic gymnasts (N = 68), team gymnasts (N = 116) and cheerleaders (N = 135) exploring the extent, associated factors and bothers of UI and AI. Study II was a survey of high-level male (N = 204) and female (N = 180) Olympic weightlifters and powerlifters, exploring the extent, associated factors and bothers of UI, AI and pelvic organ prolapse (POP). Study III was an experimental crossover study where we assessed the acute effects of heavy weightlifting on the PFM's resting pressure, strength, endurance, and resting activity in 47 nulliparous, strength-trained women. Finally, study IV was an assessor-blinded randomized controlled trial evaluating the effects of PFMT on symptoms of UI in 47 strenuous female exercisers involved in CrossFit© and functional fitness.

Results and conclusion: In study I, the prevalence of UI and AI were 67% and 84%, respectively. The most common subtypes were stress UI (SUI, involuntary leakage of urine on physical effort), reported by 63% and involuntary loss of gas (81%). Age of 16 and 17, training ≥4 days/week, straining to void and type of sports (gymnastics vs. cheerleading) were significantly associated with SUI and years of training with AI. Eighty-three percent of athletes with SUI reported negative effect on sports performance. Forty-one percent had never heard about the PFM, but 74% reported an interest in PFMT to prevent/treat UI or AI. In study II, the prevalence of UI, AI and POP in females was 50%, 80% and 23% respectively. SUI was reported by 42% of the females and 88% of these reported negative influence on sport performance.

Prevalence of UI and AI in males were 9% and 62%. Involuntary loss of gas was the most common subtype of AI among both males and females. In females, increasing body mass index (BMI) was significantly associated with SUI and international level of competition and weightlifting ≥4 days/week with AI. In males, increasing age and frequently straining to void were significantly associated with AI. Twenty one percent of the females and 59% of the males had never heard about PFM and most of the females (78%) and half of the males reported an interest in PFMT to prevent/treat PFD. In study III, we found no significant differences in change of PFM resting pressure (mean difference: 0.7 cmH_2O, 95%CI: -0.8-2.2), strength (mean difference: -1.6 cmH_2O, 95%CI: -5.1–1.8), endurance (median difference after exercise: 6, IQR: -24.5-26.5 vs. rest: 13, IQR: -15-40.2, $p = 0.255$) or resting activity (mean difference: 0.3, 95%CI: -0.9-0.5) when comparing the immediate effect of heavy weightlifting with the effect of rest. In study IV, we found that CrossFit© and functional fitness exercisers performing 16 weeks of PFMT had significantly larger improvement in symptoms and bother of the total score compared to the control group with a mean difference of -1.4 (95% CI: -2.6 to -0.2) of total score of the International Consultation on Incontinence Urinary Incontinence Questionnaire Short Form (ICIQ-UI-SF). The proportion of women reporting self-perceived improvement of SUI symptoms after 16 weeks was significantly larger in the PFMT group compared to the control group (64% vs. 8%, $p < 0.001$, RR: 8.0, 95% CI 2.0 to 31.2). None in the PFMT group and one participant in the control group reported worsening of symptoms. There were no significant differences in change of PFM resting pressure, strength, or endurance between groups, with mean differences of 1.3 (95% CI: -1.4 to 4.0), 3.8 (95% CI: -0.8 to 8.4) and 39.28 (95% CI: -1.5 to 80.1) respectively. Changes in symptoms of AI and POP were similar in both groups after 16 weeks. The participants in the PFMT group did not improve their self-efficacy for PFMT or beliefs in expected results after 1 month of training.

Sammendrag (summary written in Norwegian)

Bakgrunn: Trening og fysisk, tungt arbeid er foreslått som risikofaktorer for bekkenbunnsplager blant kvinner. Urininkontinens (UI), og spesielt stressinkontinens (ufrivillig lekkasje av urin under fysisk anstrengelse), har vist seg å være svært vanlig blant kvinnelig idrettsutøvere. Spesielt høy forekomst har blitt rapportert i idretter som innebærer løp og hopp (som f.eks. trampoline, friidrett og ballsport). Det finnes lite kunnskap om forekomst og etiologi av UI og andre typer bekkenbunnsplager blant eliteutøvere innen akrobatiske idretter (turn og cheerleading) og styrkeidretter (vektløfting og styrkeløft). I tillegg er det usikkert hvilken effekt tunge løft/tung styrketrening har på bekkenbunnsmusklene og om bekkenbunnstrening kan bedre symptomer på stressinkontinens blant kvinner som driver med hard, fysisk trening.

Metode og formål: Dette doktorgradsprosjektet består av 4 separate studier som undersøker forskjellige aspekter ved bekkenbunnplager blant idrettsutøvere. Studie 1 var en spørreundersøkelse av kvinnelige turnere (N = 68), troppsgymnaster (N = 116) og cheerleadere (N = 135) som konkurrerte på høyt nasjonalt nivå, hvor vi undersøkte forekomst, assosierte faktorer og påvirkning av UI og analinkontinens (AI). Studie 2 var en spørreundersøkelse av mannlige (N = 204) og kvinnelige (N = 180) vektløftere og styrkeløftere på høyt nasjonalt nivå, hvor vi undersøkte forekomst, assosierte faktorer og påvirkning av UI, AI og underlivsprolaps. Studie 3 var en eksperimentell studie med crossover design hvor vi undersøkte akutt effekt av tung styrketrening på bekkenbunnsmusklenes hviletrykk, styrke, utholdenhet og hvileaktivitet. Studie 4 var en randomisert kontrollert studie hvor vi undersøkte effekt av bekkenbunnstrening på urininkontinens blant 47 kvinner som jevnlig trente CrossFit© og functional fitness.

Resultat og konklusjon: I studie I rapporterte 67% og 84% UI og AI. Det vanligste typene var stressinkontinens (63%) og ufrivillig lekkasje av luft (81%). Alder (16 og 17 år), trening ≥4 dager per uke, trykking/pressing ved vannlating og idrettstype (apparatturn og troppsgymnastikk vs. cheerleading) var signifikant assosiert med stressinkontinens, mens antall år med idrett var assosiert med AI. Åttitre prosent av utøverne rapporterte at urinlekkasje i forbindelse med idrett kunne påvirke idrettsprestasjon og -deltakelse negativt. Førtien prosent hadde aldri hørt om bekkenbunnsmusklene før, men 74% rapporterte at de var villig til å gjøre bekkenbunnstrening for å forebygge eller behandle bekkenbunnsplager. I studie II var forekomsten av UI, AI og

underlivsprolaps blant kvinnene 50%, 80% og 23%. Stressinkontinens var rapportert av 42% av kvinnene og 88% av disse rapporterte at lekkasje påvirke idrettsprestasjon og -deltakelse negativt. Blant menn, var forekomst av UI og AI 9% og 62%. Ufrivillige lekkasje av luft var den vanligste typen AI blant både menn og kvinner. Økning i BMI var den eneste faktoren som var assosiert med stressinkontinens blant kvinnene, mens internasjonalt konkurransenivå og vektløfting ≥4 dager i uken var signifikant assosiert med AI. Blant menn var økning i alder og hyppig pressing/trykking ved vannlatning signifikant assosiert med AI. Tjueen prosent av kvinnene og 59% av mennene hadde aldri hørt om bekkenbunnsmusklene tidligere. Majoriteten av kvinnene (78%) og halvparten av mennene rapporterte en interesse for å gjøre bekkenbunnstrening for å forebygge/behandle bekkenbunnsplager. I studie III, fant vi ingen signifikante forskjeller på endring av bekkenbunnsmusklenes hviletrykk (gjennomsnittsforskjell: 0.7 cmH_2O, 95%KI: -0.8-2.2), styrke (gjennomsnittsforskjell: -1.6 cmH_2O, 95%KI: -5.1–1.8), utholdenhet (medianforskjell: 6, IQR: -24.5-26.5 vs. rest: 13, IQR: -15-40.2, p = 0.255) eller hvileaktivitet (gjennomsnittsforskjell: 0.3, 95%KI: -0.9-0.5) når vi sammenlignet effekt av tung styrketrening med hvile (stillesitting). I studie IV fant vi at CrossFit© og functional fitness kvinnene som hadde gjort bekkenbunnstrening i 16 uker hadde signifikant større forbedring i symptomer på UI sammenlignet med kontrollgruppen. Vi fant en gjennomsnittsforskjell for endring av total-score av «the International Consultation on Incontinence Urinary Incontinence Questionnaire Short Form» (ICIQ-UI-SF) på -1.4 (95% KI: -2.6 to -0.2). Andelen kvinner som rapporterte forbedring av UI-symptomer var signifikant større i bekkenbunnstreningsgruppen vs. kontrollgruppen (64% vs. 8%, p > 0.001, RR: 8.0, 95% KI: 2.0-31.2). Ingen i bekkenbunnstreningsgruppen rapporte negative utfall fra treningsprogrammet. Det var ingen signifikante forskjeller mellom gruppene i endring av bekkenbunnsmusklenes hviletrykk, styrke eller utholdenhet. Endringer i symptomer på AI og underlivsprolaps var lik i begge gruppene og treningsgruppen endret ikke sin mestringstro til bekkenbunnstrening etter en måned av intervensjonsperioden.

Introduction

Historically, sports medicine research has predominantly focused on male athletes, leaving a large knowledge gap concerning the health of the female athlete (1). However, women's health in sports has gained more attention during the last decade. There is substantial evidence supporting high prevalence of urinary incontinence (UI) among female athletes and women engaging in strenuous exercise (2-5). Activities such as running, jumping and heavy lifting may lead to large increases in intraabdominal pressure (IAP), potentially straining the pelvic floor (2). The pelvic floor consists of muscles, fascia and ligaments located at the base of the abdomino-pelvic cavity. Its main functions include providing support to the pelvic organs and maintaining continence (6). If the muscles are not able to withstand the increases in the IAP during physical efforts, symptoms of pelvic floor disorders (PFD), such as urinary leakage, may occur (7). UI during sport and exercise can lead to embarrassment, frustration, negative effect on performance and further limit sports participation (8). The etiology of UI in athletes is to date not well-established. Research on risk factors is limited with conflicting results, but participation in high-impact sports and increased training volume may seem to increase the risk (2, 9). Although heavy lifting may produce extensive increases in IAP (10) with potential large loads on the pelvic floor, knowledge is lacking on PFD in strength athletes and how heavy lifting affects the pelvic floor.

To date, there is level 1 evidence, and grade A recommendation for pelvic floor muscle training (PFMT) as the first line treatment for UI and POP in the general female population(11, 12). However, evidence of the effect of PFMT in athletes or strenuous exercisers is sparse (13). Based on today's knowledge we do not know whether PFMT is effective in female strenuous exercisers and athletes exposed to excessive impact through running, jumping and heavy weightlifting. Given the high impact on the pelvic floor in these athletes, it is presumed that they need well-functioning pelvic floor muscles (PFM) to prevent PFD. Regular PFMT has shown to change pelvic floor morphology by increased muscle volume and stiffness, reduced opening of the levator hiatus and elevated resting position of the bladder and rectum (14). By improving the strength and PFM position in the pelvis, the PFM may respond better to large (and sudden) increases in IAP, and further prevent urinary leakage from happening (15).

Enhancing our understanding of the etiology and mechanisms of PFD in female athletes at risk is essential for establishing targeted and effective treatment/prevention strategies. From a broader public health perspective, increased knowledge of treatment options for PFD may encourage women to maintain their participation in exercise and stay active.

Theoretical framework

The theoretical framework for this thesis is primarily based on the available literature when we planned the study in August/September 2018. However, the Covid-19 pandemic led to large delays of our two final studies, and we had to change our original plan after the reopening of the society in 2020. Two totally new projects had to be developed and replace two of the originally planned studies (study III and IV). Therefore, more recent background information relevant for the two last papers is also presented in the theory section.

Women in sport and exercise

According to the International Olympic Committee (IOC) sport is "the most powerful platforms for promoting gender equality and empowering women and girls" (16). Sport and exercise are also important leisure activities that can contribute to achievement of the recommended levels of physical activity for children, adolescents and adults (17). The positive health benefits of regular physical activity are well-documented, and includes improved all-cause mortality, cardiovascular mortality and mental health, prevention of cardiovascular diseases, type-2 diabetes, breast and colon cancer, and delayed onset of dementia (17). Furthermore, girls and women who participate in sports are likely to have better grades at school, less unintended pregnancies, higher levels of confidence and self-esteem, lower levels of depression and overall better physical well-being (18). However, in a historical perspective sport has been a male-dominant domain. The common beliefs in the 1900s-centrury were that the female body was too fragile to cope with the stressors of vigorous activity. Participation in physical exertion was considered a threat to their reproductive capabilities (18). Female athletes took part in the Olympic Games for the first time in Paris in 1900 with only 22 women out of a total of 997 athletes (16). During the last century, female participation in sports has increased steadily and women have gained more access to participate in athletic events (18). The Olympics has grown to be the largest, gender equal sporting event in the world. In the 2020 Games in Tokyo, it was almost an equal number of women participating (48%) as men (16). A similar growth of exercising women has been seen in the fitness industry. In 2020, more than half of fitness gym-members in the United States of America were women (19).

With the exponential growth of women in sports, there has also been an increased attention and interest of female athlete health. Female athletes have specific biological, sociocultural and environmental considerations that may impact health outcomes in sports (20). However, sports medicine research has historically been favoring male athletes, leaving a large knowledge gap

concerning female athlete health (1). A recent systematic review revealed that 71% of 669 included sport medicine studies isolated male athletes, while only 9% isolated female athletes and 21% included a mix of female and male athletes (21). Recently, pelvic floor health has been suggested as one out of ten specific domains that should be addressed in female athlete injury (22). Pelvic floor related conditions can limit sport participation due to embarrassment or fear of incidents of i.e., involuntary leakage of urine, and may, in worst case, lead to cessation of sports. The other domains includes menstrual and gynecological health; preconception and assisted reproduction; pregnancy; postpartum; menopause; breast health; breast feeding, parenting and caregiving; mental health and sport environments (22).

The female pelvic floor

The pelvic floor consists of muscles, fascia and ligaments attached to the pelvic bones and forms a hammock-like support at the base of the abdomino-pelvic cavity. The functions of the pelvic floor are to provide support to the pelvic organs (the bladder, urethra, vagina, uterus and rectum) and to counteract all increases in IAP and ground reactions forces during daily activities. Additionally, the pelvic floor facilitates intercourse, vaginal birth, storage of stool and urine and voluntary defecation and urination (6).

The pelvic floor muscles (PFM)

The PFM comprise the urogenitial diaphragm (superficial layer) and pelvic diaphragm (deep layer with the largest muscle group; the levator ani) (Figure 1) (23). The levator ani muscles play an important role in protecting the pelvic connective tissues from excessive load (24). It is a broad and thin muscle, originating from each side of the pelvic wall from the posterior aspect of the pubic bone. It courses medially and inferiorly and attaches to the superior surface of the perineal membrane and is joined together in the midline (posterior to the vagina in women and around the anal aperture) (25). A voluntary contraction of the PFM is described as an inward lift and squeeze around the urethra, vagina and rectum (24). The mean inward lift during a voluntary contraction of the PFM has been shown to be 10.8 (SD: 6.0) mm on magnetic resonance imaging (MRI) in 16 women with and without UI (26). The muscles are innervated from S2-4 and have been measured to have a thickness of approximately 1 cm (27, 28). It is divided in three different parts based on the site of origin and relationship to viscera in the midline: the pubococcygeus, the puborectalis and the iliococcygeus (25). The levator ani fascia covers the superior and inferior sides of the levator ani muscles by connective tissue, and these combined structures make up the pelvic diaphragm (24). The interaction between the pelvic floor ligaments, fascia and muscles is

critical to the pelvic organ support. Constant action of the PFM (except during voiding and defecation) helps to carry the weight of the abdominal and pelvic organs and prevents constant straining of the pelvic connective tissue (24). This constant contraction also eliminates any opening of the levator hiatus. The levator hiatus an opening in the pelvic floor surrounding the urethra, vagina and rectum in females (29). During increases in IAP there is an automatic additional pre/co-contraction of the PFM. Together with the connective tissues from ligaments and fascia, the muscles act to decelerate the downward movement of the pelvic organs and decrease the opening of the levator hiatus (24, 27).

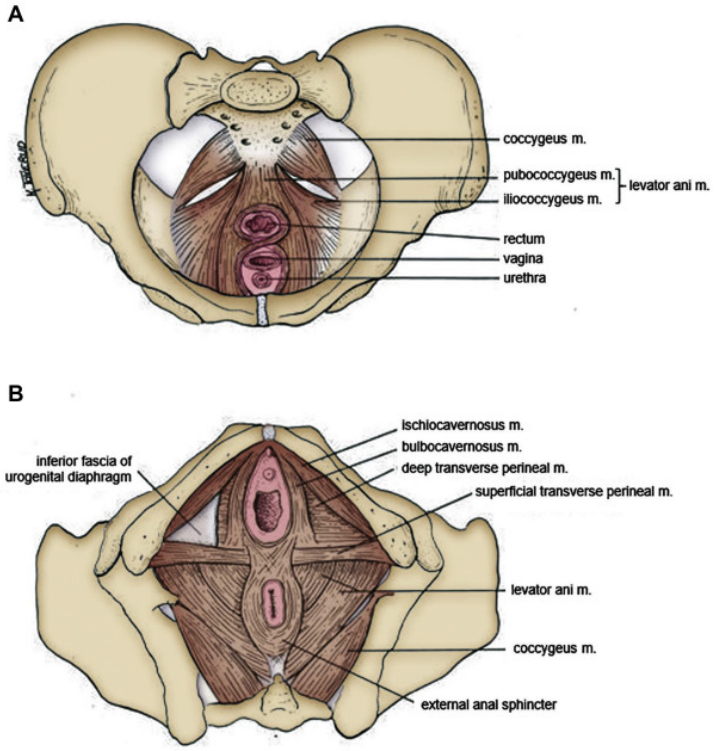

Figure 1. *Anatomy of the pelvic floor muscles in women.* ***A****. Superior view of the pelvic floor in the transverse plane, with pubic symphysis at the bottom.* ***B****. Inferior view of the pelvic floor in the transverse plane, with pubic symphysis at the top. © 2020 Australian Physiotherapy Association.*

From: Bo K. Physiotherapy management of urinary incontinence in females. J Physiother. 2020;66(3):147-54.

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Female pelvic floor disorders

Non-optimal function of the pelvic floor connective tissue, muscles, or failure of the interaction between the two components, may cause PFD (24). PFD comprises a variety of conditions including UI and AI, POP, sensory and emptying abnormalities of the lower urinary tract, defecatory dysfunction, sexual dysfunction, and chronic pelvic pain syndromes (30). UI is the most common PFD in women and is defined as "the complaint of involuntary loss of urine". The prevalence rates reported in general population studies are about twice as high in women compared to men and varies between 25-45% (31). In women, stress UI (SUI) accounts for approximately half of all incontinence types and is the most common subtype, followed by urgency UI and mixed UI. SUI is defined as "the complaint of involuntary loss of urine on effort or physical exertion (e.g. sporting activities), or on sneezing or coughing". The term "activity-related incontinence" is sometimes used in the literature to avoid confusion with psychological stress. Urgency UI is defined as the "complaint of involuntary loss of urine associated with urgency" and mixed UI as the "complaint of involuntary loss of urine associated with urgency" (32). SUI is uncommon in men, except after prostatectomy (33). The etiology of UI remains unclear, due to inconsistencies in results from epidemiological studies and lack of longitudinal clinical studies to assess causal risk factors (31). Well-established risk factors include obesity, pregnancy and childbirth, while increasing age, hysterectomy and different comorbidities (e.g. diabetes, urinal tract infections and dementia) seem to be associated with UI (31). In addition, symptoms of UI at a young age, both before and during pregnancy, has shown to be a risk factor for later development and more severe UI (33, 34). POP in women may be presented as anatomical signs and/or symptoms. The anatomical definition of POP is "the descent of one or more of the anterior vaginal wall, posterior vaginal wall, the uterus (cervix) or the apex of the vagina (vaginal vault or cuff scar after hysterectomy)"(35). According to the standardized POP quantification (POP-Q) system (35), the degree of POP can be divided in four stages:

Stage 0: "No prolapse is demonstrated."

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

Stage II: "The most distal portion of the prolapse is situated between 1 cm above the hymen and 1cm below the hymen."

Stage III: "The most distal portion of the prolapse is more than 1cm beyond the plane of the hymen but everted at least 2cm less than the total vaginal length."

Stage IV: "Complete eversion or eversion at least within 2 cm of the total length of the lower genital tract is demonstrated." (35)

The presence of anatomical signs of POP should always be correlated to relevant symptoms of POP. Common symptoms are vaginal bulging ("the complaint of a "bulge" or "something coming down" towards or through the vaginal introitus") and sensations of pelvic pressure ("complaint of increased heaviness or dragging in the suprapubic area and/or pelvis"). The symptoms may be more prominent after exercise, long periods of standing, or at times of abdominal straining, e.g., defecation (35).

Prevalence rates of symptomatic POP range between 5-10% in the general female population. Childbirth is associated with increased risk of POP later in life and the risk increases with the number of childbirths. Other factors shown to be associated with POP are obstructive defecation, hysterectomy, somatic diseases and conditions (e.g., joint hypermobility, obesity) and increased age, but since most results are from cross-sectional studies the cause-effect relationship is underdetermined (31). AI is defined as involuntary loss of feces or flatus (gas) (25). Based on prevalence rates reported in various population-based studies, the occurrence of AI symptoms appears to be similar in both men and women. AI can be present in all age groups, but the prevalence increases with age (from 1.5% in children to >50% in nursing home residents) and with birth injuries, such as third- and fourth-degree perineal tears (33). PFD has been shown to have negative affect on quality of life (QoL) and may lead to withdrawal from social activities, especially exercise and physical activity (36-38).

Assessment of pelvic floor disorders and the pelvic floor muscles in females

The use of The International Classification of Functioning, Disability and Health (ICF) has been encouraged by the World Health Organization (WHO) since 2001 (39). The ICF is a theoretical framework with the purpose to establish a common language for describing health/disease-related states. The ICF is divided in two parts. Part 1 covers functioning and disability, including the physiological functions of the body function and anatomical parts of the body structures, activity (execution of a task or action), and participation (involvement in a life situation). While part 2 includes contextual factors (participation restrictions and environmental factors) (39). In assessments of the PFD and the PFM, symptoms of the PFD can be as a classified as disability (e.g. involuntary leakage of urine), while the non-functioning PFM can be classified as the pathophysiological component (40). In clinical practice of prevention and treatment of PFD it is

recommended to cover all components of the ICF (40). However, in the following section the focus will be on assessment of self-reported symptoms and clinical assessments of the PFM.

Patient-reported outcome measures (PROMs)

A patient-reported outcome can be defined as "any report of a patient's health condition that comes directly from the patient, without interpretation of the patient's response by a clinician or anyone else". PROMs are tools or questionnaires that can be used to collect the data of either generic (outcomes of a broad range of populations) or condition-specific measures (41).

If proven valid and reliable, short, and easy to use, PROMs can be the most suitable method to assess the patient's perspective of PFD. To date, many currently available questionnaires assess patient-reported outcomes of related to UI, POP and AI (41).

The International Consultation on Incontinence (ICI) Questionnaires have been developed to assess patient-reported outcomes of different pelvic floor conditions. The modules designed to specifically evaluate symptoms of UI, POP and AI have Grade A recommendations by the ICI, meaning that they have been found valid, reliable, and responsive to change following standard psychometric testing (41).

The ICI Questionnaire-UI-Short Form (ICIQ-UI-SF) is a short and simple 4-item tool used to assess frequency, severity, and impact of UI. The fourth item is a self-diagnostic item of different types of UI. The ICI Questionnaire of Vaginal Symptoms (ICIQ-VS) consist of 14 items and evaluates vaginal symptoms, including symptoms of POP (lump coming down in or out of the vagina), associated sexual matters and impact of quality of life. The ICI questionnaire of bowel symptoms (ICIQ-B) is a 20-item questionnaire evaluating symptoms of AI. The questionnaire is divided into three domains: bowel patterns, bowel control (control of wind/flatus, loose or solid stool) and impact of AI on quality of life (42).

Assessments of the PFM

Assessments of the PFM have been proposed to be subsumed into 6 ICF-terms: tone, involuntary movement reaction, control, coordination, strength, and endurance (43). However, the PFM terms relevant for the following sections of the thesis will be described, including assessments of PFM tone, strength and endurance.

Assessments of PFM tone includes functions related to tension present in resting muscles and resistance offered when trying to move muscles passively (43). Muscle tone is a complex phenomenon that can be influenced by alterations in active (neural drive) or passive components (e.g. physical properties of muscle and connective tissue) (44). It is a dynamic condition modulated by various outputs (such as the spinal cord, cortex, stretch reflexes, pain and emotions) and exist on a spectrum, from hypotonicity (low tone) to hypertonicity (high tone/overactivity) (44). Interpretations of measures of PFD muscle tone can be challenging since no normative values have been established (45). PFM strength is related to the muscles ability to the generate force (43), and is commonly assessed during the performance of a maximum voluntary contraction (MVC) (44). A MVC is defined as the attempt to recruit as many fibers in as muscle as possible with the purpose of developing force (46). Muscular endurance refers to the ability to either perform repeated near maximal or maximal contraction force or to maintain a maximal or near maximal contraction for a predetermined period (44). There are several measurements methods available to assess these PFM parameters: visual observation, palpation, vaginal pressure measurements (manometry), dynamometry, electromyography (surface electromyography (sEMG), wire and concentric needle) and imaging (ultrasound and magnetic resonance imaging (MRI)) are some of the most common tools in clinical practice and research (44).

Visual observation and palpation

Visual observation and palpation are low-cost methods and easy to conduct (40). During visual observation the patient/participants perineum is observed under different PFM states (at rest, contraction, and with raised IAP e.g., coughing). Visual observation is suited to give the assessor a first impression of ability to contract the PFM and should be conducted prior of palpation (40, 44). An observation of a perineal elevation (inward/ventrocephalad movement of the vulva, perineum and anus) during voluntary PFM contraction is considered as a normal finding (44). The contraction may further be rated as absent, uncertain or as a perineal descent. A previous study from Slieker-ten Hove, Pool-Goudzwaard (47) demonstrated 100% intra-and inter-observer agreement regarding visible inward movement during a PFM contraction. Palpation allows the assessor to feel the texture, size, consistency, and location of the PFM with the finger(s) or fingertips (44). Vaginal palpation can be used to assess the ability to perform a correct PFM contraction (felt as a tightening, lifting, and squeezing action under the examining finger (44)), PFM strength during an MVC, and other characteristics of the PFM such as resting tone/stiffness, the ability to relax after a contraction, the coordination, speed and quality of the contraction, and presence of PFM injuries/avulsions (44). However, due to the subjectivity in

interpreting findings from palpation, many of these characteristics are more accurately assessed using quantifiable measurement instruments with better responsiveness, reliability, and validity (44, 48). Previous research on vaginal palpation have demonstrated limited ability to discriminate between high, moderate or high PFM stiffness (49) and to grade of PFM strength (50). Therefore, vaginal palpation is considered a suitable method for assessing and teaching a correct PFM contraction, rather than evaluating PFM strength and stiffness (muscle tone).

Intra-vaginal manometry

Intra-vaginal manometry is measurements of vaginal resting pressure or pressure rise generated during contraction of the PFM using a manometer connected to a pressure sensor, which is inserted into the vagina (44). Manometry is the most common method to measure PFM strength and endurance (40), traditionally measured in mmHg, cmH_2O or hPa (44). Resting pressure is defined as the vaginal pressure recorded at rest. The resting pressure may be interpreted as a measure of the summative contribution of passive and active components of PFM tone, but it is important to be aware that the measurement is not limited to the pressure originated from the PFM. E.g., IAP, vaginal tissue scaring, rectal contents may influence the resting pressure. In a study of 18 women with and without SUI, there was a significant rise in resting pressure measured in standing position compared to supine position, with a mean difference of 8.6 cmH_2O (51). The position of the participant/patient during measurements should therefore be standardized.

PFM strength is defined as the peak pressure during a PFM MVC, while PFM endurance can be measured as the duration of a sustained contraction (the length of time in seconds) or as the area under the curve multiplied by the predefined time of the contraction (e.g., 10 seconds) (44, 52). Measurements during PFM contractions can potentially be influenced increases in IAP. Currently, the available pressure sensors are unable to differentiate and confirm whether the measured pressure originates from the PFM or the IAP (44). However, valid measurement can be ensured by a simultaneous inward movement of the perineum or the instrument, while measurements with downward movement can be interpreted as erroneous due to straining by increases in IAP (40, 44). To further ensure the validity of the measurements, the participant's/patient's ability to perform a correct PFM contraction should be confirmed by vaginal palpation prior of the measurements and simultaneous observation of inward movement of the perineum/probe during measurement with the manometer (53). Measurements of PFM contractions with simultaneous use of hip muscles, increased IAP by e.g., Valsalva maneuver, or with movement of the pelvis should be ignored (44). Pressure measurements are usually easier to

perform and standardize in lying positions, but in scientific research the position can also be considered according to the research questions (40). There are several manometry instruments available (44). The Camtech AS apparatus and the Peritron are commonly used in research. Both devices are shown to be reliable and valid in measurements of the PFM muscles, but due to differences in measurement properties (e.g., size of the probe) comparisons of results across studies is not recommended (54).

Intra-vaginal PFM dynamometry

Intra-vaginal PFM dynamometry involves measurements of active (contractile) and passive (non-contractile) PFM forces using strain gauges mounted on a speculum inserted into the vagina (44). Various PFM dynamometers have been developed, differing in size, shape, force-vector recordings (antero-posterior, latero-lateral or multidirectional) and device specifications (44, 48). The antero-posterior direction is commonly used to measure active or maximal PFM force (strength), while latero-lateral measurements are used to evaluate the elastic properties of the muscles. Intra-vaginal dynamometers can be either fixed or dynamic (48). Elastometry is type of vaginal dynamometry used to assess the passive forces during dynamic stretches (44). The resistance to deformation in the PFM is defined as the ratio of change in the passive resistance or passive force to the ratio of length displacement (Newton/mm). Higher N/mm values indicates stiffer muscles, which is considered to contribute to overall measurements of muscle tone (55). PFM strength is measured during a MVC and registered as the peak force generated in Newton, while endurance is measured by a sustained PFM contraction. Dynamometers can be divided into two different types: clinical dynamometers meant for research settings and personal industry-developed dynamometers, meant to be used by patients at home (48). In a recent review of available intra-vaginal dynamometers, reliability was assessed in 13 out of 20 clinical dynamometers, showing overall moderate to strong repeatability of the measurements. for hand-held dynamometers the repeatability of measures may be influenced by the assessors' skills and experience (48). Validity studies were conducted for six of the clinical dynamometers, confirming pelvic floor dynamometry as a valid measurement tool of both passive and contractile properties. However, few studies had evaluated how much the active force during av PFM contraction was influenced by other forces, such as increases in IAP. Due to the heterogeneity of existing dynamometers, comparisons of measures from different dynamometers can be challenging and normative data of PFM measures is not yet established. Further research is needed to develop standardized assessment procedures with low risk of assessment bias (48). Finally, clinical

dynamometers are not commercially available (40), and may therefore not be as accessible for researchers compared to manometry or sEMG.

Surface electromyography (sEMG)

sEMG is the recording of electrical potentials generated by depolarization of muscle fiber membranes, recorded by surface electrodes placed on the skin or mucosa close to the muscles of interest. When assessing the PFM by sEMG, electrodes may be placed on the skin of the perineum or inside the urethra, vagina, or rectum (44). Baseline muscle activity (resting activity) is recorded as the microvolts generated by activated motor units in the PFM at rest. EMG measures the active component of muscle tone, which is constantly subject to ongoing variations by the neural drive. When combined with other measurements methods of active and passive muscle tone, such as dynamometry, the EMG may enable to differentiate the neural contributions of muscle tone from the passive non-contractile component (44). sEMG can be used to measure the peak amplitude during a PFM MVC, recorded in microvolts. However, the amplitude reflects muscle activation related to recruitment of motor units and increased firing rate, rather than muscle force/strength. sEMG using intravaginal probes is widely used in PFM measurements of women (44). The method has shown good reliability for assessing PFM activity (56, 57). However, the validity of such measurements should be questioned due to the possibility of the presence of EMG signals origination from a neighboring muscle rather than the investigated muscle. This phenomen is called crosstalks and should be considered in the standardization of the PFM sEMG measurements (58). It is likely that measurements during movements involving nearby muscles (e.g., internal and external hip rotators, abdominal, gluteal and hip adductors), such as running and resistance training, may be largely influenced by crosstalks, and such measures should be questioned.

Imaging

Imaging of the pelvic floor can be conducted by use of ultrasound imaging or MRI (44). Ultrasound imaging can provide accurate measures PFM morphology and function and can be measured with transabdominal, trans-perineal, trans-vaginal or trans-anal placement of the tranducer. In two-dimentional (2D) the transducer sends and receive ultrasound waves in one anatomical plane, while 3D/4D ultrasound creates volume data from multiple 2D images from a variety of angles. Three-dimentional ultrasound produces a single 3D-image, while 4D ultrasound

enables real-time visualization of 3D-images (44). This technique has been proven to have very good interobserver reliability in measurements of position and dimensions of the pubovisceral muscle and the levator hiatus at rest and during PFM contractions, with intraclass correlations coefficients (ICCs) varying from 0.61-0.96 (28). It is important to be aware that ultrasound imaging of the PFM provides images of movement and morphologic measurements of the muscles and does not directly measure muscle tone or strength (44). However, increased levator ani muscle thickness has been observed after 6 months of strength training of the PFM (14). Further, the cross-sectional area of the levator ani muscles, and size of levator hiatus may be indirectly related to PFM strength and endurance (59). Smaller levator hiatus has been shown to have a moderate association with higher vaginal resting pressure measured by manometry (59).

Dynamic pelvic floor MRI allows for detailed anatomical and functional evaluations of the pelvic floor. MRI is suited to accurately measure levator ani defects and its position in the pelvis (normal, elevated, or descended), levator hiatus area and POP and associated pelvic floor compartment defects (40, 44). However, MRI is not commonly available in clinical practice, and referral to MRI is recommended if there are clear indications of use to diagnose functional and anatomical defects (60). If available, MRI can be a useful tool in research to investigate functional and morphological parameters (e.g. cross-sectional area) of the PFM (61) and development of biomechanical models of the pelvic floor (62).

Exercise and the pelvic floor

Exercise and strenuous work have been suggested as possible risk factors for UI and other PFD. However, results from observational studies report conflicting results regarding the associations between physical activity and UI. While some large epidemiological studies report protective effect of physical activity (walking) on UI, others report high prevalence and increased risk of UI among female athletes and regular exercisers (31). Furthermore, cross-sectional studies of physical activity and UI in the general female population can be challenging to interpret, since it is plausible that the results is biased by women who may have stopped exercising because of urinary leakage (63).

In 2004, Bø (64) proposed to opposite hypothesis regarding the effect of exercise on the pelvic floor:

1. General exercise training strengthens the PFM

   Increases in IAP during exercise may lead to simultaneous co-contraction of the PFM This could potentially lead to an indirect training effect and strengthening of the PFM, which further can prevent PFD.

2. General exercise training overloads, stretches and weakens the pelvic floor

   Repeated increases the IAP due to strenuous physical activity could stretch and damage the PFM and the connective tissue if the PFM are fatigued or not able to co-contract quickly or strongly enough to counteract the increased downward pressure. Thus, overload of the PFM and the connective tissue may increase the risk of PFD.

Prevalence of PFD in athletes

When planning the PhD project in 2018, there were already substantial evidence to support that UI, and especially SUI, is highly common among female athletes and exercisers (3-5, 64, 65). Depending on the type of sport, the previously reported prevalence rates vary from 0% in golf to 80% in trampolining (3, 5, 63). Especially high prevalence have been reported in high-impact sports involving running and jumping activities (such as gymnastics, track and field and ball

games) compared to low impact activities (e.g. swimming, cycling and Pilates) with pooled prevalence of 58.1% in high-impact vs. 12.6% in low-impact sports (3). Results from a meta-analysis it revealed that female athletes/exercising women may have three times the risk of experiencing UI compared to non-exercising controls (4). Among the studies published prior of the planning of this project, especially high prevalence were reported in studies of female athletes in acrobatic sports: 68-80% in trampolining (66-68) and 56-67% in artistic gymnastics (69, 70). These athletes are often young, normal-weight and nulliparous, suggesting that the exposure of high-impact activities may have put them at risk rather than the previously mentioned risk factors in the general female population. However, the studies in female gymnasts were conducted >10 years ago and did not cover other PFD than UI. Also, no studies were found in female cheerleaders, who assumably have similar risk of UI due to the characteristics of the sport, involving acrobatic and gymnastic elements.

Few studies existed of other PFD, such as POP and AI. In an internet-survey of 311 female triathletes, POP was reported by 5% and AI by 28% (71). In another study of 58 female athletes from various sports, none of the athletes (0%) reported symptoms of POP compared to 2 females (2.3%) in the non-athlete control group. Involuntary loss of gas was reported by 65% of the athletes and 59% of the controls. No one reported any other types of AI (72). Finally, a study comparing AI in an intensive sport group (n = 169) with a non-intensive sport group (n = 224), found prevalence of 15 and 5% respectively, with the majority of reported cases categorized as involuntary loss of gas (73).

Heavy weightlifting may produce considerable increases in IAP (10). Olympic weightlifters and powerlifters train and compete with high external loads, often exceeding their own body mass (74, 75). During competitions, the athletes have 3 attempts in each barbel event (powerlifting: (a) squat, (b) bench press, and (c) deadlift and Olympic weightlifting: the snatch and (b) the clean and jerk) to lift a maximum load in a single repetition (76, 77). Due to the potential load on the pelvic floor during heavy lifting, it is presumed that these athletes need well-functioning PFM and connective tissues capable of withstanding the increased IAP to prevent PFD. Additionally, lifting extremely heavy external loads may potentially bring male athletes to the threshold of pelvic floor load tolerance as well. However, we were not able to find any studies of PFD in competitive male or female strength athletes.

In our second planning phase of the project (after the Covid-19-pandemic), the interest of PFD in CrossFit© and functional fitness exercisers had become large. A simple search on PubMed

(("CrossFit" OR "functional fitness") AND ("urinary incontinence" OR "pelvic floor disorders" OR "pelvic floor dysfunction")) revealed 8 new cross-sectional studies of PFD in CrossFit© and functional fitness published between 2019 and 2020. Functional fitness involves a variety of activities with elements from calisthenics, gymnastics, powerlifting, Olympic weightlifting, cycling, running, rowing and plyometric exercises, often performed at high intensities (78). CrossFit®, which is a branded functional fitness regime, was officially established in 2000 and is to date one of the fastest growing fitness phenomes in the world (79). The prevalence rates of UI reported in the above-mentioned studies ranges between 26-84% (80-87). The large range may primarily be a result of differences in methodology, questionnaires used to assess UI and sample characteristics. Three of the studies also reported prevalence of AI and POP. The reported prevalence rates of AI were 53% (with flatus incontinence accounting for >90% of the cases)(80), 28% (87) and 6% (defined as "involuntary loss of stool") (82). The prevalence of POP were lower: 1.4% (80), 7.8% (87) and 3.2% (82).

Etiology of PFD in athletes

Understanding the cause of PFD can be a challenge because the development of these condition is often multifactorial and complex, rather than caused by a single factor and may develop over time (88). Delancey, Kane Low (88) described a conceptual model to help understand how PFD might be caused by different combinations of anatomical, physiological, lifestyle and reproductive factors throughout a woman's life span (Figure 2). The model classifies factors into three different phases:

- Phase I: Predisposing factors (growth and development, genetic constitution, nutritional factors and socialization (toilet training))
- Phase II: Inciting factors (predisposing maternal-fetal factors, effects of obstetrical interventions, mechanism of birth injury such as levator ani avulsion)
- Phase III: intervening factors (variations in age-related changes in muscles, connective tissue, and nerves, increased stresses on the pelvic floor, factors that leads to weakening of the connective tissue, and lifestyle factors)

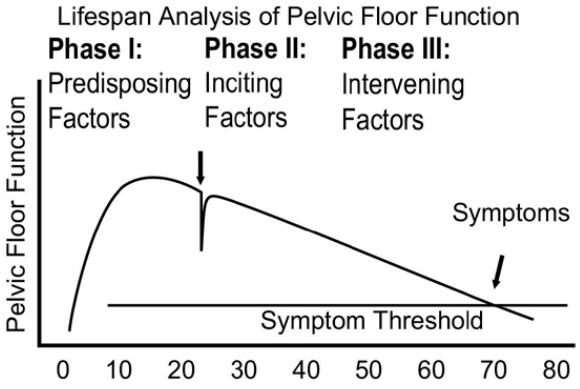


Figure 2. *Integrated life span analysis of pelvic floor function*

This graphical display of the abstract concept of pelvic floor function tracks the functional reserve throughout different phases of a woman's life span. Initially pelvic floor structure growth in the late teens leads to a fully developed pelvic floor. Vaginal birth affects pelvic floor function. Finally, age-related deterioration occurs until a symptom threshold is reached at which the functional reserve present earlier in life is lost. (© DeLancey 2007)

From: Delancey JO, Kane Low L, Miller JM, Patel DA, Tumbarello JA. Graphic integration of causal factors of pelvic floor disorders: an integrated life span model. Am J Obstet Gynecol. 2008;199(6):610 e1-5.

With permission from John O. L. DeLancey.

In the following section, possible mechanisms, and risk factors of PFD in female athletes and strenuous exercisers is described, based on the literature available when we planned the study in 2018. Since there were few studies of other PFD, such as AI and POP, the main focus is on the etiology of SUI.

Predisposing factors

Although female gender seems to be a predisposing factor of SUI, there are few studies to confirm this since a vast majority of studies are conducted on female athletes only. Only two studies were found of PFD in male athletes. A large cross-sectional study found that male cyclists had comparable sexual function/dysfunction (related conditions such as erectile dysfunctions and

genital numbness) as swimmers and runners, but they seemed more prone to urethral stricture (89). Prevalence of UI and AI were not reported. In a study of fitness instructors, more female instructors reported UI (26.4%) than the male instructors (2%) (90). Among the males who reported UI, none experienced leakage during physical activity and exercise. Regarding age and weight/body mass index (BMI) and their relation to SUI in athletes, there is inconsistency of results across studies. In a study of Olympic athletes, higher BMI was associated with regular symptoms of UI, but not age (91). Also, among middle-aged recreational exercisers, the incontinent women had significant higher BMI than the continent ones (92). In contrast, athletes from track and field, basketball and indoor football who reported UI had lower BMI, but were not different in age of those without UI (93).

Previous studies have also found positive associations between disordered eating and UI (94) (91). Carvalhais, Araujo (94) found that athletes from different sport modalities with disordered eating were 3 times more likely to present UI than athletes without disordered eating. Also, significant higher frequency of SUI were reported among Olympic athletes with disordered eating compared with athletes without disordered eating ($p = 0.003$) (91). However, in a study of female triathletes, being at risk of the female athlete triad was no associated with presence of SUI and other PFD (AI and POP) (71).

Family history of UI, inability to stop the urine flow, constipation, history of frequent urinary tract infections and ranking in championship (athletic skills) have also been found to be positively associated with SUI in athletes (66, 68, 95), but more studies are needed to confirm these associations.

PFM function and morphology in athletes

Individual variation in pelvic floor development can be influenced by factors such as genetics, nutrition and environment. The degree of functional reserve development during early life may influence how well the load by physical effort is tolerated by the pelvic floor (88). Regular participation in strenuous exercise may also affect PFM development. As mentioned earlier, exercise may potentially lead to either strengthening or weakening of PFM. Among existing studies where PFM strength in athletes and non-athletes has been compared, the results are conflicting. De Araujo et al. (2015) found that the athletes had stronger PFM compared to sedentary women (70.1 ± 2.4 cmH2O and 34.3 ± 1.7 cmH2O respectively, p=0.001). Despite stronger PFM, the athletes reported significant higher prevalence of UI (70%) compared to the

non-athletes (16%). Similar results were found by Ludviksdottir et al. (2018): Female athletes from different sport disciplines had greater PFM strength, but higher prevalence of UI, than less active women. In contrast, Borin, Nunes and Guirro (96) found that female volleyball and basketball players had significantly weaker PFM compared to non-athletes, while no differences were found between a group of handball players and the non-athletes. They also found a moderate correlation of decreased muscle strength PFM strength and SUI ($r = -0.51$, $p = 0.04$). The heterogeneity of the studies regarding sample size, measurement equipment used and participant characteristics, may explain the conflicting results and makes comparisons between studies challenging.

In a small pilot study, 10 high-level athletes from different sport modalities had greater cross-sectional area of the levator ani muscles compared to the 10 non-athletes (106 ± 46.1 mm^2 vs. 86.4 ± 28 mm^2, $p = 0.05$) on MRI (61). In a follow-up study, pelvic floor morphology and bladder neck descent during Valsalva were assessed in 46 nulliparous women (22 high-intensity training athletes and 22 non-exercising controls) using 3D/4D ultrasonography. The athletes had higher mean diameter of the pubovisceral part of levator ani muscles compared to the control group (96 mm vs. 70 mm, $p < 0.01$), confirming the results from the previous MRI study (97). Interestingly, in another MRI-study of young, female football players, the incontinent players ($n = 5$) had thicker PFM at midvagina compared to continent players ($n = 7$) (98). However, this was a small study with limited external validity.

Overall, the results suggests that athletes may have stronger and thicker PFM than non-athletes, and wider levator hiatus, but the results are conflicting, and more research are needed to confirm this. Despite stronger muscles, the athletes still report higher prevalence of SUI. Larger bladder neck descent and hiatus opening during Valsalva may explain why female athletes may be more exposed to SUI, but the role of these factors in relation to SUI in athletes should be further evaluated. All studies were cross-sectional and no causal relationships between exercise and PFM development can be made. No studies were found on long-term PFM development in athletes.

Inciting factors

The inciting factors in phase II relates to pregnancy and childbirth in the life span model. For women, the risk of PFD may be largely influenced by the amount of injury of the pelvic floor during birth and the ability to recover from these injuries (88). However, most active athletes

have not experienced pregnancy or childbirth due to their young age or prioritize of the sporting career. In sport injury research, the inciting event of injuries can be defined as the factors describing how the injury occurs, often called "injury mechanisms" (99). To date, the mechanisms of SUI in athletes are not fully understood but increases in IAP and the PFM response/non-response to these increases has been suggested as leading mechanisms.

Increases in IAP during physical effort

Both at rest and during increases in IAP, the urethral pressure must be greater than the bladder pressure to prevent urine leakage from happening (41). SUI occurs when bladder pressure exceeds urethral closure pressure in sudden increases of IAP, for instance during coughing, laughter, or physical exertion (24). Activity of the striated urogenital sphincter in the vesical neck and smooth muscles surrounding the urethra primarily contributes to this closure pressure. During increases in IAPs, the urethra is displaced in a downward direction. However, an underlying supportive layer, consisting of the anterior vaginal wall and pelvic floor connective tissues and muscles, creates resistance and slows down the downward momentum (24). The supportive layer firms a backstop against which the urethra is compressed leading to closure of the urethral lumen and prevention of urine leakage. The PFM are additionally recruited to counteract the increased load and the downward movement. An elevated positioning of the levator plate, larger stiffness and thickness of the PFM and connective tissues may potentially facilitate a faster automatic response and more effectively decelerate the descent of the urethra (100). Although the PFM may play an important role in preventing urinary leakage during physical effort, the pathophysiology of SUI is multifactorial (101). Deficiencies in urethral and bladder neck structure and function and impaired neuromuscular and mechanical function of the striated urethral sphincter have been shown to be associated with SUI (101).

In high-impact sports, large and repetitive increases in IAP have been proposed as a leading mechanism of SUI in athletes (64). .Shaw, Hamad (102) found that similar increases in IAP were produced during coughing (90.5 cmH2O), seated vasalva (129.3 cmH2O) and jumping (median: 91.2), while lower pressures were produced by running (66.5 cmH2O) and lifting of 18.2 kg (47.9 cmH2O) among exercising women. In a study of women who habitually performed CrossFit©/functional fitness training, especially high increases in IAP were produced during rope jumps, push ups, front squats and wall balls, with peak IAP pressures exceeding 100-300 cmH2O (103). In some exercises, e.g. back squats, there were also significant increases in peak

IAP as the participants progressed through repetitions (103). During heavy weightlifting with loads exceeding 80% of 1 repetition maximum (1RM), the Valsalva maneuver (defined as a forced exhalation against a closed glottis) is unavoidable (104). The proposed benefit of a Valsalva during heavy lifting are increased stability of the spine due to augmented IAPs that may further improve lifting technique and prevent injuries by lowering the load on the spinal structures (10, 104). However, the strain on the pelvic floor may potentially become larger, and well-functioning PFM may be necessary to withstand the increased IAP and prevent urinary leakage from happening during lifting with Valsalva maneuver. The whole-body exercises back squat and deadlift (or exercises including a squat positions) have shown to produce the largest increases in IAP, with peak IAP reported between 160-219 mmHg (10). Most studies are performed in well-trained men and although the IAPs during lifting in women remains unknown, it is likely the IAP will increase exponentially with the increased loads or when lifting weight until failure in female lifters similar to male lifters (104).

Due to the large increases in IAP, it is reasonable to assume that athletes who participate in sports involving high-impact and/or heavy weightlifting activities, such as gymnastics, powerlifting, Olympic weightlifting, and CrossFit©, may have higher risk of experiencing SUI if the IAP exceeds the PFM ability to withstand the load. However, the threshold of load tolerance may be influenced individual factors, such as weaknesses or damage of the connective tissue or the PFM (e.g. after childbirth), urethral sphincter insufficiencies, length of urethra and urethral hypermobility (41).

Effect of exercise on pelvic floor support, muscle tone and function

Few studies have investigated the effect of exercise on the PFM. Muscle fatigue has been suggested as a possible explanation for SUI during exercise. If the PFM gradually fatigues during exercise, PFM force development and pelvic floor support may be reduced. Consequently, urinary leakage may occur. Ree, Nygaard and Bo (105) found 17% reduction of MVC pressure of the PFM after 90 minutes of strenuous physical activity in nulliparous women with mild symptoms of SUI. No differences were found in the PFM resting pressure and endurance measured immediately before and after activity. The results indicates that strenuous physical activity may lead to fatigue of the PFM. The training program consisted of both heavy strengthening exercises and high-impact endurance activities, and it is not clear whether the reduction in MVC were mainly caused by the strengthening exercises, the high impact activities, or the combination of both types. The included women were not elite athletes, but all participated in regular exercise, with a mean of 4 days per week (SD: 2.1).

Middlekauff, Egger (106) compared the immediate effect of exercise at different intensities on vaginal support, PFM strength and resting pressure in nulliparous strenuous exercisers and non-strenuous exercisers. PFM MVC, vaginal resting pressure and vaginal support (maximal vaginal descent) were measured before and after 25-minute bouts of exercise. The strenuous group performed high-impact CrossFit© exercises and the non-strenuous group self-paced low-intensity walking. No acute changes in MVC of the PFM were found among the strenuous and non-strenuous exercisers. Maximal vaginal descent and PFM resting pressure slightly decreased in both groups. These results indicate similar effects of exercise on PFM function and support, regardless of exercise intensity. However, the bouts of exercise were only 25 minutes, and it can be questioned whether the duration of the exercise bouts were enough to cause potential fatigue and between-group differences.

Both above-mentioned studies reported short-term effects of single bouts of exercise. Whether short-term fatigue would lead to weaker or stronger muscles in the long term has not been studied and is open for discussion.

Intervening factors

It has been proposed that higher levels of strenuous physical activity may lower the threshold for experiencing symptoms of PFD. Not because of potential damage to the pelvic floor structures, but because strenuous activity will require a more robust pelvic floor function (88). Thus, sedentary individuals may never experience SUI due to the lack of exposure of potential triggering activities. As previously mentioned, the prevalence of UI varies depending on type of sport. Participation in sports with higher exposure of triggering activities, may increase the risk of experiencing SUI. Jumping, high-impact landings and running have been reported as common activities likely provoke urinary leakage (69, 70, 92, 107). Among young trampolinists, urinary leakage could be triggered by new, strenuous, and difficult exercises or in double somersaults (67). When planning the study in 2018, there was limited knowledge of triggering activities related to strength training. But in recent studies of strength athletes, heavy lifting/maximum lifts and the exercises deadlift, back squat and clean and jerk, were reported to most commonly provoke urinary leakage (108-110).

Positive associations between UI and training volume have been reported in several cross-sectional studies, and there seem to be a dose-response relationship (66-68, 111-113). In a study

where women were divided in different quartiles based on the physical activity level, the women from 4th quartile had significant higher risk of UI than the 1st quartile (RR: 2.53, CI: 1.3-2.7), 2nd quartile (RR: 0.80, CI: 0,9-1.1) and the 3rd quartile (RR: 1.10, CI: 0.9-1.1) (111). Further, athletes from various high-impact sports who had practiced sport for more than 8 years had almost three times higher odds of developing UI compared to athletes with less experience (114). In young trampolinists, years of training were positively correlated with ICIQ-UI-SF score ($r = 0.61$, $p = 0.003$), frequency of urine leakage ($r = 0.47$, $p = 0{,}023$) and amount of leakage ($r = 0.58$, $p = 0.005$) (68).

Impact of UI on sports participation and quality of life

Results from previous research show that UI may negatively affect the athletes' quality of life and sport performance and limit their participation in sports (66, 93, 115). In a study of female former trampolinists, 12% reported that UI had led to cessation of sports (66). In other studies, athletes have reported that urinary leakage during sports may cause embarrassment, fear, anxiety and frustration (69, 93). It also seems that few (< 5%) discuss the condition openly with their coach, trainer, or medical personnel (69, 116).

Pelvic floor muscle training (PFMT)

The PFM are skeletal muscles and can adapt to regular strength training in the same way as other skeletal muscles (15). Regular PFMT has shown to change pelvic floor morphology by increased muscle volume and stiffness, reduced opening of the levator hiatus and elevated resting position of the bladder and rectum (14). By increasing the strength and improve the PFM position in the pelvis, the PFM may respond better to large (and sudden) increases in IAP, and further prevent urinary leakage from happening (15).

To date, there is level 1 evidence, and grade A recommendation for PFMT as the first line treatment for UI and POP in the general female population (11, 12). In addition, PFMT is highly effective as primary prevention; pregnant continent women who exercise the PFM are at 62% less risk of UI in late pregnancy and 29% less risk of UI 3-6 months postpartum (117).

Evidence of the effect of PFMT in athletes or strenuous exercisers is sparse. One study on female soldiers and two small case series reported that PFMT reduced the symptoms of UI (118-120). However, none of the above-mentioned studies included a non-treated control group and

therefore the internal validity of these studies is low. In an randomized controlled trial (RCT) of 32 volleyball players, PFMT showed significant improvement of UI amount and frequency compared to written information only (121). Similarly, promising results were reported in a small-scaled pilot-study of 16 female volleyball athletes favoring of the PFMT group (122). Based on today's knowledge we do not know whether PFMT is effective in strenuous exercisers exposed to excessive impact by high-impact and heavy weightlifting. Exercisers are highly motivated for regular training, and strength training of the PFM, if proven effective, may be easily incorporated in their basic training regimens both as prevention and treatment strategies of SUI (2).

Gaps of knowledge

Before the project start in 2018, there was lack of studies on the extent and etiology of PFD, including UI and AI in young high-level female athletes with a presumed increased risk of PFD due to participation in strenuous high-impact activities (e.g. gymnastics and cheerleading). Further, there were limited knowledge of extent and etiology of PFD, including UI, AI and POP, in female strength athletes (Olympic weightlifters and powerlifters) with comparisons to male athletes and possible mechanisms of SUI during heavy weightlifting. Further, there was limited knowledge of the impact of urinary leakage while exercising on sports participation and performance in and the athletes' awareness and knowledge of the pelvic floor. In our second planning phase of the study after the COVID 19-pandemic in 2020, several new publications on PFD in CrossFit© and functional fitness had been published, revealing high prevalence of especially SUI. To our knowledge, there were no interventional studies of effects of conservative treatments, such as PFMT, in this large group of female strenuous exercisers.

Aims

Overall aim

This PhD. project aimed to investigate the extent, etiology, and mechanisms of PFD, especially SUI, in female athletes with presumed increased risk of PFD due to high-impact exercise involving elements of running, jumping and heavy lifting and the impact of exercise-induced

urinary leakage on sports participation and performance. Further, we wanted to assess if PFMT could improve SUI among female strenuous exercisers.

Specific aims

Paper 1: To assess the prevalence, bother and associated factors of UI and AI among female artistic gymnasts, team gymnasts and cheerleaders and explore the impact of SUI on sports participation and performance and the athletes' knowledge of the PFM.

Paper 2: To assess the prevalence, bothers and risk factors of PFD among male and female Olympic weightlifting and powerlifting athletes and explore the impact of SUI on sports participation and performance and the athletes' knowledge of the PFM.

Paper 3: To investigate the immediate effect of heavy weightlifting on PFM strength, resting pressure, endurance and resting activity in strength-trained, nulliparous women.

Paper 4: To evaluate the effect of PFMT on SUI in female CrossFit© and functional fitness exercisers.

Methods

Study design

The four studies had the following study designs and samples:

Paper I: A descriptive observational cross-sectional study of 319 Norwegian female elite artistic gymnasts, team gymnasts and cheerleaders.

Paper II: A descriptive observational cross-sectional study of 180 female and 204 male Norwegian elite Olympic weightlifters and powerlifters

Paper III: An experimental study with crossover design and random order of sessions of 47 strength-trained, nulliparous women aged between 18-35 years.

Paper IV: A two-armed assessor-blinded randomized controlled trial comparing a PFMT intervention (n=22) to no intervention (n=25) in female CrossFit© and functional fitness exercisers with SUI.

Study sampling

Data collection for paper I and II were conducted between March 2019 and June 2020. Data were collected by electronic questionnaires (Survey Xact). Official result lists from Norwegian National Championships in artistic gymnastics, team gym and cheerleading (paper I) and powerlifting and Olympic weightlifting (paper II) in 2018/2019 were used to identify eligible subjects. Collaboration with the Norwegian Gymnastics Federation and the Norwegian Federation of American Sports for paper I and the Norwegian Weightlifting Federation and the Norwegian Powerlifting Federation for paper II were established for recruitment of athletes. Subjects were recruited at different national championships, by email correspondence with clubs/coaches, club visits and through a registration link on webpages and social media. Participants for the experimental study (paper III) and the RCT (paper IV) were recruited through social media (Facebook, Instagram) and in collaborations with CrossFit© boxes, weightlifting/powerlifting clubs and federations between December 2021-October 2022 (paper

III) and April-December 2022 (paper IV). Women with interest in participating could register via an online registration links (Survey Xact). Those who fulfilled the inclusion criteria were invited to participate by e-mail. Data collection for paper III were performed at The Norwegian School of Sport Sciences from January-October 2022. For paper IV, data were collected between May 2022-April 2023 and most participants were tested at the Norwegian School of Sport Sciences. Seven participants were tested at Trondheim Fysikalske Institutt, Trondheim, Norway and three participants at Klinikk for Alle, Drammen, Norway.

Change of the project protocol due to Covid-19

Due to delays in the data collection after the Covid-19 pandemic, we had to make changes to the original project protocol in August 2020.

Originally, we planned to recruit participants from the two cross-sectional studies for our following two studies. The third study were supposed to have a case-control design, where we aimed to investigate differences in vaginal support, PFM anatomy, resting pressure, strength, and endurance between high-level female strength athletes (powerlifters and Olympic weightlifters) and age- and parity matched non-athlete controls. The data collection was planned to take place at Akershus University Hospital in collaborations with experienced gynecologists during spring 2020. However, due to the pandemic lock-down the study had to be postponed. A combination of long-lasting COVID-restrictions and the PhD-candidate's maternity leave in the period between spring 2020 and autumn 2021, led to the decision to cancel the study.

In the fourth study we planned to recruit female gymnasts and cheerleaders from study 1 to an RCT of PFMT for gymnasts and cheerleaders with SUI. Eligible athletes from study 1, were invited to participate by email-contact. We were able to recruit and test 4 participants prior of the Covid-19 pandemic, but due to full lock-down and strict Covid-restriction in the period between March 2019-june 2020 followed by the maternity leave of the PhD. Candidate, we had to postpone and later cancel the data collection.

Inclusion criteria and sample size

Inclusion criteria

Paper I: Female artistic gymnasts, team gymnasts or cheerleaders of ≥ 12 years of age, who had participated in ≥ 1 Norwegian National Championship during 2018/2019 were included. The exclusion criteria were neurological disease or previous surgery for UI or completion of < 90% of the questionnaire.

Paper II: Male and female powerlifters or Olympic weightlifters of ≥ 18 years of age who had participated in ≥ 1 Norwegian National Championship during 2018/2019 were included. Those who reported ongoing pregnancy, previous surgery for UI or POP, neurological disease or had completed < 90% of the questionnaire were excluded from the data analysis.

Paper III: Nulliparous women aged 18-35 years who habitually performed strength training (≥3 sessions/week and ≥ 2 years' experience) with the ability to lift their own bodyweight times 1.2 in squat and 1.5 in deadlift were included. The exclusion criteria were previous pelvic surgery to correct POP, UI or AI, ongoing pregnancy, or inability to perform the exercise protocol (e.g., due to musculoskeletal injuries). Participants who were unable to perform a correct PFM contraction at baseline evaluations were also excluded.

Paper IV: Women aged ≥18 years who habitually participated in CrossFit® or functional fitness training (≥ 6 months of consistent participation, ≥ 3 times per week) with self-reported SUI. Eligibility was verified by the ICIQ-UI-SF. A sum-score of ≥ 3 of the questions regarding frequency and amount of leakage was required. Further, the option "I leak when I am physical active/exercising" on the question "When does urine leak?" had to be chosen. The exclusion criteria were pregnancy/planning to get pregnant during the intervention period, history of hysterectomy/pelvic surgery to correct UI, AI or POP, musculoskeletal injuries for the past 6 months with negative effect on exercise, childbirth within the previous 12 months and inability to perform a correct PFM contraction.

Sample size:

Paper I: All female athletes ≥ 12 years of age competing in ≥ 1 Norwegian National Championship in artistic gymnastics, team gymnastics or cheerleading in 2018/2019 were invited (n= 178 artistic gymnasts, 592 team gymnasts and 1084 cheerleaders).

Paper II: All male and female athletes ≥ 18 years of age competing in ≥ 1 Norwegian National Championship in Olympic weightlifting or powerlifting in 2018/2019 were invited (n=353 females and 541 males)

Paper III: An a priori power calculation was performed based on previous results from a study with similar crossover-design of Ree et al. (105) who found that a 90-min bout of strenuous exercise led to a mean change in PFM strength of -4.4 cm H_2O (SD: 4.3) in women with SUI. Our calculations showed that a sample size of 42 was required to detect a pre-post difference in PFM strength of -4.4 cm H_2O (SD: 4.3) after heavy weightlifting and 0.6 cm H_2O (SD: 4.3) after rest with 80% power and a 5% significance level. To account for uncertainties in the power calculations, we aimed to include 50 participants.

Paper IV: An a priori power calculation was conducted based on mean ICIQ-UI-SF score (4.3, SD: 2.8) from our previous cross-sectional study in female strength athletes (123) and the previously reported minimum important difference (MID) in total score of 2.5 (124). With a decrease in ICIQ-UI-SF score from 4.3 to 1.8 (SD: 2.8) in the PFMT group and no change (SD: 2.8) in the control group, 80% power, 5% significance level and an estimated drop-out rate of 20%, at least 24 participants were required in each group (total N = 48). To account for uncertainties in the power calculations, we aimed to include 50 participants.

Primary and secondary outcomes

Paper I: The primary outcomes were prevalence of UI and AI. Secondary outcomes included the association of possible factors for UI and AI, descriptive reports of the impact of UI and AI on daily life and sports participation/performance, exercise-related triggers of urinary leakage, measures to prevent or disguise UI, communications of UI and the athletes' knowledge of the PFM.

Paper II: The primary outcomes were prevalence of UI, AI and POP in women and UI and AI in men. Secondary outcomes included the association of possible factors for UI, AI, and POP, descriptive reports of the impact of UI and AI on daily life and sports participation/performance,

exercise-related triggers of urinary leakage, measures to prevent or disguise UI, communications of UI and the athletes' knowledge of the PFM.

Paper III: The primary outcome was the change in PFM variables (PFM resting activity, resting pressure, strength, and endurance) after a single bout of heavy weightlifting compared to the change after seated rest (control).

Paper IV: Our primary outcome was change in symptoms of UI between groups (total score of ICIQ-UI-SF). Secondary outcomes included perceived change of SUI (PGI-I), change in PFM resting pressure, strength and endurance and symptoms of anal incontinence (AI) and pelvic organ prolapse (POP) and self-efficacy to the PFMT.

Data Collection

Questionnaire data

Electronic questionnaires (Appendix 3-6), including questions on background information (age, training habits, chronic diseases, parity and birth history) and reports of PFD were sent out to participants of all four studies.

PROMs with Grade A recommendation from the ICI 2017 were used in all studies (paper I-IV) to assess symptoms and bother of PFD. For UI, we used the ICIQ-UI-SF. The ICIQ-UI-SF is easily completed and has shown to have acceptable convergent validity, ability to discriminate among different groups, and good reliability (Cronbach alpha of 0.95) (125). The ICIQ-UI-SF consists of four questions on frequency of UI, amount of leakage, overall impact/bother of UI (scale: 0-10) and a self-diagnostic item. The ICIQ-UI-SF score (0-21) is the total score of frequency, amount, and bother (125). Participants were considered continent if they answered "never" to the fourth question "When does urine leak?". Those who responded "I leak when I am physical active/exercising" or "I leak when I cough or sneeze" were classified with SUI. In study I-II, UI was also classified into other subgroups: involuntary loss of urine before reaching the toilet as urgency UI, a mix of both SUI and urgency UI as mixed UI and the remainder as other types of UI.

To assess AI and symptomatic POP in paper I-IV, we used questions from the ICIQ-B and ICIQ-V respectively (126). Participants who responded "always" to questions regarding ability to control for leakage of watery/loose stool, formed/solid stool, and wind (flatus) were classified as

continent. Symptomatic POP was considered present among women who responded positively to the questions "Are you aware of a lump or bulge coming down in your vagina?" or "Do you feel a lump or bulge come out of your vagina, so that you can feel or see it on the outside?". Bothers of AI and POP were assessed with questions from ICI questionnaires on how the conditions affected their daily life (scale from 0-10).

To assess associations of possible risk factors for PFD in study I and II (paper I-II), we included questions of age, BMI, training frequency (days/week and hours/session), level of competition (national/international), years specializing in their sport, straining at toilet, urinary tract infections, risk of female athlete triad. The female strength athletes in study II were also asked about parity. We did not assess parity in study I since we expected that the high-level gymnasts and cheerleaders would be nulliparous due to their young age. The female athlete triad refers to the interrelationship of menstrual dysfunction, low energy availability (with or without an eating disorder), and impaired bone health and was assessed with The Low Energy Availability in Females Questionnaire (LEAF-Q) (127). The questionnaire has demonstrated acceptable validity to classify current energy availability, bone health and/or reproductive function in female athletes. Female athletes with scores ≥8 were considered at risk of the triad (127). Straining at toilet was assessed by the questions: "Do you need to strain to empty your bladder?" (128) and "Do you need to strain to open your bowels?" (126). Response alternatives from "never" to "always"/ "daily" were given. To control for possible confounding of chronic disease and previous pelvic/lumbar surgery, the participants were asked to answer yes/no to the questions: "Do you have a chronic disease (e.g., diabetes, Morbus Crohn) or other health problems?" and "have you previously had surgery in the pelvic or lumbar area?". Athletes responding "yes" were asked to add their disease or type of surgery as free text.

In study I and II we also included questions of Bothers of UI and AI were assessed with questions from ICI questionnaires on how UI and AI affected their daily life (scale from 0-10). Further, questions regarding UI during sports activities, impact of UI on sports participation and performance, protective or preventive measures for UI during training or competition were included with provided options for responses. Some of these questions were based on a previous survey in rhythmic gymnasts (129) and others were constructed by the authors in collaboration with contact persons from the sports federations. Finally, we included questions regarding the athletes' knowledge of the PFM. We asked if they had previously heard about the PFM and from where, if they knew how or why to train the PFM, to rate their knowledge of the PFM on a scale

of 1-10 and if they were willing to do PFMT if they knew how. These questions were selected from two studies by Neels et al. (130) and Gram & Bo (129).

In the RCT (paper IV), we assessed the participants self-efficacy of PFMT at baseline by a reliable and valid self-efficacy scale (Self-Efficacy Scale for Practicing Pelvic Floor Exercises (SESPPFE)) (131), including 17 items. This was repeated after one month of PFMT. At 16 weeks all participants were asked to rate their perceived change of SUI. A validated 7-point Patient Global Impression of Improvement (PGI-I) scale with response choices ranging from "very much better" to "very much worse" was used (132).

Pelvic floor muscle assessments

In study 3 and 4 (paper III and IV) we used vaginal manometry to measure PFM resting pressure, strength, and endurance. Vaginal sEMG were also used in study III to assess PFM resting activity.

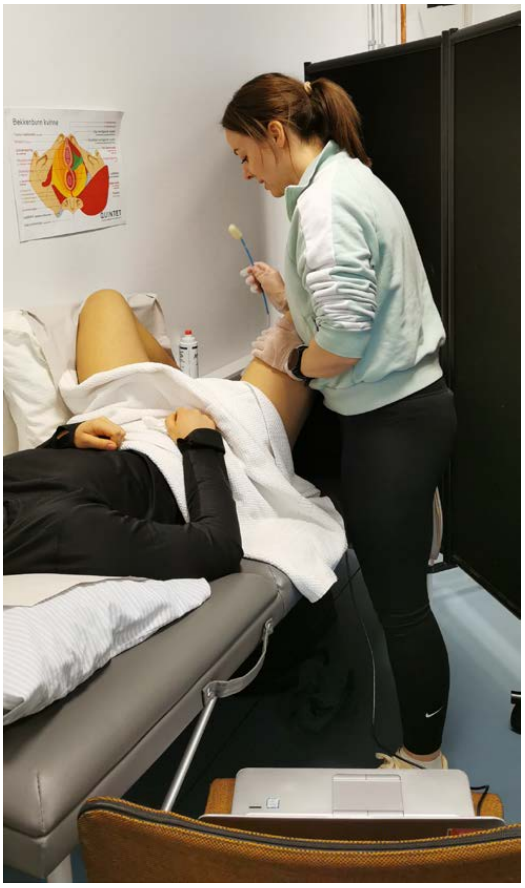
After voiding, the participants were given a short lecture of functional anatomy of the pelvic floor followed by assessment of ability to contract the PFM by observation and vaginal palpation. The teaching and assessments were performed by the Phd. candidate who had training in the measurement methods (44). The woman was in a supine position on a flat bench with a pillow underneath the head, both legs bent with one leg resting against the wall and the other supported by the physiotherapist (Figure 3).

PFM resting pressure, strength and endurance were measured with a high precision pressure transducer connected to a vaginal balloon catheter (Camtech AS, Oslo, Norway) (Figure 4). The method has demonstrated good intra-observer reliability (52, 53, 133-135). The instructions were standardized, and we followed the same procedure as Bø, Kvarstein (53), Bø, Kvarstein (133) and Tennfjord, Engh and Bo (52). The participants were instructed to perform three repetitions of maximum voluntary PFM contractions of approximately three seconds and one endurance PFM contraction of 10 seconds. PFM resting pressure was measured as the difference between the atmospheric pressure and the vaginal high-pressure zone at rest (after inhalation-exhalation

before the first voluntary PFM contraction) in cmH_2O (Figure 5). PFM strength was calculated as the mean peak from the resting pressure line of three maximum voluntary contraction curves (cmH_2O), while PFM endurance was quantified as the area under the curve for 10 seconds (cmH_2O/sec) (Figure 5) (52, 136). Only PFM strength and endurance measurements with simultaneous observed inward movement of the catheter and no use of external muscles (abdominal and hip muscles) were considered valid (53).

PFM resting activity was assessed by surface electromyography (sEMG) (44) with the apparatus NeuroTrac MyoPlus Pro (Quintet, Bergen, Norway) and a 33 mm transverse diameter vaginal probe with two stainless steel lateral electrodes (35 x 15 mm) (Periform, Quintet, Bergen, Norway). The method has shown very good test-retest intra-rater reliability for measurements of vaginal resting activity (ICC: 0.90, 95% CI: 0.84-0.94) (135). The PFM resting activity was calculated as the overall average microvolts recorded in the rest periods.

Figure 3. Pelvic floor muscle examination of the participant in supine position on a flat bench. One leg rest against the wall and the other against the assessor.



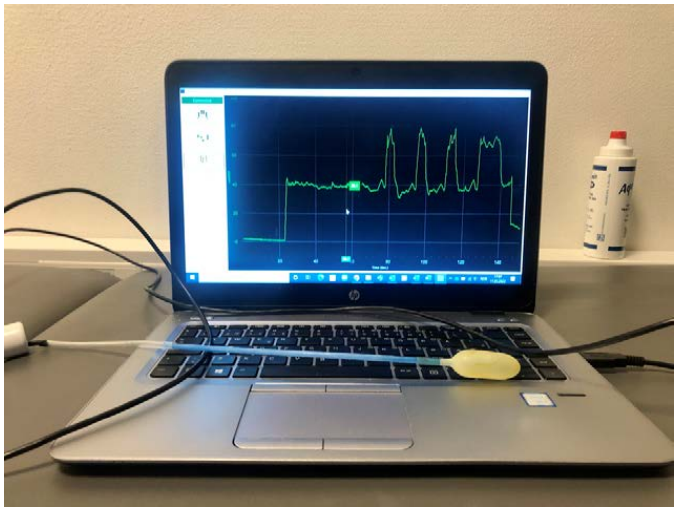


Figure 4. *Camtech AS, Oslo, Norway.*

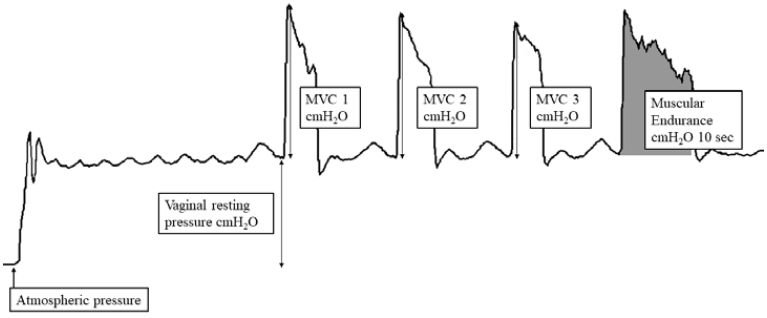


Figure 5. *Example of pressure curves of vaginal resting pressure, pelvic floor muscle strength (MVC 1-3), and muscular endurance. MVC maximum voluntary contraction. From Skaug KL, Engh ME, Bo K. Acute Effect of Heavy Weightlifting on the Pelvic Floor Muscles in Strength-Trained Women - An Experimental Crossover Study. Med Sci Sports Exerc. 2023.*

1 repetition maximum tests

In study III 1 repetition-maximum (1RM) tests were conducted for back squat and deadlift. The participants completed a warm-up including 5 minutes on an ergometer bike and 5 minutes of individual optional exercises. The 1RM protocol for back squat (Figure 6) and deadlift (Figure 7) was standardized, progressing from 10 repetitions at 20%, 4 repetitions at 55%, 3 repetitions at 65%, 2 repetitions at 75%, 1 repetition at 85%, and 1 repetition at 93-95% of expected 1RM with 3-minute rests between the warm-up sets and 5-minute rests before and between the 1RM trials. Participants were allowed to use belts, shoes, or straps for lifting. The test protocol was developed in collaborations with a professor in exercise science and biomechanics and a professional powerlifting coach.

Figure 6. *Back Squat*

Figure 7. *Deadlift*

Other assessments

Height and weight were measured by the Phd. Candidate at the clinical visits of study III-IV. Height was measured to the nearest 0.5 cm using a portable stadiometer (SECA 123, Hamburg, Germany). Weight was measured to the nearest 0.1 kg using an electronic scale (SECA 899, Hamburg, Germany).

Randomization and blinding

Paper III: The participants were randomized to start with 60-minutes of weightlifting or 60-minutes of rest (control period) with a washout period of 60 minutes before crossing over to the remaining session. A randomization list in blocks of 4 was computer-generated by an independent biostatistician using a random number generator. Allocation was concealed in sealed and opaque envelopes that were sequentially numbered. Randomization was unknown for the assessor and participant during the baseline evaluations and was revealed before the first session (weightlifting or rest) on the test day. The assessor was not blinded to the order of sessions, mainly due to logistics and lack of resources.

Paper IV: A randomization list was computer-generated by an independent biostatistician in blocks of 4, using a random number generator. Allocation was concealed in sequentially numbered sealed and opaque envelopes. The assessor and statistician were blinded to group allocation. Randomization was revealed to the participants and physiotherapist in charge of the intervention after baseline testing.

Blinding during analysis of the manometry measurements

The analysis of the PFM measurements was performed by the same person who assessed the participants. Data of the manometry measurements were stored at the apparatus hard disk with the time and date of the measurements. The values of the PFM measures were recorded in an excel-sheet for each participant using a unique ID. The time and date were the only links to the clinical measurements. Previous questionnaire recordings were not linked to the measurements during analysis.

Interventions

Paper III

Our test protocol included a 1-hour session of heavy weightlifting and a 1-hour control sessions of seated rest with random order of sessions and a 1-hour wash-out period between sessions. The weightlifting session started with a 10-minute warm-up (same as for the 1RM-tests). Following, the participants performed specific warm up sets (10 repetitions at 20-30% of 1RM, 5 repetitions at 50%, and 3 repetitions at 70%) followed by 4 sets with 4 repetitions in back squat and deadlift at 75-85% 1RM. "Repetitions in reserve" (RIR) was used to assess the participants perceived exertion between sets and to adjust load. They were asked to estimate how many repetitions remained before failure (137). A RIR score of 1-3 was considered acceptable and a score closer to 1 was preferable for the last two sets. The equipment used for the session were a weightlifting rack, barbells, and weight plates. The participants could use belt, shoes, and straps for lifting.

During the control session, the participants were allowed to work, study, read or to do similar sedentary activities, but had to remain seated for the whole session (except for toilet visits). The sessions were conducted at the exercise facilities at Norwegian School of Sport Sciences.

Paper IV

The intervention consisted of a 16-week home-based PFMT program with weekly follow-up by phone (alternating follow-up phone call or SMS) with the physiotherapist who randomized the participants. Prior to the intervention, the participants were taught how to perform a correct PFM contraction by vaginal palpation (during baseline assessments) and received instructions on how to perform the training program. The program consisted of 3 sets of 8-12 maximum PFM contractions per day in lying, seated, or standing. To assess adherence to the prescribed exercises, the participants were asked to register their sessions in an electronic app (Athlete Monitoring). A reminder was sent by SMS if registration of the daily session was lacking by 8 PM. The training period lasted 16 weeks, and the program took about 10 minutes per day. The participants received individual advise for progression of the exercises throughout the training period with options to change position (Figure 8), increase the number of contractions and to add 3-4 fast contractions on top of each holding period (138, 139). They also received an information booklet (Appendix 7) and a video showing the exercise program.

The participants in the control group were informed to continue their CrossFit® and functional fitness training as usual and asked not to perform any specific training of the PFM during the

intervention period. All participants in the control group were offered instructions for PFMT after the completion of post-tests.

Figure 8. *Different positions used to progress and vary the pelvic floor muscle training.*

Statistics

Data were analyzed in SPSS version 24-28 (SPSS, Inc., Armonk, NY, USA). Demographic data and descriptive variables were reported as means with standard deviations (SD) for continuous data or numbers with percentages (%) for categorical data. For all papers the level of significance was set to < 0.05. Normality tests were performed.

Paper I: Pearson chi-square test was used to investigate differences in proportions of SUI/AI between the different sport groups. Risk factors for UI and AI were estimated by multivariate binary logistic regression analysis and reported as odds ratio (OR) with 95% confidence intervals (CI). The "Purposeful Selection" approach was used to select variables in the multivariate logistic regression models (140). Variables with $p < 0.1$ were left in the final model. Categorical variables with >2 categories were recoded into dichotomous variables (straining on voiding, training frequency/week, urinary tract infection). Choice of reference group when comparing risk between the different sport groups was based on results from the chi-square test. Continuous variables showing non-linear associations with SUI/AI in univariate analysis were recoded into

ordinal variables based on quartiles. No power calculations were made, since we aimed to include all athletes fulfilling the inclusion criteria.

Paper II: Risk factors for PFD were estimated by multivariate binary logistic regression analysis and reported as OR with 95% CI. Age, BMI, parity, training frequency, years specializing in power- or Olympic weightlifting, level of competition, straining at toilet, hypermobility and risk of female athlete triad were considered as possible risk factors. The "Purposeful Selection" approach was used to select variables for the multivariate logistic regression models in order to avoid overfitting of the models (140). Variables with $p < 0.1$ were left in the final model. Variables considered to have clinical relevance or possible confounding effect were included in all models (age, parity, chronic disease, and previous surgery in the pelvic area/lumbar spine). No power calculations were drawn, since we aimed to include all eligible athletes fulfilling the inclusion criteria.

Paper III: Differences in the changes of PFM variables within-group are reported as mean differences with 95% CI. The data of PFM resting activity, resting pressure, and strength were considered normally distributed. Paired t-tests were used to analyze within-group differences pre- and post-weightlifting and rest, and to compare the changes from weightlifting vs. rest. The PFM endurance data were not normally distributed, and Wilcoxon signed-rank tests were used. Changes in PFM endurance were described by median and interquartile range (IQR). Endurance data from 4 participants were excluded from the analysis due to measurement errors. To control for possible trends and systematic errors of the repeated PFM measurements on test day, boxplots and spaghetti plots were constructed and evaluated by inspection by one of the researchers and a biostatistician. To assess whether the washout period was sufficient, we compared the mean change in pre-values of PFM strength and endurance between the participants who began with weightlifting and those who began with rest by independent-sample t-tests. The relationships between 1RM/relative strength (1RM/bodyweight) in back squat/deadlift and PFM strength were assessed by Pearson correlation coefficient. The first measurements of PFM strength from the test day were used. Preliminary analyses were performed to ensure normality, linearity, and homoscedasticity.

Paper IV: Within-group group differences were analyzed by paired-sample t-test and between-group differences of categorical data by the chi-square test for independence or Mann-Whitney U-test. Between-group comparisons of continuous variables, were analyzed by ANCOVA as a linear regression with week 16 value as the dependent variable and group allocation and the baseline variable as the independent variables. Difference in change between groups from

baseline to week 16 are reported with 95% CI. The analyses were based on full analysis set where all available participants at follow-up were analyzed in the groups to which they were originally randomized. Additional sensitivity analyses were conducted with imputations of missing data due to loss to follow-up.

Ethics

- The study procedures are in accordance with the World Medical Association, Declaration of Helsinki-Ethical Principles for Medical Research Involving Human Subjects (updated 2013) (141)

- Study I-IV were approved by the Regional Ethics Committee (2018/2211/REK Sør-øst B, 20.12.2018) and the Norwegian Centre for Research Data (NSD: 199381, 24.01.2019). The RCT protocol (study IV) was also registered in the ClinicalTrials.gov-registry by the U.S. National Library of Health (April 22, 2022, NCT05341024) (Appendix 1).

- The Regional Committee for Medical and Health Research Ethics of Norway and the Norwegian Centre for Research Data approved all changes for study I-IV during the project period (Appendix 2).

- In study I and II written information was sent by email to all participants. Participants above 16 years gave their consent by ticking boxes before entering the electronic questionnaire (Appendix 3-4). For athletes below the age of 16, information was sent by e-mail to their parents or legal guardians. When parents/legal guardians had given written consent, an electronic link for the questionnaire was sent to the athletes. Before entering the questionnaire, age-appropriate information about the study was given to the participant. Oral information was also given to eligible athletes during recruitment at different Norwegian National Championships and sports club visits. Athletes/parents/legal guardians were encouraged to contact the Phd. Candidate or the main supervisor by phone or email if they had any questions regarding the study.

- Information about study III-IV was given and written consent was taken from all participants before entering the study (Appendix 5-6).

- Vaginal examinations of the PFM in study III-IV were performed in a private environment. Screens where the participants could undress, and dress were used. The participants were asked to bring their own towel for draping above their pelvic with the purpose of making the participant feel less exposed. Before and during the examinations thorough information was given about the procedure, allowing the participants to make informed decisions and ask questions. The examinations were performed in a careful manner to minimize possible pain or discomfort. The assessment procedure was originally developed by the main supervisor. The PhD. Candidate who performed all PFM assessments, underwent thorough preparations. These included attendance of a course in PFM assessments developed by the Women's Health Group of the Norwegian Physiotherapist Association and supervised training in clinical practice with experienced women's health physiotherapists trained in the measurement methods.

Results

The following summarizes the results from paper I-IV. For further details, the reader is referred to the original papers included at the end of this thesis.

Paper I

We were able to include a total of 319 female athletes: 68 artistic gymnasts (response rate: 38.2%), 116 team gymnasts (response rate: 19.6%) and 135 cheerleaders (response rate: 12.5%). The athletes had a mean age of 17.4 years (SD: 3.2), mean BMI of 21.7 (SD: 2.7) and a mean of 6.8 years of experience with gymnastics or cheerleading. Most athletes had ≥ 4 training sessions per week, with 203 (63.6%) reporting 4-5 training sessions and 46 (14.4%) 6-7 sessions per week. The overall prevalence of UI and AI were 67% and 84%, respectively. The most common subtype of UI was SUI, reported by 63%. Urgency UI was reported by 11.6% and mixed UI by 9.4%. Involuntary loss of gas was the most reported type of AI (81.2%), while involuntary of loss of liquid or solid stool were less common, reported by 40.8% and 12.2% respectively.

In our multivariate logistic regression analysis, the factors found to be significantly associated with SUI were age of 16 (OR: 3.45, 95% CI: 1.66-7.18) and 17 years (OR: 5.18, 95% CI: 2.15-12.48), ≥4 training sessions per week (OR: 2.31, 95% CI: 1.22-4.37) and straining to void (OR: 2.66, 95% CI: 1.26-5.64). Also, cheerleaders were shown to have significantly lower odds compared to both artistic gymnasts (OR: 2.75, 95% CI: 1.39-5.46) and team gymnasts (OR: 4.07, 95% CI: 2.15-7.69). Years with specialization in gymnastics/cheerleading was the only variable found to be positively associated with AI (OR: 1.14, 95% CI: 1.02-1.26).

Among athletes reporting any UI, the mean ICIQ-UI-SF score was 6.3 (SD: 3.7, range: 0-17) and mean impact of UI on daily activities was 2.5 (SD: 2.4, range: 0-10), with 46 (21.4%) scoring ≥5. The majority (N=199, 99.0%) of athletes with SUI experienced leakage during gymnastics or cheerleading, with take-off and landing from gymnastic/acrobatic elements reported as the most provocative activity**.** One hundred and sixty-six (82.6%) reported negative effect of leakage on sports performance. Fear of visible leakage and embarrassment were the most common complaints. Forty-five (22.4%) reported they would occasionally avoid training or specific exercises because of leakage and 53 (26.4%) had never spoken about the condition with anyone.

Of females reporting AI, mean bother of accidental loss of gas, liquid and solid stool were 3.0 (SD: 2.6, range: 0-10), 2.3 (SD: 2.3, 0-10) and 2.4 (SD: 2.4, range 0-10), respectively. Among

athletes reporting accidental loss of gas, 227 (87.6%) experienced leakage during training and/or competition: 99 (38.2%) rarely, 91 (35.1%) occasionally, 31 (9.7%) often and 6 (1.9%) all the time. Of those reporting liquid AI, 24 (18.7%) rarely and 5 (3.8%) occasionally experienced leakage during training and/or competition. Of those with solid AI, 7 (2.2%) reported leakage during training/competition and all experienced it rarely.

One hundred and thirty-two (41.4%) of the athletes had never heard about the PFM. Only thirty-two (10.0%) knew how and 58 (18.2%) why to train the PFM, but 235 (73.7%) reported willingness to perform PFMT to prevent or treat UI and AI if they knew how to.

Paper II

We were able to recruit 191 female (response rate: 54.1%) and 204 male (response rate: 37.7%) Olympic weightlifters and powerlifters. Of these, eleven females were excluded due to either ongoing pregnancy, history of surgery for UI/POP or neurological disease. Finally,180 females and 204 males were included in the data analysis.

Prevalence of UI, AI and POP in females were 50.0%, 80.0% and 23.3% respectively. Stress UI was the most common subtype of UI, reported by 41.7% of the females. Prevalence of UI and AI in males was 9.3% and 61.8%. Involuntary loss of gas was the most common subtype of AI among both females (76.7%) and males (56.4%). Involuntary loss of liquid and solid stool was less common, reported by 32.8% and 7.2% females and 25% and 6.9% males respectively.

In the multivariate logistic regression analysis of possible risk factors and PFD, we found that increasing BMI was significantly associated with SUI (OR: 1.09, 95% CI: 1.01-1.17) and international level of competition (OR: 3.27, 95% CI: 1.32-8.07) and weightlifting ≥4 days/week (OR: 0.26, 95%CI: 0.08-0.86) with AI in females. In males, increasing age (OR: 1.03, 95% CI: 1.00-1.07) and frequently straining to void (OR: 4.84, 95% CI: 1.02-22.94) were significantly associated with AI.

Of females reporting UI, the mean ICIQ-UI-SF score was 4.3 (SD: 2.8) and mean impact of UI on daily activities was 1.8 (SD: 2.0, range: 0-9), with 11 (12.2%) scoring ≥5. Exercises reported to trigger leakage the most were heavy weightlifting (at 1-5 RM), deadlifts and back squat. Seventy-two (87.8%) of those with SUI reported negative effect of UI on sports performance. Fear of visible leakage and loss of concentration were the most common complaints. Sixteen (19.5%)

reported they would occasionally avoid training or specific exercises because of leakage and 21 (25.6%) had never spoken about the condition with anyone.

Of females reporting AI, mean bother of accidental loss of gas, liquid and solid stool was 2.3 (SD: 2.5), 2.0 (SD: 2.5) and 2.2 (SD: 2.8), respectively. Among females reporting accidental loss of gas, liquid, or solid stool 89.1%, 23.8% and 15.4% experienced leakage during training/competition. The mean score of bother of POP was 1.0 (SD: 2.1) and 1.0 (SD: 1.6) for bulge felt on the inside and outside of the vagina respectively.

Among the male athletes the mean score of bother of involuntary loss of gas, liquid or solid stool were 1.2 (SD: 1.8), 1.3 (SD: 2.1) and 2.6 (SD: 3.0) respectively. Among males reporting accidental loss of gas, liquid, or solid stool, 91.3%, 39.2% and 28.6% experienced leakage during training and/or competition.

Thirty-seven females (20.6%) and 120 males (58.8%) had never heard about PFM. Seventy-seven (42.8%) females and 150 (73.5%) males did not know why and how (80 females, 44.4% and 148 males, 72.5%) to train the PFM. However, 141 (78.3%) females and 101 (49.5%) males responded they would do PFMT to prevent or treat PFD, if they knew how.

Paper III

The study included 47 nulliparous women with a mean age of 27 years (SD: 4.2) and a mean BMI 25.1 (2.9). Among these, 15 were powerlifters, 14 were functional fitness exercisers, 14 were recreational exercisers, and 4 were Olympic weightlifters, with a mean of 7.3 years (SD: 2.7) of experience in weightlifting and 6.3 hours (SD: 2.7) of weightlifting per week. The mean 1 RM were 108.1 kg (SD: 18.8) in back squat and 128.1 kg (19.6) in deadlift.

There were small but statistically significant, decreases in mean PFM resting activity on sEMG after both weightlifting (mean change: 1.6, 95%CI: 0.5 – 2.7) and rest (mean change: 1.3 (CI: 0.4 – 2.1). No other significant changes were found in PFM muscle resting pressure, strength, or endurance from either weightlifting or rest. When comparing the effect of heavy weightlifting with the effect of rest, we found no significant differences in change of PFM resting pressure (mean difference: 0.7 cmH_2O, 95%CI: -0.8-2.2), strength (mean difference: -1.6 cmH_2O, 95%CI: -5.1–1.8), endurance (median difference after exercise: 6, IQR: -24.5-26.5 vs. rest: 13, IQR: -15-40.2, p = 0.255) or resting activity (mean difference: 0.3, 95%CI: -0.9-0.5). We did not find any patterns/trends of the repeated PFM measures by inspection of box plots and spaghetti plots,

and the risk of systematic errors, e.g. learning effect, was considered low. Further, there were no significant differences in mean change in pre-values of PFM strength ($p = 0.705$) and endurance ($p = 0.295$) between the participants who began with weightlifting and those who began with rest.

Finally, the PFM strength was not significantly correlated to 1RM strength in back squat ($r = 0.1$, 95%CI: -0.19-0.38, $p = 0.506$) or deadlift ($r = 0.08$, 95%CI: -0.21-0.36, $p = 0.58$), nor to relative strength (1RM/bodyweight) in back squat ($r = 0.19$, 95%CI: -0.10-0.45, $p = 0.213$) or deadlift ($r = 0.18$, 95%CI: -0.11-0.44, $p = 0.226$).

Paper IV:

In this RCT, 54 women were recruited to baseline assessments. Two were excluded due to inability to perform a correct PFM contraction and one participant chose not to participate due to ongoing PFMT with promising results. Of the remaining 51 participants, 26 participants were randomized to the PFMT group and 25 to the control group. Four participants dropped out of the PFMT group and none in the control group. Finally, 47 women were included in the data analysis. The women had a mean age of 33.5 years (SD: 8.1) and mean BMI of 25.4 (SD: 3.2). The mean ICIQ-UI-SF score was 7.5 (SD: 3.3) in the PFMT group and 7.5 (SD: 3.1) in the control group at baseline. Thirteen (59.1%) women in the PFMT and 10 (43.5%) in the control group were parous, with a mean parity of 1.9 (SD: 0.7) and 2.0 (0.7) respectively. The participants in the PFMT group completed 70% (SD: 23) of the prescribed exercise sessions. Thirteen (59%) adhered to >70%. No adverse effects of the intervention were reported.

We found a mean change in the ICIQ-UI-SF score of -1.3 (95% CI: -2.6 to -0.03) in the PFMT group and 0.1 (95% CI: -0.6 to 0.9) in the control group. The PFMT group had significantly larger improvement in the total score compared to the control group with a mean difference of -1.4 (95% CI: -2.6 to -0.2). The proportion of women reporting improved symptoms of SUI (≥1) after 16 weeks was significantly larger in the PFMT group compared to the control group (64% vs. 8%, $p < 0.001$, RR: 8.0, 95% CI 2.0 to 31.2) on the PGI-I scale. None in the PFMT group and one participant in the control group reported worsening of symptoms.

There were no significant differences in change of PFM resting pressure, strength, or endurance between groups, with mean differences of 1.3 (95% CI: -1.4 to 4.0), 3.8 (95% CI: -0.8 to 8.4) and 39.28 (95% CI: -1.5 to 80.1) respectively. Changes in symptoms of AI and POP were similar in both groups after 16 weeks. The participants in the PFMT group did not improve their self-efficacy for PFMT or beliefs in expected results after 1 month of training.

Discussion

Methodological strengths and limitations

Paper I-II

Strengths of the studies are use the of valid and recommended questionnaires used to assess prevalence and symptoms of PFD and the exclusive samples of high-level athletes. We included a variety of questions of different topics in our survey which can contribute to improved insights of the etiology of PFDs, the impact of SUI on sports participation, openness of PFDs, and the athletes' knowledge of the pelvic floor. The high number of participants with PFDs allowed for analysis of associations. To our knowledge, study II was one of the first studies to investigate PFDs in male athletes.

The limitations of the studies are the cross-sectional designs, use of self-reported measures and the low response rate. As for all cross-sectional studies exposure and outcome were measured at the same time point and a cause-effect relation cannot be inferred (142). The use of self-reported measures may have influenced the results by response bias, such as recall bias or social desirability bias (143). Due to the low response rate our results may have been prone to non-response bias (144). Non-response bias may have occurred if the non-responding athletes differed from the responders regarding sociodemographic, behavior, or attitudes. If so, the external validity of the studies may have been threatened. Non-response bias is common in cross-sectional studies, but are challenging to address due to limited information about the non-responders (145).

Paper III

Strengths of this study is the crossover design, which allowed each participant to serve as their own control, and the randomized order of the interventions. With this design the risks of inter-subject variability and confounding can be minimized (146). Other strengths are the inclusion of an a-priory power calculation and 1RM strength tests, the latter provided accurate measures of training intensity and muscular strength. We also used responsive, reliable and valid measurement methods (52, 53, 56, 133). All manometer measurement were done with simultaneous observation of inward movement of the perineum/catheter ensuring a correct PFM contraction

(53).The testing procedure was standardized and performed by the same examiner, which ensured consistency throughout the data collection.

One limitation of the study is that we cannot completely assure that the wash-out period between sessions were sufficient to restore maximum voluntary contraction force, due to a lack of supporting literature on fatigue and recovery of PFM force development. However, we found no significant changes in pre-values of PFM strength and endurance between those who performed the weightlifting session first compared to those who started with rest. Also, Häkkinen (147) found that maximum knee extension force recovered to approximately 90% of the pre-exercise force in females one-hour post-exercise. If we assume that the PFMs are indirectly loaded at moderate intensity during weightlifting, a one-hour washout should be enough.

Other limitations are the lack of statistical power to analyze differences in response to weightlifting between women with and without SUI and blinding of the assessor of PFM variables to the order of the sessions. Further, the wide confidence intervals may be a result of measurement errors due to learning effects, since the participants had little experience with PFM assessments before entering the study. However, by including baseline PFM measurements, the participants were familiarized with the measurements, and we may have minimized systematic errors due to learning effects on the test day. We did not ask about the participants reproductive profiles (menstrual status/cycle/irregularities, use of contraceptives or hormonal therapy). However, we believe the results were not influenced by differences in reproductive profiles and variations in menstrual cycle, since we performed within-subject analyses and all measurements of the PFMs were performed on the same day. Furthermore, measurements of PFM contraction time and force have previously been found to be stable during different phases of the menstrual cycle (148). Finally, due to strict inclusion criteria our study sample may have been too homogeneous to detect any linear relationships between whole-body strength and PFM strength.

Paper IV

A major strength of study IV is the randomized design. RCT's are considered the most rigorous study designs to determine whether a cause-effect relation exists between the treatment and the outcome (149). The random allocation of the participants to either a PFMT group or a control group, ensured that no systematic differences between the intervention group and the control group could have affected the results. Blinding of the subjects involved in the study (participants and clinicians) ensures that? preconceived views cannot systematically bias the assessment of

outcomes (149). In our study the assessor was blinded for group assignment, but since it was an exercise trial blinding of the participants and the physiotherapist who administered the intervention was not possible. Other strengths of the study are the a priori power calculation and use of valid and reliable measurement tools to assess UI (125) and PFM variables (52, 53, 56, 133). The same assessor performed all measurements of the PFMs following standardized procedures, ensuring consistency throughout the data collection. Further, the intervention was based on strength training principles and followed a previously proven effective protocol to improve SUI and PFM strength (136, 139, 150, 151). The participants received advise on progression alternatives and reminders to adhere to the prescribe training sessions. Our inclusion criteria were not restricted to performance level, age or severity of SUI and our results may therefore be generalizable to a variety of female adults who engage in CrossFit® or functional fitness training with symptoms of SUI.

A limitation of the study is the lack of supervised training and follow-up assessments which may have negatively influenced adherence and intensity of the training. The use of self-reported questionnaire as main outcome may have been affected by recall bias and the treatment effect may have been underestimated by categorical responses. Intention-to-treat analysis is advised to use when assessing effectiveness of a trial (152). Due to missing data of post-tests for four participants who dropped out in the PFMT group, we decided to perform a full set analysis, since imputation of missing data is generally not recommended (152). This decision was made in collaboration with a biostatistician at The Norwegian School of Sport Sciences. Additional sensitivity analysis with imputed data of different outcomes of the main outcome (improvement, no change and worsening) for the participants who dropped out were performed. The between-group mean differences became larger or smaller but remained statistically different in favor of the PFMT group. Hence, we can be reasonably confident about the validity of our results of primary outcome.

Interventional quality study IV

The International Consensus on Therapeutic Exercise and Training (i-CONTENT) tool is a checklist used to assess quality of interventions in RCTs (153). It consists of seven items: 1. Patient selection, 2. Type of exercise, 3. Dosage parameters (frequency, intensity, time), 4. Qualified supervisor, 5. Type and timing of outcome assessment, 6. Safety of the exercise program, and 7. Adherence to the exercise program.

1. Patient selection and type of exercise

To date, there is level 1 evidence with grade A to support PFMT as first-line treatment of SUI in women(11). The rationale for PFMT is previously described in the theoretical section. Overall, we believe that our intervention (PFMT) matches the participants problem (SUI) and consider the risk of ineffectiveness low in regard to patient-selection and type of exercise.

2. Dosage of the training program

Our intervention followed the same protocol as previous studies with promising results for improving SUI (136, 139, 150, 151). In one of these studies, the PFMT protocol led to increased PFM strength with an effect size of 1.21 compared to the control group, 15% increase in PFM thickness, 7% reduction in the opening of levator hiatus and elevation of the bladder and rectum (14, 136). However, compared to our protocol the intervention period was longer (+2 months). In previous interventional studies of volleyball athletes, intervention periods of 12 and 16 weeks resulted decreased amount and frequency of SUI (121, 122). Altogether, we consider the risk of ineffectiveness regarding training dosage low. Sixteen weeks of strength training of the PFM should be sufficient to improve the PFM strength when the training is followed as prescribed. However, it is reasonable that a longer training period could have led to larger improvements on PFM strength. Is should also be questioned if even higher training dosage is necessary in women who are exposed to repetitive and high loads on the PFM during exercises compared to non-strenuous exercisers.

3. Qualified supervisor

Prior of the intervention, all participants had received thorough instruction on how to perform a correct PFM contraction by a trained physiotherapist. The physiotherapist who supervised the PFMT throughout the intervention period had training and experience with PFMT. Altogether, we believe that the risk of infectiveness regarding the supervisors was low.

4. Outcome assessments

We used valid and reliable outcomes measures at baseline and post-intervention. The ICIQ-UI-SF reflects potential changes in symptoms of SUI, while the manometry measures provide objective measures of changes in the PFM. We consider the risk of ineffectiveness related to outcome assessments low.

5. Safety of the exercise program

In previous studies of PFMT very few adverse effects have been reported (worsening of symptoms after the two first months which disappeared as treatment continued, uncomfortable feeling during the exercises and feeling that the exercises were bothersome) (11). No adverse effects were reported among our participants. Therefore, we consider the risk of infectiveness due to adverse effects low.

6. Adherence to the exercise program

Unfortunately, not all participants adhered to the training program as prescribed. The adherence was various among the participants. We considered adherence >70% sufficient to improve both symptoms of UI and PFM strength, but only 13/22 adhered to >70% of the training program. Therefore, we cannot exclude that the low adherence may have influenced the interventional effects on SUI and PFM strength. However, this may reflect the actual adherence in a real-life setting. A per-protocol was not recommended due to the low number of adhering participants and was therefore avoided, but it is plausible that those who adhered to the protocol may have improved more than those performing less PFMT during the intervention.

Interpretation of results

Paper I-II

Prevalence

We found high prevalence of PFDs in our studies of female gymnasts and cheerleaders (paper I) and strength athletes (paper II). To our knowledge these were the first studies to report of other PFD (AI and POP) than UI in these sport groups. In previous studies of UI in artistic gymnasts, slightly lower prevalence rates (56 and 67%) have been reported (69, 70). The extremely high prevalence rates of UI found in our study, especially in gymnasts, is comparable to those (73 and 80%) reported among young, female trampolinists (67, 68). Lower prevalence of UI was reported among elite rhythmic gymnasts (32%) (129). Artistic gymnastic, team gym and cheerleading may be more comparable to trampolining, due to similarities in the amount of high impact acrobatic activity, including elements with somersaults, twist and turns. A more recent study in cheerleaders reported lower prevalence of UI (27%) and AI (63%) in their sample compared to ours. These differences may be explained by differences in how UI/AI were defined and participant characteristics. Altogether, results from these studies indicates that both UI and AI are highly

common concerns in athletes from acrobatic sports. Bø and Sundgot-Borgen (91) found that UI at an early age predicted UI later in life. In addition, symptoms of UI at a young age, both before and during pregnancy, has shown to be a risk factor for more severe UI (34). Hence, detection of UI and early intervention is warranted to prevent further deterioration or chronicity of the condition.

When planning study II in 2018, few had previously investigated PFDs in a strength-trained population. In a study of recreational exercisers who regularly performed body-building exercises, only 14% reported UI (107). However, recreational athletes may not be comparable to elite strength athletes regarding training load and volume, and these factors may explain the lower prevalence. In the recent years, there has been a growing interest in UI in strength athletes. The reported prevalence of SUI in our sample is within the range of prevalence rates (32-59%) reported in newer studies of female powerlifters (109, 110),Olympic weightlifters (108, 154), and combined strength athletes (155).

In summary, nearly 3 out of 4 female gymnasts/cheerleaders and 1 out of 2 women in strength sports experience UI according to results from our studies. Increased knowledge of preventive measures is warranted to lower the prevalence rates, prevent UI later in life (e.g. during pregnancy) and to encourage maintenance of sport participation among female athletes from acrobatic and strength-specific sports – especially in young, nulliparous, and adolescent athletes.

POP and AI in females athletes are less studied (2). In studies of athletes from other sport disciplines, the overall prevalence of AI and POP ranged between 6.1-64.4% (71-73, 156) (157) and 0-8% respectively (71, 72, 156) (157), which overall are lower than prevalence reported in our studies. Like our findings, AI was mainly reported as involuntary loss of gas. The above-mentioned studies of AI and POP differs in participant characteristics and questionnaires/definitions used to assess PFD. Differences in results could much likely be attributed to these differences and comparisons of results across studies is therefore challenging.

Generally, SUI is not a common condition in men, except after prostatectomy (33). The prevalence of UI among males in study II was within the same range as in the general male population (1-39%) (33). Only two male athletes in our study reported SUI. This agrees with results from other studies including male athletes from rope-skipping athletes (158), the fitness

industry (90), CrossFit© (159), track and field (160) and different sport modalities (161) with reported prevalence rates of UI between 2-19%. One of these studies reported a 5.5-fold increased risk of UI among the females compared to the male athletes (161). Similar to our results, SUI were less common than other types of UI, such as urgency UI. Altogether, these results may confirm SUI as a female-specific issue in the athletic population in primary. Women may generally be more at risk of SUI compared to men due to functional and anatomical differences, such as a wider pelvis with three orifices instead of two, length of the urethra, composition of different muscle fiber types (I and II) of the urethral striated muscles and muscle thickness of levator ani (162), but the understanding of the pathophysiology of SUI in women is not complete (41).

The prevalence of AI among males in our study was high compared to rates reported in general population studies (4-16%) (31), suggesting that competitive male athletes in strength sports may have increased risk of experiencing AI. This may be explained by the high exposure of heavy lifting resulting in large elevations of the IAP in our sample compared to non-lifting males. But there is limited evidence to support this claim, and further studies of PFD in male athletes are warranted. In addition, male athletes (especially cyclists) may also be prone to conditions such as erectile dysfunction, urethral stricture, and genitalia numbness (89, 163), which also should be considered in future studies.

Finally, it should be noted that the true extent of these conditions in female acrobatic and strength athletes is uncertain due to low-response rate and limited information of non-responders in both of our studies. This is an issue regarding most of the mentioned cross-sectional studies, and interpretations of prevalence should be interpreted with caution.

Risk factors

In our multivariate logistic regression analysis in paper I and II, we found that few factors could explain the high prevalence rates of UI and AI reported. Among gymnasts/cheerleaders the factors found to be positively associated with SUI were straining to void, the age group 16-17 yeas, training frequency (>4 days per week) and type of sports (artistic gymnastic/team gym vs. cheerleading) were positively associated with SUI. For AI, the only related factor was higher number of years specializing in gymnastics or cheerleading. We have not been able to find other studies evaluating risk factors in female gymnasts and cheerleaders. But increased training volume and frequency have been found to be associated with presence or severity of UI symptoms in

studies of young, female trampoline athletes (66, 68). Gymnasts/cheerleaders in our sample reported that sport specific situations that would most commonly trigger UI were take-off or landings from gymnastic or acrobatic elements and jumping/trampoline jumping. It is therefore likely that higher exposure of these activities (by increased training volume) may lead to leakage happening more frequently.

Increased age and BMI are well-established risk factors for UI in general female population (31), but these factors were not associated with SUI in our sample of gymnasts and cheerleaders, except for aged 16 and 17 years who had higher odds compared to younger athletes. These athletes may be more exposed by other factors as well (such as higher training dosage, hormonal/weight changes during puberty) and the increased odds may not be attributed to age alone. Furthermore, our sample may have been to homogenic to explore associations between age/BMI and SUI. Straining to void were also found to be associated with UI in ex-trampolinists (OR: 1.8, 98%CI: 1.08-3.36). Anecdotally, straining to void may be a bad habit caused by women trying to hurry and increase their flow rate when voiding. The flow rate has been shown to increase by abdominal straining, Valsalva or suprapubic pressure (32). "Non-relaxing pelvic floor" has been suggested to be a condition affecting female athletes (164). This condition may lead to impaired ability to evacuate urine or stool. However, research on inability to relax the PFM during voiding and its relation to other urinary tract symptoms, such as SUI, is limited both in the general population and in athletes.

In study 2, the only factor found to be associated with SUI in female strength athletes was increasing BMI. These results are supported in newer studies of strength athletes (109, 154), except for one study in female weightlifters ((108). High BMI is a well-established risk factor of SUI in the general female population (31). However, high BMI values in strength athletes are more likely to be a result of high muscle mass than overweight and obesity.

Parity is considered one of the most important risk factors for both SUI and POP in women (31). However, no association between parity and SUI or POP was found among the females in the present study. In contrast, in the newer studies of strength athletes positive associations between parity (108, 109), prior pregnancies (154) or history of vaginal birth (155) and UI/SUI were found. Also, Forner et al.Forner, Beckman and Smith (165) found that vaginal delivery was the strongest associated factor to POP (OR: 5.3, 95%CI: 4.0-7.1) in women who habitually lifted weights at different loads. These results may conflict to ours due to differences in study methodologies (questionnaires, statistical methods). Furthermore, our sample consisted of a more

homogenic sample regarding competition level. National and international level competitors must be able to lift a certain load in their respective weight class to qualify for competition. This may require higher training dosage/loads, possibly reaching the thresholds of loads tolerated by the pelvic floor in both nulliparous and parous women. Also, at this level of competition there might have been a natural selection of parous women tolerating high weightlifting loads due to adequate pelvic floor recovery after pregnancy and birth giving. In the above-mentioned studies in strength athletes (including ours) few sport-related factors were found to be associated with UI. Only competition total (load in kg) in powerlifters (109) and prior participations high-impact sports in master weightlifters (154) were found to be related to UI. Sport-related risk factors should be further evaluated, aiming to identify modifiable risk factors that could be targeted in future preventive research studies.

Few studies have investigated risk factors of AI in female athletes (2). Vitton et al. (73) found that athletes who participated in sports >8 hours per week had a 3-fold increased risk of AI compared to those who trained less. We also found that female gymnasts/cheerleaders and male strength athletes with training experience had higher odds of AI compared to those with less experience. However, more investigations are needed to establish risk factors of AI in athletes.

Finally, there are some issues when comparing results from different studies that needs to be addressed. First, a vast majority of studies are cross-sectional exploring associations and correlations of several proposed risk-factors, but no casual relationships can be inferred. Longitudinal studies evaluating differences among athletes who develop SUI and those who do not, should be considered in future studies. However, these studies are often more time-consuming and costly compared to cross-sectional studies (142). Secondly, standardized questionnaires used to assess UI/SUI, such as the ICIQ-UI-SF (125), are developed for a general urogynecological populations and do not include sport-specific questions. Therefore, the authors of the above-mentioned studies (including ours) have developed their own questions to cover issues related to sport performance and sport-related risk factors (such as training exposure and load). A recent screening tool for PFD (The SENTINEL-PFD) in female athletes was recently developed by an Italian research team using a Delphi modified consensus, including questions of UI, POP and AI symptoms and possible risk factors (166). If proven valid and reliable, such athletic-specific questionnaires should be considered as primary measures in future studies to make comparisons of results between studies possible. Further, there should be consensus regarding statistical methods used to analyze results.

Impact of SUI on sport performance, participation, and knowledge of the PFM

More than >80% of the female gymnasts, cheerleaders (paper I) and strength athletes (paper II) reported that urinary leakage during sports could negatively affect their performance and participation in sports. These findings agree with results from other studies of the female athletic population showing that UI may have a large impact on performance and their emotions (e.g., feelings of embarrassment and fear of UI incidents) (8). The most concerning finding is that some athletes report limitations or cessation of sports activity. In both of our studies, almost 1 out of 5 athletes with SUI, reported that they would occasionally avoid training or certain exercises due to concerns of leakage. Fear of visible leakage was another common concern reported among athletes in both studies. This was also reported as the most common complaint by rhythmic gymnasts with SUI (129). In these sports, athletes wear tight and minimal clothes and therefore signs of leakage may be especially visible. Furthermore, few of the gymnasts, cheerleaders and strength athletes had spoken to health professionals about their conditions. These results align with findings in a recent study of female strength athlete, where 2 out of 3 believed that UI was a normal part of their sport, but only 9% had ever sought treatment (155). Improved knowledge of PFD among health care personnel working with high-risk athletes could potentially contribute to early identification and management of these conditions. Evaluations of validity and implementation of screening-tools, such as the previously mentioned PFD-SENTINEL (167), is considered useful in future studies.

The male strength athletes (paper II) seemed to be minimally bothered by PFD. Avoiding discussions about AI or not recognizing the condition as a problem, have previously been reported as common coping mechanisms among men and women (168). These mechanisms may also apply for our sample of male athletes. On the other hand, they may also consider AI, especially involuntary loss of gas, as an accepted and non-problematic consequence of heavy lifting.

Although knowledge of the PFM was sparse among athletes in the both studies (paper I-II), most athletes expressed an interest in PFMT if they knew how to perform the training. Given the high impact on the pelvic floor in these athletes, it is presumed that they need much stronger PFM than non-exercisers (2). The PFM are skeletal muscles which can adapt to strength training in the same way as other skeletal muscles by following principles of strength training (100). Further research is warranted to assess feasibility, effects, and implementation of PFMT in these sports groups.

Paper III

In our cross-sectional study of PFD in strength athletes, the females who experienced SUI symptoms reported that sport-related situations that could most commonly trigger urinary leakage were heavy lifting at intensities of 1-5 RM (78%) and performing back squats (56%) and deadlifts (63%) (Paper II). These results were used as basis when planning the exercise protocol in study III. To our knowledge, this is the first experimental study to investigate the effects of heavy weightlifting on the PFM. Abilities to produce maximum muscle force (MVC) or to sustain muscle contractions are frequently used to assess levels of muscle fatigue/exhaustion following physical effort (169). Previous research indicates a relationship between PFM fatigue and the development and/or worsening of SUI (170). However, we found that a single session of heavy weightlifting did not affect PFM strength (MVC) or endurance (ability to sustain a PFM contraction for 10 seconds). Our results indicate that, the loads may be considered tolerable and below the intensity level to cause PFM fatigue in nulliparous, young, and strength-trained women. Despite our results, PFM fatigue as a possible mechanism of SUI in powerlifters and other strength specific sports cannot be fully rejected. A recent cross-sectional study of female powerlifters the females fatigue was reported as a trigger of UI, especially if not well rested before lifting or the training sets were long, heavy, difficult, or slow (109). Powerlifters often use rigorous training regimes with high specificity to improve their 1RM in back squats, bench presses, and deadlifts before competitions above intensities (171). Our weightlifting session lasted only 1 hour, while the duration of a lifting session often exceeds 2 hours in competitive strength athletes (171). Therefore, the role of higher training load (>85% of 1RM) or volume and restitution between sessions on PFM fatigue should be further evaluated.

We were able to find two other experimental studies of the impact of exercise combinations on the pelvic floor. However, these differ in exercise type and participant characteristics, which may challenge the comparability of the results. The exercise protocols in the above-mentioned studies consisted of high-impact jumping and running activities in addition to weightlifting exercises, and loading characteristics of the pelvic floor may not be comparable to weightlifting alone. To increase the knowledge of mechanisms of SUI in strength athletes, PFM response during weightlifting should be measured. Unfortunately, PFM response during movement and exercise is challenging to evaluate due to a lack of good-quality in-vivo measurement methods (6). Vaginal sEMG has been used in previous studies of PFM activity during running and jumping activities (57, 172), but movements of the vaginal probe and crosstalk from nearby muscles may potentially affect the outcomes (44). The validity of such measurements is therefore questioned.

Individual variations in response to exercise were also observed in our study. Bø and Nygaard (2) have suggested that there might be an individual thresholds of IAP tolerance to the pelvic floor during exercise. Hence, the response to strength training may be differently tolerated by strength athletes. A small ultrasound-study comparing anatomical and functional differences among high-impact athletes and non-athletes found that athletes had thicker PFM, but larger bladder neck-descent and opening of the levator hiatus on straining (61). Deficits in urethral and bladder neck support, functions of the striated urethral sphincter and levator ani muscles have been shown to be associated with SUI in the general female population (101). Therefore, anatomical and functional differences in strength athletes with and without SUI should be further explored.

Manometry and sEMG were used to measure changes PFM resting tone after weightlifting and rest. Muscle tone can be influenced by alterations in active (neural drive) or passive components (e.g. physical properties of muscle and connective tissue) (55). sEMG specifically measures the active electrogenic component of tone, while vaginal resting pressure measures the summative contribution of both active and passive components (55). We found small but significant decreases in PFM resting activity (sEMG) after both weightlifting and rest. These results may indicate a decrease in activated motor units and possible relaxation of the muscles. However, the smallest detectable change with vaginal sEMG was previously reported to be 3.11 (56), and the changes in our study of 1.6 after weightlifting and 1.3 after rest may be too small to be considered clinically relevant. It has been suggested that strenuous training may cause non-relaxing/overactive PFMs. This can potentially lead to pelvic pain, sexual disorders, and the inability to pass urine or stool (164). In our study, muscle tone did not increase following heavy weightlifting and there is currently a lack of evidence to support these assumptions. Further, well-established normative values and convincing evidence of an association of increased muscle tone with pain or other PFD are currently lacking (45). Therefore, measures of muscle tone should be interpreted carefully.

We found that strength in whole-body exercises was not correlated to PFM strength, which indicates that strength adaptions from heavy weightlifting exercises, such as back squats and deadlifts, are not specific to the PFM. Consistent with our results, Moss et.al. (173) found no associations between PFM strength and different measures of strength and fitness (e.g. hand grip strength) in postpartum women. Several studies have compared PFM strength in female athletes/exercises and non-exercisers, but the results are conflicting across studies (2). Altogether, as many studies have confirmed that the prevalence of UI, AI, and POP are high in athletes, existing evidence does not support the assumption that general exercise can improve PFM strength and PFD (2). Luigenbuhl et al (174) found no additional effect of adding jumping and

running activities to PFMT alone. Evidence from RCTs, systematic reviews, and meta-analyses show that specific and targeted PFM strengthening training is necessary to improve PFM strength (11, 175).

Paper IV

Originally, we planned to perform a follow-up RCT to our cross-sectional study in female gymnasts and cheerleaders with the aim to assess the effect of PFMT in athletes with SUI. Unfortunately, as previously mentioned, we had to cancel the study due to delays after the COVID-19 pandemic. Elite athletes are highly motivated to engage in regular training, and strength training of the PFM could easily be incorporated in their basic training regimens both as prevention and treatment strategies of PFD. In a recent systematic review of PFMT in athletic women with SUI (13), the results from the included studies showed promising results for improving SUI and PFM strength. However, the review included intervention studies of all designs and only one RCT (121) of female athletes volleyball players. However, these results indicate that there is a potential for evaluating effects of PFMT as treatment for SUI in female athletes in high-quality RCTs.

Our decision to evaluate PFMT program in CrossFit© and functional fitness exercisers (paper IV) was based on the growing body of literature and research in this group of women, revealing high prevalence of PFD, and especially SUI (176). CrossFit© has been one of the fastest growing exercise modalities since its foundation in 2000 (79). In 2023, >160 000 women participated in the CrossFit© Open, which is a global online competition for women in all age groups and performance levels (177). Therefore, we believe that the results of our study are of relevance to a large group of women world-wide. To our knowledge, this was the first RCT of PFMT in female CrossFit© and functional fitness exercisers. We found that a 16-week home-training program PFM could improve the frequency, amount, and bother of SUI. The within-group reduction of the ICIQ-UI-score of 1.3 for the PFMT group and the between-group difference of 1.4 to the control group were below the previously reported MIDs of 2.5 and 1.6 respectively (124). However, the upper ends of the CIs reached worthwhile effects, indicating a possibility of beneficial effects on symptoms of SUI in favor of the PFMT group. Our sample had a lower severity of pre-intervention total scores compared to the sample used to calculate MIDs (mean: 10.2) (124). A large prospective study of an app-based approach to PFMT found that more severe baseline scores of the ICIQ-UI-SF were related to larger improvements (178) and a change of 1.33 has been calculated as MID for women with moderate severity (179). ICIQ-UI-SF

baseline severity should therefore be considered when using MID to interpret results. Additionally, nulliparous women often report mild UI symptoms (180, 181). Given the large proportion of nulliparous women in our sample (50%), the mean reduction in ICIQ-UI-SF-score may have been influenced by less severe UI at baseline among these women. In our sample, >60% of the women in the PFMT group and only 8% in the control group reported improvements on PGI-I scale, suggesting clinically relevant changes of the ICIQ-UI-SF score in favor of the PFMT group.

A Cochrane-review of >1800 women showed that women who performed PFMT were 6 times more likely to be cured of SUI compared to control groups with no treatment (11). None of the participants in our study reported cure of SUI. This may be explained by a higher exposure of high-intensity training and possible constant triggers of leakage in this group of sportswomen compared to the general female population. Furthermore, women with SUI may respond differently to PFMT based on functional and anatomical differences in the PFM and urethral system. A recent study of PFMT in women (mean age: 50 years) with SUI, showed that women with higher bladder neck positions and lower severity on the ICIQ-UI-SF scores were more likely to be cured of SUI after the intervention (182). These findings may also apply to our sample and could explain the various results in our study where some benefitted more than others to the PFMT program.

The ICIQ-UI-SF was chosen as primary outcome since it has been proven valid, reliable and responsive to change (125). In studies of PFMT in volleyball athletes, short-term pad-tests were used as the primary outcome measure (121, 122). The pad-test offers the advantage of providing a direct measure of the amount of urine loss during exercise. However, studies of short-term pad-tests has revealed poor reproducibility and various sensitivity (34-83%) and specificity (65-89%) in accurately predicting UI (183). If the pad-test is to be utilized in future studies, a standardized and sport-specific protocol should be established and further validated and reliability-tested.

Our PFMT protocol followed recommendations for effective training dosage (100) (184), but the PFMT group did not improve their PFM strength or endurance significantly compared to the control group. The CIs were wide, suggesting various response related to improvements of PFM strength and endurance. The upper limits of the CIs for within- and between group differences were above the previously reported minimal detectable change of 7.6 cmH_2O for PFM strength and 59.5 cmH_2O for endurance (52), suggesting possible worthwhile effects in favor of the PFMT group. Previous studies with similar intervention and measurement methods used to assess PFM variables have shown larger improvements in PFM strength, of 15.5 (138) and 13.1

cmH_2O (136). In these studies, the participants had weekly supervised training with a physiotherapist and more follow-up assessments of the PFMs, and the intervention period was longer compared to ours (6 vs. 4 months). The two former RCTs also reported better adherence with close to 100 and 80% respectively. These results suggest that supervised training, follow-up assessments and training durations of at least 6 months should be recommended to improve PFM strength and endurance. However, our pragmatic approach may be more in-line with a real-life setting for athletes where not all may have the opportunity to attend to weekly/monthly visits with a physiotherapist. Nevertheless, an intervention incorporating specific PFMT as part of the regular training programs in Crossfit© would be interesting to test in an RCT.

Clinical implications

- Our results from paper I-II indicate that PFD, especially SUI and flatus incontinence are very common conditions among female gymnast, cheerleaders, and strength athletes, but there is a lack of openness and knowledge of treatment options, such as PFMT. Our results may contribute to increased knowledge, awareness, and openness of PFD among athletes, coaches, and medical personnel in these sport environments. This may potentially lead to reduced stigma and improve help-seeking behavior among athletes with these conditions.

- Most athletes participating in study I and II with SUI, reported that leakage during sports could limit sport performance and participation. In worst case, PFD may lead to avoidance or cessations of sports. From a broader perspective, engagement in sports and physical activity is considered crucial for promoting health throughout life in adolescents and adults (17, 185). Unfortunately, sports dropout is a major concern in female adolescents (1). Enhanced awareness and screening of PFD in high-risk sports could potentially contribute to early identification and management of these conditions (166) and further prevent dropouts.

- Although heavy weightlifting exercises (e.g., back squat and deadlift) are assumed to produce strain on the pelvic floor, our results in paper III imply that these exercises are well tolerated by the PFM in healthy, nulliparous strength-trained women. Heavy weightlifting did not affect levels of exhaustion or muscle tone in our sample. These results are of importance in the prescription of pelvic floor-safe exercises. However, the

effect may be different with higher loads and years of regular heavy exercise and in women with severe SUI, parous, postpartum, or older women.

- In paper IV, we found that a PFMT program may improve frequency, amount, and bother of SUI in strenuous female exercisers involved in CrossFit© and functional fitness. PFMT is non-invasive and should be offered as first line treatment for SUI in female athletic populations. However, the large variability in our results indicate various effects, where some improved more than others. Measures to improve adherence and training quality should be considered and supervised training and closer follow-up measurements with a pelvic floor specialist may be needed to treat SUI in women who are regularly exposed to heavy impact on the pelvic floor.

Conclusions

I. UI and AI were highly prevalent in female gymnasts and cheerleaders. Higher training frequency was found to be associated with SUI and years with gymnastic/cheerleading experience with AI, indicating an increased risk of UI/AI with higher training exposure. Most athletes with SUI reported that urinary leakage negatively influenced sport performance and some athletes reported they would occasionally avoid training or specific exercises because of leakage. Few athletes had spoken with their coach or medical personnel about the condition and the athletes' knowledge of the PFM were limited.

II. We found high prevalence of UI, AI and POP in female power- and Olympic weightlifters. SUI and involuntary loss of gas were the most common subtypes of UI and AI. Increased BMI was the only factors shown to be associated with SUI and international level of competition and weightlifting ≥4 days/week with AI in women. In males, prevalence of overall AI was high, while UI was less common. Similar to women, involuntary loss of gas was the most common type of AI. Increasing age and frequently straining to void were significantly associated with AI. Most of the females with SUI reported negative effect of UI on sports performance and only few females had knowledge on why or how to train the PFM. The males seemed to be less bothered by symptoms of AI and less knowledgeable of the PFM than the females.

III. A 60-minute bout of heavy weightlifting (back squat and deadlift of 75-85% of 1RM) had no immediate effect on the PFM compared to rest in strength-trained, nulliparous women. Further, there was no correlation between strength in back squat/deadlift and PFM strength.

IV. A 16-week home training program of the PFM led to improvements of SUI in female CrossFit® and functional fitness exercisers. However, the PFMT group did not improve their PFM strength and endurance significantly compared to the control group.

Further research

- Considering the high prevalence of PFD found in paper I-II, there is an urgent need for increased knowledge of treatment options for PFD in female strenuous exercisers. To our knowledge no high-quality studies in these sport groups (acrobatic and strength sports) have been published. In our RCT of female CrossFit© and functional fitness exercisers, there were large individual variations in effect on SUI. Feasibility studies with focus on adherence, implementation and incorporation of PFMT as a natural part of the athletes' training regimes is therefore warranted. Finally, high-quality RCTs are necessary to evaluate the treatment effects of PFMT protocols on SUI and other PFD in the female athletic population.

- Further knowledge of the etiology and pathophysiology of PFD in athletes are necessary to establish effective prevention programs in high-risk sports. To fully understand the mechanisms of SUI and other PFD, pelvic floor biomechanics and muscle activity during rises in IAP from exercise should be evaluated. Unfortunately, good quality in vivo measurement methods with ability to accurately measure the pelvic floor during activities are currently not available. Development and thorough evaluations of the measurement properties of such assessments tools is therefore warranted in future research of PFD in athletes. Furthermore, since a vast majority of studies of risk factors are cross-sectional, there is a need for high-quality prospective studies assessing risk factors for SUI and other PFD in female athletes. Case-control studies comparing athletes with and without SUI are also of interests, to gain more knowledge of factors that may influence the development of SUI.

- In paper III, we assessed the immediate impact of heavy weightlifting on the PFM. To our knowledge, there is a lack of studies assessing long-term effects of strenuous exercise on pelvic floor morphology and function. Furthermore, the role of exercise intensities, restitution, variations through the menstrual cycle and thresholds for pelvic floor load tolerance should be further evaluated.

- In our RCT (paper IV) of PFMT in CrossFit© and functional fitness exercisers, the training group showed improvement of symptoms of SUI, but not in PFM strength. Improvements of UI symptoms could be caused by factors other than enhanced PFM strength, such as improved muscle stiffness, better automatic response from the PFM, improved bladder neck support and better awareness and timing. Such mechanisms of PFMT for improving UI in exercising women, should be further evaluated. Future RCTs in the athletic population,

should consider use of reliable, valid, and objective measures of changes in pelvic floor morphology in addition to PFM assessments.

- Today, more and more pregnant athletes want to return to high level competitive sport after giving birth. There is an urgent need for studies addressing the impact of early postpartum exercise on the pelvic floor. Furthermore, we need more knowledge of pelvic floor recovery post-partum to ensure pelvic floor safe return-to-play with low risk of complications (such as POP).

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Paper I

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ORIGINAL ARTICLE

Urinary and anal incontinence among female gymnasts and cheerleaders—bother and associated factors. A cross-sectional study

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Abstract

Introduction and hypothesis Artistic gymnastics, team gymnastics and cheerleading are sports including high-impact activities. It is presumed that the athletes' pelvic floor must be functioning well to prevent urinary (UI) and anal incontinence (AI) during sports. The aim of this study was to investigate the prevalence and risk factors for UI and AI in female artistic gymnasts, team gymnasts and cheerleaders; the influence of UI and AI on daily living and sport performance; and the athletes' knowledge about the pelvic floor muscles (PFM).

Methods All female athletes ≥ 12 years of age competing in ≥ 1 National Championship in artistic gymnastics, team gymnastics or cheerleading in 2018/2019 were invited. International Consensus on Incontinence Questionnaires were used to assess the prevalence/bother of UI and AI.

Results Among the 319 gymnasts and cheerleaders who participated, the prevalence of UI and AI was 67% and 84%, respectively. Age, training ≥ 4 days/week and straining to void were significantly associated with stress urinary incontinence (SUI) and years of training with AI. Eighty-three percent of athletes with SUI reported a negative effect on sports performance, 22% would occasionally avoid training or specific exercises because of leakage, and 28% used pads for protection. Forty-one percent of the athletes had never heard about the PFM, and 74% reported an interest in PFM training to prevent/treat UI or AI.

Conclusions UI and AI were prevalent in female gymnasts and cheerleaders, and SUI negatively influenced sport performance. The athletes' knowledge about the PFM was limited.

Keywords Anal incontinence · Athletes · Epidemiology · Females · Stress urinary incontinence · Urinary incontinence

Introduction

Stress urinary incontinence (SUI) is the most common form of urinary incontinence, defined as "the complaint of involuntary loss of urine on effort or physical exertion (e.g., sporting activities), or on sneezing or coughing" [1, 2]. This definition highlights that SUI may be a condition of concern in exercising women, and high prevalence has been reported among female athletes from different sports [3]. Anal incontinence (AI) includes involuntary loss of liquid or solid stool or gas [2]. AI among female athletes is less studied than UI [3].

The main functions of the pelvic floor are to provide support to the pelvic organs (the bladder, urethra, vagina, uterus and rectum) and to counteract to increases in intra-abdominal pressure (IAP) and ground reaction forces during daily activities [4]. Artistic gymnastics, team gymnastics and cheerleading are sports including significant levels of high-impact acrobatic and gymnastic elements. Landing from 90 cm height may incur ground reaction forces up to 56.0 N/kg [5]. It is therefore presumed that gymnasts and cheerleaders need well-functioning pelvic floor connective tissue and muscles to prevent incontinence during sports. Hence, their pelvic floor may serve as a model to understand the mechanisms of pelvic floor dysfunctions (PFDs). Elite gymnasts and cheerleaders reach

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their top level at a young age, often as adolescents, and the clothing used in training and competition is often tight and minimal. Therefore, it is reasonable that these athletes may be especially exposed and bothered by incontinence. To date, there is scant knowledge on UI or AI in female gymnasts or cheerleaders, and there is limited knowledge on risk factors, bother and whether these conditions affect daily life and sport performance [3]. Durnea et al. [6] found that symptoms of UI at a young age (before and during pregnancy) have been shown to increase the risk of later development of and more severe UI. Early detection of incontinence in young athletes may therefore prevent further development of the condition.

The aim of this study was to investigate the prevalence of and risk factors for UI and AI in high-performance female artistic gymnasts, team gymnasts and cheerleaders and to investigate the bother of UI and AI, influence of SUI on sport performance and the athletes' knowledge of the pelvic floor muscles (PFM).

Methods

Experimental approach

This was a cross-sectional study targeting all female artistic gymnasts, team gymnasts and cheerleaders at the top national junior and senior level in Norway. The study was approved by the Regional Ethics Committee (2018/2211/REK Sør-øst B, 20.12.2018) and the Norwegian Centre for Research Data (NSD: 199381, 24.01.2019). All participants or parents of athletes < 16 years old gave written informed consent.

Subjects

Inclusion criteria were being ≥ 12 years of age and participation in ≥ 1 Norwegian National Championship (NCC) in artistic gymnastics, team gymastics or cheerleading during 2018/2019. Athletes who did not meet the inclusion criteria, reported neurological disease or previous surgery for UI or completed < 90% of the questionnaire were excluded. The response percentage was calculated by the survey software and included informative text and questions (90% response: 85/92 questions with 7 questions on knowledge of the PFM excluded). Participant lists of NCCs in 2018/2019 were used to identify eligible athletes.

Questionnaire design, data collection and recruitment

The questionnaire was author-designed and included validated questions on incontinence. Prior to distribution to the full cohort, contact persons from the Norwegian Gymnastics Federation and the Norwegian Federation of American Sports were asked to distribute the questionnaire to a group of athletes/coaches for revision and feedback on the content. Minor revisions to questions regarding sport activities were made based on the feedback. Data were collected by an electronic questionnaire (Survey Xact) between March 2019 and June 2020. Collaboration with the two sport federations was established for recruitment of participants. Participants were recruited at four different NCCs, by email correspondence with clubs/coaches and via a registration link on the federations' webpages and social media platforms, such as Facebook and Instagram.

Outcome measures

Our primary outcomes were prevalence of UI and AI. Definitions of UI and AI were based on the International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for female PFD [2]. Patient-reported outcome measures with Grade A recommendation from the International Consensus on Incontinence (ICI) 2017 were used to assess prevalence of UI and AI: the ICI Questionnaire-Urinary Incontinence Short Form (ICIQ-UI-SF) for UI and questions from the ICI Questionnaire Anal Incontinence Symptoms and Quality of Life Module (ICIQ-B) for AI [7]. Athletes were considered continent if they answered "never" to the question "When does urine leak?" and "always" to questions regarding control of watery/loose stool, formed/solid stool and wind (flatus) for UI and AI, respectively. UI was further classified into different subgroups based on participant response to the fourth question of the ICIQ-UI-SF: "When does urine leak?". AI was classified into three subgroups: involuntary loss of gas, solid stool and liquid stool. Age, body mass index (BMI), training frequency (days/week and hours/session), level of competition (national/international), years specializing in gymnastics/cheerleading, straining at toilet, urinary tract infections and risk of female athlete triad were considered possible risk factors for UI and AI. Parity was not assessed, since we expected that participants would be of young age and nulliparous. The female athlete triad refers to the interrelationship of menstrual dysfunction, low energy availability (with or without an eating disorder) and impaired bone health and was assessed with The Low Energy Availability in Females Questionnaire (LEAF-Q) [8]. The questionnaire has demonstrated acceptable validity in classifying current energy availability, bone health and/or reproductive function in female athletes [8]. Female athletes of ≥ 15 years of age with scores ≥ 8 were considered at risk of the triad. Straining at toilet was assessed by the questions: "Do you need strain to empty your bladder?" [9] and "Do you need to strain to open your bowels?" [7]. Response alternatives from "never" to "always"/"daily" were given. To control for possible confounding of chronic disease and previous pelvic/lumbar surgery, the participants were asked to answer yes/no to the questions: "Do you have a chronic disease (e.g., diabetes, Crohn's disease) or other health problems?" and "Have

you previously had surgery in the pelvic or lumbar area?" Athletes responding "yes" were asked to add their disease or type of surgery as free text.

Bothers of UI and AI were assessed with questions from ICI questionnaires on how UI and AI affected their daily life (scale from 0 to 10). Furthermore, questions regarding UI during gymnastic and acrobatic activities, impact of UI on sports performance, and protective or preventive measures for UI during training or competition were included with provided options for responses. Some of these questions were based on a previous survey in rhythmic gymnasts [10] and others were constructed by the authors in collaboration with the sports federations. Questions from the ICIQ-B regarding sudden AI and worries of AI were added.

The questionnaire finally included questions regarding the athletes' knowledge about the PFM. We asked if they had previously heard about the PFM and from where, if they knew how or why to train the PFM, to rate their knowledge of the PFM on a scale of 1–10 and if they were willing to do PFM training if they knew how. These questions were selected from two studies by Neels et al. [11] and Gram and Bo [10].

Statistical analysis

Statistical analyses were performed in SPSS statistical software package version 24 (SPSS Inc., Chicago IL, USA). Background variables are presented as numbers with percentages or means with standard deviation (SD). Prevalence is reported as frequency and percentage. Pearson chi-square test was used to investigate differences in proportions of SUI/AI between the different sport groups. Risk factors for UI and AI were estimated by multivariate binary logistic regression analysis and reported as odds ratio (OR) with 95% confidence intervals (CI). The p value was set to 0.05. The "purposeful selection" approach was used to select variables in the multivariate logistic regression models [12]. Variables with $p < 0.1$ were left in the final model. Categorical variables with more than two categories were recoded into dichotomous variables (straining on voiding, training frequency/week, urinary tract infection). Choice of reference group when comparing risk between the different sport groups was based on results from the chi-square test. Continuous variables showing non-linear associations with SUI/AI in univariate analysis were recoded into ordinal variables based on quartiles. No power calculations were made, since we aimed to include all athletes fulfilling the inclusion criteria.

Results

One hundred seventy-eight female artistic gymnasts, 592 team gymnasts and 1084 cheerleaders were identified from participation lists of NCCs during 2018/2019. Of these, we were able to invite 107 artistic gymnasts (60.1%), 219 team gymnasts (37.0%) and 246 cheerleaders (22.7%) to the study. Finally, 68 artistic gymnasts, 116 team gymnasts and 135 cheerleaders were included, resulting in a response rate of 38.2%, 19.6% and 12.5%, respectively. Four hundred twenty-seven (99.5%) athletes completed 100% and two > 90% of the questionnaire. The number of participants at each stage of the inclusion process is presented in Fig. 1.

Background data, medical and sport practice characteristics are presented in Table 1 and prevalence of UI, AI and subtypes of UI/AI in Table 2. High prevalence of both UI and AI were reported among all sports. There were no differences in proportions of SUI between the artistic gymnasts and team gymnasts ($p = 0.14$). The proportion of SUI was significantly lower in cheerleaders compared to artistic gymnasts ($p < 0.001$) and team gymnasts ($p < 0.001$). No differences were found when comparing proportions of AI in artistic gymnasts and team gymnasts ($p = 0.48$), artistic gymnasts and cheerleaders ($p = 0.91$) or team gymnasts and cheerleaders ($p = 0.48$).

Results from multivariate logistic regression analysis of possible risk factors and SUI/AI are presented in Table 3. Cheerleading was chosen as the reference group when comparing the different sport groups and risk of SUI. A non-linear relationship between age and SUI was found in the univariate analysis, and a recoded ordinal variable for age (based on quartiles) was used in the multivariate regression model. Gymnastic/cheerleading training ≥ 4 days per week and straining to void were found to be significantly associated with SUI. Athletes aged 16 or 17 years had significantly higher odds of SUI than younger athletes (12–15 years), and cheerleaders had significantly lower odds compared to both artistic gymnasts and team gymnasts. No significant differences in odds of SUI were found when comparing team gymnasts with artistic gymnasts (OR: 1.82, 95% CI: 0.87–3.80, $p = 0.11$). Years with specialization in gymnastics/cheerleading was the only variable found to be positively associated with AI.

Among athletes reporting any UI, 107 (49.9%) experienced leakage once a week or less often, 65 (30.2%) two or three times per week, 14 (6.5%) once a day, 16 (7.4%) several times a day and 3 (1.4%) all the time. Ten (4.7%) had not experienced any leakage during the past 4 weeks. The amount of leakage was reported as small by 175 (81.4%) and moderate by 23 (10.7%). Mean ICIQ-UI-SF score was 6.3 (SD: 3.7, range: 0–17), and mean impact of UI on daily activities was 2.5 (SD: 2.4, range: 0–10), with 46 (21.4%) scoring ≥ 5. Most ($n = 199$, 99.0%) athletes with SUI experienced leakage during gymnastics or cheerleading, with take-off and landing from gymnastic/acrobatic elements reported as the most provocative activities (Fig. 2).

One hundred sixty-six (82.6%) of those with SUI reported a negative effect of UI on sports performance. Fear of visible leakage and embarrassment were the most common complaints (Fig. 3).

Most athletes with SUI reported leakage during training ($n = 198$, 98.0%) followed by during competition ($n = 90$, 44.8%).

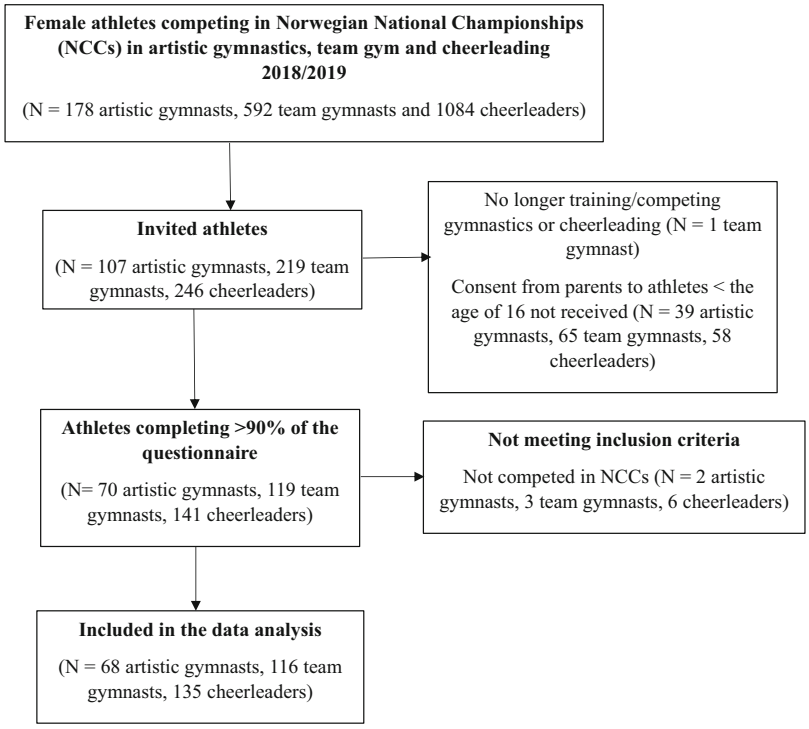

Fig. 1 Flow chart of participant enrollment

Fifty-seven (28.4%) reported use of pads to protect against visible leakage. Reported measures to prevent leakage were voiding before training/competition ($N = 134$, 66.7%), decreased fluid intake ($N = 17$, 8.5%), use of an intra-vaginal tampon ($N = 9$, 4.5%) and other measures ($N = 7$, 3.5%), such as multiple toilet visits during training or PFM training. Forty-five (22.4%) reported they would occasionally avoid training or specific exercises because of leakage. Fifty-three (26.4%) had never spoken about the condition with anyone, 13 (6.5%) had spoken with their coach and 12 (6.0%) with health care personnel, such as a physician or physiotherapist. One hundred fifteen (57.2%) had spoken about urinary leakage with their teammates, 76 (37.8%) with friends and 40 (19.9%) with a parent.

Of females reporting AI, mean bother of accidental loss of gas, liquid and solid stool was 3.0 (SD: 2.6, range: 0–10), 2.3 (SD: 2.3, 0–10) and 2.4 (SD: 2.4, range 0–10), respectively. The number of athletes scoring ≥ 5 on bother was 69 (26.6%) for loss of gas, 20 (15.4%) for loss of liquid stool and 6 (15.4%) for solid stool. Fifty-six (20.9%) reported that bowel leakage could happen occasionally or more often without warning. and 13 (4.9%) reported that they sometimes or more often were worried about bowel leakage.

Among athletes reporting accidental loss of gas, 227 (87.6%) experienced leakage during training and/or competition: 99 (38.2%) rarely, 91 (35.1%) occasionally, 31 (12.0%) often and 6 (2.3%) all the time. Of those reporting liquid AI, 24 (18.5%) rarely and 5 (3.8%) occasionally experienced leakage during training and/or competition. Of those with solid AI, 7 (17.9%) reported leakage during training/competition and all experienced it rarely.

One hundred thirty-two (41.4%) of the athletes had never heard about the PFM. Thirty-nine (12.2%) of the athletes reported that they had heard about the PFM from their coach, 32 (10.0%) from teammates, 61 (19.1%) from health personnel and 54 (16.9%) from other sources (friends, siblings or parents). The mean self-rated knowledge of the PFM was 1.5 (SD: 1.7) of 10. Thirty-two (10.0%) knew how and 58 (18.2%) why to train the PFM. Two hundred thirty-five (73.7%) responded they would do PFM training to prevent or treat UI and AI if they knew how. Three athletes (0.9%) reported they did or had tried PFM training. Responses on knowledge of the PFM were lacking from two athletes.

Discussion

The aim of this study was to investigate the prevalence and risk factors for UI and AI in high-performance gymnasts and cheerleaders. Furthermore, we aimed to investigate bother of UI and AI, influence of SUI on sport performance and the

Table 1 Sociodemographic, anthropometric, medical and sport practice characteristics of female artistic gymnasts, team gymnasts and cheerleaders

	Total, $n=319$	Artistic gymnasts, $n=68$	Team gymnasts, $n=116$	Cheerleaders, $n=135$
Age (years), mean (SD, min–max)	17.4 (3.2, 12–36)	16.8 (3.6, 12–36)	17.1 (2.7, 13–28)	17.9 (3.3, 12–29)
BMI[1], mean (SD, min–max)	21.7 (2.7, 14.6–37.2)	21.1 (2.5, 16.0–28.2)	21.7 (2.2, 16.0–31.0)	21.9 (3.1, 14.6–37.2)
Gymnastic/cheerleading training				
Days/week, N (%)				
1–3 days	70 (21.9)	5 (7.4)	8 (6.9)	57 (42.2)
4–5 days	203 (63.6)	26 (38.2)	102 (87.9)	75 (55.6)
6–7 days	46 (14.4)	37 (54.4)	6 (5.2)	3 (2.2)
Hours/session, mean (SD, min–max)	2.6 (0.6, 1–6)	3.3 (0.7, 2–5)	2.6 (0.4, 2–6)	2.2 (0.4, 1–3.25)
Years specializing in gymnastics/cheerleading, mean (SD, min–max)	6.8 (3.5, 0–28)	8.6 (4.3, 2–28)	6.6 (3.3, 1–17)	6.1 (2.7, 0–14)
Level of competition, N (%)				
National	176 (55.2)	54 (79.4)	72 (62.1)	50 (37.0)
International	143 (44.8)	14 (20.6)	44 (37.9)	85 (63.0)
Menarche, N (%)	294 (92.2)	58 (85.3)	110 (94.8)	126 (93.3)
Risk of female athlete triad, N (%)	122 (38.2)	22 (32.4)	54 (46.6)	46 (34.1)
Chronic disease, N (%)	47 (14.7)	7 (10.3)	12 (10.3)	28 (20.7)
Previous surgery in pelvic/lower back area, N (%)	7 (2.2)	0 (0)	1 (0.9)	6 (4.4)
Urinary tract infections, N (%)				
Never	291 (91.2)	64 (94.1)	113 (97.4)	114 (84.4)
1–3/year	23 (7.2)	4 (5.9)	2 (1.7)	17 (12.6)
4–12/year	5 (1.6)	0 (0)	1 (0.9)	4 (3.0)
>1/month	0 (0)	0 (0)	0 (0)	0 (0)
Straining to void, N (%)				
Never	115 (36.1)	31 (45.6)	37 (31.9)	47 (34.8)
Occasionally	145 (45.5)	26 (38.2)	56 (48.3)	63 (46.7)
Frequently	45 (14.1)	9 (13.2)	18 (15.5)	18 (13.3)
Daily	14 (4.4)	2 (2.9)	5 (4.3)	7 (5.2)
Straining to defecate, N (%)				
Never	10 (3.1)	4 (5.9)	0 (0)	6 (4.4)
Rarely	110 (34.5)	30 (44.1)	39 (33.6)	41 (30.4)
Some of the time	167 (52.4)	30 (44.1)	64 (55.2)	73 (54.1)
Most of the time	31 (9.7)	4 (5.9)	12 (10.3)	15 (11.1)
Always	1 (0.3)	0 (0)	1 (0.9)	0 (0)

[1] Total N for BMI was 315 due to missing data

athletes' knowledge of the PFM. As far as we have ascertained, this is the first study including questions on the prevalence, risk factors and bother of both UI and AI, in addition to the influence on sport performance, in these sports.

We found a high prevalence of both UI (67.4%) and AI (84.0%) among female gymnasts and cheerleaders. Self-reported bothers of UI and AI were low, but most athletes with SUI reported that leakage negatively influenced sport performance. Training frequency (≥ 4 days per week), age of 16 or 17 years, straining to void and type of sport (artistic gymnastics and team gymnastics) were significantly associated with SUI and years with gymnastic or cheerleading participation with AI. Overall, the athletes' knowledge of the PFM was low.

We did not include a control group of non-athletes in our study. However, much lower prevalence rates of UI (12–13%) have been reported in large studies of nulliparous young women [13, 14], and female athletes/exercisers have been found to have a three times increased risk of UI compared to non-exercisers [3]. In previous studies of UI in artistic gymnasts, slightly lower prevalence rates (56 and 67%) have been reported [15, 16]. The extremely high prevalence rates of UI found in our study, especially in gymnasts, is comparable to those (73 and 80%) reported among young female trampolinists [17, 18]. A similarity between these sports is the significant level of high-impact acrobatic activity, including elements with somersaults, twist and turns. In cheerleaders, we

Table 2 Prevalence of urinary and anal incontinence in female artistic gymnasts, team gymnasts and cheerleaders

	Total, $n=319$ N (%)[1]	Artistic gymnasts, $n=68$ N (%)[2]	Team gymnasts, $n=116$ N (%)[3]	Cheerleaders, $n=135$ N (%)[4]
Overall UI	215 (67.4)	48 (70.6)	97 (83.6)	70 (51.9)
SUI	201 (63.0)	48 (70.6)	93 (80.2)	60 (44.4)
UUI	31 (11.6)	6 (8.8)	15 (12.9)	16 (11.9)
MUI	30 (9.4)	6 (8.8)	13 (11.2)	11 (8.1)
Other UI	32 (10.0)	6 (8.8)	13 (11.2)	13 (9.6)
Overall AI	268 (84.0)	56 (82.4)	100 (86.2)	112 (83.0)
Liquid	130 (40.8)	25 (36.8)	48 (41.4)	57 (42.2)
Solid	39 (12.2)	8 (11.8)	16 (13.8)	15 (11.1)
Gas	259 (81.2)	56 (82.4)	97 (83.6)	106 (78.5)

AI, anal incontinence; MUI, mixed; SUI, stress UI; UUI, urgency UI; UI, urinary incontinence

[1] Percentage of total N, [2] percentage of total N of artistic gymnasts, [3] percentage of total N of team gymnasts, [4] percentage of total N of cheerleaders

also found higher prevalence of both UI and AI than reported in a recent study (UI: 27%, AI: 63%) [19]. As in our study, SUI and gas incontinence was the most common subtype. In their study, the level of competition was not reported, and the athletes had less cheerleading experience compared to the high national level cheerleaders in our study. Hence, the studies may not be directly comparable.

Our results showed that athletes who trained ≥ 4 times per week had 2.3 times higher odds of SUI than those who trained less. Higher training dosage has also been associated with UI in studies of female trampolinists [17, 18] and athletes from different sport modalities [20], indicating that higher training exposure may increase the risk of UI. As in our study, one of the above-mentioned studies [18] found a higher prevalence

Table 3 Odds ratios with 95% confidence intervals of risk factors for stress urinary incontinence and anal incontinence in female artistic gymnasts, team gymnasts and cheerleaders ($n = 319$)

	B	OR (95% CI)	*p* value
SUI			
Age			
12–15 years[1]			
16 years (1)	1.24	3.45 (1.66–7.18)	0.001
17 years (2)	1.64	5.18 (2.15–12.48)	<0.001
≥ 18 years (3)	0.48	1.62 (0.83–3.17)	0.157
Gymnastic/cheerleading training ≥ 4 days/week			
No		1.00 (−)	
Yes	0.84	2.31 (1.22–4.37)	0.010
Straining to void	0.98	2.66 (1.26–5.64)	0.011
Type of sport			
Cheerleading[1]		1.00 (−)	
Team gymnastics (1)	1.40	4.07 (2.15–7.69)	< 0.001
Artistic gymnastics (2)	1.01	2.75 (1.39–5.46)	0.004
AI			
Years specializing in gymnastics/cheerleading	0.13	1.14 (1.02–1.26)	0.016
Chronic disease			
No		1.00 (−)	
Yes	1.10	3.00 (0.88–10.15)	0.078
Straining to defecate			
No		1.00 (−)	
Yes	0.14	3.06 (0.70–13.46)	0.137

[1] Reference group

AI: anal incontinence, B: regression coefficient, CI: confidence interval, OR: odds ratio, SUI: stress urinary incontinence

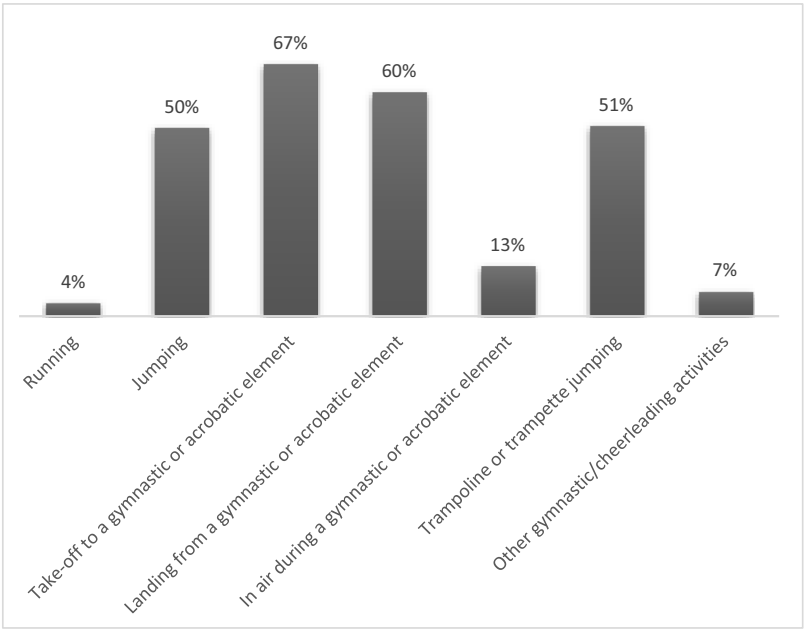

Fig. 2 Gymnastic/cheerleading activities provoking urinary leakage among female artistic gymnasts, team gymnasts and cheerleaders with stress urinary incontinence ($n = 201$)

of UI with increasing age. Gymnasts and cheerleaders of 16 and 17 years of age may have a higher training dosage, but also increased weight and hormonal changes due to puberty may explain the associations between age and SUI. Further studies are warranted to explore such associations in adolescent athletes. The higher odds of SUI found in artistic and team gymnasts compared to cheerleaders could possibly be explained by differences in training and competition surfaces, characteristics of the acrobatic/gymnastics elements and the forces applied on the athletes in the different sport types. However, this needs further investigations. We also found that athletes who strained to void had significantly increased odds of SUI. Straining to void has also been associated with UI among female ex-trampolinists (OR: 1.8, 95% CI: 1.1–3.4,

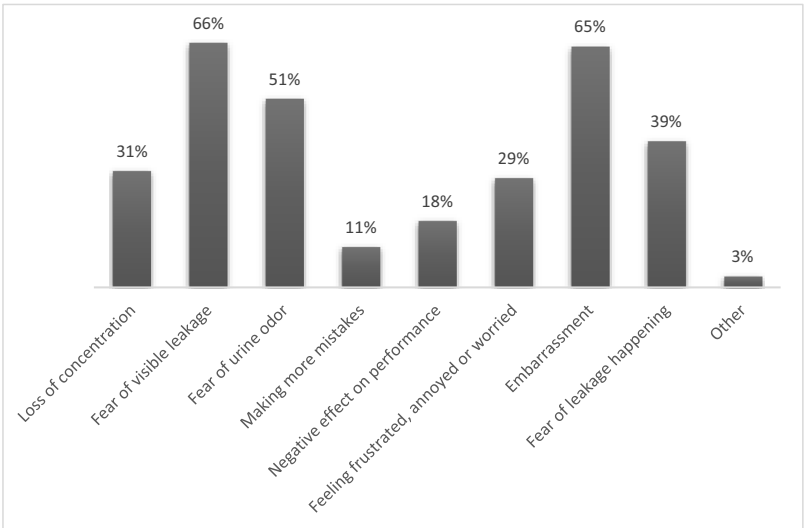

Fig. 3 Impact of urinary leakage on sport performance in female artistic gymnasts, team gymnasts and cheerleaders with stress urinary incontinence ($n = 201$)

$p = 0.03$) [21]. Anecdotally, straining to void may be a bad habit caused by women not giving themselves time to relax and trying to increase their flow rate when voiding. The flow rate is increased by abdominal straining, Valsalva or suprapubic pressure [2] and may further explain the association with SUI. A possible explanation of why these athletes strain to void may be a hypertonic or non-relaxing pelvic floor. This condition may lead to impaired ability to evacuate urine or stool and has been suggested by Louis-Charles et al. [22] to be a condition affecting female athletes. However, research on hypertonicty or inability to relax the PFM during voiding is limited both in the general population and in athletes, and we have no data in our study on the athletes' PFM. We found no associations between SUI and other variables (BMI, level of competition, years specializing in gymnastics/cheerleading, urinary tract infections, risk of female athlete triad). In other studies of female athletes, associations among BMI, eating disorders/female athlete triad, training dosage and UI have been studied, but the results are inconsistent [3].

The only factor found to be associated with AI in our study was the number of years specializing in gymnastics/cheerleading. To date, there are few other studies of AI in female athletes [3]. The high prevalence rates reported in our study demonstrate a need for further studies of possible risk factors and mechanisms of AI in high-impact athletes.

High, repetitive increases in intraabdominal pressure (IAP) have been proposed as a mechanism leading to increased risk of UI in athletes participating in high-impact sports [3]. No studies of IAP and gymnastics or cheerleading were found. However, in a study by Seegmiller et al. [5], ground reaction forces produced during drop landings were found to be higher in high-level gymnasts compared to recreational athletes. An opposing hypothesis is that impact during exercise can lead to co-contractions of the PFM and create a strengthening effect on the pelvic floor and further reduced risk of PFD [3]. However, in a recent randomized controlled trial (RCT) by Luginbuehl et al. [23], "involuntary reflexive PFM training" (e.g., jumping exercises) did not produce any additional treatment effects in reducing UI symptoms compared to standard strength training of the PFM. In our study, the prevalence of UI and AI were high despite the great amount of high-impact training. In addition, jumping and landing from acrobatic or gymnastic elements were reported as the activities provoking the most urinary leakage. These results indicate that high-impact exercise training cannot prevent or treat PFD.

Fatigue of the PFM during exercise could be another possible mechanism of SUI in gymnasts and cheerleaders. In a cross-over study of young women with SUI, Ree et al. [24] found that 90 min of heavy exercise (lifting and jumping/running) reduced maximum voluntary PFM contractions by 17%, and Middlekauff et al. [25] found that high-intensity CrossFit exercises caused an immediate descent of the pelvic floor. To our knowledge, no studies have evaluated the immediate or long-term effect of gymnastic and cheerleading activity on the pelvic floor. Given the high impact on the pelvic floor in these athletes, it is presumed that they require much better function of the PFM and connective tissue than non-exercisers to prevent UI and AI. The fact that UI and AI did not seem to bother them during daily activities indicates that the impact during such activities was not enough to induce incontinence and leakage may be mostly related to sport activities.

Most of the athletes with SUI in our study reported negative effects on performance; > 60% reported that leakage led to embarrassment. This could explain why few had discussed their condition with coaches or medical personnel. Fear of visible leakage was another common concern. This was also reported as the most common complaint by rhythmic gymnasts with SUI [10]. In these sports, athletes wear tight and minimal clothes; therefore, signs of leakage may be especially visible. In other studies, female athletes have reported a negative effect of UI on the performance and quality of life [26, 27], and for some athletes, UI has led to avoidance or cessation of sport activity or exercise [21, 27]. The latter was also found in the present study where about 1/5 of the athletes with SUI reported they would occasionally avoid training or specific exercises due to leakage.

The gymnasts and cheerleaders in our study had limited knowledge about the PFM. Although few of those with SUI had spoken with their coach or medical personnel about the condition, most of the athletes reported an interest in PFM training to prevent or improve incontinence. This is in line with findings from a study of female college athletes [28], indicating that few athletes seek advice on how to treat or prevent UI or other PFD.

Strength training of the PFM has been shown to be effective in treating UI in women and is recommended by international clinical practice guidelines as first-line treatment (evidence level 1, recommendation Grade A) [29]. However, evidence of the effect of PFM training in female elite athletes is limited. In a RCT of 32 female volleyball players, PFM training showed significant improvement of UI compared to written information only [30]. However, based on current knowledge we do not know whether PFM training is effective in athletes exposed to excessive impact during gymnastics or acrobatics. Possible effects should be investigated in future high-quality RCTs.

Strengths of the present study were the inclusion of top-level athletes from different high-impact gymnastic and acrobatic sports and assessment of possible risk factors, bother and athletes' knowledge about the pelvic floor. We used valid and reliable questionnaires to collect data on UI and AI [7], and the total number of participants compares favorably with other studies of young female athletes [10, 15–18, 20].

A limitation of our study was the low response rate, with a possible selection bias and further influence on the external validity. Our results were based on self-reported measures,

and no clinical measures were used to verify PFD or possible risk factors. As for all cross-sectional studies, exposure and outcome were measured at the same time point, and a cause-effect relation cannot be inferred.

Conclusion

Our study found that UI and AI were highly prevalent in female gymnasts and cheerleaders. Higher training frequency was found to be associated with SUI and years with gymnastic/cheerleading experience with AI, indicating an increased risk of UI/AI with higher training exposure. The mechanisms of UI/AI in gymnasts and cheerleaders are to date unknown, and studies investigating the mechanistic effect of high-impact acrobatics and gymnastics on the pelvic floor are warranted. Most athletes with SUI reported that urinary leakage negatively influenced sport performance. Research to test interventions to treat/prevent PFD in these athletes, such as PFM training, is urgently required.

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Author contributions All authors contributed to the study conception and design. Kari Bø conceived the study and was the main supervisor of the project. Material preparation was performed by Kristina Lindquist Skaug and Kari Bø. Data collection and analysis were performed by Kristina Lindquist Skaug. The first draft of the manuscript was written by Kristina Lindquist Skaug, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

Conflicts of interest None.

Ethics approval The study was performed in accordance with the ethical standards of the Declaration of Helsinki and its later amendments and was approved by the Regional Ethics Committee (2018/2211/REK Sør-øst B, 20.12.2018) and the Norwegian Centre for Research Data (NSD: 199381, 24.01.2019).

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Paper II

Title: Prevalence of pelvic floor dysfunction, bother and risk factors and knowledge of the pelvic floor muscles in Norwegian male and female power- and Olympic weightlifters

ABSTRACT

Strenuous exercise has been suggested as a risk factor of pelvic floor dysfunction (PFD). Power- and Olympic weightlifters compete with high external loads. To date, knowledge of PFD in these athletes is sparse. The aim of this study was to investigate prevalence, risk factors and bother of PFD in power- and Olympic weightlifters and their knowledge of the pelvic floor muscles (PFM).

All athletes of ≥18 years of age competing in ≥1 National Championship in power- or Olympic weightlifting in 2018/2019 were invited. International Consensus on Incontinence Questionnaires were used to assess PFD.

One hundred and eighty females and 204 males participated. Prevalence of urinary incontinence (UI), anal incontinence (AI) and pelvic organ prolapse in females was 50.0%, 80.0% and 23.3% respectively. Stress UI was reported by 41.7% of the females and 87.8% reported negative influence on sport performance. Prevalence of UI and AI in males was 9.3% and 61.8%.

In females, increasing BMI was significantly associated with stress UI (OR: 1.09, 95% CI: 1.01-1.17) and international level of competition (OR: 3.27, 95% CI: 1.32-8.07) and weightlifting ≥4 days/week (OR: 0.26, 95%CI: 0.08-0.86) with AI. In males, increasing age (OR: 1.03, 95% CI: 1.00-1.07) and frequently straining to void (OR: 4.84, 95% CI: 1.02-22.94) were significantly associated with AI.

Forty-three percent of the females and 74% of the males did not know why, and 44.4% and 72.5% how, to train the PFM. In conclusion, prevalence of PFD was high, and the athletes had limited knowledge of the PFM.

Keywords: Athletes, Stress Urinary Incontinence, Pelvic Organ Prolapse, Anal Incontinence, Powerlifting, Olympic Weightlifting

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INTRODUCTION

The pelvic floor consists of muscles, fascia and ligaments and forms a hammock-like support at the base of the abdomino-pelvic cavity. Its main functions are to provide support to the pelvic organs (the bladder, urethra, vagina, uterus and rectum) and to counteract to all increases in intra-abdominal pressure (IAP) and ground reactions forces during daily activities (37). A dysfunctional pelvic floor can lead to urinary incontinence (UI), anal incontinence (AI) and pelvic organ prolapse (POP) (12). UI is the most common symptom of pelvic floor dysfunction (PFD) in women and stress urinary incontinence (SUI), defined as "the complaint of involuntary loss of urine on effort or physical exertion (e.g. sporting activities), or on sneezing or coughing", accounts for approximately half of all subtypes of UI (25, 33). SUI is uncommon in men, except after prostatectomy (33). POP is the downward descent of the female pelvic organs into or through the vagina and symptoms may be more prominent after exercise, long periods of standing or at times of abdominal straining (25). AI includes involuntary loss of feces and/or flatus (gas) (25). Symptoms of AI seems to be almost as common in men and women, according to prevalence rates reported in different population-based studies. AI can be present in all age groups, but prevalence increases with age and birth injuries, such as 3rd and 4th degree perineal tears (33).

Strenuous work and exercise have been suggested, but not established, as possible risk factors for PFD in women (33). Female athletes/exercising women have three times the risk of UI compared to non-exercising controls (10). Especially high prevalence have been reported in high impact sports including running and jumping activities (such as gymnastics and ball games), compared to low impact activities (e.g. swimming, cycling and Pilates) with total prevalence of 58.1% in high-impact vs. 12.6% in low-impact sports (14). There is sparse knowledge on prevalence and risk factors for PFD in athletes participating in strength sports,

such as power- and Olympic weightlifting. Powerlifting includes three different barbel events: a) squat, b) bench press and c) deadlift (40), while Olympic weightlifting includes two different overhead barbel events: a) the snatch and b) the clean and jerk (41). During competitions, the athletes have three attempts in each event to lift a maximum load in a single repetition (40, 41). These athletes train and compete with high external loads, often exceeding their own bodyweight (4, 30) and the sports may therefore serve as a model to study heavy load and PFD. In one recent study, prevalence and risk factors of UI in female powerlifters were reported (43), but studies of PFD in males and other PFD than UI in females are lacking. Negative impact of UI on sports performance have been reported in studies of females from other sport disciplines (10). Most athletes do not report PFD to coaches and health care providers and they have limited knowledge of the pelvic floor (10). The aim of the present study was to investigate prevalence and risk factors for PFD power- and Olympic weightlifters. Further, we aimed to investigate impact and bother of PFD and knowledge of the pelvic floor muscles (PFM) among the same athletes.

METHODS

Experimental Approach to the Problem

This was a cross-sectional study targeting all top national and international level male and female power- and Olympic weightlifters of ≥18 years of age in Norway. Data were collected by an electronic questionnaire (Survey Xact) between March 2019 and March 2020. Questions on background data, sport activity, symptoms of bladder/bowel and POP, expected risk factors, impact of PFD on sports participation and knowledge of the PFM were included. Prior to distribution to the full cohort, contact persons in the Norwegian Weightlifting Federation and the Norwegian Powerlifting Federation were asked to distribute the

questionnaire to a group of athletes/coaches, who reviewed the questions and gave feedback on the content. Minor revisions to questions regarding weightlifting activity were made based on the feedback.

Subjects

The study was approved by the Regional Ethics Committee (2018/2211/REK Sør-øst B, 20.12.2018) and the Norwegian Centre for Research Data (NSD: 199381, 24.01.2019). All participants gave written informed consent. Inclusion criteria were ≥18 years of age and participation in at least one Norwegian National Championship (NCC) in powerlifting or Olympic weightlifting during the 2018/2019 season. Athletes who did not meet the inclusion criteria, completed <90% of the questionnaire or reported ongoing pregnancy, previous surgery for UI/POP or neurological disease were excluded from the data analysis. Official result lists of NCC in 2018/2019 were used to identify potentially eligible participants. Collaboration with the Norwegian Weightlifting Federation and the Norwegian Powerlifting Federation was established for recruitment of eligible participants. Participants were recruited at two different NCCs, by email correspondence with clubs/coaches and via a registration link on webpages and social media. The number of participants at each stage of the inclusion process is presented in **Figure 1**. One hundred and ninety-one females (response rate: 54.1%) and 204 males (response rate: 37.7%) of the athletes identified from official NCC lists completed > 90% of the questionnaire. Eleven females were excluded due to either ongoing pregnancy, history of surgery for UI/POP or neurological disease. Finally,180 females and 204 males were included in the data analysis. Background data, medical and sport practice characteristics are presented in **Table 1.**

FIGURE 1 about here

Procedures

Definitions of PFD was based on the International Urogynecological Association/International Continence Society (ICS) joint report on the terminology for female PFD (25). UI was defined as "complaint of involuntary loss of urine", AI as “complaint of involuntary loss of feces or flatus” and POP as “complaint of a “bulge” or “something coming down” towards or through the vaginal introitus”. To assess the prevalence and bother of PFD, patient reported outcome measures with Grade A recommendation from the ICI 2017 were used: the ICI Questionnaire-Urinary Incontinence Short Form (ICIQ-UI-SF) for UI, questions from the ICI Questionnaire Anal Incontinence Symptoms and Quality of Life Module (ICIQ-B) for AI and ICI Questionnaire Vaginal Symptoms Module (ICIQ-V) for POP (15). Athletes were considered continent if they answered “never” to the question: “When does urine leak?” and “always” to questions regarding control of watery/loose stool, formed/solid stool and wind (flatus), for UI and AI, respectively. POP was considered present in female athletes who responded positively to the questions “Are you aware of a lump or bulge coming down in your vagina?” or “Do you feel a lump or bulge come out of your vagina, so that you can feel or see it on the outside?”. The ICIQ-UI-SF has shown to have construct validity, acceptable convergent validity and good reliability (3) and has been translated to Norwegian (29). UI incontinence was further classified into different subgroups based on their response to the fourth question of the ICIQ-UI-SF (“When does urine leak?”): involuntary loss of urine associated with coughing, sneezing, physical activity or exercises as SUI, involuntary loss of urine before reaching the toilet as urgency urinary incontinence (UUI), a mix of both SUI and UUI as mixed urinary incontinence (MUI) and the remainder as other types of UI. AI was classified into three subgroups: involuntary loss of gas, solid stool and liquid stool. Bother of PFD was assessed using questions from the ICI questionnaires on how UI, AI and POP affects the athletes’ daily life (scale from 0-10). The

ICIQ-UI-SF also includes question on frequency and amount of leakage. The ICIQ-UI-SF score (0-21) is the total score of frequency, amount and bother.

Further, UI during specific weightlifting activities, impact of UI on sports performance and AI during sport activity were included. These questions were constructed by the authors in collaboration with the previously mentioned sports federations. Options for responses were provided.

In addition, questions on possible risk factors (age, BMI, parity, training frequency, level of competition, years specializing in power- or Olympic weightlifting, generalized hypermobility, straining at toilet, female athlete triad) were included. The female athlete triad was assessed using The Low Energy Availability in Females Questionnaire (LEAF-Q). The questionnaire has shown acceptable validity in order to classify current energy availability, bone health and/or reproductive function in female athletes (31). Female athletes with scores ≥8 were considered at risk of the triad. A five-point questionnaire was used to identify athletes with benign joint hypermobility. The questionnaire has reported sensitivity of 84% and specificity of 80% (24). To control for possible confounding, the participants were asked to answer yes/no to questions regarding chronic disease or previous surgery in the pelvic/lumbar area. If they answered yes, the participants were asked to add their disease or type of surgery as free text.

The questionnaire also included questions regarding the athletes' knowledge of the PFM. These questions were selected from two previous studies by Neels et al. (34) and Gram & Bo (22).

Statistical analysis

Statistical analyses were performed in SPSS statistical software package version 24 (SPSS Inc., Chicago IL, USA). Background variables are presented as numbers with percentages or

means with standard deviation (SD). Prevalence is reported as frequency and percentage. Risk factors for PFD were estimated by multivariate binary logistic regression analysis and reported as odds ratio (OR) with 95% confidence intervals (CI). P-value was set to 0.05. Age, BMI, parity, training frequency, years specializing in power- or Olympic weightlifting, level of competition, straining at toilet, hypermobility and risk of female athlete triad were considered as possible risk factors. The "Purposeful Selection" approach was used to select variables for the multivariate logistic regression models in order to avoid overfitting of the models (27). Variables with $p < 0.1$ were left in the final model. Variables considered to have clinical relevance or possible confounding effect were included in all models (age, parity, chronic disease and previous surgery in the pelvic area/lumbar spine). No power calculations were drawn, since we aimed to include all eligible athletes in Norway fulfilling the inclusion criteria.

TABLE 1 about here

RESULTS

Prevalence of PFD is presented in **Table 2**. Of females reporting UI, 71 (78.9%) were powerlifters and 19 (21.1%) Olympic weightlifters. Mean ICIQ-UI-SF score was 4.3 (SD: 2.8) and mean impact of UI on daily activities was 1.8 (SD: 2.0, range: 0-9), with 11 (12.2%) scoring ≥5. The majority (N=74, 90.2%) of the females with SUI (including those reporting MUI) experienced leakage during weightlifting. As demonstrated in Figure 2, heavy lifting was the most common weightlifting activity and deadlift the most common exercise provoking leakage. Seventy-two (87.8%) of those with SUI reported negative effect of UI on sports performance. Fear of visible leakage and loss of concentration were the most common complaints (Figure 3). Most of the females with SUI reported leakage during training (N=75,

91.5%) and more than half during competition (N=46, 56.1%). Forty-five (54.9%) reported use of pads to protect against visible leakage. Reported measures to prevent leakage were voiding before training/competition (N=71, 86.6%), decreased fluid intake (N=11, 13.4%) and use of an intra-vaginal tampon (N=6, 7.3%). Sixteen (19.5%) reported they would occasionally avoid training or specific exercises because of leakage and 21 (25.6%) had never spoken about the condition with anyone.

TABLE 2 about here

Of females reporting AI, mean bother of accidental loss of gas, liquid and solid stool was 2.3 (SD: 2.5, range: 0-9), 2.0 (SD: 2.5, range: 0-9) and 2.2 (SD: 2.8, range: 0-9), respectively. Number of females scoring ≥5 on bother was 22 (15.9%) for loss of gas, 9 (15.3%) for loss of liquid stool and 2 (15.4%) for solid stool. Among females reporting accidental loss of gas, 123 (89.1%) experienced leakage during training and/or competition. Of females reporting liquid AI and solid AI, 14 (23.8%) and 2 (15.4%) experienced leakage during training and/or competition. Among females reporting symptoms of POP, mean score of bother was 1.0 (SD: 2.1, range: 0-8) and 1.0 (SD: 1.6, range: 0-3) for bulge felt on the inside and outside of the vagina respectively. Four (10.8%) of the females with symptoms of a bulge felt on the inside scored ≥5.

As presented in **Table 2**, AI was the most common PFD among male athletes, with involuntary leakage of gas as the most common type of AI. Mean bother of accidental loss of gas, liquid and solid stool was 1.2 (SD: 1.8, range: 0-10), 1.3 (SD: 2.1, range: 0-10) and 2.6 (SD: 3.0, range: 0-10) respectively. Number of males scoring ≥5 on bother was 7 (6.1%) for loss of gas, 4 (7.8%) and 3 (21.4%) for solid stool. Among males reporting accidental loss of gas, liquid or solid stool, 105 (91.3%), 20 (39.2%) and 4 (28.6%) experienced leakage during

training and/or competition. Both males who reported SUI, experienced leakage during weightlifting, but none reported negative effect of UI on sport participation.

FIGURE 2 AND FIGURE 3 about here

Results from multivariate logistic regression analysis of possible risk factors and PFD in females are presented in **Table 3**. The regression model for risk factors and SUI in females correctly classified 61.1% of those with and without SUI. BMI was the only factor found to have a significant positive association with SUI. The model for risk factors and POP correctly classified 78.3% of those with and without POP. However, only 11.9% of females with POP were correctly classified. Occasional and daily straining on voiding were significantly associated with POP. Chronic disease was found to be negatively associated with POP. International level of competition was positively associated with AI, while weightlifting training of ≥4 days per week had a significant negative association. The model classified overall 79.3% of those with and without AI correctly, but none of those without AI and 99.3% of those with AI were correctly classified.

Increasing age and frequently straining to void were the only factors found to be significantly associated with AI in males in multiple logistic regression analysis (**Table 4**). Overall, 61.8% of males with and without AI were correctly classified with this model.

Only 8 females and 5 males responded “often” or “always” to the question regarding straining to defecate. The number of participants with this concern was considered too small to give any valuable contribution to the regression analysis and the factor was therefore excluded from the analysis for both males and females.

TABLE 3 AND TABLE 4 about here

Thirty-seven females (20.6%) and 120 males (58.8%) had never heard about PFM. Seventy-seven (42.8%) females and 150 (73.5%) males did not know why and how (80 females,

44.4% and 148 males, 72.5%) to train the PFM. However, 141 (78.3%) females and 101 (49.5%) males responded they would do PFM training to prevent or treat PFD, if they knew how.

DISCUSSION

We found high prevalence of both UI, POP and AI in female power- and Olympic weightlifters. SUI was the most common form of UI and involuntary loss of gas the most common form of AI among the females. In males, prevalence of overall AI was high, while UI was less common. Similar to women, involuntary loss of gas was the most common form of AI in males. The majority of the females with SUI reported negative effect of UI on sports performance and only few females had knowledge on why or how to train the PFM. The males seemed to be less bothered by symptoms of AI and less knowledgeable of the PFM than the females.

High prevalence rates of UI among both parous and nulliparous female athletes and exercisers have previously been reported in several cross-sectional studies, especially in high-impact athletes (10). Other PFD, such as POP and AI, in athletes are less studied (10). In a previous study by Wikander et al. (43), the prevalence of lifting-related UI in female powerlifters (37%) was similar to prevalence of UI reported by the females in our study. In contrast, only 14% of recreational exercising women who performed body-building exercises reported UI (20). It is reasonable to believe that both the load lifted, and amount/frequency of weightlifting training was lower in these recreational exercisers compared to the elite strength athletes in our study, which could explain the differences in prevalence. In two other studies, female bodybuilders (39) and power- and Olympic weightlifters (8, 39) were grouped with

athletes from other sport discipline. Unfortunately, prevalence of UI was not reported separately for each sport discipline and comparisons to our results are therefore difficult.

There is a growing interest of PFD in female CrossFit exercisers; the prevalence of UI among the females in our study was within the same range as the rates reported in three recent CrossFit studies (26-48%) (26, 35, 44). In one of these studies (26), the prevalence of other PFD were reported in addition to UI, and both prevalence of POP (3.2%) and fecal incontinence (6.1%) were lower than rates reported among females in our study. Although CrossFit includes elements from both power- and Olympic weightlifting, a variety of other high-impact or gymnastic exercises are included as well (21), therefore the prevalence of PFD cannot be attributed to strength training alone in these studies.

In studies of female athletes from other sport disciplines, the overall prevalence of AI and POP ranged between 14.8-64.4% (1, 13, 42, 45) and 0-8% respectively (1, 13, 45), which overall are lower than our findings. Similar to our findings, AI was mainly reported as involuntary loss of gas. The above-mentioned studies of AI and POP differ in age range, training volume, level of competition, sport types, parity and different types of questionnaires and definitions used to assess PFD. Comparisons should therefore be interpreted with caution.

The prevalence of UI among males in our study was within the same range as in the general male population (1-39%) (33). Only two male athletes in our study reported SUI, and other types of UI were more common. Generally, SUI is not a common condition in men, except after prostatectomy (33). This accords with results from two other studies of male rope-skipping athletes (16) or fitness instructors (9). However, the sample size in these studies were small. No other studies of PFD in male athletes were found. The prevalence of AI among males in our study was high compared to rates reported in general population studies

(0-16%) (33), suggesting that competitive male athletes in strength sports may have increased risk of experiencing AI. Further studies of PFD in male athletes are therefore warranted.

An important finding of this study was the negative effect of UI on sport performance among female power- and Olympic weightlifters with SUI. Fear of visible leakage was the most common concern. Power- and Olympic weightlifting athletes compete and train in tight clothes on weightlifting platforms and often use spotters who assist them in heavy lifts. They may therefore be specially exposed. Fear of visible leakage was also reported as the most common bother among female rhythmic gymnasts (22). For some athletes, UI has led to avoidance or cessation of sport or exercise (18, 38). In previous studies, female athletes have reported that leakage affected their performance and quality of life (23, 28). Hopefully, our results can raise awareness of and reduce the stigma related to PFD in strength sports environments. In addition, there is a need for future studies to evaluate the effect of treatment options for athletes bothered by these conditions.

The males seemed to be minimally bothered by PFD. Avoiding discussions about fecal incontinence or not recognizing the condition as a problem, have previously been reported as common coping mechanisms among both men and women (6). These mechanisms may have been applied by the male strength athletes in order to protect their self-esteem or prevent embarrassment. On the other hand, it could be that they consider AI, especially involuntary loss of gas, as an accepted and non-problematic consequence of heavy lifting.

Our multivariate regression analyses showed that increasing BMI was the only risk factor found to be significantly associated with SUI among females. High BMI is a well-established risk factor of SUI in the general female population (33). However, high BMI values in strength athletes are more likely to be a result of high muscle mass than overweight and obesity. Wikander et. al. (43) did not find a relationship between bodyweight class and UI in

female powerlifters. Since BMI was not calculated and their analyses were not adjusted for parity, previous pelvic/lumbar surgery or chronic diseases, their results are not comparable to ours. Associations between BMI and UI have previously been studied in female athletes from different sports, but results are inconsistent across studies (10).

Only straining to void and lower rates of chronic disease were found to be significantly associated with POP among the females. The negative association between chronic disease and POP could be explained by adjustments to less strenuous training habits (e.g. less load lifted) by these athletes, but these factors were unfortunately not assessed.

Parity is considered one of the most important risk factors for both SUI and POP in women (33). However, no association between parity and SUI or POP was found among the females in the present study. Similarly, Bø and Borgen (8) found no significant differences in UI prevalence between elite athletes and non-athlete controls when adjusting for parity. This may be due to natural selection, as athletes with PFD may cease or limit especially high-level competitive sport (18, 38).

We found that female athletes who competed at the international level had more than three times higher odds of AI compared to athletes at national competition level, and those who did weightlifting more than 4 times per week had lower risk than athletes with lower training frequency. In males, increasing age and frequently straining to void were the only factors we found to be significantly associated with AI. Other known risk factors could not explain the high prevalence of AI among the males and females, and other possible risk factors or mechanisms of AI, such as weightlifting load, should be further investigated.

High, repetitive increases in intraabdominal pressure (IAP) have been proposed as a mechanism leading to increased risk of UI during exercise (10). Heavy weightlifting can

produce substantial increases in IAPs. The Valsalva maneuver (forced exhalation against a closed glottis) is unavoidable when lifting heavy loads of >80% of maximum voluntary contraction, which contributes to even higher increases in IAP (5). Over time this may overload and weaken the PFM (10). Another possible mechanism is fatigue of the PFM during exercise. In a cross-over study of young women with SUI, Ree et al. (36) found that 90 minutes of heavy exercise (lifting and jumping/running) reduced maximum voluntary PFM contraction by 17%, and Middlekauff et al. (32) found that CrossFit activities caused an immediate descent of the pelvic floor. One could hypothesize that pre-contracting the PFM during heavy lifting may reduce such negative impact (2). In addition, such a PFM contraction may stabilize the pelvic floor and positively increase IAP and lifting capacity. To date, it is not known whether heavy lifting and strength training has a weakening or a strengthening effect on the pelvic floor. Future studies evaluating PFM function in strength athletes and the effect of heavy lifting on the pelvic floor are therefore needed.

Although knowledge of the PFM was sparse among athletes in the present study, both genders expressed an interest in PFM training if they knew how to perform the training. Given the high impact on the pelvic floor in these athletes, it is presumed that they need much better PFM function than non-exercisers. The PFM are skeletal muscles which can adapt to strength training in the same way as other skeletal muscles by following principles of strength training (7). Morphological changes in the muscles, such as increased thickness and stiffness, have been shown in females with POP who followed a structured and supervised PFM strength training program (11). PFM training is recommended as first line treatment for UI and POP in the general female population (17). For AI the results of PFM training for both men and women are inconsistent (6). Elite athletes are highly motivated to engage in regular training, and strength training of the PFM may be easily incorporated in their basic training

regimens both as prevention and treatment strategies of PFD. In a RCT of 32 female volleyball players, PFM training showed significant improvement of UI compared to written information only (19). Based on current knowledge we do not know whether PFM training is effective in elite strength athletes exposed to excessive impact during weightlifting activities and possible effects should be investigated in high quality RCTs.

As far as we have ascertained, this is the first study including questions on AI and POP in addition to UI and targeting both men and women in power- and Olympic weightlifting. We used valid and reliable questionnaires to collect data on PFD (15) and expected risk factors (24, 31).

A limitation of our study was the low response rate with a possible selection bias. There were especially few males participating, which influences the external validity of the study. Small numbers in some categories may also have negatively influenced the regression models. Our results were based on self-reported survey-based measures and no clinical measures were used to verify PFD or possible risk factors.

PRACTICAL APPLICATIONS

We found that PFD is common in both female and male power- and Olympic weightlifting athletes. In addition, most of the females who experienced urinary leakage during weightlifting activities reported that the condition negatively influenced their performance. Our results can be used to improve the awareness of these conditions among athletes and coaches in strength sport environments. The athletes' knowledge of the PFM in our study was sparse, but both males and females reported an interest of PFM training to prevent or treat PFD if they knew how. These results show a potential for strength training of the PFM in this

group of athletes which needs to be evaluated in high quality RCT's in participants of these sports.

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503 **Figure 1: Flow chart of participant enrollment**

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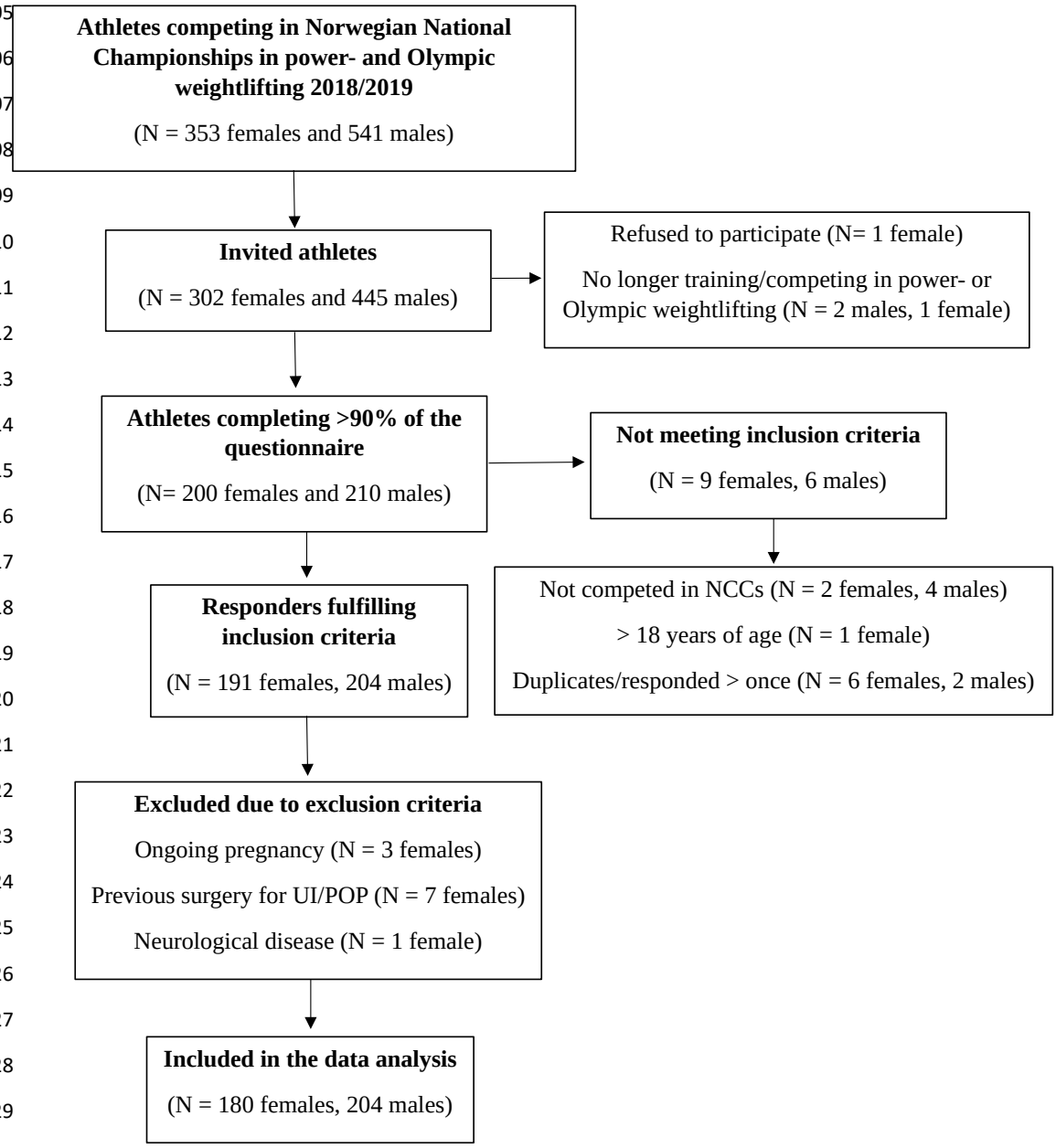
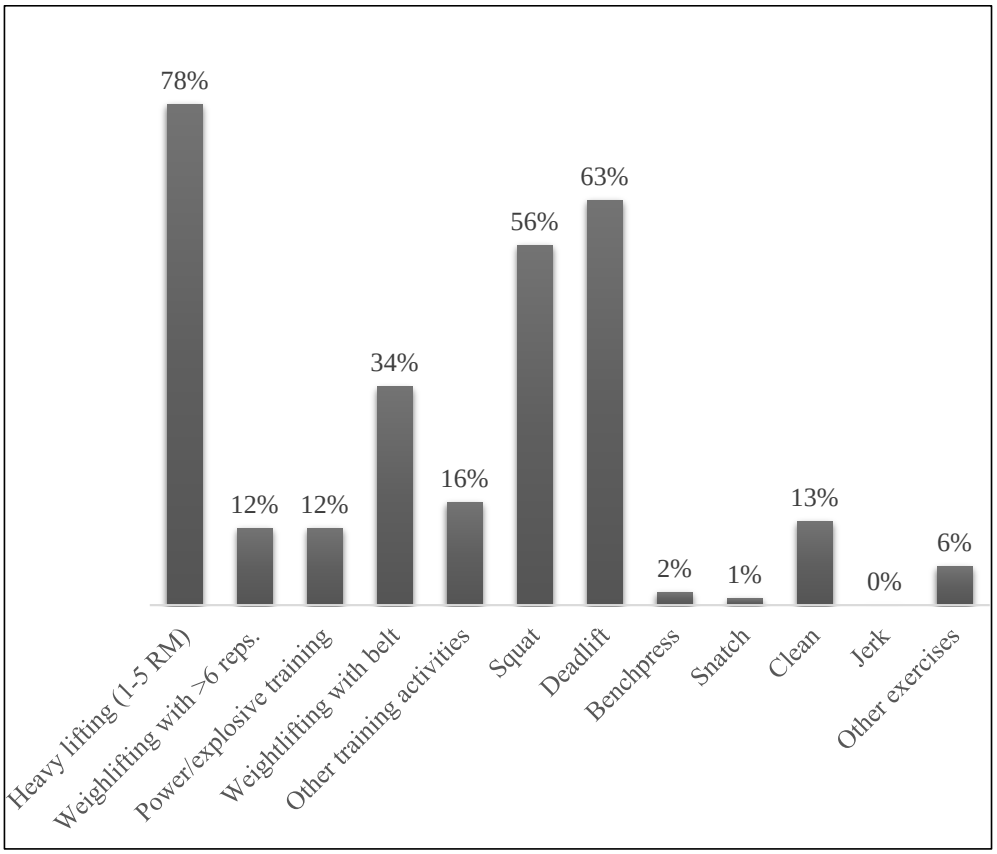

Athletes competing in Norwegian National Championships in power- and Olympic weightlifting 2018/2019
(N = 353 females and 541 males)
Invited athletes
(N = 302 females and 445 males)
Refused to participate (N= 1 female)
No longer training/competing in power- or Olympic weightlifting (N = 2 males, 1 female)
Athletes completing >90% of the questionnaire
(N= 200 females and 210 males)
Not meeting inclusion criteria
(N = 9 females, 6 males)
Not competed in NCCs (N = 2 females, 4 males)
> 18 years of age (N = 1 female)
Duplicates/responded > once (N = 6 females, 2 males)
Responders fulfilling inclusion criteria
(N = 191 females, 204 males)
Excluded due to exclusion criteria
Ongoing pregnancy (N = 3 females)
Previous surgery for UI/POP (N = 7 females)
Neurological disease (N = 1 female)
Included in the data analysis
(N = 180 females, 204 males)

Figure 2: Weightlifting activities/exercises provoking UI among female power- and Olympic weightlifting with stress urinary incontinence (n = 82)



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538 **Figure 3: Impact of leakage on sport performance in female power- and Olympic**
539 **weightlifters with stress urinary incontinence (n = 82)**

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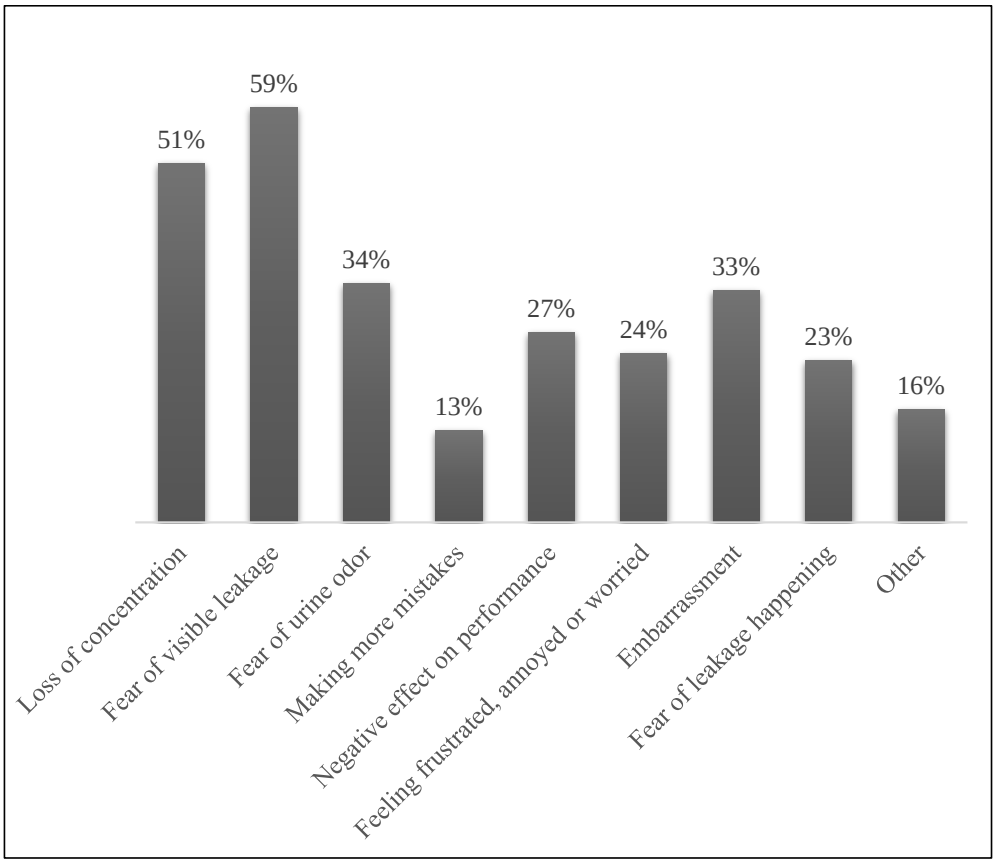
59%
51%
34%
27%
24%
33%
23%
16%
13%
Loss of concentration
Fear of visible leakage
Fear of urine odor
Making more mistakes
Negative effect on performance
Feeling frustrated, annoyed or worried
Embarrassment
Fear of leakage happening
Other

541

542

543 **Table 1: Sociodemographic, anthropometric, medical and sport practice characteristics**
544 **of female and male power- and Olympic weightlifting athletes. Mean with standard**
545 **deviations (SD) and maximum-minimum (max-min) or number with percentages**

	Female athletes (N= 180)	**Male athletes (N= 204)**
Age	31.0 (10.7, 18-65)	34.0 (13.5, 18-84)
BMI	26.1 (4.4, 19.5-45.9)	29.5 (4.0, 20.7-43.2)
Type of sport		
Olympic weightlifters	53 (29.4)	63 (30.9)
Powerlifters	127 (70.6)	141 (69.1)
Childbirth	49 (27.2)	N/A
Parity	2.2 (1.3, 1-9)	N/A
Weight- or powerlifting training		
Days/week		
1-3 days	37 (20.6)	50 (24.5)
4-5 days	124 (68.9)	124 (60.8)
6-7 days	19 (10.6)	30 (14.7)
Hours/session	2.1 (0.5, 1.5-6)	2.1 (0.5, 1-4)
Years specializing in power- or Olympic weightlifting	4.1 (3.6, 0-27)	10.1 (11.7, 0-67)
Level of competition		
National	114 (63.3)	143 (70.1)
International	66 (36.7)	61 (29.9)
Benign joint hypermobility	74 (41.1)	54 (26.5)
Risk of female athlete triad	57 (31.7)	N/A
Chronic disease	45 (25.0)	37 (18.1)

Previous surgery in pelvic/lower back area	14 (7.8)	11 (5.4)
Straining to void		
Never	78 (43.3)	122 (59.8)
Occasionally	72 (40.0)	60 (29.4)
Frequently	20 (11.1)	13 (6.4)
Daily	10 (5.6)	9 (4.4)
Straining to defecate		
Never	17 (9.4)	41 (20.1)
Rarely	71 (39.4)	101 (49.5)
Some of the time	84 (46.7)	58 (28.4)
Most of the time	7 (3.9)	3 (1.5)
Always	1 (0.6)	1 (0.5)

549 **Table 2: Prevalence of pelvic floor dysfunctions in female (N = 180) and male (N = 204)**
550 **power- and Olympic weightlifters**

	Females, N (%)	Males, N (%)
Overall UI	90 (50.0)	19 (9.3)
SUI	75 (41.7)	2 (1.0)
UUI	3 (1.7)	3 (1.5)
MUI	7 (3.9)	-
Other UI	12 (6.7)	17 (8.3)
Overall AI	144 (80.0)	126 (61.8)
Liquid	59 (32.8)	51 (25.0)
Solid	13 (7.2)	14 (6.9)
Gas	138 (76.7)	115 (56.4)
POP	42 (23.3)	-
Bulge in vagina	37 (20.6)	
Bulge outside introitus	13 (7.2)	

551 AI, Anal Incontinence; MUI, mixed; POP, Pelvic Organ Prolapse; SUI, Stress UI; UUI,
552 Urgency UI; UI, Urinary Incontinence.

553

554

555 **Table 3: Odds ratios (OR) with 95% confidence intervals (CI) of risk factors for stress**
556 **urinary incontinence (SUI), anal incontinence (AI) and pelvic organ prolapse (POP) in**
557 **female power- and Olympic weightlifters (n = 180)**

	B	OR (95% CI)	P-value
SUI			
Age	0.04	1.04 (0.99-1.08)	0.11
BMI	0.08	1.09 (1.01-1.17)	0.04
Parity	-0.08	0.93 (0.65-1.32)	0.67
Chronic disease			
No		1.00 (-)	
Yes	0.18	1.19 (0.59-2.43)	0.63
Previous surgery in pelvic or lumbar area			
No		1.00 (-)	
Yes	0.19	1.21 (0.38-3.85)	0.75
POP			
Age	-0.29	0.97 (0.91-1.03)	0.35
Straining on voiding			
Never		1.00 (-)	
Occasionally (1)	0.98	2.67 (1.15-6.23)	0.02
Frequently (2)	0.10	1.10 (0.29-4.12)	0.89
Daily (3)	2.34	10.34 (2.14-49.99)	<0.01
Parity	0.06	1.06 (0.66-1.69)	0.81
Risk of female athlete triad	0.69	2.00 (0.86-4.62)	0.11
Chronic disease			
No		1.00 (-)	

Yes	-1.08	0.34 (0.12-0.97)	0.04
Previous surgery in pelvic or lumbar area			
No		1.00 (-)	
Yes	0.10	1.01 (0.23-4.38)	0.89
AI			
Age	-0.03	0.97 (0.93-1.03)	0.31
Level of competition			
National		1.00 (-)	
International	1.183	3.27 (1.32-8.07)	0.01
Weightlifting ≥4 days/week			
No		1.00 (-)	
Yes	-1.360	0.26 (0.08-0.86)	0.03
Parity	-0.173	0.84 (0.57-1.25)	0.39
Chronic disease			
No		1.00 (-)	
Yes	0.522	1.67 (0.66-4.29)	0.27
Previous surgery in pelvic or lumbar area			
No		1.00 (-)	
Yes	0.155	1.17 (0.28-4.81)	0.83

560 **Table 4: Odds ratios (OR) with 95% confidence intervals (CI) of risk factors for anal**
561 **incontinence (AI) in male power- and Olympic weightlifters (n = 180)**

	B	OR (95% CI)	P-value
Age	0.03	1.03 (1.00-1.07)	0.05
Years specializing in power- or Olympic weightlifting	-0.03	0.97 (0.93-1.00)	0.07
Straining on voiding			
Never		1.00 (-)	
Occasionally (1)	0.65	1.91 (0.98-3.73)	0.06
Frequently (2)	1.58	4.84 (1.02-22.94)	0.05
Daily (3)	1.24	3.44 (0.67-17.69)	0.14
Chronic disease			
No		1.00 (-)	
Yes	-0.01	0.99 (0.46-2.14)	0.99
Previous surgery in pelvic or lumbar area			
No		1.00 (-)	
Yes	0.60	1.82 (0.44-7.59)	0.41

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Paper III

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Acute Effect of Heavy Weightlifting on the Pelvic Floor Muscles in Strength-Trained Women – An Experimental Crossover Study

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This was a university-initiated and conducted study. There was no extra funding. All authors declare that they have no conflicts of interest. The results of the study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation. The results of the present study do not constitute endorsement by the American College of Sports Medicine.

ABSTRACT

Introduction/Purpose: Heavy lifting may produce strain on the pelvic floor muscles (PFM) due to high increases in intraabdominal pressure, but knowledge of the impact of weightlifting on the PFM is lacking. Therefore, this study aimed to investigate acute effects of heavy weightlifting on the PFM in strength-trained women and whether general strength in whole-body exercises correlated to PFM strength. **Methods:** Forty-seven nulliparous women between 18-35 years who regularly performed weightlifting and were able to lift their own body weight x 1.2 in back squat and 1.5 in deadlift were included in this experimental crossover study. They participated in baseline evaluations (questionnaire/measurements of background characteristics and pelvic floor disorders, 1 repetition maximum (1RM) tests in back squat and deadlift) and one test day where they were randomized to start with 60 minutes of weightlifting (4 sets of 4 repetitions at 75-85% of 1RM in back squat and deadlift) or seated rest of 60 minutes. Vaginal pressure measurements of PFM resting pressure, strength, and endurance and sEMG-measurements of PFM resting activity were performed before/after weightlifting and rest. **Results:** No statistically significant differences were found when comparing the change in PFM resting pressure, strength, endurance, and resting activity after heavy weightlifting and rest. There were no statistically significant correlations between PFM strength and maximum (1RM) or relative strength (1RM/bodyweight) in either back squat or deadlift. **Conclusions:** Our results imply that heavy weightlifting is well tolerated by the PFM in short-term among young, nulliparous, and strength-trained women. Strength in whole-body exercises was not correlated to PFM strength.

Key Words: WOMEN'S HEALTH, FEMALE ATHLETE, RESISTANCE TRAINING, STRESS URINARY INCONTINENCE

INTRODUCTION

Strength training with free weights is currently the second most popular fitness trend worldwide (1). Furthermore, there has been a substantial growth in women participating in strength-specific sports and activities that may generate large increases in intraabdominal pressure (2), such as Olympic weightlifting (3), powerlifting (4, 5) and functional fitness training (6, 7). The pelvic floor is situated in the abdomino-pelvic cavity and consists of ligaments, fascia, and muscles. In addition to providing support to the pelvic organs (bladder, urethra, vagina, uterus, and rectum in women), it must counteract increases in intraabdominal pressure during physical exertion (8). To date, two opposing hypotheses regarding the impacts of intraabdominal pressure during exercise on the pelvic floor exist (9). The pelvic floor muscles (PFM) may be strengthened due to possible training adaptions of indirect loading. In contrast, if the PFMs are not able to resist increases in intraabdominal pressure, the pelvic floor may be stretched, overloaded, and weakened. This may cause pelvic floor disorders (PFD) such as urinary and anal incontinence (UI, AI) and pelvic organ prolapse (POP) (9). Recent studies show that PFDs are common in female strength athletes, especially stress urinary incontinence (SUI, "involuntary leakage of urine on physical effort") with prevalence rates ranging from 32-46% (10-13).

Overall, knowledge of the impacts of heavy lifting on the PFM and mechanisms of PFDs in strength athletes is limited. Clinical studies investigating PFM variables in sport women show contradicting results with no clear conclusion (9) and there is a lack of such investigations in women performing strength exercise (9). Some also suggests that participation in sports may cause overactive PFM muscles (17), but further evidence is needed to support this claim. Vaginal

manometry and surface electromyography (sEMG) measurements of the PFM before and after one bout of exercise can provide information on the immediate levels of exhaustion (fatigue) and alterations in muscle tone following exercise (18). These short-term assessments can be useful for a better understanding on how load affects the PFM and thereby mechanisms of PFD.

Therefore, our aim was to assess the acute effects of heavy weightlifting on PFM resting pressure, strength, endurance, and resting activity in nulliparous strength-trained women. Additionally, we aimed to investigate if general strength in whole-body exercises was correlated to PFM strength.

METHODS

Participants

Nulliparous women between 18-35 years, who regularly participated in strength training (with ≥2 years' experience and ≥3 training sessions per week) and were able to lift their own bodyweight x 1.2 in back squat and 1.5 in deadlift, were included in the study. The exclusion criteria were: previous pelvic surgery to correct POP, UI, or AI, ongoing pregnancy, and inability to perform the exercise protocol or a correct PFM contraction. Participants were recruited through social media (FaceBook, Instagram) and in collaborations with weightlifting/powerlifting clubs and federations between December 2021-October 2022. Eligible participants were invited to participate in two different test sessions (1 baseline evaluation and 1 test day) at the Norwegian School of Sport Sciences, Oslo, Norway, with at least 48 hours between sessions (Fig. 1).

We were able to recruit 51 women who fulfilled the inclusion criteria. Two were not able to attend the second test day and two were excluded due to inability to perform correct PFM contractions. Data from the remaining 47 women were included in the data analysis. Participant characteristics are shown in Table 1. Among these, 15 were powerlifters, 14 were functional fitness exercisers, 14 were recreational exercisers, and 4 were Olympic weightlifters. Twenty-eight (59.6%) competed in their sport, and 13 (27.7%) were qualified to/had competed in national or international championship competitions. Most (n=41, 87.2%) had completed or were current students of a higher level of education. Twelve (25.5%) reported chronic disease (irritable bowel syndrome, ulcerative colitis, endometriosis, vulvodynia, anemia, neurological disease, migraine, frequent herpes virus, and ovarian cysts). The prevalence of PFDs are reported in Table 2.

Procedures

The study was approved by the regional ethics committee (2018/2211/REK Sør-øst B, 20.12.2018) and the Norwegian Centre for Research Data (NSD: 199381, 24.01.2019). All subjects gave electronic and written informed consent before participation.

This was an experimental crossover study with random order of sessions. Informed consent, background variables (age, training exposure, chronic diseases), and reports of PFDs were collected using an electronic questionnaire (Survey Xact) 1-2 days before the baseline evaluation. To assess prevalence of PFDs, we used patient-reported outcome measures recommended by the International Consultation on Incontinence (ICI) (19). For urinary incontinence, we used the ICI Questionnaire-Urinary Incontinence Short Form (ICIQ-UI-SF).

The ICIQ-UI-SF is easily completed and has shown to have acceptable convergent validity, ability to discriminate among different groups, and good reliability (Cronbach alpha of 0.95) (20). Women who responded "I leak when I am physically active" were considered to have SUI. To assess AI and symptomatic POP, we used questions from the ICI Questionnaire Anal Incontinence Symptoms and Quality of Life Module (ICIQ-B) and ICI Questionnaire Vaginal Symptoms Module (ICIQ-V), respectively (19).

Day 1 – baseline evaluation:

During the baseline visit, the participant's weight and height were measured. After voiding, the participants were given a short lecture on functional anatomy of the pelvic floor. Following, a trained physiotherapist assessed the ability to contract the PFM by observation and vaginal palpation (16).

PFM resting activity was assessed by surface electromyography (sEMG) (16) with NeuroTrac MyoPlus Pro (Quintet, Bergen, Norway) and a 33 mm transverse diameter vaginal probe with two stainless steel lateral electrodes (35 x 15 mm) (Periform, Quintet, Bergen, Norway). The method has shown very good test-retest intra-rater reliability for measurements of vaginal resting activity (ICC: 0.90, 95% CI: 0.84-0.94) (21). The PFM resting activity was calculated as the overall average microvolts recorded. PFM resting pressure, strength, and endurance were measured with a high-precision pressure transducer connected to a vaginal balloon catheter (Camtech AS, Oslo, Norway). The method has demonstrated good intra-observer reliability (21-25). The instructions were standardized, and we followed the same procedure as Bø, Kvarstein (23), Bø, Kvarstein (22), and Tennfjord, Engh (25). The participants

were instructed to perform three repetitions of maximum voluntary PFM contractions of approximately three seconds and one endurance PFM contraction of 10 seconds. PFM resting pressure was measured as the difference between the atmospheric pressure and the vaginal high-pressure zone at rest in cmH_2O (Fig 2). PFM strength was calculated as the mean peak from the resting pressure line of three maximum voluntary contraction curves (cmH_2O), while PFM endurance was quantified as the area under the curve for 10 seconds (cmH_2O/sec) (Fig. 2).

Finally, 1 repetition-maximum (1RM) tests were conducted for back squat and deadlift. The participants completed a warm-up including 5 minutes on an ergometer bike and 5 minutes of individual optional exercises. The 1RM protocol for back squat and deadlift was standardized, progressing from 10 repetitions at 20%, 4 repetitions at 55%, 3 repetitions at 65%, 2 repetitions at 75%, 1 repetition at 85%, and 1 repetition at 93-95% of expected 1RM with 3-minute rests between the warm-up sets and 5-minute rests before and between the 1RM trials. Participants were allowed to use belts, shoes, or straps for lifting.

Day 2- Test day:

The participants were randomized to start with 60-minutes of weightlifting or 60-minutes of rest (control period) with a washout period of 60 minutes before crossing over to the remaining session (Fig.1). “A randomization list in blocks of 4 was computer-generated by an independent biostatistician using a random number generator. Allocation was concealed in sealed and opaque envelopes that were sequentially numbered. Randomization was unknown for the assessor and participant during the baseline evaluations and was revealed before the first session (weightlifting or rest) on the test day”. PFM measurements were performed immediately

before/after the sessions and took approximately 15 minutes. The order of measurement was standardized (sEMG measurements of PFM resting activity followed by manometry measurements of PFM resting pressure, 3 MVCs, and 10 sec. sustained contraction). The participants were instructed to void before all measurements. We used test facilities that were placed in the same area to ensure time-laps of <5 min between the sessions and measurements.

The weightlifting session included a 10-minute warm-up (same as for the 1RM test), followed by 4 sets of 4 repetitions of back squat and deadlift at 75-85% of 1RM. Three warm-up sets were included before the work sets (10 repetitions at 20-30% of 1RM, 5 repetitions at 50%, and 3 repetitions at 70%). We used "repetitions in reserve" (RIR) to assess perceived exertion between sets. The participants were asked to estimate how many repetitions remained before failure (26). An RIR score of 1-3 was considered acceptable and a score closer to 1 was preferable for the last two sets. If necessary, adjustments to the load were made. Symptoms of PFD (e.g. urinary leakage, vaginal bulging) during the session were asked about and noted.

During the control session, the participants were allowed to read, work/study, or similar activities, but had to remain seated for the whole session (except for toilet visits).

Statistical analyses

Statistical analyses were performed in SPSS statistical software package version 28 (SPSS Inc., Chicago IL, USA). Background data were described by mean, standard deviations (SD), and minimum-maximum and prevalence of PFD with numbers and percentages. Histograms, boxplots, and coefficient of skewness were used to check for normality. Differences

in the changes of PFM variables within-group are reported as mean differences with 95% CI. The data of PFM resting activity, resting pressure, and strength were considered normally distributed. Paired t-tests were used to analyze within-group differences pre- and post-weightlifting and rest, and to compare the changes from weightlifting vs. rest. The PFM endurance data were not normally distributed, and Wilcoxon signed-rank tests were used. Changes in PFM endurance were described by median and interquartile range (IQR). Endurance data from 4 participants were excluded from the analysis due to measurement errors. The P-value was set to 0.05. To control for possible trends and systematic errors of the repeated PFM measurements on test day, boxplots and spaghetti plots were constructed and evaluated by inspection by one of the researchers and a biostatistician. To assess whether the washout period was sufficient, we compared the mean change in pre-values of PFM strength and endurance between the participants who began with weightlifting and those who began with rest by independent-sample t-tests. The relationships between 1RM/relative strength (1RM/bodyweight) in back squat/deadlift and PFM strength were assessed by Pearson correlation coefficient. The first measurements of PFM strength from the test day were used. Preliminary analyses were performed to ensure normality, linearity, and homoscedasticity.

Power calculation

We performed a priori power calculation based on previous results from Ree et al. (15). A sample size of 42 was required to detect a pre-post difference in PFM strength of -4.4 cm H_2O (SD: 4.3) after resistance training and 0.6 cm H_2O (SD: 4.3) after rest with 80% power and a 5% significance level.

RESULTS

Table 3 shows manometry and sEMG measurements before and after heavy weightlifting and rest. There were small but statistically significant, decreases in mean PFM resting activity on sEMG after both weightlifting and rest. When comparing the effect of heavy weightlifting with the effect of rest, we found no significant differences in change of PFM resting pressure (mean difference: 0.7 cmH_2O, 95%CI: -0.8-2.2), strength (mean difference: -1.6 cmH_2O, 95%CI: -5.1–1.8), endurance (median difference after exercise: 6, IQR: -24.5-26.5 vs. rest: 13, IQR: -15-40.2, p = 0.255) or resting activity (mean difference: 0.3, 95%CI: -0.9-0.5). We did not find any patterns/trends of the repeated PFM measures by inspection of box plots and spaghetti plots, and the risk of systematic errors, e.g. learning effect, was considered low. There were no significant differences in mean change in pre-values of PFM strength (p = 0.705) and endurance (p = 0.295) between the participants who began with weightlifting and those who began with rest.

Finally, no significant correlations between PFM strength and 1RM strength in back squat (r = 0.1, 95%CI: -0.19-0.38, p = 0.506) or deadlift (r = 0.08, 95%CI: -0.21-0.36, p = 0.58), nor in relative strength (1RM/bodyweight) in back squat (r = 0.19, 95%CI: -0.10-0.45, p = 0.213) or deadlift (r = 0.18, 95%CI: -0.11-0.44, p = 0.226) were found.

DISCUSSION

To our knowledge, this is the first experimental study to investigate the effects of heavy weightlifting on the PFM. Abilities to produce maximum muscle force (MVC) or to sustain muscle contractions are frequently used to assess levels of muscle fatigue/exhaustion following physical effort (27). Previous research indicates a relationship between PFM fatigue and the

development and/or worsening of SUI (28). However, we found that a single session of heavy weightlifting did not affect PFM strength (MVC) or endurance (ability to sustain a PFM contraction for 10 seconds). Hence, the loads may be considered tolerable and below the intensity level to cause PFM fatigue in nulliparous, young, and strength-trained women.

We used sEMG and manometry to measure PFM resting tone and no significant differences in change in PFM tone were found after weightlifting compared to rest. Muscle tone can be influenced by alterations in active (neural drive) or passive components (e.g. physical properties of muscle and connective tissue) (29). sEMG specifically measures the active electrogenic component of tone, while vaginal resting pressure measures the summative contribution of both active and passive components (29). We found small but significant decreases in PFM resting activity (sEMG) after both weightlifting and rest. This indicates a decrease in activated motor units, which can be interpreted as more relaxed muscles. However, the smallest detectable change with vaginal sEMG is previously reported to be 3.11 (21), and it should be questioned if the changes in our study of 1.6 after weightlifting and 1.3 after rest are clinically relevant. It has been suggested that strenuous training may cause non-relaxing/hypertonic PFMs. This can potentially lead to pelvic pain, sexual disorders, and the inability to pass urine or stool (17). In our study, muscle tone did not increase following heavy weightlifting and there is currently a lack of evidence to support these assumptions. Further, well-established normative values and convincing evidence of an association of increased muscle tone with pain or other PFD are currently lacking (30). Therefore, measures of muscle tone should be interpreted carefully.

Altogether, our results suggest that heavy weightlifting at intensities of 75-85% of 1RM can be considered PFM-safe for women who habitually lift heavy weights. However, PFDs are highly prevalent in female strength athletes (10-12). Powerlifters often use rigorous training regimes with high specificity to improve their 1RM in back squats, bench presses, and deadlifts before competitions (31). Effects of heavy lifting above 85% of 1RM and long-term effects were not addressed in this study and should therefore be further investigated. Bø and Nygaard (9) suggest that there might be individual thresholds of intraabdominal pressure related to possible harm or benefits of exercise on the pelvic floor. Individual variations in response to exercise were also observed in our study. Hence, strength athletes may experience PFD, such as urinary leakage, at different intensity levels. Female athletes/exercisers who experience PFD (e.g., SUI or pelvic pain) should be referred to a PFD specialist (e.g., urogynecologist or pelvic floor/women's health physiotherapist) for early PFD management to ensure maintenance of exercise (32).

We found that strength in whole-body exercises was not correlated to PFM strength, which indicates that strength adaptions from heavy weightlifting exercises, such as back squats and deadlifts, are not specific to the PFMs. Consistent with our results, Moss et.al. (33) found no associations between PFM strength and different measures of strength and fitness (e.g. hand grip strength) in postpartum women. Several studies have compared PFM strength in female athletes/exercises and non-exercisers, but the results are conflicting across studies (9). Altogether, as many studies have confirmed that the prevalence of UI, AI, and POP are high in

athletes, existing evidence does not support the assumption that general exercise can improve PFM strength and PFD (9). Evidence from RCTs, systematic reviews, and meta-analyses show that specific and targeted PFM strengthening training is necessary to improve PFM strength (34, 35).

We were able to find two other experimental studies of the impact of exercise combinations on the pelvic floor. However, these differ in exercise type and participant characteristics, which may challenge the comparability of the results. Middlekauff et al. (14) assessed the immediate effect of a 25-minute bout of strenuous exercise, including typical functional fitness exercises (push-ups, deadlift, push-press, burpees, and sit-ups) on PFM strength and resting pressure in nulliparous strenuous exercisers. Like our results, they found no significant changes in PFM strength, but on the contrary a significant decrease in vaginal resting pressure. They also found an immediate and small, negative effect on vaginal support assessed by gynecological examination (POP-Q). The PFM were assessed with a different vaginal pressure device, and the values are therefore not directly comparable to ours. Ree et al. (15) found that a 90-min bout of strenuous exercise (running and jumping activities, back squats, and lunges) led to a 20% decrease in PFM muscle strength, but no significant changes in vaginal resting pressure in nulliparous women with SUI. This study had a similar crossover design as ours and used the same (but older version) vaginal pressure device to measure the PFM. The pre-test values of PFM strength and vaginal resting pressure, are close to the pre-test values found in our sample, implying a similar preconditioning of the PFM. However, Ree et al. (15) included only women with SUI, and the effect of exercise on the pelvic floor is likely different in women with incontinence compared to those without. In our study, we included both women with and

without incontinence but unfortunately lacked statistical power to perform analyses between groups (14).

The exercise protocols in the above-mentioned studies consisted of high-impact jumping and running activities in addition to weightlifting exercises, and loading characteristics of the pelvic floor may not be comparable to weightlifting alone. In a study of female functional fitness exercisers, intraabdominal pressure curves showed higher and more sudden peak pressures during jumping activity compared to weightlifting activities (36). PFM response during weightlifting and exercise is, unfortunately, challenging to investigate due to a lack of good-quality in-vivo measurement methods (8). Vaginal sEMG has been used in previous studies of PFM activity during running and jumping activities (37, 38), but a movement of the vaginal probe and crosstalk from nearby muscles may potentially affect the outcomes (16). The validity of such measurements is therefore questioned.

Strengths and limitations

One strength of our study is the crossover design, which allowed each participant to serve as their own control. The order of intervention was randomized. The advantages of this design are that the risk of inter-subject variability and the risk of confounding is minimized (39). The number of participants was based on an a-priory power calculation, all participants had experience with heavy weightlifting and were able to follow the test protocol as planned. Training experience in our sample allowed for heavy loads during weightlifting and 1RM strength tests provided accurate measures of training intensity and muscular strength. The PFM measurement methods used are reliable and valid (21-23, 25). The testing procedure was

standardized and performed by the same examiner, which ensured consistency throughout the data collection.

The washout period between sessions and randomizing of the order of sessions may have minimized the risk of carry-over effects. Häkkinen (40) found that maximum knee extension force recovered to approximately 90% of the pre-exercise force in females one-hour post-exercise. If we assume an indirect loading of the PFM of moderate intensity during the weightlifting session, a one-hour washout should be sufficient to restore maximum voluntary contraction force. However, due to a lack of supporting literature on fatigue and recovery of PFM force development, we cannot completely assure this. Changes in the pre-values of PFM strength and endurance were not significantly different between those who performed the weightlifting session first compared to those who started with rest, implying a sufficient washout period to restore PFM force and endurance.

Unfortunately, our sample was not powered to analyze differences in response to weightlifting between women with and without SUI. Further, the assessor of PFM variables was not blinded to the order of the sessions. This was mainly due to testing logistics and a lack of resources. Wide confidence intervals imply individual variation in results. Since our participants had no or little experience with assessments of the PFM, we cannot rule out that individual improvement of PFM strength could be a result of a learning effect. However, the purpose of baseline PFM measurements was to have the participants familiarized with the tests and minimize the learning effect on the test day. We lack information about the participants reproductive profiles (menstrual status/cycle/irregularities, use of contraceptives or hormonal

therapy). However, we do not believe our results was influenced by differences in reproductive profiles and variations in menstrual cycle, since the participants served as their own control and the PFM measurements were performed on the same day. Furthermore, measurements of contraction time and force parameters have previously been found to be stable during different phases of the menstrual cycle (41)" Finally, our study sample may have been too homogeneous regarding genetic factors, training experience, and strength levels to detect linear relationships between whole-body strength and PFM strength.

Long-term effects on the PFM and risks of developing PFD were not addressed in this study and should be further investigated. It is also possible that weightlifting at higher intensities (≥90% of 1RM) may have a larger effect on the PFM. Further, PFD has been reported as a common barrier to exercise among women (42). Our sample consisted of women who persisted with strength training (not those who stopped lifting weights due to PFD) which may be a result of a natural selection of women who tolerate weightlifting with high loads well.

Clinical implications

Although heavy weightlifting exercises (e.g. back squat and deadlift) are assumed to produce strain on the pelvic floor, our results imply that these exercises are well tolerated by the PFM in healthy, nulliparous strength-trained women. Heavy weightlifting did not affect levels of exhaustion or muscle tone in our sample. However, the effect may be different among women with a higher risk of PFD, such as parous, postpartum, or older (>35 years) women. Our findings suggest that heavy weightlifting at 75-85% of 1RM has limited effects on levels of fatigue and muscle tone in strength-trained women. Since PFD is common among female powerlifters and

Olympic weightlifters, the long-term effects of heavy weightlifting and lifting above 85% of 1RM should be further investigated. Furthermore, individual PFM tolerance to training loads may vary, and PFD in strength athletes are important to address to identify relevant treatment options. Finally, our results show that whole-body strength is not associated with stronger PFM. Studies assessing the effect of targeted PFM training in strength athletes are therefore warranted – especially for women with SUI or other PFD.

CONCLUSIONS

We found no immediate effect on the PFM by heavy weightlifting (back squat and deadlift of 75-85% of 1RM) compared to rest in strength-trained, nulliparous women. Further, there was no correlation between strength in back squat/deadlift and PFM strength.

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Conflicts of Interest

All authors declare that they have no conflicts of interest. The results of the study are presented clearly, honestly, and without fabrication, falsification, or inappropriate data manipulation. The results of the present study do not constitute endorsement by the American College of Sports Medicine.

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FIGURE LEGENDS

Figure 1 Study design (R*, randomization)

Figure 2 Pressure curves from one participant including vaginal resting pressure, pelvic floor muscle strength (MVC 1-3), and muscular endurance. MVC maximum voluntary contraction

Figure 1

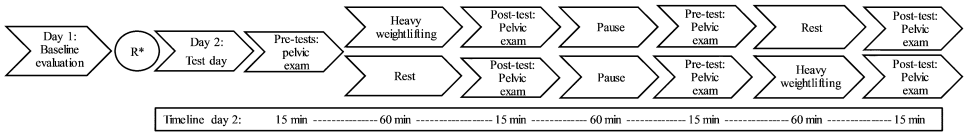

Figure 2

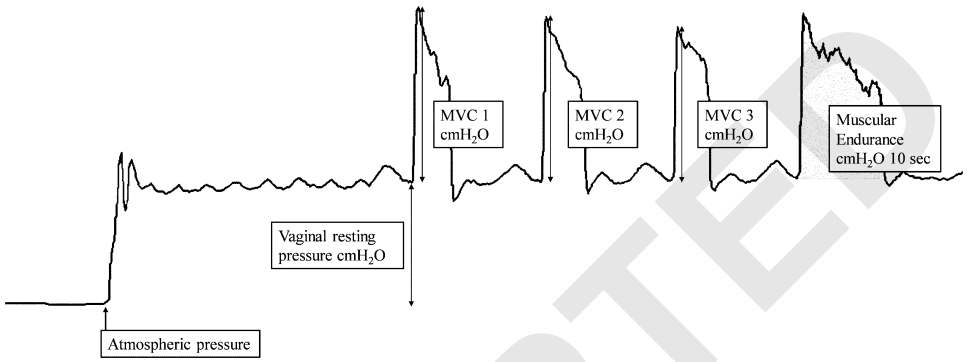

Table 1 Participant characteristics. Mean with standard deviations (SD) and minimum-maximum (min-max). N=47

	Mean (SD, min-max)
Age	27 (4.2, 19-34)
Height (cm)	164 (6.7, 150-179)
Weight (kg)	68.3 (9.3, 51.3-94.8)
BMI	25.1 (2.9, 20-32.6)
Years of experience with strength training	7.3 (2.7, 2-15)
Hours of strength training/week	6.3 (2.7, 2-15)
Hours of other training/week	2.4 (1.9, 0-8)
1RM squat	108.1 (18.8, 71-180)
1RM deadlift	128.1 (19.6, 95-185)
Relative strength squat (1RM/bodyweight)	1.6 (0.2, 1.2-2.2)
Relative strength deadlift (1RM/bodyweight)	1.9 (0.3, 1.4-2.5)
PFM resting pressure (cmH_2O)[a]	29.1 (6.1, 19.8-45.7)
PFM strength[a]	24.7 (11.4, 6.3-58.1)
PFM endurance[ab]	166.4 (82.1, 21-481)
PFM resting activity (mV)[a]	12.5 (8.6, 0.5-36)

BMI Body Mass Index, PFM Pelvic Floor Muscle, RM Repetition Maximum,

[a] Values of the first measurements on the test day are used, [b] N=43

Table 2 Prevalence of reported pelvic floor dysfunctions (N=47)

	N (%)
Any type of urinary incontinence	22 (46.8)
Stress urinary incontinence	19 (40.4)
Anal incontinence	
Liquid	10 (21.3)
Solid	3 (6.4)
Gas	29 (61.7)
Pelvic organ prolapse	5 (10.6)

Table 3 Pelvic floor muscle measures: Pre and post heavy weightlifting and rest. N = 47. Data represented as mean and standard deviations (SD), mean difference and 95% confidence intervals (CI) or median and interquartile range (IQR)

	Heavy weightlifting				Rest				Heavy weightlifting vs. Rest
	Pre	Post	Mean difference	P-value	Pre	Post	Mean difference	P-value	P-value
PFM resting pressure, cmH_2O	29.1 (SD: 6.5)	28.2 (SD: 6.2)	0.9 (CI: -0.2 – 2.0)	0.096	30.3 (SD: 6.2)	30.1 (SD: 6.7)	0.2 (CI: -0.9 – 1.3)	0.715	0.349
PFM strength, cmH_2O	23.4 (SD: 11.1)	23.7 (SD: 15.4)	-0.2 (CI: -2.5 - 2.1)	0.857	26.5 (SD: 15.4)	25.2 (SD: 16.8)	1.4 (CI: -1.3 – 4.2)	0.302	0.341
PFM endurance[b], cmH_2O/sec	164 (IQR: 105.8-206.3)[c]	134 (IQR: 88.0-218.0)[c]	N/A	0.876[c]	154 (IQR: 92.8-225.8)[c]	131 (IQR: 97.2-174.3)[c]	N/A	0.053[c]	0.225[c]
PFM resting activity, mV	10.8 (SD: 8.0)	9.2 (SD: 7.4)	1.6 (CI: 0.5 – 2.7)	0.005[a]	10.8 (SD: 8.5)	9.5 (SD: 8.0)	1.3 (CI: 0.4 – 2.1)	0.004[a]	0.614

IQR: Interquartile Range, N/A Not Applicable, mV Microvolt, PFM Pelvic Floor Muscle, SD Standard Deviation, CI Confidence Interval

[a] $P < 0.005$, [b] n = 4 values missing, [c] non-parametric test, Wilcoxon Signed Rank test reported with median and interquartile range

Paper IV

TITLE PAGE

Title: Pelvic Floor Muscle Training in Female CrossFit® and Functional Fitness Exercisers – An Assessor-blinded Randomized Controlled Trial

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ABSTRACT

Objectives

Stress urinary incontinence (SUI) is common among female CrossFit® and functional fitness exercisers. However, the knowledge of treatment options is sparse. Therefore, the aim of this study was to assess the effect of pelvic floor muscle training (PFMT) on SUI in female CrossFit®/functional fitness exercisers.

Methods

This was an assessor-blinded randomized controlled trial with a PFMT group and a control group. The PFMT group followed 16-week home training with weekly follow-up/reminders by phone. Primary outcome was change in total score of the International Society of Incontinence Questionnaire Urinary Incontinence – Short Fort (ICIQ-UI-SF). Secondary outcomes were perceived change of SUI (PGI-I), change of pelvic floor muscle (PFM) strength, self-efficacy to PFMT and symptoms of anal incontinence (AI) and pelvic organ prolapse (POP).

Results

At 16 weeks, the PFMT group had significantly larger improvement in ICIQ-UI-SF score compared to the control group (mean difference: -1.43, 95% CI: -2.62 to -0.24, $p = 0.02$). Sixty-four percent in the PFMT group vs. 8% in the control group reporting improved symptoms of SUI group ($p < 0.001$, RR: 7.96, 95% CI 2.03 to 31.19) on the PGI-I scale. We found no significant differences in change of PFM strength or symptoms of AI/POP between groups. The PFMT group did not improve their self-efficacy during the intervention.

Conclusion

A16-week home training program of the PFM led to improvements of SUI in female CrossFit® and functional fitness exercisers. However, the PFMT group did not improve their PFM strength, AI and POP significantly compared to the control group.

- **What is already known in this topic:**

Current evidence supports pelvic floor muscle training (PFMT) to improve or cure urinary incontinence in the general female population. Stress urinary incontinence (involuntary leakage of urine on physical effort) is highly prevalent among female CrossFit® and functional fitness exercisers. There is limited knowledge of the effect of PFMT in these women who are exposed to potential strain on the pelvic floor muscles due to large increases in intraabdominal pressure during exercise (e.g., running, jumping and heavy lifting).

- **What this study adds:**

This study demonstrates that targeted PFMT may improve frequency, amount, and bother of SUI in CrossFit® and functional fitness exercisers. A pragmatic approach home-based training was chosen, and the sample showed large variability of effects on symptoms of SUI and pelvic floor muscle strength.

- **How this study might affect research, practice or policy:**

PFMT should be offered as first line treatment for SUI in female CrossFit® and functional fitness exercisers. For optimal effect, supervised training and in-person follow up with a pelvic floor specialist may be necessary to ensure muscle strength gains, training quality, self-efficacy, and adherence to the prescribed exercises. Increased knowledge of treatment options of SUI may encourage women to stay active and continue their functional fitness training.

INTRODUCTION

The pelvic floor consists of muscles, fascia and ligaments and forms a hammock-like support for the pelvic organs at the base of the abdomino-pelvic cavity (1). During exercise, the pelvic floor muscles (PFM) must counteract the increase in intra-abdominal pressure (IAP), especially during weightlifting and high-impact activities (e.g. running and jumping) (1, 2). Indirect loading of the pelvic floor may potentially lead to stronger PFM muscles and better pelvic floor support. However, if not able to withstand the increases in IAP, the PFM may be overloaded and weakened. This can further increase the risk of pelvic floor disorders (PFD), such as urinary incontinence (UI) (2, 3). CrossFit® and functional fitness training includes various high-intensity weightlifting and high-impact activities (e.g. rope jumping, box jumps) (4), which are shown to generate large increases in IAP (5). Given the potential impact on the pelvic floor, it is presumed that female CrossFit® and functional fitness exercisers need well-functioning PFMs to prevent PFDs. A recent meta-analysis revealed a pooled prevalence of UI of 45% among CrossFit® practitioners with 50% increased odds of UI compared to control groups (6). The most common type was stress UI (SUI), which is the complaint of involuntary leakage of urine on physical effort (7).

There is level 1 evidence, and grade A recommendation for PFM training (PFMT) as the first line treatment for SUI in the general female population (8). Regular PFMT has shown to change pelvic floor morphology by increased muscle volume and stiffness, reduced opening of the levator hiatus (the surrounding area where urethra, vagina and rectum pass through) and elevated resting position of the bladder and rectum (9). Despite high prevalence of SUI in female strenuous exercisers, the knowledge of treatment options is sparse (10). Therefore, the aim of this study was to assess the effects of PFMT on SUI in female CrossFit®/functional fitness exercisers.

METHODS

Design

This was an assessor-blinded randomized controlled trial, approved by the regional ethics committee (2018/2211/REK Sør-øst B, 20.12.2018) and the Norwegian Centre for Research Data (NSD: 199381, 24.01.2019). All subjects gave electronic and written informed consent before participation. We have followed the Consolidated Statements of Reporting Trials

(CONSORT) checklist (11). The study protocol was registered in the ClinicalTrials.gov-registry by the U.S. National Library of Health (April 22, 2022, NCT05341024).

Participants

Participants were recruited through social media (FaceBook, Instagram) and CrossFit® or functional fitness affiliates between April and December 2022. Women aged ≥18 years who habitually participated in CrossFit® or functional fitness training (≥ 6 months of consistent participation, ≥ 3 times per week) with self-reported SUI were invited to participate in the study. Eligibility was verified by the International Consultation on Incontinence Questionnaire-Urinary Incontinence Short Form (ICIQ-UI-SF), prior of baseline evaluations. A sum-score of ≥ 3 of the questions regarding frequency and amount of leakage was required. Further, the option "I leak when I am physical active/exercising" on the question "When does urine leak?" had to be chosen. The exclusion criteria were pregnancy/planning to get pregnant during the intervention period, history of hysterectomy/pelvic surgery to correct UI, AI or POP, musculoskeletal injuries for the past 6 months with negative effect on exercise, childbirth within the previous 12 months and inability to perform a correct PFM contraction. Eligible participants were invited to participate in two test sessions (at baseline and post-intervention) with 16 weeks between sessions.

Intervention

The intervention consisted of a home-based PFMT program with weekly follow-up by phone with a physiotherapist (alternating follow-up phone call or SMS). Prior to the intervention, the participants were taught how to perform a correct PFM contraction by vaginal palpation and received instruction on how to perform the training program. The program consisted of 3 sets of 8-12 maximum PFM contractions per day in lying, seated, or standing. To assess adherence to the prescribed exercises, the participants were asked to register their sessions in an electronic app (Athlete Monitoring). A reminder was sent by SMS if registration of the daily session was lacking by 8 PM. The training period lasted 16 weeks, and the program took about 10 minutes per day. The participants received individual advise for progression of the exercises throughout the training period with options to change position, increase the number of contractions and to add 3-4 fast contractions on top of each holding period (12, 13). They also received an information booklet and a video showing the exercise program.

The participants in the control group were informed to continue their CrossFit® and functional fitness training as usual and asked not to perform any specific training of the PFMs during the intervention period. All participants in the control group were offered instructions for PFMT after the completion of post-tests.

Outcomes

Primary outcome:

Primary outcome was change in total score of the ICIQ-UI-SF. The ICIQ-UI-SF is a reliable and valid questionnaire assessing frequency, amount, bother of urinary leakage and type of UI (14). The ICIQ-UI-SF score (0–21) is the sum of the first 3 questions (frequency, amount, and bother). A change of the ICIQ-UI-SF score of 2.5 has been identified to be the minimal important difference (MID) and 1.58 as between-treatment MID (15).

Secondary outcomes:

Manometry measurements of the PFM: Vaginal resting pressure (VRP), PFM strength (maximum voluntary contraction), and PFM endurance was measured with a high precision pressure transducer connected to a vaginal balloon catheter (Camtech AS, Sandvika Norway). The method has demonstrated good intra-observer reliability (16-20). PFM resting pressure was measured as the difference between the atmospheric pressure and the vaginal high-pressure zone at rest in cmH_2O (Fig 1). PFM strength was calculated as the mean peak from the resting pressure line of three maximum voluntary contraction curves (cmH_2O), while PFM endurance was quantified as the area under the curve for 10 seconds (cmH_2O/sec) (Figure 1). Only measurements with simultaneous observable inward movement of the catheter/perineum was considered valid measurement of correct PFM contraction (17).

Other PFD: Questions from patient-reported outcome measures (PROM) with Grade A recommendation from the International Consensus on Incontinence 2017 was used to assess prevalence and bother of AI (ICIQ-B) and symptomatic POP (ICIQ-VS) (21). AI was classified into 3 subgroups as follows: involuntary loss of gas, solid stool, and liquid stool.

Self-Efficacy Scale for Practicing Pelvic Floor Exercises (SESPPFE):

At baseline, the participants were asked to rate their self-efficacy of pelvic floor exercises by using a reliable and valid self-efficacy scale (22), including 17 items. The participants in the

intervention group were asked to rate their self-efficacy again using the same after one month of PFMT.

Patient Global Impression of Improvement (PGI-I) Scale: At post-test the participants were asked to rate their perceived change of SUI. A validated 7-point scale with response choices ranging from "very much better" to "very much worse" was used (Yalcin et al. 2003).

Data collection and procedures

The data were collected between May 2022 and April 2023. Informed consent, background variables (age, parity, mode of delivery, training habits, chronic diseases), the ICIQ-UI-SF, report of AI, POP and SESPPFE were collected in an electronic questionnaire (Survey Xact) 1-2 days prior to the baseline evaluation. Baseline testing included measurements of height, weight, and the PFMs. All participants were reassessed with a questionnaire (ICIQ-UI-SF, report of AI and POP and PGI-I) and measurements of the PFMs after the 16-week intervention period.

Randomization and blinding

A randomization list was computer-generated by an independent biostatistician in blocks of 4, using a random number generator. Allocation was concealed in sequentially numbered sealed and opaque envelopes. The assessor and statistician were blinded to group allocation. Randomization was revealed to the participants and physiotherapist in charge of the intervention after baseline testing.

Statistics

An a priori power calculation was conducted based on mean ICIQ-UI-SF score (4.3, SD: 2.8) from a previous study in female strength athletes (23) and the MID in total score of 2.5 (15). With a decrease in ICIQ-UI-SF score from 4.3 to 1.8 (SD: 2.8) in the PFMT group and no change (SD: 2.8) in the control group, 80% power, 5% significance level and an estimated drop-out rate of 20%, at least 24 participants were required in each group (total N = 48). To account for uncertainties in the power calculations, we aimed to include 50 participants.

Data were analyzed in SPSS 28. Background variables were reported as means with standard deviations (SD) or numbers with percentages. Within-group group differences were analyzed

by paired-sample t-test and between-group differences of categorical data by the chi-square test for independence or Mann-Whitney U-test. Between-group comparisons of continuous variables, were analyzed by ANCOVA as a linear regression with week 16 value as the dependent variable and group allocation and the baseline variable as the independent variables. Difference in change between groups from baseline to week 16 are reported with 95% CI. *P*-values < 0.05 were considered statistically significant. The analyses were based on full analysis set where all available participants at follow-up were analyzed in the groups to which they were originally randomized. Additional sensitivity analyses were conducted with imputations of missing data due to loss to follow-up.

RESULTS

Flow of participants

Fifty-four women were recruited to baseline assessments. Two were excluded due to inability to perform a correct PFM contraction and one participant chose not to participate due to ongoing PFMT with promising results. Of the remaining 51 participants, 26 participants were randomized to the PFMT group and 25 to the control group. Four participants dropped out of the PFMT group and none in the control group. Reasons for drop-out are described in Figure 2. PFM-measurement data at week 16 was missing for one participant in the control group due to equipment impairments. There were no observed differences in background variables between groups at baseline (Table 1).

The participants in the PFMT group completed 70% (SD: 23) of the prescribed exercise sessions. Thirteen (59%) adhered to >70%. No adverse effects were reported.

Table 1: Participant characteristics of the training group and control group at baseline. Mean with standard deviations (SD) and maximum-minimum (max-min) or number with percentages

	Total sample (N=47)	PFMT group (N= 22)	Control group (N= 25)
Age (y), mean (SD)	33.5 (8.1)	34.7 (8.3)	32.5 (7.8)
Height (cm), mean (SD)	167.9 (5.4)	167.7 (5.9)	168.1 (5.0)
Weight (kg), mean (SD)	71.6 (10.1)	71.1 (8.6)	72.0 (11.4)
Body mass index (kg/m^2), mean (SD)	25.4 (3.2)	25.3 (2.8)	25.4 (3.6)
Years of CF/FFT participation, mean (SD)	3.8 (2.2)	4.0 (2.5)	3.6 (2.0)
Hours of CF/FFT per week, mean (SD)	5.6 (3.3)	5.4 (2.9)	5.8 (3.6)
College/university degree, n yes (%)	40 (85)	18 (81.8)	22 (88)
Numbers of parous women, n yes (%)	23 (49)	13 (59.1)	10 (43.5)
Parity, n (%)	1.9 (0.7)	1.9 (0.7)	2.0 (0.7)
Years since last childbirth, mean (SD)	7.4 (5.1)	7.7 (4.4)	7.0 (6.0)
Modes of delivery			
Vaginal, n (%)	22 (95.7)	13 (100)	9 (90.0)
Caesarian section, n (%)	2 (8.7)	0 (0.0)	2 (20.0)
Instrumental, n (%)	4 (17.4)	3 (23.1)	1 (10.0)
Chronic disease, n yes (%)	13 (27.7)	6 (27.3)	7 (28.0)
ICIQ-UI-SF score	7.5 (3.2)	7.5 (3.3)	7.5 (3.1)
Other pelvic floor disorders, n yes (%)			
Involuntary leakage of gas	31 (66.0)	14 (63.6)	17 (68.0)
Involuntary leakage of solid stool	2 (4.3)	1 (4.5)	1 (4.0)
Involuntary leakage of liquid stool	16 (34.0)	8 (36.4)	8 (32.0)
Symptoms of pelvic organ prolapse	9 (19.1)	5 (22.7)	4 (16.0)
Score of SESPPFE (scale 0-100), mean (SD)	78.9 (15.2)	81.2 (15.0)	76.9 (15.4)

CF = CrossFit (TRADEMARK), FFT = functional fitness training, ICIQ-UI-SF = International Consultation of Incontinence Questionnaire Urinary Incontinence Short Fort, PFMT = Pelvic floor muscle training, SESPPFE = Self-Efficacy Scale for Practicing Pelvic Floor Exercises\

ICIQ-UI-SF

We found a change in ICIQ-UI-SF score of -1.3 (95% CI: -2.6 to -0.03, p = 0.04) in the PFMT group and 0.1 (95% CI: -0.6 to 0.9, p = 0.75) in the control group. The PFMT group had significantly larger improvement in the total score compared to the control group with a mean difference of -1.4 (95% CI: -2.6 to -0.2, p = 0.02).

Sensitivity analysis

Post-ICIQ-UI-SF scores for the four participants who dropped out in the PFMT group were imputed (improvement, no change and worsening), based on lower-limit CIs for score-reduction in in the PFMT group (-2.6) or upper-limit of score-increase in the control group (0.9) from the main analysis. The between-group mean differences became larger or smaller but remained statistically different in favor of the PFMT group (Table 2).

Table 2: Sensitivity analysis of the between-group mean differences (95% CI) of change in ICIQ-UI-SF score with imputations of post-ICIQ-UI-SF (reduction, no change or increase) for the missing data for the 4 participants who were lost to follow-up at week 16. PFMT group (N = 26) vs. Control group (N = 25).

	Between-group differences		
	Mean difference (Week 16 minus Week 0, PFMT minus Control)	**95% CI**	**P-value**
ICIQ-UI-SF score (-2)	-1.6	-2.7 to -0.5	0.005
ICIQ-UI-SF score (-3)	-1.8	-2.3 to -0.6	0.003
ICIQ-UI-SF score (no change)	-1.3	-2.4 to -0.2	0.020
ICIQ-UI-SF score (+1)	-1.2	-2.3 to -0.1	0.042

ICIQ-UI-SF = International Consultation of Incontinence Questionnaire Urinary Incontinence Short Fort, PFMT = Pelvic floor muscle training

PFM resting pressure, strength, and endurance

Change in PFM variables are described in Table 3. We found no significant differences in change of PFM resting pressure, strength, or endurance between groups.

Table 3: Mean of groups (SD), mean (SD) within-group difference, and mean (95% CI) between-group difference for manometry measures of the pelvic floor muscles

Outcome	Groups				Within-group differences		Between-group difference
	Week 0		Week 16		Week 16 minus Week 0		Week 16 minus Week 0
	PFMT (n = 22)	Control (n = 25)	PFMT (n = 22)	Control (n = 24) *	PFMT (n = 22)	Control (n = 24) *	PFMT minus Control
PFM resting pressure	30.5 (7.1)	32.3 (7.9)	28.5 (5.7)	28.0 (5.3)	-2.1 (6.6)	-4.4 (5.6)	1.3 (-1.4 to 4.0)
PFM strength	17.4 (10.)	22.2 (14.4)	21.3 (10.5)	20.9 (14.0)	3.9 (7.9)	-1.0 (8.3)	3.8 (-0.8 to 8.4)
PFM endurance	122.1 (86.9)	143.2 (110.8)	147.5 (84.1)	119.9 (94.2)	28.0 (82.4)	-19.8 (77.2)	39.28 (-1.5 to 80.1)

PFM = Pelvic floor muscle, PFMT = Pelvic floor muscle training

* Missing data of one participant due to measurement error

Patient Global Impression of Improvement (PGI-I) Scale

The proportion of women reporting improved symptoms of SUI (≥1) after 16 weeks was significantly larger in the PFMT group compared to the control group (64% vs. 8%, $p < 0.001$, RR: 8.0, 95% CI 2.0 to 31.2) on the PGI-I scale (Table 4). None in the PFMT group and one participant in the control group reported worsening of symptoms.

Other pelvic floor disorders

Table 4 shows that changes in symptoms of AI and POP were similar in both groups.

Self-Efficacy Scale for Practicing Pelvic Floor Exercises (SESPPFE)

Twenty (90.1%) participants in the PFMT group responded to the SESPPFE after 1 month of PFMT. The mean change in total score was -0.7 (95% CI: -9.2 – 7.8, $p = 0.875$) on a scale of 0-100, suggesting that the participants did not improve their self-efficacy for PFMT or beliefs in expected results.

198 **Table 4: Self-perceived improvements of Stress Urinary Incontinence reported by PGI-I**
199 **and change in frequency of bowel symptoms and pelvic organ prolapse, numbers with**
200 **percentages**

	PFMT group (N = 22)	Control group (N = 25)	Group differences P-value
PGI-I: How is your urinary leakage now compared to before you entered the study? N (%)			< 0.001[1]
Very much better	0 (0)	1 (4)	
Much better	3 (13.6)	0	
Better	11 (50)	1 (4)	
No change	8 (36.4)	22 (88)	
Worse	0 (0)	1 (4)	
Much worse	0 (0)	0	
Very much worse	0 (0)	0	
Improvement PGI-score ≥1	15 (63.6)	2 (8)	< 0.001[2]
Bowel symptoms, N (%)			
Involuntary leakage of gas:			
Reduced frequency	5 (22.7)	6 (24.0)	
No change	11 (50.0)	13 (52.0)	
Increased frequency	6 (27.2)	6 (24.0)	0.890[1]
Involuntary leakage of solid stool:			
Reduced frequency	1 (4.5)	1 (4.0)	
No change	18 (81.8)	22 (88.0)	
Increased frequency	3 (13.6)	2 (8.0)	0.642[1]
Involuntary leakage of liquid stool:			
Reduced frequency	3 (13.6)	3 (12.0)	
No change	17 (77.3)	22 (88.0)	
Increased frequency	2 (9.1)	0 (0.0)	0.568[1]
Pelvic organ prolapse symptoms, N (%)			
Bulging/lump inside of the vagina:			
Reduced frequency	1 (4.5)	3 (12.0)	
No change	19 (86.4)	21 (84.0)	
Increased frequency	2 (9.1)	1 (4.0)	0.263[1]
Bulging/lump outside of the vagina:			
Reduced frequency	2 (9.1)	1 (4.0)	

No change	19 (86.4)	22 (88.0)	
Increased frequency	1 (4.5)	2 (8.0)	0.440[1]

PFMT = Pelvic floor muscle training, PGI-I = Patient Global Impression of Improvement

[1] Analyzed by Mann-Whitney U test, [2] Analyzed by Chi-Squared test

DISCUSSION

We found that a 16-week home-training program PFM may improve the frequency, amount, and bother of SUI in female CrossFit® and functional fitness exercisers. The within-group reduction of the ICIQ-UI-score of 1.3 for the PFMT group and the between-group difference of 1.4 to the control group were below the previously reported MIDs of 2.5 and 1.6 respectively (15). However, the upper ends of the CIs reached worthwhile effects, indicating a possibility of beneficial effects on symptoms of SUI in favor of the PFMT group. Our sample had a lower severity of pre-intervention total scores compared to the sample used to calculate MIDs (mean: 10.2) (15). A large prospective study of an app-based approach to PFMT found that more severe baseline scores of the ICIQ-UI-SF were related to larger improvements (24) and a change of 1.33 has been calculated as MID for women with moderate severity (25). ICIQ-UI-SF baseline severity should therefore be considered when using MID to interpret results. Additionally, nulliparous women often report mild UI symptoms (26, 27). Given the large proportion of nulliparous women in our sample (50%), the mean reduction in ICIQ-UI-SF-score may have been influenced by less severe UI at baseline among these women. In our sample, >60% of the women in the PFMT group and only 8% in the control group reported improvements on PGI-I scale, suggesting clinically relevant changes of the ICIQ-UI-SF score in favor of the PFMT group.

A Cochrane-review of >1800 women showed that women who performed PFMT were 6 times more likely to be cured of SUI compared to control groups with no treatment (8). None of the participants in our study reported cure of SUI. This may be explained by a higher exposure of high-intensity training and possible constant triggers of leakage in this group of sportswomen compared to the general female population.

To our knowledge, this is the first RCT of PFMT in female CrossFit® and functional fitness exercisers. In a recent systematic review of PFMT in athletic women with SUI (28), the results from the included studies showed promising results for improving SUI and PFM strength. However, none of the studies included CrossFit®/functional fitness exercisers and most studies were small scaled. In a RCT of PFMT in female volleyball athletes, the intervention group significantly reduced the amount of leakage compared to the control group (10). However, comparisons of the results to our study are challenging due to differences in intervention, participant characteristics and measurement methods.

The ICIQ-UI-SF was chosen as primary outcome since it has been proven valid, reliable and responsive to change (14) and has recommendation A by the International Continence Society to assess symptoms of UI (29). However, self-reported data may be limited by recall bias and inaccuracy of categorical data (30). In studies of PFMT in volleyball athletes, short-term pad-tests were used as the primary outcome measure (10, 31). The pad-test offers the advantage of providing a direct measure of the amount of urine loss during exercise. However, studies of short-term pad-tests has revealed poor reproducibility and various sensitivity (34-83%) and specificity (65-89%) in accurately predicting UI (32). If the pad-test is to be utilized in future studies, a standardized and sport-specific protocol should be established and further validated and reliability-tested.

Our PFMT protocol followed recommendations for effective training dosage (33), but the PFMT group did not improve their PFM strength or endurance significantly compared to the control group. The CIs were wide, suggesting various response related to improvements of PFM strength and endurance. The upper limits of the CIs for within- and between group differences were above the previously reported minimal detectable change of 7.6 cmH_2O for PFM strength and 59.5 cmH_2O for endurance (19), suggesting possible worthwhile effects in favor of the PFMT group. Previous studies with similar intervention and measurement methods used to assess PFM variables have shown larger improvements in PFM strength, of 15.5 (12) and 13.1 cmH_2O (34). In these studies, the participants had weekly supervised training with a physiotherapist and more follow-up assessments of the PFMs, and the intervention period was longer compared to ours (6 vs. 4 months). The two former RCTs also reported better adherence with close to 100 and 80% respectively. These results suggests that supervised training, follow-up assessments and training durations of at least 6 months should be recommended to improve PFM strength and endurance. However, our pragmatic approach may be more in-line with a real-life setting for athletes where not all may have the opportunity to attend to weekly/monthly visits with a physiotherapist.

Strengths of the present study are the randomized design, concealed allocation, blinding of the assessor, a priori power calculation and the use of valid and reliable measurement tools to assess UI and PFM variables. Further, the same assessor performed all measurements of the PFMs with a standardized and consistent protocol. Finally, the intervention was based on strength training principles and followed a previously proven effective protocol to improve SUI and PFM strength. The women received advise on progression alternatives and reminders to adhere to the prescribe training sessions. Our inclusion criteria were not

restricted to performance level, age or severity of SUI and our results may therefore be generalizable to a variety of female adults who engage in CrossFit® or functional fitness training with symptoms of SUI.

A limitation of the study is the lack of supervised training and follow-up assessments which may have negatively influenced adherence and intensity of the training. The use of self-reported questionnaire as main outcome may have been affected by recall bias and the treatment effect may have been underestimated by categorical responses.

Practical implications

PFMT should be recommended as first-line treatment in female CrossFit® and functional fitness exercisers as it may improve symptoms of SUI. However, supervised training and follow up assessments with a pelvic floor specialist may be beneficial to improve self-efficacy, adherence, and PFM strength. A longer training period (>6 months) may lead to further improvements of SUI and PFM strength. Increased knowledge of treatment options may encourage women to stay active and continue their functional fitness training.

CONCLUSION

We found that a 16-week home training program of the PFM led to improvements of SUI in female CrossFit® and functional fitness exercisers. However, the PFMT group did not improve their PFM strength and endurance significantly compared to the control group.

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Conflicts of interest

All authors declare that they have no conflicts of interest. The authors also declare that the results of the study are presented, honestly, and without fabrication, falsification, or inappropriate data manipulation.

Patient and public involvement

In the planning phase, the main investigator (KLS) met with two experienced CrossFit®-trainers (Level 1 and 2) to discuss the inclusion criteria and study protocol. The public were involved in the recruitment process by sharing content about the study on social media platforms (Instagram, Facebook) and in private Facebook-groups for members of different CrossFit®-affiliates.

Equity, diversity and inclusion statement

The study included only female participants and authors. Several publications in the Br J Sports Med have pointed out that women are strikingly under-represented both as authors and participants in sports medicine and exercise research. Also, PFD has been shown to affect female athletes/exercisers in a much larger scale than males (35, 36). Women with different ethnic and socioeconomic backgrounds were welcome to participate. Male statisticians provided advice on power calculations, randomization and statistical analysis.

Figure 1 Example of pressure curves of vaginal resting pressure, pelvic floor muscle strength (MVC 1-3), and muscular endurance. MVC; maximum voluntary contraction

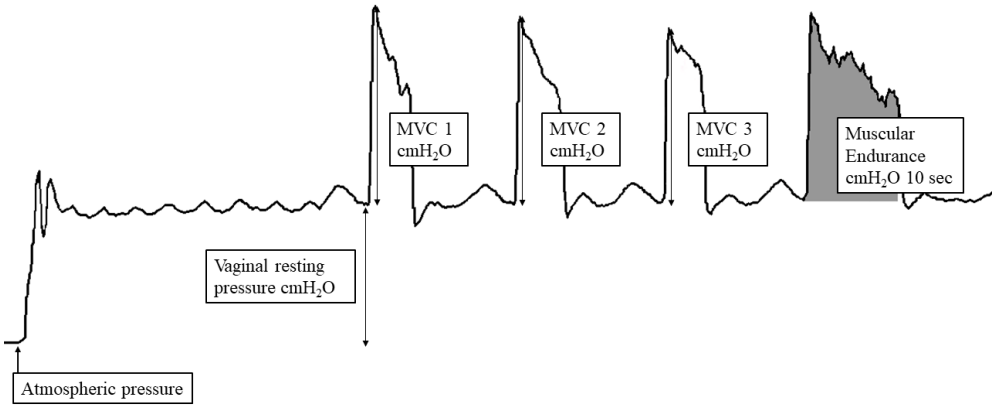
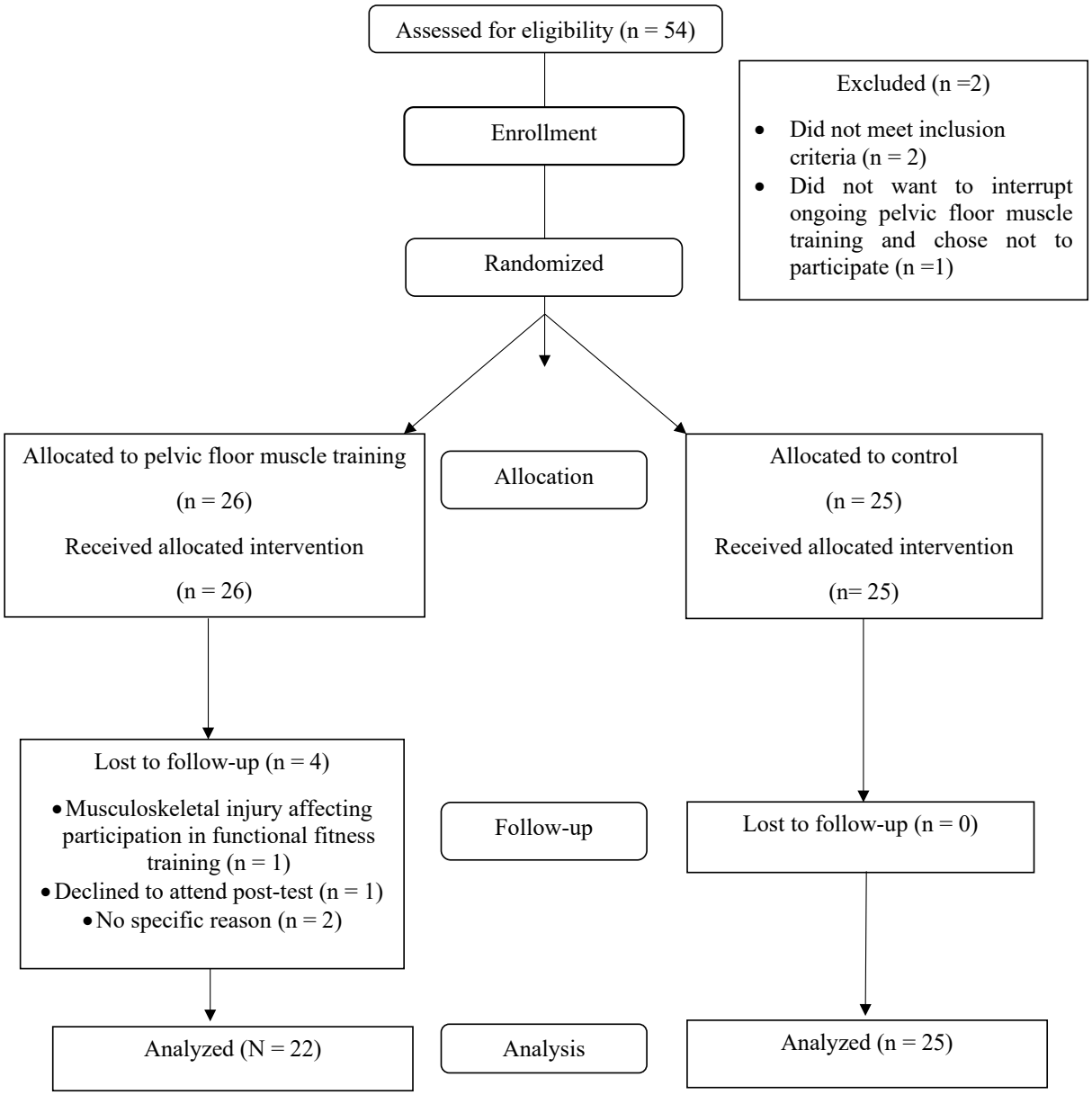


Figure 2 Flowchart of participants through each stage of the randomized controlled trial



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431

Appendix 1

Paper I-IV

Approvals from the Regional Committee for Medical and Health Research Ethics of Norway (REK South East 2018/2211) and the Norwegian Centre for Research Data (199381).

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Ingrid Dønåsen	22845523	20.12.2018	2018/2211 REK sør-øst B
			Deres dato:	**Deres referanse:**
			06.11.2018	

Vår referanse må oppgis ved alle henvendelser

Kristina Lindquist Skaug
Norges idrettshøgskole

2018/2211 Idrett, fysisk aktivitet og bekkenbunn

Forskningsansvarlig: Norges idrettshøgskole
Prosjektleder: Kristina Lindquist Skaug

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst B) i møtet 05.12.2018. Vurderingen er gjort med hjemmel i helseforskningsloven (hforsknl) § 10.

Prosjektomtale
Flere studier har vist at det er høy forekomst av urinlekkasje blant kvinnelige idrettsutøvere under trening og konkurranse. Hensikten med doktorgradsprosjektet er å undersøke hvordan bekkenbunnsmuskulaturen påvirkes av idrettsaktivitet og effekt av bekkenbunnstrening på bekkenbunnsplager som urinlekkasje og underlivsprolaps hos kvinnelige idrettsutøvere. Formålet i de første to studiene er å øke kunnskapen om forekomst av og risikofaktorer for bekkenbunnsplager hos hos kvinnelige turnere, troppsgymnaster og cheerleadere og hos mannlige og kvinnelige styrke- og vektløftere. I den tredje studien vil vi sammenligne funksjon i bekkenbunnsmusklene hos kvinnelige styrke- og vektløftere og kontroller som ikke trener styrke. Den siste studien er en randomisert kontrollert studie hvor hensikten er å undersøke om styrketrening av bekkenbunnsmusklene har effekt på symptomer og forekomst av urinlekkasje hos kvinnelige turnere, troppsgymnaster og cheerleadere.

Vurdering
Prosjektet består av fire delstudier:

Studie 1
I denne delen skal det inkluderes kvinnelige deltakere over 13 år; 70 turnere, 400 troppsgymnaster og 300 cheerleadere. Studien har som formål å undersøke forekomst av bekkenbunnsplager og tilknyttede risikofaktorer hos målgruppen.

Studie 2
Delstudie 2 skal se på forekomst av bekkenbunnsplager og tilknyttede risikofaktorer hos vekt- og styrkeløftere som er kvalifisert til å delta på norgesmesterskap. Det skal rekrutteres ca. 100 kvinnelige og 100 mannlige styrkeløftere og ca. 40-50 kvinnelige og 50-80 mannlige vektløftere.

Studie 3
I studie 3 vil man sammenlikne funksjon i bekkenbunnsmusklene hos kvinnelige vektløfter- og

styrkeløftutøvere på høyt nasjonalt nivå med matchede kontroller som ikke trener styrke. Det vil inkluderes 28 personer i hver gruppe, og dermed totalt 56 deltakere i denne delstudien. Funksjon i bekkenbunnmusklene undersøkes vaginalt og det vil derfor bare inkluderes deltakere over 18 år.

Studie 4
Studie 4 er en intervensjonsstudie der man vil undersøke effekten av et nytt behandlingstiltak med bekkenbunnstrening. Aktuelle deltakere er personer fra studie 1 som rapporterte urinlekkasje. Det skal inkluderes 28 deltakere i denne studien, 14 i intervensjonsgruppa og 14 i kontrollgruppa. I søknaden oppgis det at «*Dersom treningen viser positive resultater for bekkenbunnstrening vil kontrollgruppen få instruksjon i treningsprogrammet i etterkant av intervensjonsperioden*.». I informasjonsskrivet står det at deltakere i kontrollgruppen «*vil få tilbud om en veiledningstime hos fysioterapeut med instruksjon i riktig bekkenbunnsammentrekning og gitt et bekkenbunnstreningsprogram i etterkant av studien.*». Komiteen har lagt til grunn at det som står i informasjonsskrivet er korrekt.

Prosjektleder
Ph.d.-stipendiaten er oppført som prosjektleder for prosjektet. Blant annet grunnet prosjektets omfang og fordi det skal inkluderes mindreårige deltakere mener komiteen at prosjektleder bør være en person med mer forskningskompetanse og -erfaring, jf. helseforskningsloven § 4, bokstav f. Det må derfor sendes inn en søknad om prosjektendring til REK for bytte av prosjektleder, fortrinnsvis til stipendiatens hovedveileder, Kari Bø.

Informasjons- og samtykkeskriv:

- Komiteen synes informasjonsskrivene til deltakere under 16 år kan tilpasses bedre til deres alder. For eksempel må ord som underlivsprolaps forklares eller byttes ut med andre begreper.
- I informasjonsskrivet til studie 1 står det at «*Utøvere som svarer at de opplever urinlekkasje vil få muligheten til å være med i en oppfølgingsstudie hvor vi ønsker å undersøke effekt av styrketrening for bekkenbunnsmusklene på symptomer og forekomst av urin lekkasje blant turnere, troppsgymnaster og cheerleadere.*». Dette kan gi urealistiske forhåpninger hos deltakerne, ettersom det kun skal inkluderes 28 deltakere i studie 4. Komiteen ber derfor om at ordet «*vil*» byttes ut med «*kan*», samt at det oppgis hvor mange det er planlagt å inkludere i oppfølgingsprosjektet.
- Det mangler signaturdel i informasjonsskrivene til unge over 16 år og til foresatte i studie 1 og i studie 4.
- Informasjonsskrivet til kontrolldeltakere i studie 3 mangler.

Prosjektet fremstår som nyttig og gjennomtenkt, og utover ovennevnte har komiteen ingen innvendinger til prosjektet slik det er presentert i søknaden. Prosjektet godkjennes dermed på følgende vilkår:

1. Det må sendes inn et skjema for prosjektendring for bytte av prosjektleder.
2. Informasjonsskrivet til kontrolldeltakere i studie 3 og reviderte versjoner av informasjonsskrivene i studie 1 og 4 må ettersendes. Endringene i skrivene må markeres. Skrivene skal vurderes av REK før de kan tas i bruk.

Vedtak
REK har gjort en helhetlig forskningsetisk vurdering av alle prosjektets sider. Prosjektet godkjennes med hjemmel i helseforskningsloven § 10, under forutsetning av at ovennevnte vilkår oppfylles.

I tillegg til vilkår som fremgår av dette vedtaket, er godkjenningen gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad og protokoll, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Tillatelsen gjelder til 20.08.2022. Av dokumentasjonshensyn skal opplysningene likevel bevares inntil 20.08.2027. Forskningsfilen skal oppbevares atskilt i en nøkkel- og en opplysningsfil. Opplysningene skal deretter slettes eller anonymiseres, senest et halvt år fra denne dato.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriften kapittel 2, og Helsedirektoratets veileder «*Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse og*

omsorgssektoren».

Sluttmelding og søknad om prosjektendring
Dersom det skal gjøres vesentlige endringer i prosjektet i forhold til de opplysninger som er gitt i søknaden, må prosjektleder sende endringsmelding til REK.

Prosjektet skal sende sluttmelding på eget skjema, senest et halvt år etter prosjektslutt.

Klageadgang
REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Eventuell klage sendes til REK sør-øst B. Klagefristen er tre uker fra mottak av dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Komiteens avgjørelse var enstemmig.

Med vennlig hilsen

Ragnhild Emblem
Professor, dr. med.
leder REK sør-øst B

Ingrid Dønåsen
Rådgiver

Kopi til:
s.a.anderssen@nih.no
Norges idrettshøgskole ved øverste administrative ledelse: postmottak@nih.no

Vurdering av behandling av personopplysninger

Skriv ut

24.01.2019

Referansenummer
199381

Vurderingstype
Standard

Dato
24.01.2019

Tittel
Idrett, fysisk aktivitet og bekkenbunn

Behandlingsansvarlig institusjon
Norges idrettshøgskole / Institutt for idrettsmedisinske fag

Prosjektansvarlig
Kari Bø

Prosjektperiode
15.01.2019 - 20.08.2022

Kategorier personopplysninger
Alminnelige
Særlige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)
Uttrykkelig samtykke (Personvernforordningen art. 9 nr. 2 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 20.08.2027.

Meldeskjema

Kommentar
Prosjektet er vurdert og godkjent av REK etter helseforskningsloven § 10, REKs referanse 2018/2211.

Det er NSD sin vurdering at behandlingen også vil være i samsvar med personvernlovgivningen, så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg 24.1.2019. Behandlingen kan starte.

MELD ENDRINGER
Dersom behandlingen av personopplysninger endrer seg, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. På våre nettsider informerer vi om hvilke endringer som må meldes. Vent på svar før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige personopplysninger samt særlige kategorier av personopplysninger om helseforhold frem til 20.8.2022. Etter dette vil opplysningene oppbevares ved institusjonen i fem år for etterprøvbarhet og kontroll.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 nr. 11 og art. 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse, som kan dokumenteres, og som den registrerte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være den registrertes uttrykkelige samtykke, jf. personvernforordningen art. 6 nr. 1 a), jf. art. 9 nr. 2 bokstav a, jf. personopplysningsloven § 10, jf. § 9 (2).

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om
- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er

adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

SurveyXact fra Rambøll er databehandler i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis og ved planlagt avslutning for å avklare status for behandlingen av personopplysninger.

Lykke til med prosjektet!

Kontaktperson hos NSD: Lasse Raa
Tlf. personverntjenester: 55 58 21 17 (tast 1)

b84efb3e3

Appendix 2

Paper I-IV

Approvals of changes during the project period from the Regional Committee for Medical and Health Research Ethics of Norway (REK South East 2018/2211) and the Norwegian Centre for Research Data (199381).

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Ingrid Dønåsen	22845523	23.01.2019	2018/2211 REK sør-øst B
			Deres dato:	**Deres referanse:**
			28.12.2018	

Vår referanse må oppgis ved alle henvendelser

Kari Bø og Kristina Lindquist Skaug
Norges idrettshøgskole

2018/2211 Idrett, fysisk aktivitet og bekkenbunn

Forskningsansvarlig: Norges idrettshøgskole
Prosjektleder: Kari Bø

Vi viser til søknad om prosjektendring datert 28.12.2018 for ovennevnte forskningsprosjekt. Søknaden er behandlet av sekretariatet i REK sør-øst på delegert fullmakt fra REK sør-øst B, med hjemmel i helseforskningsloven § 11.

Endringene gjelder oppfølging av vilkår for godkjenning fastsatt i vedtak av 20.12.2018, og innebærer:
1. Kari Bø registreres som prosjektleder
2. Kristina Lindquist Skaug, PhD-stipendiat, registreres som prosjektmedarbeider
3. Reviderte informasjonsskriv:
REK rettelser Studie 4 Informasjonsskriv unge under 16.pdf
REK rettelser Informasjonsskriv studie 4 unge over 16 år.pdf
REK rettelser Informasjonsskriv studie 4 foresatte.pdf
REK rettelser Informasjonsskriv studie 3 kontrollpersoner.pdf
REK rettelser Studie 1 Informasjonsskriv unge under 16 år.pdf
REK rettelser - Informasjonsskriv studie 1 unge over 16 år.pdf
REK rettelser - Informasjonsskriv studie 1 foresatte.pdf

Vurdering
Sekretariatet i REK har vurdert de omsøkte endringene. REKs kommentarer er etterfulgt, og vi har ingen forskningsetiske innvendinger til endringene slik de er beskrevet i skjema for prosjektendring. Språket informasjonsskrivene til unge under 16 år fremstår fortsatt noe komplisert, men REK godkjenner disse under forutsetning av at det vil gis god og grundig muntlig informasjon til deltakerne i tillegg til skrivene.

Vi bekrefter dermed at vilkår for godkjenning fastsatt i vedtak av 20.12.2018 er oppfylt.

Vi gjør oppmerksom på at alle informasjonsskrivene må oppdateres med riktig versjonsnummer og dato.

Vedtak
REK har gjort en forskningsetisk vurdering av endringene i prosjektet, og godkjenner prosjektet slik det nå foreligger, jf. helseforskningsloven § 11.

Godkjenningen er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad, endringssøknad, oppdatert protokoll og de bestemmelser som følger av helseforskningsloven med forskrifter.

Klageadgang
REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Eventuell klage sendes til REK sør-øst B. Klagefristen er tre uker fra mottak av dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Vi ber om at alle henvendelser sendes inn på korrekt skjema via vår saksportal: http://helseforskning.etikkom.no. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: post@helseforskning.etikkom.no.

Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Knut Ruyter
Avdelingsdirektør
REK sør-øst sekretariatet

Ingrid Dønåsen
Rådgiver

Kopi til: *s.a.anderssen@nih.no*
Norges idrettshøgskole ved øverste administrative ledelse: postmottak@nih.no

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Ingrid Dønåsen	22845523	25.03.2019	2018/2211 REK sør-øst B
			Deres dato:	**Deres referanse:**
			22.02.2019	

Vår referanse må oppgis ved alle henvendelser

Kari Bø
Norges idrettshøgskole

2018/2211 Idrett, fysisk aktivitet og bekkenbunn

Forskningsansvarlig: Norges idrettshøgskole
Prosjektleder: Kari Bø

Vi viser til søknad om prosjektendring datert 22.02.2019 for ovennevnte forskningsprosjekt. Søknaden er behandlet av sekretariatet i REK sør-øst på delegert fullmakt fra REK sør-øst B, med hjemmel i helseforskningsloven § 11.

Endringen innebærer:
- Nedre aldersgrense for deltakelse i studie 1 og 4 endres fra 13 til 12 år. Prosjektleder skriver i skjema for prosjektendring:

"*I studie 1 og 4 ønsker vi å sette inklusjonskriteriet for alder fra 13 år slik det er i nåværende prosjektplan til det året de fyller 13, dvs at de kan være 12 år, men fyller 13 i løpet av 2019. Dette for å følge idrettenes konkurransealder for jr.*"

Vurdering
Sekretariatet i REK har vurdert den omsøkte endringen, og har ingen forskningsetiske innvendinger til endringen slik den er beskrevet i skjema for prosjektendring.

Vi gjør oppmerksom på at setningene "*Vi ønsker å spørre deg som er turner, troppsgymnast eller cheerleader over 13 år på høyt nasjonalt nivå om å delta i studien.*" og "*Vi ønsker å inkludere turnere, troppsgymnaster og cheerleadere over 13 år på høyt nasjonalt nivå.*" i informasjonsskrivene til barn, unge og foresatte må revideres i henhold til endringen. Vi ber om at reviderte skriv ettersendes REK til orientering via e-post.

Vedtak
REK har gjort en forskningsetisk vurdering av endringene i prosjektet, og godkjenner prosjektet slik det nå foreligger, jf. helseforskningsloven § 11.

Godkjenningen er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad, endringssøknad, oppdatert protokoll og de bestemmelser som følger av helseforskningsloven med forskrifter.

Klageadgang
REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Eventuell klage sendes til REK sør-øst B. Klagefristen er tre uker fra mottak av dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering, jf.

forskningsetikkloven § 10 og helseforskningsloven § 10.

Vi ber om at alle henvendelser sendes inn på korrekt skjema via vår saksportal: http://helseforskning.etikkom.no. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: post@helseforskning.etikkom.no.

Vennligst oppgi vårt referansenummer i korrespondansen.

Med vennlig hilsen

Knut Ruyter
Avdelingsdirektør
REK sør-øst sekretariatet

Ingrid Dønåsen
Rådgiver

Kopi til: *s.a.anderssen@nih.no*
Norges idrettshøgskole ved øverste administrative ledelse: postmottak@nih.no

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst B	Hanne Johansen Pekovic	22845501	25.11.2021	15858

Kari Bø

Prosjektsøknad: Idrett, fysisk aktivitet og bekkenbunn
Søknadsnummer: 2018/2211
Forskningsansvarlig institusjon: Norges idrettshøgskole

Prosjektsøknad: Endring godkjennes

Søkers beskrivelse

Flere studier har vist at det er høy forekomst av urinlekkasje blant kvinnelige idrettsutøvere under trening og konkurranse. Hensikten med doktorgradsprosjektet er å undersøke hvordan bekkenbunnsmuskulaturen påvirkes av idrettsaktivitet og effekt av bekkenbunnstrening på bekkenbunnsplager som urinlekkasje og underlivsprolaps hos kvinnelige idrettsutøvere. Formålet i de første to studiene er å øke kunnskapen om forekomst av og risikofaktorer for bekkenbunnsplager hos hos kvinnelige turnere, troppsgymnaster og cheerleadere og hos mannlige og kvinnelige styrke- og vektløftere. I den tredje studien vil vi sammenligne funksjon i bekkenbunnsmusklene hos kvinnelige styrke- og vektløftere og kontroller som ikke trener styrke. Den siste studien er en randomisert kontrollert studie hvor hensikten er å undersøke om styrketrening av bekkenbunnsmusklene har effekt på symptomer og forekomst av urinlekkasje hos kvinnelige turnere, troppsgymnaster og cheerleadere.

Vi viser til søknad om prosjektendring mottatt 01.09.21 for ovennevnte forskningsprosjekt. Søknaden er behandlet av leder for REK sør-øst B på delegert fullmaktfra komiteen, med hjemmel i forskningsetikkforskriften § 7, første ledd, tredje punktum. Søknaden er vurdert med hjemmel i helseforskningsloven § 11.

REKs vurdering

REK har vurdert følgende endringer:

- Ny dato for prosjektslutt 12.06.2023 (tidligere 20.08.2022).
- Delstudie 3 er endret for design, utvalg, inklusjonskriterier, klinisk undersøkelse og spørreskjema.
- Delstudie 4 er endret for inklusjonskriterie, rekruttering og spørreskjema.
- Reviderte informasjonsskriv og spørreskjema for delstudie 3 og 4.
- Protokollen er revidert for omsøkte endringer.

Endringer i delstudie 3:
Endringene begrunnes av prosjektleder med at opprinnelig planlagt opplegg er vurdert for

logistikkrevende og vanskelig å gjennomføre i praksis. Oppstart ble i tillegg utsatt på grunn av korona, og man har derfor endret på designet for å kunne gjennomføre delstudien.

Designet er endret fra case-kontroll til eksperimentelt cross-over. Kontrollgruppen med utrente kvinner fjernes fra prosjektet, og det skal kun inkluderes voksne styrketrente kvinner i utvalget. Det er utført nye styrkeberegninger, og man vil inkludere 42 kvinner i utvalget.

Man vil undersøke akutt effekt av styrketrening (sammenlignet med hvile) på bekkenbunnsvariabler (styrke, motstand, trykk/aktivitet og utholdenhet). Bekkenbunns-variabler og utmattelse vil sammenlignes mellom styrketrente kvinner med og uten stressindusert urinlekkasje.

Den fysiske undersøkelsen for å teste bekkenbunnsvariabler vil nå bli utført av fysioterapeut og gjennomføres på Norges Idrettshøyskole (tidligere fysioterapeut og gynekolog ved Ahus). Man vil videre ikke utføre ultralyd av bekkenbunn og gynekologisk undersøkelse for underlivsprolaps. For å måle hvileaktivtet i bekkenbunnen vil man, i tillegg til allerede godkjent vaginal trykkmåling, anvende overflate-sEMG.

Deltakerne må møte opp ved NiH to separate dager for baseline-måling (1 time) og testing (opptil 4 timer). Prosedyren for testing er beskrevet i protokollen.

Protokollen er i revidert for ovennevnte endringer.

Det er utformet nytt informasjonsskriv for delstudie 3.

Endringer delstudie 4:

For delstudie 4 ønsker man å utvide utvalget ved å kunne inkludere kvinnelige gymnaster (turnere, troppsgymnaster og cheerleadere) med selvrapportert urinlekkasje. Opprinnelig ville man kun inkludere deltakere med selvrapportert urinlekkasje i delstudie 1. Som følge av utsettelser på grunn av korona ser man at å kun inkludere deltakere fra delstudie 1 vil kunne føre til at man ikke får rekruttert nok deltakere, da studiepopulasjonen kan ha hatt en del utskiftninger siden gjennomføring av delstudie 1. Nedre aldergrense for inklusjon er 13 år, tilsvarende til delstudie 1. Det skal innhentes samtykke fra begge foreldre for deltakere under 16 år.

Rekruttering vil foregå i samarbeid med Den Norske Turnforening og Den norske foreningen for amerikansk sport, via sosiale medier, og ved kontakt med gymnast/turn eller cheerleader foreninger i Oslo og omegn.

Man ønsker i tillegg å inkludere spørsmål om vekt, høyde, utdanningsnivå, treningsbakgrunn, kunnskap om og erfaring med bekkenbunnstrening i spørreskjema. Dette da man opprinnelig ville innhente disse opplysningene fra spørreskjema i delstudie 1, men som følge av utvidelse av utvalget vil ikke alle inkluderte ha deltatt i delstudie 1.

Informasjonsskriv for deltakere over og under 16 år, samt til foresatte, for delstudie 4 er revidert i henhold til ovennevnte endringer.

Vurdering

REK har ingen forskningsetiske innvendinger til de endringer som er beskrevet i skjema for prosjektendring.

Vedtak

REK godkjenner med hjemmel i helseforskningsloven § 11 annet ledd at prosjektet videreføres i samsvar med det som fremgår av søknaden om prosjektendring og i samsvar med de bestemmelser som følger av helseforskningsloven med forskrifter.

Vi gjør samtidig oppmerksom på at det etter personopplysningsloven av 2018 også må foreligge et behandlingsgrunnlag etter personvernforordningen. Dette må forankres i egen institusjon.

Godkjenningen gjelder til 12.06.2023.

Sluttmelding
Prosjektleder skal sende sluttmelding til REK på eget skjema via REK-portalen senest 6 måneder etter sluttdato 12.06.2023, jf. helseforskningsloven § 12. Dersom prosjektet ikke starter opp eller gjennomføres meldes dette også via skjemaet for sluttmelding.

Søknad om endring
Dersom man ønsker å foreta vesentlige endringer i formål, metode, tidsløp eller organisering må prosjektleder sende søknad om endring via portalen på eget skjema til REK, jf. helseforskningsloven § 11.

Klageadgang
Du kan klage på REKs vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes på eget skjema via REK portalen. Klagefristen er tre uker fra du mottar dette brevet. Dersom REK opprettholder vedtaket, sender REK klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Med vennlig hilsen

Ragnhild Emblem
Professor, dr. med.
leder REK sør-øst B

Hanne Johansen Pekovic
Rådgiver, REK sør-øst B

Kopi til:

Norges idrettshøgskole
Kristina Lindquist Skaug

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst B	Hanne Johansen Pekovic	22845501	21.03.2022	15858

Kari Bø

Prosjektsøknad: Idrett, fysisk aktivitet og bekkenbunn
Søknadsnummer: 2018/2211
Forskningsansvarlig institusjon: Norges idrettshøgskole

Prosjektsøknad: Endring godkjennes

Søkers beskrivelse

Flere studier har vist at det er høy forekomst av urinlekkasje blant kvinnelige idrettsutøvere under trening og konkurranse. Hensikten med doktorgradsprosjektet er å undersøke hvordan bekkenbunnsmuskulaturen påvirkes av idrettsaktivitet og effekt av bekkenbunnstrening på bekkenbunnsplager som urinlekkasje og underlivsprolaps hos kvinnelige idrettsutøvere. Formålet i de første to studiene er å øke kunnskapen om forekomst av og risikofaktorer for bekkenbunnsplager hos hos kvinnelige turnere, troppsgymnaster og cheerleadere og hos mannlige og kvinnelige styrke- og vektløftere. I den tredje studien vil vi sammenligne funksjon i bekkenbunnsmusklene hos kvinnelige styrke- og vektløftere og kontroller som ikke trener styrke. Den siste studien er en randomisert kontrollert studie hvor hensikten er å undersøke om styrketrening av bekkenbunnsmusklene har effekt på symptomer og forekomst av urinlekkasje hos kvinnelige turnere, troppsgymnaster og cheerleadere.

Vi viser til søknad om prosjektendring mottatt 31.01.2022 for ovennevnte forskningsprosjekt. Søknaden er behandlet av sekretariatet i Regional komité for medisinsk og helsefaglig forskningsetikk (REK) på delegert fullmakt fra komiteen. Søknaden er vurdert med hjemmel i helseforskningsloven § 11. Vi beklager for lang saksbehandlingstid.

REKs vurdering

REK har vurdert følgende endringer:

- Delstudie 4 omgjøres til en case-studie.
- Ny delstudie 5, hvor man viderefører tidligere design fra delstudie 4 (RCT) men med nytt et utvalg (crossfit-utøvere).

Prosjektleder oppgir i endringsmeldingen at de opplever problemer med å rekruttere nok unge turnere og cheerleadere til studien. Man vil derfor innføre endringer for delstudie 4 og 5.

Delstudie 4:
«*Vil bli omgjort til en case-studie hvor vi ønsker å rekruttere 3-6 deltakere. Formålet vil være å undersøke om et bekkenbunnstreningsprogram vil være gjennomførbart og om det potensielt kan gi effekt på urinlekkasje. Vi vil gjøre de samme undersøkelsene som tidligere planlagt (pad-test, spørreskjemaundersøkelse) og intervensjonen er lik, men vi har ingen kontrollgruppe som ikke skal trene. Vi har lagt til noen spørsmål om bekkenbunnstrening og hvordan urinlekkasje påvirker idrettsdeltakelse i spørreskjemaet. I informasjonsskrivene har vi fjernet det som står om kontrollgruppe, men ellers ingen endringer*.»

Vedlagt for delstudie 4 var: Informasjonsskriv for 1) deltakere over 16 år, 2) deltakere under 16 år, og 3) foresatte, samt revidert spørreskjema.

Delstudie 5:
For delstudie 5 vil man beholde RCT design og intervensjon som tidligere beskrevet for delstudie 4, men man ønsker å inkludere kvinner som trener crossfit/functional fitness (og er over 18 år og med urinlekkasje). Videre vil man innføre følgende endringer:

- Man vil inkludere måling av bekkenbunnsstyrke og hviletrykk, med samme målemetode som tidligere er beskrevet og godkjent i delstudie 3.
- Nye spørsmål om andre bekkenbunnsplager enn urinlekkasje (analinkontinens og underlivsprolaps) er lagt inn i spørreskjemaet.

Vedlagt for delstudie 5 var: Informasjonsskriv, spørreskjema og skjema for klinisk undersøkelse.

Sekretariatet i REK sør-øst B har vurdert de omsøkte endringenen disse er beskrevet i søknadsskjema og vedleggene, og har ingen forskningsetiske innvendinger til endringene. Endringene godkjennes derfor slik som de er beskrevet.

Vedtak

REK godkjenner med hjemmel i helseforskningsloven § 11 annet ledd at prosjektet videreføres i samsvar med det som fremgår av søknaden om prosjektendring og i samsvar med de bestemmelser som følger av helseforskningsloven med forskrifter.

Vi gjør samtidig oppmerksom på at det etter personopplysningsloven av 2018 også må foreligge et behandlingsgrunnlag etter personvernforordningen. Dette må forankres i egen institusjon.

Godkjenningen gjelder til 12.06.2023.

Sluttmelding
Prosjektleder skal sende sluttmelding til REK på eget skjema via REK-portalen senest 6 måneder etter sluttdato 12.06.2023, jf. helseforskningsloven § 12. Dersom prosjektet ikke starter opp eller gjennomføres meldes dette også via skjemaet for sluttmelding.

Søknad om endring
Dersom man ønsker å foreta vesentlige endringer i formål, metode, tidsløp eller organisering må prosjektleder sende søknad om endring via portalen på eget skjema til REK, jf. helseforskningsloven § 11.

Klageadgang
Du kan klage på REKs vedtak, jf. forvaltningsloven § 28 flg. Klagen sendes på eget skjema via REK portalen. Klagefristen er tre uker fra du mottar dette brevet. Dersom REK opprettholder vedtaket, sender REK klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag (NEM) for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Med vennlig hilsen

Jacob C. Hølen
Sekretariatsleder
REK sør-øst

Hanne Johansen Pekovic
Seniorrådgiver, REK sør-øst B

Kopi til:

Norges idrettshøgskole
Kristina Lindquist Skaug

Vurdering av behandling av personopplysninger

Skriv ut

31.10.2019

Referansenummer
199381

Vurderingstype
Standard

Dato
31.10.2019

Tittel
Idrett, fysisk aktivitet og bekkenbunn

Behandlingsansvarlig institusjon
Norges idrettshøgskole / Institutt for idrettsmedisinske fag

Prosjektansvarlig
Kari Bø

Prosjektperiode
15.01.2019 - 20.08.2022

Kategorier personopplysninger
Alminnelige
Særlige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)
Uttrykkelig samtykke (Personvernforordningen art. 9 nr. 2 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 20.08.2027.

Meldeskjema

Kommentar
NSD har vurdert endringene registrert i perioden 23.9.2019 til 30.10.2019. REK har godkjent endringene i vedtak av 25.10.2019 og 8.5.2019, deres referanse 15858 (tidligere 2018/2211). Prosjektet er tidligere vurdert og godkjent av REK etter helseforskningsloven § 10, referanse 2018/2211.

Det er vår vurdering at behandlingen av personopplysninger i prosjektet fortsatt vil være i samsvar med personvernlovgivningen, så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjema med vedlegg 31.10.2019. Behandlingen kan fortsette.

MELD ENDRINGER
Dersom behandlingen av personopplysninger endrer seg, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. På våre nettsider informerer vi om hvilke endringer som må meldes. Vent på svar før endringen gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige personopplysninger samt særlige kategorier av personopplysninger om helseforhold frem til 20.8.2022. Etter dette vil opplysningene oppbevares ved institusjonen i fem år for etterprøvbarhet og kontroll.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 nr. 11 og art. 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse, som kan dokumenteres, og som den registrerte kan trekke tilbake.

Lovlig grunnlag for behandlingen vil dermed være den registrertes uttrykkelige samtykke, jf. personvernforordningen art. 6 nr. 1 a, jf. art. 9 nr. 2 bokstav a, jf. personopplysningsloven § 10, jf. § 9 (2).

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om
- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke

viderebehandles til nye uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

SurveyXact fra Rambøll samt FITSTATS Technologies Inc er databehandlere i prosjektet. NSD legger til grunn at behandlingen oppfyller kravene til bruk av databehandler, jf. art 28 og 29.

NSD legger videre til grunn at behandlingen oppfyller kravene til behandling av personopplysninger utenfor EU (personvernforordningen kapittel V).

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og eventuelt rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp underveis og ved planlagt avslutning for å avklare status for behandlingen av personopplysninger.

Lykke til med prosjektet!

Kontaktperson hos NSD: Lasse Raa
Tlf. personverntjenester: 55 58 21 17 (tast 1)

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Vurdering av behandling av personopplysninger

Skriv ut

13.01.2022

Referansenummer
199381

Vurderingstype
Standard

Dato
13.01.2022

Tittel
Idrett, fysisk aktivitet og bekkenbunn

Behandlingsansvarlig institusjon
Norges idrettshøgskole / Institutt for idrettsmedisinske fag

Prosjektansvarlig
Kari Bø

Prosjektperiode
15.01.2019 - 12.06.2023

Kategorier personopplysninger
Alminnelige
Særlige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)
Uttrykkelig samtykke (Personvernforordningen art. 9 nr. 2 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 12.06.2028.

Meldeskjema

Kommentar
Personverntjenester har vurdert endringen registrert 13.01.2022.

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 13.01.2022. Behandlingen kan fortsette.

Endringen innebærer
- Ny dato for prosjektslutt 12.06.2023 (tidligere 20.08.2022).
- Delstudie 3 er endret for design, utvalg, inklusjonskriterier, klinisk undersøkelse og spørreskjema.
- Delstudie 4 er endret for inklusjonskriterie, rekruttering og spørreskjema.
- Reviderte informasjonsskriv og spørreskjema for delstudie 3 og 4.
- Protokollen er revidert for omsøkte endringer.

Endringen er vurdert og godkjent etter helseforskningsloven § 11 av REK (se under Tillatelser).

OPPFØLGING AV PROSJEKTET
Vi vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet/pågår i tråd med den behandlingen som er dokumentert.

Lykke til videre med prosjektet!

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Vurdering av behandling av personopplysninger

Skriv ut

30.03.2022

Referansenummer
199381

Vurderingstype
Standard

Dato
30.03.2022

Tittel
Idrett, fysisk aktivitet og bekkenbunn

Behandlingsansvarlig institusjon
Norges idrettshøgskole / Institutt for idrettsmedisinske fag

Prosjektansvarlig
Kari Bø

Prosjektperiode
15.01.2019 - 12.06.2023

Kategorier personopplysninger
Alminnelige
Særlige

Lovlig grunnlag
Samtykke (Personvernforordningen art. 6 nr. 1 bokstav a)
Uttrykkelig samtykke (Personvernforordningen art. 9 nr. 2 bokstav a)

Behandlingen av personopplysningene er lovlig så fremt den gjennomføres som oppgitt i meldeskjemaet. Det lovlige grunnlaget gjelder til 12.06.2028.

Meldeskjema

Kommentar

Personverntjenester har vurdert endringen registrert 29.03.2022.

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 30.03.2022. Behandlingen kan fortsette.

OPPFØLGING AV PROSJEKTET
Vi vil følge opp underveis (hvert annet år) og ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet/pågår i tråd med den behandlingen som er dokumentert.

Lykke til videre med prosjektet!

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Appendix 3

Paper I

Study information and consent forms

Questionnaire

FORESPØRSEL OM DELTAKELSE I FORSKNINGSPROSJEKTET

IDRETT, FYSISK AKTIVITET OG BEKKENBUNN

Dette er et spørsmål til deg som foresatt til turner, troppsgymnast eller cheerleader under 16 år om å samtykke til at ditt barn kan delta i en spørreundersøkelse om forekomst av og risikofaktorer for bekkenbunnsplager hos turnere, troppsgymnaster og cheerleadere. I dette skrivet gir vi informasjon om prosjektet og hva deltakelse vil innebære for ditt barn.

FORMÅL

Denne undersøkelsen er en del av et doktorgradsgradsprosjekt ved Norges idrettshøgskole (NIH) som handler om trening og belastning på bekkenbunnen hos konkurranseutøvere i ulike idretter. Bekkenbunnen består av muskler, bindevev og leddbånd og befinner seg på inn –og undersiden av bekkenet. Den har i oppgave å støtte bekkenets organer (blære og rektum for menn og i tillegg livmor og vagina for kvinner). Den skal også kunne motstå all trykkbelastning fra underlaget og økning i buktrykk ved fysisk anstrengelse som hopp, løp, landinger og tunge løft, hosting og nysing. Bekkenbunnsplager kan forekomme dersom bekkenbunnen ikke fungerer optimalt ved fysisk anstrengelse. De vanligste bekkenbunnsplagene er lekkasje av urin, luft eller avføring og underlivsprolaps.

Flere studier viser at det er vanlig at idrettsutøvere lekker urin, spesielt under aktiviteter som innebærer løp og hopp. Dette kan påvirke konsentrasjon og prestasjon, i tillegg til at tidlig forekomst av tilstanden er en risikofaktor for urinlekkasje senere i livet, f.eks. ved graviditet og etter fødsel. Vi ønsker å øke kunnskapen om hvordan bekkenbunnen påvirkes av store belastninger i turn, gymnastikk og akrobatiske elementer og vil derfor gjøre en spørreundersøkelse blant norske turnere, troppsgymnaster og cheerleadere om urinlekkasje og potensielle risikofaktorer.

Norges idrettshøgskole (NIH) finansierer og er ansvarlig for forskningsprosjektet. Doktorgradsstipendiat og fysioterapeut Kristina L. Skaug, ansatt ved Seksjon for idrettsmedisinske fag (SIM), NIH, har det daglig ansvaret for studien. Professor, dr. scient og fysioterapeut Kari Bø ved NIH, Seksjon for idrettsmedisinske fag, er initiativtager og hovedveileder for prosjektet. Biveileder er Marie Ellström Engh, professor og gynekolog, Kvinneklinikken, Akershus universitetssykehus.

Vi ønsker å inkludere turnere, troppsgymnaster og cheerleadere over 13 år (eller som fyller 13 år i løpet av 2019) på høyt nasjonalt nivå. NIH, Seksjon for idrettsmedisinske fag og Norges gymnastikk og turnforbund (NTGF) og Norges amerikanske idretters forbund (NAIF) samarbeider om dette forskningsprosjektet.

HVA INNEBÆRER PROSJEKTET?

Deltakelse i studien innebærer å svare på et elektronisk spørreskjema. Barnet ditt vil få tilsendt en mail med en link til spørreundersøkelsen. Vi vil spørre om alder, høyde, vekt, idrettsaktivitet og eventuelle sykdommer. For å kartlegge urinlekkasje vil vi benytte spørsmål fra et internasjonalt standardisert spørreskjema som brukes innen forskning. Vi vil også spørre om hvordan disse plagene eventuelt påvirker utøverens hverdag og idrettsaktiviteter. I tillegg ønsker vi å undersøke forekomst av andre bekkenbunnsplager. For å undersøke risikofaktorer for bekkenbunnsplager vil vi stille spørsmål om bl.a. lav energitilgjengelighet og toalettvaner.

MULIGE FORDELER OG ULEMPER

Mulige ulemper ved å delta i undersøkelsen er at det vil ta ca. 10-15 minutter å svare på spørsmålene. Noen av spørsmålene kan virke personlige og intime. Hvis utøveren opplever at noen av spørsmålene er vanskelig å forstå eller svare på kan hun spørre om hjelp av Kristina L Skaug, daglig ansvarlig for prosjektet.

Deltakelse i studien medfører ikke noen umiddelbare fordeler. Svarene fra spørreundersøkelsen vil være med på å gi økt kunnskap om hvilke bekkenbunnsplager og -utfordringer som oppleves blant turnere, troppsgymnaster og cheerleadere. Denne kunnskapen er viktig for å kunne sette inn tiltak på et tidlig stadium for å forebygge, behandle, unngå forverring og/eller øke idrettsprestasjon. Utøvere som svarer at de opplever urinlekkasje kan få muligheten til å være med i en oppfølgingsstudie hvor vi ønsker å undersøke effekt av styrketrening for bekkenbunnsmusklene på symptomer og forekomst av urinlekkasje blant turnere, troppsgymnaster og cheerleadere.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE SITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du tillater ditt barn å delta, undertegner du samtykkeerklæringen på siste side. Du kan på vegne av ditt barn når som helst og uten å oppgi grunn, trekke samtykke om deltakelse. Dette vil ikke få konsekvenser for barnet ditt for videre oppfølging eller behandling. Dersom du trekker barnet ditt fra prosjektet, kan du kreve å få slettet innsamlede opplysninger, med mindre opplysningene allerede er inngått i analyser eller vitenskapelige publikasjoner. Dersom du senere ønsker å trekke samtykket eller har spørsmål til prosjektet, kan du kontakte prosjektleder eller annen kontaktperson. Se telefonnummer og mailadresse under kontaktopplysninger.

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om barnet ditt skal kun brukes slik som beskrevet i hensikten med prosjektet. Du har som foresatt rett til innsyn i hvilke opplysninger som er registrert om barnet ditt og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. I tillegg har du rett til få utlevert en kopi av barnets personopplysninger og sende klage til Datatilsynet om behandlingen av

personopplysningene. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene.

Svar fra det elektroniske spørreskjemaet overføres sikkert fra SurveyXact av Rambøll og vil lagres og analyseres elektronisk på en beskyttet server på NIH. Brukere til programmet har tilgang via brukernavn og passord og det er kun organisasjonsmanager for spørreundersøkelsen, Kristina L. Skaug, som vil ha tilgang til besvarelsene. Innsamlede opplysninger oppbevares slik at navn og kontaktopplysninger er erstattet med en referansekode som viser til en adskilt liste. Det er kun Kristina L. Skaug som har adgang til koblingslisten. Denne listen lagres på en lokal pc og på et eget passordbeskyttet område. En kopi av listen vil bli skrevet ut og oppbevares i en låsbar skuff på NIH. Det vil ikke være mulig å identifisere barnet ditt i resultatene fra undersøkelsen når disse publiseres. Prosjektet skal etter planen avsluttes 20.08.2022. Opplysningene om barnet ditt vil bli anonymisert eller slettet senest fem år etter prosjektslutt.

OPPFØLGINGSPROSJEKT

Det planlegges en studie hvor vi ønsker å undersøke effekt av styrketrening av bekkenbunnsmusklene på urinlekkasje hos turnere, gymnaster og cheerleadere. I denne studien er det planlagt å inkludere 46 utøvere. Ved å samtykke til deltakelse i denne studien kan du på et senere tidspunkt bli spurt om barnet ditt vil delta i denne oppfølgingsstudien. I dette tilfellet vil det bli gitt et nytt informasjonsskriv og det vil bli innhentet nytt samtykke.

GODKJENNING

Vi behandler opplysninger om barnet ditt basert på ditt samtykke. Regional komité for medisinsk og helsefaglig forskningsetikk har vurdert prosjektet, og har gitt forhåndsgodkjenning (Saksnummer: 2018/2211). Etter ny personopplysningslov har behandlingsansvarlige NIH og Kristina L. Skaug et selvstendig ansvar for å sikre at behandlingen av barnets opplysninger har et lovlig grunnlag. Norsk senter for forskningsdata (NSD) har, på vegne av NIH, vurdert at prosjektet er i overensstemmelse med personvernregelverket. Dette prosjektet har rettslig grunnlag i EUs personvernforordning artikkel 6a og artikkel 9 nr. 2 og ditt samtykke.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet kan du ta kontakt med:

Doktorgradsstipendiat: Kristina L. Skaug, 40609916, k.l.skaug@nih.no
Hovedveileder og prosjektleder: Kari Bø, 99047363, kari.bo@nih.no

Du kan ta kontakt med institusjonens personvernombud dersom du har spørsmål om behandlingen av ditt barns personopplysninger i prosjektet:
Karine Justad, 97536704, karine.justad@nih.no

Dersom du har spørsmål til Norsk senter for forskningsdata AS kan du ta kontakt med:
NSD – Norsk senter for forskningsdata AS, 55 58 21 17, personverntjenester@nsd.no

JEG HAR MOTTATT OG FORSTÅTT INFORMASJONEN OM PROSJEKTET "IDRETT, FYSISK AKTIVITET OG BEKKENBUNN", OG HAR FÅTT ANLEDNING TIL Å STILLE SPØRSMÅL.

FOR BARN OG UNGDOM UNDER 16 ÅR, SKAL I UTGANGSPUNKTET BEGGE FORESATTE UNDERTEGNE:

Som foresatte til_ (Fullt navn) samtykker vi til at hun kan:

☐ delta i *spørreundersøkelse*

Jeg samtykker til at opplysninger om barnet mitt behandles frem til prosjektet er avsluttet, ca. *20.08.2022*

Sted og dato	Foresattes signatur
	Foresattes navn med trykte bokstaver
Sted og dato	Foresattes signatur
	Foresattes navn med trykte bokstaver

FORESPØRSEL OM DELTAKELSE I FORSKNINGSPROSJEKTET

IDRETT, FYSISK AKTIVITET OG BEKKENBUNN

Dette er et spørsmål til deg om å delta i en spørreundersøkelse om forekomst av og risikofaktorer for bekkenbunnsplager hos turnere, troppsgymnaster og cheerleadere. I dette skrivet gir vi informasjon om prosjektet og hva deltakelse vil innebære for deg.

FORMÅL

Denne undersøkelsen er en del av et doktorgradsgradsprosjekt ved Norges idrettshøgskole (NIH) som handler om trening og belastning på bekkenbunnen hos konkurranseutøvere i ulike idretter. Bekkenbunnen består av muskler, bindevev og leddbånd og befinner seg på inn –og undersiden av bekkenet. Den har i oppgave å støtte bekkenets organer (blære og rektum for menn og i tillegg livmor og vagina for kvinner). Den skal også kunne motstå all trykkbelastning fra underlaget og økning i buktrykk ved fysisk anstrengelse som hopp, løp, landinger og tunge løft, hosting og nysing. Bekkenbunnsplager kan forekomme dersom bekkenbunnen ikke fungerer optimalt ved fysisk anstrengelse. De vanligste bekkenbunnsplagene er lekkasje av urin, luft eller avføring og underlivsprolaps.

Flere studier viser at det er vanlig at idrettsutøvere lekker urin, spesielt under aktiviteter som innebærer løp og hopp. Dette kan påvirke konsentrasjon og prestasjon, i tillegg til at tidlig forekomst av tilstanden er en risikofaktor for urinlekkasje senere i livet, f.eks. ved graviditet og etter fødsel. Vi ønsker å øke kunnskapen om hvordan bekkenbunnen påvirkes av store belastninger i turn, gymnastikk og akrobatiske elementer og vil derfor gjøre en spørreundersøkelse blant norske turnere, troppsgymnaster og cheerleadere om urinlekkasje og potensielle risikofaktorer.

Norges idrettshøgskole (NIH) finansierer og er ansvarlig for forskningsprosjektet. Doktorgradsstipendiat og fysioterapeut Kristina L. Skaug, ansatt ved Seksjon for idrettsmedisinske fag (SIM), NIH, har det daglig ansvaret for studien. Professor, dr. scient og fysioterapeut Kari Bø ved NIH, Seksjon for idrettsmedisinske fag, er initiativtager og hovedveileder for prosjektet. Biveileder er Marie Ellström Engh, professor og gynekolog, Kvinneklinikken, Akershus universitetssykehus.

Vi ønsker å inkludere turnere, troppsgymnaster og cheerleadere over 13 år (eller som fyller 13 år i løpet av 2019) på høyt nasjonalt nivå. NIH, Seksjon for idrettsmedisinske fag og Norges gymnastikk og turnforbund (NTGF) og Norges amerikanske idretters forbund (NAIF) samarbeider om dette forskningsprosjektet.

Idrett, fysisk aktivitet og bekkenbunn – d.01.04.2019 – versjon 3

HVA INNEBÆRER PROSJEKTET?

Deltakelse i studien innebærer å svare på et elektronisk spørreskjema. Du vil få tilsendt en link på mail med tilgang til spørreskjemaet. Vi vil spørre deg om alder, høyde, vekt, idrettsaktivitet og eventuelle sykdommer. For å kartlegge urinlekkasje vil vi stille deg spørsmål fra et standardisert spørreskjema som brukes innen forskning. Vi vil også spørre deg hvordan disse plagene eventuelt påvirker deg i din hverdag og idrettsaktiviteter. I tillegg ønsker vi å undersøke forekomst av andre bekkenbunnsplager. For å undersøke risikofaktorer for bekkenbunnsplager vil vi stille spørsmål om bl.a. lav energitilgjengelighet og toalettvaner.

MULIGE FORDELER OG ULEMPER

Mulige ulemper ved å delta i undersøkelsen er at det vil ta deg ca. 10-15 minutter å svare på spørsmålene. Noen av spørsmålene kan virke personlige og intime. Hvis noen av spørsmålene er vanskelig å forstå eller svare på kan du spørre om hjelp av Kristina L Skaug, daglig ansvarlig for prosjektet.

Deltakelse i studien medfører ikke noen umiddelbare fordeler. Dine svar vil være med på å gi økt kunnskap om hvilke bekkenbunnsplager og -utfordringer som oppleves blant turnere, troppsgymnaster og cheerleadere. Denne kunnskapen er viktig for å kunne sette inn tiltak på et tidlig stadium for å forebygge, behandle, unngå forverring og/eller øke idrettsprestasjon. Utøvere som svarer at de opplever urinlekkasje kan få muligheten til å være med i en oppfølgingsstudie hvor vi ønsker å undersøke effekt av styrketrening for bekkenbunnsmusklene på symptomer og forekomst av urinlekkasje blant turnere, troppsgymnaster og cheerleadere.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE SITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta, logger du deg inn på svarfabrikken.no og taster inn din personlige kode (tilsendt på mail eller i brev). Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke. Dette vil ikke få konsekvenser for deg videre oppfølging og behandling. Dersom du trekker deg fra prosjektet, kan du kreve å få slettet innsamlede prøver og opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner. Dersom du senere ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder eller annen kontaktperson. Se telefonnummer og mailadresse under kontaktopplysninger.

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet i hensikten med prosjektet. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. I tillegg har du rett til få utlevert en kopi av dine personopplysninger og sende klage til Datatilsynet om behandlingen av dine personopplysninger. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene.

Svar fra det elektroniske spørreskjemaet overføres sikkert fra SurveyXact av Rambøll og vil lagres og analyseres elektronisk på en beskyttet server på NIH. Brukere til programmet har tilgang via

brukernavn og passord og det er kun organisasjonsmanager for spørreundersøkelsen, Kristina L. Skaug, som vil ha tilgang til besvarelsene. Innsamlede opplysninger oppbevares slik at navn og kontaktopplysninger er erstattet med en referansekode som viser til en adskilt liste. Det er kun doktorgradsstipendiat, Kristina L. Skaug, som har adgang til koblingslisten. Denne listen lagres på en lokal pc på harddisk på et eget passordbeskyttet område. En kopi av listen vil bli skrevet ut og oppbevares i en låsbar skuff på NIH. Det vil ikke være mulig å identifisere deg i resultatene fra undersøkelsen når disse publiseres.

Prosjektet skal etter planen avsluttes 20.08.2022. Opplysningene om deg vil bli anonymisert eller slettet senest fem år etter prosjektslutt.

OPPFØLGINGSPROSJEKT

Det planlegges en studie hvor vi ønsker å undersøke effekt av styrketrening av bekkenbunnsmusklene på urinlekkasje hos turnere, gymnaster og cheerleadere. I denne studien er det planlagt å inkludere 46 utøvere. Ved å samtykke til deltakelse i denne studien kan du bli spurt om å delta i denne oppfølgingsstudien på et senere tidspunkt. I dette tilfellet vil det bli gitt et nytt informasjonsskriv og det vil bli innhentet nytt samtykke.

GODKJENNING

Vi behandler opplysninger om deg basert på ditt samtykke. Regional komité for medisinsk og helsefaglig forskningsetikk har vurdert prosjektet, og har gitt forhåndsgodkjenning (Saksnummer: 2018/2211). Etter ny personopplysningslov har behandlingsansvarlige NIH og Kristina L. Skaug et selvstendig ansvar for å sikre at behandlingen av dine opplysninger har et lovlig grunnlag. Dette prosjektet har rettslig grunnlag i EUs personvernforordning artikkel 6a og artikkel 9 nr. 2 og ditt samtykke. Norsk senter for forskningsdata (NSD) har, på vegne av NIH, vurdert at prosjektet er i overensstemmelse med personvernregelverket. Dette prosjektet har rettslig grunnlag i EUs personvernforordning artikkel 6a og artikkel 9 nr. 2 og ditt samtykke.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet kan du ta kontakt med:

Doktorgradsstipendiat: Kristina L. Skaug, 40609916, k.l.skaug@nih.no
Hovedveileder og prosjektleder: Kari Bø, 99047363, kari.bo@nih.no

Du kan ta kontakt med institusjonens personvernombud dersom du har spørsmål om behandlingen av dine personopplysninger i prosjektet:
Karine Justad, 97536704, karine.justad@nih.no

Dersom du har spørsmål til Norsk senter for forskningsdata AS kan du ta kontakt med:
NSD – Norsk senter for forskningsdata AS, 55 58 21 17, personverntjenester@nsd.no

JEG HAR MOTTATT OG FORSTÅTT INFORMASJONEN OM PROSJEKTET "IDRETT, FYSISK AKTIVITET OG BEKKENBUNN", OG HAR FÅTT ANLEDNING TIL Å STILLE SPØRSMÅL. JEG SAMTYKKER TIL:

☐ å delta i *spørreundersøkelse*

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca. *20.08.2022*

Sted og dato	Deltakers signatur
	Deltakers navn med trykte bokstaver

NIH NORGES IDRETTSHØGSKOLE

NORGES GYMNASTIKK- OG TURNFORBUND

NORGES AMERIKANSKE IDRETTERS FORBUND

FORESPØRSEL OM DELTAKELSE I FORSKNINGSPROSJEKTET

IDRETT, FYSISK AKTIVITET OG BEKKENBUNN

Dette er et spørsmål til deg om å delta i en spørreundersøkelse om bekkenbunnsplager hos turnere, troppsgymnaster og cheerleadere. I dette skrivet gir vi informasjon om prosjektet og hva deltakelse vil innebære for deg.

FORMÅL

Denne undersøkelsen er en del av et doktorgradsgradsprosjekt ved Norges idrettshøgskole (NIH) som handler om trening og belastning på bekkenbunnen hos konkurranseutøvere i ulike idretter. Bekkenbunnen består av muskler, bindevev og leddbånd og befinner seg på inn –og undersiden av bekkenet. Den har i oppgave å støtte bekkenets organer (blære og rektum for menn og i tillegg livmor og vagina for kvinner). Den skal også kunne motstå all trykkbelastning fra underlaget og økning i buktrykk ved fysisk anstrengelse som hopp, løp, landinger og tunge løft, hosting og nysing. Bekkenbunnsplager kan forekomme dersom bekkenbunnen ikke fungerer optimalt ved fysisk anstrengelse. De vanligste bekkenbunnsplagene er lekkasje av urin og luft eller avføring og en type underlivsplage som kalles underlivsprolaps.

Flere studier viser at det er vanlig at idrettsutøvere lekker urin, spesielt under aktiviteter som innebærer løp og hopp. Dette kan påvirke konsentrasjon og prestasjon, i tillegg til at urinlekkasje i ung alder kan gi større risiko for at man får denne tilstanden senere i livet, f.eks. ved graviditet og etter fødsel. Vi ønsker å øke kunnskapen om hvordan bekkenbunnen påvirkes av store belastninger under gymnastiske og akrobatiske aktiviteter og vil derfor gjøre en spørreundersøkelse blant norske turnere, troppsgymnaster og cheerleadere om urinlekkasje og mulige risikofaktorer.

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Vi ønsker å spørre deg som er turner, troppsgymnast eller cheerleader over 13 år (eller som fyller 13 år i 2019) på høyt nasjonalt nivå om å delta i studien. NIH, Seksjon for idrettsmedisinske fag og Norges gymnastikk og turnforbund (NTGF) og Norges amerikanske idretters forbund (NAIF) samarbeider om dette forskningsprosjektet.

HVA INNEBÆRER PROSJEKTET?

Deltakelse i studien innebærer å svare på et elektronisk spørreskjema. Du vil få tilsendt en sikker link på spørreundersøkelsen på mail og/eller sms. Vi vil spørre deg om alder, høyde, vekt, idrettsaktivitet og eventuelle sykdommer. Spørsmål om urinlekkasje er fra et spørreskjema som brukes innen forskning. Vi vil også spørre

deg hvordan disse plagene eventuelt påvirker deg i din hverdag og idrettsaktiviteter. I tillegg vil vi spørre deg om du har andre bekkenbunnsplager. For å undersøke hva som gir økt risiko for bekkenbunnsplager, vil vi stille deg spørsmål om bl.a. leddbevegelighet (hypermobilitet), eventuelle idrettsskader, bruk av medisiner og prevensjonsmidler, menstruasjon og toalettvaner.

MULIGE FORDELER OG ULEMPER

Mulige ulemper ved å delta i undersøkelsen er at det vil ta deg ca. 10-15 minutter å svare på spørsmålene. Noen av spørsmålene kan virke personlige og intime. Hvis noen av spørsmålene er vanskelig å forstå eller svare på, kan du spørre om hjelp av Kristina L Skaug, daglig ansvarlig for prosjektet.

Deltakelse i studien medfører ikke noen umiddelbare fordeler. Dine svar vil være med på å gi økt kunnskap om hvilke bekkenbunnsplager og -utfordringer som oppleves blant turnere, troppsgymnaster og cheerleadere. Denne kunnskapen er viktig for å kunne sette inn tiltak på et tidlig stadium for å forebygge, behandle, unngå forverring og/eller øke idrettsprestasjon. Utøvere som svarer at de opplever urinlekkasje, kan få mulighet til å være med i en oppfølgingsstudie hvor vi ønsker å undersøke effekt av bekkenbunnstrening på symptomer og forekomst av urinlekkasje blant turnere, troppsgymnaster og cheerleadere.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE SITT SAMTYKKE

Det er frivillig å delta i prosjektet, men siden du er under 16 år må dine foreldre/foresatte godkjenne at du er med. Når dine foresatte samtykker til at du kan delta, vil du motta linken til spørreundersøkelsen på mail eller sms. Du kan når som helst og uten å oppgi noen grunn trekke deg fra prosjektet. Dette vil ikke få konsekvenser for din videre oppfølging og behandling. Dersom du trekker deg kan du kreve å få slettet innsamlede opplysninger, med mindre opplysningene allerede er brukt i analyser eller forskningsartikler. Dersom du ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder eller annen kontaktperson. Se telefonnummer og mailadresse under kontaktopplysninger.

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes som beskrevet i formålet med prosjektet. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få rettet opp eventuelle feil i de opplysningene som er registrert. I tillegg har du rett til få utlevert en kopi av dine personopplysninger og sende klage til Datatilsynet om behandlingen av dine personopplysninger. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene.

Svar fra det elektroniske spørreskjemaet overføres sikkert fra SurveyXact av Rambøll og vil lagres og analyseres elektronisk på en beskyttet dataserver på NIH. Brukere til programmet har tilgang via brukernavn og passord og det er kun organisasjonsmanager for spørreundersøkelsen, Kristina L. Skaug, som vil ha tilgang til besvarelsene.

Opplysningene oppbevares slik at navn og kontaktopplysninger er erstattet med en id-kode som viser til en liste som er adskilt fra listen med personopplysningene. Det er kun doktorgradsstipendiat, Kristina L. Skaug, som har adgang til koblingslisten. Listen lagres på en lokal pc på harddisk på et eget passordbeskyttet område. En kopi av listen vil bli skrevet ut og oppbevares i en låsbar skuff på NIH. Det vil ikke være mulig å identifisere deg i resultatene fra undersøkelsen når disse publiseres.

Prosjektet skal etter planen avsluttes 20.08.2022. Opplysningene om deg vil bli anonymisert eller slettet senest fem år etter prosjektslutt.

OPPFØLGINGSPROSJEKT

Det planlegges en studie hvor vi ønsker å undersøke effekt av bekkenbunnstrening på urinlekkasje hos turnere, gymnaster og cheerleadere. I denne studien er det planlagt å inkludere 46 utøvere. Ved at dine foresatte samtykker til deltakelse i denne studien, kan du bli spurt om delta i denne oppfølgingsstudien på et senere tidspunkt. I dette tilfellet vil det bli gitt et nytt informasjonsskriv og det vil bli innhentet nytt samtykke.

KONTAKTOPPLYSNINGER

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Spørrekjema studie 1: Bekkenbunnsplager blant turnere, troppsgymnaster og cheerleadere

Kjære deltaker!

Denne spørreundersøkelsen er en del av et doktorgradsprosjekt ved Norges idrettshøgskole, Seksjons for idrettsmedisinske fag, og gjøres i samarbeid med Norges Gymnastikk- og Turnforbund (NGTF) og Norges Amerikanske Idretters Forbund (NAIF).
Spørreundersøkelsen handler om trening og belastning på bekkenbunnen blant norske turnere, troppsgymnaster og cheerleadere som konkurrerer på høyt nivå.

Vi vil spørre deg om forekomst av og potensielle risikofaktorer for bekkenbunnsplager og vi bruker blant annet spørsmål fra internasjonale, standardiserte spørreskjemaer som benyttes innen forskning (LEAF-Q, 5PQ, ICIQ-UI-SF, ICIQ-B). Noen av spørsmålene kan oppleves som personlige og intime, men vi ber deg likevel svare på spørsmålene så godt du kan. Dine svar behandles konfidensielt.

Det tar ca.10-15 minutter å besvare undersøkelsen og det er viktig at du svarer på alle spørsmålene.

NB: Dersom spørreskjemaet skulle stoppe å fungere eller henge seg opp kan du klikke deg inn på tilsendt link og fortsette der du falt ut.

Samtykke til deltakelse

Før du kan delta i undersøkelsen er det viktig at du leser informasjonsskrivet du har blitt tilsendt på mail. Hvis du er under 16 år skal dine foresatte ha sendt inn samtykke til deltakelse på vegne av deg. Hvis du er over 16 vil du på neste side få spørsmål om å samtykke til å delta i studien.

Er du over 16 år?

(1) ❍ Ja, jeg er over 16 år

(2) ❍ Nei, jeg er under 16 år og mine foresatte har gitt samtykke til at jeg kan delta

Jeg har motatt, lest og fortsått informasjonen om prosjektet, og har fått anledning til å stille spørsmål. Jeg samtykker til:

(1) ❑ å delta i spørreundersøkelsen

(2) ❑ at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 20.08.2022

Personlige opplysninger (LEAF-Q)

Hva er din nåværende idrettsgren?

(1) ❍ Turn

(2) ❍ Troppsgymnastikk

(3) ❍ Cheerleading

Hvilke andre idretter/idrettsgrener har du eventuelt drevet aktivt med tidligere?

_____
_____
_____
_____
_____
_____

Hvor gammel var du da du begynte å spesialisere deg i din nåværende idrett?

_____

Er du idrettsutøver på heltid?

(1) ❍ Ja

(2) ❍ Nei

Hva driver du med ved siden av idretten?

(1) ❍ Heltidsjobb

(2) ❍ Deltidsjobb

(3) ❍ Studier/skolegang

(4) ❍ Annet, beskriv: _____

Hvilken utdannelse har du/holder du på med?

(1) ❍ Barne- og ungdomsskole

(2) ❍ Videregående skole

(3) ❍ Universitet eller høgskole

(4) ❍ Annet, beskriv: _____

Hva er ditt høyeste maksimale oksygenopptak (VO2maks) siste 12 måneder?

(1) ❍ Vet ikke/har ikke målt

(2) ❍ ML/KG/MIN: _____

(3) ❍ L/MIN _____

Hva er din beste plassering i Norgesmesterskap (NM)/enkeltkonkurranse i Norgescup?

(1) ❍ 1.-3. plass

(2) ❍ 4.-6. plass

(3) ❍ 7.-10. plass

(4) ❍ 11. plass eller dårligere

(5) ❍ Ikke deltatt i NM eller norgescup

(6) ❍ Vet ikke

Hva er din normale treningsmengde i <u>antall timer</u> i forberedelses- og oppbyggingsfasen (ikke konkurransefasen) i gjennomsnitt per måned?

_____

Hvor gammel er du?

_____

Hvor høy er du (cm)?

_____

Hva er din nåværende vekt (kg)?

_____

Hva er din laveste vekt med din nåværende høyde (kg)?

_____

Hva anser du som din konkurransevekt/matchvekt (kg)?

_____

Hva er din fettprosent (%)?

(1) ❍ Vet ikke/har ikke målt

(2) ❍ Prosent: _____

Har du en kronisk sykdom (f.eks. diabetes, Morbus Chrohn) eller andre helseplager?

(1) ❍ Ja, spesifiser: _____

(2) ❍ Nei

Treningsmengde og nivå

Hvor mange dager trener du spesifikk turn-, troppsymnastikk- eller cheerleadingtrening i gjennomsnitt per uke i forberedelses- og oppbyggingsfasen (ikke i konkurransefasen)?

(1) ❍ 1-3 dager

(2) ❍ 4-5 dager

(3) ❍ 6-7 dager

Hvor mange timer trener du per gang?

_____

Hvor mange timer bruker du i gjennomsnitt per uke på annen trening utenom turn-, troppsgymnastikk- og cheerleadingtreninger i forberedelses- og oppbyggingsfasen (f.eks. ballett, styrketrening, utholdenshetstrening)?

_____

Hvilke av disse konkurransene har eller skal du delta i? (Kryss av alle alternativer som passer for deg)

(1) ❑ Norgesmesterskap 2018

(2) ❑ Norgesmesterskap 2019

(3) ❑ Mesterskap på høyere nivå i 2018 (Nordisk mesterskap, EM, VM)

(4) ❑ Mesterskap på høyere nivå i 2019 (Nordisk mesterskap, EM, VM)

(5) ❑ Jeg har ikke deltatt/skal ikke delta i noen av alternativene over

Skader (LEAF-Q)

Har du vært skadet i løpet av siste året og dermed hatt fravær fra eller vært markant begrenset i forhold til din trenings-/konkurranseevne?

(1) ❍ Nei, slett ikke

(2) ❍ Ja, 1-2 ganger

(3) ❍ Ja, 3-4 ganger

(4) ❍ Ja, 5 ganger eller flere

Hvor mange dager i løpet av det siste året har du ikke trent eller deltatt i konkurranse som planlagt på grunn av skader?

(1) ❍ 1-7 dager

(2) ❍ 8-14 dager

(3) ❍ 15-21 dager

(4) ❍ 22 dager eller flere

Hvilke typer skader har du hatt i løpet av det siste året?

_____
_____
_____
_____
_____
_____

Operasjoner/skader i bekkenområdet

Har du tidligere blitt operert i rygg og/eller bekkenområdet?

(1) ❍ Ja, spesifiser: _____

(2) ❍ Nei

Har tidligere skadet eller hatt smerter en eller flere av følgende kroppsdeler? Sett gjerne kryss ved flere alternativer.

(1) ❑ Rygg

(2) ❑ Haleben

(3) ❑ Bekken

(4) ❑ Ingen

Hypermobilitet (5PQ)

Kan du på nåværende tidspunkt (eller har tidligere kunnet) legge begge håndflatene flatt i gulvet uten å bøye i knærne?

(1) ❍ Ja

(2) ❍ Nei

Kan du på nåværende tidspunkt (eller har tidligere kunnet) ta tak i tommelen og føre den helt inntil undersiden av underarmen?

(1) ❍ Ja

(2) ❍ Nei

Pleide du som barn å underholde andre med at du kunne vri kroppen din i merkelige posisjoner eller kunne du gjøre spagat uten å ha trent på det?

(1) ❍ Ja

(2) ❍ Nei

Skjedde det gjentagende ganger at skulder eller kneskjell gikk ut av ledd da du var barn eller tenåring? Hvis du er tenåring: skjer det ofte nå?

(1) ❍ Ja

(2) ❍ Nei

Kan det virke som om du har flere/løsere ledd enn andre personer?

(1) ❍ Ja

(2) ❍ Nei

Bruker du p-piller?

(1) ❍ Ja

(2) ❍ Nei

Hvorfor bruker du p-piller?

(1) ❍ Prevensjonsmiddel

(2) ❍ Redusere menstruasjonssmerter

(3) ❍ Redusere blødningsmengden

(4) ❍ For å regulere menstruasjonssyklus i forbindelse med konkurranser etc.

(5) ❍ Hvis ikke, uteblir menstruasjon

(6) ❍ Annet, spesifiser: _____

Har du brukt p-piller tidligere?

(1) ❍ Ja, i så fall når og hvor lenge? _____

(2) ❍ Nei

Bruker du noen annen form for hormonell prevensjon? (f.eks. p-stav, hormonspiral)

(1) ❍ Ja (p-stav, p-plaster, hormonspiral eller annet). Spesifiser hvilken type: _____

(2) ❍ Nei

Menstruasjon (LEAF-Q)

Hvor gammel var du da du fikk din første menstruasjon?

(1) ❍ Har aldri hatt menstruasjon

(2) ❍ 11 år eller yngre

(3) ❍ 12-14 år

(4) ❍ 15 år eller eldre

(5) ❍ Husker ikke

Kom din første menstruasjon naturlig? (av seg selv)

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Husker ikke

Hva ble gjort for å igangsette din menstruasjon?

(1) ❍ Hormonbehandling

(2) ❍ Vektøkning

(3) ❍ Redusert treningsmengde

(4) ❍ Annet

Har du normal menstruasjon?

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Vet ikke

Når hadde du menstruasjon sist?

(1) ❍ 0-4 uker siden

(2) ❍ 1-2 måneder siden

(3) ❍ 3-4 måneder siden

(4) ❍ 5 eller flere måneder siden

Har du regelmessig menstruasjon? (hver 28.-34.dag)

(1) ❍ Ja, som regel

(2) ❍ Nei, som regel ikke

Hvor mange dager pleier du å ha blødning?

(1) ❍ 1-2 dager

(2) ❍ 3-4 dager

(3) ❍ 5-6 dager

(4) ❍ 7-8 dager

(5) ❍ 9 dager eller mer

Har du noen ganger problemer med kraftig blødning?

(1) ❍ Ja

(2) ❍ Nei

Hvor mye påvirker dette deg i forbindelse med trening og/eller konkurranse? Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——————— 10

Hvor mange menstruasjonsblødninger har du hatt i løpet av det siste året?

(1) ❍ 12 eller flere blødninger

(2) ❍ 9-11 blødninger

(3) ❍ 6-8 blødninger

(4) ❍ 3-5 blødninger

(5) ❍ 0-2 blødninger

Hvor lenge er det siden sist du hadde menstruasjon?

(1) ❍ 2-3 måneder

(2) ❍ 4-5 måneder siden

(3) ❍ Mer enn 6 måneder siden

(4) ❍ Jeg er gravid og har derfor ikke menstruasjon

(5) ❍ Jeg bruker minipiller og har derfor ikke menstruasjon

Har din menstruasjon uteblitt helt i 3 måneder eller lengre uten at det skyldtes graviditet eller minipiller?

(1) ❍ Nei, det har aldri skjedd

(2) ❍ Ja, det har skjedd tidligere

(3) ❍ Ja, jeg opplever det nå

Opplever du at din menstruasjon endrer seg ved økt treningsintensitet, -frekvens og/eller varighet?

(1) ❍ Ja

(2) ❍ Nei

Hvordan endrer menstruasjonen seg? (sett ett eller flere kryss)

(1) ❑ Jeg blør mindre

(2) ❑ Jeg blør i færre dager

(3) ❑ Min menstruasjon uteblir

(4) ❑ Jeg har kraftigere blødninger

(5) ❑ Jeg blør i flere dager

Har du noen gang smerter ved menstruasjon som påvirker trening og konkurranse negativt?

(1) ❍ Ja

(2) ❍ Nei

Urinlekkasje (ICIQ-UI-SF)

Flere studier har vist at idrettsaktive jenter/kvinner i idretter, som for eksempel trampoline, turn, dans og ballett, lekker urin. Dette skjer særlig ved elementer som innebærer løp og hopp. Det kan være snakk om noen få dråper til større mengder. Vi vil gjerne vite om du har opplevd dette de siste 4 ukene.

Hvor ofte lekker du urin? (Kryss av i en boks)

(1) ❍ Aldri

(2) ❍ Omtrent en gang i uken eller sjeldnere

(3) ❍ 2-3 ganger i uken

(4) ❍ ca. 1 gang per dag

(5) ❍ Flere ganger per dag

(6) ❍ Hele tiden

Hvor mye urin lekker du <u>vanligvis</u> (enten du buker beskyttelse eller ikke)? (Kryss av i <u>en</u> boks)

(1) ❍ Ikke noe

(2) ❍ En liten mengde

(3) ❍ En moderat mengde

(4) ❍ En stor mengde

Hvor mye påvirker urinlekkasje ditt hverdagsliv? Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Når lekker du urin? (Kryss av alt som passer for deg)

(1) ❑ Aldri, jeg lekker ikke urin

(2) ❑ Lekker før jeg når toalettet

(3) ❑ Lekker når jeg hoster eller nyser

(4) ❑ Lekker når jeg sover

(5) ❑ Lekker når jeg er fysisk aktiv/trener

(6) ❑ Lekker når jeg er ferdig med å late vannet (tisse) og har tatt på meg klærne

(7) ❑ Lekker uten noe opplagt grunn

(8) ❑ Lekker hele tiden

Urinlekkasje og idrettsaktivitet

Dersom du lekker urin under fysisk aktivitet, trening og/eller konkurranse - hvordan påvirker dette deg? (Kryss av alt som passer for deg)

(1) ❑ Ikke i det hele tatt

(2) ❑ Jeg mister konsentrasjonen

(3) ❑ Jeg er redd for at det skal synes

(4) ❑ Jeg er redd for lukt

(5) ❑ Jeg gjør oftere feil

(6) ❑ Jeg presterer dårligere

(7) ❑ Jeg blir frustrert og/eller irritert

(8) ❑ Jeg synes det er flaut

(9) ❑ Jeg er redd for at det skal skje

(10) ❑ Annet, forklar kort: _____

Dersom du lekker under turn- eller cheerleadingaktiviteter, når er det vanligst at du lekker? (Kryss av alle alternativer som passer for deg)

(1) ❑ Lekker ikke under turn- eller cheerleadingaktiviteter

(2) ❑ Når jeg løper

(3) ❑ Når jeg hopper

(4) ❑ Når jeg satser til et gymnastisk ellet akrobatisk element

(5) ❑ Ved landing etter et gymnastisk eller akrobatisk element

(6) ❑ I luften under et gymnastisk eller akrobatisk element

(7) ❑ Når jeg hopper på trampoline eller trampett

(8) ❑ I andre situasjoner enn de som er nevnt. Spesifiser: _____

I hvilke(n) av disse situasjonene opplever du lekkasje? (Kryss av alle alternativer som passer for deg)

(1) ❑ Under trening

(2) ❑ Under konkurranse

(3) ❑ I andre situasjoner som ikke har med trening/konkurranse å gjøre

Har du snakket med noen om at du lekker urin? (Kryss av alle alternativer som passer for deg)

(1) ❑ Ingen

(2) ❑ Trener

(3) ❑ Fysioterapeut

(4) ❑ Lege

(5) ❑ Annet helsepersonell

(6) ❑ Lagkamerat(er)

(7) ❑ Forelder

(8) ❑ Venn(er)

Gjør du noen tiltak for å beskytte mot urinlekkasje eller unngå at du lekker? (Kryss av alle alternativer som passer for deg)

(1) ❑ Nei, ingen tiltak

(2) ❑ Bruker beskyttelse/truseinnlegg

(3) ❑ Reduserer væskeinntak

(4) ❑ Bruker tampong under trening/konkurranse

(5) ❑ Tømmer blæren (tisser) før trening/konkurranse

(6) ❑ Andre tiltak. Spesifiser: _____

Hender det at du unngår trening, fysisk aktivitet og/eller bestemte øvelser fordi du er bekymret for at du skal lekke urin?

(1) ❍ Aldri

(2) ❍ Av og til

(3) ❍ Ofte

(4) ❍ Hele tiden

Blærefunksjon og andre symptomer fra blære

Hvor mange ganger tømmer du blæren (tisser) i løpet av dagen?

(1) ❍ opp til 7 ganger

(2) ❍ 8-10 ganger

(3) ❍ 11-15 ganger

(4) ❍ mer enn 15 ganger

Må du presse/trykke for å tømme blæren?

(1) ❍ Aldri

(2) ❍ En gang i blant (under 1 gang i uken)

(3) ❍ Ofte (mer enn 1 gang i uken)

(4) ❍ Daglig

Har du ofte urinveisinfeksjon?

(1) ❍ Nei

(2) ❍ 1-3 ganger i året

(3) ❍ 4-12 ganger i året

(4) ❍ Oftere enn 1 gang i måneden

Klarer du å stoppe strålen når du tisser? (Test dette før du svarer hvis du er usikker)

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Usikker

Funksjon og plager fra mage/tarm (LEAF-Q og ICIQ-B)

Vi ber deg besvare spørsmålene i forhold til hvordan du har hatt det de siste 4 ukene.

I gjennomsnitt, hvor ofte har du avføring?

(1) ❍ Flere ganger per dag

(2) ❍ 1 gang per dag

(3) ❍ Hver 2. dag

(4) ❍ 2 ganger per uke

(5) ❍ 1 gang per uke eller sjeldnere

Føler du deg oppblåst eller oppsvulmet i magen, også når du ikke har menstruasjon?

(1) ❍ Sjeldent eller aldri

(2) ❍ Ja, 1-2 ganger per uke eller sjeldnere

(3) ❍ Ja, flere ganger per uke

(4) ❍ Ja, flere ganger per dag

Har du kramper og/eller magesmerter, som ikke kan relateres til din menstruasjon?

(1) ❍ Sjeldent eller aldri

(2) ❍ Ja, 1-2 ganger per uke eller sjeldnere

(3) ❍ Ja, flere ganger per uke

(4) ❍ Ja, flere ganger per dag

Hvordan pleier din avføring å være?

(1) ❍ Normal (fast eller bløt)

(2) ❍ Meget tynn, som diaré

(3) ❍ Hard og tørr

Må du presse hardt for å få ut avføringen?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Kan du hindre lekkasje av diaré/løs avføring?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Har du opplevd eller opplever du lekkasje av løs avføring under trening/konkurranse

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Av og til

(4) ❍ Ofte

(5) ❍ Hele tiden

Kan du hindre lekkasje av fast avføring?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Har du opplevd eller opplever du lekkasje av fast avføring under trening/konkurranse

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Av og til

(4) ❍ Ofte

(5) ❍ Hele tiden

Kan du hindre ufrivillig luftlekkasje?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Har du opplevd eller opplever du ufrivillig luftlekkasje under trening/konkurranse

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Av og til

(4) ❍ Ofte

(5) ❍ Hele tiden

Kan lekkasje fra tarmen komme uten forvarsel?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——————— 10

Bekymrer det deg at du kan ha uhell med avføring?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——————— 10

Eventuelle kommentarer eller utdyping angående magefunksjon

_____
_____
_____
_____
_____
_____

Bekkenbunn

I denne delen spør vi om din kjennskap til bekkenbunnsmusklene og deres funksjon

Hadde du hørt om bekkenbunnsmusklene av trener, helsepersonell eller andre før denne studien? (Kryss av alt som passer for deg)

(1) ❑ Nei, ingen

(2) ❑ Trener

(3) ❑ Lagkamerat(er)

(4) ❑ Fysioterapeut

(5) ❑ Lege

(6) ❑ Annet helsepersonell

(7) ❑ Forelder/foresatt

(8) ❑ Søsken

(9) ❑ Venn(er)

Hvor mye vet du om bekkenbunnsmusklene på en skala fra 0 til 10? (0 er absolutt ingenting og 10 er ekspertkunnskap)

0 ——— ◯ ——————— 10

I hvilke av disse øvelsene mener du at bekkenbunnsmusklene trenes spesifikt? (Velg et eller flere svar)

(1) ❑ Sit-ups

(2) ❑ Planken

(3) ❑ Inndragning (trekke inn navlen)

(4) ❑ Seteløft

(5) ❑ Knebøy

(6) ❑ Vet ikke

(7) ❑ Ingen av alternativene ovenfor trener bekkenbunnsmusklene

Hvilken bevegelse skjer når bekkenbunnsmusklene brukes?

(1) ❑ Sammentrekning rundt åpningene i bekkenet

(2) ❑ Løft opp og inn i bekkenet

(3) ❑ Press/trykk nedover

(4) ❑ Ingen av alternativene

(5) ❑ Jeg vet ikke

Vet du hvorfor det er anbefalt å trene bekkenbunnsmusklene?

(1) ❍ Ja, spesifiser: _____

(2) ❍ Nei

Vet du hvordan du skal trene bekkenbunnsmusklene?

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Usikker

Ville du gjort øvelser for bekkenbunnsmusklene for å forebygge eller unngå urinlekkasje og andre bekkenbunnsplager hvis du visste hvordan du skulle trene?

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Vet ikke

Takk for at du tok deg tid til å svare på spørsmålene og bidra til prosjektet!

Appendix 4

Paper II

Study information and consent forms

Questionnaire

FORESPØRSEL OM DELTAKELSE I FORSKNINGSPROSJEKTET

IDRETT, FYSISK AKTIVITET OG BEKKENBUNN

Dette er en spørsmål til deg om å delta i en spørreundersøkelse om forekomst av og risikofaktorer for bekkenbunnsplager hos styrkeløftere og vektløftere. I dette skrivet gir vi informasjon om prosjektet og hva deltakelse vil innebære for deg.

FORMÅL

Denne undersøkelsen er en del av et doktorgradsgradsprosjekt ved Norges idrettshøgskole (NIH) som handler om trening og belastning på bekkenbunnen hos konkurranseutøvere i ulike idretter. Bekkenbunnen består av muskler, bindevev og leddbånd og befinner seg på inn –og undersiden av bekkenet. Den har i oppgave å støtte bekkenets organer (blære og rektum for menn og i tillegg livmor og vagina for kvinner). Den skal også kunne motstå all trykkbelastning fra underlaget og økning i buktrykk ved fysisk anstrengelse som hopp, løp, landinger og tunge løft, hosting og nysing. Bekkenbunnsplager kan forekomme dersom bekkenbunnen ikke fungerer optimalt ved fysisk anstrengelse. De vanligste bekkenbunnsplagene er lekkasje av urin, luft eller avføring og underlivsprolaps.

Flere studier viser at det er vanlig at idrettsutøvere lekker urin, spesielt under aktiviteter som innebærer løp og hopp. Dette kan påvirke konsentrasjon og prestasjon, i tillegg til at tidlig forekomst av tilstanden er en risikofaktor for urinlekkasje senere i livet, f.eks. ved graviditet og etter fødsel. Vi ønsker å øke kunnskapen om hvordan bekkenbunnen påvirkes av store belastninger ved tung styrketrening og vil derfor gjøre en spørreundersøkelse blant norske vektløftere og styrkeløftere om forekomst av bekkenbunnsplager og potensielle risikofaktorer.

Norges idrettshøgskole (NIH) finansierer og er ansvarlig for forskningsprosjektet. Doktorgradsstipendiat og fysioterapeut Kristina L. Skaug, ansatt ved Seksjon for idrettsmedisinske fag (SIM), NIH, har det daglig ansvaret for studien. Professor, dr. scient og fysioterapeut Kari Bø ved NIH, Seksjon for idrettsmedisinske fag, er initiativtager og hovedveileder for prosjektet. Biveileder er Marie Ellström Engh, professor og gynekolog, Kvinneklinikken, Akershus universitetssykehus.

Vi ønsker å inkludere vekt- og styrkeløftere over 18 år på høyt nasjonalt nivå og vil derfor spørre deg som konkurrerer i norgesmesterskap eller på høyere nivå om å delta i studien. NIH, Seksjon for idrettsmedisinske fag, Norges vekløfterforbund og Norges styrkeløftforbund samarbeider om dette prosjektet.

HVA INNEBÆRER PROSJEKTET?

Deltakelse i studien innebærer å svare på et elektronisk spørreskjema. Du vil få tilgang til spørreundersøkelsen ved å klikke på vedlagt link. Vi vil spørre deg om alder, høyde, vekt, idrettsaktivitet og eventuelle sykdommer. For å kartlegge bekkenbunnsplager brukes spørsmål fra standardiserte spørreskjemaer som brukes innen forskning. Vi vil også spørre deg hvordan disse plagene eventuelt påvirker deg i din hverdag og idrettsaktiviteter. For å undersøke risikofaktorer for bekkenbunnsplager vil stille spørsmål om bl.a. lav energitilgjengelighet, toalettvaner. Hos kvinner vil vi også spørre om eventuelle barnefødsler.

MULIGE FORDELER OG ULEMPER

Mulige ulemper ved å delta i undersøkelsen er at det vil ta deg ca. 10-15 minutter å svare på spørsmålene. Noen av spørsmålene kan virke personlige og intime. Hvis noen av spørsmålene er vanskelig å forstå eller svare på kan du spørre om hjelp, Kristina L. Skaug, daglig ansvarlig for prosjektet.

Deltakelse i studien medfører ikke noen umiddelbare fordeler. Dine svar vil være med på å gi økt kunnskap om hvilke bekkenbunnsplager og -utfordringer som oppleves blant vekt- og styrkeløftere. Denne kunnskapen er viktig for å kunne sette inn tiltak på et tidlig stadium for å forebygge, behandle, unngå forverring og/eller øke idrettsprestasjon.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE SITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta trykker du på tilsendt link for å besvare spørreskjema. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke. Dette vil ikke få konsekvenser for din videre oppfølging og behandling. Dersom du trekker deg fra prosjektet, kan du kreve å få slettet innsamlede prøver og opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner. Dersom du senere ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder eller annen kontaktperson. Se telefonnummer og mailadresse under kontaktopplysninger.

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet i hensikten med prosjektet. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. I tillegg har du rett til få utlevert en kopi av dine personopplysninger og sende klage til Datatilsynet om behandlingen av dine personopplysninger. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene.

Svar fra det elektroniske spørreskjemaet overføres sikkert fra SurveyXact av Rambøll og vil lagres og analyseres elektronisk på en beskyttet server på NIH. Brukere til programmet har tilgang via brukernavn og passord og det er kun organisasjonsmanager for spørreundersøkelsen, Kristina L. Skaug, som vil ha tilgang til besvarelsene. Innsamlede opplysninger oppbevares slik at navn og

kontaktopplysninger er erstattet med en referansekode som viser til en adskilt liste. Det er kun doktorgradsstipendiat, Kristina L. Skaug, som har adgang til koblingslisten. Denne listen lagres på en lokal pc på harddisk på et eget passordbeskyttet område. En kopi av listen vil bli skrevet ut og oppbevares i en låsbar skuff på NIH. Det vil ikke være mulig å identifisere deg i resultatene fra undersøkelsen når disse publiseres.

Prosjektet skal etter planen avsluttes 20.08.2022. Opplysningene om deg vil bli anonymisert eller slettet senest fem år etter prosjektslutt.

OPPFØLGINGSPROSJEKT

Det planlegges en studie hvor vi ønsker å sammenlikne funksjon av bekkenbunnsmusklene (hviletrykk, muskelstyrke og utholdenhet) hos kvinner som trener tung styrketrening (vekt- og styrkeløftere) med kvinner som ikke regelmessig trener tung styrketrening eller utholdenhetstrening. Ved å samtykke til deltakelse i denne studien kan du bli spurt om delta i denne oppfølgingsstudien på et senere tidspunkt. I dette tilfellet vil et nytt samtykke bli innhentet.

GODKJENNING

Vi behandler opplysninger om deg basert på ditt samtykke. Regional komité for medisinsk og helsefaglig forskningsetikk har vurdert prosjektet, og har gitt forhåndsgodkjenning (Saksnummer: 2018/2211). Etter ny personopplysningslov har behandlingsansvarlige NIH og Kristina L. Skaug et selvstendig ansvar for å sikre at behandlingen av dine opplysninger har et lovlig grunnlag. Dette prosjektet har rettslig grunnlag i EUs personvernforordning artikkel 6a og artikkel 9 nr. 2 og ditt samtykke. På oppdrag fra Norges idrettshøgskole har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet kan du ta kontakt med:

Doktorgradsstipendiat: Kristina L. Skaug, 40609916, k.l.skaug@nih.no
Prosjektleder og hovedveileder: Kari Bø, 99047363, kari.bo@nih.no

Du kan ta kontakt med institusjonens personvernombud dersom du har spørsmål om behandlingen av dine personopplysninger i prosjektet:
Karine Justad, 97536704, karine.justad@nih.no

Dersom du har spørsmål til Norsk senter for forskningsdata AS kan du ta kontakt med:
NSD – Norsk senter for forskningsdata AS, 55 58 21 17, personverntjenester@nsd.no

JEG SAMTYKKER TIL Å DELTA I PROSJEKTET OG TIL AT MINE PERSONOPPLYSNINGER BEHANDLES FREM TIL PROSJEKTET ER AVSLUTTET, CA. 20.08.2022

Sted og dato	Deltakers signatur
	Deltakers navn med trykte bokstaver

Spørreskjema studie 2: Bekkenbunnsplager blant styrkeløftere og vektløftere

Kjære deltaker!

Denne undersøkelsen er en del av et doktorgradsprosjekt ved Norges idrettshøgskole, Seksjon for idrettsmedisinske fag, og gjøres i samarbeid med Norges Vektløfterforbund og Norges Styrkeløftforbund. Spørreundersøkelsen handler om trening og belastning av bekkenbunnen blant norske vektløftere og styrkeløftere.

Vi vil spørre deg om forekomst av og potensielle risikofaktorer for bekkenbunnsplager og vi bruker blant annet spørsmål fra internasjonale, standardiserte spørreskjemaer som benyttes innen forskning (LEAF-Q, 5PQ, ICIQ-B, ICIQ-VS). Noen av spørsmålene kan oppleves som personlige og intime, men vi ber deg likevel svare på spørsmålene så godt du kan. Dine svar behandles konfidensielt.

Det tar ca.15-30 minutter å besvare undersøkelsen og det er viktig at du svarer på alle spørsmålene.

NB: Dersom spørreskjemaet skulle stoppe å fungere eller henge seg opp kan du klikke deg inn på tilsendt link og fortsette der du falt ut.

Samtykke til deltakelse

Før du kan delta på undersøkelsen er det viktig at du leser og gjør deg forstått med informasjonsskrivet du har blitt tilsendt på mail. På neste side vil du få spørsmål om å samtykke til å delta i studien.

Jeg har mottatt, lest og forstått informasjonen om prosjektet, og har fått anledning til å stille spørsmål. Jeg samtykker til:

(1) ❑ å delta i spørreundersøkelsen

(2) ❑ at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 20.08.2022

Personlige opplysninger (LEAF-Q)

Er du mann eller kvinne?

(1) ❍ Mann

(2) ❍ Kvinne

Hva er din nåværende idrettsgren?

(1) ❍ Vektløfting

(2) ❍ Styrkeløft

Hvilke andre idretter/idrettsgrener har du eventuelt drevet aktivt med tidligere?

_____
_____
_____
_____
_____
_____

Hvor gammel var du da du begynte å spesialisere deg i din nåværende idrett?

_____

Er du idrettsutøver på heltid?

(1) ❍ Ja

(2) ❍ Nei

Hva driver du med ved siden av idretten?

(1) ❍ Heltidsjobb

(2) ❍ Deltidsjobb

(3) ❍ Studier/skolegang

(4) ❍ Annet, beskriv: _____

Hvilken utdannelse har du/holder du på med?

(1) ❍ Barne- og ungdomsskole

(2) ❍ Videregående skole

(3) ❍ Universitet eller høgskole

(4) ❍ Annet, beskriv: _____

Hva er ditt høyeste maksimale oksygenopptak (VO2maks) siste 12 måneder?

(1) ❍ Vet ikke/har ikke målt

(2) ❍ ML/KG/MIN: _____

(3) ❍ L/MIN _____

Hva er din beste plassering i Norgesmesterskap (NM)/enkeltkonkurranse i Norgescup?

(1) ❍ 1.-3. plass

(2) ❍ 4.-6. plass

(3) ❍ 7.-10. plass

(4) ❍ 11. plass eller dårligere

(5) ❍ Ikke deltatt i NM eller norgescup

(6) ❍ Vet ikke

Hva er din normale treningsmengde i antall timer i forberedelses- og oppbyggingsfasen (ikke konkurransefasen) i gjennomsnitt per måned?

_____

Hvor gammel er du?

_____

Hvor høy er du (cm)?

_____

Hva er din nåværende vekt (kg)?

_____

Hva er din laveste vekt med din nåværende høyde (kg)?

_____

Hva anser du som din konkurransevekt/matchvekt (kg)?

_____

Hva er din fettprosent (%)?

(1) ❍ Vet ikke/har ikke målt

(2) ❍ Prosent: _____

Har du en kronisk sykdom (f.eks. diabetes, Morbus Chrohn, irritabel tarmsyndrom) eller andre helseplager?

(1) ❍ Ja, spesifiser: _____

(2) ❍ Nei

Treningsmengde og nivå

Hvor mange dager gjør du spesifikk vektløft- eller styrkeløfttrening i gjennomsnitt per uke?

(1) ❍ 1-3 dager

(2) ❍ 4-5 dager

(3) ❍ 6-7 dager

Hvor mange timer trener du i gjennomsnitt per gang?

_____

Hvor mange <u>timer</u> bruker du i gjennomsnitt på annen trening <u>utenom vektløfting og styrkeløft</u> (f.eks. utholdenshetstrening, bevegelighetstrening) per uke?

_____

Hvilke av disse konkurransene har eller skal du delta i? (Kryss av alle alternativer som passer for deg)

(1) ❑ NM i benkpress utstyr 2018

(2) ❑ NM i benkpress utstyr 2019

(3) ❑ NM i benkpress utstyrsfritt 2018

(4) ❑ NM i benkpress utstyrsfritt 2019

(5) ❑ NM i styrkeløft utstyr 2018

(6) ❑ NM i styrkeløft utstyr 2019

(7) ❑ NM i styrkeløft utstyrsfritt 2018

(8) ❑ NM i styrkeløft utstyrsfritt 2019

(9) ❑ NM ungdom, junior og veteran 2018. Spesifiser: _____

(10) ❑ NM ungdom, junior og veteran 2019. Spesifiser: _____

(11) ❑ Mesterskap på høyere nivå i 2018 (Nordisk mesterskap, EM, VM). Spesifiser: _____

(12) ❑ Mesterskap på høyere nivå i 2019 (Nordisk mesterskap, EM, VM). Spesifiser: _____

(13) ❑ Jeg har ikke deltatt/skal ikke delta i noen av disse konkurransene

Hvilke av disse konkurransene har eller skal du delta i? (Kryss av alle alternativer som passer for deg)

(1) ❑ NM Senior 2018

(2) ❑ NM Senior 2019

(3) ❑ NM Junior 2018

(4) ❑ NM Junior 2019

(5) ❑ NM Veteran 2018

(6) ❑ NM Veteran 2019

(7) ❑ Mesterskap på høyere nivå i 2018 (Nordisk mesterskap, EM, VM). Spesifiser: _____

(8) ❑ Mesterskap på høyere nivå i 2019 (Nordisk mesterskap, EM, VM). Spesifiser: _____

(9) ❑ Jeg har ikke deltatt/skal ikke delta i noen av disse konkurransene

Skader (LEAF-Q)

Har du vært skadet i løpet av siste året og dermed hatt fravær fra eller vært markant begrenset i forhold til din trenings-/konkurranseevne?

(1) ❍ Nei, slett ikke

(2) ❍ Ja, 1-2 ganger

(3) ❍ Ja, 3-4 ganger

(4) ❍ Ja, 5 ganger eller flere

Hvor mange dager i løpet av det siste året har du ikke trent eller deltatt i konkurranse som planlagt på grunn av skader?

(1) ❍ 1-7 dager

(2) ❍ 8-14 dager

(3) ❍ 15-21 dager

(4) ❍ 22 dager eller flere

Hvilke typer skader har du hatt i løpet av det siste året?

_____
_____
_____
_____
_____
_____

Operasjoner/skader i bekkenområdet

Har du tidligere blitt operert i rygg og/eller bekkenområdet?

(1) ❍ Ja, spesifiser: _____

(2) ❍ Nei

Har tidligere skadet eller hatt smerter i en eller flere av følgende kroppsdeler? Sett gjerne kryss ved flere alternativer.

(1) ❑ Rygg

(2) ❑ Haleben

(3) ❑ Bekken

(4) ❑ Ingen

Hypermobilitet (5PQ)

Kan du på nåværende tidspunkt (eller har tidligere kunnet) legge begge håndflatene flatt i gulvet uten å bøye i knærne?

(1) ❍ Ja

(2) ❍ Nei

Kan du på nåværende tidspunkt (eller har tidligere kunnet) ta tak i tommelen og føre den helt inntil undersiden av underarmen?

(1) ❍ Ja

(2) ❍ Nei

Pleide du som barn å underholde andre med at du kunne vri kroppen din i merkelige posisjoner eller kunne du gjøre spagat uten å ha trent på det?

(1) ❍ Ja

(2) ❍ Nei

Skjedde det gjentagende ganger at skulder eller kneskjell gikk ut av ledd da du var barn eller tenåring?

(1) ❍ Ja

(2) ❍ Nei

Kan det virke som om du har flere/løsere ledd enn andre personer?

(1) ❍ Ja

(2) ❍ Nei

Prevensjonsmiddel (LEAF-Q)

Bruker du p-piller?

(1) ❍ Ja

(2) ❍ Nei

Hvorfor bruker du p-piller?

(1) ❍ Prevensjonsmiddel

(2) ❍ Redusere menstruasjonssmerter

(3) ❍ Redusere blødningsmengden

(4) ❍ For å regulere menstruasjonssyklus i forbindelse med konkurranser etc.

(5) ❍ Hvis ikke, uteblir menstruasjon

(6) ❍ Annet, spesifiser: _____

Har du brukt p-piller tidligere?

(1) ❍ Ja, i så fall når og hvor lenge? _____

(2) ❍ Nei

Bruker du noen annen form for hormonell prevensjon eller hormonbehandling? (f.eks. p-stav, hormonspiral)

(1) ❍ Ja (p-stav, p-plaster, hormonspiral eller annet). Spesifiser hvilken type: _____

(2) ❍ Nei

Menstruasjon (LEAF-Q)

Hvor gammel var du da du fikk din første menstruasjon?

(1) ❍ Har aldri hatt menstruasjon

(2) ❍ 11 år eller yngre

(3) ❍ 12-14 år

(4) ❍ 15 år eller eldre

(5) ❍ Husker ikke

Kom din første menstruasjon naturlig? (av seg selv)

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Husker ikke

Hva ble gjort for å igangsette din menstruasjon?

(1) ❍ Hormonbehandling

(2) ❍ Vektøkning

(3) ❍ Redusert treningsmengde

(4) ❍ Annet

Har du normal menstruasjon?

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Vet ikke

(4) ❍ Jeg har ikke lenger menstruasjon. Begrunn: _____

Når hadde du menstruasjon sist?

(1) ❍ 0-4 uker siden

(2) ❍ 1-2 måneder siden

(3) ❍ 3-4 måneder siden

(4) ❍ 5 eller flere måneder siden

Har du regelmessig menstruasjon? (hver 28.-34.dag)

(1) ❍ Ja, som regel

(2) ❍ Nei, som regel ikke

Hvor mange dager pleier du å ha blødning?

(1) ❍ 1-2 dager

(2) ❍ 3-4 dager

(3) ❍ 5-6 dager

(4) ❍ 7-8 dager

(5) ❍ 9 dager eller mer

Har du noen ganger problemer med kraftig blødning?

(1) ❍ Ja

(2) ❍ Nei

Hvor mye påvirker dette deg i forbindelse med trening og/eller konkurranse? Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Hvor mange menstruasjonsblødninger har du hatt i løpet av det siste året?

(1) ❍ 12 eller flere blødninger

(2) ❍ 9-11 blødninger

(3) ❍ 6-8 blødninger

(4) ❍ 3-5 blødninger

(5) ❍ 0-2 blødninger

Hvor lenge er det siden sist du hadde menstruasjon?

(1) ❍ 2-3 måneder

(2) ❍ 4-5 måneder siden

(3) ❍ Mer enn 6 måneder siden

(4) ❍ Jeg er gravid og har derfor ikke menstruasjon

(5) ❍ Jeg bruker minipiller og har derfor ikke menstruasjon

Har din menstruasjon uteblitt helt i 3 måneder eller lengre uten at det skyldtes graviditet eller minipiller?

(1) ❍ Nei, det har aldri skjedd

(2) ❍ Ja, det har skjedd tidligere

(3) ❍ Ja, jeg opplever det nå

Opplever du at din menstruasjon endrer seg ved økt treningsintensitet, -frekvens og/eller varighet?

(1) ❍ Ja

(2) ❍ Nei

Hvordan endrer menstruasjonen seg? (sett ett eller flere kryss)

(1) ❑ Jeg blør mindre

(2) ❑ Jeg blør i færre dager

(3) ❑ Min menstruasjon uteblir

(4) ❑ Jeg har kraftigere blødninger

(5) ❑ Jeg blør i flere dager

Har du noen gang smerter ved menstruasjon som påvirker trening og konkurranse negativt?

(1) ❍ Ja

(2) ❍ Nei

Fødsler

Har du født barn?

(1) ❍ Ja

(2) ❍ Nei

Hvor mange barn har du født?

_____

Hvor mange barn har du født vaginalt?

_____

Ble barnet/noen av barna født med tang eller vakuum?

(1) ❑ Nei

(2) ❑ Ja, med tang

(3) ❑ Ja, med vakuum (sugekopp)

Hvor mange barn har du født med keisersnitt?

_____

Har du opplevd å få en underlivsskade/rift i forbindelse med fødsel?

(1) ❑ Nei

(2) ❑ Ja, grad 1-2

(3) ❑ Ja, grad 3-4

(4) ❑ Ja, men er usikker på hvilken grad

(5) ❑ Vet ikke

Urinlekkasje (ICIQ-UI-SF)

Flere studier viser at det er vanlig at idrettsutøvere lekker urin, spesielt under aktiviteter som innebærer løp og hopp. Det kan være snakk om noen få dråper til større mengder. Vi vil undersøke hvordan bekkenbunnen påvirkes av store belastninger ved tung styrketrening og vil gjerne vite om du har opplevd dette de siste 4 ukene.

Hvor ofte lekker du urin? (Kryss av i en boks)

(1) ❍ Aldri

(2) ❍ Omtrent en gang i uken eller sjeldnere

(3) ❍ 2-3 ganger i uken

(4) ❍ ca. 1 gang per dag

(5) ❍ Flere ganger per dag

(6) ❍ Hele tiden

Hvor mye urin lekker du vanligvis (enten du buker beskyttelse eller ikke)? (Kryss av i en boks)

(1) ❍ Ikke noe

(2) ❍ En liten mengde

(3) ❍ En moderat mengde

(4) ❍ En stor mengde

Hvor mye påvirker urinlekkasje ditt hverdagsliv? Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Når lekker du urin? (Kryss av alt som passer for deg)

(1) ❑ Aldri, jeg lekker ikke urin

(2) ❑ Lekker før jeg når toalettet

(3) ❑ Lekker når jeg hoster eller nyser

(4) ❑ Lekker når jeg sover

(5) ❑ Lekker når jeg er fysisk aktiv/trener

(6) ❑ Lekker når jeg er ferdig med å late vannet (tisse) og har tatt på meg klærne

(7) ❑ Lekker uten noe opplagt grunn

(8) ❑ Lekker hele tiden

Urinlekkasje og idrettsaktivitet

Dersom du lekker urin under fysisk aktivitet, trening og/eller konkurranse - hvordan påvirker dette deg? (Kryss av alt som passer for deg)

(1) ❑ Ikke i det hele tatt

(2) ❑ Jeg mister konsentrasjonen

(3) ❑ Jeg er redd for at det skal synes

(4) ❑ Jeg er redd for lukt

(5) ❑ Jeg gjør oftere feil

(10) ❑ Jeg presterer dårligere

(6) ❑ Jeg blir frustrert, irritert og bekymret

(7) ❑ Jeg synes det er flaut

(8) ❑ Jeg er redd for at det skal fortsette/skje på nytt

(9) ❑ Annet, forklar kort: _____

Dersom du lekker under styrkeløft- eller vektløftingaktiviteter, når er det vanligst at du lekker? (Kryss av alle alternativer som passer for deg)

(6) ❑ Lekker ikke under styrkeløft- eller vektløftingaktiviteter

(1) ❑ Tunge løft/maksstyrke (1-5 RM)

(3) ❑ Styrketrening med flere (>6) repetisjoner

(4) ❑ Eksplosiv styrketrening eller spensttrening

(5) ❑ Styrketrening/løft med belte

(7) ❑ I andre situasjoner enn de som er nevnt. Spesifiser: _____

I hvilke av disse øvelsene vanligst at du lekker? (Kryss av alle alternativer som passer for deg)

(1) ❑ Knebøy

(2) ❑ Markløft

(3) ❑ Benkpress

(4) ❑ Rykk

(5) ❑ Vending

(6) ❑ Overstøt

(7) ❑ Andre øvelser. Spesifiser: _____

(8) ❑ Ingen av de nevnte alternativene

I hvilke(n) av disse situasjonene opplever du lekkasje? (Kryss av alle alternativer som passer for deg)

(1) ❑ Under trening

(2) ❑ Under konkurranse

(4) ❑ I andre situasjoner som ikke har med trening/konkurranse å gjøre

Har du snakket med noen om at du lekker urin? (Kryss av alle alternativer som passer for deg)

(1) ❑ Ingen

(2) ❑ Trener

(3) ❑ Fysioterapeut

(4) ❑ Lege

(5) ❑ Annet helsepersonell

(6) ❑ Lagkamerat(er)

(7) ❑ Forelder

(8) ❑ Venn(er)

Gjør du noen tiltak for å beskytte mot urinlekkasje eller unngå at du lekker? (Kryss av alle alternativer som passer for deg)

(1) ❑ Nei, ingen tiltak

(2) ❑ Bruker beskyttelse/truseinnlegg

(3) ❑ Reduserer væskeinntak

(4) ❑ Bruker tampong under trening/konkurranse

(6) ❑ Tømmer blæren (tisser) før trening/konkurranse

(7) ❑ Andre tiltak. Spesifiser: _____

Hender det at du unngår trening, fysisk aktivitet og/eller bestemte øvelser fordi du er bekymret for at du skal lekke urin?

(1) ❍ Aldri

(2) ❍ Av og til

(3) ❍ Ofte

(4) ❍ Hele tiden

Blærefunksjon og andre symptomer fra blære

Hvor mange ganger tømmer du blæren (tisser) i løpet av dagen?

(1) ❍ opp til 7 ganger

(2) ❍ 8-10 ganger

(3) ❍ 11-15 ganger

(4) ❍ mer enn 15 ganger

Må du presse/trykke for å tømme blæren?

(1) ❍ Aldri

(2) ❍ En gang i blant (under 1 gang i uken)

(3) ❍ Ofte (mer enn 1 gang i uken)

(4) ❍ Daglig

Har du ofte urinveisinfeksjon?

(1) ❍ Nei

(2) ❍ 1-3 ganger i året

(3) ❍ 4-12 ganger i året

(4) ❍ Oftere enn 1 gang i måneden

Klarer du å stoppe strålen når du tisser? (Test dette før du svarer hvis du er usikker)

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Usikker

Vaginale symptomer

Kan du kjenne en kul/utbuling <u>inne</u> i skjeden?

(1) ❍ Aldri

(2) ❍ Av og til

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Hele tiden

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Kan du kjenne en kul/utbuling <u>utenfor</u> skjeden?

(1) ❍ Aldri

(2) ❍ Av og til

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Hele tiden

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Funksjon og plager fra mage/tarm (LEAF-Q og ICIQ-B)

Vi ber deg besvare spørsmålene i forhold til hvordan du har hatt det de siste 4 ukene.

I gjennomsnitt, hvor ofte har du avføring?

(1) ❍ Flere ganger per dag

(2) ❍ 1 gang per dag

(3) ❍ Hver 2. dag

(4) ❍ 2 ganger per uke

(5) ❍ 1 gang per uke eller sjeldnere

Føler du deg oppblåst eller oppsvulmet i magen, også når du ikke har menstruasjon?

(1) ❍ Sjeldent eller aldri

(2) ❍ Ja, 1-2 ganger per uke eller sjeldnere

(3) ❍ Ja, flere ganger per uke

(4) ❍ Ja, flere ganger per dag

Føler du deg oppblåst eller oppsvulmet i magen?

(1) ❍ Sjeldent eller aldri

(2) ❍ Ja, 1-2 ganger per uke eller sjeldnere

(3) ❍ Ja, flere ganger per uke

(4) ❍ Ja, flere ganger per dag

Har du kramper og/eller magesmerter, som ikke kan relateres til din menstruasjon?

(1) ❍ Sjeldent eller aldri

(2) ❍ Ja, 1-2 ganger per uke eller sjeldnere

(3) ❍ Ja, flere ganger per uke

(4) ❍ Ja, flere ganger per dag

Har du kramper og/eller magesmerter?

(1) ❍ Sjeldent eller aldri

(2) ❍ Ja, 1-2 ganger per uke eller sjeldnere

(3) ❍ Ja, flere ganger per uke

(4) ❍ Ja, flere ganger per dag

Hvordan pleier din avføring å være?

(1) ❍ Normal (fast eller bløt)

(2) ❍ Meget tynn, som diaré

(3) ❍ Hard og tørr

Må du skynde deg veldig til toalettet når du har avføringstrang?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Bruker du medisiner (tabletter eller mikstur/dråper) for å stoppe avføring?

(1) ❍ Aldri

(2) ❍ Mindre enn 1 gang i måneden

(3) ❍ Mindre enn 1 gang i uken

(4) ❍ Mindre enn 1 gang i løpet av dage

(5) ❍ Flere ganger om dagen

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Har du opplevd flekker av avføring i undertøyet eller trenger du å bruke bind på grunn av avføringslekkasje?

(1) ❍ Aldri

(2) ❍ Mindre enn 1 gang i måneden

(3) ❍ Mindre enn 1 gang i uken

(4) ❍ Mindre enn 1 gang om dagen

(5) ❍ Hver dag

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Må du presse hardt for å få ut avføringen?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Kan du hindre lekkasje av <u>diaré/løs</u> avføring?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Har du opplevd eller opplever du lekkasje av løs avføring under trening/konkurranse

(1) ❍ Aldri

(3) ❍ Sjelden

(4) ❍ Av og til

(5) ❍ Ofte

(6) ❍ Hele tiden

Kan du hindre lekkasje av fast avføring?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——————— 10

Har du opplevd eller opplever du lekkasje av fast avføring under trening/konkurranse

(1) ❍ Aldri

(3) ❍ Sjelden

(4) ❍ Av og til

(5) ❍ Ofte

(6) ❍ Hele tiden

Kan du hindre ufrivillig luftlekkasje?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Har du opplevd eller opplever du ufrivillig luftlekkasje under trening/konkurranse

(1) ❍ Aldri

(3) ❍ Sjelden

(4) ❍ Av og til

(5) ❍ Ofte

(6) ❍ Hele tiden

Kan lekkasje fra tarmen komme uten forvarsel?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Bekymrer det deg at du kan ha uhell med avføring?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Føler du deg ille berørt på grunn av avføringsplager?

(1) ❍ Aldri

(2) ❍ Sjelden

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Alltid

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Eventuelle kommentarer eller utdyping angående magefunksjon

_____
_____
_____
_____
_____
_____

Bekkenbunn

I denne delen spør vi om din kjennskap til bekkenbunnsmusklene og deres funksjon

Hadde du hørt om bekkenbunnsmusklene av trener, helsepersonell eller andre før denne studien? (Kryss av alt som passer for deg)

(1) ❑ Nei, ingen

(2) ❑ Trener

(3) ❑ Lagkamerat(er)

(4) ❑ Fysioterapeut

(5) ❑ Lege

(6) ❑ Annet helsepersonell

(7) ❑ Forelder/foresatt

(8) ❑ Søsken

(9) ❑ Venn(er)

Hvor mye vet du om bekkenbunnsmusklene på en skala fra 0 til 10? (0 er absolutt ingenting og 10 er ekspertkunnskap)

0 ——— ◯ ——— 10

I hvilke av disse øvelsene mener du at bekkenbunnsmusklene trenes spesifikt? (Velg et eller flere svar)

(1) ❑ Sit-ups

(2) ❑ Planken

(3) ❑ Inndragning (trekke inn navlen)

(4) ❑ Seteløft

(5) ❑ Knebøy

(6) ❑ Vet ikke

(7) ❑ Ingen av alternativene ovenfor trener bekkenbunnsmusklene

Hvilken bevegelse skjer når bekkenbunnsmusklene brukes?

(1) ❑ Sammentrekning rundt åpningene i bekkenet

(2) ❑ Løft opp og inn i bekkenet

(3) ❑ Press/trykk nedover

(4) ❑ Ingen av alternativene

(5) ❑ Jeg vet ikke

Vet du hvorfor det er anbefalt å trene bekkenbunnsmusklene?

(1) ❍ Ja. Spesisfiser: _____

(2) ❍ Nei

Vet du hvordan du skal trene bekkenbunnsmusklene?

(1) ❍ Ja

(2) ❍ Nei

Ville du gjort øvelser for bekkenbunnsmusklene for å forebygge eller unngå urinlekkasje og andre bekkenbunnsplager hvis du visste hvordan du skulle trene?

(1) ❍ Ja

(2) ❍ Nei

(3) ❍ Vet ikke

Er det noe du ønsker å legge til eller har du kommentarer til spørreundersøkelsen?

_____
_____
_____
_____
_____
_____

Takk for at du tok deg tid til å svare på spørreundersøkelsen og bidra til prosjektet!

Appendix 5

Paper III

Study information and consent forms

Questionnaire

Clinical assessment form

NIH NORGES IDRETTSHØGSKOLE

FORESPØRSEL OM DELTAKELSE I FORSKNINGSPROSJEKTET

IDRETT, FYSISK AKTIVITET OG BEKKENBUNN

Dette er et spørsmål til deg om å delta i en undersøkelse av bekkenbunnsmusklene før og etter styrketrening og hvile hos kvinner som trener styrketrening regelmessig. I dette skrivet gir vi informasjon om prosjektet og hva deltakelse vil innebære for deg.

FORMÅL

Denne undersøkelsen er en del av et doktorgradsgradsprosjekt ved Norges idrettshøgskole (NIH) som handler om trening og belastning på bekkenbunnen hos kvinner som utøver idrett eller hard fysisk trening. Bekkenbunnen består av muskler, bindevev og leddbånd og befinner seg på inn –og undersiden av bekkenet. Den har i oppgave å støtte bekkenets organer (blære, rektum, livmor og vagina). Den skal også kunne motstå all trykkbelastning fra underlaget og økning i buktrykk ved fysisk anstrengelse (f.eks. hopp, løp og tunge løft), hosting og nysing. Bekkenbunnsplager kan forekomme dersom bekkenbunnen ikke fungerer optimalt ved fysisk anstrengelse. De vanligste bekkenbunnsplagene er lekkasje av urin, luft eller avføring og underlivsprolaps.

Flere studier viser at det er vanlig at idrettsutøvere og treningsaktive kvinner lekker urin. Dette kan påvirke konsentrasjon og prestasjon, i tillegg til at tidlig forekomst av tilstanden er en risikofaktor for urinlekkasje senere i livet, f.eks. ved graviditet og etter fødsel. Vi ønsker i denne studien å sammenlikne av hviletrykk- og aktivitet, muskelstyrke og utholdenhet av bekkenbunnsmusklene blant kvinner som regelmessig trener styrketrening før og etter en tung styrketreningsøkt. Effekten av styrketrening på bekkenbunnsmusklene vil vi sammenligne med effekt av hvile (dvs. stillesitting). Vi vil også spørre om forekomst og symptomer av bekkenbunnsplager (ufrivillig lekkasje av urin, luft og avføring og underlivsprolaps) blant deltakerne. Målet med undersøkelsen er å få økt kunnskap om hvordan bekkenbunnen påvirkes av tung styrketrening for deretter å kunne sette inn forebyggende tiltak gjennom spesifikk trening.

NIH finansierer og er ansvarlig for forskningsprosjektet. Doktorgradsstipendiat og fysioterapeut Kristina L. Skaug, ansatt ved Institutt for idrettsmedisinske fag (IIM), NIH, har det daglige ansvaret for studien. Professor, dr. scient og fysioterapeut Kari Bø ved NIH, IIM, er initiativtager og hovedveileder for prosjektet. Biveileder er Marie Ellström Engh, professor og gynekolog, Kvinneklinikken, Akershus universitetssykehus.

Vi ønsker å spørre deg som er enten er kvinnelig vektløfter/styrkeløfter eller som trener styrketrening regelmessig (≥3 ganger per uke), som er over 18 år og som ikke er gravid eller tidligere har født barn til å delta i studien.

HVA INNEBÆRER PROSJEKTET?

Deltakelse i studien innebærer å svare på et elektronisk spørreskjema, samt delta på fysiske tester og kliniske undersøkelser på NIH. Spørreskjemaet vil ta deg ca. 10-15 minutter å besvare, mens vi vil be deg møte to ganger på NIH for bakgrunnsmålinger (ca. 2 timer) og gjennomføring av fysiske tester og kliniske undersøkelser (ca. 4 timer). En til to dager i forkant av første avtale på NIH vil du få tilsendt en sikker og personlig link til

spørreskjemaet på mail eller sms. Vi vil spørre deg om alder, utdanningsnivå, treningsbakgrunn og eventuelle sykdommer. For å kartlegge bekkenbunnsplager brukes spørsmål fra standardiserte spørreskjemaer som er vanlige å bruke innen forskning.

Dag 1 (bakgrunnsmålinger og introduksjon til bekkenbunnsmålinger): En fysioterapeut vil starte med å måle din vekt og høyde, samt en enkel klinisk undersøkelse for hypermobilitet som består av 5 leddtester (Beighton score). Samme fysioterapeut vil instruere deg i riktig bekkenbunnssammentrekning ved å observere om du kan trekke opp og inn i underlivet og deretter kjenne i ytre del av skjeden. Du vil også få opplæring i målemetoder (vaginal trykkmåling og overflate-sEMG) som skal benyttes på testdagen. Hviletrykk og maksimal og utholdende muskelstyrke i bekkenbunnsmusklene måles med en vaginal trykkmåler som er festet til en luftfylt ballong (på størrelse med en tampong) som legges i ytre del av skjeden. For å måle bekkenbunnens aktivitet i hvile vil vi benytte overflate-sEMG (eletromyografi) med en vaginal probe. Vaginale trykkmålinger og sEMG er undersøkelser som benyttes i vanlig klinisk praksis. Til sist skal du gjennomføre en makstest i øvelsene knebøy og markløft for å finne riktig vektbelastning på styrketreningsøkten på testdagen. Oppvarminsprotokoll og belastning vil justeres etter behov og treningserfaring hos deltaker.

Dag 2 (testdag): Oppmøte vil være minimum 48 timer etter dag 1. På denne dagen skal du gjennomføre en økt med tung styrketrening på ca. 60 minutter og en stillesittende hvileøkt med samme varighet. Deltakere blir tilfeldig fordelt til å starte med enten styrketrening eller hvile og rekkefølgen trekkes når du ankommer. Stryketreningsøkten består av en 10 minutters generell oppvarming på ergometersykkel og 4 sett med 4 repetisjoner i øvelsene knebøy og markløft på ca. 80% av maks. Individuelle tilpasninger for belastning og antall sett/repetisjoner kan gis ved behov. Spesifikk oppvarming med gradvis økning av belastning legges inn i forkant av øvelsene. I hvileøkten vil du bli bedt om å sitte i ro i 60 minutter (med unntak av toalettbesøk dersom det er nødvendig). Aktiviteter hvor du kan holde deg i ro sittende, som f.eks. lesing, scrolling eller se film/serie på telefon/nettbrett er tillatt. Før og etter styrkeøkten og hvileøkten gjennomføres målinger av bekkenbunnen (vaginal trykkmåling og overflate-sEMG). Mellom styrkeøkten og hvileøkten vil du ha en pause på 60 minutter, hvor vi også ber deg om å holde deg i ro.

MULIGE FORDELER OG ULEMPER

Som deltaker i undersøkelsen vil du få en grundig opplæring i riktig bekkenbunnssammentrekning, få undersøkt og få tilbakemelding på om du gjør det riktig og få målt hviletrykk- og aktivitet, maksimal og utholdende muskelstyrke. En mulig ulempe er at du må sette av tid til å besvare spørreundersøkelsen og de kliniske undersøkelsene. Bekkenbunnsundersøkelsen som inngår i studiene er ikke forbundet med risiko for skade. Helsepersonell med spesialkompetanse innen kvinnehelse foretar undersøkelsene og svarer på eventuelle spørsmål. Funnene fra undersøkelsen vil være med på å gi økt kunnskap om hvordan trening med tunge vekter påvirker bekkenbunnen og om man skal sette inn forebyggende og behandlende tiltak.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE SITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta, trenger vi ditt samtykke som du kan gi elektronisk ved å krysse av i boksene for samtykke i det elektroniske spørreskjema. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke. Dette vil ikke få konsekvenser for din videre oppfølging og behandling. Dersom du trekker deg fra prosjektet, kan du kreve å få slettet innsamlede prøver og opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner. Om du på et senere tidspunkt ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder eller annen kontaktperson, se telefonnummer og mailadresse til disse under kontaktopplysninger.

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet i hensikten med prosjektet. Undersøker har taushetsplikt. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. I tillegg har du rett til få utlevert en kopi av dine personopplysninger og sende klage til Datatilsynet om behandlingen av dine personopplysninger. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene.

Svar fra det elektroniske spørreskjemaet overføres sikkert fra SurveyXact av Rambøll og vil lagres og analyseres elektronisk på en beskyttet server på NIH. Brukere til programmet har tilgang via brukernavn og passord og det er kun organisasjonsmanager for spørreundersøkelsen, Kristina L. Skaug, som vil ha tilgang til besvarelsene. Opplysninger fra den kliniske undersøkelsen oppføres på et standardisert arbeidsdokument som videre overføres og analyseres på en beskyttet server på NIH.

Innsamlede opplysninger oppbevares slik at navn og kontaktopplysninger er erstattet med en referansekode som viser til en adskilt liste. Det er kun prosjektleder, Kristina L. Skaug, som har adgang til koblingslisten. Denne listen lagres på en lokal pc på harddisk på et eget passordbeskyttet område. En kopi av listen vil bli skrevet ut og oppbevares i en låsbar skuff på NIH. Manuelle skjema/rådata oppbevares i et låsbart skap adskilt fra koblingslisten. Det vil ikke være mulig å identifisere deg i resultatene fra undersøkelsen når disse publiseres.

Prosjektet skal etter planen avsluttes 12.06.2023. Opplysningene om deg vil bli anonymisert eller slettet og manuelle skjema/rådata vil makuleres senest fem år etter prosjektslutt.

GODKJENNING

Vi behandler opplysninger om deg basert på ditt samtykke. Regional komité for medisinsk og helsefaglig forskningsetikk har vurdert prosjektet, og har gitt forhåndsgodkjenning (Saksnummer: 2018/2211). Etter ny personopplysningslov har behandlingsansvarlige NIH og Kristina L. Skaug et selvstendig ansvar for å sikre at behandlingen av dine opplysninger har et lovlig grunnlag. Dette prosjektet har rettslig grunnlag i EUs personvernforordning artikkel 6a og artikkel 9 nr. 2 og ditt samtykke. På oppdrag fra NIH har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet kan du ta kontakt med:

Prosjektleder: Kristina L. Skaug, 40609916, k.l.skaug@nih.no
Hovedveileder: Kari Bø, 99047363, kari.bo@nih.no

Du kan ta kontakt med institusjonens personvernombud dersom du har spørsmål om behandlingen av dine personopplysninger i prosjektet:
Rolf Haavik, 90733760, personvernombud@nih.no

Dersom du har spørsmål til Norsk senter for forskningsdata AS kan du ta kontakt med:
NSD – Norsk senter for forskningsdata AS, 55 58 21 17, personverntjenester@nsd.no

JEG SAMTYKKER TIL Å DELTA I PROSJEKTET OG TIL AT MINE PERSONOPPLYSNINGER BEHANDLES FREM TIL PROSJEKTET ER AVSLUTTET, CA. 12.06.2023

Sted og dato	Deltakers signatur
	Deltakers navn med trykte bokstaver

Spørreskjema studie 3: Effekt av styrketrening på bekkenbunnsmusklene – en eksperimentell crossover studie

Takk for din interesse!

Denne undersøkelsen er del av Kristina Lindquist Skaugs doktorgradsprosjekt ved Norges idrettshøgskole, Institutt for idrettsmedisinske fag, som handler om idrett, fysisk aktivitet og bekkenbunn.
Vi ber deg svare på dette spørreskjema i forkant av bekkenbunnsundersøkelsen som du har blitt invitert til delta i på Norges idrettshøgskole.

Det tar ca. 10 minutter å besvare undersøkelsen og det er viktig at du svarer på alle spørsmålene.

På neste side er et skriv med utdypende informasjon om studien - les dette nøye før samtykker til å delta.

Forespørsel om deltakelse i forskningsprosjektet "Idrett, fysisk aktivitet og bekkenbunn"

--- sett inn informasjonsskriv her ---

Jeg har mottatt, lest og forstått informasjonen om prosjektet, og har fått anledning til å stille spørsmål. Jeg samtykker til:

(1) ❑ å delta i spørreundersøkelsen

(3) ❑ å delta i medisinske undersøkelser (beskrevet i informasjonsskrivet)

(2) ❑ at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 12.06.2023

Personlige opplysninger

Hvor gammel er du?

_____

Hvor mange år/måneder har du trent styrketrening regelmessig (≥ 3 ganger i uken)

(1) ❑ År _____

(2) ❑ Måneder _____

Hvor mange timer trener du spesifikk styrketrening i gjennomsnitt per uke?

_____

Trener du styrke i forbindelse med en idrett?

(4) ❍ Nei, som mosjonist

(1) ❍ Ja, vektløfting

(2) ❍ Ja, styrkeløft

(5) ❍ Ja, CrossFit eller functional fitness

(3) ❍ Ja, annen idrett. Spesifiser: _____

Konkurrerer du i din idrett, og i så fall på hvilket nivå?

(1) ❍ Nei, jeg konkurrerer ikke

(2) ❍ Ja. Nivå på konkurranser (f.eks. NM, EM, CrossFit Open): _____

Trener du regelmessig andre typer treningsformer i tillegg til styrketrening (f.eks. bevegelighetstrening eller utholdenhetstrening).

(1) ❍ Nei

(2) ❍ Ja. Oppgi hvilke: _____

Hvor mange timer bruker du i gjennomsnitt på annen trening utenom styrketrening? (f.eks. utholdenshetstrening eller bevegelighetstrening) per uke?

_____

Hva driver du med til daglig?

(1) ❍ Idrett på fulltid

(2) ❍ Heltidsjobb

(3) ❍ Deltidsjobb

(4) ❍ Studier/skole

(5) ❍ Annet, beskriv: _____

Hvilken utdannelse har du/holder du på med?

(1) ❍ Barne- og ungdomsskole

(2) ❍ Videregående skole

(3) ❍ Universitet eller høgskole

(4) ❍ Annet, beskriv: _____

Har du en kronisk sykdom (f.eks. diabetes, Morbus Chrohn, irritabel tarmsyndrom) eller andre helseplager?

(1) ❍ Ja, spesifiser: _____

(2) ❍ Nei

Urinlekkasje (ICIQ-UI-SF)

Flere studier viser at det er vanlig at idrettsutøvere lekker urin, spesielt under aktiviteter som innebærer løp og hopp. Det kan være snakk om noen få dråper til større mengder. Vi vil undersøke

hvordan bekkenbunnen påvirkes av store belastninger ved tung styrketrening og vil gjerne vite om du har opplevd dette de siste 4 ukene.

Hvor ofte lekker du urin? (Kryss av i en boks)

(1) ❍ Aldri

(2) ❍ Omtrent en gang i uken eller sjeldnere

(3) ❍ 2-3 ganger i uken

(4) ❍ ca. 1 gang per dag

(5) ❍ Flere ganger per dag

(6) ❍ Hele tiden

Hvor mye urin lekker du vanligvis (enten du buker beskyttelse eller ikke)? (Kryss av i en boks)

(1) ❍ Ikke noe

(2) ❍ En liten mengde

(3) ❍ En moderat mengde

(4) ❍ En stor mengde

Hvor mye påvirker urinlekkasje ditt hverdagsliv? Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ———— 10

Når lekker du urin? (Kryss av alt som passer for deg)

(1) ❑ Aldri, jeg lekker ikke urin

(2) ❑ Lekker før jeg når toalettet

(3) ❑ Lekker når jeg hoster eller nyser

(4) ❑ Lekker når jeg sover

(5) ❑ Lekker når jeg er fysisk aktiv/trener

(6) ❑ Lekker når jeg er ferdig med å late vannet (tisse) og har tatt på meg klærne

(7) ❑ Lekker uten noe opplagt grunn

(8) ❑ Lekker hele tiden

Andre bekkenbunnsplager

Denne delen handler om andre bekkenbunnsplager, som underlivsprolaps og analinkontinens (ufrivillig lekkasje av luft eller avføring). For de som ikke har disse plagene kan spørsmålene virke uaktuelle. Hvis dette er tilfellet for deg, ber vi deg likevel svare ved å velge første svaralternativ da dette er benektende.

Vi ber deg besvare spørsmålene i forhold til de siste 4 ukene.

Kan du kjenne en kul/utbuling inne i skjeden?

(1) ❍ Aldri

(2) ❍ Av og til

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Hele tiden

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Kan du kjenne en kul/utbuling utenfor skjeden?

(1) ❍ Aldri

(2) ❍ Av og til

(3) ❍ Noen ganger

(4) ❍ Mesteparten av tiden

(5) ❍ Hele tiden

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Kan du hindre ufrivillig luftlekkasje?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Kan du hindre lekkasje av <u>fast</u> avføring?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Kan du hindre lekkasje av <u>diaré/løs</u> avføring?

(1) ❍ Alltid

(2) ❍ Mesteparten av tiden

(3) ❍ Noen ganger

(4) ❍ Sjelden

(5) ❍ Aldri

Hvor mye plager dette deg?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

0 ——— ◯ ——— 10

Husk å trykke "avslutt" før du lukker spørreundersøkelsen

Takk for at du tok deg tid til å svare på spørsmålene!

Eksperimentell crossoverstudie: Styrketrening og bekkenbunn

Baseline: Klinisk undersøkelse av fysioterapeut

ID:

Dato:

VEKT OG HØYDE

Høyde (cm): _____

Vekt (kg): _____

LEDDBEVEGELIGHET

Hypermobilitet (Beighton)

Ekstensjon 5. MCP hø. Hånd, over 90 grader?	nei	ja	ugyldig test
Eksakt (grader):			
Ekstensjon 5. MCP ve. Hånd, over 90 grader?	nei	ja	ugyldig test
Eksakt (grader):			
Kontakt hø. tommel mot underarm?	nei	ja	ugyldig test
Kontakt ve. tommel mot underarm?	nei	ja	ugyldig test
>10 grader hyperekstensjon hø. albue?	nei	ja	ugyldig test
>10 grader hyperekstensjon ve. albue?	nei	ja	ugyldig test
>10 grader hyperekstensjon hø. kne?	nei	ja	ugyldig test
>10 grader hyperekstensjon ve. kne?	nei	ja	ugyldig test
Håndflater lett i gulvet?	nei	ja	ugyldig test

FUNKSJON - BEKKENBUNN

Standardisert utgangsstilling

Ryggliggende med bøyde bein (ett hviler mot veggen – ett mot terapeuten) med pute under hodet.

Observasjon av perineum under kontraksjonen

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

Ingen kontraksjon ☐

Riktig kontraksjon ☐

Trykker ☐

Palpasjon

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

☐ Ingen kontraksjon

☐ Korrekt kontraksjon (sammentrekning/omslutning og løft)

☐ Kontraksjon med hjelp av hjelpemuskler

☐ Usikker

☐ Trykker nedover

HVILEAKTIVITET BEKKENBUNN (sEMG)

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Uten kontraksjoner:

Mikrovolt: _____

Med kontraksjoner:

Mikrovolt: _____

MUSKELSTYRKE BEKKENBUNN

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Maksimal muskelstyrke

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

***MVC1:____ MVC2: ____ MVC3:____ Gj.snitt: _____**

Vaginalt hviletrykk før kontraksjon: ____

Vaginalt hviletrykk etter kontraksjon: ____

Utholdende muskelstyrke (10 sek)

Kommando: "Nå skal du gjøre det samme som når vi måler maksimal styrke, men du skal prøve så godt du kan å holde kontraksjonen i 10 sek. "Pust rolig inn og ut". "Du er klar", "Trekk sammen rundt alle åpningene nedentil, trekk opp og inn i bekkenet så hardt du kan – hold der oppe – bli der – hold – hold". "Slipp og pust rolig ut".

Utholdenhet (areal under kurven) *minus* (hviletrykk x10): _____

Eksperimentell crossoverstudie: Styrketrening og bekkenbunn

Testdag: Klinisk undersøkelse av fysioterapeut

ID:

Dato:

Rekkefølge:

FUNKSJON - BEKKENBUNN

Standardisert utgangsstilling

Ryggliggende med bøyde bein (ett hviler mot veggen – ett mot terapeuten) med pute under hodet.

1. Test FØR styrketrening:

HVILEAKTIVITET BEKKENBUNN (sEMG)

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Myoplus Pro: Knip/hvil program. Innstillinger: knipetid 6 sek, hviletid 10 sek, 2 forsøk. Registrer gjennomsnittsverdi hvile.

Uten kontraksjoner:

Mikrovolt: _____

Med kontraksjoner:

Mikrovolt: _____

MUSKELSTYRKE BEKKENBUNN

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Maksimal muskelstyrke

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

***MVC1:____ MVC2: ____ MVC3:____ Gj.snitt:**

Vaginalt hviletrykk FØR kontraksjon: ____

Vaginalt hviletrykk ETTER kontraksjon: ____ Gj.snitt:

Utholdende muskelstyrke (10 sek)

Kommando: "Nå skal du gjøre det samme som når vi måler maksimal styrke, men du skal prøve så godt du kan å holde kontraksjonen i 10 sek. "Pust rolig inn og ut". "Du er klar", "Trekk sammen rundt alle åpningene nedentil, trekk opp og inn i bekkenet så hardt du kan – hold der oppe – bli der – du holder – 5 sekunder igjen – 4 – 3 – 2 – 1". "Slipp og pust rolig ut".

Utholdenhet (areal under kurven) *minus* (hviletrykk x10): _____

Notater (host, nys, snakk, påvirkning av måling):

2. Test ETTER styrketrening:

HVILEAKTIVITET BEKKENBUNN (sEMG)

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Myoplus Pro: Knip/hvil program. Innstillinger: knipetid 6 sek, hviletid 10 sek, 2 forsøk. Registrer gjennomsnittsverdi hvile.

Uten kontraksjoner:

Mikrovolt: _____

Med kontraksjoner:

Mikrovolt: _____

MUSKELSTYRKE BEKKENBUNN

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Maksimal muskelstyrke

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

Vaginalt hviletrykk FØR kontraksjon: ____

Vaginalt hviletrykk ETTER kontraksjon: ____

***MVC1:____ MVC2: ____ MVC3:____ Gj.snitt:**

Utholdenhet (areal under kurven) *minus* (hviletrykk x10): _____

Notater (host, nys, snakk):

3. Test FØR hvile:

HVILEAKTIVITET BEKKENBUNN (sEMG)

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Myoplus Pro: Knip/hvil program. Innstillinger: knipetid 6 sek, hviletid 10 sek, 2 forsøk. Registrer gjennomsnittsverdi hvile.

Uten kontraksjoner:

Mikrovolt: _____

Med kontraksjoner:

Mikrovolt: _____

MUSKELSTYRKE BEKKENBUNN

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Maksimal muskelstyrke

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

***MVC1:____ MVC2: ____ MVC3:____ Gj.snitt:**

Vaginalt hviletrykk FØR kontraksjon: ____

Vaginalt hviletrykk ETTER kontraksjon: ____

Utholdenhet (areal under kurven) *minus* (hviletrykk x10): _____

Notater (host, nys, snakk):

4. Test ETTER hvile:

HVILEAKTIVITET BEKKENBUNN (sEMG)

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Myoplus Pro: Knip/hvil program. Innstillinger: knipetid 2 sek, hviletid 10 sek, 2 forsøk. Registrer gjennomsnittsverdi hvile.

Uten kontraksjoner:

Mikrovolt: _____

Med kontraksjoner:

Mikrovolt: _____

MUSKELSTYRKE BEKKENBUNN

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Maksimal muskelstyrke

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

***MVC1:____** **MVC2: ____** **MVC3:____** **Gj.snitt:** regnes ut i SPSS

Vaginalt hviletrykk FØR kontraksjon: ____

Vaginalt hviletrykk ETTER kontraksjon: ____ **Gj.snitt:**

Utholdenhet (areal under kurven) *minus* (hviletrykk x10): _____

Notater (host, nys, snakk):

Appendix 6

Paper IV

Study information and consent forms

Questionnaire baseline

Questionnaire post-test

Clinical assessment form

NORGES IDRETTSHØGSKOLE

FORESPØRSEL OM DELTAKELSE I FORSKNINGSPROSJEKTET

IDRETT, FYSISK AKTIVITET OG BEKKENBUNN

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å undersøke effekt av bekkenbunnstrening på symptomer og forekomst av urinlekkasje hos kvinner som trener CrossFit ® eller functional fitness. I dette skrivet gir vi informasjon om prosjektet og hva deltakelse vil innebære for deg.

FORMÅL

Denne undersøkelsen er en del av et doktorgradsgradsprosjekt ved Norges idrettshøgskole (NIH) som handler om trening og belastning på bekkenbunnen hos idrettsutøvere i ulike idretter og kvinner som utøver hard fysisk trening. Bekkenbunnen består av muskler, bindevev og leddbånd og befinner seg på inn –og undersiden av bekkenet. Den har i oppgave å støtte bekkenets organer (blære og rektum for menn og i tillegg livmor og vagina for kvinner). Den skal også kunne motstå all trykkbelastning fra underlaget og økning i buktrykk ved fysisk anstrengelse som hopp, løp, landinger og tunge løft, hosting og nysing. Bekkenbunnsplager kan forekomme dersom bekkenbunnen ikke fungerer optimalt ved fysisk anstrengelse. De vanligste bekkenbunnsplagene er lekkasje av urin, luft eller avføring og underlivsprolaps.

Flere studier viser at det er vanlig at kvinnelige idrettsutøvere lekker urin, spesielt under aktiviteter som innebærer løp og hopp. Studier har vist at bekkenbunnstrening har forebyggende og behandlende effekt på urinlekkasje i den generelle kvinnelige befolkningen. Bekkenbunnsmusklene hos idrettsutøvere må imidlertid kunne motstå langt høyere belastning og derfor antakelig være sterkere enn hos kvinner som ikke trener. Flere nye studier har vist at urinlekkasje også er vanlig blant kvinner som deltar i høyintensiv trening, som CrossFit® og functional fitness. I dag mangler det kunnskap om hvordan urinlekkasje kan forebygges og behandles hos idrettsutøvere eller kvinner som utøver hard fysisk trening. Vi ønsker derfor å undersøke effekten av styrketrening av bekkenbunnsmusklene på forekomst og symptomer på urinlekkasje blant norske kvinner som regelmessig trener trener CrossFit® og/eller functional fitness.

Norges idrettshøgskole (NIH) finansierer og er ansvarlig for forskningsprosjektet. Doktorgradsstipendiat og fysioterapeut Kristina L. Skaug, ansatt ved Institutt for idrettsmedisinske fag (IIM), NIH, har det daglig ansvaret. Professor, dr. scient og fysioterapeut Kari Bø ved NIH, IIM, er initiativtaker og hovedveileder for prosjektet. Biveileder er Marie Ellström Engh, professor og gynekolog, Kvinneklinikken, Akershus universitetssykehus.

I dette prosjektet ønsker vi å inkludere deg som er over 18 år, som trener regelmessig CrossFit® og/eller functional fitness regelmessig (≥3 ganger i uken) og som opplever urinlekkasje under treningsaktivitet.

HVA INNEBÆRER PROSJEKTET?

Deltakelse i studien innebærer å møte 2 ganger på NIH for klinisk undersøkelse med 4 måneders mellomrom. Kristina L. Skaug vil avtale tidspunkt med deg på telefon eller mail for undersøkelsene. I forkant av undersøkelsen vil vi be deg svare på et spørreskjema om urinlekkasje, andre bekkenbunnsplager og bakgrunnsopplysninger. I de kliniske undersøkelsene vil det gjøres målinger av bekkenbunnsmusklenes hviletrykk, styrke og utholdenhet. Først vil fysioterapeuten instruere deg i riktig bekkenbunnssammentrekning

ved å observere om du kan trekke opp og inn i underlivet og deretter kjenne i ytre del av skjeden. Hviletrykk og maksimal og utholdende muskelstyrke i bekkenbunnsmusklene måles deretter med en vaginal trykkmåler som er festet til en luftfylt ballong (på størrelse med en tampong) som legges i ytre del av skjeden. Alle disse undersøkelsene benyttes i vanlig klinisk praksis. Etterfølgende blir du tilfeldig trukket ut til enten en treningsgruppe eller en kontrollgruppe. Blir du trukket ut til treningsgruppen vil du få en individuell veiledningstime hos fysioterapeut som instruerer deg i riktig bekkenbunnsammentrekning og et hjemmetreningsprogram. Hjemmetreningen består av et daglig styrketreningsprogram for bekkenbunnsmusklene som tar ca. 10 min. Treningsperioden varer i 16 uker.

Registrering av hjemmetreningen gjøres via en treningsdagbok i en app og en fysioterapeut vil følge deg opp ukentlig per telefon/sms. Deltakere i treningsgruppen vil i tillegg få tilbud om minst en individuell oppfølgingstime hos fysioterapeut i løpet av treningsperioden. Dersom du kommer i kontrollgruppen ønsker vi at du ikke gjør bekkenbunnstrening i løpet av treningsperioden. Alle deltakere i kontrollgruppen vil få tilbud om en veiledningstime hos fysioterapeut med instruksjon i riktig bekkenbunnsammentrekning og gitt et bekkenbunnstreningsprogram i etterkant av studien.

Fysioterapeuten som utfører undersøkelser av bekkenbunnen skal ikke vite hvilken gruppe du har tilhørt.

MULIGE FORDELER OG ULEMPER

Mulige ulemper ved å delta i undersøkelsen er at du må sette av 1-2 timer til testing på NIH. Dersom du kommer i treningsgruppen må i tillegg sette av ca. 10 min til daglig bekkenbunnstrening i treningsperioden. Denne kan imidlertid gjøres på kveldstid, f.eks. rett før du legger deg.

Ved å delta i studien vil du få instruksjon i korrekt bekkenbunnsammentrekning og fått målt styrke og hviletrykk av din bekkenbunnsmuskulatur. Studien vil gi økt kunnskap om effekt av bekkenbunnstrening på urinlekkasje blant kvinner som trener CrossFit® og/eller functional fitness. Denne kunnskapen er viktig for å kunne sette inn tiltak på et tidlig stadium for å forebygge, behandle, unngå forverring og/eller øke trivsel og prestasjon under trening eller konkurranse.

FRIVILLIG DELTAKELSE OG MULIGHET FOR Å TREKKE SITT SAMTYKKE

Det er frivillig å delta i prosjektet. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke. Dette vil ikke få konsekvenser for din videre oppfølging og behandling. Dersom du trekker deg fra prosjektet, kan du kreve å få slettet innsamlede prøver og opplysninger, med mindre opplysningene allerede er inngått i analyser eller brukt i vitenskapelige publikasjoner. Dersom du senere ønsker å trekke deg eller har spørsmål til prosjektet, kan du kontakte prosjektleder eller annen kontaktperson, se telefonnummer og mailadresse til disse under kontaktopplysninger.

HVA SKJER MED OPPLYSNINGENE OM DEG?

Opplysningene som registreres om deg skal kun brukes slik som beskrevet i hensikten med prosjektet. Behandlere og undersøkere har taushetsplikt. Du har rett til innsyn i hvilke opplysninger som er registrert om deg og rett til å få korrigert eventuelle feil i de opplysningene som er registrert. I tillegg har du rett til få utlevert en kopi av dine personopplysninger og sende klage til Datatilsynet om behandlingen av dine personopplysninger. Du har også rett til å få innsyn i sikkerhetstiltakene ved behandling av opplysningene.

Spørreskjema og opplysninger fra den kliniske undersøkelsen oppføres på et standardisert arbeidsdokument. Besvarelsene og opplysningene overføres elektronisk og analyseres på en beskyttet server på NIH.

Innsamlede opplysninger oppbevares slik at navn og kontaktopplysninger er erstattet med en referansekode som viser til en adskilt liste. Det er kun prosjektleder, Kristina L. Skaug, som har adgang til koblingslisten. Denne listen lagres på en lokal pc på et eget passordbeskyttet område. En kopi av listen vil bli skrevet ut og oppbevares i en låsbar skuff på NIH. Manuelle skjema/rådata oppbevares i et låsbart skap adskilt fra koblingslisten. Det vil ikke være mulig å identifisere deg i resultatene fra undersøkelsen når disse publiseres.

Prosjektet skal etter planen avsluttes 12.06.2023. Opplysningene om deg vil bli anonymisert eller slettet og manuelle skjema/rådata vil makuleres senest fem år etter prosjektslutt.

GODKJENNING

Vi behandler opplysninger om deg basert på ditt samtykke. Regional komité for medisinsk og helsefaglig forskningsetikk har vurdert prosjektet, og har gitt forhåndsgodkjenning (Saksnummer: 2018/2211). Etter ny personopplysningslov har behandlingsansvarlige NIH og Kristina L. Skaug et selvstendig ansvar for å sikre at behandlingen av dine opplysninger har et lovlig grunnlag. Dette prosjektet har rettslig grunnlag i EUs personvernforordning artikkel 6a og artikkel 9 nr. 2 og ditt samtykke. På oppdrag fra Norges idrettshøgskole har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

KONTAKTOPPLYSNINGER

Dersom du har spørsmål til prosjektet kan du ta kontakt med:

Prosjektleder: Kristina L. Skaug, 40609916, k.l.skaug@nih.no
Hovedveileder: Kari Bø, 99047363, kari.bo@nih.no

Du kan ta kontakt med institusjonens personvernombud dersom du har spørsmål om behandlingen av dine personopplysninger i prosjektet:
Rolf Haavik, 90733760, rolf.haavik@habberstad.no

Dersom du har spørsmål til Norsk senter for forskningsdata AS kan du ta kontakt med:
NSD – Norsk senter for forskningsdata AS, 55 58 21 17, personverntjenester@nsd.no

JEG HAR MOTTATT OG FORSTÅTT INFORMASJONEN OM PROSJEKTET "IDRETT, FYSISK AKTIVITET OG BEKKENBUNN", OG HAR FÅTT ANLEDNING TIL Å STILLE SPØRSMÅL. JEG SAMTYKKER TIL:

- ☐ å delta i *kliniske undersøkelser*
- ☐ å delta i *spørreskjemaundersøkelse*
- ☐ å delta i *intervensjonsstudie i trenings- eller kontrollgruppe*

Jeg samtykker til at mine opplysninger behandles frem til prosjektet er avsluttet, ca.12.06.*2023*

Sted og dato	Deltakers signatur
	Deltakers navn med trykte bokstaver

Spørreskjema til RCT for kvinner som trener CrossFit/functional fitness med urinlekkasje

Spørreskjema baseline

Kjære deltaker!

Takk for din deltakelse i vår studie om bekkenbunnstrening for urinlekkasje blant kvinner som trener CrossFit og functional fitness.

Vi ber deg svare på dette spørreskjemaet innen vi går videre med testing - det vil ta ca. 10 minutter å svare på.

Samtykke til deltakelse

-- informasjonsskriv inn her --

Jeg har mottatt, lest og forstått informasjonen om prosjektet, og har fått anledning til å stille spørsmål. Jeg samtykker til:

(1) ❑ å delta i elektronisk spørreskjema

(2) ❑ å delta i medisinske/fysisk tester

(3) ❑ at mine opplysninger behandles frem til prosjektet er avsluttet, ca. 12.06.2023

Personlige opplysninger og treningsbakgrunn

Hvor gammel er du?

_____

Hva driver du med til daglig?

❑ Idrett på fulltid

❑ Heltidsjobb

❑ Deltidsjobb

❑ Studier/skole

❑ Annet, beskriv: _____

Hvilken utdannelsesnivå har du?

❑ Grunnskole (Barneskole/ungdomsskole)

❑ Videregående skole

❑ Fullført utdanning på universitet/høgskole med varighet på 4 år eller mindre

❑ Fullført utdanning på universitet/høgskole med varighet på mer enn 4 år

❑ Holder på med høyere utdannelse (universitet/høgskole)

❑ Annet: _____

Hvor mange år og måneder har du trent CrossFit og/eller functional fitness?

År: ___

Måneder: ___

Konkurrerer du i CrossFit eller functional fitness, og i så fall på hvilket nivå?

(1) ❑ Nei, jeg konkurrerer ikke

(2) ❑ Ja. Nivå på konkurranser (f.eks. NM, CrossFit Open): _____

Hvor mange timer trener du <u>i gjennomsnitt</u> CrossFit eller functional fitness per uke?

_____

Trener du regelmessig andre typer treningsformer i tillegg til CrossFit/functional fitness (f.eks. styrketrening, bevegelighetstrening, utholdenhetstrening eller idrett).

❑ Nei

❑ Ja. Oppgi hvilke:

Hvor mange timer bruker du i gjennomsnitt på annen trening utenom CrossFit/functional fitness? (f.eks. styrketrening, utholdenshetstrening, bevegelighetstrening) per uke?

_____

Har du født barn?

(1) ❑ Ja

(2) ❑ Nei

Hvor mange barn har du født?

_____

Hvor mange barn har du født vaginalt?

_____

Ble barnet/noen av barna født med tang eller vakuum?

(1) ❑ Nei

(2) ❑ Ja, med tang

(3) ❑ Ja, med vakuum (sugekopp)

Har du opplevd å få en underlivsskade/rift i forbindelse med fødsel?

(1) ❑ Nei
(2) ❑ Ja, grad 1-2
(3) ❑ Ja, grad 3-4
(4) ❑ Ja, men er usikker på hvilken grad
(5) ❑ Vet ikke

Hvor mange barn har du født med keisersnitt?

_____

Har du en kronisk sykdom (f.eks. diabetes, Morbus Chrohn, irritabel tarmsyndrom) eller andre helseplager?

(1) ❑ Ja, spesifiser: _____
(2) ❑ Nei

Har du hørt om bekkenbunnstrening tidligere? (Kryss av alt som passer for deg)

(1) ❍ Nei
(2) ❍ Ja, av trener
(3) ❍ Ja, av lagkamerat(er)
(4) ❍ Ja, av fysioterapeut
(5) ❍ Ja, av lege
(6) ❍ Ja, av annet helsepersonell
(7) ❍ Ja, av forelder/foresatt
(8) ❍ Ja, av søsken
(9) ❍ Ja, av venn(er)
(10) ❍ Ja, i sosiale medier, radio, TV eller ukeblad

I hvilke av disse øvelsene mener du at bekkenbunnsmusklene trenes spesifikt? velg ett eller flere svar

(1) ❑ Sit-ups
(2) ❑ Planken
(3) ❑ Inndragning (trekke inn navlen)

(4) ❑ Seteløft
(5) ❑ Knebøy
(7) ❑ Vet ikke
(8) ❑ Ingen av alternativene ovenfor trener bekkenbunnsmusklene

Hvilken bevegelse skjer når bekkenbunnsmusklene brukes?

(1) ❑ Sammentrekning rundt åpningene i bekkenet
(2) ❑ Løft opp og inn i bekkenet
(3) ❑ Press/trykk nedover
(4) ❑ Ingen av alternativene
(5) ❑ Jeg vet ikke

Har du gjort eller gjør du bekkenbunnstrening for å forebygge eller behandle bekkenbunnsplager som f.eks. urinlekkasje?

(3) ❍ Nei, aldri
(2) ❍ Ja, jeg gjør øvelser en gang i blant, men ikke regelmessig
(1) ❍ Ja, jeg gjør øvelser regelmessig (3 ganger i uken eller oftere)
(4) ❍ Ja, jeg har gjort det tidligere (i løpet av de siste 12 månedene)
(5) ❍ Ja, jeg har gjort det tidligere (over 12 måneder siden)

Urinlekkasje (ICIQ-UI-SF)

Flere studier har vist at idrettsaktive jenter/kvinner i idretter, som for eksempel turn, dans og ballett, lekker urin, særlig ved elementer som innebærer løp og hopp. Vi vil gjerne vite hvordan du har hatt det, gjennomsnittlig, de siste 4 ukene.

Hvor ofte lekker du urin? (Kryss av i en boks)

(0) ❑ Aldri
(1) ❑ Omtrent en gang i uken eller sjeldnere
(2) ❑ 2-3 ganger i uken
(3) ❑ ca. 1 gang per dag

(4) ❑ Flere ganger per dag
(5) ❑ Hele tiden

Hvor mye urin lekker du vanligvis (enten du buker beskyttelse eller ikke)? (Kryss av i en boks)

(0) ❑ Ikke noe
(2) ❑ En liten mengde
(4) ❑ En moderat mengde
(6) ❑ En stor mengde

Hvor mye påvirker urinlekkasje ditt hverdagsliv?
Velg et tall mellom 0 (ikke i det hele tatt) og 10 (svært mye)

_____

Når lekker du urin? (Kryss av alt som passer for deg)

(1) ❑ Aldri, jeg lekker ikke urin
(2) ❑ Lekker før jeg når toalettet
(3) ❑ Lekker når jeg hoster eller nyser
(4) ❑ Lekker når jeg sover
(5) ❑ Lekker når jeg er fysisk aktiv/trener
(6) ❑ Lekker når jeg er ferdig med å late vannet (tisse) og har tatt på meg klærne
(7) ❑ Lekker uten noe opplagt grunn
(8) ❑ Lekker hele tiden

Andre bekkenbunnsplager

Denne delen handler om andre bekkenbunnsplager, som underlivsprolaps og analinkontinens (ufrivillig lekkasje av luft eller avføring). For de som ikke har disse plagene kan spørsmålene virke uaktuelle. Hvis dette er tilfellet for deg, ber vi deg likevel svare ved å velge første svaralternativ da dette er benektende.

Vi ber deg besvare spørsmålene i forhold til de siste 4 ukene.

Kan du kjenne en kul/utbuling inne i skjeden?

(1) ❑ Aldri
(2) ❑ Av og til
(3) ❑ Noen ganger
(4) ❑ Mesteparten av tiden
(5) ❑ Hele tiden

Hvor mye plager dette deg?

_____

Kan du kjenne en kul/utbuling utenfor skjeden?

(1) ❑ Aldri
(2) ❑ Av og til
(3) ❑ Noen ganger
(4) ❑ Mesteparten av tiden
(5) ❑ Hele tiden

Hvor mye plager dette deg?

_____

Kan du hindre ufrivillig luftlekkasje?

(1) ❑ Alltid
(2) ❑ Mesteparten av tiden
(3) ❑ Noen ganger
(4) ❑ Sjelden
(5) ❑ Aldri

Hvor mye plager dette deg?

_____

Kan du hindre lekkasje av fast avføring?

(1) ❑ Alltid

(2) ❑ Mesteparten av tiden
(3) ❑ Noen ganger
(4) ❑ Sjelden
(5) ❑ Aldri

Hvor mye plager dette deg?

_____

Kan du hindre lekkasje av diaré/løs avføring?

(1) ❑ Alltid
(2) ❑ Mesteparten av tiden
(3) ❑ Noen ganger
(4) ❑ Sjelden
(5) ❑ Aldri

Hvor mye plager dette deg?

_____

Self-efficacy skala

I denne delen vil vi stille deg spørsmål om din mestringstro (self-efficacy) til bekkenbunnstrening. Spørsmålene vil handle om dine meninger og forventninger til gjennomføring og effekt av treningen. Det gjør ikke noe om du ikke vet så mye om bekkenbunnstrening eller hvordan du skal gjøre det. Prøv å svare så godt du kan.

Svar på påstandene ved å bruke en skala fra 0-100:

0 10 20 30 40 50 60 70 80 90 100

Ikke i det hele tatt Moderat sikker Helt sikker

Hvor sikker føler du deg på at du kan:

1. **Gjennomføre bekkenbunnstrening på egenhånd**

_____

2. **Huske å gjøre øvelsene hver dag**

_____

3. **Gjennomføre bekkenbunnstrening minst 3 ganger i uken**

_____

4. **Gjøre bekkenbunnstrening som en del av din daglige rutine**

_____

5. **Fortsette med bekkenbunnstrening selv om øvelsene ikke gir merkbar effekt**

_____

6. **Gjennomføre øvelsene når du har ferie eller er ute og reiser**

_____

7. **Utføre øvelsene stående**

_____

8. **Utføre øvelsene sittende**

_____

9. **Trekke sammen bekkenbunnsmusklene før hosting, nysing eller kraftig latter for å forebygge at du lekker**

_____

10. Fortsette å gjennomføre bekkenbunnstrening selv når omgivelsene stiller større krav til deg enn vanlig (fra f.eks. familie, skole, trener, venner)

_____

11. Fortsette å gjennomføre bekkenbunnstrening når du har flere aktiviteter og gjøremål enn vanlig

_____

12. Fortsette å gjennomføre bekkenbunnstrening selv om du har et annet helseproblem eller skade som krever mer oppmerksomhet

_____

13. Fortsette å gjennomføre bekkenbunnstreningen selv om andre sier at det er unødvendig (f.eks. familie, venner, trener)

_____

Svar på påstandene ved å bruke en skala fra 0-100:

0 10 20 30 40 50 60 70 80 90 100

Ikke i det hele tatt Moderat sikker Helt sikker

Hvor sikker føler du deg på at:

14. Bekkenbunnstrening kan forebygge eller forbedre problemer som urinlekkasje og underlivsprolaps

_____

15. Bekkenbunnstrening kan forbedre din kroppsbevissthet

_____

16. Bekkenbunnstrening kan forbedre din helse og ditt velvære

_____

Husk å trykke "avslutt" for å avslutte spørreundersøkelsen.

Takk for dine svar!

Spørreskjema retest

Kjære deltaker!

Takk for din deltakelse i vår studie om bekkenbunnstrening mot urinlekkasje blant kvinner som trener CrossFit og functional fitness.

Vi ber deg svare på dette spørreskjemaet før retest - det tar ca. 10 minutter å svare på.

Urinlekkasje (ICIQ-UI-SF)

Flere studier har vist at idrettsaktive jenter/kvinner i idretter, som for eksempel turn, dans og ballett, lekker urin, særlig ved elementer som innebærer løp og hopp. Vi vil gjerne vite hvordan du har hatt det, gjennomsnittlig, de siste 4 ukene.

Hvor ofte lekker du urin? (Kryss av i en boks)

(1) ❑ Aldri
(2) ❑ Omtrent en gang i uken eller sjeldnere
(3) ❑ 2-3 ganger i uken
(4) ❑ ca. 1 gang per dag
(5) ❑ Flere ganger per dag
(6) ❑ Hele tiden

Hvor mye urin lekker du vanligvis (enten du buker beskyttelse eller ikke)? (Kryss av i en boks)

(1) ❑ Ikke noe
(2) ❑ En liten mengde

(3) ❑ En moderat mengde

(4) ❑ En stor mengde

Hvor mye påvirker urinlekkasje ditt hverdagsliv?

_____

Når lekker du urin? (Kryss av alt som passer for deg)

(1) ❑ Aldri, jeg lekker ikke urin

(2) ❑ Lekker før jeg når toalettet

(3) ❑ Lekker når jeg hoster eller nyser

(4) ❑ Lekker når jeg sover

(5) ❑ Lekker når jeg er fysisk aktiv/trener

(6) ❑ Lekker når jeg er ferdig med å late vannet (tisse) og har tatt på meg klærne

(7) ❑ Lekker uten noe opplagt grunn

(8) ❑ Lekker hele tiden

Andre bekkenbunnsplager

Denne delen handler om andre bekkenbunnsplager, som underlivsprolaps og analinkontinens (ufrivillig lekkasje av luft eller avføring). For de som ikke har disse plagene kan spørsmålene virke uaktuelle. Hvis dette er tilfellet for deg, ber vi deg likevel svare ved å velge første svaralternativ da dette er benektende.

Vi ber deg besvare spørsmålene i forhold til de siste 4 ukene.

Kan du kjenne en kul/utbuling inne i skjeden?

(1) ❑ Aldri

(2) ❑ Av og til

(3) ❑ Noen ganger

(4) ❑ Mesteparten av tiden

(5) ❑ Hele tiden

Hvor mye plager dette deg?

_____

Kan du kjenne en kul/utbuling utenfor skjeden?

(1) ❑ Aldri
(2) ❑ Av og til
(3) ❑ Noen ganger
(4) ❑ Mesteparten av tiden
(5) ❑ Hele tiden

Hvor mye plager dette deg?

_____

Kan du hindre ufrivillig luftlekkasje?

(1) ❑ Alltid
(2) ❑ Mesteparten av tiden
(3) ❑ Noen ganger
(4) ❑ Sjelden
(5) ❑ Aldri

Hvor mye plager dette deg?

_____

Kan du hindre lekkasje av fast avføring?

(1) ❑ Alltid
(2) ❑ Mesteparten av tiden
(3) ❑ Noen ganger
(4) ❑ Sjelden
(5) ❑ Aldri

Hvor mye plager dette deg?

_____

Kan du hindre lekkasje av diaré/løs avføring?

(1) ❑ Alltid
(2) ❑ Mesteparten av tiden
(3) ❑ Noen ganger
(4) ❑ Sjelden
(5) ❑ Aldri

Hvor mye plager dette deg?

_____

Patient Global Impression of Improvement (PGI-I) Skala

1. Med henhold til urinlekkasje, hvordan vil du beskrive at du har det i dag sammenlignet med hvordan du hadde det for 4 måneder siden?

(1) ❑ Veldig mye bedre
(2) ❑ Mye bedre
(3) ❑ Bedre
(4) ❑ Ingen endring
(5) ❑ Verre
(6) ❑ Mye verre
(7) ❑ Veldig mye verre

2. Med henhold til andre symptomer på andre bekkenbunnsplager enn urinlekkasje (lekkasje av luft eller avføring fra tarmen eller symptomer på underlivsprolaps), hvordan vil du beskrive at du har det i dag sammenlignet med hvordan du hadde det for 4 måneder siden?

(1) ❑ Veldig mye bedre
(2) ❑ Mye bedre
(3) ❑ Bedre
(4) ❑ Ingen endring
(5) ❑ Verre
(6) ❑ Mye verre
(7) ❑ Veldig mye verre

Husk å trykke "avslutt" for å avslutte spørreundersøkelsen.

Takk for dine svar!

Randomisert kontrollert studie – CrossFit og functional fitness

Klinisk undersøkelse av bekkenbunn

ID:

Dato:

VEKT OG HØYDE

Høyde (cm): _____

Vekt (kg): _____

FUNKSJON - BEKKENBUNN

Standardisert utgangsstilling

Ryggliggende med bøyde bein (ett hviler mot veggen – ett mot terapeuten) med pute under hodet.

Observasjon av perineum under kontraksjonen

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

Tilstede ☐

Usikker ☐

Ikke tilstede ☐

Palpasjon

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

☐ Ingen kontraksjon

☐ Korrekt kontraksjon (sammentrekning/omslutning og løft)

☐ Kontraksjon med hjelp av hjelpemuskler

☐ Usikker

☐ Trykker nedover

MUSKELSTYRKE BEKKENBUNN

Ryggliggende bøyde bein (ett bein hviler mot veggen – ett mot terapeuten)

Maksimal muskelstyrke

Kommando: *"Pust rolig inn og ut." "Du er klar." "Trekk sammen rundt alle åpningene, løft opp og inn i bekkenet – trekk sammen så hardt du kan." "Slipp og pust rolig ut".*

***MVC1:____ MVC2:____ MVC3:____ Gj.snitt: _____**

Vaginalt hviletrykk FØR kontraksjon: ____

Vaginalt hviletrykk ETTER kontraksjon: ____

Utholdende muskelstyrke (10 sek)

Kommando: "Nå skal du gjøre det samme som når vi måler maksimal styrke, men du skal prøve så godt du kan å holde kontraksjonen i 10 sek. "Pust rolig inn og ut". "Du er klar", "Trekk sammen rundt alle åpningene nedentil, trekk opp og inn i bekkenet så hardt du kan – hold der oppe – bli der – du holder – 5 sekunder igjen – 4 – 3 – 2 – 1". "Slipp og pust rolig ut".

Utholdenhet (areal under kurven) *minus* (hviletrykk x10): _____

Appendix 7

Pamphlet about pelvic floor muscle training

Bekkenbunnstrening for kvinner som trener CrossFit eller functional fitness

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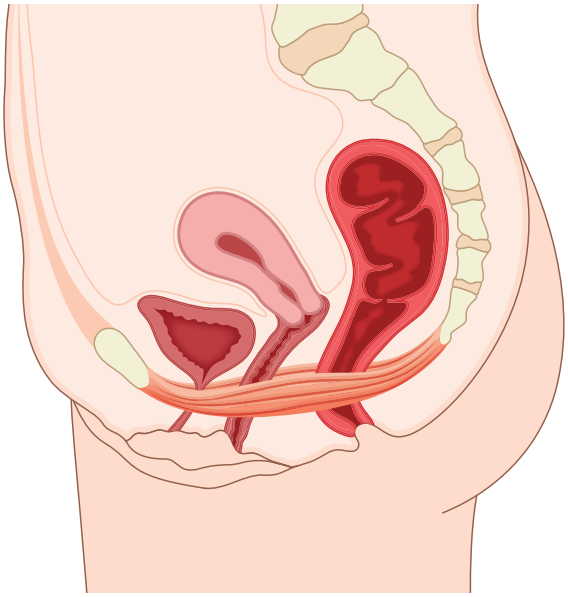
Bekkenbunnsmusklene
Bekkenbunnsmusklene ligger innvendig i bekkenet og danner "gulvet" i kroppen. Musklene omslutter urinrør, skjede og endetarm og utøver sammen med lukkemusklene åpning og lukking av urinrøret. Musklene skal automatisk trekke seg raskt og kraftig nok sammen til å stenge av når vi hoster, nyser, løfter, gjør brå bevegelser, løper eller hopper. Man kan tenke seg bekkenbunnsmusklene som en stram trampoline som effektivt står imot når buktrykket øker. En ikke-fungerende bekkenbunn kan blant annet føre til urinlekkasje. Musklene trenes ved at du trekker sammen rundt åpningene i bekkenet og løfter opp og innover.



Stressinkontinens
Stressinkontinens er ufrivillig urinlekkasje under fysisk anstrengelse som løp, hopp, tunge løft, brå bevegelser, hosting, nysing og latter, og er svært vanlig hos kvinner. Denne lekkasjeformen kan oppstå i alle aldre, men er også utbredt hos idrettsutøvere eller kvinner som deltar i hard, fysisk trening – spesielt ved aktiviteter som innebærer mye løp, hopp og tunge løft. Nye studier har vist at så mange ca. 40-80% av kvinner som trener CrossFit eller functional fitness lekker urin når de trener.

Bekkenbunnstrening
Studier har vist at styrketrening av bekkenbunnsmusklene har forebyggende og behandlende effekt på urinlekkasje i den generelle kvinnelige befolkningen. Bekkenbunnsmusklene hos kvinner som trener med høy intensitet må imidlertid kunne motstå langt høyere belastning og derfor antakelig være sterkere enn hos kvinner som ikke trener.

Test av riktig bekkenbunnstrening
1. Sitt på et armlene eller en bordkant med rett rygg og tyngden litt frempå. Kjenn at du løfter vekk fra stolen og opp og inn i bekkenet. Ta i så hardt at du kjenner at det skjelver litt innvendig i bekkenet. Musklene i sete og lår skal ikke strammes, men hvis du tar i hardt vil kjenne at nedre del av magen trekkes litt inn. Slipp sammentrekningen av bekkenbunnsmusklene uten å skyve eller presse nedover. Forsøk å kjenne forskjell på når du har avslappet bekkenbunn og når du strammer.

2. Forsøk å stanse dryppingen på slutten av en vannlatning ved å trekke opp og sammen Bruk dette kun som en test på om du får det til riktig og ikke som regelmessig trening.

Treningsprogram

1. Velg en utgangsstilling med bena godt fra hverandre. Trekk sam men rundt alle åpninger (urinrør, skjede og endetarm), løft opp og inn i bekkenet.
2. Ta i så hardt du kan!
3. Forsøk å holde 6-8 sekunder før du slipper rolig ned – uten å presse/skyve nedover.
4. Gjør 3 serier med 8-12 sammentrekninger så hardt du kan hver dag.

Start med færre sammentrekninger hvis du synes dette er for hardt. Det er bedre å gjøre færre sammentrekninger så hardt du kan enn mange svake sammentrekninger. Velg et tidspunkt som passer inn i ditt hverdagsliv med skole/jobb, trening og sosialt liv.

Velg en av disse utgangsstillingene hvor du føler at du klarer å gjøre flere harde sammentrekninger. Bytt gjerne utgangsstilling mellom seriene:

1. Ligg på magen med ett ben ut til siden

2. Stå på knærne med føttene sammen og knærne godt ut til siden

3. Sitt i skredderstilling. Hold ryggen rett og støtt med armene

4. Sitt på stol med bena godt fra hverandre. Hold armene på knærne

5. Stå med bena godt fra hverandre. Hold hendene på setemusklene og kjenn at disse ikke strammes når du trekker sammen bekkenbunnsmusklene

6. Stå med bøy i kne og hofteledd.
Hold ryggen rett og støtt armene på lårene

Hvordan øke vanskelighetsgraden (progresjon):

1. Når du klarer 12 kraftige sammentrekninger kan du gjerne gjøre 3-4 raske sammentrekninger videre innover på toppen av "holdet". Pass på å ikke slippe "holdet" mellom hver av de raske sammentrekningen.

2. Bytt til en utgangsstilling som føles mer utfordrende og tyngre for deg å gjøre sammentrekningene i – for eksempel stående med bena fra hverandre og bøy i knærne (bilde 6)

Vi i prosjektgruppen ønsker deg

LYKKE TIL MED TRENINGEN!

Vennlig hilsen prosjektgruppen:
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Marte Charlotte Dobbertin Gram, doktorgradsstipendiat
og fysioterapeut
Institutt for idrettsmedisinske fag, Norges idrettshøgskole

Foto: Shutterstock, Kjetil Grude Flekkøy. Modell: Nina Sølvberg

Institutt for idrettsmedisinske fag ved Norges idrettshøgskole.

NIH NORGES IDRETTSHØGSKOLE