



DEFYING TRADITION: RETURN TO SPORT AFTER CHILDBIRTH

Margie H. Davenport, PhD

Program for Pregnancy and Postpartum Health, Faculty of Kinesiology, Sport and Recreation, University of Alberta

KEY POINTS

- The postpartum period is a time of rapid transition from a physical, psychological and social perspective.
- When returning to sport postpartum, load management is essential with a gradual, symptom-based progression in activity recommended.
- Appropriate hydration and fueling is critical for the postpartum athlete, especially if they are lactating.
- With appropriate guidance and robust support, athlete-mothers can return to peak performance postpartum.

INTRODUCTION

Beginning immediately after delivery until the infant is 12 months of age, the postpartum period sets the course for long-term health and wellbeing for mother and child. While it is a critical time of recovery and transition, female athletes have defied expectation of what is possible during this period. Traditionally starting a family meant the end of an athletic career but this societal perception has rapidly changed with the visible “baby boom” of high profile athletes who have returned to peak performance (Darroch et al., 2023; Forstmann et al., 2022; Kimber et al., 2021). Yet, despite some women’s successes, others face barriers to returning to sport due, at least in part, to a lack of individualized, research-informed guidance. Most physical activity guidelines do not account for the challenges unique to the postpartum period (sleep deprivation, breastfeeding, pelvic floor dysfunction, low mood), or how they specifically impact athletic populations. This is rapidly changing. Recognizing the critical need to “rehabilitate” following childbirth, return-to-sport and performance frameworks specific to postpartum runners have recently emerged (Deering et al., 2020; Donnelly et al., 2022; Goom et al., 2019). However, they do not yet encompass the full scope of training and competition demands of all sports (e.g., team-based training, contact) due to a lack of empirical information. Clearly this is an area ripe for vigorous investigation to support a growing demographic.

This Sport Science Exchange (SSE) article explores our current understanding of how to support athletes to successfully return-to-sport after childbirth. Recognizing this area is rapidly developing, a strong understanding of the physical, psychological and social realities of the postpartum period alongside a flexible and adaptable approach centered on the athlete voice is essential. This SSE provides general principles and practical guidance for postpartum athletes, coaches and healthcare providers to navigate a return to sport following birth.

BIOPSYCHOSOCIAL CONSIDERATIONS AFTER CHILDBIRTH

Traditionally, postpartum women attended a single health visit at six weeks postpartum where they received medical clearance to resume unrestricted exercise. More recently the American College

of Obstetricians and Gynecologists have advocated that the first 12 weeks postpartum be considered a “fourth trimester” where women receive greater assistance to address key challenges including sleep, stress, fatigue, mental health and a changing identity (Tully et al., 2017). Given the significant physical, emotional and social challenges faced by postpartum women, robust support from their partner, family and friends is essential for wellbeing, and creates opportunities to re-engage in exercise.

Pregnancy is a period of profound adaptation and growth that affects virtually every organ system within the body (Brislane et al., 2021; Davenport, 2024). Following childbirth, these adaptations slowly reverse - albeit at different rates and some not fully. The cardiovascular system is of particular interest for postpartum athletes as an early prospective study found that pregnancy may have long-term beneficial impacts in that ventricular blood volume, cardiac output and systemic resistance do not return to pre-pregnancy levels by one year postpartum (Clapp & Capeless, 1997). The persistence of these beneficial changes may underpin the so-called “pregnancy advantage” noted in some endurance sports, although future research substantiating this claim is required (but ongoing).

The postpartum hormonal milieu undergoes rapid change following delivery. Estrogen and progesterone that are necessary for pregnancy-related adaptations rapidly drop towards preconception levels after childbirth, while oxytocin (supporting maternal-infant bonding) and prolactin (responsible for lactation) increase (Stock et al., 1991). The rapid change in hormones, especially sex hormones, can lead to low mood (“baby blues”) and feelings of anxiety. Mental health concerns including depression and anxiety affect 13% and 39% of women in the perinatal period, both of which can reduce maternal-infant bonding and adversely affect overall health. Although both conditions can challenge exercise participation, recent research has suggested that returning to moderate to vigorous intensity physical activity (MVPA) within the first 12 weeks postpartum has a net positive influence on mental wellbeing including a 45% reduction in the odds of developing depression (Deprato et al., 2024; Özkan et al., 2020). Nonetheless, it is essential that all postpartum athletes experiencing mental health

challenges speak to their healthcare provider to obtain support and treatment as required.

Another common postpartum health condition is pelvic floor dysfunction, with the most common form being stress urinary incontinence (involuntary leakage of urine when coughing, sneezing or during impact activities) which affects ~1/3 of postpartum women (Moosdorff-Steinhauser et al., 2021). Both pregnancy and being an athlete increase the risk for developing pelvic floor dysfunction. Therefore, women who are athlete-mothers are expected to be at even greater risk. In a cohort of non-pregnant rugby players, ~40% of athletes experienced stress urinary incontinence and most perceived this to have a negative impact on their performance. However, the risk of stress urinary incontinence more than doubled if the player had previously given birth (Molly et al., 2024). Thus, all athletes should be referred to a pelvic floor physiotherapist for prevention and treatment as pelvic floor muscle training reduces the odds of urinary incontinence by 37% following childbirth (Beamish et al., 2024).

The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life (WHO, 2022). Breastfeeding provides essential nutrition and hydration for the infant and has cardiovascular benefits for the mother. However, many athletes report challenges with coordinating breastfeeding and their training schedules, discomfort with exercise and altered milk supply (Davenport et al., 2023). Lactation is a highly energetic process requiring ~500 kcal/day (Lambrinou et al., 2019) which can challenge training and recovery if the energetic needs of exercise and lactation are not met through adequate fueling. While current studies do not support a link between exercise and altered breastmilk quality and quantity, it has been proposed that the lactating athlete may be at increased risk for low energy availability which could adversely impact breastmilk supply (Deering & Mountjoy, 2023). Calcium losses are also significant during lactation with estimates suggesting that the losses through nine months of lactation are double that of the nine months of pregnancy (Kovacs, 2016). Longitudinal data suggests a decline in maternal bone mineral density between 3-10% during pregnancy and lactation that typically recovers after cessation of lactation (Karlsson et al., 2005; Møller et al., 2012). While breastfeeding has not been linked with injury in the general postpartum population (Jones et al., 2024) there are some reports of increased risk of bony injury in highly trained athletes. This strongly suggests the need for strategies to support bone health, including load management, when returning to activity, bone loading activities (e.g., resistance exercise) (Colleran et al., 2019) and adequate dietary intake of calcium and vitamin D (see nutrition section below). During lactation breasts will change in size and mobility. Wearing a bra that is supportive and minimizes (but does not restrict) movement can reduce discomfort with exercise (McGhee & Steele, 2010). Breastfeeding or expressing milk prior to exercise can also make exercise more comfortable.

One of the defining features of the postpartum period is poor-quality, disrupted sleep. Sleep is essential to promote optimal recovery, repair and energy restoration. Short, poor-quality sleep has been consistently

associated with an increased risk of diabetes, cardiovascular disease and depression in the general population (Itani et al., 2017). While a lack of sleep is often cited as a key barrier to training, recent evidence suggests that postpartum exercise improves overall sleep quality, and reduces daytime fatigue and depressive symptom severity (Jones et al., 2025; Khan-Afridi et al., 2024; Owais et al., 2018). Given the profound effect of sleep on postpartum health, it is essential that postpartum athletes receive strong support from partners, family and friends to be able to prioritize sleep and recovery.

EXERCISE IN THE POSTPARTUM PERIOD

Guidelines around the world encourage postpartum MVPA to improve overall health and wellbeing. MVPA following childbirth is associated with a reduction in the odds of depression (49%), type 2 diabetes (28%) and urinary incontinence (31%), as well as improvements in the symptom severity of depression and anxiety, lumbopelvic pain and weight retention (Beamish et al., 2024; Deprato et al., 2024; Jones et al., 2024). Similar to other adult populations, postpartum women are generally recommended to engage in 150 min of MVPA on a weekly basis. While historical recommendations suggest waiting until the 6-week postpartum check up before starting MVPA, contemporary research suggests that early mobilization and incorporation of light physical activity (e.g., gentle walking) can facilitate postpartum recovery (Engel et al., 2022). In the early postpartum period, pelvic floor and gentle abdominal muscle training can also be reintroduced (barring significant perineal tearing) to begin to re-strengthen these muscles during the early recovery period.

Given the extensive health benefits of postpartum physical activity and sport participation, routine medical clearance before returning to physical activity and sport is no longer required. However, there are key medical conditions (contraindications) that should be screened for in the postpartum athlete with medical referral for further consultation. The *Get Active Questionnaire for Postpartum* (GAQ-PP, www.csep.ca) (CSEP, 2025) is a self-administered exercise pre-participation screening tool designed specifically for the postpartum period. The GAQ-PP includes a series of questions aimed to identify women who may have contraindications to postpartum exercise (Table 1). Those that answer 'yes' to any of the screening questions are directed to speak to their healthcare provider to discuss the risks and benefits, along with potential modifications to the intensity, duration or modality of exercise that may be required until the condition has resolved. Those who answer 'no' to all questions are empowered to begin their postpartum training. The GAQ-PP also encourages screening for key biopsychosocial barriers to exercise and sport participation. While these conditions are not contraindications to exercise, they can be barriers to postpartum exercise and may require additional consultation and treatment. These include mental health conditions (e.g., mild to moderate depression or anxiety), pelvic floor dysfunction (urinary incontinence), abdominal wall dysfunction (diastasis rectus abdominis), lactation status, low energy availability or relative energy deficiency in sport (REDS), poor sleep, fear of movement and a lack of social or emotional support.

Relative Contraindications

- severe abdominal pain
- vaginal bleeding not associated with menses
- postpartum cardiomyopathy
- caesarean section with symptoms that worsen with MVPA
- high blood pressure that is not stable
- an eating disorder
- malnutrition
- anemia
- excessive fatigue
- fractures or other significant musculoskeletal injuries
- calf pain or swelling suggestive of deep vein thrombosis
- hemodynamic instability
- breathing difficulties
- acute systemic infection accompanied by fever, body aches or swollen lymph glands
- the new onset of chest pain, discomfort and other angina-like symptoms with exertion
- dizziness or lightheadedness during MVPA
- loss of consciousness
- neurological symptoms
- renal or kidney disease
- new symptoms of heart disease, stroke
- other medical or physical conditions that may affect the ability to be physically active

Relative contraindications are those where moderate-to-vigorous physical activity (MVPA) may continue normally, or with modification to the intensity, duration or modality of exercise. Consultation with a healthcare provider is needed before beginning or continuing MVPA.

Table 1: Relative contraindications to postpartum exercise based on the Get Active Questionnaire for Postpartum (CSEP, 2025).

It is now generally accepted that returning to MVPA after childbirth should proceed in a gradual but progressive fashion. However, a number of factors will impact return to physical activity and sport postpartum. The type of delivery – vaginal, cesarean section, instrumental – plays an important role. Recovery and healing are relatively quick following an uncomplicated vaginal delivery. In contrast, healing from cesarean delivery takes longer as it is major abdominal surgery. The infant's mobility, sleep patterns, feeding practices (breastfeeding, bottle feeding, solids), as well as childcare supports available to the athlete also play a role. Although physical activity is recommended throughout

pregnancy, many athletes report a decline in their overall volume of activity as pregnancy progresses. Those who are recommended to restrict physical activity levels (e.g., with the development of pre-eclampsia) will experience more deconditioning, requiring additional effort to rebuild functional strength and fitness postpartum.

EXERCISE AND THE POSTPARTUM ATHLETE

Contrary to societal beliefs that sport and motherhood are incompatible, contemporary research demonstrates that elite sport participation following childbirth is not associated with adverse health outcomes, and that for many performance is maintained or improved (Darroch et al., 2023; Forstmann et al., 2022; Wowdzia et al., 2021). Although the reasons for this improvement are not well understood, it is expected to be due to a combination of physiological (e.g., pregnancy-associated increases in cardiac output that persists postpartum) and psychological factors (e.g., re-alignment of priorities to be more holistic – sport is not the “be all/end all”). These and other data demonstrate that pregnancy and motherhood do not necessitate the end of an athletic career.

In 2016 the International Olympic Committee produced a series of reports detailing recommendations for perinatal athletes (Bø et al., 2017). At that time there was limited evidence-based information to guide return to sport postpartum, thus an individualized approach was encouraged that could be initiated in the first few weeks after delivery. Most medical advice for the postpartum period has traditionally focused on recommendations that physical activity could gradually resume once bleeding has ceased following a vaginal delivery, or with a cesarean delivery after the first postpartum checkup. Yet, many athletes report an early and rapid return to training following childbirth resulting from a desire to “get back into it” or to secure a place on their team that is associated with an increased risk of injury and anxiety. In 2019, three physiotherapists developed the *Return to Running Postnatal* which revolutionized the way we conceptualized resumption of physical activity postpartum to emphasize rehabilitation (Goom et al., 2019). They advocated for a graded approach with progressive overload that is guided by an athlete's symptoms (e.g., urinary incontinence) and health. Since that time, a number of key frameworks have been developed that follow established principles of return-to-sport after injury. They encourage a step-by-step progression and load management through a gradual increase in the length and intensity of training but also incorporating perinatal factors required to support postpartum athletes (Christopher et al., 2024; Christopher et al., 2022; Deering et al., 2024; Donnelly et al., 2022; Goom et al., 2019). However, there is extremely limited sport-specific guidance to facilitate an effective return to training and performance outside of running. While this is a very active area of investigation, a 2024 Delphi Study of international experts provided a consensus statement of clinical and exercise professional opinion of return-to-running readiness that can provide practical guidance on appropriate progression that can be applied to other sporting contexts (Christopher et al., 2024).

NUTRITION HIGHLIGHTS FOR THE POSTPARTUM ATHLETE

Postpartum nutrition is essential as fueling the postpartum athlete, especially if lactating, requires additional consideration to optimize return to sport. Lactating athletes require sufficient energy to fuel both training and milk production, as well as ensure appropriate recovery. Hydration is of key importance during lactation as breastmilk is ~87% water. Although the increased volume of fluid intake varies between individuals, it is commonly recommended that an additional 700 mL/day of water from fluid and food intake is required (EFSA, 2010). Drinking water when thirsty and monitoring the color of urine output (dark yellow requires additional hydration, while clear or pale-yellow urine suggests appropriate hydration) is recommended. Although a common myth that exercise will curtail breastmilk volume thereby negatively impacting infant growth, empirical evidence has not substantiated this claim (Jones et al., 2024). However, inadequate hydration and insufficient caloric intake to match the energy expenditure of both exercise and lactation are known to compromise milk supply, and may be indicative of low energy availability or even REDs (Deering & Mountjoy, 2023).

As with pregnancy, lactating athletes have greater dietary requirements for vitamins and nutrients over preconception (e.g., choline and iodine) (USDA, 2020). However, there are key nutrients that are especially important for postpartum athletes. Bone health is a key consideration for postpartum athletes and while calcium supplementation does not appear to attenuate bone loss as a result of lactation (Kovacs, 2016), it remains important to ensure adequate calcium and vitamin D intake to support overall health. Calcium can be obtained from dairy products and almonds, while vitamin D is found in fatty fish, egg yolks and fortified milk. In contrast, weight-bearing exercise during breastfeeding slows bone loss from lactation (Milanović et al., 2022; O'Bryan et al., 2022). However, some postpartum women will experience reduced exercise capacity due to detraining (reduced training during pregnancy and in early postpartum), as well as pregnancy-associated anemia due to increased iron demands to support fetal development and maternal blood expansion. This anemia can persist postpartum, especially if blood loss was experienced during childbirth. During pregnancy, one in four women will experience iron deficiency (O'Brien & Ru, 2017) which can persist following delivery and continue to adversely impact aerobic capacity. Women experiencing iron deficiency postpartum can experience fatigue, reduced exercise capacity and depressive symptoms. Thus, continuation of iron supplementation is commonly recommended following childbirth for those who experienced anemia in pregnancy. Red meat and fortified cereal are excellent sources of iron. For those who experience excessive fatigue and poor recovery from training postpartum, screening and treatment for iron deficiency is recommended.

POLICY CHANGES REQUIRED TO SUPPORT POSTPARTUM ATHLETES

In the postpartum period, athletes commonly report feeling pressured to return to sport quickly and before they feel ready, often attributing early return to subsequent injury (Davenport et al., 2023). Sport

organizations around the world have begun to implement policies and practices to better support postpartum athletes. These policies work to support long-term athlete health and performance by allowing adequate recovery time and graded return to peak performance. Policies that ensure rank and point freezing, protection from dismissal, clear guidance on maternity leave and private spaces for breastfeeding and childcare, are game changers to facilitate parent's involvement in sport. However, it is equally important to foster a culture shift by creating an environment that values parenting athletes. Normalizing motherhood in sport by providing venues for athlete-mothers to share their stories – good and bad – about their challenges and successes is essential. Providing educational opportunities for athletes to learn about the impact of sport on their reproductive health (e.g., menstruation, fertility, pregnancy, postpartum), as well as available support and guidance for amateur and professional athletes also works to normalize these conversations. Investment in creating a welcoming culture for parents to remain in sport will improve athlete longevity, retain talent and experience and create positive role models for the next generation of athletes who can continue in sport without feeling limited by a desire to start a family.

PRACTICAL APPLICATIONS

- In the absence of contraindications, a gradual, progressive and individualized approach to return to exercise and sport is recommended when the athlete is ready to return.
- Screening for, and responding to, biopsychosocial barriers to physical activity including pelvic floor dysfunction, mental health challenges, lactation, lack of sleep and availability of childcare and social support is critical. Utilizing athlete-centered care to address these barriers helps ensure a sustainable return to training.
- Prioritize fueling and hydration, as well as adequate rest and recovery to optimize athlete wellbeing.
- Develop athlete-centered practices and policies to encourage inclusion of postpartum athletes in sport settings.

SUMMARY

The rise of trailblazing athlete-mothers has inspired a generation of women and girls to remain in sport throughout the reproductive years. Research, alongside the development of supportive policies and practices, will normalize postpartum challenges thereby shifting societal expectations of the role of mother athletes in the sporting setting.

The views expressed are those of the author and do not necessarily reflect the position or policy of PepsiCo, Inc.

REFERENCES

- Beamish N.F, M.H. Davenport, M.U. Ali, M.J. Gervais, T. Sjwed, G. Bains, A. Sivak, R. Deering, and S.M.R. Ruchat (2024). The impact of postpartum physical activity on pelvic floor disorders and diastasis recti abdominis: A systematic review and meta-analysis. *Br. J. Sports Med.* Online ahead of print. PMID: 39694630.

- Brislane, Á., C.D. Steinback, and M.H. Davenport (2021). The 9-month stress test: Pregnancy and exercise-similarities and interactions. *Can. J. Cardiol.* 37:2014-2025.
- Bø, K., R. Artal, R. Barakat, W.J. Brown, G.A.L. Davies, M. Dooley, K.R. Evenson, L.A.H. Haakstad, B. Kayser, T.I. Kinnunen, K. Larsén, M.F. Mottola, I. Nygaard, M. van Poppel, B. Stuge, and K.M. Khan (2017). 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. *Br. J. Sports Med.* 51:1516-1525.
- Christopher, S.M., S. Gallagher, A. Olson, S. Cichowski, R. Deering. (2022). Rehabilitation of the postpartum runner: A 4-phase approach. *J. Women's Health Phys. Ther.* 46:73-86.
- Christopher, S.M., G. Donnelly, E. Brockwell, K. Bo, M.H. Davenport, M. De Vivo, S. Dufour, L. Forner, H. Mills, I.S. Moore, A. Olson, and R.E. Deering (2024). Clinical and exercise professional opinion of return-to-running readiness after childbirth: an international Delphi study and consensus statement. *Br. J. Sports Med.* 58:299-312.
- Clapp, J.F., 3rd, and E. Capeless (1997). Cardiovascular function before, during, and after the first and subsequent pregnancies. *Am. J. Cardiol.* 80:1469-1473.
- Colleran, H.L., A. Hiatt, L. Wideman, and C.A. Lovelady (2019). The effect of an exercise intervention during early lactation on bone mineral density during the first year postpartum. *J. Phys. Act. Health* 16:197-204.
- CSEP 2025. Get Active Questionnaire for Postpartum. (GAQ-PP, www.csep.ca).
- Darroch, F., A. Schneeberg, R. Brodie, Z.M. Ferraro, D. Wykes, S. Hira, A.R. Giles, K.B. Adamo, and T. Stellingwerff (2023). Effect of pregnancy in 42 elite to world-class runners on training and performance outcomes. *Med. Sci. Sports Exerc.* 55:93-100.
- Davenport, M.H. (2024). Championing motherhood: exercise and the pregnant athlete. *SSE #258*.
- Davenport, M.H., L. Ray, A. Nسدoly, J. Thornton, R. Khurana, and T.F. McHugh (2023). We're not superhuman, we're human: A qualitative description of elite athletes' experiences of return to sport after childbirth. *Sports Med.* 53:269-279.
- Deering, R.E., and M.L. Mountjoy (2023). REDs and the lactating athlete: an evidence gap. *Br. J. Sports Med.* 57:1065-1066.
- Deering, R.E., S.M. Christopher, and B.C. Heiderscheid (2020). from childbirth to the starting blocks: Are we providing the best care to our postpartum athletes? *J. Orthop. Sports Phys. Ther.* 50:281-284.
- Deering, R.E., G.M. Donnelly, E. Brockwell, K. Bo, M.H. Davenport, M. De Vivo, S. Dufour, L. Forner, H. Mills, I.S. Moore, A. Olson, and S.M. Christopher (2024). Clinical and exercise professional opinion on designing a postpartum return-to-running training programme: an international Delphi study and consensus statement. *Br. J. Sports Med.* 58:183-195.
- Deprato A, S.M. Rushat, M. Usman Ali, C. Cai, M. Forte, M. Cierc, S. Meyer, T. Sjwed, S. Shirazi, B.A. Matenchuk, P.A.T. Jones. A. Sivak, and M.H. Davenport (2024). Impact of postpartum physical activity on maternal depression and anxiety: A systematic review and meta-analysis. *Br. J. Sports Med.* Online ahead of print. PMID: 39500542.
- Donnelly, G.M., I.S. Moore, E. Brockwell, A. Rankin, and R. Cooke (2022). Reframing return-to-sport postpartum: the 6 Rs framework. *Br. J. Sports Med.* 56:244-245.
- EFSA Panel on Dietetic Products, & Allergies. (2010). Scientific opinion on dietary reference values for water. *EFSA J.* 8:1459.
- Engel, O., E. Haikin Herzberger, Y. Yagur, A. Hershko Klement, A. Fishman, N. Constantini, N., and T. Biron Shental (2022). Walking to a better future? Postoperative ambulation after cesarean delivery and complications: A prospective study. *Int. J. Gynaecol. Obstet.* 157:391-396.
- Forstmann, N., A. Meignié, Q. Laroche Lambert, S. Duncombe, K. Schaal, C. Maître, J.F. Toussaint, and J. Antero (2022). Does maternity during sports career jeopardize future athletic success in elite marathon runners? *Eur. J. Sport Sci.* 23:896-903.
- Goom T, G. Donnelly, and E. Brockwell (2019). Returning to running postnatal – guidelines for medical, health and fitness professionals managing this population. <https://www.absolute.physio/wp-content/uploads/2019/09/returning-to-running-postnatal-guidelines.pdf>
- Itani, O., M. Jike, N. Watanabe, and Y. Kaneita (2017). Short sleep duration and health outcomes: a systematic review, meta-analysis, and meta-regression. *Sleep Med.* 32:246-256.
- Jones, P.A.T., A. Moolyk, S.M. Ruchat, M. Usman, K. Fleming, S. Meyer, T. Sjwed, J.B. Woldzia, L. Maier, M.F. Mottola, A. Sivak, and M.H. Davenport (2024). Impact of postpartum physical activity on cardio-metabolic health, breastfeeding, injury & infant growth and development: A systematic review and meta-analysis. *Br. J. Sports Med.* Online ahead of print. PMID: 39375006.
- Jones, P.A.T., S.M. Ruchat, Z. Khan-Afridi, U.M. Ali, B.A. Matenchuk, S. Leonard, A. Jantz, K. Vander Leek, L.E. Maier, L. Osachoff, M.J. Hayman, M. Forte, A. Sivak, and M.H. Davenport (2025). Impact of postpartum physical activity on maternal sleep: A systematic review and meta-analysis. *Br. J. Sports Med.* In press.
- Karlsson, M.K., H.G. Ahlborg, and C. Karlsson (2005). Maternity and bone mineral density. *Acta Orthop.* 76:2-13.
- Khan-Afridi Z., S.M. Ruchat, P.A.T. Jones, A. Usman, B.A. Matenchuk, S. Leonard, A. Jantz, K. Vander Leek, L. Maier, L. Osachoff, M. Hayman, M. Forte, A. Sivak, and M.H. Davenport (2024). Impact of sleep on postpartum health outcomes: A systematic review and meta-analysis. *Br. J. Sports Med.* In press.
- Kimber, M.L., S. Meyer, T.L. McHugh, J. Thornton, R. Khurana, A. Sivak, and M.H. Davenport (2021). Health outcomes after pregnancy in elite athletes: A systematic review and meta-analysis. *Med. Sci. Sports Exerc.* 53:1739-1747.
- Kovacs, C.S. (2016). Maternal mineral and bone metabolism during pregnancy, lactation, and post-weaning recovery. *Physiol. Rev.* 96:449-547.
- Lambrinou, C.P., E. Karaglani, and Y. Manios (2019). Breastfeeding and postpartum weight loss. *Curr. Opin. Clin. Nutr. Metab. Care* 22:413-417.
- McGhee, D.E., and J.R. Steele (2010). Breast elevation and compression decrease exercise-induced breast discomfort. *Med. Sci. Sports Exerc.* 42:1333-1338.
- Milanovi , Z., N. ovi , E.W. Helge, P. Krstrup, and M. Mohr, M. (2022). Recreational football and bone health: A systematic review and meta-analysis. *Sports Med.* 52:3021-3037.
- Møller, U.K., S. Við Streym, L. Mosekilde, and L. Rejnmark (2012). Changes in bone mineral density and body composition during pregnancy and postpartum. A controlled cohort study. *Osteoporos Int.* 23:1213-1223.
- Molly, M.-R., P. Joanna, M.D. Gráinne, C. Yeomans, I. Mairead, L. Karina, B. Kari, O.H. Patrick, and S.M. Isabel (2024). Stress urinary incontinence prevalence and risk factors in female rugby players: a common health problem across four nations. *BMJ Open Sport Exerc. Med.* 10:e001832.
- Moosdorff-Steinhauser, H.F.A., B.C.M. Berghmans, M.E.A. Spaanderman, and e.M.J. Bols (2021). Prevalence, incidence and bothersomeness of urinary incontinence in pregnancy: a systematic review and meta-analysis. *Int. Urogynecol. J.* 32:1633-1652.
- O'Brien, K.O., and Y. Ru (2017). Iron status of North American pregnant women: an update on longitudinal data and gaps in knowledge from the United States and Canada. *Am. J. Clin. Nutr.* 106(Suppl 6):1647s-1654s.
- O'Bryan, S.J., C. Giuliano, M.N. Woessner, S. Vogrin, C. Smith, G. Duque, and I. Levinger (2022). Progressive resistance training for concomitant increases in muscle strength and bone mineral density in older adults: a systematic review and meta-analysis. *Sports Med.* 52:1939-1960.
- Owais, S., C.H.T. Chow, M. Furtado, B.N. Frey, and R.J. Van Lieshout (2018). Non-pharmacological interventions for improving postpartum maternal sleep: A systematic review and meta-analysis. *Sleep Med. Rev.* 41:87-100.
- Özkan, S.A., D.S. Küçükkelepçe, B. Korkmaz, G. Yılmaz, and M.A. Bozkurt (2020). The effectiveness of an exercise intervention in reducing the severity of postpartum depression: A randomized controlled trial. *Perspect. Psychiatr. Care* 56:844-850.
- Stock, S., K. Bremme, and K. Uvnäs-Moberg (1991). Plasma levels of oxytocin during the menstrual cycle, pregnancy and following treatment with HMG. *Human Reprod.* 6:1056-1062.
- Tully, K.P., A.M. Stuebe, and S.B. Verbiest (2017). The fourth trimester: a critical transition period with unmet maternal health needs. *Am. J. Obstet. Gynecol.* 217:37-41.
- USDA (2020). Dietary Guidelines for Americans 2020-2025. https://www.dietaryguidelines.gov/sites/default/files/2021-03/Dietary_Guidelines_for_Americans-2020-2025.pdf
- WHO (2022). WHO recommendations on maternal and newborn care for a positive postnatal experience. <https://www.who.int/publications/i/item/9789240045989>
- Woldzia, J.B., T.L. McHugh, J. Thornton, A. Sivak, M.F. Mottola, and M.H. Davenport (2021). Elite athletes and pregnancy outcomes: A systematic review and meta-analysis. *Med. Sci. Sports Exerc.* 53:534-542.