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Exercise and pregnancy in recreational and elite athletes: 2016/17 evidence summary from the IOC Expert Group Meeting, Lausanne. Part 3 - Exercise in the postpartum period

Kari Bø
Norges idrettshøgskole

Raul Artal
St. Louis University

Ruben Barakat
Universidad Politécnica de Madrid

Wendy J. Brown
The University of Queensland

Gregory A.L. Davies
Queen's University

See next page for additional authors

Exercise and pregnancy in recreational and elite athletes: 2016/17 evidence summary from the IOC Expert Group Meeting, Lausanne. Part 3—exercise in the postpartum period

Kari Bø,[1] Raul Artal,[2] Ruben Barakat,[3] Wendy J Brown,[4] Gregory A L Davies,[5] Michael Dooley,[6,7] Kelly R Evenson,[8] Lene A H Haakstad,[1] Bengt Kayser,[9] Tarja I Kinnunen,[10] Karin Larsén,[11] Michelle F Mottola,[12] Ingrid Nygaard,[13] Mireille van Poppel,[14] Britt Stuge,[15] Karim M Khan,[16] IOC Medical Commission[17]

For numbered affiliations see end of article.

Correspondence to
Professor Kari Bø, Department of Sport Medicine, Norwegian School of Sport Sciences, Oslo 0806, Norway; kari.bo@nih.no

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BACKGROUND

This is Part 3 in the series of reviews from the IOC expert committee on exercise and pregnancy in recreational and elite athletes. Part 1 focused on the effects of training during pregnancy and on the management of common pregnancy-related complaints experienced by athletes[1]; Part 2 addressed maternal and fetal perinatal outcomes.[2] In this part, we review the implications of pregnancy and childbirth on *return to exercise* and *on common illnesses and complaints in the postpartum period*.

The postpartum period can be divided into hospital-based (during hospital stay), immediate postpartum (hospital discharge to 6 weeks postpartum) and later postpartum (6 weeks to 1 year, corresponding sometimes to cessation of breast feeding).[3] In the literature, the postpartum period is usually defined as the first 6 weeks after pregnancy, during which time women have not typically been encouraged to exercise, except for strength training of the pelvic floor muscles. However, 6 weeks is an arbitrary time point and, anecdotally, many elite athletes report starting exercise inside that period. For the purpose of the present review, we consider the postpartum period to be up to 12 months following birth.

AIMS

The aims of this paper are to present (1) the findings from a systematic review of the scientific literature on factors related to returning to exercise after childbirth in recreational and elite athletes, and (2) the prevalence, risk factors and evidence for prevention and treatment of common postpartum conditions that may affect sport performance and overall quality of life.

METHODS

For each section of the document, a search strategy was performed using search terms such as 'pregnancy' OR 'pregnant' OR 'postpartum' AND 'exercise' OR 'physical activity' OR 'leisure activity' OR 'leisure' OR 'recreation' OR 'recreational activity' OR 'physical fitness' OR occupational activity' AND terms related to the condition under study (eg, 'pelvic girdle pain', 'urinary incontinence', 'weight retention'). All available databases were searched, with an emphasis on PubMed, Embase, Cochrane, PEDro, Web of Science and SPORTDiscus. In addition, existing postpartum physical activity guidelines with reference lists were scanned. The review of each topic followed the general order: prevalence of the condition in the general postpartum population, prevalence in high-level exercisers or elite athletes, risk factors in the general population and in relation to exercise and sport, and effect of preventive and treatment interventions for common conditions and complaints following pregnancy and childbirth. Level of evidence and grade of recommendations are reported for the common conditions and complaints only, and are according to the Cochrane Handbook (table 1), for prevention and treatment interventions.

Each member of the working group was assigned to be the lead author of one or more topics, and one to three others were assigned to review each topic. A first full consensus draft was reviewed before and during the 3-day IOC meeting (27–29 September 2015), and a new version of each topic was submitted to the meeting chairs (KB and KMK) shortly after the meeting. Each topic leader made amendments before sending a new version for comments to the working group.

FACTORS RELATED TO RETURNING TO EXERCISE AFTER CHILDBIRTH IN ELITE ATHLETES

Pelvic floor injury and recovery after childbirth

To date, scant research has been conducted regarding the regenerative capacity of the pelvic floor muscles following first-time vaginal delivery.[4–6] However, early histological and proteomic markers of regeneration have been observed in the largest muscle of the pelvic floor, the levator ani muscle.[4 5]

Nerve injuries to the pelvic floor muscles during delivery have not been widely studied. In a longitudinal study of 96 first-time pregnant women, concentric needle electromyography tests showed partial denervation of the pelvic floor with consequent reinnervation in 80%.[7] In another study of primiparous women, 30% demonstrated

Table 1 Levels of quality of a body of evidence in the GRADE statement

Underlying methodology	Quality rating
Randomised trials, or double-upgraded observational studies	High
Downgraded randomised trials, or upgraded observational studies	Moderate
Double-downgraded randomised trials, or observational studies	Low
Triple-downgraded randomised trials, or downgraded observational studies or case series/ case reports	Very low

denervation of the levator ani muscle at 6 weeks postpartum. Only 35% recovered by 6 months.[8]

Changes in preparation for childbirth begin long before the onset of labour. The levator hiatus area begins to widen during pregnancy, increases significantly after vaginal birth, and in most women returns to an area similar to that seen after caesarean birth by 12 months postpartum.[9] Recovery of the levator hiatus area, a reflection of recovery of the levator ani muscle and associated connective tissue and nerves, is generally maximised by 4–6 months postpartum.[9 10] Bladder neck mobility increases after vaginal birth and, while the support to the bladder neck improves postpartum, mobility remains higher than when measured at 37 weeks' gestation.[9 11]

Postpartum MRI or ultrasound has shown that levator ani muscle defects resolve in some women between 6 weeks and 1 year.[9 12–15] It is unclear whether this represents actual repair, anatomic variation in muscle insertions or the technical limitations of the procedures.[16]

There are scant data about whether or not future pelvic floor health is impacted by resuming strenuous physical activity in the early postpartum period, during which muscles, nerves and connective tissue are actively recovering from vaginal birth. Early return to heavy physical work after childbirth increased the risks of urinary incontinence and pelvic organ prolapse in small populations of women in India[17] and Nepal,[18] respectively. We identified no studies on how the timing of return to strenuous exercise or competitive sport postpartum affects pelvic floor function in elite athletes. Theoretically, the pelvic floor muscles may be overloaded if they have not recovered completely before resuming strenuous exercise. It may be prudent for athletes whose delivery was complicated by a risk factor for levator ani muscle injury (anal sphincter tear, forceps delivery, long second stage, large baby) to minimise activities that generate large increases in intra-abdominal pressure and/or repetitive high impact for several months postpartum. However, we emphasise that there is no evidence to support this recommendation. There is an urgent need for more research on the effect of exercise postpartum on the pelvic floor.

Returning to sport after operative delivery

Women who undergo operative vaginal delivery (vacuum and forceps procedures) or caesarean section will have different recovery timelines than those who have had an uncomplicated vaginal birth. This may impact their desire and functional ability to return to exercise. The prevalence of levator avulsion is substantially higher after forceps compared with vacuum delivery.[19–21]Compared with spontaneous vaginal delivery, forceps delivery, but not vacuum delivery, is associated with greater odds of pelvic organ prolapse and surgery for prolapse.[20] There is conflicting information about the long-term impact of forceps versus vacuum delivery on urinary and faecal incontinence.[22–25]

Women who have undergone caesarean birth will experience more abdominal pain postpartum than those who have had vaginal birth. The Pfannenstiel incision, typically used for caesarean birth, is a horizontal incision about 3 cm above the symphysis pubis and typically 12–15 cm in length. The Pfannenstiel incision is not a muscle-cutting incision but rather splits the rectus abdominis muscles in the midline. The transversalis fascia is incised horizontally and during closure is usually closed with a running suture with a knot at either end of the incision. After caesarean birth, most women experience pain along the incision site requiring analgesia for 5–10 days. This pain is commonly worse in the corners of the incision where the body has begun reacting to the stitch material in the knots. Most, but not all, women will be physically recovered to begin training 4–6 weeks after surgery.

A multicentre follow-up study of 1507 primiparous women in Australia identified those who experienced caesarean section were more likely to report extreme tiredness at 6 (adjusted OR: 1.39; 95% CI 1.07 to 1.82) and 12 months postpartum (adjusted OR: 1.40; 95% CI 1.05 to 1.85), and were more likely to report back pain at 6 (adjusted OR: 1.37; 95% CI 1.06 to 1.77) and 12 months postpartum (adjusted OR: 1.41; 95% CI 1.06 to 1.87). Women who had a caesarean section were less likely to report urinary incontinence at 3, 6 and 12 months postpartum, respectively (adjusted OR: 0.26; 95% CI 0.19 to 0.36; adjusted OR: 0.36; 95% CI 0.25 to 0.52; adjusted OR: 0.48; 95% CI 0.33 to 0.68). For all other physical health problems, the pattern of morbidity did not differ between caesarean section and spontaneous vaginal birth.[26] After caesarean delivery, the uterine scar is initially about fivefold thicker on ultrasound but decreases gradually over 6 weeks. At 6 weeks, the scar thickness is still increased, suggesting that the process of uterine scar remodelling extends beyond this traditional postpartum period.[27] We are not aware of any literature suggesting an association between physical activity and uterine scar dehiscence in non-pregnant women, regardless of whether the incision on the uterus is made horizontally or vertically.

The decision when to recommence exercise after caesarean section will be dependent on issues such as blood pressure, anaemia, fatigue, pain management and wound healing. Elite athletes who plan to regain their prepregnancy fitness levels should do this in collaboration with their obstetric care provider to ensure they are medically fit for exercise. Once medically cleared, women may participate in both aerobic and strength training starting gradually and increasing exercise time, frequency and intensity as tolerated by their body. Women need to be conscious of the fact that even a 15-day to 30-day detraining period can lead to significant muscle atrophy, which will require reconditioning over time to replace.[28] Given the recent abdominal surgery, women postcaesarean section must also be conscious of the time required for complete repair of the abdominal fascia, which regains 51%–59% of its original tensile strength 6 weeks postsurgery and by 6–7 months has only 73%–93% of its original tensile strength.[29] Elite athletes returning to exercise postcaesarean section should reduce their level of exercise if they experience pain or other negative symptoms related to their surgery site.

Physiological adaptations postpartum

The substantial cardiovascular and respiratory adaptations of pregnancy were discussed in the first part of this series.[1] After

giving birth, in a non-athlete female population, one study suggested that it takes at least 2 months postpartum for the augmented cardiac response to exercise during pregnancy to subside.[30] Another study found that, relative to prepregnancy values, fitness (VO_2=MAX) and strength (1-RM) levels were decreased at 6 weeks postpartum, presumably as a consequence of reduced physical activity levels during pregnancy.[31] Some of the loss was restored at 27 weeks postpartum. In one study of 13 healthy women, systemic vascular resistance remained decreased at 12 weeks postpartum compared with before conception.[32]

Longitudinal data from 15 nulliparous and 15 parous women, collected every 8 weeks during pregnancy, showed that resting heart rate peaked at term 15+/−1 beat/min above prepregnancy levels (57+/−1 beat/min), while resting mean arterial pressure reached its low (−6+/−1 mm Hg) at 16 weeks, returning to baseline at term.[33] The increases in left ventricular volumes peaked and the decrease in peripheral resistance troughed at 24 weeks of gestation, and cardiac output peaked (2.2+/−0.2 L/min) at 38 weeks. The magnitude was significantly greater during the second pregnancy than during the first.[33] Postpartum measures at 12, 24 and 52 weeks showed that all cardiovascular measures (heart rate, arterial pressure, cardiac output, etc) gradually returned towards baseline, but remained significantly different from prepregnancy values at 1 year after both the first and second pregnancy. All respiratory parameters returned to prepregnancy values within 6–12 weeks postpartum.

One pregnancy training study was found on trained women among whom several were elite athletes.[34] The general conclusion was that high fitness levels could be maintained or even increased during pregnancy with appropriate strenuous training regimens. No formal studies were found on elite athletes reporting the timing of return to prepregnancy training regimens and competition.

Exercise and breast feeding

The WHO advises women to breast feed for at least 6 months.[35] In a study of long distance runners, many modified their running behaviour during breast feeding, but of those who ran competitively prior to pregnancy and breast fed, 84.1% reported running during breast feeding.[36] Most felt that running had no effect on their ability to breast feed.

Pivarnik *et al* reviewed breast feeding in athletes, and found that the increased caloric expenditure associated with breast feeding impacts an athlete's postpartum weight loss and return to competition.[37] The concern that intense exercise may impair milk production in quantity and nutritional qualities has not been confirmed.[38 39] Instead, high-volume aerobic exercise during breast feeding resulted in slightly greater quality and quantity of milk.[40] Moderate weight reduction while nursing is safe and does not compromise neonatal weight gain.[41] Lactic acid concentration in breast milk increases after intense exercise.[42] Further, as energy expenditure increases during physical activity, there is an increase in proinflammatory cytokines, but no change in immunoglobulin A.[43]

During pregnancy, if intestinal calcium is insufficient to meet the combined needs of the mother and the baby, there may be some bone resorption, which may be exacerbated by breast feeding. There is no evidence that this causes osteoporosis or fractures, as the maternal skeleton is restored to its prepregnancy mineral content and strength after weaning. To our knowledge there are no reports of pregnancy or lactation-related fractures in athletes, although 'excess exercise' is thought to be a risk factor for these rare conditions.[44]

At this time, data do not support a recommendation concerning exercise intensity and breast feeding. The Society of Obstetricians and Gynaecologists of Canada (SOGC) Clinical Practice Obstetrics Committee, the Executive and Council of SOGC, and the Board of Directors of the Canadian Society for Exercise Physiology guidelines state that women should be advised that moderate exercise during lactation does not affect the quantity or composition of breast milk or impact infant growth.[45] In reviewing guidelines from different countries, Evenson *et al*[3] found that breast feeding was mentioned in the Australian, Norwegian and Canadian guidelines.[3] In particular, the Australian guideline indicated that physical activity would not impact breast milk volume or composition or infant growth as long as the woman had appropriate food and fluid intake. The American College of Obstetricians and Gynecologists recommends that nursing women ensure adequate hydration before commencing exercise and that they consider feeding their infants before exercising to avoid the discomfort of engorged breasts during exercise.[46]

Athletes may benefit from wearing a personally fitted sports bra that offers support rather than compression,[47 48] as this provides significantly increased breast and bra comfort compared with a standard encapsulation sport bra during exercise.[49] Using a breast pump before exercise may allow the postpartum athlete greater flexibility in the workout and feeding schedule and should result in a more comfortable exercise experience if the breasts are not full.[42]

Return to competitive sport

There is scant knowledge on athletes returning to exercise and competition after childbirth. Beilock *et al*[50] suggested that athletes may be able to alter their training patterns during pregnancy without a significant impact on their postpartum training programme. In a retrospective study of 40 Norwegian elite athletes, 77% continued to compete at the same level after childbirth.[51] Within the first 6 weeks postpartum, 12 (38%) of the elite athletes started jogging compared with 2 (4.3%) in non-athletes. In a case study of a marathon runner, Potteiger *et al*[52] found that while the individual did not qualify for the Olympic marathon, she was able to resume an intense training regimen within 4 weeks after delivery with no apparent medical complications. In another study, female Olympic and masters athletes reported feeling more physically fit and having improved technical skill after childbirth and often improved the records they achieved before pregnancy.[53]

Since research concerning the exercise patterns of physically fit athletes during the postpartum period is limited, studies on physically fit soldiers can serve as a guide. The amount of time needed for postpartum soldiers to return to prepregnancy fitness condition, as evidenced by Army Physical Fitness Test scores, ranged from 2 to 24 months, with a mean of 11 months.[54] Postpartum test scores were significantly affected by complications (postpartum thyroiditis, hypertension, haemorrhoids, mastitis and postpartum surgery), weight gain and breast feeding. Only 17% of the soldiers believed that 6 months is enough time to return to prepregnancy physical condition, while only 19% of the women performed at levels equal to or better on the 6-month test, compared with their prepregnancy test.

Postpartum resumption of physical activity is an individualised process. Given the scant data, there are no studies indicating that rapid resumption of activities is associated with adverse outcomes. However, because postpartum women have a degree of deconditioning, accepted wisdom is for gradual resumption of

exercise. This phase clearly requires additional research. (Part 4 of this series will address research gaps.)

Elite athletes are likely to encounter the same physiological limitations during pregnancy as those faced by recreational athletes during pregnancy.[37] Elite athletes tend to maintain a more strenuous training schedule throughout pregnancy and resume high-intensity postpartum training sooner. Based on the available data, prepregnancy exercise routines may be resumed gradually, as soon as it is physically and medically safe. This will vary from one individual to another and some women may resume an exercise routine within a few weeks of delivery.[55] Women should discuss plans to resume exercise during the postpartum period with their physician to obtain individualised advice.

COMMON POSTPARTUM COMPLAINTS AND DISEASES: RISK FACTORS, PREVENTION AND TREATMENT OPTIONS

Postnatal depression

The most common mental health problem in the postpartum period is postpartum or postnatal depression.[56] This is defined as depression occurring within the 12 months after giving birth, and is experienced by approximately 20% of women. However, up to 50% of women experience high levels of depressive symptoms in this period.[56 57] Depressive symptoms typically include feelings of helplessness and hopelessness, sleep problems, decreased energy, decision-making difficulties, sad mood, loss of interest in activities, irritability, changes in eating patterns, restlessness and suicidal ideations or attempts.[57] There is no specific information about the prevalence of postnatal depression in female athletes.

Postnatal depression is associated with lower quality of life in mothers and their babies, negative parenting behaviours, poorer mother–infant bonding, and physical and emotional problems.[58–60] Women who experience postnatal depression also have twice the risk of suffering episodes of depression later in life.[61]

Prevention of postnatal depression

In a review of associations between physical activity (either prepregnancy, during pregnancy or postpartum) and postnatal depressive symptoms, there was an inverse association in 7/7 intervention studies and 6/10 observational studies.[62] While noting the limited quality of many of these studies, the authors concluded that leisure time physical activity prior to, during and after pregnancy may be important for reducing the risk of postnatal depressive symptoms.[62]

The results of a large Norwegian randomised controlled trial (RCT) (n=855) published after the above 2013 review concluded that a 12-week programme of aerobic and strength training during weeks 20–36 of pregnancy did not result in differences in the prevalence of high depressive symptoms in the intervention and control groups.[63] Surprisingly, a subsample of the intervention group who had not exercised prior to pregnancy had reduced risk of postnatal depression at follow-up.[63]

Level of evidence: Low, no studies of athletes.

Treatment of postnatal depression

Treatment options for postnatal depression are the same as in other periods, and include the use of antidepressants and cognitive therapy.[64] Although there are plausible mechanisms by which exercise may improve the symptoms of postnatal depression, a 2004 review of 21 non-biological or behavioural interventions for the treatment of postnatal depression found insufficient data from which to draw conclusions relating to exercise.[65] In contrast, a 2007 review found two small RCTs that supported exercise as a useful treatment for women with postnatal depression.[66] A further review and meta-analysis in 2009 included five RCTs or quasi-RCTs that compared any type of exercise intervention with other treatments in women with diagnosed postnatal depression.[67] Three trials showed a significant difference and two did not. The effect of exercise (compared with no exercise) was small, there was considerable heterogeneity, and the overall difference was reduced and not significant when one study that included social support and exercise was excluded. The authors concluded that it was uncertain whether or not exercise reduces symptoms of postnatal depression, or whether or not the effects of exercise were confounded by the beneficial effects of social support.[67] Further RCTs are required.

Level of evidence: Low, insufficient studies, none in athletes.

Postpartum weight retention/loss

Background

Average weight retention 1 year after pregnancy in the general population ranges from 0.5 to 4 kg.[68–70] Gaining more weight during pregnancy is consistently identified as the strongest predictor of excess postpartum weight retention.[71 72] Excess weight retention postpartum is associated with increased long-term risk of obesity, cardiovascular disease and type 2 diabetes during midlife.[69 73] Both energy intake and energy expenditure (including energy expended through breast feeding) are associated with the rate of weight loss postpartum.

There are sparse data on postpartum weight loss in athletes. One small retrospective observational study of elite Norwegian athletes has shown that self-reported body mass index was lower at prepregnancy, at 6 weeks postpartum and at the time of completing the survey than in age-matched controls.[51] At the time of completing the questionnaire, 81% of the athletes (mean: 6.5 years after birth) and 48% of the controls (mean: 8.5 years after birth) had returned to their prepregnancy weight.

Role of physical activity in postpartum weight loss

Most of the systematic reviews in this area included studies that evaluated the role of physical activity, either alone or in combination with a dietary intervention, on postpartum weight retention or weight loss. All of the included studies were with population samples (ie, non-athletes), and most physical activity interventions aimed to encourage the women to achieve recommended levels of physical activity for health benefits (ie, ≥150 min per week of at least moderate-intensity activity). This is much less than that typically reported by elite athletes and results differed between studies.[69 71 74–77] We identified only one small intervention study with athletes. Kardel compared the effects of two training interventions on gestational weight gain and postpartum weight.[34] Both groups had the same intensity of muscle strength training, aerobic interval training and aerobic endurance training in their programmes, but the high-volume exercise group (n=20) had more of each type of training than the medium-volume exercise group (n=21). There was no non-exercising control group, and the athletes selected their preferred programme. There were no differences in body weight between the groups at 6 or 12 weeks postpartum. The mean weight was 72.2 kg in both groups at 38 weeks' gestation. At 6 weeks postpartum the high-volume exercise group weighed slightly less than the medium exercise group, but the mean weight at 12 weeks postpartum was very similar (63.2 and 63.0 kg, respectively).

Level of evidence: Low, insufficient studies in the general exercising population and in elite athletes.

MUSCULOSKELETAL COMPLAINTS

Low back and pelvic girdle pain

Although the majority of women with low back pain and pelvic girdle pain recover spontaneously soon after delivery, about 20% report persistent pain for years.[78] A large longitudinal population-based study found that 22% of women with pelvic girdle pain in pregnancy reported persistent pelvic girdle pain 6 months after delivery.[79] Of these, 16% reported severe complaints. The recovery rates were high, but decreased with increasing levels of pain severity in pregnancy.[80] Caesarean delivery increased the risk for persistent severe pelvic girdle pain 6 months postpartum.[80] In the only study among elite athletes, 12.6% reported retrospectively that they experienced pelvic girdle pain 6 weeks postpartum and 9.7% experienced low back pain.[51] The prevalence increased to 19.4% for pelvic girdle pain and 29.0% for low back pain from 6 weeks postpartum to the time of completing the questionnaire 0–17 years after delivery.

Prevention and treatment

Four RCTs of high methodological quality have investigated the effectiveness of different exercise programmes of low back pain and pelvic girdle pain in the general postpartum population.[81–84] Only one of these RCTs demonstrated statistically and clinically significant positive and long-lasting effects of specific exercises in combination with individual physiotherapy on functional status, pain and physical health (SF-36).[84 85] Disability was reduced by more than 50% for the exercise group compared with negligible changes in the control group. The main focus of the exercises (which was on the dynamic control of a neutral position of the lumbopelvis, ergonomic advice and development of strength and endurance to manage the physical demands facing each individual) was to improve coordination of the local and overall muscle system. The women were asked to perform their 30–60 min exercise programme 3 days per week and they adhered closely to this individually designed programme for 20 weeks. Compared with the other three studies, the study by Stuge *et al* differed in many aspects, such as individual guidance of a specialised women's health physiotherapist, dosage, and type and duration of exercises.[86] No studies examining a treatment programme for low back pain or pelvic girdle pain in elite athletes were found. In the last decade, core stabilisation exercises have grown in popularity.[87] However, a recent systematic review showed strong evidence that stabilisation exercises generally are not more effective than any other form of active exercise in the long term.[88] A condition-specific outcome measure, the Pelvic Girdle Questionnaire, is reliable, valid and developed for pregnant and non-pregnant women with pelvic girdle pain for use in research and in clinical practice.[89 90]

Level of evidence: Moderate in the general postpartum population. No studies in elite athletes.

Diastasis recti abdominis

Postpartum prevalence rates of diastasis recti abdominis in the general population vary between 30% and 68%.[91 92] In a longitudinal study of 300 first-time pregnant women, prevalence rates were 33% at gestational week 21, 60% at 6 weeks postdelivery, 45.4% at 6 months and 32.6% at 12 months postpartum.[93] Diastasis recti abdominis is also common in middle-aged women with a prevalence of 52% among all questioned and 35% in nulliparous women,[94] and may also be present in men.[95] No studies were found on elite athletes postpartum.

Influence of diastasis recti abdominis on abdominal strength

In six women from gestational week 14 to 8 weeks postpartum, Gilleard and Brown found that women with inter-rectus distance >3.5 cm measured with palpation had reduced curl-up capacity.[96] This was supported by a study following 40 women postpartum, which found that postpartum women had weaker abdominal muscles than a control group.[97] However, at 6 months postpartum there was no correlation between inter-rectus distance and reduced abdominal muscle strength.

Diastasis and low back and pelvic girdle pain

Parker *et al*[98] found that women with diastasis recti abdominis had more abdominal and pelvic pain at 3 months postpartum than women without diastasis recti abdominis.[98] However, two other studies found no differences in prevalence rates of low back pain or pelvic girdle pain in primiparous women 6 and 12 months postpartum with or without diastasis recti abdominis.[93 99] No studies were found on elite athletes postpartum.

Prevention and treatment

While several web pages recommend different types of abdominal exercises to treat diastasis, there are no data to support these recommendations. A case–control study by Lo *et al* showed a protective effect of antepartum physical activity level.[100] This was also the case in the study by Chiarello *et al*.[101] In a systematic review by Benjamin *et al*,[102] eight studies reported treating diastasis recti abdominis using abdominal exercises: four case studies, two retrospective observational studies, one quasi-experimental post-test study and one small RCT of a brief training intervention.[103] This review concluded that non-specific exercise may or may not help to prevent or reduce diastasis recti abdominis during the antenatal or postnatal periods. An additional small RCT of only nine women, 3 months to 3 years postpartum, found a decline in diastasis recti abdominis in women doing a traditional abdominal exercise programme and women performing a core stability plank exercise, but no difference between the two groups.[104]

Given the limited research from very small studies of low methodological quality, there is no consensus on which abdominal exercises to recommend to correct diastasis recti abdominis postdelivery.[99 105] Recent research has questioned the use of the recommended in-drawing exercises (lifting the naval towards the spine, activating mainly the transversus abdominis and internal obliques) as these appear to widen, rather than narrow, the gap on ultrasound.[105–107]

There is little evidence for surgery to restore diastasis. Akram and Matzen identified 15 studies on surgical repair and found only one RCT, which compared the results of using two different sutures.[108] The authors concluded that both groups had adequate correction of diastasis recti abdominis 6 months after surgery. This was supported by a recent RCT also comparing different sutures.[109] No studies have been found on the prevention or treatment of diastasis recti abdominis in elite athletes.

Level of evidence: Insufficient evidence for the effect of either surgery or different exercise regimens on diastasis recti abdominis in the postpartum period. No studies on elite athletes.

Pelvic floor disorders

The main pelvic floor disorders postpartum are urinary incontinence, anal incontinence and pelvic organ prolapse. The

prevalence of any type of urinary incontinence in primiparous women during the first year postpartum, regardless of delivery mode, is between 15% and 30%.[110] Johannessen *et al* found that one in five primiparous women suffered from anal incontinence 1 year after delivery.[111] The main predictor for anal incontinence 1 year postpartum was anal incontinence in late pregnancy. Obstetric anal sphincter injury increased the risk of incontinence of stool and flatus (OR: 4.1; 95% CI 1.7 to 9.6). Urgency of bowel evacuation was associated with older age and operative delivery. It is estimated that >50% of women lose some pelvic support after vaginal delivery.[112] At 3–6 months postpartum, prevalence rates of pelvic organ prolapse (stage II or higher in a scale of 0–4) are between 18% and 56%.[113–115] Moreover, 15%–40% of primiparous women have a major defect of the levator ani muscle, and these women are twice as likely to have pelvic organ prolapse stage II or higher than those with an intact levator ani muscle.[116]

In a small retrospective questionnaire study on 40 elite athletes who had given birth (selected from Norwegian Olympic Committee and Confederation of Sport), the prevalence rate of stress urinary incontinence was 29% at 6 weeks postpartum and 35% at the time of completing the questionnaire.[51] There were no differences in stress urinary incontinence prevalence between elite athletes and a matched control group of 80 women, with a measured mean of 7.5 years after delivery (range: 0–17 years).

Prevention and treatment

A Cochrane review concluded that postnatal women with persistent urinary incontinence 3 months after delivery and who received pelvic floor muscle training were about 40% less likely than women who did not receive treatment, or who received usual postnatal care, to report urinary incontinence 12 months after delivery (RR: 0.60, 95% CI 0.35 to 1.03, combined result of three trials).[117] The more intensive the programme, the greater the treatment effect.[117] However, the Cochrane review also concluded that 'the extent to which mixed prevention and treatment approaches to pelvic floor muscle training in the postnatal period are effective is less clear' (ie, offering advice on pelvic floor muscle training to all pregnant or postpartum women whether or not they have incontinence symptoms). Further, 'it is possible that mixed prevention and treatment approaches might be effective when the intervention is intensive enough'.

There is lack of evidence from RCTs on the effect of pelvic floor muscle training on anal incontinence postpartum.[117] Several RCTs have found that pelvic floor muscle training can reduce pelvic organ prolapse stage and symptoms in middle-aged women, and it is recommended as first-line treatment (Durnea et al 2013).[118] However, one RCT did not find any effect of pelvic floor muscle training starting 6 weeks postpartum on pelvic organ prolapse in primiparous women.[119] Postpartum, the pelvic floor is weak and injured in most women, and women who did not train these muscles before birth may need instruction and supervision to be able to perform a correct pelvic floor muscle contraction. Women should start with contractions of short duration, with progression to holding periods of 6–8 s and continue to contract as close to maximum as possible with three sets of 8–12 contractions per day.[117 120]

A pessary, or a vaginal device placed into the vagina to support the pelvic organs, is also used to treat symptoms of pelvic floor disorders. Scant data suggest that in women with urinary incontinence, a pessary might be better than no treatment in reducing leakage.[121] In women with pelvic organ prolapse, one randomised trial that compared two types of pessaries found reduction in symptoms in about 60% of women who completed the study.[122] Whether a pessary might prevent pelvic floor symptoms, postpartum or at any other time has not been studied.

Level of evidence: Low for pelvic floor muscle training as prevention, but strong for pelvic floor muscle training as treatment of urinary incontinence in the general postpartum population. No studies on elite athletes. Low for pessary treatment of urinary incontinence or pelvic organ prolapse in the general population. No studies with postpartum women or elite athletes. Elite athletes with urinary incontinence or pelvic organ prolapse should be referred for pelvic floor muscle training and pessary use if necessary.

Pelvic floor pain

Pelvic floor pain is a specific subset of pelvic pain that consists of pain due specifically to the pelvic floor muscles, connective tissue or ligaments. Given this musculoskeletal aetiology, it is conceivable that highly active women might report different rates of pelvic floor pain than less physically active women. However, studying pelvic floor pain is difficult, as many different terms are used to express the finding of pelvic floor muscle pain and increased tension, including 'pelvic floor muscle pain syndrome', 'overactive pelvic floor', 'myofascial pelvic pain', 'levator tension myalgia' or 'hypertonic pelvic floor muscles'. Further compounding this difficulty is the fact that pain thought to be related to the pelvic floor is often due to other aetiologies. For example, in a prospective study of 114 female athletes with a suspected musculoskeletal aetiology for pelvic pain, who were referred to a surgical practice, 64.9% turned out to have injuries of the hip and/or soft tissue surrounding the hip.[123] We identified no observational studies about pelvic floor pain in athletes.

Prevention and treatment

In a systematic review of 10 RCTs of pelvic floor muscle training for pelvic floor pain, Frawley concluded that to date there is scant evidence from high-quality RCTs to guide clinical practice in prevention and treatment of pelvic floor pain.[124] Scant data suggest that, compared with saline injection, injection of botulinum toxin A into the pelvic floor muscles may decrease pain scores in non-athletes with chronic pelvic pain and 'evidence of pelvic floor muscle spasm'.[125] We identified no RCTs about treatment of such pain in athletes.

Level of evidence: Low. No studies in elite athletes.

Sexual dysfunction

Sexual function is divided into four categories: pain, desire, arousal and orgasmic disorders. Disorders in each category are common,[126] and diagnosing these disorders relies on self-report. A three-item screening questionnaire has been shown to be as effective as an interview with a psychologist in identifying sexual problems.[127] About 90% of women are sexually active during pregnancy; this decreases to about 30% in the ninth month of pregnancy.[128] Sexual desire generally decreases postpartum and improves over the course of the first postpartum year.[129]

About half of women who have a spontaneous vaginal delivery resume intercourse before 8 weeks postpartum[130 131] Women with an intact perineum are more likely to resume vaginal intercourse earlier (by 6 weeks postpartum).[132] However, the effect of perineal trauma on delaying intercourse is lost by 7–12 weeks postpartum.[129] Women who breast feed are less likely to resume intercourse early in the postpartum period.[133]

Incidence of postpartum sexual dysfunction

Forty-one per cent to 83% of women report sexual dysfunction at 2–3 months postpartum.[128 134] Sexual pain is the most common cause of sexual dysfunction in the postpartum period.[129] Of note, pain with intercourse may be present in up to one-quarter of women before pregnancy.[135 136]

Risk factors for postpartum sexual dysfunction

Risk factors for postpartum sexual dysfunction include infrequent sexual activity or delayed initiation of sexual activity (later than 9 weeks postpartum), being within the first 5 months after childbirth, primiparity, postpartum depression, treatment for depression and relationship dissatisfaction.[128 134]

The 2006 National Institutes of Health Consensus Conference on Maternal Demand Cesarean concluded that there was no high-quality evidence to show that either vaginal or caesarean birth resulted in better postpartum sexual function.[137] In agreement with this, 6 years after first delivery, mode of delivery was not related to sexual function, with the exception that women who delivered by caesarean perceived that their vaginal tone was better.[138] We identified no data on postpartum sexual dysfunction in female athletes and also no data on whether physical activity during or after delivery impacts sexual function in women.

Treatment of postpartum sexual dysfunction

In a systematic review that included 1341 women from eight RCTs, pelvic floor muscle training was found to improve at least one sexual variable in women with pelvic floor dysfunction. One study showed an improvement in postpartum women.[139] Six years after first delivery, women who reported performing pelvic floor muscle training scored better on numerous sexual function questions than women who did not report this.[138]

Treatment is generally based on anecdotal evidence and includes, most importantly, addressing sexual function as a serious concern, reviewing the importance of adequate rest and time for intimacy, and encouraging the use of vaginal lubricants. In women who report pain with intercourse, a careful examination of the vagina and vulva to assess healing is recommended.

Level of evidence: Low, no studies on elite athletes.

SUMMARY

This review found a limited number of studies on factors relating to return to exercise following pregnancy and childbirth in the general exercising population, and very few in elite athletes. There is also little information or evidence on which to base advice for athletes on issues relating to common complaints in the postpartum period. Both high-quality prospective cohort studies and RCTs are required. The former would be useful from a prevention viewpoint, in terms of understanding the determinants of common problems such as postnatal depression, weight retention and musculoskeletal complaints including pelvic floor disorders. More RCTs would shed light on the most effective treatment regimens for women with these problems, and would inform the advice given to athletes in terms of the optimal time to recommence training the cardiorespiratory and musculoskeletal systems.

Given the challenges of conducting studies with pregnant athletes, it would be helpful if researchers who are working on each of the main topics included in this chapter could agree on the same valid and reliable outcome measures, so that data can be pooled and treatments compared. Similarly, consensus is needed around how to assess physical activity to compare across studies. We agree with the thoughtful recommendations regarding return to sport from the First World Congress in Sports Physical Therapy 2016 Consensus statement,[140] published after our own proceedings: Return to sport should be considered a continuum with three distinct elements: (1) return to participation, (2) return to sport and (3) return to performance. Within each element, the athlete, physician, physiotherapist and coach should carefully consider the unique elements of the athlete's personal performance, childbirth experience, lactation and sport demands to provide a flexible and individualised programme during recovery.[140]

Author affiliations
[1]Department of Sport Medicine, Norwegian School of Sport Sciences, Oslo, Norway
[2]Department of Obstetrics, Gynecology and Women's Health, Saint Louis University, St Louis, Missouri, USA
[3]Facultad de Ciencias de la Actividad Física y del Deporte – INEF, Universidad Politécnica de Madrid, Madrid, Spain
[4]Centre for Research on Exercise Physical Activity and Health, School of Human Movement and Nutrition Sciences, University of Queensland, St Lucia, Australia
[5]Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Queen's University, Kingston, Canada
[6]Department of Sport Gynaecology, Poundbury Clinic, Dorchester, UK
[7]Poundbury Clinic, King Edward VII Hospital, London, UK
[8]Department of Epidemiology, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina, USA
[9]Faculty of Biology and Medicine, Institute of Sport Science, University of Lausanne, Lausanne, Switzerland
[10]School of Health Sciences, University of Tampere, Tampere, Finland
[11]The Swedish School of Sport and Health Sciences, Stockholm, Sweden
[12]R Samuel McLaughlin Foundation-Exercise and Pregnancy Lab, The University of Western Ontario, London, Canada
[13]Department of Obstetrics and Gynecology, University of Utah, Salt Lake City, Utah, USA
[14]Institute of Sport Science, University of Graz, Graz, Austria
[15]Division of Orthopaedic Surgery, Oslo University Hospital, Oslo, Norway
[16]Department of Family Practice and School of Kinesiology, Centre for Hip Health and Mobility, University of British Columbia, Vancouver, Canada
[17]IOC, Medical, Commission

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